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Renal Autotransplantation—Past, Present and Future:

SEVEN CASE STUDIES OF PATIENTS AT CLEVELAND CLINIC

Shawn P Huelsman, CST, BSHM

INTRODUCTION

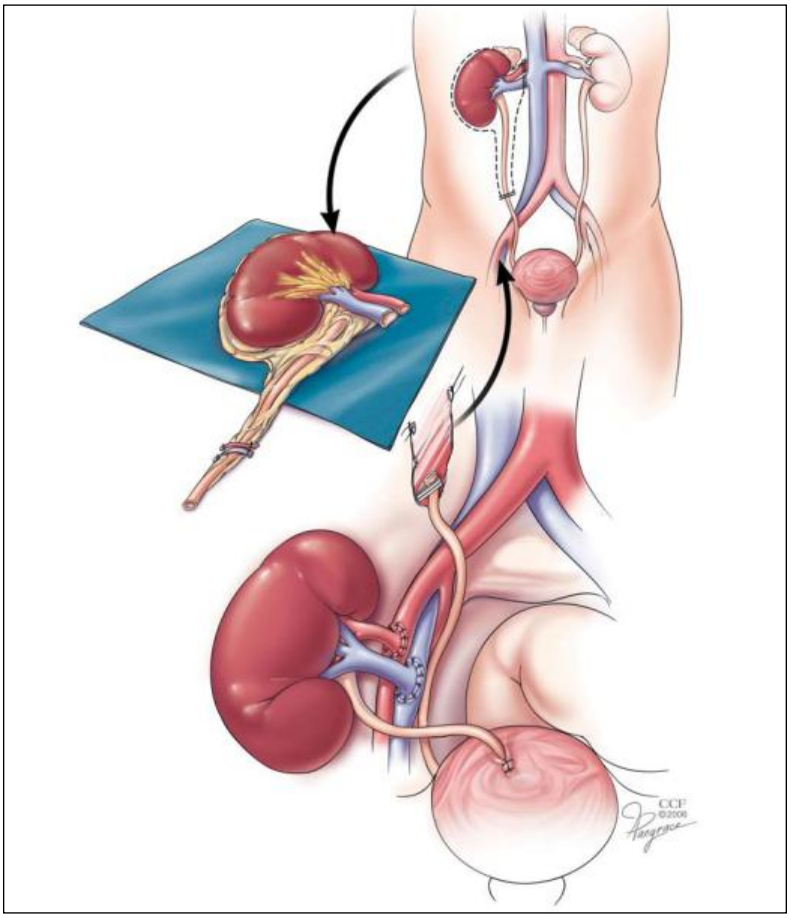
Renal autotransplantation is a method of removing a kidney from its place of origin, repairing it, and transplanting it in another location of the body (most commonly, the iliac fossa) of the same patient. This procedure was first performed by James Hardy, MD, at the University of Mississippi Medical Center in 1963.[3]

Since Hardy's landmark surgery for management of a high ureteral injury, renal autotransplantation has been described in the treatment of renal arterial disease (eg arterial aneurysm), complex urological reconstruction (eg ureteral stenosis due to retroperitoneal fibrosis), renal cell carcinoma (primarily in patients with a solitary kidney), advanced nephrolithiasis, and loin pain hematuria syndrome.[1,4,7,8,9,11]

During the 1980s, numerous journal articles on the subject of renal autotransplantation were published. During the 1990s, though, there were few new developments in the field, and few articles were published. This reduction in literature could be due in part to the introduction of laparoscopic urologic surgery.[5]

With the introduction of laparoscopic surgery, the number of open autotransplantation procedures was greatly reduced. Laparoscopy became an alternative way of performing complex ureteral procedures and partial nephrectomies that once could be completed only by open autotransplantation.

By the start of the new millennium, a newfound interest in autotransplantation was sparked by the use of new laparoscopic techniques. In an article written in 2000, Gill described the use of laparoscopic retroperitoneal nephrectomy for autotransplantation.[2] Nephrectomy of the kidney needing repair was performed under direct laparoscopic vision. A Gibson incision was made for extraction of the kidney.



Renal autotransplantation.

The kidney was removed, perfused with Collins solution, and repaired via an extracorporeal operation (an operation performed with the organ removed from the body) and performed on a separate "bench" table. While the kidney was being "benched," the Gibson incision was extended to allow visualization of the external iliac vessels for future transplantation. Laparoscopic assisted renal autotransplantation allowed the patients in Gill's article to benefit from decreased morbidity rates and shortened hospital stays as compared to those associated with open autotransplantation.

This article will introduce the reader to current techniques used during autotransplantation procedures by focusing on the author's experience in assisting with extracorporeal and laparoscopic operations performed on seven patients at the Cleveland Clinic from January through October, 2006.

The author will also show the difference in total ischemic times as they relate to open vs laparoscopic autotransplantation techniques.

CASE STUDIES

From January through October, 2006, the Cleveland Clinic performed seven autotransplantation procedures. Six of these procedures (Cases One through Six) were done utilizing current open techniques, and one (Case Seven) was performed utilizing laparoscopic techniques.

Of the six procedures done utilizing the open technique, two (Cases Two and Three) utilized a flank incision over the eleventh rib with the patient positioned in a right flank position. The four remaining open procedures were performed with use of an extended midline incision. In the case utilizing the laparoscopic technique (Case Seven), the patient was positioned in a 45-degree flank position with the left side up.

PROCEDURE

For all of the open autotransplantation procedures (Cases One through Six), the kidney was removed and placed in a basin of slush and cold, normal saline solution. The kidney was then taken to a separate "bench" table for intra-arterial perfusion. The renal artery was cannulated utilizing the tip of a 2.5-mm uncuffed endotracheal tube or a 14-gauge Angiocath™ catheter attached to cystoscopy tubing. The kidney was then per-

fused with 1000 cc of Collins intracellular electrolyte solution to remove contents.

The extracorporeal operation was begun utilizing techniques described by Novick in 1981.[10] The renal artery and renal vein were mobilized by sharp and blunt dissection, and perinephric fat was removed. To maintain hemostasis, venous branches not affecting the function of the kidney were tied with silk ties and dissected.

After extracorporeal surgical repair of the kidney, it was transplanted into the patient's iliac fossa by attaching the renal vein and artery to the external (or common) iliac vein and artery, respectively. Clamps placed on the hypogastric artery and external iliacs were removed. Blood flow was slowly returned to the kidney by removing a bulldog clamp from the renal artery. After vascular anastomosis, the ureter was reattached to the bladder.

Techniques used during the laparoscopic procedure will be described in Case Seven.

CASE ONE

The patient is a 32-year-old male with a history of renal insufficiency, nephrolithiasis and ureteral reflux who underwent bilateral ureteral implants at the age of three. He did well with this surgery until 1998 when he presented with left renal colic and underwent left ureteral reimplantation. He continued to have constant left renal pain and had problems emptying his bladder. The patient had normal blood urea nitrogen and creatine levels at preadmission.

During the procedure, access to the kidney was made via a midline excision from xiphoid to pubis. Upon entry into the peritoneum, many adhesions from prior operations were observed. These adhesions were taken down, and the surgery progressed to visualization of the renal artery, renal vein, and ureter. Once identified, the native ureter, renal artery, and renal vein were dissected. The kidney was removed from the patient's abdomen and placed in a basin of sterile slush.

The extracorporeal surgery was performed using techniques previously described. A 2-mm renal artery originating from the upper pole was sacrificed, which left a 2-cm area of ischemia. The ureteral stump was resected to its anastomosis with the native renal pelvis. The ileum was completely removed from the native renal pelvis, as well as the stump left on the bladder due to ischemia.

The renal artery and vein were retransplanted via an end-to-side anastomosis into the corresponding external iliac artery and vein. Due to the complex repair of the ureter and the adhesions from previous surgeries, the kidney was exposed to two hours and 46 minutes of cold ischemic time. Total revascularization of the kidney took 43 minutes. Total ischemic time was three hours and 33 minutes. No postoperative complications were noted.

CASE TWO

The patient is an 18-year old-female with a history of Gardner's syndrome who developed a retroperitoneal desmoid tumor, which caused a right ureteral obstruction. She had been previously managed by ureteral stents and percutaneous nephrostomy; both of which failed. The patient's BUN and creatine levels were normal at preadmission.

During the procedure, the kidney was removed from the patient's right flank and was perfused with techniques previously mentioned. Due to a large entry into the pleura, a thoracostomy tube was inserted, and the incision was closed. The patient was placed in a supine position, prepped and draped, and a left lower quadrant incision was made to gain access to the iliac fossa for transplantation.

Due to patient repositioning, the kidney was exposed to a total of four hours and 29 minutes of ischemic time. Total revascularization time of the kidney was 55 minutes. The patient did well without any complications reported.

CASE THREE

The patient is a 26-year-old female who suffered from the same condition as mentioned in Case Two with a primary diagnosis of bilateral ureteral obstruction. Prior to her right kidney autotransplantation surgery, she had been managed with bilateral percutaneous nephrostomy tubes. She also had undergone a left renal autotransplantation into the right iliac fossa. The patient's BUN and creatine levels were normal at preadmission.

During the procedure, the kidney was removed from the patient's right flank and perfused as mentioned in Case Two. This kidney contained two small renal arteries—one main renal artery, which contained an early bifurcation, and a smaller renal artery leading to the lower pole of the kidney. Due to the early bifurcation of the main renal artery, it was decided to utilize the right gonadal vein as an extension graft.

After determining proper orientation and flow of the gonadal vein, it was anastomosed to the arteries utilizing 7-0 Prolene.™ The graft was tested for patency and leaks using heparinized saline. The patient was returned from the right flank position to a supine position. A Gibson incision was made and dissected down until there was exposure of the iliac vessels. The kidney was then transplanted using the methods described previously.

When the clamps were removed, the kidney was slow to pink appropriately. Papaverine and verapamil were given to prevent vasospasm of the kidney and to increase blood flow. Upon palpation, a pulse could not be felt on the lower pole artery. A sterile Doppler wand was utilized to locate a signal in the lower pole artery. Upon placement, Doppler signals were heard in both the upper and lower poles of the kidney.

Due to repositioning and extensive arterial reconstruction on the "bench" table, total ischemic time was six hours and 14 minutes. Total revascularization of the kidney took one hour and five minutes. No postoperative complications were noted.

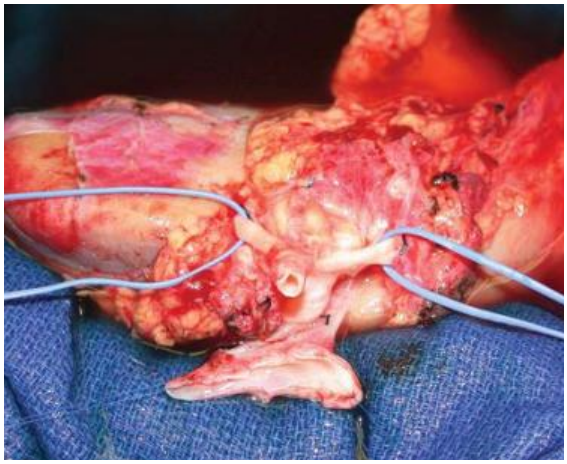


FIGURE 1: Renal artery aneurysm intimately attached to renal vein.

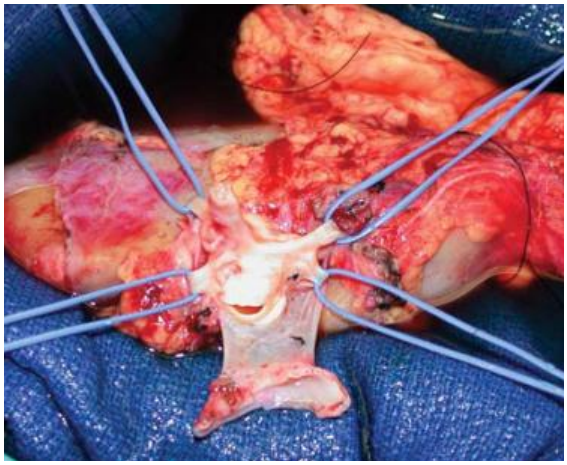


FIGURE 2: Renal artery branches marked with vessel loops.

CASE FOUR

The patient is a 48-year-old female who complained of right flank pain. During evaluation for her pain, a 2.3-cm noncalcified renal arterial aneurysm was found. A renal angiogram was performed and showed that there were two saccular aneurysms originating along the bifurcation of the right renal artery. BUN and creatine levels were normal at preadmission.

The kidney was removed and perfused as previously described. Perirenal fat was dissected off the kidney to maintain a hypothermic core temperature. The renal vein was dissected utilizing sharp and blunt dissection. Venous branches not affecting the function of the kidney were tied with silk ties and dissected. While continuing the dissection, it was observed that the vein was intimately attached to the aneurysm (Figure 1).

At this point, the aneurysm sac was opened in order to preserve a patch of the aneurysm wall close to the venotomy. Four segmental branches of the renal artery that arose distally to the aneurysm were observed. These were identified and marked with vessel loops (Figure 2).

The aneurysm was carefully dissected to preserve all four arterial branches. A hypogastric artery graft was utilized in order to accurately perform the anastomosis of the four renal arterial branches. After deciding placement of the arterial branches on the hypogastric artery graft, anastomosis began by utilizing 8-0 and 7-0 Prolene with an end-to-end and end-to-side anastomosis (Figure 3). After anastomosis, the

graft with the connected renal artery branches was flushed with heparinized saline to check for patency and leakage.

After all branches and grafts were checked, the kidney was transplanted into the iliac fossa as described previously. When clamps were removed, there was prompt arterial inflow, and all of the branches were patent (Figure 4). Due to the complex anastomosis of the renal artery, there was a total ischemic time of four hours and 38 minutes. Revascularization of the kidney took 25 minutes. No postoperative complications were noted.

FIGURE 3:
Anastomosis of renal artery branches to hypogastric artery graft.

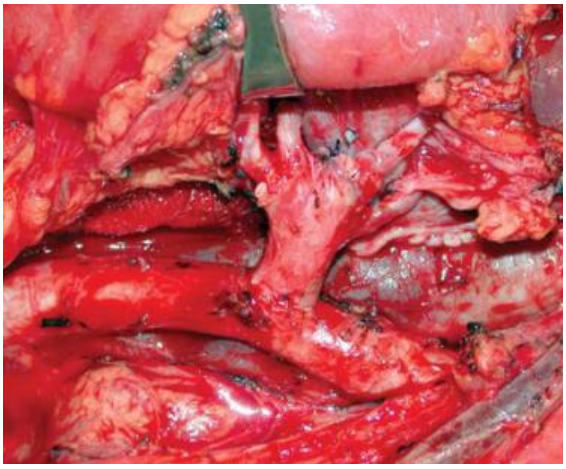


FIGURE 4:
Kidney in situ after anastomosis in the external iliac vein and artery.

CASE FIVE

The patient is a 35-year-old female with a primary diagnosis of a left, mid-ureteral stenosis and a secondary diagnosis of nephrolithiasis. The patient has a surgical history of multiple cystoscopies and ureteroscopies for treatment of the ureteral stenosis. The most recent of these surgical procedures occurred two months prior to the autotransplantation procedure. She also has a history of extensive extracorporeal shock wave lithotripsy (ESWL) treatments for her nephrolithiasis. The patient's BUN and creatine levels were normal at preadmission.

During the procedure, the kidney was removed via a midline incision from xiphoid to pelvis. Once the kidney was removed, it was perfused using Collins solution.

After mobilization of the renal artery and renal vein, it was decided to perform a pyeloplasty with ureteroureterostomy. The ureter was spatulated to the renal pelvis utilizing Metzenbaum and Potts scissors. No ureteral stones were visualized, but observation of the spatulated ureter showed a presence of dense, fibrous scar tissue that contributed to the patient's diagnosis of ureteral stricture.

After performing the pyeloplasty, the kidney was transplanted into the iliac fossa. Since the ureter could not be reconnected using normal anastomosis techniques, it was reconnected to the bladder utilizing a psoas hitch with a Boari-Ockerblad flap (will add an explanation of this flap here). Iliquis augait, quismodit, commodipit ullan eu facilisit eu facidunt nonsectem do eu feugait lorero do ea conse el utat.

Due to the complexity of the repair of the ureter, total ischemic time was three hours and 28 minutes. Total revascularization of the kidney took one hour and 30 minutes. No postoperative complications were noted.

CASE SIX

The patient is a 32-year-old male who presented with a primary diagnosis of a solitary left kidney with cystinuria/amino acid transport disorder and a secondary diagnosis of advanced nephrolithiasis. The patient also complained of severe left flank pain and had intermittent hydronephrosis.

Since the patient had lost his right kidney prior to this procedure, it was important to maintain the function of the left kidney, in order to avoid dialysis and placement on the United Network for Organ Sharing (UNOS) kidney trans-

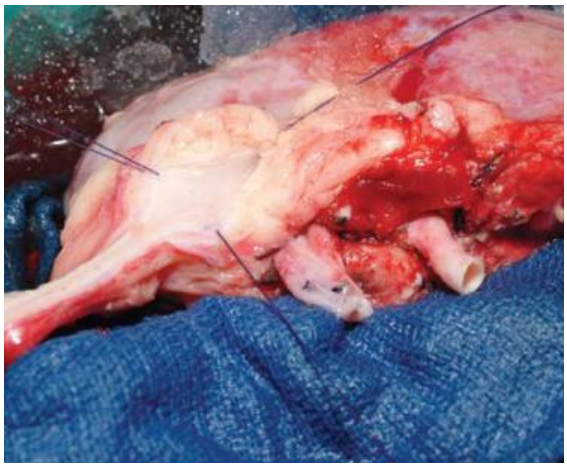


FIGURE 5:
Renal artery and vein mobilized after dissection. Ureter opened to renal pelvis.

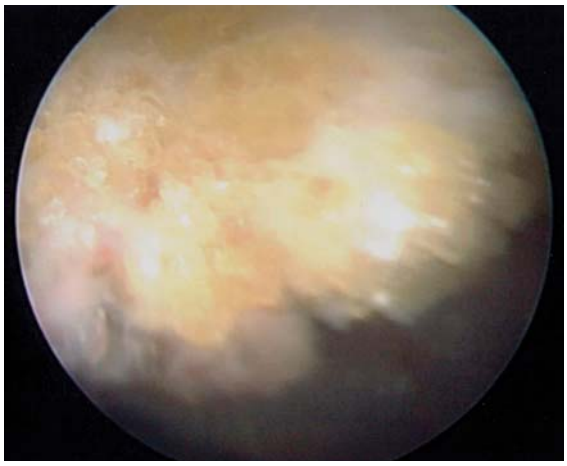


FIGURE 6:
Calculus as seen by flexible ureteroscope.

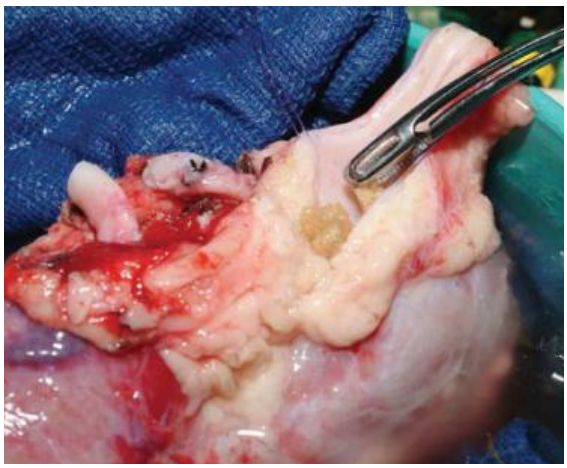


FIGURE 7:
Stone fragments removed via Randal stone forceps.

plant waiting list. Preadmission BUN and creatine levels were unknown.

The kidney was removed via a midline incision from xiphoid to pubis. Once removed, it was placed in a basin of sterile slush and perfused with 1000 cc of cold Collins solution. The renal artery and vein were mobilized to allow easier transplantation of the kidney (Figure 5). Once dissection was complete, efforts focused on the ureter and the condition of nephrolithiasis.

While maintaining cold ex vivo perfusion of the kidney, the ureter and the renal pelvis were opened posteriorly in a longitudinal fashion (done for preparation of the pyelocystostomy) (Figure 5). Ex vivo perfusion continued to be maintained utilizing cold Collins solution, cold lactated Ringers solution, and cold sterile water. After the incision of the ureter, a rigid and flexible nephroscopy was performed.

An infundibular stricture was observed in the upper part of the renal pelvis. In order to pass the nephroscope, the stricture was dilated utilizing a 30-Fr Amplatz™ dilatation system with a pressure syringe. The balloon was inflated to 16 atmospheres for two minutes. Subsequently, the sheath-less nephroscope was passed into the upper pole of the kidney.

Upon entering the upper pole of the kidney, a large calculus was found (Figure 6). In order to shatter it, a LithoClast® fragmenting device was used. This device was also used to shatter some of the calculi in the remaining branches of the renal collecting system.

The large stone fragments were tediously and meticulously removed with a Randal stone forceps (Figure 7) and endoscopically by utilizing a lithotripsy basket (Figure 8). All large fragments were removed, and small fragments were irrigated and suctioned out. After removing all the stones, the pyelotomy proximal to the renal pelvis was closed utilizing 3-0 Vicryl™.

Transplantation of the kidney into the external iliac vessels was then begun. Since the external vessels were small in caliber, the kidney would be anastomosed to the common iliac vein and artery (Figure 9). The kidney was perfused without leakage or vasospasm.

After successful anastomosis and visualization of potent blood flow to the kidney, the ureter was anastomosed to the bladder utilizing a psoas hitch with a Boari flap. In addition, a nephrostomy tube was inserted into the kidney and irrigated to facilitate the removal of small stones and sand that were not able to be removed on the "bench" table.

Due to the complexity of the dilatation, lithotripsy, and stone extraction, the total ischemic time was three hours and 16 minutes. Total revascularization time for the kidney was 57 minutes. No postoperative complications were noted.

CASE SEVEN

Unlike the previously discussed cases, Case Seven was performed utilizing laparoscopic techniques.

In an article written in 2001, Meraney described a new technique for total laparoscopic renal autotransplantation that was performed while maintaining the kidney in situ.[6] This procedure was performed on six female farm pigs with uneventful recovery in five of the six animals.

On September 22, 2006, the first successful human laparoscopic autotransplantation was performed at Cleveland Clinic.

The patient is a 25-year-old female with a history of left flank pain, which led to a diagnosis of loin-pain hematuria syndrome. Her physicians believed that autotransplantation via laparoscopic technique would provide relief of her symptoms by dissecting the nerves leading from the left flank into the kidney. This procedure would also provide the patient the opportunity for a shorter hospital stay with limited scarring. The patient's BUN and creatine levels were normal at preadmission.

The patient was positioned in a 45-degree flank position, with her left side up. A 2-mm Veress needle was used to achieve proper insufflation of the abdomen with carbon dioxide. The Veress needle was replaced with a 12-mm port, and two other 10-mm ports were inserted. The colon and spleen were then dissected from the left kidney.

The renal vein and artery were skeletonized, and the adrenal, gonadal, and lumbar attachments of the renal vein were clipped and cut. A 2-mm port was placed below the costal margin in order to retract the ureter laterally. A second 2-mm port was placed to provide insertion of an angioplasty balloon catheter later on in the procedure.

After the structures were dissected and visualized, two laparoscopic bulldog clamps were placed close to the abdominal aortic side of the renal artery, and one laparoscopic bulldog was placed close to the vena caval side of the renal vein.

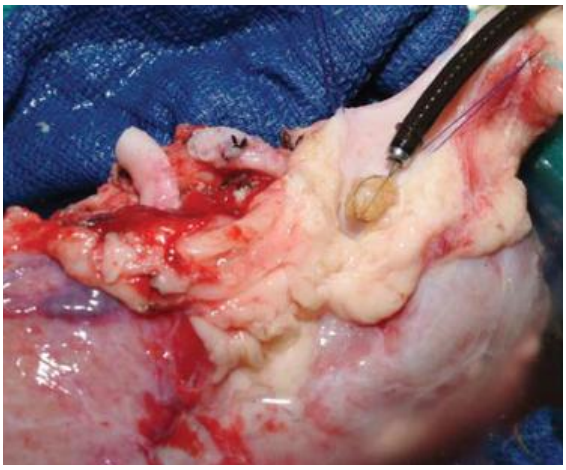


FIGURE 8: Stone fragments removed via lithotripsy basket.

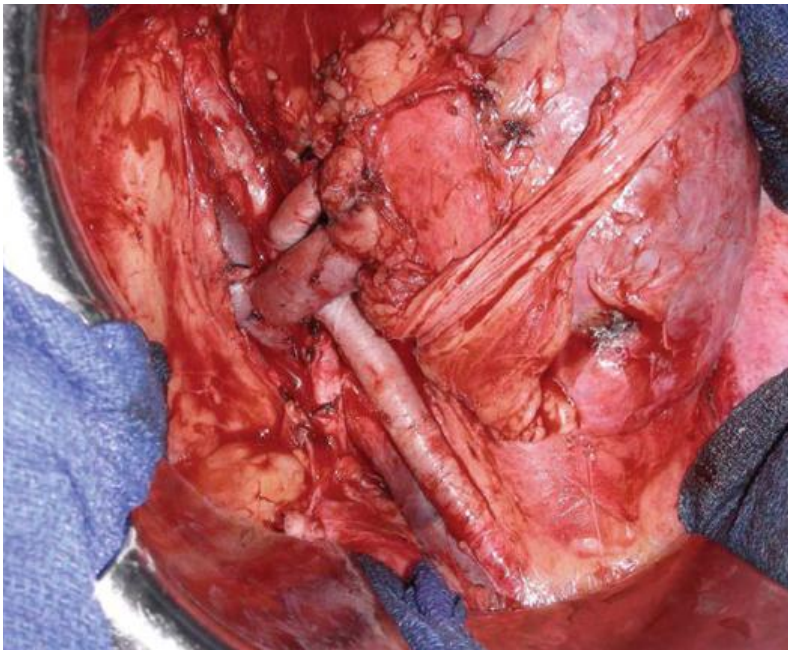


FIGURE 9: In situ view of kidney anastomosed to common iliac vein and artery.

The renal artery was cut approximately 50% of the circumference, leaving a stump on the abdominal aorta for later anastomosis. An angioplasty balloon catheter with a 0.035″-guidewire was inserted into the renal artery. The guidewire was removed, and the catheter was immediately attached to a 1000-cc bag of cold Collins solution via a cystoscopy "Y" connector and a double line perfusion set.

The balloon was inflated along its entire 2-cm length in order to dilate the renal artery, as well as to keep the catheter in position during perfusion. A thermocouple probe was used and inserted in the lower pole of the kidney.

Once perfusion of the renal artery commenced, a small cut was made in the renal vein

in order to aid in the ventilation of the kidney. As the kidney was perfused, its core temperature was documented and recorded. The starting core temperature at pre-perfusion was 37° C. This temperature became steadily hypothermic to a core temperature of 18° C post-perfusion.

Instead of transplanting the kidney into the iliac fossa as mentioned in Meraney's article, the kidney was reanastomosed to stumps left at the point of dissection. After removing the catheter, the renal artery was irrigated with heparinized saline and was anastomosed to the aortic stump utilizing 5-0 double-armed Prolene.

After the artery had been totally anastomosed, the renal vein was anastomosed to the vena caval stump in the same way, utilizing 5-0 double-armed Prolene.

The bulldog clamps were removed from the vena caval and aortic stumps. The kidney appeared soft and looked as if there was insufficient blood flow to it. A laparoscopic bulldog clamp was replaced on the renal artery, and the artery was partially reopened.

A small piece of adipose tissue was found within the lumen of the renal artery, which was then removed with a Maryland dissector. Once the adipose tissue was removed, the catheter was reinserted into the renal artery, which was then reperfused using cold lactated Ringers solution. Three interrupted 5-0 Prolene stitches were used to close the defect, and the renal bulldog clamp was removed.

The kidney appeared to be well perfused, and pinked up immediately with good outflow from the renal vein. A small defect in the renal vein was visualized and repaired with a simple 5-0 Prolene stitch.

The ureter was attached to the bladder by spatulating the ureter laterally and performing a pyeloplasty-type closure of the ureter with 4-0 Vicryl. An intraoperative renal ultrasound was performed with Doppler flow to ensure good blood flow to the kidney.

Total ischemic time was one hour and 32 minutes. Total revascularization of the kidney took one hour and 15 minutes.

The patient developed a retrograde fever postoperatively. An ultrasound of the kidney was performed and showed a possible thrombosis. It is believed that this was not a thrombosis, but the anastomosis site. This error could be contributed to the radiologist's inexperience in seeing this type of anastomosis. The patient was placed on preventative anticoagulants and was scheduled for follow-up.

Table 1: Total ischemic time in presented autotransplantation procedures.

Case Number (Open/Laparoscopic)	Warm Ischemic Time	Cold Ischemic Time	Revascularization Time	Total Ischemic Time
Case One (Open)	4 min	2 hrs, 46 min	43 min	3 hrs, 33 min
Case Two (Open)	5 min	3 hrs, 29 min	55 min	4 hrs, 29 min
Case Three (Open)	2 min	5 hrs, 7 min	1 hr, 5 min	6 hrs, 14 min
Case Four (Open)	3 min	4 hrs, 10 min	25 min	4 hrs, 38 min
Case Five (Open)	2 min	1 hr, 56 min	1 hr, 30 min	3 hrs, 28 min
Case Six (Open)	3 min	2 hrs, 16 min	57 min	3 hrs, 16 min
Case Seven (Laparoscopic)	7 min	10 min	1 hr, 15 min	1 hr, 32 min

DISCUSSION

As demonstrated in the case studies, there has been successful progress in the field of autotransplantation since it was first performed in 1963. As shown in Table 1, the use of new laparoscopic techniques for autotransplantation has lowered the amount of cold ischemic time placed on the kidney.

The more cold ischemic time placed on an organ, the higher the risk of decreased function. In addition, laparoscopic autotransplantation has given a relatively safe alternative to open autotransplantation techniques.

CONCLUSION

Renal autotransplantation still remains a last resort procedure for complex urological conditions. With current techniques in autotransplantation procedures, urological laparoscopic surgery may soon become common treatment for many of these conditions.

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EAR SURGERY– An Overview

Mary Sutton, CST, CFA

OVERVIEW

Most ear procedures are performed to restore or improve hearing, although surgeries to relieve vertigo are also common.

This article will begin with an overview of ear anatomy and the physiology of hearing, followed by a presentation of the equipment, instruments and supplies typically used in ear surgeries. The focus of the article will then turn to a discussion of five common procedures: myringotomy with tympanoplasty tube insertion, tympanoplasty, ossicular reconstruction, tympanomastoidectomy and stapedectomy.

ANATOMY OVERVIEW

The ear consists of three anatomic regions: the external, middle and inner ear. With the exception of the auricle, the ear structures are contained within the temporal bones on each side of the skull and are surrounded by the mastoid air cells, which are part of the temporal bones.

Below the mastoid is the sigmoid sinus, which is filled with venous blood and drains into the internal jugular vein. The facial nerve (cranial nerve VII) travels through the temporal bone and exits in front of the ear to innervate the face. The facial nerve has two branches in the middle ear: one branch innervates the stapedius muscle, which moves the stapes, and the other branch (the chorda tympani) is a taste sensor for the tongue.

EXTERNAL EAR

The external ear is composed of the outer appendage, called the auricle or pinna, and the external auditory canal. There is a small, protruding cartilaginous outgrowth (tragus), which protects the opening of the external auditory canal.

Glands that produce cerumen are embedded in the walls of the canal. Cerumen acts as a lubricant and also traps dead skin cells and foreign matter, which are then expelled from the canal with the help of cilia. The external ear ends at the lateral aspect of the tympanic membrane.

MIDDLE EAR

The middle ear begins at the medial aspect of the tympanic membrane or eardrum, which lies across the inner aspect of the external auditory canal. The tympanic membrane is cone-shaped, with its convexity facing downward and outward toward the auditory canal.

The three auditory ossicles within the middle ear are the malleus, incus and stapes. The handle of the malleus rests against the tympanic membrane, causing its conical protrusion. Ligaments attach its head to the body of the incus.

The incus articulates with the head of the stapes, and the base—or footplate—of the stapes rests in the oval window. The eustachian tube drains fluid from the middle ear to the nasopharynx and allows for pressure equalization within the middle ear.

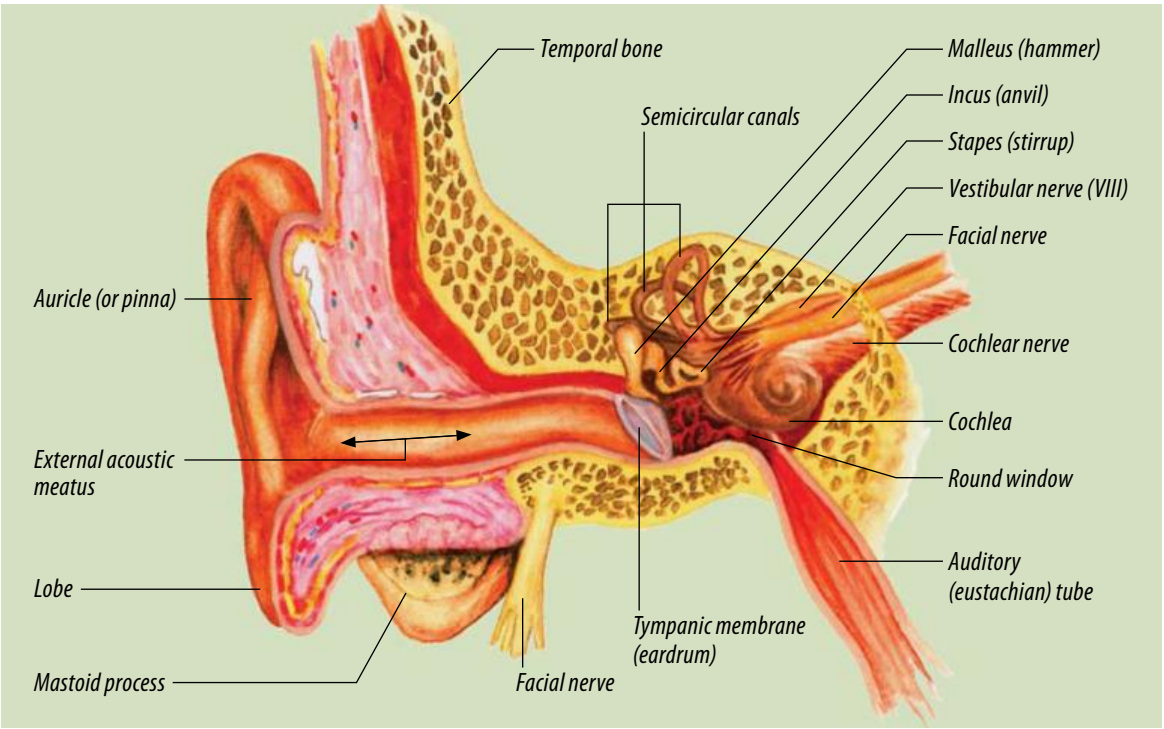
INNER EAR

The oval window is one of two membranes separating the middle and inner ear. The oval window transmits sound waves from the footplate of the stapes to the fluid contained within the vestibule of the inner ear. The vestibule contains the utricle and saccule—the sense organs for balance—and connects the two divisions of the inner ear.

The first division consists of the semicircular canals that function in the maintenance of balance, and the second division consists of the cochlea, which contains the organ of Corti that functions in hearing. Branches of the vestibulocochlear nerve (cranial nerve VIII) transmit information concerning sound and balance to the brain for interpretation.

The round window is the second membrane that separates the middle and inner ear. This window relieves pressure in the inner ear by bulging outward (into the middle ear) when necessary.

FIGURE 1:
Anatomy of the ear.



PHYSIOLOGY OF HEARING

Hearing, which is a mechanoreceptive sense, is made possible by the ear's response to the mechanical vibrations of sound waves through the exter-

nal auditory canal toward the tympanic membrane. Sound is funneled into the external auditory canal by the pinna to the tympanic membrane and amplified as it moves through the narrowing canal. Sound waves strike the tympanic membrane, causing it to vibrate, which subsequently causes the ossicles of the middle ear to vibrate.

The ossicles are suspended by ligaments that allow the malleus and incus to act as a single lever, with its fulcrum approximately at the border of the tympanic membrane. The head of the malleus, which is opposite its handle, balances the other end of the lever, so that changes in body position do not cause fluctuations in tension on the tympanic membrane.

The handle of the malleus is held in a constant state of being pulled inward by ligaments and by the tensor tympani muscle, which keeps the tympanic membrane tense. Such conditions allow vibrations acting on any portion of the tympanic membrane to be transmitted to the malleus. The incus moves in concert with the malleus because the two are tightly bound to one another by ligaments.

The articulation of the ossicles with one another is such that the stapes presses on the fluid of the inner ear each time the incus moves inward. When the malleus moves outward, the stapes pulls on the fluid within the cochlea. As the fluid moves, hair cells within the cochlea are stimulated and send nerve impulses from the cochlear branch of the vestibulocochlear nerve to the temporal lobe of the brain—culminating in the sensation of hearing.

COMMONLY USED EQUIPMENT, INSTRUMENTS AND SUPPLIES

The following three sections present a general list of items commonly used in ear surgeries. As in all procedures, consult each surgeon's preference card.

EQUIPMENT

A microscope is used in most ear procedures. A 250-mm lens is most commonly used, but some surgeons may use a 300-mm lens as well. Consult the preference card to see if the surgeon uses angled or straight eyepieces for the microscope. In some hospitals, the microscope is connected to video equipment, enabling the surgical technologist to view the procedure and anticipate the surgeon's needs more effectively.

Some surgeons use an adjustable, hydraulic chair when looking through the microscope. A facial nerve monitor may be used to prevent injury to the facial nerve, particularly during stapedectomies and cochlear implant procedures.

Several different sizes of round cutting and diamond burrs should be available to give the surgeon options. Lasers may be used for stapedectomies or to remove scar tissue and cholesteatoma from the middle ear.

INSTRUMENTS

Most hospitals have a general ear set with larger instrumentation, such as ear specula (all sizes), a specula holder, retractors (eg, angled or hinged Weitlaner, mastoid (Jansen) and Senn), House suction tips (usually 3, 5 and 7 Fr and 20 and 22 ga), scalpel handle, tissue forceps, hemostats, needle holders, periosteal elevator and dissecting scissors. Some hospitals have surgery-specific instrument sets, and some surgeons have their own sets of instruments.

Some of the microsurgery instruments have dedicated trays to prevent damage. Ear picks also may have a special tray, which can be placed on the Mayo stand for convenience.

It is important to clean off the instrument tips with a microwipe sponge after they are handed back to you. This helps the surgeon see the end of the instrument more clearly through the microscope and thus determine more accurately the depth to which it should be inserted.

There are numerous ear picks available, so they should chosen according to surgeon preference.

Micro-cup and alligator forceps are typically used. Many surgeons use a small, smooth alligator forceps to prevent damage during placement of prostheses. Bellucci and Glasscock scissors also may used.

Some surgeons, especially for stapedectomies, prefer a special speculum holder that attaches to the operating table.

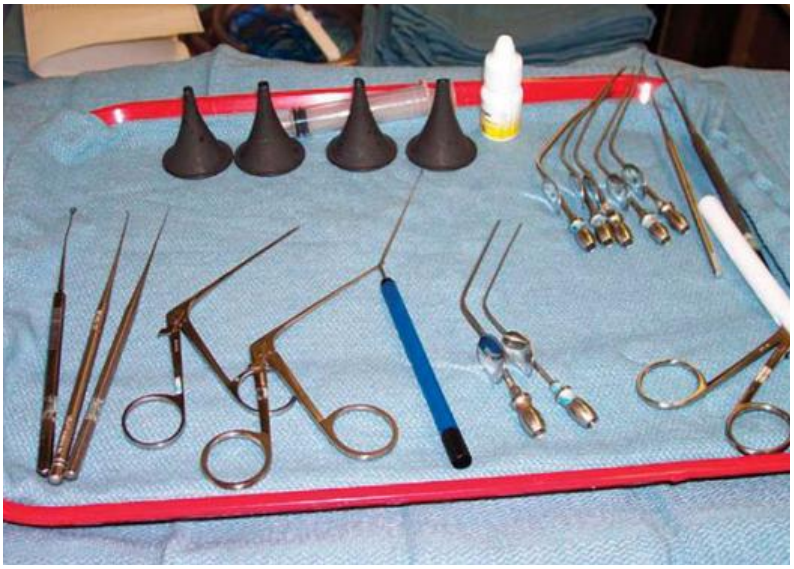


Photo courtesy of Mary Sutton, CST, CFA

FIGURE 2:
Myringotomy set-up.

SUPPLIES

If a microscope is used for a sterile procedure, then a sterile drape is needed. Cotton balls may be used either as a dressing or as a sponge. Occasionally, a hemostatic agent may be applied with a portion of a cotton ball. An absorbable gelatin sponge may be used as a hemostatic agent or as packing to secure graft material.

Commonly used medications include topical adrenaline, lidocaine (with or without epinephrine) and an antibiotic otic suspension.

TYMPANOSTOMY TUBE INSERTION

Myringotomy with insertion of tympanostomy tubes is the most common operation in the United States with approximately two million procedures per year.

INDICATIONS FOR SURGERY

The most common indication for placement of tympanostomy tubes is chronic otitis media with effusion. Other indications include recurrent otitis media, retraction of the tympanic membrane, and a collapsed eustachian tube.

TUBE SELECTION

Several factors influence the choice of tympanostomy tubes: surgeon preference, the size of the child's ear canal, the length of time the tubes are expected to remain in position, the condition of the eardrum, and the condition of the ossicles. Most tubes stay in the eardrum approximately four months and then fall out, after which time the tympanic membrane heals.

T-tubes are designed for long-term use, and grommet tubes are designed for short-term use. Once tympanostomy tubes are placed, the patient must take care to prevent water from entering the ear canal and traveling to the middle ear.

INSTRUMENTATION

A myringotomy set usually includes a myringotomy blade handle; large and small alligator forceps; a Rosen needle or middle ear pick; House suction tips in sizes 5 and 7 Fr and 20 ga; a cerumen loop or curette; and a set of ear specula, usually in sizes 4, 4.5 and 5 mm.

Equipment needed includes a microscope with a 250-mm lens, suction tubing, towels and cotton balls.

Myringotomy is considered a clean procedure. No patient preparation is performed, and draping is optional. If a drape is used, it may be a small fenestrated sheet or towels.

Author's tips: 1. Suction tips can become clogged easily. It's a good idea to have two suction tips in each size on your set-up, as well as some saline and a syringe to remove serous fluid build-up. 2. When selecting specula, keep in mind that some physiological conditions affect ear canal size. For example, some patients with Down syndrome have small ear canals and thus require smaller specula.

PROCEDURAL OVERVIEW

This procedure may be performed with sterile gloves but without a sterile gown, according to hospital policy. Surgeons should remove the powder from their gloves before handling the instruments to prevent the introduction of powder into the ear.

The surgeon drapes per individual routine and places the speculum in the ear canal. The microscope is focused on the tympanic membrane. A cerumen loop or curette or a large suction tip is used to remove wax or debris from the ear canal.

An incision is made in the tympanic membrane with a myringotomy blade, and a smaller suction is placed through the incision to remove any fluid in

the middle ear. In some cases, a thick serous fluid, called "glue," is found, and then a larger suction tip may be necessary to evacuate this fluid.

Once the middle ear is clear, the tympanostomy tube is placed into the incision with a small alligator forceps. The tube is then seated properly with a Rosen needle or middle ear pick, and the speculum is removed. If necessary, antibiotic otic suspension is applied to the ear canal, and a small cotton ball is placed in the external canal to prevent drainage.

The patient is repositioned, and the surgeon moves to the other side of the table to repeat the procedure on the contralateral side, if necessary.

POTENTIAL COMPLICATIONS

The most frequent complication following tympanostomy tube insertion is otorrhea, characterized by serous fluid draining from the ear, often due to water contamination of the middle ear. Other complications include tympanosclerosis (often due to repeated tube placement), persistent tympanic membrane perforation (the incidence of which increases with long-term tube placement), and cholesteatoma.

TYMPANOPLASTY

Reconstruction of the tympanic membrane is usually indicated in cases of membrane perforation. Initially, full- or split-thickness skin grafts from the postauricular area were used to repair perforations. The major disadvantages of using this type of graft were excessive desquamation and reperforation, therefore creating the need for an alternative grafting material as well as a second operation.

Surgeons then tried ear canal skin and various connective tissue grafts, with the connective tissue grafts becoming extremely prevalent in the early 1960s. Most surgeons today use the temporalis fascia as a graft.

INSTRUMENTATION

Equipment typically needed includes a microscope with a 250-mm lens, adjustable chairs for the seated team members, and a video monitor placed where the surgical technologist can see it clearly. A rotating drill and facial nerve monitor are commonly used, according to surgeon preference. A variety of burrs for the drill and a speculum holder should be available.

Typically, a general ear set and a microsurgery ear set with ear picks are used. Beaver blades are commonly used and are selected according to surgeon preference.

Supplies include nonsterile and sterile preparation items, appropriate basins and drapes (including drapes for the microscope and the back of the hydraulic chair), electrosurgical pencil with dispersive electrode and holster, suction tubing, ear bulb syringe, razor and hair restraint (eg, a bouffant cap secured with tape).

Author's tip: In the author's experience, a 3-cc syringe with a 27-ga needle is often used to inject medications, and a 12-cc syringe should be on the field to unclog suction tips, if necessary.

Other supplies commonly used include absorbable gelatin, lidocaine, epinephrine and antibiotics.

PROCEDURAL OVERVIEW

A nonsterile setup is prepared according to surgeon preference. The patient is placed in the supine position with the head turned so that the operative ear is turned upward. The operating table may be turned 90 to 180 degrees to accommodate the surgical team and equipment.

Author's tip: The blood pressure cuff should not be placed on the same arm as the affected ear, because the inflating and deflating may cause unwanted movement.

The patient is prepped and draped according to surgeon preference. Drape the microscope as soon as possible, because it will be used immediately. After gowning and gloving, make sure that powder is removed from the gloves of all surgical staff.

The surgeon will place the speculum in the canal and excise a "vascular strip," typically with a beaver blade and a local anesthetic. The vascular strip is a section of tissue taken from the ear canal or ear drum and placed over the temporalis fascia graft later on in the procedure to improve healing.

If tissue is taken from the ear drum, the remaining tympanic membrane usually is dissected, or the perforation is trimmed (or rimmed).

Some surgeons perform a tympanoplasty through the ear canal, while others use a postauricular approach. Surgeon preference and the pathology of the area determine the approach.

With both approaches, a small incision will be made from near the top of the ear to the temporalis fascia to retrieve the graft. The tissue is removed and prepared according to surgeon preference, and the incision is closed.

In some cases, the tissue is compressed with a fascial press or flattened on a Teflon® block with a sponge. The fascia may be left in the press or removed to dry until placement.

The graft is cut to fit and placed in the ear canal with a small, smooth alligator forceps and an ear pick. The vascular strip removed earlier is laid over the temporalis fascia graft. Cut pieces of moist, absorbable gelatin may be used to secure the graft and to create a bed that supports the graft.

To prevent drainage, additional gelatin may be placed in the ear canal, usually with a small alligator forceps or with a small suction tip and ear pick. A cotton ball is often placed in the external ear canal to prevent liquid from leaking out.

While placing the graft in the ear canal, the surgeon may ask the anesthesia provider to stop using nitrous oxide, which can cause pressure on the eardrum which may cause the graft not to seat properly on the membrane or vascular strip.

If the patient has a small ear canal, the surgeon may do a Sheehy tympanoplasty, which involves removing the ear canal skin and enlarging the canal with an ear drill. A full thickness skin graft may be placed in the canal if extra skin is needed to supplement the existing skin. When using the ear drill, make sure appropriate irrigation is done, so that the bone will not become overheated and damaged.

POTENTIAL COMPLICATIONS

The most common complication of tympanoplasty is reperforation. Other complications include hemorrhage, infection and unsuccessful restoration of the patient's hearing. In rare cases, a patient may have to undergo several procedures before the graft epithelializes.

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Editor's note: *This article will continue in next month's issue. In Part II, the author will continue her overview of aural surgeries by focusing on three procedures: ossicular reconstruction, tympanomastoidectomy and stapedectomy.*

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EAR SURGERY– An Overview

Mary Sutton, CST, CFA

PART 2 OF 2

In the first half of this article, published last month, the author presented an overview of ear anatomy, the physiology of hearing, and the instrumentation, equipment and supplies typically used in ear surgeries. Following this overview was a discussion of two commonly performed types of ear surgeries: myringotomy with tympanoplasty tube insertion and tympanoplasty.

This month's article continues with a discussion of ossicular reconstruction, tympanomastoidectomy and stapedectomy. The first two procedures can become necessary to perform during a tympanoplasty, so the surgical technologist must be aware of them. Please refer to last month's article for the procedural details of a tympanoplasty procedure.

OSSICULAR RECONSTRUCTION

Reconstructive surgery to repair damage to or a break in the ossicles is often performed in conjunction with a tympanoplasty. In some cases, the need for bone reconstruction is known prior to surgery. In other cases, though, the damage—or the extent of the damage—is unknown until the surgeon is able to view the area under microscope.

Damage to the ossicles can be congenital or caused by injury, infection, disease or cholesteatomas (keratinized squamous epithelium), which are highly destructive to bone and can grow in the middle ear and mastoid. Once cholesteatomas are diagnosed, surgery should be performed as soon as possible to prevent serious injury to the ossicles.

INDICATIONS FOR SURGERY

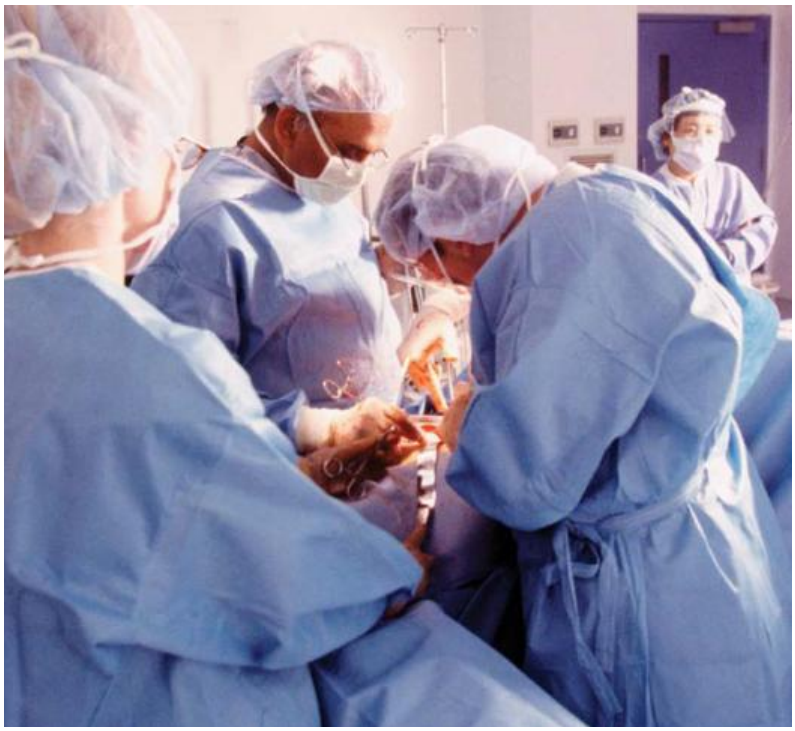
Ossicular reconstruction is contraindicated by the presence of infection or cholesteatoma. Antibiotics and frequent cleaning are typically prescribed for the infection. Once the infection has been treated successfully, a decision can be made regarding surgery to remove the cholesteatoma. In some patients, it is necessary to repeat the procedure several times to ensure complete removal of all cholesteatomas.

PROCEDURAL OVERVIEW

Ossicular reconstructions require the same instrumentation and set-up as a tympanoplasty.

Reconstruction is typically performed under general anesthesia, although local anesthesia with intravenous sedation may be given. If local anesthesia is used, the patient must be kept very still throughout the entire procedure. Therefore, the patient's age and ability to comply must be considered. Surgeon or anesthesiologist preference and the patient's physical health are also factors.

The choice of prosthesis depends on which, if any, ossicles remain intact and viable.



Often, the incus can be removed, resculpted and then replaced, if the stapes and part of the malleus are present. This procedure is called incus interposition. Doctors may save the incus in cases of cholesteatoma either in the mastoid bowl (after a mastoidectomy) or by freeze-drying it for a later procedure involving an incus interposition.

Allografts, produced from materials such as bioglass, hydroxyapatite, or plastipore (high-density polyethylene), may be used. These grafts are called either partial or total ossicular reconstruction prostheses (PORP or TORP, respectively).

A PORP is used when the stapes arch is intact and functioning properly. The prosthesis is fit on the stapes head, and the tympanic membrane rests over it.

A TORP is used when only the stapes footplate remains. The prosthesis rests on the footplate, and the tympanic membrane rests over it.

The choice of a PORP or TORP is determined by the surgeon. Due to the size and delicate structure of the implants, it is advisable to have at least two of each size prosthesis available.

Moist absorbable gelatin is often used to support the graft. A tragal cartilage graft also may be used to help support the tympanic membrane.

POTENTIAL COMPLICATIONS

Postoperative challenges include prosthesis dislodgement or failure, tympanic membrane perforation, and perilymph leak around the stapes footplate (if a TORP was used).

TYMPANOMASTOIDECTOMY

Tympanomastoidectomy is removal of a portion of the mastoid bone and repair or reconstruction of the tympanic membrane. The goal of tympanomastoidectomy is to expose disease, remove diseased tissue as necessary, and reconstruct the sound-conducting mechanism, leaving the anatomy intact, if possible.

INDICATIONS FOR SURGERY

Tympanomastoidectomy is indicated for diseases of the mastoid portion of the temporal bone, most often cholesteatoma. An acute infection of the mastoid may require an emergency mastoidectomy, because a brain abcess can occur (due to close proximity) if the infection is not treated immediately. A myringotomy may be performed to relieve acute mastoiditis, but a mastoidectomy often becomes necessary eventually.

SET-UP AND PREOPERATIVE CONSIDERATIONS

The set-up for a tympanomastoidectomy is the same as that used for a tympanoplasty, with the addition of an ear drill (surgeon preference, with cutting and diamond burrs of various sizes and

configurations), as well as the surgeon's preferred mode of irrigation, typically either on the drill or via a suction irrigation tip attached to irrigation tubing, and saline.

Surgeons also may use a drain, such as a 7-mm Jackson-Pratt, in the mastoid bowl after doing a mastoidectomy for acute mastoiditis.

Several key areas must be preserved while performing a mastoidectomy. The sigmoid sinus, which drains into the internal jugular vein, is located in the inferior portion of the mastoid. Most surgeons leave a thin layer of bone over the sinus while performing the mastoidectomy. If the sigmoid sinus is inadvertently entered, there may be a great deal of blood loss. The perforation in the sinus will likely be packed with oxidized cellulose or dry absorbable gelatin.

Next is the facial nerve, which runs through the mastoid bone and the middle ear to innervate the face. The tract where the nerve lies is under the ear canal wall in an area called the facial recess. Surgeons will drill out this area to find the nerve, typically while using a facial nerve monitor to prevent damage.

The third key area is the dura mater, located directly below the mastoid.

The ear canal wall is another key area of anatomy. The canal wall may be taken down during a mastoidectomy if needed, but most often a thin wall will be left. The surgeon is careful not to make a hole in the wall.

PROCEDURAL OVERVEW

The surgery is typically performed via a postauricular approach. Some surgeons use a small penrose drain to protect the vascular strip they create inside the canal. They generally place the drain through the ear canal and out the postauricular incision, clamping the drain above the auricle. A mastoid retractor or Weitlaner is used to retract the auricle.

If performing a radical mastoidectomy, the surgeon may enlarge the auditory meatus to facilitate regular cleaning of the mastoid area. Usually this is done for patients with chronic mastoiditis.

If cholesteatoma is present, the tympanomastoidectomy may be staged to check for residual disease, and an ossicular reconstruction will be scheduled for a later date, if necessary.

Following wound closure, a mastoid dressing will be applied.

POTENTIAL COMPLICATIONS

Possible complications of tympanomastoidectomy include infection and damage to the facial nerve, sigmoid sinus or dura mater.

STAPEDECTOMY

Stapedectomy involves removal of a nonfunctioning stapes and reconstruction of its function with an artificial replacement.

INDICATIONS FOR SURGERY

A stapedectomy is indicated for loss of hearing typically resulting from otosclerosis, a condition in which the ossicles become immobilized over time. In the case of the stapes, the otosclerosis interferes with the bone's ability to vibrate properly.

INSTRUMENTATION

The stapedectomy set-up is the same as for a tympanoplasty with the addition of a stapes drill. Also, the topical adrenaline dosage may be more concentrated to ensure hemostasis is achieved, as too much blood in the wound obstructs the surgeon's vision.

The stapes prosthesis is shaped like a piston with a hook on top. The hook fits over the incus, and the piston fits into the hole made by the surgeon in the stapes footplate.

Instruments commonly used for stapedectomy include the strut guide and the crimper. The groove on the strut guide is used to push the hook of the prosthesis over the incus, and the crimper is used to close the hook over the incus.

PROCEDURAL OVERVIEW

Many surgeons prefer that the patient be awake for this procedure. This allows for communication with the patient, which helps the surgeon determine what can be accomplished during the surgery. Patients are typically asked whether or not their hearing has improved following certain actions taken by the surgeon.

They are also asked whether or not they feel dizzy or nauseous during the procedure. If the prosthesis is too long, the stapes footplate will be pushed too far down, and the patient will immediately feel dizzy and/or nauseous. If this occurs, the surgeon may abort the procedure.

Another reason to abort is a dehiscient facial nerve, which is usually covered with a layer of bone. In some patients, though, the nerve is not covered and is lying free in the middle ear. In these cases, the surgeon may elect not to perform the stapedectomy, due to the risk of facial nerve injury.

The surgeon may use a muscle or fascial plug to pack the hole in the stapes footplate created earlier. The surgeon then replaces the tympanic membrane and places a cotton ball in the ear for dressing.

POTENTIAL COMPLICATIONS

Complications of stapedectomy include otitis media (rare, but may lead to bacterial meningitis due to the hole in the stapes footplate), granuloma of the oval window, perilymph fistula, sensorineural hearing loss, loose prosthesis wire, and incus necrosis (resulting from the hook being crimped too tightly).

LESS COMMON EAR PROCEDURES

There are several other types of ear procedures, which are less commonly performed. Only a brief overview of two types of these procedures will be presented in this article. With the basic knowledge of the preceding surgeries, a surgical technologist will be capable of setting up and scrubbing for other related procedures.

An exploratory tympanotomy is essentially the same as a tympanoplasty, but without the reconstruction of the eardrum. It is usually performed to verify the presence of cholesteatoma or to examine an unknown pathology in the middle ear. An exploratory tympanotomy is the approach used for stapedectomies and ossicular reconstruction without mastoidectomy or tympanoplasty.

Cochlear implant surgery, indicated for bilateral sensorineural deafness, requires extensive patient preparation prior to surgery. The procedure is performed via a mastoidectomy with a facial recess. A hole is made near the round window of the cochlea, and the implant tail, which consists of electrodes, is inserted. The electrodes restore hearing by stimulating the acoustic nerve in the cochlea. The implant is programmed via computer at a postoperative followup appointment.

An endolymphatic shunt procedure may be performed if a patient suffers from perilymph fistula and more conservative approaches were unsuccessful. However, opinions on fistula diagnosis and treatment vary significantly among surgeons, so this procedure is not often seen by surgical technologists.

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Total Abdominal Hysterectomy

Douglas Hughes, cst, crcst

Total abdominal hysterectomy (TAH) is commonly used to treat patients suffering from a variety of pathologies, such as hemorrhage, fibroids, abdominal pain and various types of cancer. Approximately 500,000 hysterectomies are performed in the United States each year.[13]

Hysterectomy is indicated typically in the following three conditions: as a life-saving intervention, as a corrective procedure for serious functional problems, and to improve the patient's quality of life. Some of the more common, specific indications for surgery include uterine cancer, ovarian cancer, cervical cancer, fibroids, endometriosis, prolapse, precancer of the uterus, pelvic adhesions, unusually heavy bleeding, and pelvic pain.[8]

Hysterectomy may be performed either vaginally or abdominally, depending on the patient's diagnosis and age, the size of the uterus, and other related factors.[13] The abdominal approach is most commonly employed when nearby structures, such as regional lymph nodes, must be examined, when the ovaries and fallopian tubes will be removed in conjunction with the uterus, and when large tumors are present.

The vaginal approach may be indicated when the size of the uterus is determined to be less than that during 12 weeks of gestation, when no other related pathology is suspected, and when the hysterectomy will be done in conjunction with cystocele, rectocele, or enterocele repair, [3,13]

This article will chronicle the preoperative, intraoperative, and postoperative case management of a 38-year-old patient undergoing total abdominal hysterectomy for treatment of large symptomatic uterine fibromata.

PATIENT INFORMATION

The patient is a 38-year-old caucasian female approximately 5'3" tall who weighs 146 pounds. She has no known drug allergies and is currently taking nonsteroidal anti-inflammatory drugs to relieve menstrual cramping and

heavy menstrual bleeding. She has also been taking nonprescription iron supplements to correct anemia caused by fibroid-related blood loss.

The patient's blood type is O negative. The patient has admitted to heavy illegal drug use in the past, but indicates she has been free of any drug or alcohol use, including smoking, for approximately eight months prior to surgery.

A pelvic examination done prior to admission revealed a uterine mass. Sonohysterography was later performed and confirmed the diagnosis of uterine fibroids, leading to the current surgical intervention.

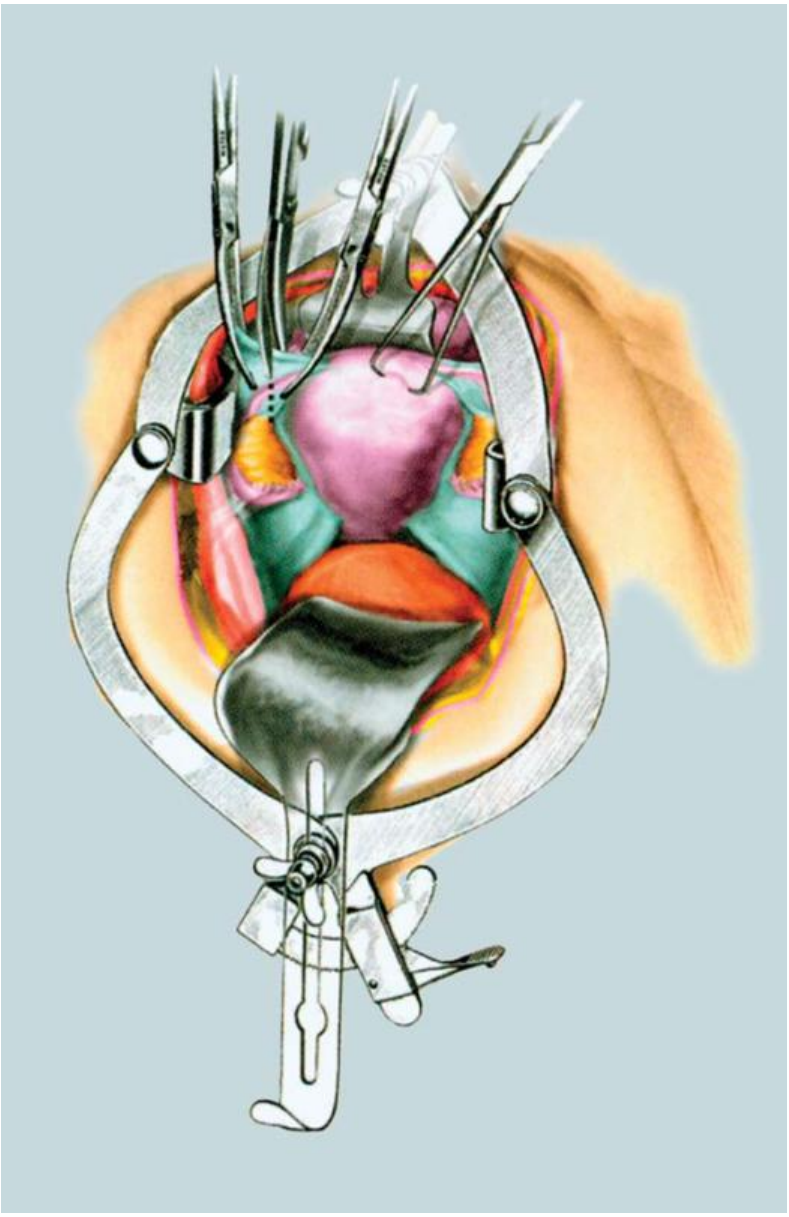

FIGURE 1: Total abdominal hysterectomy (TAH): Division of round ligament.

Courtesy Thomson Delmar Learning. *Surgical Technology for the Surgical Technologist: A Positive Care Approach*. ©2004.

MEDICAL HISTORY

The patient reported that her symptoms have lasted approximately nine months and have become progressively worse. Symptoms include dysmenorrhea, consistent episodes of urinary frequency and urgency, abdominal distension, chronic lower-back pain, and dyspareunia. No trauma that may be associated with these symptoms was reported.

The patient's medical history includes mild asthma, generalized anxiety disorder and a previous cesarean section.

Current medications include:

- Ibuprofen—400 mg every four hours
- Ferrous sulfate—300 mg per day
- Inhaled sympathomimetic—180 mcg (two inhalations) every four to six hours as needed
- Benzodiazepine—0.25-0.50 mg three times daily, not to exceed 4 mg per day

PHYSICAL CONDITION AT ADMISSION

The preoperative physical examination revealed that the patient was in good health and that she was well nourished. Her skin was warm, dry, had good texture, and was free of any notable lesions or abnormalities. Normal, wet mucosa was noted during evaluation of the patient's ears, nose and throat. No pathologies were encountered. An evaluation of the patient's neck produced normal results with no masses found.

Auscultation of the lungs indicated they were normal and without congestion or other anomaly. Examination of the abdomen revealed palpable masses and distention, though bowel sounds were normal.

The patient's extremities were normal and without edema, cyanosis, other pathology, or vascular abnormality. No neurologic disorders were noted, and the patient was alert.

Vital signs were normal and stable:

Heart rate	84 bpm
Respirations	18 breaths per minute
Blood pressure	126/82 mm/Hg
O_2 saturation	98%
Temperature	98.8° F

SURGERY INDICATED

Drugs on the field included 1,000 cc of normal saline irrigation fluid, 30 cc of 0.25% bupivacaine with epinephrine for local anesthesia, and triple antibiotic ointment (neomycin, polymyxin, and bacitracin zinc) for application with the dressing.

ANESTHESIA

Prior to anesthesia induction, the patient's jewelry and wristwatch were removed. General anesthesia was administered via an endotracheal tube. Vital signs and airway were managed, and the patient's level of consciousness was assessed. Nothing abnormal was reported.

Intravenous induction and maintenance agents used:

- Midazolam Hydrochloride
- Propofol
- Fentanyl Citrate

Inhalation agents used:

- Oxygen
- Desflurane

PATIENT POSITIONING

The patient was transported to the O.R. via gurney and transferred to the operating table with the assistance of the surgical team. Her head was placed on a gel donut headrest. The patient was then covered with a blanket for warmth and privacy.

The patient was positioned in the supine position with padding under bony prominences and a restraint proximal to her knees to prevent falling. Arms were extended laterally on padded armboards and were positioned to slightly less than 90°.

A pulse oximeter was applied to the right index finger, and a blood pressure cuff to the upper right arm. The electrosurgical unit dispersive pad was placed under the left buttock.

Following intubation and induction of anesthesia, the blankets were repositioned, and a Foley catheter was inserted.

SKIN PREPARATION

The patient had no known allergy to iodine-based chemicals, so a standard iodine prep solution was used in accordance with the surgeon's preference card. Abdominal and vaginal preparation techniques were employed.

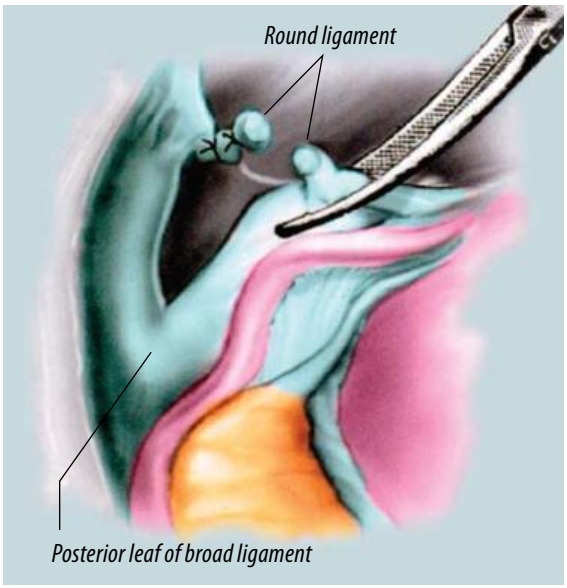

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FIGURE 2: Broad ligament–posterior and anterior leaves.

An impervious drape with a reservoir was placed under the buttocks to collect excess prep solution. Disposable towels were placed at the patient's sides. For the vaginal prep, a downward movement was used over the genitalia and perineum. Each sponge was discarded after prepping over the anus. The upper thighs, pubis, vulva, labia, perineum and anus were prepped. The vaginal vault was prepped with sponge sticks, and each was discarded after use.

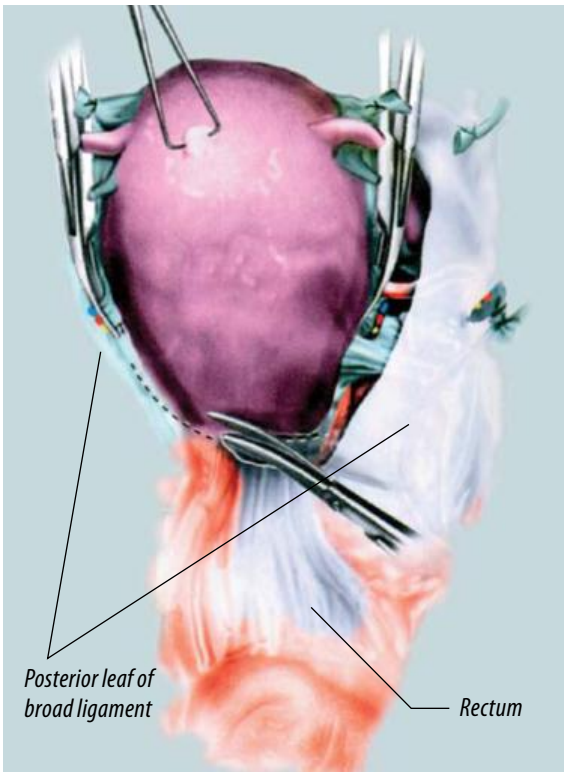
The abdomen was prepped beginning at the incision site (low transverse) and extending from the nipples to midthighs, and laterally as far as possible. This was accomplished using circular motions starting from the incision site outward. A sterile, disposable towel was used to collect and dry any excess solution.

DRAPING

Folded towels and a laparotomy drape were used to create the sterile field. Sterile blue towels were placed one-by-one around the planned incision site in order to outline the area for placement of the drape. Towel clips were not used to secure the towels, as it was determined that they would not be needed.

The protective strips were removed from the adhesive backing of the laparotomy drape, and it was passed to the surgeon. The drape was orient-

FIGURE 3:
Dissection line.



ed for maximum exposure of the surgical site just superior to the mons pubis. The sheet was slowly unfolded bilaterally and stabilized. The head of the drape was extended and passed to the anesthesia provider, who fastened it to IV poles located on either side of the patient's head. The foot of the drape was extended downward beyond the operating table to cover the body.

The electrosurgical pencil and suction apparatus were placed on the drapes and secured with nonmetallic, nonperforating towel clips. Finally, sterile light handles were attached, and the lights were positioned for maximum exposure of the operative site.

TIME-OUT AND INCISION

A surgical time-out was done to verify correct patient and procedure, and a low transverse (Pfannenstiel) incision was made superior to the pubic symphysis and extended transversely to approximately 10-15 cm with a #10 blade on a #3 knife handle. Rat-toothed forceps were used to assist with manipulation of the tissues.

The subcutaneous (adipose) tissue was incised with electrocautery, and hemostasis was maintained by coagulation. The anterior rectus sheath was incised with curved Mayo scissors and reflected superiorly using two Kocher clamps. The bellies of the rectus muscles were dissected longitudinally, and the peritoneum was incised vertically with a #10 blade and toothed forceps, to elevate it from underlying structures. A medium Richardson retractor was used to aid in exposure of the operative site.

PROCEDURAL OVERVIEW

Once entrance into the peritoneal cavity was achieved, the uterus and surrounding structures were assessed for any unsuspected pathology. The adnexae, including the ovaries and fallopian tubes, were also assessed. The operating table was put in the Trendelenburg position to improve visualization of the abdominal cavity and operative site.

The bowel was positioned away from the operative area and packed with five laparotomy sponges moistened with warm normal saline. The surgical site was exposed with an O'Connor-O'Sullivan self-retaining retractor, which was placed into the abdominal cavity.

Short instruments on the Mayo stand were replaced by extra long instruments in order to reach deeper anatomy. Incorporating the round and ovarian ligaments, Phaneuf clamps were placed across each broad ligament close to the cornu. Some of the clamps were left in place along with perforating towel clips to aid in elevating and manipulating the uterus during excision.

0 Vicryl® ties were used to ligate the round ligaments, which were divided and cut with curved Mayo scissors. Anterior and posterior leaves were created on the broad ligaments, which were incised using Metzenbaum scissors.

The peritoneum of the bladder was separated from the lower portion of the uterus. A sponge stick was used to bluntly dissect the bladder away from the uterus and cervix along an avascular plane. The retroperitoneum was opened to expose the iliac vessels and ureters underneath. Once these important structures were identified, they were protected for the remainder of the procedure.

The infundibulopelvic ligament and uterine artery were exposed by enlarging the peritoneal opening. A Heaney clamp was placed medial to

the ovary. The infundibulopelvic ligament was double-ligated with a stick tie and divided. Cephalad retraction of the uterus was achieved, and it was deviated laterally. Exposure of the uterine vessels was thus attained, and the vessels were cross-clamped with a curved Phanuef clamp. The vessels were then ligated and cut.

The rectum was mobilized from the posterior portion of the uterus and reflected inferiorly. Following a clamp-clamp-cut-tie routine, the cardinal ligament was clamped, ligated and divided bilaterally. Incorporating the uterosacral ligaments, curved clamps were placed bilaterally as the uterus was retracted cephalad.

A basin was made available to receive the specimen. The uterus was freed using Jorgensen scissors and was placed, along with dirty instruments, in a stainless steel kidney basin by the surgical technologist. The vaginal cuff was then closed using 0 Vicryl suture on a CT-1 needle.

A count of all disposable supplies was initiated and was reported as correct. Extra long forceps were used to facilitate closure. The peritoneum was closed in a similar fashion. Warm irrigation fluid was prepared for use in the peritoneum. The abdominal cavity was thoroughly irrigated with approximately 700 cc of 0.9% sodium chloride irrigation fluid.

Irrigation fluid was aspirated using a Via-Guard® suction device over a Yankauer suction tip, and hemostasis was achieved. The ureters were then assessed for integrity and proper position. As no other pathology of the ovaries was detected, they were left and sutured to the lateral pelvic walls.

The abdomen was then prepared for closure. The self-retaining retractor and five laparotomy sponges were removed and counted. The peritoneum was closed using 2-0 Monocryl® CT-1 suture. The peritoneal count was initiated and consisted of a complete count of all disposables and instrumentation. The count was reported as correct.

The fascia, muscle and subcutaneous tissue were closed using 0 Vicryl CT-1 suture. Toothed tissue forceps were used to aid in closure. The skin was then closed with staples. Toothed Adson forceps were used to aid in approximation of the skin.

The skin count was initiated upon closure, and the count of all disposables was correct. Triple antibiotic ointment was applied to the staple line, followed by Telfa pads for non-adhesive contact with the wound, 4x4 fluffs and ABDs for absorption, and paper tape as an adhesive layer for support of the dressing. All equipment was disconnected, and the drape was removed.

The patient emerged from anesthesia successfully and was assessed and extubated by the anesthetist. The restraints were removed, and the patient was transferred to PACU by the surgical team. No postoperative complications were noted. Intraoperative blood loss was approximately 150 cc. Total urine output was 140 cc.

The specimen was transferred to a biohazardous materials specimen container, which

Brief overview of fibroids

A fibroid, also known as a uterine fibroma (or, more correctly, uterine leiomyoma), is a benign tumor of the myometrium.[2,13] These tumors grow from the middle layer of the uterine wall and are composed of muscle and fibrous tissue. Fibroids are common in women, especially those over 35 years of age, and they are the most frequent indication for hysterectomy.[8]

As many as 50% of women have fibroids. Although the condition is typically asymptomatic, many women experience such complications as dysmenorrhea, menorrhagia, leukorrhea, pelvic pain and discomfort, and pressure on other surrounding tissues and organs.[8] The various types of symptoms experienced are directly related to the location of the tumors.

Fibroid size can vary from a few millimeters in diameter to a tumor large enough to fill the entire abdominal cavity. The size of the tumor may be affected by the age of the patient with regard to their reproductive capability. Fibromata are usually much larger in younger patients and tend to regress after menopause.[13]

There are several treatment options available, including induction of leutinizing hormone-release hormone (LHRH), which will temporarily shrink fibroids; electrosurgical removal during hysteroscopy; myomectomy; laser removal; cryoablation; and hysterectomy for more severe cases.[8,13]

was labeled with patient information according to facility policy. The specimen was prepared by adding a formaldehyde solution and was transported to pathology by the circulating nurse.

DISCHARGE AND PROGNOSIS

A discharge letter and discharge information packet was signed and dated by the patient on the fourth postoperative day. The patient was voiding normally and ambulating well without aid. Wound dressings were clean and dry, and there was no sign of surgical site infection. The patient was instructed by the doctor that she would be able to return to normal activities after six to eight weeks.

At the time of discharge, the patient was given a prescription for hydrocodone 500 mg for pain. The patient was instructed to follow a regular diet and not to lift anything over 20 lbs. A follow-up appointment was scheduled for one week postsurgery.

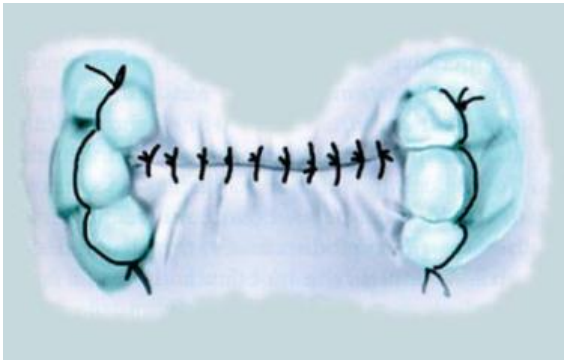


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FIGURE 4:
Vaginal cuff closure.

POTENTIAL COMPLICATIONS

Complications following total abdominal hysterectomy occur in approximately 10–15% of patients.[1] Potential complications include bowel obstruction or damage, bladder injury, wound infection or dehiscence, injury to the ureters, and hemorrhage.[9]

ABOUT THE AUTHOR

Douglas Hughes currently works as a Certified Surgical Technologist and Certified Registered Central Service Technician at Mercy Medical Center at Nampa, Idaho. In February, 2007, he graduated with an associate degree from San Joaquin Valley College in Fresno, California and received his CST credential shortly after graduation.

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Bilateral Femoral-Popliteal Bypass—

From Supine to Prone

Candice A Montgomery, CST

A femoral-popliteal bypass grafting procedure is usually performed to treat patients who have an arterial occlusion situated in the femoral and/or popliteal arteries distal to the inguinal ligament.[3]

The occlusion is typically caused by atherosclerosis, which prohibits or substantially reduces the flow of oxygenated arterial blood to the lower extremities. If left untreated, this occlusion can lead to necrosis of the tissue of the lower extremities and, inevitably, amputation.[3]

PATIENT'S MEDICAL HISTORY

The patient is a 56-year-old male, six feet tall, weighing 267 lbs. He has been a cigarette smoker for 40 years, at a rate of 20–30 cigarettes per day. He was diagnosed with type 2 diabetes mellitus approximately 16 years ago and has been treated with insulin injections for six years.

PREOPERATIVE DIAGNOSIS

The patient has been diagnosed with peripheral vascular disease secondary to type 2 diabetes mellitus and hyperlipidemia. He has atherosclerotic occlusion of both the right and left popliteal arteries with severe stenosis.

Preoperative exam

Blood pressure	115/53
Pulse	71
Temperature	98.5°F
Respirations	12
Glucose FBS	226 mg/dL

No positive popliteal or pedal pulses were noted. The patient was given 1 gm of cefazolin sodium. The patient was known to be on the following medications: pioglitazone, insulin glargine, lisinopril hydrochlorothiazide, pentoxifylline, metformin, glipizide, and pravastatin.

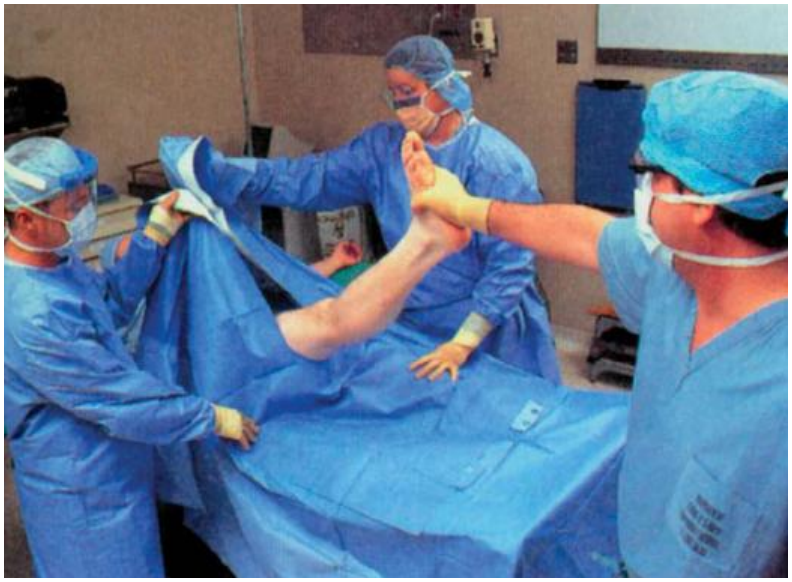

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FIGURE 1:
An example of a split sheet being placed under a patient's leg.

The patient's last tobacco cigarette was smoked at midnight the day before surgery. The day of surgery, the patient complained of mild nausea, which he admitted was attributable to anxiety in relation to the surgery.

SPECIAL PREOPERATIVE PREPARATION

Since this procedure entails a patient position change, the most important preparation a surgical technologist should account for is the need for double the supplies required to reposition the patient. Sterile supplies include drapes, skin preparation solution, towels, gowns, gloves, ESU pencils, suctions and light handle covers. Nonsterile repositioning supplies include an additional Bair Hugger® blanket, prone headrest, prone under-ankle padding, and prone under-shoulders, -arms and -hands padding.

Additional preoperative preparation includes soaking vessel loops in saline and attaching them to mosquito clamps; placing rubber shods or ligaboots on the mosquito clamps; preloading small and medium hemoclip appliers with appropriate hemoclips and verifying they are attached securely; attaching free ties to tonsil clamps, in case the surgeon requests a tie on a pass; preloading vascular suture on a Castroviejo needle holder, in case the surgeon decides to make a quick vascular repair; arranging all free ties in correct order, so they're readily accessible if a vessel needs to be ligated immediately; flushing the olive tip catheter extension on the heparinized syringe with heparin saline solution before handing it to the surgeon; and verifying that the asepto syringe is full and prepared with heparinized saline for quick irrigation.

Since a second surgeon is assisting, the surgical technologist needs to be able to accommodate both surgeons simultaneously. For example, if the surgeon requests forceps, the assistant will typically require forceps at the same time.

In addition, since the procedure is bilateral, both surgeons may want to close at the same time. The surgical technologist should have available two needle holders preloaded with the appropriate suture.

The surgical technologist also should anticipate the use of Doppler and C-arm fluoroscopy, which will require lead shields for all surgical team members and, possibly, a lead-shielded wall to stand behind. Additional large drapes also will be needed to cover the fluoroscope and to protect the sterile field and patient from intraoperative contamination.[2]

SAPHENOUS VEIN GRAFT PROCUREMENT IN SUPINE

ANESTHESIA AND MEDICATIONS

General anesthesia was administered. Adjuncts to the anesthesia included oxygen, nitrous oxide, dolasetron, metoclopramide, fentanyl, vecuronium bromide, propofol, esmolol, ephedrine, lidocaine, morphine, glycopyrrolate, neostigmine

bromide and lactated Ringers solution. The surgeon also requested that intravenous heparin be available.

POSITIONING, SKIN PREPARATION AND DRAPING

The head of the operating table was removed and placed at the foot of the table to facilitate intraoperative C-arm X-rays. Padding was checked to determine whether repositioning was necessary to match the new configuration.

Gel padding was placed on the full length of the table. The patient was positioned in supine with both arms tucked in at the sides, a donut headrest under the head, and a safety strap across the chest.

The circulator shaved the patient's anterior medial thigh to prepare for the saphenous vein graft procurement. Shaved hair was removed with tape.

The circulator applied skin preparation solution to the left leg while it was being abducted by the surgical technologist, using a sterile, impervious stockinette to hold the foot. The left leg was prepped from umbilicus to just distal to the knee and circumferentially around the left leg.

The groin was then prepped and covered with a sterile towel folded in thirds. The groin area was not shaved due to surgeon's preference.

A large drape was placed underneath both legs. A split sheet was placed underneath the left thigh, and slits were secured around the thigh. A fenestrated sheet was placed with fenestration over the intended vein procurement site. The fenestration was then extended to include the entire thigh from abdominocrural crease to distal knee.

PROCEDURAL OVERVIEW

The surgeon used a #10 blade on a #3 knife handle to make small, two-inch interrupted incisions along a previously marked saphenous vein site on the anterior medial thigh. The electrosurgical unit was used to achieve hemostasis. DeBakey forceps were given to the surgeon, and Army-Navy retractors were given to the assistant surgeon.

Dissection was continued down to the saphenous vein, which was then examined for branches. The previous interrupted two-inch incisions were extended from the primary proximal incision to the distal incision.

Remaining tissue was dissected down to the saphenous vein using Metzenbaum scissors and DeBakey forceps. Blunt Weitlaner retractors were then used to retract the tissue.

Approximately 35 cm of saphenous vein were exposed for graft procurement. The surgeon used a right-angle clamp, a mosquito clamp and a vessel loop to isolate the proximal end of the exposed saphenous vein.

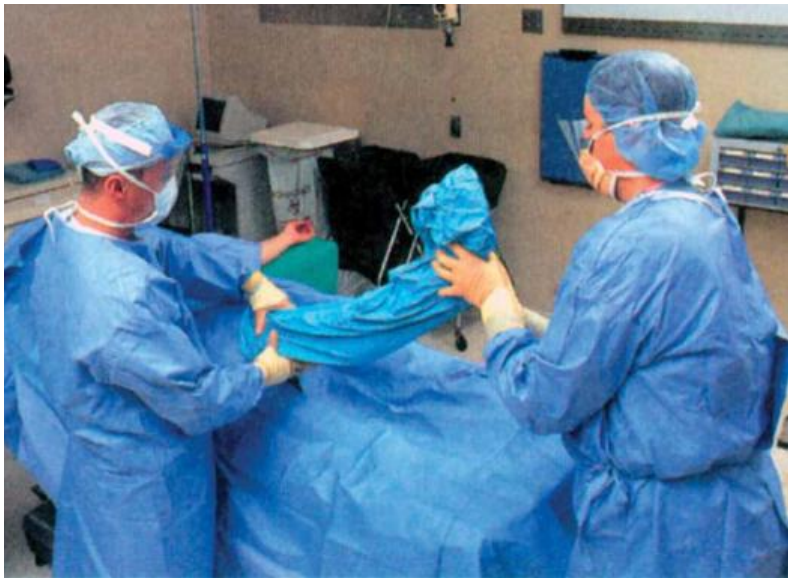

FIGURE 2:
An example of a stockinette being applied and unrolled to the proper level.

The surgeon repeated these steps using the same instrumentation and supplies to isolate the distal portion of the exposed saphenous vein. Tributaries and branches of the exposed saphenous vein were ligated with small hemoclips and 3-0 nonabsorbable silk 18-inch ties.

The distal end of the saphenous vein was marked with a straight line using a sterile marking pen. The proximal and distal ends of the saphenous vein were ligated with medium hemoclips, and the vein was removed.

The vein was untwisted and flushed with heparinized saline using an olive-tip cannula on a 30-cc syringe. The vein was then placed in a kidney basin containing a solution of heparinized saline.

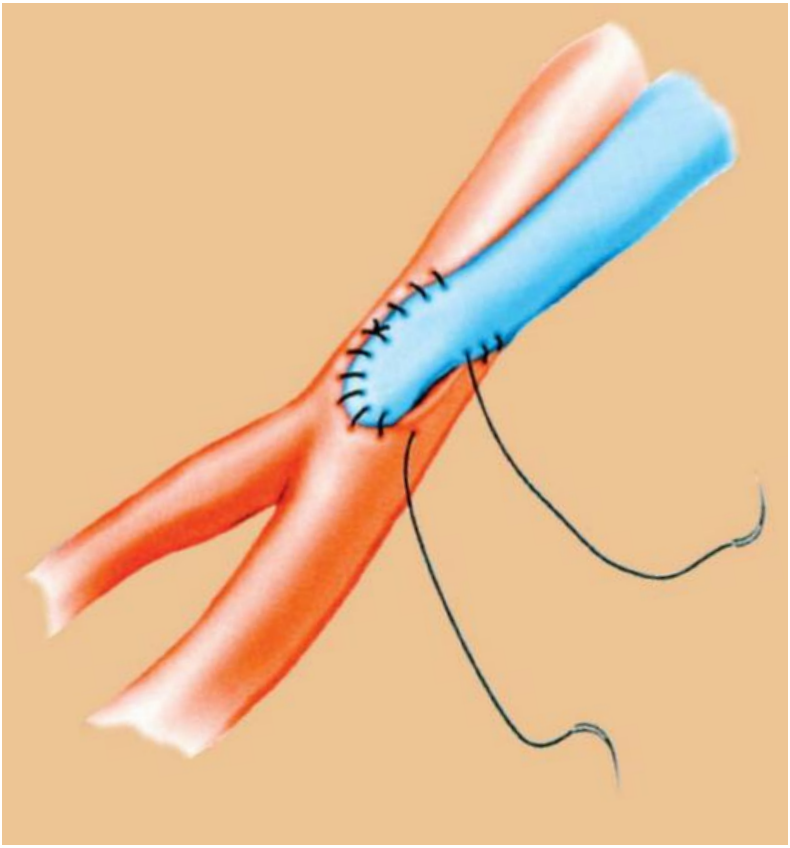

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FIGURE 3:
Popliteal artery—saphenous vein anastomosis.

A soft goods and sharps count was initiated, and wound closure was begun. Subcuticular tissue was closed with 2-0 synthetic polyester suture on a GS-21 needle. The skin was closed with staples.

Points to remember:

- When passing ligating suture ties, pass them in forceps, or pass them onto the field near the surgeon where the suture is visible.
- When passing vessel loops, make sure they are premoistened in saline solution before passing them to the surgeon.
- Due to the vein's oily surface, the sterile marking pen may not be effective, and an alternative should be available.
- When handing the stapler to the surgeon, also pass off two Adson forceps with teeth.

BILATERAL FEMORAL-POPLITEAL BYPASS GRAFTING IN PRONE

POSITIONING, SKIN PREPARATION AND DRAPING

The stretcher was brought back into the room to facilitate patient repositioning. The patient was rolled over onto the stretcher in a prone position and then transferred back to the table with the roll board still in prone position.

The patient was properly padded and secured with the donut headrest in correct position to ensure a proper airway. The arms were tucked in at both sides, and rolls were placed underneath both shoulders to pad pressure points. A roll was also placed under each ankle.

Light covers, drapes, gowns and gloves were changed for all team members. The circulating nurse prepared each leg circumferentially from just underneath the buttocks to the toes. The legs were abducted for the skin preparation with a sterile, impervious stockinette for each leg to grip each foot.

The perineal area was covered with two sterile towels. A large drape was placed underneath both legs. Two split sheets were positioned for each leg. Then a fenestrated drape was placed in position for each leg.

Points to remember:

- Position the back table and Mayo stand out of the way to ensure they remain sterile during repositioning. The surgical technologist should then remove his or her gown and outer gloves and assist with patient repositioning.
- Additional supplies, such as gowns, gloves, drapes and light handle covers, should have already been opened and available on the back table. A second scrub is necessary.
- Special care should be taken when placing the perineal towel on the patient, so that sterility is not compromised.

PROCEDURAL OVERVIEW

The surgeon made the popliteal artery incision on the right leg first, using a #10 blade on a #3 knife handle. The incision was then dissected down to the femoropopliteal artery using DeBakey

forceps, Metzenbaum scissors and right-angle clamps. Blunt Weitlaner retractors were used proximally and distally to expose the bypass site.

The surgeon then made a popliteal artery incision on the left leg and dissected down to the femoropopliteal artery in the same manner as was performed on the right leg. Additional blunt Weitlaners were used proximally and distally to expose the bypass site on the left leg.

The femoropopliteal arteries in both legs were isolated proximally and distally using large, red artery vessel loops, right-angle clamps and mosquito clamps in the same manner as was performed on the saphenous vein. The saphenous vein was sized for both bypass sites to ensure sufficient length before cutting.

The saphenous vein was then rotated 180 degrees, so that the distal end became the proximal end. This was done to prevent use of the valvulotome, which could cause damage to the vein. The femoral artery was clamped with DeBakey vascular clamps proximally and distally on the right leg.

An incision was made into the femoral artery using a #11 blade on a #7 knife handle just distal to the proximal clamp on the right leg. DeBakey vascular forceps and a Freer elevator was used to remove the plaque that was occluding the artery. The removed plaque was placed on the back table and was cared for later.

Small tributaries and bleeders were ligated using small and medium hemoclips and 3-0 nonabsorbable silk 18-inch ties. The saphenous vein was flushed again with heparinized saline and then shaped in a toe-to-heel fashion to facilitate anastomosis. Potts-Smith scissors were used to cut the graft into proper shape.

The surgeon requested that the patient be treated systemically with heparin. After a sufficient amount of time passed to ensure sufficient circulation, the saphenous vein was anastomosed to the proximal portion of the femoral artery using 6-0 nonabsorbable, polypropylene sutures on double-armed CV-1 needles, a Castroviejo needle holder, and a DeBakey vascular forceps with a 1-mm tip. Rubber shods on straight mosquito clamps were used to isolate and protect one of the double-armed needles while the other was used to suture.

Before suture closure, the arterial vascular clamp was released, and the artery was flushed with arterial blood. The distal portion of the saphenous vein was shaped in the same toe-to-heel fashion and then anastomosed in the same way to the distal femoropopliteal artery just proximal to the distal clamp using the same suture and instrumentation described above. The arterial vascular clamp was released to allow the blood to flow. Suture lines were verified and found stable.

The same procedure with the same suture and instrumentation was then repeated on the left leg.

The surgeon used his fingers to verify palpable pulses in both arteries. A Doppler probe was sterile-draped and used to test the distal popliteal arteries of both legs.

C-arm fluoroscopy was then requested to determine sufficient blood flow. The C-arm was draped with sterile towels and enabled for use. To ensure sterility, a large drape was placed next to the operative site where the C-arm gets closest to the field.

Team members used lead shields and a lead-shielded wall to protect themselves from radiation. A contrast agent was injected into the patient's arteries, and X-rays were taken. The surgeons then verified sufficient blood flow to the lower extremities and the absence of any arterial occlusion.

The C-arm was removed from the field, and the large drape used to protect the operative site was discarded. Each surgeon simultaneously used interrupted sutures to bilaterally close the subcuticular tissue with 2-0 synthetic polyester suture on a GS-21 needle, a Mayo-Hegar needle holder and DeBakey forceps.

Staples and two pairs of Adson forceps with teeth were used by both surgeons simultaneously to approximate and close the skin. A soft goods and sharps count was initiated at the start of wound closure.

Dressings for both incision sites included nonadhesive pads, 4x4 pads, a gauze roll and three-inch paper tape. After dressing the femoropopliteal incision sites, the patient was returned

to supine position, and the same dressings were applied to the saphenous graft incision site.

The back table and Mayo stand were removed from the field and isolated to remain sterile until the patient left the room.

Points to remember:

- During any peripheral vascular surgery, tissue forceps need to be given with any cutting tool, including suture.
- Mosquito clamps should always be passed after vessel loops to clamp the loops.
- If the surgeon requests a right-angle clamp, a vessel loop or free tie will typically be requested, too.
- If the surgeon asks for a hemoclip, a second hemoclip typically will be needed, followed by Metzenbaum scissors, in accordance with the clamp-clamp-cut routine. Always keep hemoclip appliers loaded.
- Metzenbaum scissors may be used for cutting suture in peripheral vascular surgeries, because Mayo scissors are large and bulky in tight spaces.
- Double-armed needles often require rubber shods to follow.
- If the surgeon is wearing loops, remember that loops provide only a limited view, and take care when passing items to the surgeon.
- When the surgeon uses double-armed vascular suture, place a sterile towel over the retractors and clamps to prevent the suture from catching on these items.
- While the surgeon flushes the arteries to check for stable suture lines, preload vascular suture in a Castroviejo needle holder, in case the surgeon needs to throw a repair stitch.
- If intraoperative X-rays are performed, the surgical technologist is responsible for protecting him- or herself from radiation.
- After the procedure is completed, the surgical technologist should remain sterile and should keep the back table and Mayo stand sterile until the patient has left the room, due to the increased risk of hemorrhage during any kind of vascular graft procedure.

PATIENT POSTOPERATIVE CONDITION

The patient stayed in the hospital for seven days. He exhibited no known complications. He reported mild to moderate pain, which was relieved by pain medications. Prior to discharge, the patient was instructed to quit smoking, eat healthy foods, exercise and monitor his diabetes carefully.

POTENTIAL COMPLICATIONS

Possible complications following this procedure include infection, hemorrhage, dehiscence, recurrence of stenosis, and amputation.[5]

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Intraoperative Autologous Blood Transfusion

Margaret Sterling, CST, LPN, MA

Autologous transfusion refers to those transfusions in which the blood donor and the transfusion recipient are the same. Allogenic transfusions refer to blood transfused to someone other than the donor.[1]

Autologous blood is most commonly collected and banked in the weeks prior to an elective surgical procedure. Shed blood also may be salvaged for reinfusion during a surgical procedure in which the patient has significant blood loss. Although once used almost exclusively for open heart and vascular procedures, it is now commonly used for orthopedic procedures, liver transplants, trauma cases and complex spinal surgeries.[1]

The advantages of autologous blood transfusion are many and include reduction of the risk of virus transmission, avoidance of allogenic transfusion reactions, and supplementation of the sometimes-sparse supply of allogenic blood.[7]

In intraoperative autologous blood transfusions, shed blood is collected from the patient during surgery and reinfused intravenously during surgery or immediately following surgery.

Autotransfusion can be accomplished either with a device that collects whole blood and washes it to separate its components or with a device that simply collects whole blood and filters it before reinfusion.[4]

The advantage of the former process is that blood is separated into its components (red blood cells, platelets, and plasma), and the patient can be given only the component needed. It also, theoretically, removes toxic byproducts, but may also remove clotting factors in the process.[4]

The washing devices also may require operation by specially trained personnel. While hemofiltration systems are limited in function, they are easy to use and costeffective.

HISTORY

The need for the salvage of blood during surgery was first recognized in the early 1800s when James Blundell, MD, suggested its use to treat postpartum hemorrhage. However, the first use of salvaged blood was clinically described in 1886 when John Duncan, MD, retransfused shed blood from the operative field of a trauma patient undergoing amputation. He removed the blood from the amputated limb and returned it to the patient by femoral injection. This method was fairly successful. These early experiences with salvage blood, while successful, did not gain serious attention.[3]

The history of autologous blood transfusion changed dramatically in 1915 with the development of the first sodium citrate blood anticoagulant and the ability to maintain blood outside the body. This discovery not only renewed interest in salvaged blood, but also sparked an interest in predeposit autologous blood transfusions.

The first predeposit transfusion was described in 1921 by F C Grant, MD, in a patient undergoing surgery to remove a cerebellar tumor and became standard medical practice in the 1920s and early 1930s. The era of organized blood banks in the late 1930s and during the outbreak of World War II helped to change transfusion practice when allogenic products became readily available.[8]

However, salvage procedures continued to be explored throughout this period. In 1931, Brown and Debenheim used salvage blood in civilian, hemothorax cases. In 1943, a milestone in blood salvage was reached when Arnold Griswold developed the first salvage autotransfusion device. Griswold collected blood into a bottle by suction, strained it through cheesecloth and reinfused it into the patient by gravity.[8]

After World War II, blood testing, typing and crossmatching techniques were improved, making blood banks the answer to increased demand for blood. However, in the 1960s, interest in autotransfusion revived once again.

With all the advances in the field of surgery, companies developed new autotransfusion devices. Problems still arose, however, with air embolisms, coagulopathy and hemolysis. The devices used during the Korean and Vietnam Wars collected and provided gross filtration of blood before it was reinfused.[6]

With the introduction of cardiopulmonary bypass in 1952, autotransfusion became an area of serious study. Klebanoff applied principles from cardiopulmonary bypass technology to develop a salvage device. His system—the Bentley Autotransfusion System®—aspirated, collected, filtered and reinfused autologous whole blood shed from the operative field. The problems with the Bentley system included the requirement of systemic anticoagulation of the patient, introduction of air embolism, and renal failure resulting from unfiltered particulate in the reinfused blood.[5]

As the Bentley system lost favor, Wilson and Associates proposed the use of a discontinuous flow centrifuge process for autotransfusion that would wash the red cells with normal saline solution.[11] In 1976, this system was introduced by Haemonetics Corporation and is known commonly as Cell Saver®. More recently, in 1995, Fresenius HemoCare introduced a continuous autotransfusion system.

THREE TYPES OF SYSTEMS

There are three types of autotransfusion systems: unwashed filtered blood, washed discontinuous flow centrifugal and washed continuous flow centrifugal. The unwashed systems are popu-

Autotransfusion in 1936

Like many of the technologies we take for granted today, autotransfusion hasn't been around very long.

TIME magazine published an article on Monday, February 24, 1936, about a young boy whose life was saved by two quick-thinking surgeons, who happened to be father and son.

The boy—"the skinny, scrappy son of a Pittsburgh butcher"—was stabbed in the chest by another boy. The surgeons used cheesecloth to soak up blood that was pooling in the boy's chest.

The entire article is available online at: ***http://www.time.com/time/magazine/article/0,9171,755869,00.html***

lar, because of their perceived low cost and simplicity. However, unwashed systems can cause increased potential for clinical complications.

The washed system requires a properly trained and clinically skilled operator. It returns only red blood cells suspended in saline and is rarely associated with any clinical complications. The autotransfusion process described in this article represents the washed discontinuous centrifugal system. This type of autotransfusion can practically eliminate the need for exposure to homologous blood in elective surgery and can greatly reduce the risk of exposure for emergency surgical patients.

CELL SALVAGERS

Intraoperative cell salvage includes collecting, concentrating and washing the blood in the operating room. Salvage begins when shed blood is obtained from the operating site and immediately mixed with an anticoagulant (usually 30,000 units of heparin per liter of 0.9% normal saline or citrated dextrose) near the suction tip.

The anticoagulated blood is stored in a collection reservoir, where a 120-micron filter removes tissue, clots, orthopedic cement and other macro debris.[2] A simple push of a button activates the process.

A volume of 400–700 ml of blood is pumped into a spinning centrifuge. The centrifugal force in the bowl captures the red blood cells, concentrates and separates them from the plasma and other waste products.

Plasma overflows from the bowl into the waste bag, taking with it white cells, platelets, free hemoglobin, irrigation fluids, activated clotting factors and cell debris.

A light sensor detects when the centrifuge bowl is full of red cells (225 ml concentrated to a hematocrit above 50%), thereby activating the wash cycle. Sterile normal saline is pumped through the red blood cells within the centrifuge bowl, washing the packed red cells.

It takes 1–1.5 L to wash away the unwanted elements, such as soluble activated clotting factors, proteolytic enzymes, potassium, heparin, red cell debris and free hemoglobin. Orthopedic procedures have more debris to remove and therefore require more fluid for washing (usually 1.5–2 L).[2]

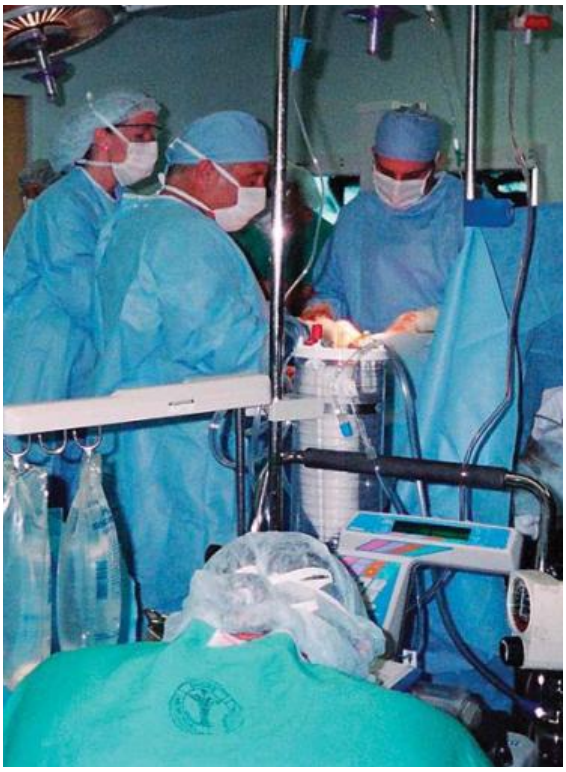

FIGURE 1:
Cell Saver® in use during author's chest surgery.

At the completion of the wash cycle, packed red cells suspended in saline (≥50% Hct) are pumped from the centrifuge bowl into a reinfusion bag. The washed cells are reinfused into the patient using a 40-micron filter in the usual manner.

These processed red cells contain no clotting factors and no anticoagulants. The entire procedure takes less than 10 minutes. Approximately 50% of the shed red blood cells are saved.[2]

INDICATIONS FOR AUTOTRANSFUSION

Autotransfusion is commonly used intraoperatively and postoperatively and is intended for use in situations characterized by loss of one or more units of blood. It may be particularly advantageous for use in cases involving rare blood groups, risk of infectious disease transmission, restricted homologous blood supply or other medical situations for which use of homologous blood is contraindicated.

Common autotransfusion cases include the following:

Orthopedic/ Neurosurgery

- Total knee replacement
- Total shoulder replacement
- ORIF of pelvic fractures
- Total hip replacement
- Femoral fracture repair
- IM rodding
- Insertion of spinal instrumentation
- Laminectomy
- Spinal fusion
- Discectomy

Trauma

- Subdural hematoma
- Chest injuries
- Liver fractures
- Aneurysms
- Amputations
- Blunt trauma (thoracic or abdominal)
- Gun shot wounds/ Stab wounds
- Kidney fractures
- Major vessel lacerations

Other

- Removal of ectopic pregnancy
- Abdominal aortic aneurysmectomy
- Thoracotomy (for non-malignant tumor)
- Craniotomy
- Liver resection (for non-malignant tumor)
- Treatment for cerebral aneurysms
- Hysterectomy (for non-malignant tumor)

ADVANTAGES OF INTRAOPERATIVE RED CELL SALVAGE

Blood salvage does not require the preoperative storage of the patient's own blood—Predeposit donation requires that the patient make periodic trips to the blood donation facility and submit to repeated "needle sticks." This type of donation is not available in emergency situations, and all of the same changes occur in allogenic blood during the storage process, including loss of red cell function. Hemolysis and acidosis also may occur in stored autologous blood.[8]

Rapid availability of the patient's own blood—Since the blood is being collected as it is shed, its return is almost immediate. It is possible to actually return the blood that is lost during surgery before stored blood can be retrieved.

Reduced net intraoperative blood loss—Retransfusion of blood loss during surgery reduces the need for allogenic transfusion and decreases the overall blood loss.

Decreased need for blood from the blood bank—This may be particularly important in emergency and trauma situations and in patients with rare blood types.

No compatibility testing required—Since the procedure is performed in the operating room, and only one patient with one blood type is involved, there is no need to type and crossmatch this blood.

Better quality of red blood cells than in stored blood—The higher levels of 2, 3 diphosphoglycerate (DPG) and normal survival of red blood cells in salvaged blood have been established. While red cell damage with release of hemoglobin into the plasma occurs in the salvage process just as it does in stored blood, the concentration and washing process prevent potential harm to the patient.[8]

Acceptable to religious groups—Some religious groups refuse to receive donated blood, because it is contrary to their beliefs. When blood salvage can be performed using direct reintransfusion—therefore establishing a "continuous circuit"—it may be more acceptable to some groups.

Usually costeffective—Many studies have been done on costeffectiveness of blood salvage procedures. Many considerations should be made, including the cost of allogenic blood and the cost of specialized equipment and trained operators necessary to perform these procedures, as well as the complication rate associated with allogenic blood transfusions. Most experts agree that costeffectiveness is accomplished if three units of red cells can be recovered and returned to the patient.[10]

THE DISADVANTAGE OF AUTOTRANSFUSION

The main disadvantage of autotransfusion is the depletion of plasma and platelets. The washed autotransfusion system removes plasma and platelets to eliminate activated clotting factors

and activated platelets, which could cause coagulopathy if they were reinfused into the patient.

This disadvantage is only evident when very large blood losses occur. The autotranfusionist monitors blood loss and will recommend the transfusion of fresh frozen plasma and platelets when the blood loss and return of autotransfused blood increases. Typically, the patient will require fresh frozen plasma and platelets as the estimated blood loss reaches the total blood volume of the patient.

CONTRAINDICATIONS[8]

The use of blood recovered from the operative field is contraindicated in the presence of bacterial contamination or malignancy. The use of autotransfusion in the presence of such contamination may result in the dissemination of pathologic microorganisms and/or malignant cells.

Contamination of the surgical site from infection, generalized sepsis or bowel contents—Any abdominal procedure poses the risk of enteric contamination of shed blood. The surgical team must be diligent in observing for signs of bowel contamination of the blood. If there is a question of possible contamination, the blood may be held until the surgeon determines whether or not bowel contents are in the surgical field. If the blood is contaminated, the entire contents should be discarded.

Malignancy—There is the possibility of the reinfusion of cancer cells from the surgical site. There are two possible exceptions to this contraindication:

- The surgeon feels complete removal of an encapsulated tumor is possible. Blood may be aspirated from the surgical site, processed and reinfused with the surgeon's consent.
- If an inadequate supply of blood exists, the washed cells may be used to support the patient's vital signs, with the surgeon's consent.

Cesarean sections—Autotransfusion is contraindicated in these procedures, because of the possibility of an amniotic fluid embolism. The amniotic fluid may not be washed away during the wash phase of the autotransfusion process.

SPECIAL CONSIDERATIONS DURING COLLECTION[6]

Antibiotics that are plasma-bound can be removed during the autotransfusion wash cycle. However, topical antibiotics, which are typically not plasma-bound, may not be washed out during autotransfusion and may actually become concentrated to the point of being nephrotoxic.

When collagen-type products are used, autotransfusion should be interrupted, and a waste or wall suction source must be used. Autotransfusion can be resumed once these products are flushed from the surgical site.

If products like Gelfoam® are used, autotransfusion can be continued. However, direct suctioning of these products should be avoided.

Find Out More…

Historical perspectives

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- Blood strained, 1932, *TIME* magazine—Available at: ***http://www.time.com/time/magazine/article/0,9171,929851,00.html***
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Autologous blood

- Autologous blood donation—Available at: ***http://www.nataonline.com/Topics.php3?NumTopic=38***
- Blood conservation in orthopaedic surgery, European Society of Anaesthesiologists—Available at: ***http://www.euroanesthesia.org/education/rc_nice/6rc2.html***
- Transfusion alert use of autologous blood, National Heart Lung and Blood Institute—Available at: ***http://www.nhlbi.nih.gov/health/prof/blood/transfusion/logo.htm#expert***

Blood alternatives

- Alternatives to regular blood transfusions, US Food and Drug Administration—Available at: ***http://www.fda.gov/bbs/topics/CONSUMER/CON284b.html***
- Artificial blood experiment in 2006, ABC News—Available at: ***http://abcnews.go.com/WNT/Story?id=2166058&page=1***
- How do scientists make artificial blood? How effective is it compared with the real thing?, *Scientific American*—Available at: ***http://www.sciam.com/askexpert_question.cfm?articleID=0007ACC0-ACD3-1C71-9EB7809EC588F2D7***

Cement is often used or encountered during primary or revision total joint replacement surgery. The cement—when in a liquid or soft state—should not be introduced into the autotransfusion system.

When cement is applied, a waste or wall suction must be used. Once the cement hardens, autotransfusion may be resumed.

In some institutions, to maximize the effectiveness of autotransfusion and provide the best conservation and return of red cells, the soaking of sponges is employed. During the surgical procedure, the blood soaked sponges are collected and placed in a sterile basin by the surgical team.

Sterile heparinized saline is added to the basin to prevent clotting and facilitate the release of red cells.

The remaining solution can be suctioned into the autotransfusion reservoir, so that the red cells can be recovered. It has been estimated that 90% of the lost red cells can be returned when autotransfusion is performed in conjunction with soaking sponges.

CONCLUSION

Today, we see the use of red cell salvage both perioperatively and postoperatively, as well as in a variety of surgical procedures. Clinical applications for red blood salvage outside the operating room include the emergency center, the postanesthesia care unit (PACU) and other intensive care units.

A more recent application of postoperative collection has been in the area of wound drainage during orthopedic surgery. Studies have shown that in some types of orthopedic surgery, the patient experiences the greatest blood loss in the immediate postoperative period in the PACU and that collection and reinfusion of this drainage can reduce a patient's need to receive allogenic blood during this period.[9] The American Association of Blood Banks (AABB) has specific guidelines on the period of time that postoperative wound drainage can be collected for subsequent transfusion.

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Margaret Sterling, CST, LPN, MA, is the educational coordinator for surgery at Shore Memorial Hospital in Somers Point, New Jersey. She is responsible for planning, implementation and evaluation of formal and informal learning and assisting surgical services personnel to perform competently. She also serves on hospital committees that deal with clinical ladders, clinical competency and cultural diversity.

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A Teamwork Approach to Quality Patient Care in the Operating Room

Ann Marie McGuiness, CST, CNOR, MSEd
Teri Junge, CST, CFA, FAST

Editor's Note: *During a previous AST national conference in New Orleans, Betty Schultz, RN, who was then president of AORN, discussed patient safety and how collaboration between professionals in the circulating and scrub roles have the potential to enhance the goal of quality patient care.*

This led to the idea of an article co-authored by a CNOR and a CST that would demonstrate how the two surgical team members perform independently, but interact mutually to ensure a safe patient outcome.

The resulting article focuses on collaboration. Much of the introductory information may appear as a review for many practitioners, but it is included to address the distinct perspectives of the two professions.

Both authors believed that the case-study format would most effectively illustrate the roles of the CNOR and CST within the context of patient safety. The reference material was selected from multiple sites that are relevant to both professions.

This article also serves to introduce a new patient care model called CARE, which melds the A-PIE model familiar to nurses and the A POSitive Care approach familiar to surgical technologists and published in the AST-written textbook, Surgical Technology for the Surgical Technologist.

INTRODUCTION

In today's operating room, the surgical team, composed of both professional and paraprofessional members, plays a vital role in the successful outcome of any surgical intervention. The teamwork model of integrated function and interaction is the foundational basis that fosters a blending of the strengths of the various team members as they come together and work as a unit in the operative setting.

It is the synergy of this team—each with their own professional knowledge, skills and behaviors—that provides the structure and environment that assure the delivery of safe patient care and enable the patient's return to an optimum level of wellness.

The Registered Nurse and the Certified Surgical Technologist function as a subunit within this team, interacting through the utilization of a unique, dynamic relationship—that of four hands and two minds, one sterile role and one nonsterile role, working in interdependent collaboration, cooperation, and mutual support to manage the complexities of the highly technical, specialized operating room environment and to deliver safe patient care.

Using the context of the patient undergoing vaginal hysterectomy, this article will highlight the roles and interactions of these two members of the surgical team—the circulator and the scrub.

ROLES OF THE SURGICAL TEAM MEMBERS

The circulator role is primarily filled by the Registered Nurse (RN). Certification by the Competency and Credentialing Institute (CCI) as a Certified Nurse Operating Room (CNOR) is the preferred credential for those individuals practicing in the capacity of circulator.

The CARE model involves collaboration by all members of the surgical team in delivering patient-focused care.

The focus of the circulating role is one of patient assessment, safety and advocacy, as well as the technical skills of operating room management. In many facilities, the circulator is assisted by the Certified Surgical Technologist in delivering safe patient care outside the sterile field and in performing the technical skills of the operating room that fall within their scope of practice.

The scrub role is primarily filled by the Certified Surgical Technologist (CST). National certification by the National Board of Surgical Technology and Surgical Assisting (NBSTSA) as a Certified Surgical Technologist is the preferred credential for individuals practicing in this role. The focus of the scrub role is one of management of the sterile field.

The roles of both the circulator and the scrub are complex and involve an interdisciplinary approach toward:

- Care of the patient and surgical team members
- Application of the principles of asepsis and implementation of the practice of sterile technique
- Awareness of the environment
- Knowledge of normal regional anatomy and physiology
- An understanding of the pathophysiology related to the planned surgical intervention
- Knowledge of the operative procedure and its variations
- Identification and management of variations that may be specific to the patient (eg, size or comorbid conditions) or surgeon

CRITICAL THINKING MODELS IN THE OPERATIVE SETTING

The day-to-day delivery of quality patient care is one of the most important responsibilities and duties of the surgical team members. It is important that this patient care be delivered based on a collaborative utilization of critical thinking models.

One model—the A-PIE model, derived from the work of Ida Jean Orlando—is a nursing-process model based on the concepts of Assessment, Planning, Intervention, and Evaluation.

A second model, utilized by the surgical technologist—the A POSitive CARE model, derived from the work of Bob Caruthers, CST, PhD, focuses on the technical aspects of patient care. The acronym A POSitive CARE represents knowledge of Anatomy, Pathology, the Operative procedure and its Specific variations, while keeping in mind the Care directed toward the patient and/or team, Aseptic principles and sterile technique, the Role of the team members, and Environmental awareness and concern.

A third model, the CARE model, was developed by the authors of this article. The CARE model embraces the essence of both the A-PIE and A POSitive CARE models and provides a common pathway for interaction among surgical team members.

THE CARE MODEL OF COLLABORATIVE SURGICAL PATIENT CARE

The CARE model is an integrated model of patient care practice that includes active participation and collaboration by all members of the surgical team. It integrates and shows the primary relationship between the roles of tech and circulator in the provision of patient-focused care throughout the intraoperative period.

It includes the concepts of Communication, Assessment, Recommended standards and guidelines, and the Execution of policies and procedures. This model is simple to remember, demonstrates an interdependent relationship among the various practitioners as they perform their duties and execute their responsibilities, and can easily be utilized by any member of the surgical team to prepare for and carry out the various components involved in the delivery of quality patient care.

COMMUNICATION

During a surgical intervention, the circulator and scrub must work together as a unit, in a manner that emulates the true meaning of the word "team." This intraoperative team carries out the myriad tasks and activities that assure the most positive patient outcome possible.

Interaction occurs before, during, and after patient contact to assure that the instrumentation, supplies, equipment and specialty items are gathered, prepared and delivered to the surgeon and assistant in a timely and efficient manner—minimizing the patient's exposure to anesthesia and surgical trauma. Effective teamwork requires planning and utilization of strategies that allow smooth, uninterrupted performance of each individual's tasks and responsibilities.

One key to the success of any team is the use of positive communication. In light of the fact that this intimate subunit must rely upon each other for follow-through of many aspects of a related task, positive communication becomes the linchpin that binds the team into a single functioning unit.

A close-knit intraoperative team communicates on many levels, both verbally and, more often, nonverbally. The circulator assesses the patient's unique needs and develops an individualized plan of care. This care plan is shared with the scrub, including patient allergies, patient limitations and any additional information, such as patient size, that may affect procedural activities.

The circulator performs ongoing patient and sterile field monitoring, anticipating and delivering needed items in a manner that permits the procedure to flow smoothly and without interruption. The scrub monitors the sterile field, the surgical team and the unfolding events of the surgical intervention—sharing observations and special requests with the circulator in a timely manner, which enables them to work together in meeting the surgeon's and patient's needs.

Communication not only occurs between the scrub and circulator, it also involves sharing information among other team members, the patient and any other caregivers who are able to provide additional information and input needed to develop a clear picture of the many patient variables that may influence their intraoperative care.

Admitting personnel and staff gather knowledge and assess the patient, documenting information that plays a vital role in addressing the unique needs of each and every patient.

As the circulator and anesthesia provider assess the patient's individual needs, it is important that any information that affects surgical intervention be shared among all members.

The surgeon is an integral part of this communication team. He or she best knows the patient's chief complaint and has had the opportunity to discuss individual patient concerns relevant to their biopsychosocial needs. By communicating this information to the intraoperative team, the surgeon can be assured that both the routine and specialty items required for the procedure are prepared in a timely and professional manner.

Communication with the anesthesia provider allows for a smooth and seamless anesthesia induction, maintenance and recovery, along with maintenance of physiological homeostasis.

ASSESSMENT

Assessment, the art of gathering information used to develop a plan of action, is the second key to a successful patient outcome and begins at the time the procedure is scheduled.

Many operating rooms now have the ability to utilize and access computerized patient information. This enhanced technology allows the surgeon to forward procedural and patient-specific information and requests directly to the intraoperative team. This information may include the laterality of the procedure, the use of a trial supply or piece of equipment, patient allergies, such as latex sensitivity, or the need for ancillary personnel not commonly utilized.

Gone are the days when the surgeon was solely responsible for the actions of the team. Today, nurses and surgical technologists are formally educated in skills, knowledge, patient safety and risk management.

Knowing this information in advance of the patient's arrival in the operating suite permits the team to optimize preparation, resulting in optimal levels of preparedness and remediation of any situation that may lead to or result in a disruption or delay in the surgical intervention.

Assessment is divided into two areas: procedure-specific information and patient-specific information:

Procedure-specific information

The surgeon's preference card is a valuable tool when gathering data related to a specific procedure and surgeon. It contains listings of routine instruments, supplies, wound closure materials, and equipment commonly used by a particular surgeon during a particular procedure. Patient position and positioning aides, skin preparation materials and techniques, surgeon's glove size and other details are contained on a well-developed and maintained card. It is important for the intraoperative team to assure that the surgeon's preference card is current and accurate, allowing all members of the surgical staff to correctly prepare for each procedure.

Procedure-specific preparation also involves assuring that specialty items, such as mesh for herniorrhaphy, prostheses for orthopedic procedures, and limited-inventory equipment, such as a microscope or stirrups for lithotomy positioning, are available. Emergency cases, unanticipated equipment failures and back-ordered inventory can lead to the staff's inability to provided necessary equipment for patient use.

Once the patient is anesthetized, discovering that needed equipment or items are not available is unproductive, inappropriate and unprofessional. Prospective management of these types of situations through anticipation, planning and effective communication can prevent the need to delay or cancel a surgical intervention—a situation that can be stressful to both the surgeon and patient.

Assessment also involves procedure-specific operating room preparation. During the initial daily room preparation, it is important that equipment, such as lights, suction and the electrosurgical generator, be checked to assure that they are in proper working order.

The same is true for any specialty equipment brought into the room for use on a specific case. It is the responsibility of the intraoperative team to review the case cart and compare it to the patient's record and surgeon's preference card to determine that all requested items are present or immediately available.

Patient-specific information

Every patient who comes to the operating room brings with him or her unique needs and requirements. The operative experience may become routine for operating room practitioners, but it is important that the patient not be defined merely as a room number, diagnosis or procedure. When we refer to patients by their intended procedure, it diminishes the value of each life that is entrusted into our care during this most critical time.

The biopsychosocial needs of each patient play an important role in their overall successful return to their optimum level of wellness. Information that has the potential to impact patient care, such as coexisting medical conditions and patient allergies, should be shared with all individuals caring for this patient.

Patient-specific information may be gathered from other members of the care team (such as the physician and personnel in the admissions or preoperative holding areas), family members or life partners, the patient's medical records, and of course, directly from the patient.

As the circulator and anesthesia provider assess the patient's individual needs, it is important that any information that affects surgical intervention be shared among all members. Patient anxiety level, allergy status, fear of certain items or noises, the need for the presence of a family member or partner for psychological support, the request for omission of a certain aspect of care, such as blood transfusions, are all issues that should be monitored and maintained by all members of the intraoperative team.

Patient anxiety affects their care by releasing cortisol and stimulating the "fight or flight" reaction. This leaves a patient less able to fight infection and may negatively impact postoperative wound healing.

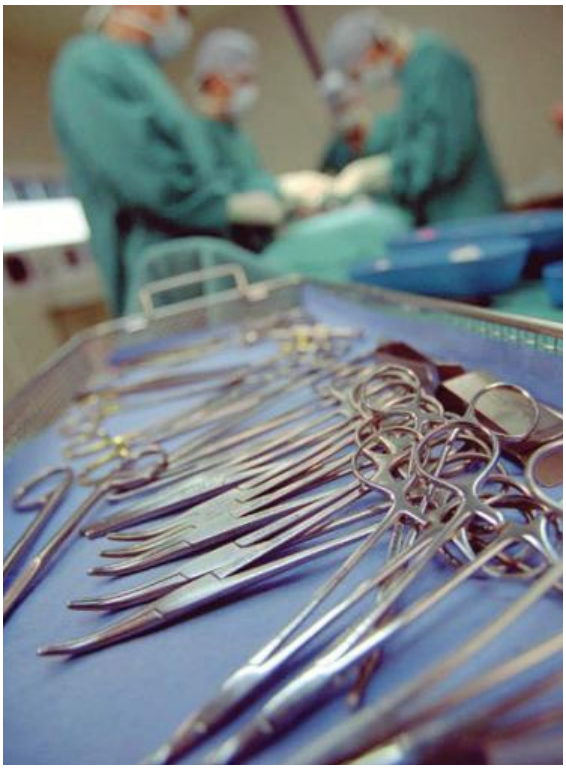
Developing a trusting and supportive relationship between patients and their caregivers should include anxiety-reducing practices, such as introducing all members of the surgical team to the patient, focusing on the patient and the patient's needs, assuring patient safety and well-being by providing physical and verbal comfort, applying warm blankets, and using patient safety devices, such as safety straps.

If possible, the scrub should refrain from making loud or unnecessary noise, requesting supplies, or performing surgical counts in the presence of the awake patient. These activities distract the circulator from providing direct patient care and tend to create an environment that generally increases patient anxiety levels.

Information pertaining to the patient's height or weight is also important. It may be necessary to modify the type, length or size of the instruments and/or the suture routine, based on this information.

RECOMMENDED STANDARDS AND GUIDELINES

A third key to a successful patient outcome is recognizing and following recommended standards of practice and guidelines. Several important groups provide input and maintain standards of practice that affect operating room practice, including the Association of periOperative Nurses (AORN), the Association of Surgical Technologists (AST), the American College of Surgeons (ACS), the American Hospital Association (AHA), the Association



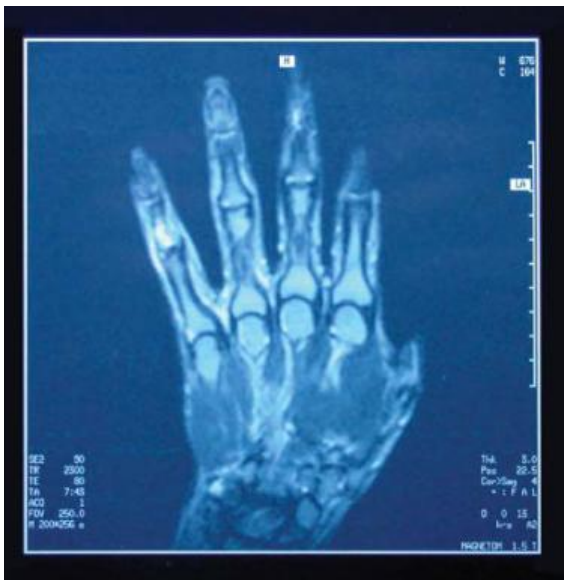
We have an obligation to our patients to account for all items prior to final closure of a body cavity.

for the Advancement of Medical Instrumentation (AAMI), and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO).

The standards of practice and guidelines of these groups, along with several others, provide insight into, and serve as a framework for, the delivery of quality, safe patient care. These documents provide a foundation upon which quality surgical patient care is based. The topics covered represent literally every aspect of operating room practice, from attire to sterilization, disinfection and standards of care.

While recommended standards serve as a guide for practice, they are developed and based on research, input and data collected from across the country. They are the standards to which the community holds the intraoperative team responsible.

When we refer to patients by their intended procedure, it diminishes the value of each life entrusted into our care.



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When in clinical practice, the intraoperative team utilizes the principles of these standards, recommended practices and guidelines to aid in decision-making and the implementation of care. Use of these principles assures the practitioner that their decisions are professional, sound, research-based and designed to provide the surgical patient with an optimal outcome.

EXECUTION OF POLICIES AND PROCEDURES

Execution of the patient's care plan, based on the recommended standards and guidelines, represents the fourth key to the CARE model for successful patient outcome. As the operative procedure is carried out, each team member is responsible for assuring that the needs of the patient and the team are met in a timely and thorough manner and with quality and integrity. Each member, while assessing their own domain of function and contributing their ideas and thoughts, needs to work collaboratively to prevent redundancy and to promote successful, competent and professional care delivery.

DELIVERING QUALITY PATIENT CARE

Easy to remember and use, the CARE model can serve as a reference point to ensuring that quality patient care is delivered each and every time. Application of this model, supported by examples referencing the standards of practice from a variety of professional organizations and industry leaders related to operating room practice, is exemplified using the following scenario.

CASE STUDY

A 32-year-old female, gravida 5, para 5, is scheduled to undergo vaginal hysterectomy due to second-degree uterine prolapse. Her medical history is unremarkable, with the exception of morbid obesity. Her social history includes the statement that both parents are deceased; her mother from a cerebrovascular accident at the age of 54 and her father from lung cancer at the age of 59.

She is married, with five children, ranging in age from four to 16. She works in a manufacturing plant on the assembly line. She smokes two packs of cigarettes per day and consumes one to two cans of beer daily. Her current medications include oral contraceptives, and she has no known drug allergies. Her admission data includes the following statistics:

- Height—5'3"
- Weight—354 pounds

ADMISSION VITAL SIGNS

- Blood pressure—146/85
- Pulse—88 bpm
- Respirations—20/min
- Temperature—97.6° F

ANATOMY, PHYSIOLOGY, AND PATHOPHYSIOLOGY OF THE FEMALE REPRODUCTIVE SYSTEM

The internal reproductive organs of the female include the uterus, ovaries, and fallopian tubes. The ovaries are both exocrine and endocrine glands, producing the hormones estrogen and progesterone, inhibitin, and relaxin, as well as storing and releasing mature ova during the course of the reproductive years. The fallopian tubes serve as a conduit for the capture and transportation of ova from the ovary to the uterus.

The uterus is a pear-shaped organ, located between the bladder and the rectum in the pelvic cavity, consisting of three layers—the endometrium, or lining; the myometrium, or muscle layer; and the perimetrium, which is part of the visceral peritoneum. The uterus is divided into several sections: the dome-shaped portion located above the fallopian tubes, referred to as the dome or fundus; the central section, called the body or corpus; and the inferior, narrow portion that controls entrance into the uterine cavity from the vagina, the cervix.

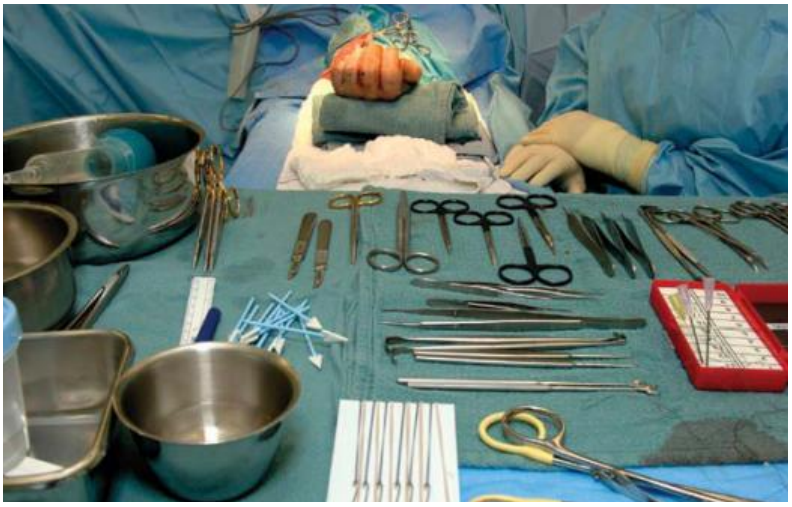
The uterus receives an ample blood supply from the uterine arteries, which are branches of the internal iliac arteries. Blood leaving the uterus returns to the internal iliac veins via the uterine veins. The uterus is the site of menstruation, implantation and development of a fertilized ovum, and labor.

The uterus is suspended in the pelvic cavity by a series of paired ligaments. The broad ligaments are double-folds of peritoneum that attach the superior segment of the uterus to the sidewalls of the pelvis. The uterosacral ligaments connect the posterior neck of the uterus to the sacrum. The cardinal ligaments extend from the broad ligaments and connect the cervix and vagina to the pelvic wall. The round ligaments extend from the uterus to the labia majora via the inguinal canal.

Uterine prolapse, or descensus, is a condition of laxity of the uterine suspensory ligaments. In first-degree prolapse, this laxity permits the cervix to be displaced downward into the vagina to the level of the vaginal introitus.

In second-degree prolapse, the cervix is displaced downward to a point where the cervix passes through the introitus and is exposed to the outside environment. In third-degree prolapse, the uterine body is displaced downward to a point where it can be seen outside the introitus.

Exposure of the vaginal mucosa to the outside environment can lead to erosion of the vaginal mucosa, ulceration and infection. In its displacement, the uterus may also pull on the posterior wall of the bladder, resulting in a bladder neck malposition that can result in urinary incontinence and chronic urinary tract infection.



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During a surgical intervention, the circulator and tech must work together as a unit, in a manner that emulates the true meaning of the word "team."

PROCEDURAL OVERVIEW

Vaginal hysterectomy involves the removal of the entire uterus, including fundus, corpus and cervix via a vaginal approach. Following injection of a hemostatic agent, such as vasopressin or epinephrine, into the vaginal cuff, an incision is made around the periphery of the cervix.

Uterine clamps, such as Kocher, Phaneuf, or Heaney clamps are used to secure the uterine body pedicles during division and ligation of the uterine ligaments and vessels with size zero absorbable suture material. The ovaries and fallopian tubes also may be removed via this approach, but are commonly left in place so that the ovaries may continue providing adequate levels of estrogen and progesterone throughout the patient's life cycle. The vaginal cuff is then closed with absorbable suture material to prevent intestinal prolapse.

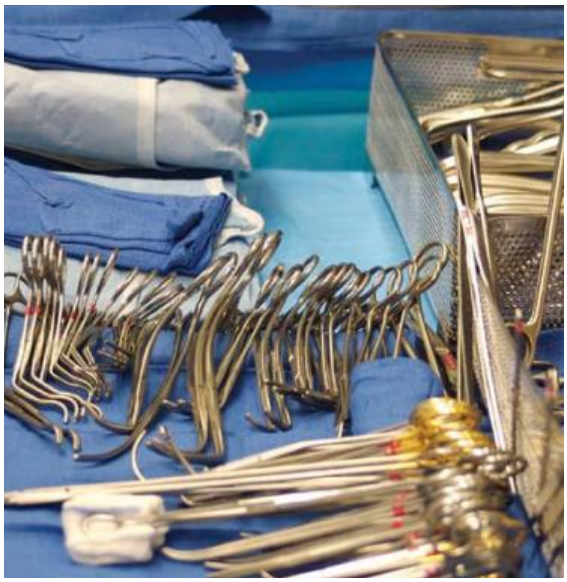
Working through the restricted space of the vagina can be challenging. Vaginal hysterectomy is the procedure of choice for the diagnosis of

uterine prolapse, or descensus, since the supporting ligaments of the pelvic floor are sufficiently relaxed to permit manipulation of the reproductive tissues using this approach. In addition, the patient's return to wellness is usually hastened by not having to address the issues and concerns that can accompany an abdominal incision.

POSITIONING

Vaginal hysterectomy involves placement of the patient in the lithotomy position, a position associated with inherent dangers and risks. The circulator and scrub must be familiar with these risks and must plan appropriate interventions based on both knowledge of the position and intervening patient factors.

Following recommended standards of practice assures the practitioners that their actions are professional, sound and research-based.



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LITHOTOMY POSITION

The lithotomy position permits access to the perineum and rectum by stabilizing the patient's legs away from the surgical site. A modification of the dorsal recumbent position, the lithotomy position uses stirrups for positioning of the lower extremities. Three types of stirrups are available: knee-crutch stirrups, candy cane or string stirrups, and boot-type stirrups.

For long procedures, such as a vaginal hysterectomy, the boot-type stirrup is the preferred positioning aid for the lower extremities. This stirrup is designed to support the lower extremity by placing the foot and calf into a boot device. The boot is attached to an arm that can be repositioned intraoperatively by the surgeon, providing support with a minimum of circulatory and vascular compromise of the extremity. The stirrup arms are attached to the siderails of the operating table using universal socket adaptors, and preliminary height and length adjustments are made.

Prior to placement of the patient on the operating table, the table is prepared in the following manner. The head segment is removed from its normal location at the head of the table, placed onto the foot section, and secured. If necessary, the Bakelite cassettes (X-ray boards) of the table are removed.

The sheet and draw sheet are placed, and an absorbent pad may be added over the perineal cutout of the table's buttocks section. To expedite the positioning process, all necessary positioning devices and padding should be assembled prior to the patient's entry into the operating room.

The patient is initially placed in the supine position, so that the sacral area of the pelvis is positioned over the perineal cutout on the operating table. Care is taken that the patient is positioned correctly, allowing self-retaining vaginal retractors to be utilized, while preventing sacral strain from hyperextension and over-rotation of the hip joint. A patient safety strap is applied over the thigh area during anesthesia induction and emergence.

The hands and arms should be positioned on bilateral armboards to prevent accidental entrapment of fingers in the foot section of the operating table as this section is raised or lowered. The armboards are positioned at an angle less than 90° to prevent brachial plexus injury. The elbows are padded, and the arms are placed with the palms facing upward to prevent ulnar nerve injury. Alternatively, the hands and arms may be placed over the patient's abdominal area, if they do not interfere with respiratory effort.

To prevent electrical injury, the patient's body should not be permitted to contact any metal portion of the operating room table. The patient is anesthetized, and the eyes are lubricated and secured in the closed position to prevent corneal drying and abrasion. Antiembolic devices, such as antiembolitic stockings or sequential com-

pression devices, are commonly applied to the lower extremities to prevent venous stasis that could lead to deep vein thrombosis.

Once permission to move the patient is obtained from the anesthesia provider, the safety strap is removed, and the legs are manipulated slowly and simultaneously by two nonsterile surgical team members to prevent hyperextension of one leg, which could result in sacral nerve damage. While supporting the foot in one hand and the calf with the other, the legs are positioned in the boot with the hips flexed and the legs abducted and externally rotated, exposing the perineum and vaginal introitus.

The boots must be properly positioned and well padded to prevent peroneal nerve damage, due to pressure on the peroneal nerve in the popliteal space. Any final height and length adjustments are made to the stirrups. The head segment is removed from the foot of the table, and the leg section of the table is lowered as far as possible.

TRENDELENBURG'S POSITION

Trendelenburg's position may accompany the lithotomy position to displace the abdominopelvic organs away from the operative site to allow better visualization, reduce blood flow to the pelvis, and promote venous drainage. Cardiovascular and respiratory compromise, blood pressure changes, and patient movement toward the head of the operating table are potential hazards to the patient in this position. Precautionary and interventive measures to prevent patient movement include decreasing the angle of the operating table, utilizing padded shoulder braces, moving the operating table slowly, and returning the patient to the level position as soon as possible.

At the end of the surgical intervention, the leg section of the table is raised, and the head segment is reattached to the foot of the table. Permission to move the patient is obtained before both legs are returned to the dorsal recumbent position simultaneously and slowly, permitting the patient's hemodynamic status to remain within normal limits. A rapid lowering of the legs may induce a hypotensive episode, especially in the hemodynamically challenged patient. (See Tables 1A and 1B.)

Table 1A Overview of AORN Recommended Practices for Positioning the Patient in the Perioperative Practice Setting

- Preoperative assessment for positioning needs should be made before transferring the patient to the procedure bed.
- Positioning devices should be readily available, clean, and in proper working order before placing the patient on the procedure bed.
- The number of personnel and/or devices should be adequate to safely transfer and/or position the patient.
- Maintaining the patient's correct body alignment and supporting extremities and joints decreases the potential for injury during transfer and positioning.
- After repositioning or any movement of the patient, bed, or devices that attach to the procedure bed, the patient should be reassessed for body alignment.

Table 1B Injury Risks and Safety Considerations When Positioning Patients—Lithotomy

- Hip and knee joint injury
- Lumbar and sacral pressure
- Vascular congestion
- Neuropathy of obturator nerves, saphenous nerves, femoral nerves, common peroneal nerves and ulnar nerves
- Restricted diaphragmatic movement - pulmonary region
- Place stirrups at even height
- Elevate and lower legs slowly and simultaneously from stirrups
- Maintain minimal external rotation of hips
- Pad lateral or posterior knees and ankles to prevent pressure and contact with metal surface
- Keep arms away from chest to facilitate respiration
- Arms on armboards at less than 90-degree angle or over abdomen

MEDICATIONS

The female reproductive organs and associated structures have an ample blood supply. The uterine arteries arise directly off the internal iliac arteries, resulting in the potential for brisk, intraoperative bleeding. The vagina provides limited access to the pelvic tissues, and any bleeding that occurs can impair visualization of important structures.

Chemical hemostasis is the method of choice to both minimize blood loss and permit optimal visualization in the surgical field. This becomes even more critical when dealing with the morbidly obese patient, where visualization may already be compromised due to limited exposure of the perineum obtained from positioning.

Vasopressin, a vasoconstricting agent commonly used in a 0.67-units/ml solution, is inject-

ed into the vaginal cuff at the level of the cervix prior to the incision. When vasopressin is injected into tissues, a rise in systemic blood pressure is commonly observed. If vasopressin is injected systemically, via direct delivery into a blood vessel, systemic hypertension or hypertensive crisis can result, placing the patient at risk for cerebrovascular accident (CVA).

When using any medication in the operating room setting, safety guidelines for the handling of medications should be followed. Both the scrub and the circulator should verify the medication's name, expiration date, and strength or concentration. Once the medication is transferred to the sterile field, all containers that the medication is placed into must be appropriately labeled with the medication's name and concentration.

Table 2 JCAHO 2005 Critical Access Hospital Standards—Medication Management

COP Standard MM.-4.30 (TX3.2)

- Standard: Medications are appropriately labeled.
- Rationale: A standardized method for labeling all medications will minimize errors.
- Elements:
  - Medications are labeled in a standardized manner according to critical access hospital policy, applicable law and regulation, and standards of practice.
  - At a minimum, all medications are labeled with the following:
    - Drug name, strength, amount (if not apparent from the container)
    - Expiration date when not used within 24 hours
    - Expiration time when expiration occurs in less than 24 hours
    - For all compounded IV admixtures and parenteral nutrition solutions, the date prepared and the diluent

When the medication is handed to the surgeon, the name and concentration should be stated, even if this is the only medication on the sterile field. Just prior to injection and again once the injection is completed, the overall dosage delivered should be shared with the anesthesia provider, so that he or she may adjust the levels of anesthetics and monitor the patient closely for adverse medication effects.

The dosage should be reported to the circulator, too, so that accurate and thorough documentation of medication usage may be completed. These safeguards permit the safe and accurate delivery of medication to the patient. (See Table 2.)

HAZARDOUS EQUIPMENT

ESU

Technology in the operating room lets us "live better electrically" with the electrosurgical unit (ESU) having become a standard part of most surgical interventions. The ability to easily control superficial bleeding intraoperatively, though, does not come without hazards, particularly fire and electrical injury.

The activated electrosurgical pencil adds one of the three principal components of fire—that of ignition or a heat source. Combined with flammable, disposable drapes, gauze sponges and preparation solutions, and fueled by the oxygen-rich environment of the surgical suite, ESU use can instantaneously change from the role of life-saver to that of dangerous foe.

Many safeguards have been added to the use of electrosurgical technique to safeguard the patient from inadvertent injury, but many of these safeguards depend on human intervention to assure their ability to prevent injury. These interventions include the proper use and placement of the patient-return electrode and the use of the safety holster to prevent inadvertent activation of the hand-switching active electrode.

METHANE GAS

A hazard commonly overlooked when performing rectovaginal surgery is the potential for the ignition of methane gas, a flammable gas produced during the digestive process and stored in the large intestine. Should this gas be expelled during ESU activation, ignition can cause a burn to the perineum, especially in the presence of pubic hair and flammable (alcohol-based) prep solutions. Care should be taken to prevent gas evacuation by using a moistened gauze sponge to pack the rectum intraoperatively and limiting use of the ESU active electrode during periods when the patient is coughing or "bucking."

PATIENT-RETURN ELECTRODE

The manufacturer's recommended guidelines for use should always be followed when selecting a proper site for return electrode (pad) placement. An area that contains a large underlying muscle

mass provides an optimal site for pad placement. Conditions such as excessive underlying scar or thick adipose tissue, underlying metal implants or bony prominences make alternative site selection a must.

Excessive hair requires removal prior to pad placement in order to assure good contact between the skin and the electrode. A site close to the surgical incision and one closer to the incision than other potential alternative sites for ground should be selected for optimum pad placement.

Preventing alternative pathways to ground is equally important. No part of the patient, especially hands and fingers, should be in direct contact with the metal surfaces of the operating table.

SAFETY HOLSTER

Each disposable, hand-activated electrosurgical pencil comes with a disposable holster in which to store the active electrode when not in contact with the patient. Like any new behavioral pattern, holster use requires diligent monitoring and promotion of its use.

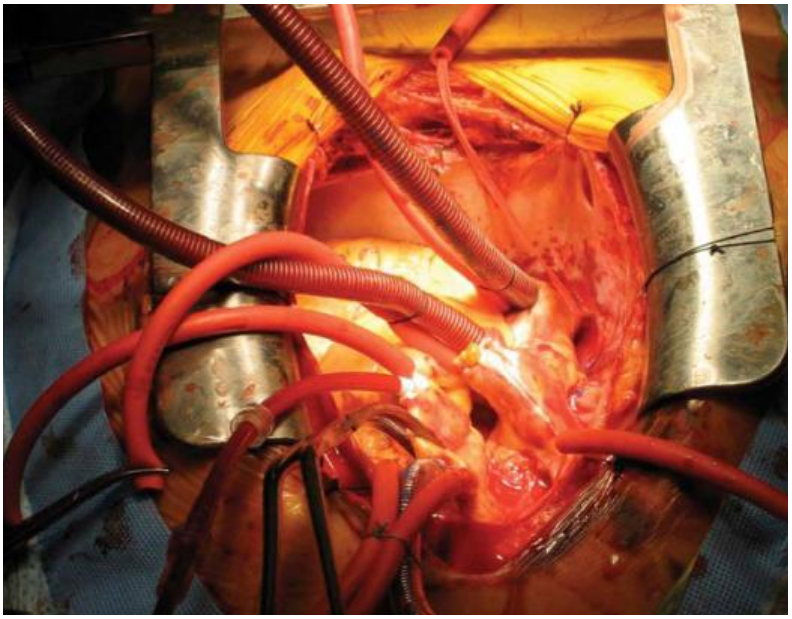
Table 3 Overview of OR Safety Precautions Related to Electrosurgery–Valley Lab, Inc

- The ESU should not be used in the presence of flammable agents (ie, alcohol and/or tincture-based agents)
- Avoid oxygen-enriched environments
- Use of a nonconductive holster is recommended by ECRI, Los Angeles Fire Marshall, AORN
- Do NOT use red rubber catheters or other materials as a sheath on active electrodes.
- Radiofrequency is not always confined by insulation. Current leakage does occur. It is recommended that cords not be wrapped around metal instruments or bundled together.

Positioning of the holster in such a manner that is conducive for the surgeon to secure the pencil will encourage routine usage and, perhaps, prevent an iatrogenic patient injury. Positive communication skills among team members will aid in developing and reinforcing this skill pattern. (See Table 3.)

RETAINED FOREIGN ITEMS

Gone are the days of "The Captain of the Ship," when the surgeon was totally and solely responsible for the actions of himself and the operative team providing patient care. Today, nurses and surgical technologists are formally educated, not only in the skills, knowledge, and behaviors of their professions, but also in patient safety and risk management.



A retained foreign item left in a patient can be devastating for the operating room professional.

Under the doctrine of *Res ipsa loquitor* ("The thing speaks for itself"), leaving an unintended foreign item inside a patient body cavity can have life-impacting consequences, not only for the patient, but for the members of the operating team as well.

The physical and physiological pain of undergoing additional surgery, as well as the potential injury to tissues and organs, compel the operating room team to assure that all unintended foreign items are removed from body cavities prior to closure of those cavities. While the likelihood of misplacing a surgical instrument in the pelvic cavity during vaginal hysterectomy is not as likely as it would be for open abdominal procedures, the potential still exists, in addition to the risk of bending or breaking surgical needles and unintentionally failing to remove a bloodied packing sponge.

As professionals, we have an obligation to our patients to account for all items prior to the final closure of a body cavity. Performing audible counts with both members of the intraoperative team—visualizing and recording each item as it is counted—provides the best assurance that these items will not become a problematic issue for the patient or the surgical team.

A retained foreign item left in a patient can be devastating for the operating room professional. The idea that a patient was directly harmed by one's actions can leave staff members with a sense of failure and low self-esteem. The trauma of defending one's professional knowledge and skills in a court of law can result in individuals leaving the profession for less demanding and less stressful careers. (See Table 4.)

Table 4 Overview of AORN Recommended Practices for Sponge, Sharp, and Instrument Counts

- Sponges should be counted on all procedures in which the possibility exists that a sponge could be retained.
- Sharps and miscellaneous items should be counted on all procedures.
- Instruments should be counted on all procedures in which the likelihood exists that an instrument could be retained.
- Sponge, sharp, and instrument counts should be documented on the patient's intraoperative record.

Table 5 JCAHO Universal Protocol for Preventing Wrong Site, Wrong Procedure, Wrong Person Surgery

Preoperative Verification Process

Purpose: To ensure that all of the relevant documents and studies are available prior to the start of the procedure and that they have been reviewed and are consistent with each other and with the patient's expectations and with the team's understanding of the intended patient, procedure, site and, as applicable, any implants. Missing information or discrepancies must be addressed before starting the procedure.

Process: An ongoing process of information gathering and verification, beginning with the determination to do the procedure, continuing through all settings and interventions involved in the preoperative preparation of the patient, up to and including the "time-out" just before the start of the procedure.

Marking the Operative Site

Purpose: To identify unambiguously the intended site of incision and insertion

Process: For procedures involving right/left distinctions, multiple structures (such as fingers and toes), or multiple levels (as in spinal procedures), the intended site must be marked such that the mark will be visible after the patient has been prepped and draped.

"Time Out" Immediately Before Starting the Procedure

Purpose: To conduct a final verification of the correct patient, procedure, site, and as applicable, implants.

Process: Active communication among all members of the surgical/procedure team consistently initiated by a designated member of the team, conducted in a "fail-safe" mode, ie, the procedure is not started until any questions or concerns are resolved.

WRONG SITE SURGERY

In response to the public outcry related to report after report of incorrect surgical interventions performed on healthy tissues, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) published the Universal Protocol for Preventing Wrong Site, Wrong Procedure, Wrong Person Surgery.

This protocol mandates that policies and procedures be implemented to avoid the incidence of surgical procedures performed on the wrong patient or wrong tissue. (See Table 5.) All JCAHO-accredited institutions are required to comply with this protocol as a means of providing safe patient care.

One aspect of the protocol requires that a "time-out" be performed just before the beginning of the procedure or the skin incision. The protocol requires that active communication take place among all members of the surgical team.

In light of the nature of hysterectomy, where the final determination as to approach is sometimes made following a bimanual examination by the physician while the patient is under anesthesia and unable to mark the appropriate incision site, it is important that clear communication regarding the patient's desires and anticipated outcomes be made known prior to anesthesia induction.

CONCLUSION

The intraoperative team, composed of formally educated and credentialed CNORs and CSTs working together to deliver quality patient care, is a concept that needs to be adopted and implemented with the sole focus of making a positive impact on patient care and operative outcome.

The results of the actions, collaboration, and synergy of this team of experienced and knowl-

edgeable experts, along with surgeons, anesthesia providers and other support staff, set the stage for a positive, safe and successful patient outcome in today's challenging O.R. environment.

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The actions of the intraoperative team set the stage for successful patient outcomes in today's challenging O.R. environment.

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Bioethics in Solid Organ Transplantation

Alternative methodologies being utilized in the prevention of solid organ shortage

Shawn P Huelsman, cst; Bijan Eghtesad, md; Charles Modlin, md

INTRODUCTION

Currently in the United States, 95,062 individuals wait for their chance of receiving a lifesaving organ for transplantation.[11] Though there were 26,689 transplants performed in 2006, there is still not a sufficient supply of donors and organs to meet the demand of those individuals needing transplantation. Unfortunately six percent of possible recipients die while on the waiting list.[11]

These staggering figures have opened the bioethical debate of how the United States can compensate for the shortage of solid organs for transplantation. With this in mind, the transplant community is utilizing new methodologies in order to increase the number of organ donors and the amount of solid organs used in transplantation.

These methodologies of utilizing marginal donors, living donation, alternative organ allocation systems, xenotransplantation and stem cell research are currently approached in bioethical debate from the local to the national levels. This article will give insight into these methodologies and how they can assist in the increased amount of solid organs for use in transplantation.

ORGAN RECOVERY FROM MARGINAL DONORS

In today's organ donation system, organs are recovered from deceased donors (DD) and living donors (LD). In the past, most surgeons would use only those organs that came from healthy, young donors. With the number of waiting candidates surpassing the number of donors 7:1, there has been a need to seek organs from donors who are considered marginal.

Marginal donors include those individuals over 55 years of age (extended criteria donors), pediatric donors under 5 years of age, non-heart beating donors (or donation after cardiac death, DCD), and donors who have certain disease processes and serologies (ie diabetes and HIV).[1]

> Should an individual with an emergent need but a shorter life expectancy receive an organ before someone with a longer life expectancy?

NON-HEART BEATING DONORS

There has been increasing debate in the field of non-heart beating donation. Until recently, few communities would allow recovery of organs from non-heart beating donors. In this type of donation, the patient does not meet all of the criteria to be pronounced "brain dead." Although, if the patient is removed from life-sustaining medications or ventilation, the patient will ultimately pass on.

DONATION AFTER CARDIAC DEATH

Donation after cardiac death allows the family to donate their loved one's organs immediately after the patient's heart stops beating. The controversy behind this donation is that when the patient enters the operating room, he or she is technically still alive. These patients are removed from their medication and from their ventilator in a controlled method by the intensive care unit staff, as the recovery team waits outside for pronouncement of death.

An ethical question surrounding DCD is this: Are physicians being presumptuous in stating that there is no hope for these patients, in order to fight against the problem of organ shortage? Or does this open up another avenue to obtain organs from those individuals for whom, if medications and ventilation are removed, there is no hope of survival?

HIV-POSITIVE DONORS

Another controversial issue concerns donors who are HIV-positive. With the creation of life-sustaining drugs (ie AZT), HIV patients are able to survive longer than first expected. With their life expectancy increasing, do HIV-positive patients have the right to obtain solid organs for transplantation if they are in need?

In order to facilitate this, organs are being recovered from HIV-positive donors and are being transplanted into HIV-positive recipients. This allows the recipient to receive an organ, which they might not otherwise have the opportunity to receive. Does their placement on the Organ Procurement and Transplantation Network (OPTN) list jeopardize HIV-negative candidates' chances of receiving an organ?

ORGAN RECOVERY FROM LIVING DONORS (RELATED, UNRELATED AND ALTRUISTIC)

In the shadows of deceased donation, there has been an increase in living donation. Living donation is the process in which a live person is willing to give an organ or a part of an organ to another individual. Though these procedures were created for individuals who were related to one another, there has been a growth of unrelated living donation and donation by altruistic strangers.

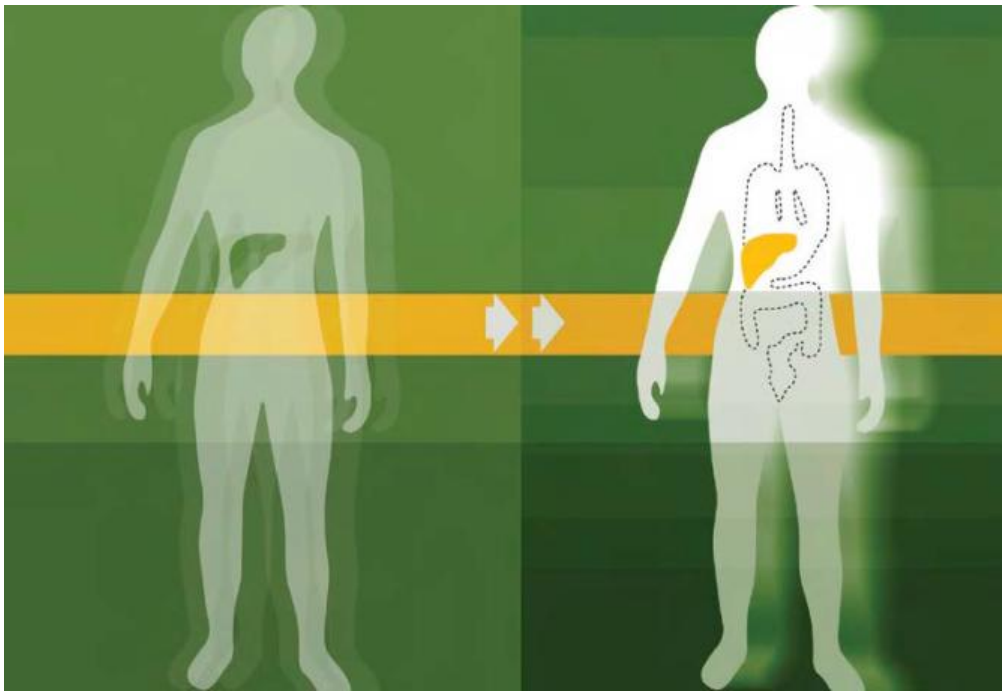
In 2006, there were 6,194 living donors, compared to 7,383 deceased donors.[11] In these cases, an individual who is not related genetically—or is a complete stranger—to the possible recipient, is willing to donate an organ or a part of an organ to someone in need.

With the invention of the Internet, it has become easier for altruistic strangers to find a

"worthy" candidate for their organs. Websites such as *www.MatchingDonors.com* and personal websites like *www.babymarkjr.com* allow prospective living donors to read stories from thousands of individuals that are in need of lifesaving organs. Currently the solid organs that can be given by a living donor include kidney, split liver, lung, split pancreas, and small bowel depending on the situation.

The ethical concerns surrounding the use of living donation has sparked the interest of discussion within the US Department of Health and Human Services (HHS), the United Network of Organ Sharing (UNOS), and has most recently been the subject of the President's Council on Bioethics.

The key issue of current discussions has been the question of whether or not performing surgery on a living donor violates the Hippocratic Oath—"To do no harm and to act always in the best interests of every patient in his care."[5]



Among the bioethical questions regarding living donation, focus has been placed on donor safety. Currently, neither UNOS nor the HHS has policies regarding a standardized informed consent for living donation.[9] This informed consent needs to be created in order to inform possible donors properly of surgical risk, their right to change their minds, and that there may be a possibility of future health problems resulting from the donation, and that those problems may not be covered by insurance.[9] In order for living donation to continue being an avenue for preventing organ shortage, the benefits to both donor and recipient must outweigh the surgical and psychological risks.

In addition, there is the question of whether living donors should be rewarded for their gift. This reward would come in the form of treatment of future complications resulting from the donor procedure. It would also include allowing the living donor extra points on the OPTN waiting list, in case they are ever in need of an organ. There are also those who feel that living donors should be given financial compensation, but it is still being debated.

One effort that has assisted in the living donation of paired exchange (where two or more sets of living donors and candidates are matched with each other to provide compatible donors to each recipient) has been the recent introduction of US House of Representatives Bill 710 and US Senate Bill 487. These proposed bills would create federal legislation that would allow more individuals to become donors, thus creating more opportunities for transplant candidates to receive needed organs.[13]

INCREASING ORGAN RECOVERY FROM DECEASED DONORS

Despite efforts to increase the use of extended criteria donors, donation after cardiac death, and living donations, the best source of donors for solid organ transplantation remains deceased donors. Unfortunately the number of deceased donors has

increased only 45% since 1988, while the number of living donors has increased 71%.[11] How can we increase the number of deceased donors, and therefore reduce the organ shortage?

PROPOSAL 1: GREATER EDUCATION

According to Cantarovich, society must increase the role of education—both for medical providers and the general public.[4] He feels that society must be informed that organ transplantation is a common and successful practice and that the act of donation "offers a unique source of health and provides a chance of life and well-being for everybody."[4]

"Should family members receive financial compensation for donation, since our society views organ donation as an altruistic and unselfish giving of one's self?"

Some of his ideas on education include a youth commitment to organ donation as an obligation to society, the assurance of integrity and respect for the cadaver during and after organ recovery, and an overall improvement in the general public's unawareness and belief in myths and superstitions regarding organ donation.[3] He concludes that education of society could change behaviors toward the use of organs after death, eventually leading to a reduction of the organ shortage.[4]

PROPOSAL 2: AUCTION MARKET

Dr Jack Kevorkian, the man made famous over the concept of physician-assisted suicide, proposed a second concept of increasing the number of deceased donors. He suggested the implementation of a free, nonprofit and potentially global online auction market.[10]

His system resembles a modern-day "organ stock market." When a donor is pronounced "brain dead," the organs are listed on the auction site. Individuals who want to purchase the organs make their bid through an "organ broker" at a regional transplant center.

Upon confirmation of a bid, the recipient must make payment within 48 hours, or the organs will be given to the next highest bidder. According to Kevorkian's formula, 33% of the funds would go to the donor's family, 11% would go to each of the recipient transplant centers (for future bidding and for those patients who are poor or uninsured). Finally a 1%-fee would be applied to cover the administrative costs of running and operating the auction. The idea behind this proposal is that it would give families an incentive to donate their loved one's organs, and it would provide financial stability to the family.

The negative side of this proposal is that some patients may not be able to compete in the bidding process as well as wealthier patients could, regardless of which patient is in greater need of the organ.

In addition, how would the money for the donor's family be distributed? Will it be deposited as part of the donor's estate, or will it be given to the family member who decides to donate the deceased person's organs?

Similar programs that have been created have included tax breaks, paying for funeral expenses and even paying the family a flat rate for donation. The question for debate is, "Should family members receive financial compensation for donation, since our society views organ donation as an altruistic and unselfish giving of one's self?"

In Kevorkian's article, "a procured human organ is the most valuable and essential item in any transplantation procedure."[10] It is a fact that without the presence of the human organ the recipient would not be able to receive a transplant, the physicians would not have patients, and the organ procurement organizations (OPO) would not receive any funding.

What is wrong with putting a financial number on the recovered human organ? OPOs currently place fees on every organ that is recovered. For instance, many OPOs charge insurance companies and Medicare upwards of $25,000 per kidney recovered. That equals $50,000 received for

just the donor's kidneys, and that doesn't include other organs that may be recovered, such as heart, lungs, liver, pancreas and small bowel. Regardless, there are still physicians and organizations that feel that payment for organs is "unethical."

PROPOSAL 3: INCREASED AWARENESS

The third proposed way of increasing deceased donation relies on the use of mass media and the Internet to focus attention on the issue. Websites such as *www.lifesharers.com* as well as personal websites have added the same dynamic as previously stated with living donation.

With Lifesharers, individuals volunteer to donate their organs to other Lifesharers members primarily and to nonmembers if there is no suitable member candidate. This allows possible donors to choose who will receive their organs when they die.

On the flip side of this method, there has been discussion over presumed consent. Currently in the US, individuals choose if they want to become organ donors by stating this information in the form of a living will, a donor organ card or an indication of consent on one's driver's license. Unfortunately, even if a deceased donor has indicated his or her consent to donate, final authorization is still requested from the donor's family.

With presumed consent, it will be presumed that the individual wanted to become an organ donor, unless there is documentation stating that he or she did not. This will eliminate the need to ask the family's permission and will allow the donor's organs to be recovered sooner.

The downside to the policy of presumed consent is that the altruistic characteristics of organ donation would be abandoned. Organ donation would no longer be "a gift of life"—it would be "an obligation to society."

CHANGES IN ORGAN ALLOCATION POLICY

Another area of concern regarding the bioethical concepts to increase the number of organs for transplant is the status of the organ allocation policy. Currently, every individual who is in need of an organ is placed on the OPTN waiting list.

This list is based on the individual need of the candidate. It is not influenced by the disease that caused the organ failure, the age of the candidate, nor the socioeconomic status of the candidate. If a deceased donor organ becomes available, the organ is allocated to the person highest on the list based on need, length of time spent on the waiting list and geographical proximity of the candidate to the donor.[7]

Should an individual with an emergent need but a shorter life expectancy receive an organ before someone with a longer life expectancy? Should individuals who have donated organs in the past be given preference on the list?

Should organs be given to individuals who are responsible for their disease processes, for example organ damage caused by smoking or alcohol abuse? Should organs be allocated based on age, geography or racial disparity? Should organs be

given to patients who are incarcerated? These are many of the questions being asked in the field of organ allocation.

UNOS is currently debating a new system of kidney allocation that would provide kidneys to those individuals who are expected to live the greatest number of years post-transplant.[8] One problem with this proposed system is that younger candidates will be given preference over those who are elderly.

The second problem is that with the emphasis on extended criteria donors, how many more years of survival will a 25-year-old recipient have with a kidney from a donor who is 60 years old? A possible solution is delegating organs from young donors to young recipients and organs from elderly donors to elderly recipients.

What is the justification for a shortage of organs in one geographical area and a surplus in another? Should these organs be distributed equally among everyone on the waiting list, regardless of geographical distance between donor and recipient?

A third problem involves geography. The *Los Angles Times* reported the story of two candidates.[15] A patient in New York was on the waiting list for a new liver for more than 10 years. Unfortunately he died on his 53rd birthday before receiving the organ. Another individual waited for four years for a liver and kidney in New York. Frustrated with waiting, he moved to Florida, where he received a new liver and kidney 14 days later.

With reports like this, one can see why an individual would move to a place where the waiting list is shorter, but what about people who are not able to relocate? What is the justification for a shortage of organs in one geographical area and a surplus in another? Should these organs be distributed equally among everyone on the waiting list, regardless of geographical distance between donor and recipient?

ALTERNATIVE METHODOLOGIES

Due to the current shortage of organs, there has been a new focus on utilizing alternative methodologies to increase the supply. Some of the methodologies, including xenotransplantation, cloning and the use of stem cell research, challenge some of our society's traditional concepts and practices and therefore become the subject of media attention and political debate.

With xenotransplantation, an organ is removed from a primate or porcine model and is transplanted into a human. Xenotransplantation first entered the bioethical area in 1963, when James D Hardy transplanted the heart of a chimpanzee into the chest of a cardiac-compromised patient.[14]

This was later followed by Leonard Bailey, MD, who transplanted a baboon heart into an infant with hypoplastic left heart syndrome in 1984. Left untreated, this congenital malformation causes mortality in the first month of life.[2] Though both of these grafts failed, research continued in the field of xenotransplantation and prevention of organ rejection.

Xenotransplantation lead the way to experimentation with other therapies, including cloning, stem cell research, islet cell research and the development of artificial organs. Unfortunately the bioethical debates concerning these modalities continue to hinder their progress.

Some of the ethical issues being debated include the experimental status of these procedures and any potential side effects that may occur, the psychological stress of receiving a cell or organ from an animal and the spread of retroviruses.[6] As for artificial organs, they still are used primarily as a temporary measure to preserve life until a human donor organ becomes available.

Consider the case of the infant who received the baboon heart. If this therapy had not been used, the chances were very slim of receiving a heart from a donor who was the same age and

weight; her only chance of survival was by xenotransplantation. As with human organs, a xenograft has the same potential for rejection. Is it not worth the risk, in order to provide a young infant a chance to live to his or her full potential?

CONCLUSION

The 21st century has become the age of discovery in the field of organ transplantation. There are increasing debates on how the US will be able to meet the need for the ever-growing number of candidates in need of lifesaving organs.

How can the country face this challenge? It can utilize marginal organs, living donors and new allocation methods. It can also utilize such controversial techniques as xenotransplantation or organs created via stem cell research. It can even give a financial reward to those who donate their organs.

Regardless of which technique is used, there is still a need to increase the number of deceased donors by educating the general public about the myths and facts involved in organ donation and transplantation. In addition, the country must also educate the growing number of individuals who are entering the various health professions. If health professionals do not understand this topic, then how will prospective donor families be convinced to donate?

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ANTIEMETIC PROPERTIES OF GINGER

TERI JUNGE, CST, CFA, FAST

INTRODUCTION

Ginger, also identified by its Latin name *zingiber officinale*, has been known for over 5,000 years to have medicinal properties in addition to providing a unique spicy flavor to various foods.

According to one online alternative medical publication, ginger was once considered the "universal medicine," because it was thought to have multiple uses.[1]

Medicinal ginger is made by grinding the rhizome (root portion) of the plant into powder. The powder is then weighed and placed into a capsule or dissolved in syrup for ingestion.

Ginger is thought to be effective in reducing the frequency of nausea and vomiting related to several conditions, including general anesthesia, pregnancy, chemotherapy and motion sickness.

Descriptions and results of five studies involving the use of ginger will be presented in this article. The first three studies relate to pregnancy, the fourth study relates to chemotherapy, and the fifth study relates to motion sickness.

GINGER SYRUP AS AN ANTIEMETIC IN EARLY PREGNANCY

A double-blind, placebo-controlled, randomized clinical trial was implemented to determine if ginger syrup was effective in the relief of nausea and vomiting frequency (rated on a 10-point scale) related to the pregnancy. The study was performed in a University of South Florida department of obstetrics and gynecology private practice office.

Twenty-six subjects, all in the first trimester of pregnancy, were suffering daily from nausea and vomiting related to the pregnancy. Each subject was given one tablespoon of ginger syrup or a placebo in four to eight ounces of water, four times per day for a total of one gram of ginger per day.[3]

Descriptive one-way analysis of variance (ANOVA) statistics were used to describe the data. Eight of the 13 (62%) subjects taking ginger reported that the vomiting had stopped completely by day six, and 10 (77%) subjects reported a four-point or greater improvement on the nausea scale by the ninth day.

Two of the 10 (20%) remaining subjects taking the placebo had stopped vomiting completely by day six, two (20%) reported a four-point or greater improvement on the nausea scale, and two had stopped vomiting completely.[3]

TREATING NAUSEA AND VOMITING IN PREGNANCY

A randomized, controlled equivalence trial was implemented to determine whether ginger was as effective in the relief of nausea and vomiting frequency (rated on a five-point scale) related to pregnancy as pyridoxine hydrochloride (vitamin B_6).

The study was performed at a teaching hospital in Adelaide, Australia. Two hundred ninety-one subjects, all in the first 16 weeks of pregnancy, were suffering daily from nausea and vomiting related to the pregnancy. Each subject was given 350 milligrams of ginger or 25 milligrams of vitamin B_6, three times per day for three weeks.[5]

Descriptive one-way ANOVA statistics were used to describe the data. On day one, 99% of subjects in both groups reported nausea and vomiting.

On day seven, 89% of the ginger subjects and 85% of the vitamin B_6 subjects reported nausea and vomiting. On day 14, 86% of the ginger subjects and 81% of the vitamin B_6 subjects reported nausea and vomiting.

On day 21, 82% of the ginger subjects and 79% of the vitamin B_6 subjects reported nausea and vomiting.[5]

USING GINGER ROOT TO DECREASE SEVERITY OF NAUSEA AND VOMITING IN EARLY PREGNANCY

A randomized, double-masked, placebo controlled trial was implemented to determine if ginger was effective in the relief of nausea and vomiting frequency (rated on a five-point scale) related to pregnancy.

The study was performed at an antenatal clinic in Thailand. Seventy subjects, all in the first 17 weeks of pregnancy, were suffering daily from nausea and vomiting related to the pregnancy.

The roots of ginger

Ginger is a tropical plant that thrives in moist soil. Its edible, underground stem is called the rhizome. The stem extends approximately one foot above ground with white or green flowers at the tip.

The ginger plant is indigenous to southern China. From there, it spread to the Spice Islands, the rest of Asia, and ultimately, West Africa and the Caribbean. Today, India is the primary producer and exporter of ginger.[2]

Ginger has been used as a cooking spice for more than 4,400 years.

Each subject was given 250 milligrams of ginger or a placebo before each meal and at bedtime for a total of one gram of ginger per day for four days.[8]

Descriptive one-way ANOVA statistics were used to describe the data. All subjects (100%) reported nausea and vomiting on the first day. On the fourth day, 37.5% of the ginger group and 65.7% of the placebo group reported nausea and vomiting.

Although the study was of short duration, inferential statistics show that the ginger was twice as effective in reducing the frequency of nausea and vomiting than the placebo.[8]

GINGER AS AN ANTIEMETIC IN NAUSEA AND VOMITING INDUCED BY CHEMOTHERAPY

A randomized, prospective, cross-over, double-blind study was performed to determine if powdered ginger root was as effective as two other antiemetics (metoclopramide or ondansetron) in the relief of nausea and vomiting frequency induced by the chemotherapeutic drug cyclophosphamide.

The study was performed at a government medical college and hospital in Nagpur, India. Sixty subjects, taking the drug cyclophosphamide, had suffered from nausea and vomiting in a previous round of chemotherapy. In addition to the chemotherapeutic agent, each subject was given either one gram of ginger powder orally, 10 milligrams of metoclopramide intravenously (IV), or four milligrams of ondansetron intravenously 20 minutes prior to the chemotherapy treatment and again six hours after the treatment.[6]

Descriptive one-way ANOVA statistics were used to describe the data. Complete control of nausea was achieved in 62% of the subjects taking ginger, 58% of the subjects taking metoclopramide, and 86% of the subjects taking ondansetron.

Complete control of vomiting was achieved in 68% of the subjects taking ginger, 64% of the subjects taking metoclopramide, and 86% of the subjects taking ondansetron.

Analysis among the groups showed that the subjects in the ondansetron group showed a statistically significant (almost 25%) improvement over the subjects taking ginger and metoclopramide.[6]

Table 1. Medicinal properties of some common spices and herbs.[4]

Common name	Medicinal properties
Allspice	Antiemetic, purgative
Anise seed	Antispasmodic, expectorant, sedative
Basil	Used for colds, antidiarrheal, kidney disease
Bergamot	Antiseptic, antispasmodic, sedative
Camphor	Antiseptic, cardiostimulant, antispasmodic
Caraway	Diuretic, antispasmodic, galactogogue
Cardamom	Antiseptic
Chocolate	Sedative, antioxidant, diuretic
Cilantro	Antibacterial, anti-inflammatory
Cinnamon	Antiseptic, Antidiarrheal
Clove	Topical anesthetic, used for dyspepsia
Coriander	Antispasmodic, anti-inflammatory, diuretic
Cumin	Antimicrobial, diuretic
Curry leaves	Antiemetic
Dill	Antiflatulent, galactogogue
Galangal	Expectorant, antibacterial
Garlic	Antimicrobial, antihypercholesterolemic, antihypertensive
Horseradish	Antimicrobial, expectorant, purgative
Marjoram	Used for indigestion and colic
Mint	Expectorant, local anesthesia, used for colds
Nutmeg, mace	Astringent, hallucinogen
Peppercorns	Expectorant, antimicrobial
Quinine (tonic water)	Antiarrhythmic, febrifuge, astringent
Saffron	Antirheumatic, used for neuralgia
Sage	Antiseptic, gastroenteritis, sedative
Turmeric	Antiarthritic, antioxidant
Wasabi	Expectorant, used for sinusitis

EFFECTS OF GINGER ON MOTION SICKNESS SUSCEPTIBILITY AND GASTRIC FUNCTION

A voluntary, placebo-controlled study was carried out to determine if ginger root was as effective as scopolamine in the relief of nausea related to motion sickness. The study also assessed gastric function; however, those results will not be presented in this report.

The benefits of ginger

Ginger has been used since ancient times in Asian, Arabic and Indian medicine. The herb has been used in China for more than 2,000 years to treat diarrhea, stomach pain and nausea. Other historical uses of ginger include treatments for arthritis, colic and heart conditions.

Today, ginger often appears as an ingredient in digestive, laxative, antiflatulent, antacid and antitussive dietary supplements.

Although modern scientific evidence is inconclusive, ginger has a long history of being used to treat a wide variety of medical conditions, including:

- Alcohol withdrawal
- Atherosclerosis
- Athlete's foot
- Baldness
- Bronchitis
- Burns
- Cancer
- Cholera
- Colds
- Colic
- Depression
- Diarrhea
- High blood pressure
- Impotence
- Intestinal parasites
- Liver disease
- Migraines
- Psoriasis
- Snake bites
- Toothaches
- Ulcers

Ginger has also been used historically as an:

- Antacid
- Antifungal
- Antioxidant
- Antiseptic
- Antiviral
- Aphrodisiac
- Blood thinner

The study was performed at Louisiana State University Medical Center in Shreveport, Louisiana. Twenty-eight subjects made timed head movements by rotating in a chair to the endpoint of nausea (without vomiting). Each subject was given either 500 milligrams of ginger or 0.6 milligrams of scopolamine and a placebo.[7]

Descriptive one-way ANOVA statistics were used to describe the data. Anti-motion sickness effectiveness was judged by an increase in head movements compared to placebo control.

No increase in head movements was noted in the subjects given ginger as compared to the placebo. However, an average increase of 147.5 head movements was noted in the scopolamine group.[7]

ANALYSIS OF RESULTS

All of the studies presented in the literature review were experimental prospective trials. Ginger, along with a placebo or a prescription antiemetic and a placebo, was used as a possible antiemetic in all five studies.

Neither the researchers nor the patients knew which medication(s) was being used at any given time. The first three studies were conducted under very similar circumstances. All of the subjects were in the early stages of pregnancy and were complaining of nausea and vomiting related to the pregnancy.

The fourth study involved patients taking the chemotherapy drug cyclophosphamide, and the fifth study was related to motion sickness.

One-way ANOVA studies were utilized for comparison in each of the studies reported. Ginger was shown to be effective in reducing the frequency of nausea and vomiting related to pregnancy in the first three studies.

Ginger was also shown to be effective in reducing the frequency of nausea and vomiting related to the use of the chemotherapeutic agent cyclophosphamide in the fourth study. Unfortunately, in the fifth study, ginger was not shown to be effective in reducing the frequency of nausea related to motion sickness.

CONCLUSION

Ginger appears to be an effective natural alternative to prescription medications for reducing the frequency of nausea and vomiting related to pregnancy and chemotherapy. The one study related to motion sickness showed that ginger was ineffective as an antiemetic in this situation—possibly because the causative mechanism of nausea related to motion sickness differs from the physiological origin of nausea related to pregnancy and chemotherapy.

However, the effectiveness of ginger in treating nausea and vomiting related to motion sickness should not be ruled out based on the results of one study. Ginger may prove useful in the postanesthesia care unit for treatment of postoperative nausea and vomiting. More testing of ginger as an antiemetic is warranted.

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Edible and ornamental ginger

The name of edible ginger—*Zingiber officinale*—comes from the Sanskrit word that means "horn root." It may be listed by different names, such as African ginger, black ginger or Jamaican ginger. Edible ginger is just one of more than 1,000 species of tropical plants in the *Zingiberaceae* family. These ornamental plants are popular among gardeners for their colorful foliage and exotic, scented flowers.

Clockwise from far left: ©iStockphoto.com/VFVK, Natasha Japp, Brent Wong, gkaniwets.

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Palatoplasty—

ONE PATIENT'S JOURNEY FROM A NINE-MONTH-OLD TO A TEENAGER

Pat Mancilla

Around the fifth week of human embryonic development, facial features begin to form. When proper development is disrupted, a cleft—a fissure or elongated opening—can occur in the lip, palate or both. A cleft in the palate is the result of a lack of fusion of the palatal shelves, which typically occurs between weeks five and 12.

PREVALENCE OF CLEFT PALATE

This condition tends to be more prevalent in boys. The cleft can be unilateral or bilateral and often appears on the left side of the patient's face.

Currently, cleft lip and palate occur in approximately 1 in 800 births. Exact causes have not been determined, although there appears to be a genetic link in some cases. Maternal age, environmental factors, drug and alcohol abuse, infection and vitamin deficiencies may play a role in cases where there is no apparent genetic link.[5]

If immediate surgical intervention is not necessary and the newborn is able to feed successfully and thus gain weight properly, surgical repair of a cleft lip or palate may be delayed until the child is between seven and 18 months of age.[5]

A palatoplasty may be performed separately or in conjunction with a cheiloplasty. Additional corrective procedures may include rhinoplasty, orthodontic treatment, speech therapy, ear tubes and dental extractions.

CASE STUDY: DIAGNOSIS AND INDICATIONS FOR SURGERY

The patient was a nine-month-old male who was diagnosed immediately after birth with right unilateral cleft lip and palate with nasal deformity. The patient's medical history included a prior cheilorrhaphy performed when the patient was three months old.

Courtesy Pat Mancilla

The patient as an infant.

PHYSICAL CONDITION

The patient underwent the following preoperative tests: complete blood count, urinalysis and hematocrit. All test results were normal. A series of facial X-rays was performed to determine the extent of the palate defect.

Vital signs were normal and stable, and the patient was in good health. The normal range for vital signs of a nine-month-old are:

Weight:	15 lbs
Heart rate:	120–130 bpm
Respirations:	20–40 breaths per minute
Blood pressure (Systolic):	80–100 mmHg
O_2 saturation:	100%
Temperature:	99.6°F

POSITIONING, SKIN PREPARATION AND DRAPING

Upon arrival in the O.R., the patient was placed in the supine position with the operating table turned so that it was at a 90-degree angle to the anesthesiologist.

General anesthesia was induced, followed by endotracheal intubation. The patient's eyes were lubricated and then covered with Tegaderm™ to protect the corneas.

Skin preparation was accomplished with 0.5% Betadine® applied from the hairline to the chin area with careful attention paid to ensuring the solution did not come in contact with the eyes and did not pool in the ears.

The patient's head was then draped turban-style for full facial exposure. A small, fenestrated sheet was used to expose the right hip (the donor site).

PROCEDURAL OVERVIEW

The lip border was tattooed with methylene blue using cotton swabs, lining the vermillion and cutaneous border of the lip. The lip was then injected with 0.5% bupivacaine with epinephrine.

A diamond-shaped excision was made after marking the vermilion cutaneous junction. The skin was then undermined with a #15 blade.

Two 5-0 silk sutures were used to gather the deep dermal layer and to take tension off the skin. The skin was then closed using 6-0 polydioxanone suture in buried and interrupted intracuticular fashion.

The mucosa of the lip was closed with the dry vermilion being closed with 6-0 chromic gut sutures in interrupted fashion.

Attention was then directed to the nose, where a marginal incision was made. Then, using tenotomy scissors, the skin was undermined in subcutaneous fashion immediately over the cartilage onto the dorsum and over the normal left lower lateral cartilage, as well as laterally over the right lower lateral cartilage.

The auricular cartilage graft could be seen. The jagged edges of the graft from the prior cheilorrhaphy were trimmed but left in place. A 4–0 polydioxanone suture on a free needle was then passed from the tip-defining point on the patient's left side just lateral to the genu of the right lower lateral cartilage. This was stitched into place, bringing the right lower lateral cartilage up to a nearly symmetrical position.

A Z-plasty was then performed on the internal surface of the nose to rid the patient of his nostril stenosis. Closure of these internasal incisions was made with 4-0 chromic gut suture in interrupted fashion.

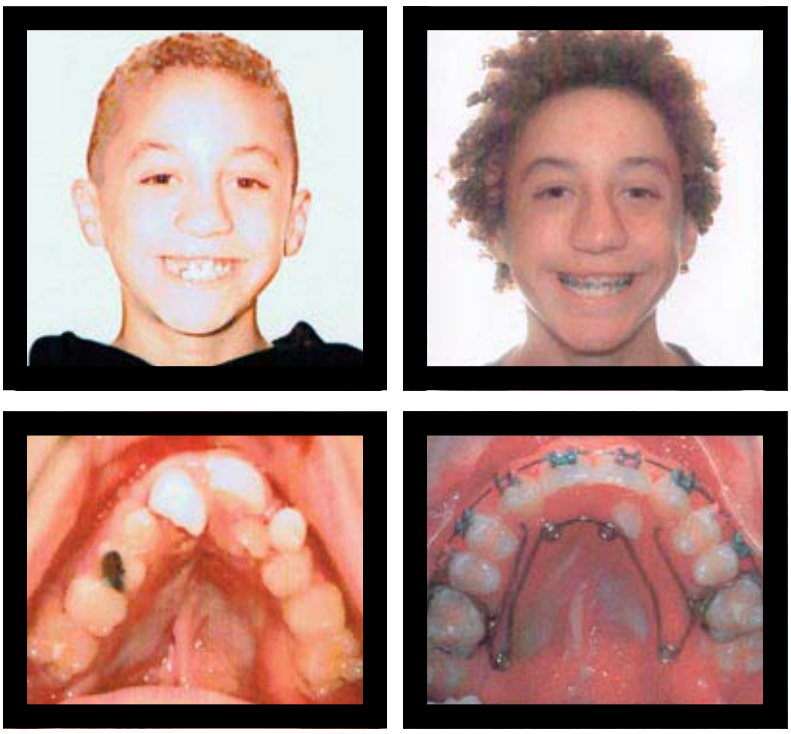
Several mattressing sutures of 5-0 polydioxanone were used—beginning intranasally, coming out through the alar nasal groove, then back through the same suture hole and back into the nose, and then tied. A total of three of these sutures were placed to pexy the cephalic margin of the lower lateral cartilage into good position.

Attention was then directed to the nasal ala, where a considerable groove was seen in the patient's nasal floor. This was excised using a #15 blade, and the nasal sill was undermined down to the piriform aperture to free it completely. Closure was achieved with 5-0 polydioxanone sutures in interrupted and buried fashion.

The skin was then closed using 6-0 plain gut suture in interrupted fashion. A solution of 0.5% bupivacaine with 1:200,000 epinephrine was injected into the infraorbital nerves bilaterally. These nerves innervate the maxilla and anterior area of the cleft palate repair.

The nose was then dressed using Mastisol® and Steri-Strips™ in rhinoplasty-type fashion. The oropharyngeal pack was placed in the posterior oral pharynx, and approximately 3 cc of 1% lidocaine with 1:100,000 epinephrine was injected in an infiltration and block fashion, in order to achieve adequate hemostasis and postoperative local anesthesia.

Next, using a #15 blade, a sulcular incision was made in the right maxillary anterior region. The periosteal elevators were used to elevate the periosteal flap proximal and distal to the cleft site.



Courtesy Pat Mancilla

The photos show how orthodontic treatment shaped the patient's mouth between the ages of 10 (at left) and almost 13 (at right).

A similar flap was elevated on the palatal aspect proximal and distal to the cleft.

Care was taken to dissect the nasal floor from the mucoperiosteal flaps. The supernumerary tooth was identified and atraumatically removed. Once the nasal floor had been developed, closure of the nasal floor was achieved using 4-0 Vicryl™ suture.

EXCISING THE BONE GRAFT

At this point, a pack was placed in the oral cavity, and attention was directed toward harvesting the bone graft from the right iliac crest.

The surgical team then rescrubbed and regowned, and a second steril set-up was used. The anterior iliac crest was identified, and approximately 2 cc of 1% lidocaine with epinephrine was injected along the planned incision site.

Using a #15 surgical blade, an incision was made just lateral to the crest of the ridge. Hemostasis was achieved using electrosurgically.

Sharp dissection to the iliac crest ridge was performed using a surgical blade and electrocautery. The crest of the ilium was then identified.

The lateral periosteum was released, and the bone graft was harvested from the lateral aspect of the right anterior iliac crest. Once the graft was harvested, the wound was irrigated with copius amounts of normal saline, and attention was directed toward hemostasis.

Avitene® sheets were placed in the wound to aid in hemostasis. Once meticulous hemostasis had been achieved, the wound was closed using 3-0 and 4-0 Vicryl sutures for primary re-approximation, followed by 5-0 nylon suture for the skin.

Triple antibiotic ointment was placed over the wound, followed by Steri-Strips.

PLACING THE GRAFT

The graft was placed into the right anterior maxillary cleft. The soft tissue of the palate was sewn over the graft to secure it.

The previously elevated mucoperiosteal flaps were then closed primarily over the bone

Global mission opportunities

There are several organizations that specialize in providing free surgical repair of cleft lips and cleft palates in children and young adults worldwide. In many cases, these patients have been ostracized from their families and communities or simply abandoned, due to lack of medical resources and misunderstandings about facial deformities.

Below are a few examples of mission programs. If you'd like to know more about supporting these groups with financial assistance, in-kind donations, equipment donations or volunteering your surgical expertise, please visit the websites listed below. There are opportunities to serve both here in the United States, as well as abroad.

Remember, the Foundation for Surgical Technology, the nonprofit 501(c)3 arm of the Association of Surgical Technologists, offers financial assistance to AST members who participate in medical mission trips. Scholarship applications are available at ***www.ast.org*** (Click on *Professionals,* then *Scholarships.*) There is no deadline for these scholarships. Applications are accepted and financial assistance is awarded throughout the year.

Healing the Children—
www.healingthechildren.org
Healing the Children has offered both stateside programs and international mission trips since its inception in 1979. The program provides free surgical care and/or specialized equipment to children here in the United States, as well as children from foreign countries who are brought to the US for specialized care that cannot be provided in the patient's homeland.

Teams of medical professionals also travel throughout the world to conduct surgical procedures in various specialties, including plastic and reconstructive surgery, ophthalmology, otolaryngology, urology, orthopedics and dentistry.

Interplast—*www.interplast.org*
With the help of 17 volunteer teams, Interplast performs about 1,800 surgeries every year in 16 countries throughout Africa, Asia and Latin America. Volunteers provide reconstructive surgery to children with cleft lips and palates, hand injuries and disabling burns.

Interplast's mission trips typically last two weeks, and the teams perform approximately 75 to 100 surgeries during each trip. Lectures and hands-on training for local physicians, residents and nurses may also be conducted during mission trips.

Operation Smile—*www.operationsmile.org*
Since the program's first mission trip to the Phillipines in 1982, Operation Smile has provided surgical repair of cleft lips and cleft palates to more than 100,000 children and young adults in Central and South America, Africa, the Middle East, Eastern Europe and Asia.

Its volunteer network encompasses more than 5,000 medical and non-medical professionals worldwide. The organization also offers its World Care Program, which brings children and young adults to the United States for surgeries that are too complex to be performed in their home countries.

Operation Rainbow—
www.operationrainbow.org
Operation Rainbow was founded in 1978 in Houston, Texas. Since then, the program has provided free plastic and orthopedic surgical care to more than 7,000 children in the US and worldwide.

In addition, the program also seeks to provide continuing education to medical professionals in underserved countries as a way of encouraging and supporting medical self-sufficiency.

The Smile Train—*www.smiletrain.org*
This organization focuses solely on providing surgical repair of cleft lip and cleft palate. Teams of medical professionals perform approximately 60,000 surgeries every year in 71 countries throughout Africa, the Middle East, Central and South America, Eastern Europe, Russia and Asia.

In addition to performing surgery, the teams also provide training to local physicians and therapists about new surgical procedures and follow-up care.

graft using 3-0 Vicryl sutures in an interrupted fashion.

Once the intra-oral wound was closed, the oral cavity was irrigated with copious amounts of normal saline, and the previously placed oropharyngeal pack was removed.

POSTOPERATIVE RECOVERY

At the time of discharge, the patient was given antibiotics and pain medication. The patient exprienced no postoperative complications.

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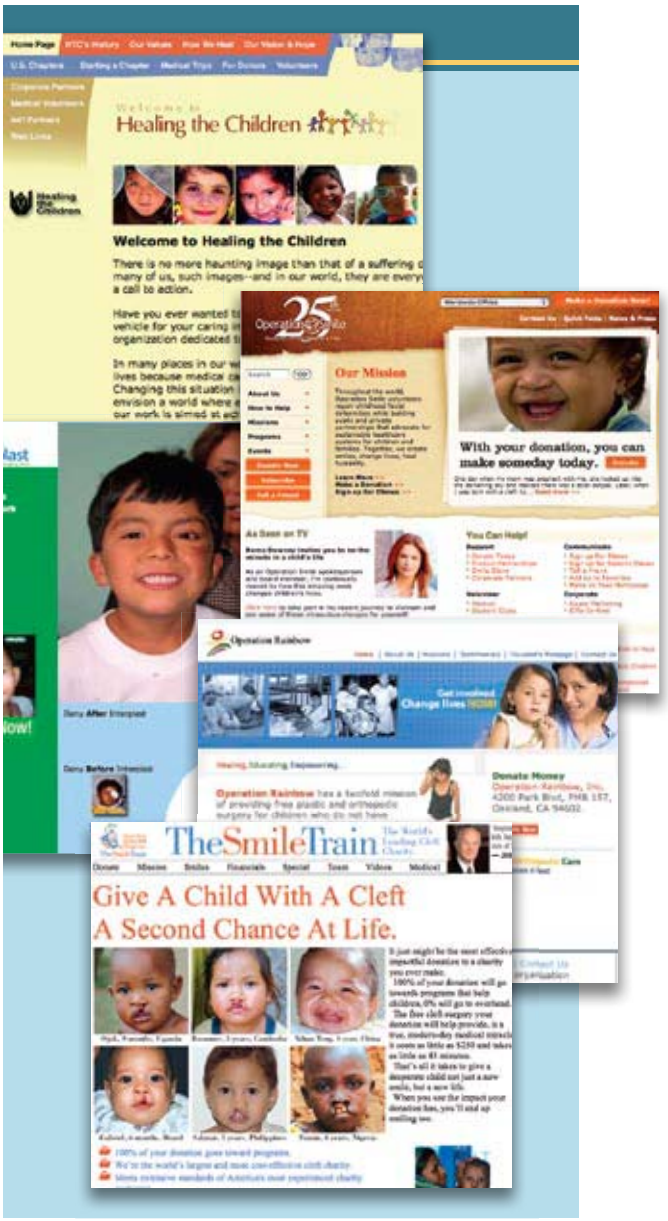


Palatoplasty—*A mother's perspective*

Pat Mancilla

Jarrod Mancilla—the patient in this article—was born on October 6, 1992. This was also the day that we—his parents—found out that Jarrod was born with a cleft lip and palate.

During the pregnancy, there were no unusual signs or symptoms. The pregnancy was considered normal, as were all of the ultrasounds. With technology today, though, we are now able to detect many facial defects, including cleft lip and palate, .

Jarrod, now 15, is a sophomore in high school, interested in a career in music or business.

At the time of Jarrod's birth, in addition to joy, a fear of the unknown was our greatest emotion.

The doctors gave us a brief explanation of cleft lip and palate and told us what our son's immediate needs would be.

Diagnosis and prognosis

Following an examination by the pediatrician in the hospital and the craniofacial team from Children's Hospital of Orange County in Orange, California, we were told that his official diagnosis was right unilateral cleft lip and palate with nasal deformity.

We were told that the lip and palate would need to be repaired surgically, with the possibility of some additional minor procedures.

In reality, Jarrod has had to endure approximately eight different types of surgeries, including nasal fistula repair with revisions, rhinoplasty, lip revisions, bone grafts to the palate and nasal area, and dental extractions.

In addition to the surgeries, Jarrod has undergone six years of orthodontics so far, and he has about another year to go.

He is scheduled for a Le Fort I maxillary osteotomy and a bilateral saggital split osteotomy (BSSO) at the completion of his orthodontic work, and he will still need a septoplasty, rhinoplasty and lip scar revision. The micrognathia repair will bring his jaw to the forward position.

The first days at home

We felt adequately prepared to bring Jarrod home due to the extensive education and counseling we received at the hospital. However, when we finally brought him home five days after he was born, the most challenging things we faced were feedings.

Due to the defect in the palate, nursing was not an option. For the next nine months, we tried several feeding techniques, including different nipple lengths and different hole placements on the nipples.

We finally ended up using a red rubber Robinson catheter to insert drops of breast milk into his mouth. All other forms of feeding would result in the milk coming out his nasal cavity, due to the fistula.

Continued

Surgeries during the first year

At three months of age, Jarrod underwent his first surgery—a cheilorrhaphy—to repair the lip and nasal defect.

Six months later Jarrod underwent a palatoplasty, which was described in this article.

In the years following this procedure, Jarrod would have to endure many more surgeries to revise, reshape or correct something new.

Throughout all this, he was always very happy, silly and confident in himself. He never fussed much after surgery and was always a good baby.

Additional surgeries

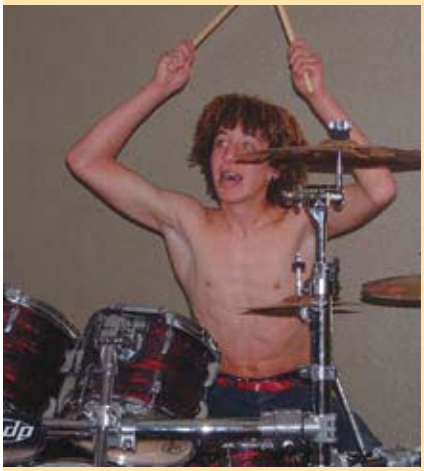
One of the surgeries performed on Jarrod was a cartilage graft from the right ear to the right nasal dorsum, because of considerable droop and flattening of the lower lateral cartilage.

The right tip-defining point of the lower lateral cartilage was also retrodisplaced compared to the normal left side, and there was stenosis of the nostril.

Then when Jarrod was, the surgeons needed to close the oronasal fistula by implanting an autogenous iliac crest bone graft in the maxilla.

We've also been told that Jarrod has an uneven alar base. The lateral ala on the left side of his nose is intruding on the nasal passage.

In 2000, a team of surgeons—including an oral surgeon—found that his occlusal exam showed a tendency toward an anterior cross bite, and the is a unilateral posterior cross bite. Tooth #8 is the one in the cross bite. Bone grafting to the cleft alveolar ridge will eventually take place. He already has had teeth extracted and moved, and the bone grafts are in place. The top braces are in place, and an expander was inserted to widen his narrowed arch.



Jarrod is a talented drummer and guitar player.

It is now 2007, and Jarrod's teeth look beautiful. All he needs to do now is have the orthognathic surgery, and possibly a rhinoplasty, septoplasty, and lip revision. This will hopefully conclude his journey, unless he chooses to undergo further procedures in adulthood.

As you can see, a child born with a cleft lip and palate endures a lot—physically and emotionally—throughout his or her lifetime.

We have taught Jarrod and our other children that when they see someone who has some type of noticeable birth defect, they should not be afraid or make fun of them. They should be courteous and should approach them if they have questions.

I know that I would have appreciated someone asking me what happened to my son, rather than making fun of him in my presence.

Throughout it all, I've learned that it's important to be happy and content in life and to live life to the fullest.

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ABOUT THE AUTHOR

Pat Mancilla is currently a student in the surgical technology program at Concorde Career College in San Bernardino, California. She will graduate in January 2008, and will take the national CST certification exam in February 2008.

Surgical technology is a career change for Pat. She wanted a career that allowed her to work with babies who are born with cleft lips and palates. After doing a lot of research, she chose this profession, because she felt it would give her the greatest satisfaction—as well as the ability to travel.

Editor's note: *The information contained in this article was compiled from the patient's medical records and a personal interview with the surgeon who performed this surgery.*

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Left frontotemporal craniotomy for sphenoid wing meningioma

Mike Steffy

In this case study, the author will present information on meningiomas and an overview of a craniotomy with specific details from a left frontotemporal craniotomy performed on a patient diagnosed with a sphenoid wing meningioma.

TYPES OF INTRACRANIAL TUMORS

Depending on their point of origin, intracranial tumors are classified typically as either primary or secondary.

Primary intracranial tumors originate within the brain, the meninges or the pituitary gland, and occur in approximately 35,000 people per year in the United States.[6] Primary tumors are classified further into:

- *Intra-axial tumors*, which originate inside the brain parenchyma and include astrocytomas, oligodendrogliomas, ependymomas, medulloblastomas, hemangioblastomas, primary central nervous system lymphomas, germ cell tumors and pineal region tumors; and
- *Extra-axial tumors*, which originate outside the parenchyma and include meningiomas, schwannomas and pituitary adenomas.

Secondary intracranial tumors are metastatic lesions of tumors that originate outside the brain. An estimated 150,000 to 250,000 patients present with this type of tumor annually in the US.[6]

MENINGIOMAS

Meningiomas represent about 20% of all primary intracranial tumors, making them the second most common type of primary brain tumor.[(S)]

The majority of meningiomas are benign, slow-growing tumors that develop from arachnoid cap cells that line the inner dura. They typically do not invade surrounding brain tissue, bone or muscle. Instead they compress or displace these structures as they grow, thus increasing intracranial pressure, which can produce noticeable symptoms in the patient. (See Table 1)

Most meningiomas are ovoid in shape, adhere to the dura, feel rubbery to the touch, and are located in the subfrontal region, cerebellopontine angle, parasagittal region and cerebral convexities.

Table 1. Symptoms commonly associated with intracranial tumors[5,6]

Compression —While some tumors, including meningiomas, do not invade the brain, they typically compress the brain and any surrounding nerves. Pressure on these nerves usually produces noticeable symptoms in the patient:

- Optic nerve (II) —Loss of vision
- Ocular muscle nerves (III, IV, VI) —Loss of eye movement
- Trigeminal nerve (V) —Facial numbness
- Facial nerve (VII) —Weakness in the face
- Accessory nerve (XI) —Loss of trapezius muscle function
- Hypoglossal nerve (XII) —Loss of tongue movement

Destruction —If a tumor attacks the brain, there may be resulting loss of function in that part of the brain. This type of damage may present as loss of speech, comprehension, sensation, coordination or mental acuity.

Irritation —If the tumor irritates the cerebral cortex, the patient may experience seizures.

Increase in intracranial pressure (ICP) —An increase in ICP can be caused directly by tumor growth and hemorrhage, and indirectly by hydrocephalus. The most commonly reported symptoms are nausea, vomiting, headaches, and a reduction in—or loss of—consciousness. Depending on the tumor's location and rate of growth, these symptoms may occur early on in the tumor's development or may remain mild and/or unnoticeable until the tumor is quite large.

Meningiomas occur most often in adults and primarily in middle-aged women. In some patients, the tumors may be associated with a condition such as meningiomatosis or neurofibromatosis, or a history of radiation therapy in childhood.

Surgery is often the indicated treatment, since gross total resection of the tumor may cure the patient. Total resection usually involves the removal of the tumor, the surrounding dural tissue and any involved skull. However, even when complete removal of these is accomplished, 10% of patients will experience a recurrence within 10 years.[6]

Due to surrounding nerves, blood vessels and other critical structures, complete removal may be difficult or impossible in some cases, leaving the surgeon to decide whether it is better to leave part of the tumor or attempt complete removal and risk neurological damage. For example, the carotid artery and the cranial nerves that enter the cavernous sinus may be inextricably involved with a meningioma that originates in the medial sphenoid wing or petroclival region.[6]

EPIDEMIOLOGY

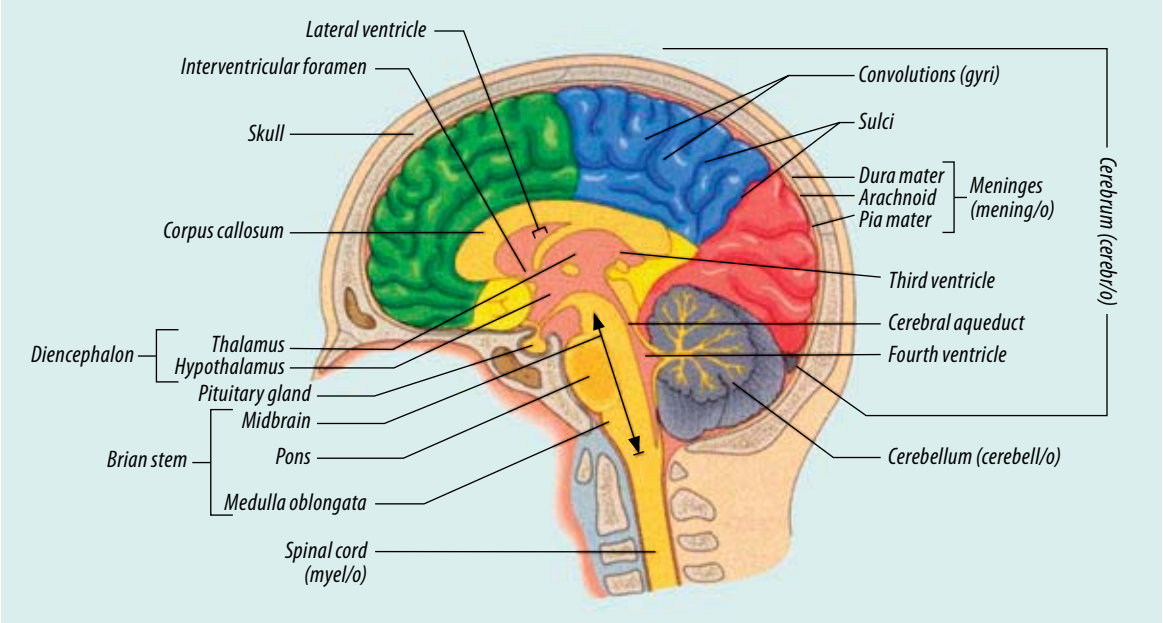
Histologically, benign meningiomas are categorized as:

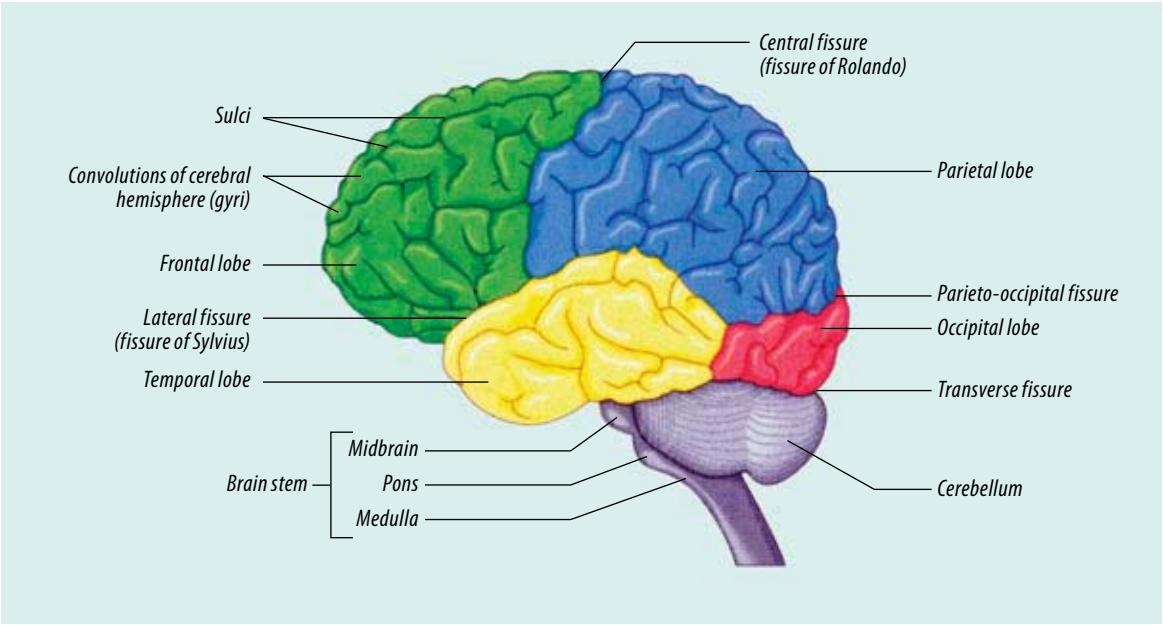
- Syncytial tumors—or meningotheliomatous meningiomas—in which cell borders are indistinct, because the cell membranes intertwine extensively.
- Transitional tumors composed of plump, polygonal cells.
- Fibroblastic—or fibrous—tumors consisting of interlacing bundles of elongated cells.

A characteristic feature of many meningiomas, especially those in which whorls are prominent, is the presence of psammoma bodies—laminated concretions often found in the pineal body.

DIAGNOSING MENINGIOMAS

A neurological exam is usually the first test given when a patient reports symptoms that suggest a brain tumor. The exam includes checking eye movements, hearing, sensation, muscle strength, sense of smell, and balance and coordination. The physician will also test mental state and memory.





Traditionally, X-rays of the skull were used, but they have now been replaced by MRI as the gold standard for diagnosing brain tumors. MRI does not use radiation and provides pictures from various angles that enables doctors to construct a three-dimensional image of the tumor. MRI allows visualization, often without the use of contrast agents. It can also detect small tumors, brainstem tumors, low-grade tumors and tumors that are located near bone.

Another diagnostic tool often used is computed tomography (CT), which uses a sophisticated X-ray machine and a computer to create a detailed picture of the body's tissues and structures. It is not as accurate as MRI and can detect only about 50% of low-grade gliomas.

A CT scan helps locate the tumor and can sometimes help determine the type. It can also detect swelling, bleeding and associated conditions. More often, CT is used to check the effectiveness of treatments and to watch for tumor recurrence.

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If there is potential for embolization or if the surgeon needs additional information about the tumor's arterial supply or venous drainage in order to plan the approach, angiography may be performed.

TREATMENT OPTIONS

Treatment options for meningiomas include surgical removal, chemotherapy and radiosurgery.

The primary objective of a craniotomy for excision of a meningioma is to remove or reduce as much of the tumor's bulk as possible. By reducing the tumor's size, other therapies—particularly stereotactic radiosurgery—can be more effective if required.

Whether or not the tumor is symptomatic—as well as the tumor's size, location and degree of involvement with surrounding neurovascular structures—will determine the treatment option selected.

CASE STUDY:

Left frontotemporal craniotomy for resection of a sphenoid wing meningioma

The patient is a 36-year-old female with mild obesity and a history of hyperthyroidism, which was treated with propylthiouracil.

Prior to the diagnosis of sphenoid wing meningioma, the patient reported the following symptoms to her physician: sudden onset of severe headache with nausea and vomiting.

She was treated initially for migraine headache and experienced some improvement.

The patient then underwent a CT scan of the head, which revealed a mass in the frontal lobe. An MRI scan was performed subsequently, and it confirmed the location of the mass on the lateral wing of the sphenoid bone, located at the base of the skull.

The scan also revealed that the meningioma was depressing the optic nerve.

TECHNICAL NOTE

The inner part of the sphenoid bone—the medial sphenoid wing—is closely approximated to several critical neurovascular structures, including the optic nerve, internal carotid artery, cavernous sinus and cranial nerves III-VI.

The outer flared part of the bone—the lateral sphenoid wing—is closely approximated to the frontal temporal lobes and the Sylvian, or lateral, fissure.[5]

The patient's symptoms were interfering with her daily life, so surgery was offered. Due to the risk of hemorrhage and a resulting increase in intracranial pressure or possible stroke, the patient's neurologist advised immediate hospitalization.

PREOPERATIVE PATIENT MONITORING

The patient was hospitalized for three days prior to surgery. While hospitalized, the edema surrounding the tumor and the patient's intracranial pressure were monitored continuously. The patient was given Decadron® to decrease the edema.

While on Decadron, the patient's blood sugar was monitored, because the medication raises blood sugar levels. She was put on a sliding scale of insulin and was monitored every six hours for rising blood sugar levels.

The patient's hyperthyroidism also was treated with medication.

EQUIPMENT, INSTRUMENTATION AND SET-UP FOR CRANIOTOMY

The preparation of the operating room consisted of arranging the furniture and setting up the basic and specialty equipment, supplies and instrumentation.

TECHNICAL NOTE

Planning prior to bringing the patient to the operating room is essential. Equipment placement, special physical needs of the patient, surgical approach, patient position, instrumentation, supplies and availability of necessary medications should all be considered. (See Table 2.)

Make sure all X-rays, MRI and CT scans, arteriograms or plain film studies are in the operating room. Verify readiness of blood products with the blood bank, if blood has been ordered.

Always test drills and saws in advance of need.[5]

PLANNING THE APPROACH

The approach should be planned and executed so as to accomplish four specific goals:

- Adequate exposure to allow extirpation of the diseased tissue, based on information obtained from physical examination and imaging studies;
- Protect critical structures near the lesion by achieving surgical access beyond the boundaries of the lesion itself to allow for direct visualization and control over the structures of interest;
- The approach should be designed so that at the completion of the extirpative phase, critical barriers between the neurocranium and viscerocranium can be readily and reliably restored;
- The choice of operative approach should reflect consideration for functional and aesthetic reconstruction, and it should include the placement of incisions within natural skin lines that respect aesthetic units of the face.[1]

Table 2. Preoperative set-up for craniotomy

EQUIPMENT	
Operating microscope and/or loupes, positioning devices (pin fixation device, Mayfield headrest, pillows and chest rolls), monopolar and bipolar electrosurgical units, a power source for the Midas Rex drill, a CUSA ultrasonic aspirator, Mayfield overhead table, two suction systems, nitrogen source, temperature monitoring device, fiberoptic headlight and light source (optional), autotransfusion machine (optional), ultrasound machine and attachments (optional), and CO_2 or Nd:YAG laser (optional).[5]	
INSTRUMENTATION	
Craniotomy or basic neurological set, Anspach or Midas Rex power with attachments (or a cranial perforator and craniotome), and air drill with bits and burs.[5] In this case study, the surgeon also requested Lorenz cranial plates.	
SUPPLIES	
A basic pack, basin set, blades (typically #10, #11 and #15), gloves, towels, craniotomy drape, microscope drape, needle magnet and counter, suction tubing (2), hypodermic needles, 4-0 silk and 4-0 braided nylon suture, closure suture (according to surgeon's preference), inner contact gauze and 4X4 dressings, laparotomy sponges, radiopaque sponges, control syringe, bipolar cord attachment to bipolar bayonet forceps, nerve stimulator, bulb syringes, graduate pitcher, electrosurgical pencil, Telfa pads for specimens, assorted sizes of radiopaque cottonoids, bone wax, cotton balls, MRI-compatible hemostatic clips, scalp clips, Hemovac drain, rubber bands, and ultrasound wand drape (if using ultrasound).[5]	
MEDICATIONS	
Hemostatic agents (absorbable gelatin sponge and topical thrombin), antibiotic irrigation, and lidoocaine 1% with epinephrine to inject into incision site for hemostasis.[5]	Sodium nitroprusside and mannitol with Decadron also may be used.[2]

POSITIONING, SKIN PREPARATION AND DRAPING

The patient was taken to the operating room in stable condition with an existing IV line and was placed on the operating table in the supine position, taking care to pad any pressure points.

Necessary safety and monitoring devices were applied or inserted, and the anesthesiologist administered general anesthesia with endotracheal intubation.

A Foley catheter was inserted to facilitate drainage of the bladder and to monitor urinary output. The patient's hair was clipped, and the head was shaved.

The Mayfield skeletal fixation device was attached to the operating table, the insertion sites for the pins were prepped by the circulator, and the device was secured to the skull with three sterile fixation pins.

The head was tilted to the patient's right, so that the left malar eminence was at its most prominent point. The headrest and pins were locked into place, and the handle was secured by the surgeon to prevent slippage.

Due to the height and weight of the patient in this case study, optimal positioning was difficult to achieve.

The incision site was marked by the surgeon with indelible marking pen.

TECHNICAL NOTE

Methylene blue is never used, because it produces an inflammatory reaction in nervous tissue.[5]

The skull and portions of the Mayfield head rest were prepped with Betadine,® using caution to ensure that the markings made by the surgeon remained visible.

Following completion of the preparation, four towels were used to square off the planned operative site and were secured in position. A craniotomy drape with a built-in adhesive drape was placed over the towels, and additional drapes were used to cover the remainder of the patient's body and to isolate the sterile field from the anesthesia provider's area.

The patient received prophylactic antibiotics, mannitol and Decadron to facilitate brain relaxation, and a surgical time-out was performed.

PROCEDURAL OVERVIEW

Following injection with an epinephrine solution to promote vasoconstriction of the blood vessels of the scalp, a curvilinear incision was made with a #10-scalpel blade behind the hairline beginning at one cm superior and anterior to the tragus and continuing toward the midpupillary line and beyond.

Raney clips were applied over the skin edges to control bleeding, and the monopolar electrosurgical unit was used to achieve hemostasis.

TECHNICAL NOTE

Bleeding from the scalp can be profuse. If the surgeon isn't using a Raney clip applicator gun, the surgical technologist will need to load the Raney scalp clips onto applicators quickly as soon as they're received from the surgeon.[5]

The dissection continued through the galea and periosteum, developing a flap to include the temporalis muscle.

TECHNICAL NOTE

At this point, the surgical technologist should be ready to hand the surgeon a small towel clip, rubber band and hemostat for attaching the flap to the drape.[5]

The scalp flap was retracted by folding it back, using caution to maintain the blood supply to the temporalis muscle, and then secured utilizing the rubber band and clamp technique.

Four bur holes were created by the surgeon using a Midas Rex® drill while the assistant cooled the bone and washed away bone fragments with irrigation fluid. The holes were located in the keyhole, frontal, pterion and temporal regions.

Bone wax was applied to the edges of the bur holes to stop bleeding from the cut edges of the bone, and the dura was undermined from the undersurface of the skull around the bur holes.

The Midas Rex drill with the footplate attachment was then used to connect the bur holes, allowing elevation of the free bone flap. The flap was placed in a safe location on the back table.

TECHNICAL NOTE

To identify dural bleeders, the surgical technologist should have an Asepto syringe filled with warm saline ready to pass after the bone flap is turned and the dura is exposed.[5]

The dura was noted to be tense and was incised in a curvilinear fashion and retracted with 4-0 braided nylon suture.

The frontal and temporal retractors were carefully and methodically advanced into the wound, allowing for frontotemporal retraction and allowing CSF fluid to egress and thus facilitate further brain relaxation.

Any bleeding encountered was treated immediately with bipolar coagulation or by placing bits of Gelfoam® soaked in topical thrombin.

The olfactory and optic nerves were protected with neurosurgical sponges at all times.

As the retractors were placed deeper into the wound, the tumor was visualized at the base of the skull. The tumor was pink and whitish in color and was adhered to the dura.

Grossly, it appeared to be a meningioma. Frozen section was not indicated, and a segment of the tumor was obtained and sent to pathology for permanent analysis.

The operating microscope was draped and positioned for use.

TECHNICAL NOTE

If the microscope is not mounted to the ceiling, the circulator may need assistance from the surgical technologist in positioning the microscope correctly.[5]

Microdissection of the tumor was initiated. The CUSA ultrasonic aspirator was also utilized for the tumor dissection.

After the surgeon was completely satisfied that the tumor had been debulked, hemostasis of the skull base was achieved with the bipolar electrosurgical unit and the use of absorbable gelatin sponges.

Following final inspection of the wound, the dura was closed using 4-0 braided nylon suture.

The first sponge, needle and instrument counts were correct, and a central tenting suture was placed.

The free bone flap was then placed back onto the skull and secured using the Lorenz cranial plate and screw set.

The galea and the skin were closed in sequence, and the final counts were correct. A head wrap style dressing was secured, and the patient's head was removed from the Mayfield fixation device.

The patient was transferred to the hospital bed and then transported to the ICU.

TECHNICAL NOTE

Extra caution should be exercised when moving the patient to the hospital bed. There will be multiple monitoring lines, in addition to wound drains and urinary catheter with drainage bag – all of which can be pulled easily.[5]

POSTOPERATIVE MONITORING

Postsurgically, the patient was monitored very closely in the ICU. Monitoring included vital signs, intracranial pressure and neurologic responses.

The steroid medication was continued, and the patient was put on a blood pressure drip medication (Cardizem®) to prevent any increase in blood pressure, which would in turn increase intracranial pressure.

The patient also was given amiodarone intravenously for short-term management of potential cardiac dysrhythmias.

Sequential compression stockings were applied to the patient's legs to promote circulation and reduce the risk of blood clot formation.

The patient remained in the ICU for five days and was then transferred to a lower acuity ward, where she stayed for two days until symptoms and vital signs were stable. The patient's diet progressed from liquids to a normal diet restricted to 2,000 calories per day.

POSTOPERATIVE INSTRUCTIONS FOR PATIENT

The pathology report confirmed that the meningioma was benign.

The patient was advised to be proactive in her ongoing care and vigilant in scheduling annual neurological exams, including CT scans. The patient also was advised to report any symptoms, especially any fluctuation in vision or balance, to her physician immediately.

If the annual CT scans show any irregularities, a follow-up MRI may be indicated. Complete gross excision alone does not rule out recurrences, which could pose a life-threatening situation, due to the location of the tumor.

Due to the patient history's of hyperthyroidism and obesity, the patient was made aware of possible complications and was instructed in preventive measures to take, including lifestyle changes.

PROGNOSIS

Even though the tumor was found to be benign and the surgeon was satisfied that complete tumor debulking had been accomplished, the potential for recurrence still exists.

If the tumor recurs, chemotherapy and/or radiation therapy may be considered as follow-up treatments.

ABOUT THE AUTHOR

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Editor's note: *Information in the case study was compiled from the patient's medical records and the surgeon's operative report, with permission from the patient and the surgeon.*

WANT TO KNOW MORE?

Interesting case studies and more information related to this article are posted on the AST website: From the homepage, click on *Publications*, then *Surgical Technologist*.

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Improving Access to Health Care for Children

An Analysis of Public and Governmental Programs to Improve the Access to Health Care:

A Comparison of Rural and Urban Children within the United States and the State of Ohio

Shawn P Huelsman, cst; Charles S Modlin, Jr, md, facs; Shannon Phillips, md; and Lateef Safore

AUTHOR'S FOREWORD

In surgery, many surgical technologists assist on surgical procedures performed on pediatric patients. From ear tubes to transplant, children of all demographics require procedures to correct a deformity or condition. Unfortunately, many of these children do not have health care insurance, or they depend on state and federally funded Medicaid and State Children's Health Insurance Programs (SCHIP). What does the future hold for these programs, and how does it affect the access to health care for the pediatric population that depends on extensive medical and surgical services? While reading this article, please take time to consider the following questions and access the surgical technology forum area at *http://www.ast.org/forum/* to further discuss these with fellow students and seasoned professionals.

1. Do hospitals have the right to decide who does and doesn't receive surgical care?
2. Are there systems that affect decisions about surgical care?
3. Do geographical and economic demographics influence how and where children will have access to care, and which surgical care will be provided (ie emergency versus elective surgery)?

4. Are surgeons restricted from using expensive instruments or discouraged from opening packs of non-vitally-necessary equipment, if the hospital knows it won't be reimbursed by Medicare?
5. Would a more cost-effective physician assistant, resident, or CFA be called in to assist, instead of having a second surgeon scrubbed in?
6. Is there a difference in the degree or amount of postoperative follow-up care given to a surgical patient who is under- or un-insured?
7. Do hospitals frown on lengthy procedures for under- or un-insured patients, because they're more costly?
8. Are there moral/ethical principles involved? Are any of them being violated?

INTRODUCTION

Currently in the United States, nearly 18 million children live in poverty; half of them are not medically insured.[14] This statistic mirrors the findings in Ohio, where there are 600,000 poor children, and 235,000 are without any health care insurance.[14] Although 43% of uninsured children come from poor or near-poor families, 73% of these children come from low-income families that are considered 200% above the poverty level ($40,000 for a family of four).[13] *(The current poverty level for a family of four is $20,650.)*[23]

2007 U.S. Department of Health and Human Services poverty guidelines

Persons in Family or Household	48 Contiguous States and D.C.	Alaska	Hawaii
1	$10,210	$12,770	$11,750
2	$13,690	$17,120	$15,750
3	$17,170	$21,470	$19,750
4	$20,650	$25,820	$23,750
5	$24,130	$30,170	$27,750
6	$27,610	$34,520	$31,750
7	$31,090	$38,870	$35,750
8	$34,570	$43,220	$39,750
For each additional person, add	$ 3,480	$ 4,350	$ 4,000

Though federal and state governments have developed programs to help children regarding their access to health care through Medicaid and the State Children's Health Insurance Programs (SCHIP), one in five poor children, and 17% of near-poor children, remain uninsured.[13] Along with children being uninsured medically, they are also uninsured in the areas of dental and mental health care. More than 25 million children lack dental care benefits, though it is a service provided by Medicaid.[27]

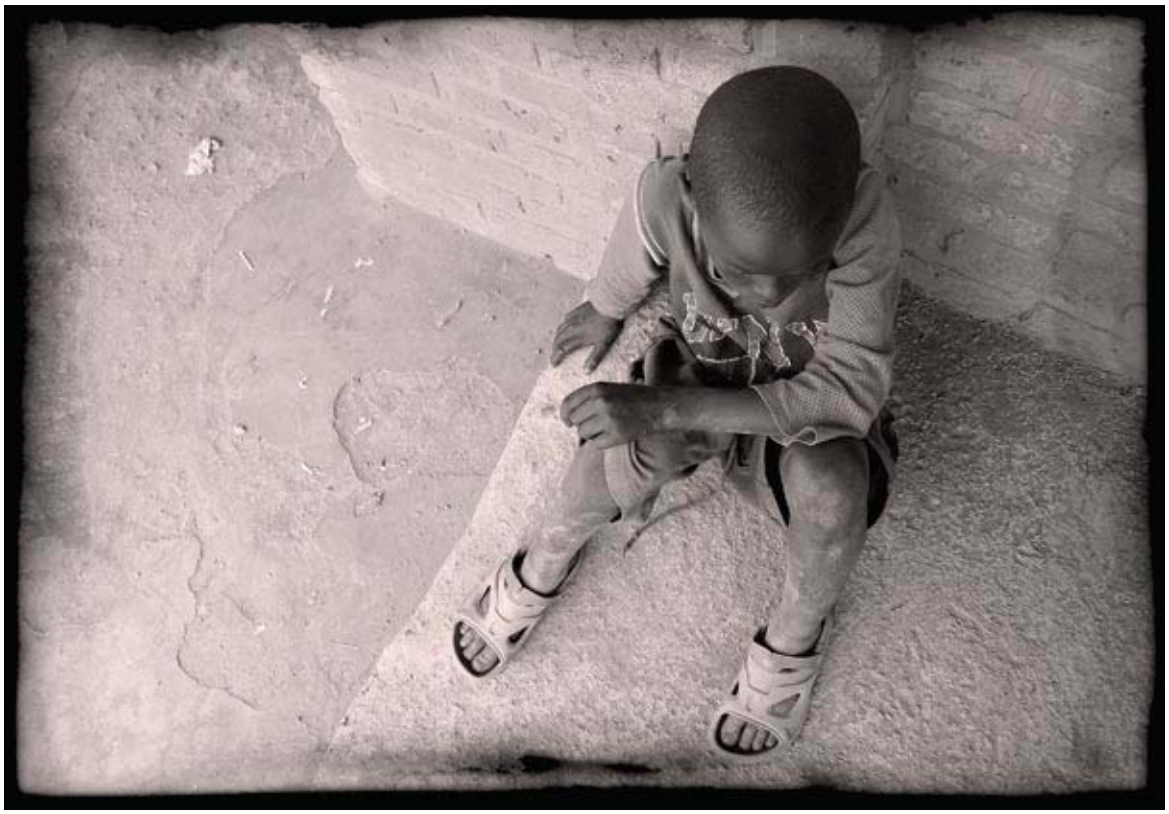
Can the federal and state governments provide health and dental care for the millions of children who are poor or near poor in the country? If so, will there be enough providers to offer the access to care that is needed? In addition, what socioeconomic barriers prevent access to care, even if a public program insures children? This article will examine all the methodologies, regarding access to care and suggests improvements to the current system.

ACCESS TO HEALTH/DENTAL CARE THROUGH THE USE OF PUBLIC INSURANCE PROGRAMS

One of the biggest problems related to access to health care services is insurance. Through the creation of Medicaid and the recently created SCHIP program in 1997, more children are able to receive health insurance benefits than ever before. In Ohio, 65% of poor children and 38% of near-poor children participate in these health care programs.[14] Though Medicaid and the SCHIP programs are available through the state, 12% of the entire child population under the age of 19 and 300% of the poverty level remain uninsured.[14]

CAUSES LEADING TO UNINSURED CHILDREN

In a 2003 study, nearly 30% of low-income parents knew what the SCHIP program was, and 40% did not know that their children were even eligible for health coverage.[10] Another study showed that if a parent (or another member of the family) had a negative experience with the process of applying for these programs, then the parent probably would not enroll the children.[10]



During an analysis of Medicaid/SCHIP eligible children in Ohio, lower household income, parental unemployment, parental health insurance coverage, and lower child age were associated with greater child participation in Medicaid and SCHIP.[18] What causes the decrease in enrollment? Parents participating in a 13-city focus group study reported frustration over answering numerous questions on the application; enduring long waiting periods in county offices; long, complicated and degrading applications, and finally, "rude" and "disorganized" social service workers.[10] Many parents reject the challenges associated with enrolling children, especially in a single-parent situation. Another frustration is an application form published in English and the absence of an interpreter for non-English speaking clients. Consequently, many communication problems occur, and the time for children to gain coverage may be prolonged.

THE BUREAUCRACY OF GOVERNMENT RUN INSURANCE PROGRAMS AND THE COST SAVINGS OF PRIVATE HMOS

Child health care issues, such as the reauthorization of the SCHIP program, have recently become lost among other questions. The SCHIP program was originally created to offer assistance to children from working families that made too much money to be covered under Medicaid, but earned less than twice the federal poverty level. It is a genuine concern that the amount of money appropriated for the SCHIP program may remain the same as its creation in 1997 ($40 billion) or even decrease.[1] How will this affect a child's access to health care? With the decrease in funds, fewer children will be able to apply to the program, or coverage for mental health services, speech and physical therapy, or dental care may become more limited.[1] For example, if SCHIP is eliminated, children who need therapy services that cost $25,000 will not receive it.[32] In some states such as Georgia, SCHIP had to close out enrollment due to a lack of money at the state level.[32]

Some members of Congress are using SCHIP as a tool to try to achieve universal health care coverage for all children, or to include other individuals besides children. Seven states (Hawaii, Illinois, Maine, Massachusetts, Pennsylvania, Vermont, and Washington) have enacted universal coverage.[13] The majority of these states have used the SCHIP program as a tool to accomplish this goal. In Ohio, House Bill 119 was passed in the 2008-2009 state budget.[11] It included an

expansion of SCHIP eligibility for children with family incomes up to 300% of the federal poverty level and represented a 100% increase from the current level. In dollar amounts, a family that now earns approximately $60,000 annually will qualify for state SCHIP benefits, which include a Medicaid Expansion Package (Individuals will receive all of the benefits as Medicaid recipients.).

Unfortunately, SCHIP will not guarantee universal coverage for children, or at least a *free* universal health care structure. SCHIP does not grant an entitlement to care as reflected in Georgia. With the number of children applying for this program and Medicaid, a sliding scale based on income is under discussion. Therefore, a family earning $60,000 annually will be charged higher co-payments and deductibles than a family earning $40,000 a year.[1]

The growing problem with SCHIP is that it was developed for uninsured children from low-income families. Over its 10-year lifespan, SCHIP has included children from middle-income families earning more than 300% above the federal poverty level, the child's family, or even single adults without children.[15] Consequently, individuals who may be able to purchase private health insurance will enroll under SCHIP and squeeze out those that cannot afford private insurance. As more beneficiaries are added, needier children may lose coverage.

In order to control the costs of SCHIP, state governments have looked for alternative ways of managing their Medicaid programs as well. In Georgia, SCHIP had to limit enrollment due to a lack of money at the state level.[32] At the same time, the state turned over responsibility for the Medicaid system to private health maintenance organizations (HMOs). In addition to Georgia, 32 other states turned their Medicaid systems into HMOs in "hopes of cutting through red tape, providing better care to needy patients and saving taxpayers money."[33] The result of this shift has been a decrease in needed covered therapy and specialty care, longer wait times to see physicians, and the elimination of some services.[33] In a "Good Morning America" report, the major HMO corporations that have assumed responsibility for state-run Medicaid programs have experienced billion dollar profits and higher stock prices.[33]

WHAT'S IN YOUR WALLET?

In the United States, 20 million children use Medicaid as their primary insurance; 700,000 of them live in Ohio.[14] Of the two public programs, Medicaid continues to be the primary public insurance resource for the poor and near poor of individuals living at 150% above the federal poverty level. Parents who spend time to apply for these benefits feel that their children have coverage for any medical, specialty, mental health or dental care issue. Unfortunately this is not the case. While children have the

necessary insurance, there is a lack of qualified providers to furnish services to clients with Medicaid as their primary insurance. In numerous reports it has been stated, "Children who lack health insurance have worse access to care than those with either public or private health insurance."[4]

Poor kids need more protection against unforeseen health effects. Early and periodic screening, diagnosis, and treatment, while perhaps unnecessary in middle-class contexts, address the real moral-hazard problem of capitated insurers' incentive to "not discover" all present and latent conditions.[21]

MEDICAID AND HOW IT RELATES TO MORE PROTECTION AGAINST UNFORESEEN EFFECTS

According to the Center for Medicare and Medicaid Services (CMS), dental care for children with Medicaid insurance is covered. A poignant example is the case of 12-year old Deamonte Driver who was covered for dental care as part of his Medicaid benefits.[27] One day, Deamonte complained of a toothache, and his mother Alyce phoned local dental clinics and dentists for an appointment. While she struggled to find a dentist who accepted Medicaid insurance, Deamonte's toothache developed into an abscess. The infection from the tooth spread into his brain requiring two major surgeries. Unfortunately, the surgeons were too late, and Deamonte died.

A study published by the American Academy of Pediatrics reports this example represents a problem within the Medicaid system. This survey found that physician participation in public programs was approximately 89%. Unfortunately only two-thirds of these providers accepted all Medicaid/SCHIP patients.[4] In Ohio, SCHIP is based on the Medicaid expansion and therefore has the same fees for reimbursement as Medicaid. Other forms of SCHIP lead to a lower reimbursement than Medicaid.

ACCESS TO HEALTH CARE VERSUS QUALITY OF HEALTH CARE

The Medicaid and SCHIP programs have reduced the number of uninsured, low-income children by one-third.[4] The problem with these programs along with private insurance companies is the failure to provide reports that show how the differences between public and private insurance affect overall quality of care for the pediatric patient. In addition, how is the quality of care affected by the access to care? In the Medicaid and SCHIP populations, it is often difficult to perform long-term studies on access versus quality of care. The main cause for this is the lack of a primary care provider (either by families opting to use a multi-practice clinic or the emergency department). Children without any form of insurance have adverse effects on medical care

use and health,[9] and children living in poverty have more health problems and poorer utilization of preventative health.[26] This is due to a lack of a "medical home," and the fact that many parents do not believe that their children are eligible for medical benefits.

With the current reduction of private providers accepting Medicaid payments, many individuals with Medicaid or SCHIP insurance are forced to

utilize the emergency department (ED) as their resource for primary care. ED care is meant to be expedient in order to assist individuals undergoing genuine medical emergencies. A more common sight in today's ED is the "Fast Track," a section that cares for patients needing treatment for non-emergency medical conditions. This gives the opportunity for uninsured individuals or those who have Medicaid to receive medications and treatments

usually performed by a primary care provider. The result is a decreased ED work force and the inability of physicians to see patients with medical emergencies. A study by Hadley regarding health care changes among uninsured individuals concluded that, "An uninsured person who experiences an unintentional injury or a new chronic condition has greater difficulty obtaining recommended medical care and takes longer to return to full health, if at all."[9] Hadley also states that uninsured individuals receive significantly less care and have poorer health outcomes than those with insurance; in addition, they depend more on EDs for their care, which will eventually become "episodic and lack continuity."[9] This lack of continuity in care can also be applied to those with Medicaid insurance. As previously noted in Georgia, if the physician or dentist does not accept Medicaid insurance, then the access to care is no longer available.

Not only do the participants in these plans suffer. Those communities that have a network of primary care physicians that do accept Medicaid payments become frustrated with the inability of their patients to access specialty services and medications along with the lack of continuing patient relationships.[3] This is especially important for those children who are medically fragile.

Medically fragile children present lifelong illnesses or conditions that leave them "technology-dependent." Causative factors commonly include the increase in extremely preterm or very low birth weight infants.[19] In 1990, the US Supreme Court ruled in the case of Sullivan versus Zebley that, "Childhood disability should be determined by individualized functional assessments of children ineligible for Supplemental Security Income (SSI) on the basis of medical standards alone."[19] The court's decision allowed medically fragile children to receive SSI benefits, and subsequently receive coverage under the state Medicaid system. The rationale for enabling medically fragile children to enter the Medicaid system was attributed to the children's increased chances of having "extensive, chronic health care needs," and that "these children would need frequent use of long-term and acute care facilities."[19] This rationale adds additional support to the argument for a consistent relationship with a primary care physician and access to the appropriate specialists who will work together in the child's long-term care.

Families with these children have major concerns, when publicly administered programs convert to privately operated agencies. First, the child's primary care may be turned over to a general practitioner who lacks experience with the child's condition and medical history. Second, many managed care plans limit the amount and type of pediatric specialists, which also may reduce specialty care in the form of family support groups, and counseling.

OTHER AREAS THAT AFFECT ACCESS TO CARE

Public insurance and the medical community are not the only culprits responsible for the lack of access to care. Two other barriers that hinder access to care include the location of the service provider and a means of transportation.

In the urban sector, missing appointments due to a lack of transportation commonly occur.[25] Low-income parents and single parents often cannot afford a reliable automobile or other mode of transportation, as well as the costs of maintenance, fuel and parking.

Children in rural areas are limited to the primary providers in their community, and therefore are geographically disadvantaged. When these children are hospitalized, they are admitted to non-rural hospitals due to the lack of local specialty or subspecialty resources in their community (ie mental health and high–risk newborn care).[5] Governmental policy has focused on ways to bring health care providers to rural patients by providing physicians with complete tuition reimbursement in exchange for serving three to four years in a rural area. This philosophy is now changing, because specialty care in rural areas may affect quality and safety of care due to the relatively small number of cases performed in the rural setting.

The trend is for mobile health clinics or other forms of outreach, including telemedicine. The Cleveland Clinic has launched a new initiative for expanding health care access to rural areas. Understanding that individuals throughout Northeast Ohio need access to the best quality care, the Cleveland Clinic created 15 Family Health Centers; six of them are located in rural areas. These Family Health Centers offer primary care services in family medicine, pediatrics, and internal medicine, while also providing experts in specialty care, radiology and lab services; and some centers also have an attached surgery center. Now individuals living miles away from Cleveland Clinic's main campus can receive the same level of care. Through the clinic's E-Chart system, if an individual is referred to the main campus, the physician on the other end has total access to the patient's chart, X-rays, lab results and other information required to maintain continuity of care.

ANALYSIS OF THE *INVEST IN CHILDREN* PROGRAM

How does a community change an ailing system in order to increase access to health care? One community has successfully reached out through collaboration. The *Invest in Children* program was created in 1999 to:

Mobilize resources and energy to ensure the well-being of all young children in Cuyahoga County, provide supportive services to parents and caregivers, and build awareness, momentum, and advocacy in the community around children and family issues.

The vision of this organization is to see that all children in Cuyahoga County (the county that includes Cleveland, Ohio, currently ranked as the fourth poorest city in America)[34] reach their full potential and are supported by a community committed to their success. This program is led by a partnership committee with representation from local and state government, philanthropic organizations, religious agencies, business owners, corporations and the three major health systems in Cleveland. This program combines agencies within Cuyahoga County, (Cuyahoga County Employment and Family Services, Cleveland Department of Public Health, Cuyahoga County Board of Health, Cuyahoga County Community Mental Health Board, Help Me Grow, and Starting Point) in a creative collaboration to provide quality services to all children within the county.

Through the contributions of the members of this collaborative, the *Invest in Children* program has made substantial impact on families and children within Cuyahoga County. Achievements include:

- Approximately 86% of all parents up to age 25 and first time parents of any age receive a newborn home visit from an RN. One percent of infants being served had contact with at least one *Invest in Children* service before six months of age.
- Approximately 89% of eligible children under age six living in poor and low-income families receive free insurance from Healthy Start, and 96% of all children in the county have some form of health insurance. The estimated percent of uninsured children under age six fell from 10.5% to 4.4 %.
- 2,924 prenatal home visits were conducted in 2006.
- 7,317 newborn home visits were conducted in 2006, for a total of 34,279 visits during the duration of the program.
- 6,525 ongoing home visits and service coordination were conducted, for a total of 19,799 visits during the duration of the program.
- 344 early childhood mental health visits were made.
- The percentage of women with adequate prenatal care rose to approximately 80%.
- 131,342 children have accessed *Invest in Children* services (107,965 from Medicaid recipients).

According to Shannon Phillips, MD, who sits on the Partnership Committee, *Invest in Children* has increased child health and early developmental services, but as with any complex initiative, there is still room for improvement. Phillips comments that dental and mental health services are inadequate largely due to the lack of qualified providers that offer services. Although 80% of women in Cuyahoga County receive adequate prenatal care, the low birth weight rate (9.0%) continues to increase. Current initiatives are focused on getting information about the program out to the community. Recently, a mass media campaign was launched in the county market. Commercials, billboards, and radio ads informed the public about the services *Invest in Children* provides the children of Cuyahoga County. This program is one of the most comprehensive of its kind in the United States, seeking to link access and education to optimal health and developmental outcomes.

HOW DO WE INCREASE THE ACCESS TO CARE?

From government-administered Medicaid and SCHIP programs to community-based programs described in the *Invest in Children* program, great steps have been made by programs across the country to increase the access to care for children. Is universal health care the answer? According to a CNN/Opinion Research Corporation Poll, 73% of Americans feel that there should be a national health insurance program for all children under the age of 18, even if this would require higher taxes.

Although Medicaid and SCHIP programs are operating effectively on behalf of poor and low-income children, the methods of provider reimbursement for services need to be re-examined so children will have continuity and quality of care.

Outpatient clinics (based on the Cleveland Clinic Family Health Center model) staffed by primary care providers could be established in other states. Operating hours could be extended to accommodate working parents and facilitate families with limited transportation options. Once established, these clinics would be available to provide a continuity of care while potentially reducing the number of non-emergency ED visits, thereby allowing the EDs to return to focusing on urgent medical care.

Ideally, these clinics would be networked within an affiliated health system in order to provide continuity of care for children with long-term medical needs, including access to highly trained specialists. To address the question of transportation, community hospitals could be enlisted to provide resources for appointments and by limiting the distance between rural children and major medical centers.

In Ohio and Cuyahoga County, there are excellent hospitals to provide medical care to children. Unfortunately, in the shadows of these great medical centers, over 26,000 children remain uninsured within Cuyahoga County, and over 212,000 are uninsured in the state.

With the rising population of uninsured children and the decreasing number of children having access to care, the community, medical centers, and health care providers have an opportunity to increase public awareness of programs and how to enroll in these programs, while also providing public health services, including education and screening.

The Cleveland Clinic Men's Minority Health Center and the Health Equity Initiative have

proven that public health programs and community involvement lead to positive outcomes in health care disparities. The Men's Minority Health Center, chaired by Charles Modlin, MD, FACS, is the first in the country to address the challenges of health care disparities among minority men. Utilizing a multidisciplinary approach to clinical care research and screening, minority men who do not have access to these services are treated, utilizing a world-class care approach to medicine. During the yearly health fair, minority men are able to participate in free screenings, such as prostate cancer, blood pressure, diabetes and cholesterol. The event represents an opportunity to provide information about diseases and other public health issues, including smoking cessation and nutritional health.

With the expansion of the Men's Minority Health Center with the Health Equity Initiative, children in Cleveland will receive the same opportunities. The initiative hopes to create a

children's health fair that will provide screenings for children, and also offer information to parents, including tips on keeping their children healthy, resources and assistance available for parents and children of need, and parenting information.

In Phillips's opinion, "Health care is a right, not a privilege." While an important part of the issue, insurance alone does not provide a direct access to health care. Society must join together in order to encourage individuals to apply for eligible benefits, while giving assistance to families unable to obtain necessary treatment, so all children can become the leaders of tomorrow.

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