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Organ Procurement

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Life – a viable, unpredictable gift that some take for granted while others savor every moment of. For those that consider themselves part of the latter category it is of no surprise that life can change without notice. It can come at a check-up with your doctor telling you that your kidneys are failing and that you may have to be put on dialysis. Or the cough you had all summer is actually a mass on your lung. Or perhaps in degenerative terms, it is your son or daughter that failed to have an organ develop.

The need for new organs is the key to cure these ailments and other diseases that obscure the health of communities around the globe. More commonly, these organ transplants are done in highly populated cities with skilled teams waiting to step into an OR suite, confident that they're working with highly trained, tenured nurses and surgical technologists that routinely conduct these operations with flawless technique and efficient procedures. Before the critical patient is rolled into the operating room and hours before the sought-after organ is transplanted, an intricate web of communication, surgical coordination and empathetic discussion occurs to bring the life-changing moment to fruition. This step is called procurement. For most largely populated cities, procuring is a routine procedure that goes hand-in-hand with a transplant surgery.

LEARNING OBJECTIVES

- Identify which organs can be donated from a live donor and which organs can be donated from a dead donor
- Examine the role the surgical technologist plays in an organ procurement operation
- Review the procedures for warm and cold dissection of a liver
- List the equipment and instruments needed for such procedures
- Analyze the concerns and possible derailments for organ procurement

But, sometimes there are cases when a much-needed organ is nowhere within city limits and could be hundreds of miles away in a less-populated town, with a less-experienced crew waiting to assist the in-route procurement team. For these team members, the procedure they are about to embark on is fraught with unfamiliar surgeon's, nurses and support staff, contradicted by their usual life of sustaining procedures and replaced with that of taking a life. This macabre thought can create anxiety, confusion and lead to a vague responsibility upon the resident staff, and perhaps, even a refusal to take part in the operation. For those who have experienced this alienating feeling, you're not alone.

> For more than half a century, the procurement of organs has allowed doctors to give their patients another chance to live.

THE HISTORY OF PROCURING

As professionals new and old, clad in attire reflective of a kind of surgery that has evolved for more than 100 years, surgery specialists have participated in operations that span from head to toe in order to mend patients. Removing organs and then possibly allowing death to take its toll is not in our language. For more than half a century, the procurement of organs has allowed doctors to give their patients another chance to live. By definition, procurement is the surgical removal of tissue or a viable organ from either a live or dead donor and transplanted into another patient.[1] The scope of procurement is vast and diverse, determined by the needs of the recipient and the match of a donor. This article will focus on clinically dead donors determined by brain death and the procurement of the liver, the second most commonly procured organ.

Other organs that a deceased donor can provide are heart, lungs, kidneys, intestine, pancreas as well skin and bone. Live donors can donate a kidney and portions of their liver.[2] Around the 1960s, the procurement of organs performed on deceased patients were done on those who had suffered a cardiac death. In present day, the procedure is also done on patients who have suffered a brain death as determined by a neurologist or neurosurgeon, and only after all life-saving efforts have been exhausted to revive the patient, is the patient considered brain dead.[3]

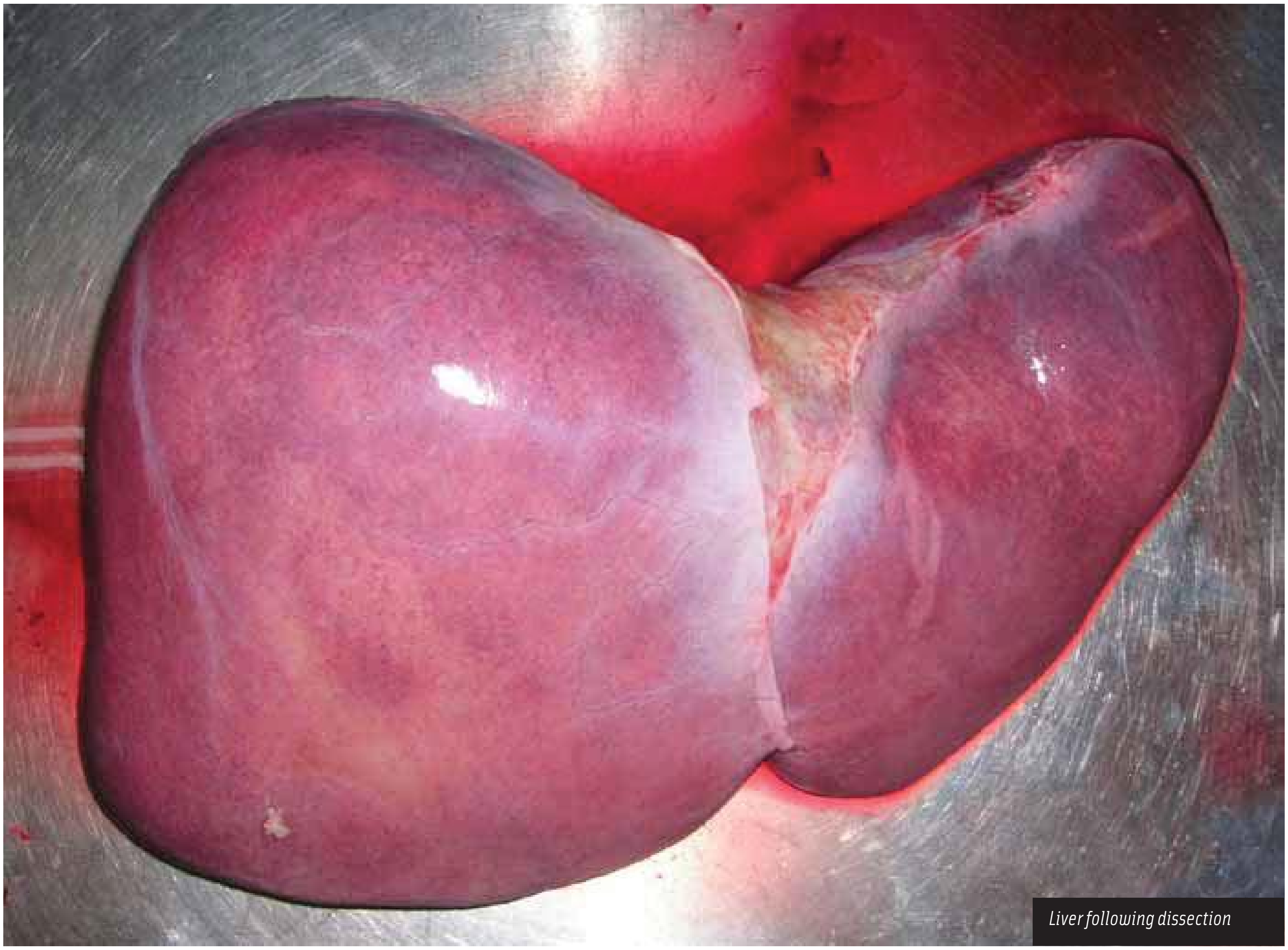
Organ Donation Contraindications

Being able to donate an organ following death is as intricate as becoming a recipient awaiting his or her match. The ability to transplant can be miraculous and daunting. There are three categories that can quickly eliminate an organ from being transplanted. They include: severe trauma, any type of malignancy outside of the Central Nervous System (CNS) and active infections.[4] The first indication is solely limited to the organ itself. Trauma to the area is an immediate cause for concern. The second, malignancy other than primary tumors to the central nervous system, will also disqualify the organ. Lastly, active infection is the most important diversion criteria because of the extent it can reach beyond the organ itself. Some examples include Hepatitis, sepsis and viral encephalitis. Multiple tests enable the waiting procurement team to determine the above contraindications and coordinate with the waiting surgical team and procurement liaison.

ORGAN CENTER OF ORGAN PROCUREMENT (OPO)

Behind the bright spot lights and intricate dissection of the patient on the operating table, is another crew. This team of expert nurses and logistics personnel will never lay a surgical hand onto the patient, but they have a large role in ensuring that the procedure is accomplished successfully. The Organ Center of the Organ Procurement Network/United Network for Organ Sharing has been in the business of organ allocation since its name changed from the Kidney Center in 1984.[5] The Organ Center, or OPTN — as it is sometimes known, is the logistical platform that many procurement companies operate under. Working alongside the Department of Health and Human Services, OPTN is available 24 hours a day, 365 days a year, running a computerized program that places recipients with donors, coordinating organ transportation and acting as resource to the US transplant community.[6] The responsibilities of the network involve not only matching recipients with donors and tracking available organs but it is also in charge of following the trends and needs of organs across the US.

Utilizing state of the art software, OPTN aggressively follows a protocol that allows for faster organ placement and



Liver following dissection

more efficient tracking methods. Before the newer system was implemented in 2005, the non-electronic method of tracking an organ and reviewing a chart between the network and an on-call transplant center was drawn out and painstaking. This process averaged only 2.5 organ offers per hour. Now, with a more precise way of managing care, that average has almost doubled to 5.5, and sometimes 6.1.[7] Overshadowing the amazing advancement of the department's coordinated efforts is the daily management of transplant centers across the country in ensuring the logistical steps in getting every viable organ to the nearest OR.

THE TICKING CLOCK

To lose someone is a horrible and painful ordeal but to have one more day with them, even if they were unresponsive, is a joy that can be a blessing in disguise. For many donors, this is how the clock starts to tick.

Engaging a patient into the transplant system is determined upon if the patient is preregistered or has voiced a want to become a donor in case of their passing. The latter is decided upon by a selected family member or set of family members that act as the patient's liaison if the patient no longer can decide for himself/herself. Depending upon the hospital, most facilities have an established relationship with donor facilities in their region, making immediate contact with such a facility once the family makes the decision. After established contact is made with the donor facility, a representative will travel to the hospital and begin a complex matrix of key steps to get the patient to the OR for procurement. The first and most important of these steps is to meet the donating family and discuss the process in the best and most understandable way possible. Then a series of labs, CT scans and MRIs are ordered for testing in the next 12 hours to determine the patient's donating status.

Surgeons work to dissect a part of a live donor's liver

Questions asked during this stage detail the specific health of the patient and the kind of life that he or she lived. Was this patient a smoker? If so, there is an immediate refusal of lungs. Was this patient a diabetic? Have they experienced any trauma in his or her life? The questions are asked until all medical conditions are covered. Multiple lab draws are conducted to check blood and platelet counts, liver function tests and more. While this is taking place, there is constant communication with the waiting procurement team, giving the anticipating surgeon enough information to make a successful decision on what organs to procure. Contact is also being made with patients and his or her surgeons awaiting such organs, as well as coordinating anticipated arrival times and possible deferring consequences.

Once the representative is satisfied with the results of all the lab tests, the surgical team is activated. Most traveling procurement teams will arrive at the facility within six to eight hours, depending on their location. A study done by the American Journal of Transplantation reports that between 2002 and 2008, the mean travel distance of most abdominal organs and those surgeons was 223 miles.[6] Most states will coordinate with in-state teams so the distance is less extensive. The adherent risks to arriving on time or not arriving at all, however, fall on Mother Nature's shoulders. Another study conducted by The Journal of Transplantation indicated that through a surveyed group of surgeon's, only 16% of them felt "very safe" during procurement travel.[7] The reason for this lowered response? Nature and the speed as to which a team must respond to a facility. Aircraft malfunction, heavy fog, snow, rain or ice can defer a team from arriving.

Once that team does arrive, the resident OR crew is anticipating a quick transition into a waiting surgical suite.

Anesthesia Concerns and Procedure

Critical to the viability of the procured organs are the perfusion they must receive pre- and intra-operatively. Inhalation and neuromuscular blocking agents are the medication of choice to help prevent reflex movement during the procedure.[8] Sustaining a normal blood pressure, heart rate and proper oxygen volume is also intensely dependent upon the anesthesia provider for the first half of the procurement surgery. This is known as the warm dissection—preparing an organ while it is still receiving perfusion. The latter half of the procedure is called the cold dissection—the steps taken when perfusion has ceased.

The following procedure is for the procurement of the liver from a clinically dead patient.[9] Ensuring correct organ recovery as it pertains to importance (ie, liver first, followed by heart, lungs, etc) is dependent upon need, not the specific organ itself.

WARM DISSECTION

The preparation of the OR needs to include placement of two electrocautery (Bovie) pads and two suction lines. The patient's arms are normally tucked and the complete torso from pubis to clavicles is exposed, shaved and prepped in a surgically sterile manner. A midline incision is extended from the pubic bone to the xyphoid. The round ligament is divided between two Kelly clamps, ligated with a 2-0 silk tie, all while ensuring that the liver is assessed. If there is no contraindication for a transplant, the thoracotomy will occur.

The pre-sternal skin is opened with the Bovie, up to the jugular notch, allowing for proper dissection and palpation of the sternum. Following a blunt dissection, a sternum saw is passed to the surgeon for a sternotomy. The sternotomy should be performed from cranial and brought distally to ensure that the left innominate vein is not injured. A modified Balfour retractor is used to retract the abdominal wall for the best possible exposure. The Balfour is considered modified due to its extensions. Utilizing the Bovie, the left triangular ligament of the liver is dissected. The surgeon performs this action by retracting the left lateral liver lobe with his or her right thumb. While retracting the liver away from the diaphragm, the surgeon divides the falciform ligament up to the Inferior Vena Cava (IVC), which gives more mobility to the liver. This is also performed with the Bovie, and special attention will be given to ensure that the IVC is not opened. The surgical technologist should have a pair of Metzenbaum scissors available in case of any adhesions that may be stuck to the inferior and lateral surfaces of the liver, needing sharp dissection. Sharp dissection is used instead of electrocautery due to the chance of tearing the liver capsule. The surgeon palpates the ventral border of the foramen of Winslow in order to identify a possible accessory or replaced right hepatic artery.

> The warm dissection ends with the cross clamp that is near the aorta. Exsanguination is performed by opening of the right atrium, allowing the blood to pool in the pleural cavity suctioned by pool tips.

Identifying and dissecting the Common Bile Duct (CBD) follows. Using a sweetheart retractor, the surgeon exposes the hepatoduodenal ligament by retracting the liver laterally. Under visualization of the duct, the CBD is dissected after opening the peritoneum, which sits near the duodenum. In order to prevent injury to the portal vein, a right angle clamp is guided around the CBD toward the hepatoduodenal ligament. A 2-0 silk tie is then placed around the CBD.

In some cases, it is advisable at times to wait until cold dissection begins to cut the CBD because it sometimes can have the similar appearance as an artery. If concern is warranted, a 18-24 gauge needle should be used to aspirate the tree to ensure proper anatomy. This action, however, this is used in a worst case scenario. For the purpose of this article, the CBD is correctly identified, and the procedure continues.

Once the silk tie is placed around the CBD, it is knotted and cut with the Metzenbaum scissors medially. Using a Bovie, the gallbladder is opened and flushed with a bulb syringe until the fluid become clear. Identifying a replaced or accessory left hepatic artery is done by exploration of the hepatogastric ligament and opening of the bursa by dividing the lesser omentum. The small bowel is then packed in a blue towel and retracted to the left side. The surgeon mobilizes the right colon, extending into a Kochers maneuver so the duodenum is mobilized to the left for uncovering the infrahepatic IVC and the abdominal aorta. These maneuvers are carried through with a Bovie.

The surgical technologist should have a right angle clamp and Debakey forceps available as the surgeon continues around the aorta and dissects for any lumbar arteries that may appear. Once all lumbar arteries are identified clamped and cut, two umbilical tapes are placed around the now-mobile distal aorta, which is secured by clamps. At this time, the procurement circulator hand the surgical technologist catheters attached to IV bags. These are to ensure that these two tubes are purged and free of air. They will be used to flush the circulatory system with a fluid known as University of Wisconsin fluid.

> Critical to the viability of the procured organs are the perfusion they must receive pre- and intra-operatively. Inhalation and neuromuscular blocking agents are the medication of choice to help prevent reflex movement during the procedure.[8]

The Inferior Mesenteric Vein (IMV) is most commonly used for access into the portal system. The surgeon retracts the blue towel pack toward the diaphragm, locating the IMV. A 2-3 cm segment will be dissected using the Debakey forceps and the Bovie. A 2-0 silk tie is used following dissection to ligate the distal segment and is left uncut to help retract the vein with a mosquito or Kelly clamp. Another 2-0 tie is placed around the cranial segment of the vein. A cranio-posterio incision is made in a 45-degree angle with Metzenbaum scissors between the two ties and the portal catheter is inserted into the IMV, ligated with an airtight knot. The intra-abdominal approach begins following the flush of the catheter with about 10 to 12 ml of heparin saline. The surgeon uses the Bovie to dissect the ventral peritoneum of the esophagus. The isolation of the esophagus can normally be performed by just the surgeon's two fingers. The surgical technologist needs to have umbilical tape ready to place around the esophagus for retraction. The tape is used to expose the supraceliac aorta located between the aorta and spine.

Once the tape is placed, the surgical technologist will pass the aorta clamp to the surgeon who will place it around the aorta in preparation for the cross clamp. The towel pack is retracted to expose the distal aorta and bifurcation, and another umbilical tape is placed around the distal aorta right above the bifurcation. The surgeon will use Mayo or Metzenbaum scissors to cut the aorta, following confirmation of the infusion of hep saline by the anesthesia provider. The aortic catheter is placed inside the aorta and tied with the cranial umbilical tape that was placed around the aorta earlier. The surgeon will then open the parietal pleura, which gives access to the cavity to allow for blood collection.

At this time, the surgical technologist should:

1. Ensure that flush lines are free of air;
2. Have an ice bucket available with slush; and
3. Make sure the pool tips are attached to the suction tubing.

The warm dissection ends with the cross clamp that is near the aorta. Exsanguination is performed by opening of the right atrium, allowing the blood to pool in the pleural cavity suctioned by pool tips. The flush lines are opened and slush ice is packed into the adnominal cavity, ensuring it reaches behind the liver and kidneys. Cold dissection can begin after perfusion is completed.

COLD DISSECTION

To begin this process, the surgical technologist needs to make sure there are four liters of UW solution at 4 degrees Celsius to be used to flush both the portal and arterial lines that you feed earlier. The flush quality is determined by the color of the fluid returning through supradiaphragmatic IVC. The fluid becomes more transparent with time and completely replaces any blood. At this time, ice slush begins to be removed and allowed for dissection of the liver and its structures. Identification and dissection of the Gastroduedonal artery (GDA) starts cold dissection. Following the dissection of the GDA and ligation of the artery with a 2-0 silk tie, the celiac artery is followed back to the aorta, using the aortic clamp for orientation as to where to cut the aorta. The surgeon dissects and cuts the portal vein now that visual ability is heightened with the already dissected CBD and GDA performed. The above and following vein and artery dissections are all performed with Metzenbaum scissors, ensuring that 2-0 silk ties are available for any ligation that may need to occur.

The remaining vascular structures that the surgeon will dissect are:

a. Superior Mesenteric Vein (SMA)

b. Suprarenal aorta

c. IVC following the dissection and removal of the inferior portion of the lateral diaphragm.

This step is done around the right triangular ligament of the liver and is continued between the liver and right kidney, usually dividing the adrenal gland. The liver can then be placed in the right thoracic space, allowing for maximum exposure of the hepato-duedonal ligament, which is now divided. The last construct to hold the liver in the abdomen is the aorta, which the surgeon incises and divides away from the spine and diaphragmatic muscle. The liver is free and taken out of the abdomen, and is flushed and packed for transport.

TRANSPORT AND CONTRAINDICATIONS

The amount of contraindications for a liver procurement is less than one might expect to find. Most tests and studies are conducted prior to the operation, enabling the surgical team to decide whether the availability of the organ is worth the time to remove it. Intra-operatively, any interaction with the bowel in which it becomes incised and its contents are emptied is when the case is then considered contaminated and abruptly canceled.

Transportation of the organs is a defined process of flush and slush, bound in multiple plastic bags and buckets that are properly marked and identified with side specifics and organ name. All organs are then placed into coolers on more ice for preservation.

CONCLUSION

Surprisingly as of the last 10 years, organ recovery and survival rate has increased tremendously. Patients who accept a major organ transplant now have a general one-year survival rate better than 90%.[10] The numbers have risen due to the advancement of technology and a desire to learn such integral procedures from surgical team members. For hundreds of community hospitals that go through this rare and exhilarating procedure, surgical professionals need to realize that procurements are not something out of a Frankenstein horror film but of something far greater. You are changing someone's life in a distant city or even state in a way that no words can express. You are giving them the chance to live again.

AUTHOR BIO

James Steele, CST, has been a surgical technologist for almost 10 years, specializing in general surgery and cadaver procurements. He has been a published author for many years, both as a freelance and fiction writer. James has been both Vice President and sat on the Board of Directors for the Oregon Association of Surgical Technologists. He currently works at Three Rivers Medical Center and lives in Grants Pass, Oregon, with his wife and two daughters.

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Organ Procurement

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1. Procurement is the surgical removal of ___________ from either a live or dead donor and transplanted into another patient.
a. Tissue
b. Organ
c. Both a and b
d. Neither a or b

2. Live donors cannot donate which organ?
a. Kidney
b. Lung
c. Liver
d. Live donors can't donate any organs

3. The _________ is responsible for matching recipients with donors all across the United States.
a. Organ Center
b. Health and Human Services
c. FDA
d. Local hospitals

4. In a published study by the American Journal of Transplantation, the mean travel distance of most abdominal organs was ____.
a. 23 miles
b. 222 miles
c. 223 miles
d. 13 miles

5. The sternotomy should be performed from cranial and brought _________ to ensure that the left innominate vein is not injured.
a. Laterally
b. Medial
c. Distally
d. Inferior

6. The surgeon divides the falciform ligament up to the IVC to provide __________.
a. Space
b. Mobility
c. Less trauma
d. Additional pathways

7. The surgical technologist should have a pair of ___________ in case of any adhesions that may stick to the inferior and lateral surfaces of the liver, which results in sharp dissection.
a. Bovie
b. Bulb syringe
c. Debakey forceps
d. Metzenbaum scissors

8. The IMV is most commonly used for access into the __________.
a. Liver
b. Portal system
c. Abdominal sac
d. Hepatogastric Ligament

9. Once tape is placed, the surgeon places a clamp around the _______ in preparation for the cross clamp.
a. Aorta
b. Liver
c. Diaphragm
d. Kidney

10. After the surgeon opens the parietal pleura, the surgical technologist should __________.
a. Ensure flush lines are free of air
b. Have an ice bucket available with slush
c. Check that pool tips are attached to the suction tubing
d. All of the above

11. In warm dissection, exsanguination is performed by opening the ____________.

a. Right atrium
b. Left Atrium
c. Aorta
d. Liver

12. One of the remaining vascular structures a surgeon will dissect during a cold dissection of the liver is _________.

a. Abdomen
b. Diaphragm
c. Suprarenal aorta
d. Portal vein

13. Organ recovery has increased greatly with patients who receive a major organ transplant now having a _____ survival rate better than 90%.

a. Three year
b. One year
c. Six Months
d. One Month

14. In cold dissection of the liver, the last item the surgeon incises and divides away from the spine and diaphragmatic muscle to free the liver is _____________.

a. Abdomen
b. SMA
c. Aorta
d. IVC

15. In warm dissection, a midline incision is extended from the pubic bone to the ____________.

a. Aorta
b. Liver
c. Xyphoid
d. Round Ligament

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Mark one box next to each number.
Only one correct or best answer can be selected for each question.