Photo courtesy of Steve Foss

Damage Control Surgery

Medical professionals work quickly to save patients with penetrating wounds

TONY FORGIONE, CST, LPN

The term "Damage Control" surgery was first penned in 1993 by Rotondo, et al,[16] in their work on penetrating injuries to the abdominal cavity. Damage control surgery is defined as a three-phased process. The first phase involves surgical intervention with the intention of controlling hemorrhage and decreasing the possibility of contamination. The second phase has the patient admitted to an Intensive Care Unit. In this phase the patient is resuscitated and hemodynamically stabilized. In the final phase, the patient will return to the operating room sometime within 24 to 48 hours later. This surgery will involve a more definitive repair or reconstruction of damaged tissue.[5]

This is not an entirely new phenomenon. Zachary, et al, reported that during World War II it was mandated that all colon injuries were to be treated with a colostomy. This resulted in a 20% decrease in mortalities.[7]

The concept of damage control surgery actually takes place well before the patient arrives at the hospital. The Emergency Medical Technicians (EMT) arriving at the scene assesses the situation during the pre-hospital care of the patient. Their analysis of the situation, the nature of the injuries and their initial treatments starts the process in motion. The rapid transportation of the patient to the Emergency Department (ED) is critical. During this time, there needs to be a detailed description of the injuries and the treatments provided on scene communicated to the receiving hospital.

LEARNING OBJECTIVES

- Define the three phrases of damage control surgery
- Identify the equipment and instruments ORs need to have on hand for emergency procedures
- Describe the specific techniques of hemorrhage control
- Learn about the role the surgical technologist plays when assisting during emergency operations
- Review how to identify injuries and the steps to prevent contamination in such areas

Communication between the EMTs and the hospital ED allows them to marshal the personnel and supplies needed when the patient arrives. Once the patient enters the ED, doctors and nurses administer intravenous fluids and perform a Focused Abdominal Sonography in Trauma (FAST) exam. A FAST exam is a noninvasive test using portable sonography to detect hemorrhage in the peritoneal cavity.[4] The FAST exam "Is performed during the American College of Surgeons Advanced Trauma Life Support secondary survey while the patient is in the supine position."[3] The exam involves the use of a hand-held transducer focused on different areas of the thoracoabdominal region. The ED doctor will start with a pericardial view to observe the sagittal subxiphoid look of the heart. The next view is the right abdominal quadrant between the 11th and 12th rib interspace. The third view involves the left upper quadrant of the abdomen through a posterior axillary line of the 10th and 11th rib interspace. The last view is at the Pouch of Douglas which is downward transverse view 4 cm superior to the symphysis pubis.[2] Positive results will have the patient immediately booked for surgery.

While the patient is in the ED, the operating room will be in communication with the emergency department nurse manager to keep them informed as to the patient's progress. Once it has been determined that the patient will need surgery, one of the attending surgeons will officially book the procedure, while at the same time ordering blood products from the blood bank.


Courtesy US Army

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Due to the nature of damage control surgery, the surgical technologist will need to set up the surgical field quickly. In many instances while the patient is being booked for the procedure, he or she is actually in the process of being transported to the OR. The surgical technologist will need to prioritize what equipment and instruments will be needed for this type of procedure. For instance, regular 4x4 Raytex sponges will not be needed for this procedure. It is useful to keep a pack of 10 to use as a "sponge on a stick" by tri-folding one and clamping it on a Forrester sponge clamp. These can be used as a temporary means of controlling bleeding if a blood vessel ruptures. The instrumentation for this procedure will involve a laparotomy instrument set along with a

A staff sergeant is operated on during a live hands-on field exercise in a mobile field surgery operating room at JBLM Courtesy US Army

variety of hand-held abdominal retractors, vascular instruments. A Bookwalter retractor should be available in the room if needed.

Also during this time, the circulating nurse is gathering and preparing any positioning supplies, such as ensuring there is a Foley catheterization kit in the room, and making sure the room temperature is set between 75°F to 80°F. A warm room, along with warm blankets and warming devises, will help prevent the patient from experiencing hypothermia during the procedure.

Since this is an emergency operation, the surgeon may wish to waiver the instrument count in order to expedite the start of the procedure. However, during the preoperative phase of anesthesia, every effort should be made to obtain an accurate count of items routinely counted as stated in the hospital policy of counted items. Some of the items counted should include laparotomy sponges, suture needles, hypodermic needles, vessel loops, Pen Rose drains, cautery tips and scratch pads.

Once the patient is put under using a rapid induction anesthesia and is intubated, the surgeon will want to prep from the suprasternal notch down to the midthighs and laterally to each side of the patient to the operating table.[2] Draping the patient will involve exposing as much of the prepped site as possible. In many instances, the surgeon will either use a large fenestrated laparotomy drape or two split sheets.

The American College of Surgeons, Advanced Trauma Operative Management, describes damage control surgery as a procedure that starts with a midline vertical incision from the xiphoid process, around the umbilicus, down to the symphysis pubis. The surgeon will attempt a rapid entry into the peritoneal cavity which means hemostasis is not an issue at this point. Once the abdomen is exposed, the surgery will involve four major components. The first component is to control hemorrhage; the second is to identify the injuries; the third is to control any contamination from the bowels or biliary tree; with the last component as repairing of injuries.[2]

HEMORRHAGE CONTROL

As mentioned earlier, control of hemorrhage is the initial goal of damage control surgery. As part of the preparation, the OR may have a means of collecting pooled blood from the patient. This blood may be washed and filtered and re-administered to the patient as a solution to replenish the patient's blood loss. Many operating rooms will have the blood bank initially set up 10 units of Type O blood – or the same amount of the patient's blood type, if known – and have them typed and cross matched for the patient.

Once the blood is available, the surgeon will pack the abdominal cavity with laparotomy sponges. The surgical technologist should have approximately 30 laparotomy sponges ready for initial packing of the abdominal cavity. The surgeon will pack the four quadrants of the abdominal cavity starting in the quadrant where the most bleeding or damage to organs is suspected.[6]

There is a specific technique for packing the abdomen. Once the peritoneal cavity has been entered, the surgical technologist will hand up a large abdominal wall retractor to the assisting surgeon on the left side of the patient. The surgeon will retract the abdominal wall to expose the spleen. Once any blood or clots have been removed, a pack can be placed in the deep regions of the left upper quadrant. Care should be taken to protect the spleen while this maneuver is occurring. The final packing in this quadrant will be placed over the spleen.

The retractor will then be used on the abdominal wall to expose the right upper quadrant. The surgeon will transect the falciform ligament to allow maximum exposure of the liver. Again, any blood and clots will need to be removed and packing placed. Packs are placed above and below the

Tony Forgione, CST, LPN, (left) scrubs during damage control surgery Photo courtesy of Tony Forgione

liver while a surgeon is compressing the liver to ensure tamponade if necessary.

In order to pack the rest of the abdominal cavity, the surgeon will need to control the small intestines. There are numerous ways to achieve this result. One method involves the use of a bowel bag. The clear bag is large enough to accommodate the entire small intestines and usually has a drawstring tie at one end. The small bowel is loosely placed in the bag, along with wet laparotomy pads or wet towels to ensure the bowel remains moist. Another technique for controlling the bowel involves the use of surgical towels. One towel is placed on either side of the incision, while the small intestines are eviscerated onto the towel and a second towel is used to wrap the contents. As with the bowel bag, the towels will be moistened.

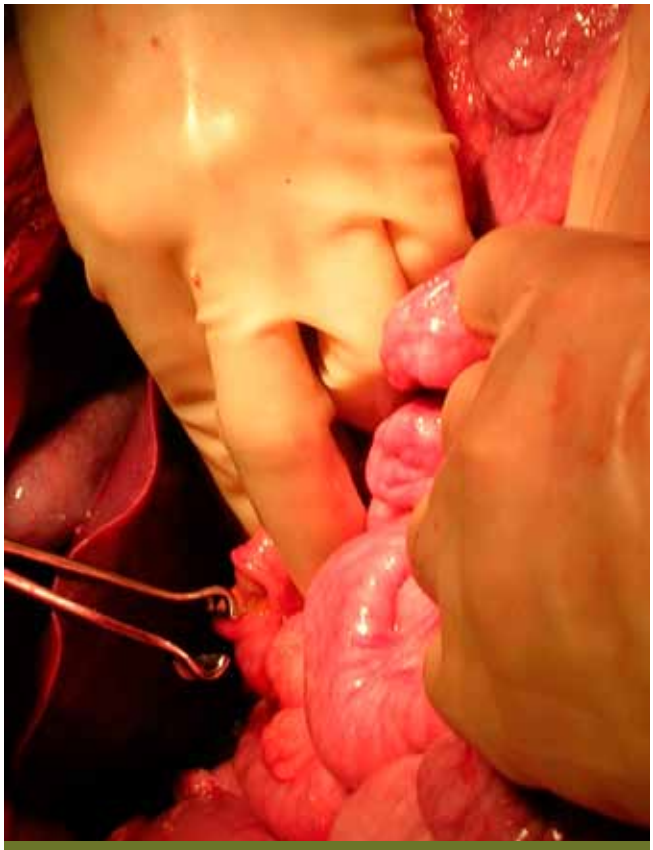
Whichever method is used, the surgeon most likely will have to transect the ligament of Treitz. This allows for maximum mobilization of the small bowel. Once the small intestines have been controlled they can be easily maneuvered to allow packing other portions of the abdomen. The wrapped bowel can be gently retracted cephaladvto allow examination of the mesentery and the retroperitoneum.

The next packing procedure will involve the colon. A hand-held retractor is used to expose the right colon which is medially retracted to allow packs to be placed. The procedure is repeated for the left colon.[3]

INJURY IDENTIFICATION

In order to identify possible damage, the surgeon will begin to carefully remove the packs. The first packs removed will be from an area where there is little possibility of injury and the surgeon will work toward the most seriously injured area. When the packs are removed, they are inspected for any evidence of fresh blood. Fresh blood will indicate active bleeding and a more thorough search of the area will need to occur. The surgical technologist should be prepared by having sutures pre-loaded on passers, a couple of 3-0 sutures loaded on needle holders and a number of clamps available. By following the surgeon, the technologist will be able to determine if vascular instruments will be needed to be opened and placed on the sterile field.

While removing the packs, the surgeon will inspect the area as well as the organs for signs of injury. It is also during this aspect of the procedure that more definitive control of the vascular structures takes place. The surgical technologist needs to have vessel loops ready as well as a couple of Forrester sponge sticks loaded with a folded absorbent



A Babcock clamp is used during a bowel injury procedure Photo courtesy of Tony Forgione

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sponges. These can be used to apply direct pressure to the inferior vena cava proximally and distally to any observed lacerations allowing time to obtain the necessary clamps and non-absorbable suture needed to repair the damage.

RETROPERITONEAL EXAMINATION

As part of the inspection process, the surgeon will evaluate the retroperitoneum for any potential damage or bleeding. The retroperitoneum is divided into zones. Zone I, the centromedial area, is bordered by the diaphragm to just pass the biforcation of the aorta. Care will be taken by the surgeon to examine the many vascular structures, the pancreas and the small intestines.

There are two Zone II sections of the retroperitoneum, which includes the lateral superior aspects of the abdomen. The structures in this area are the kidneys and adrenal glands. These will be examined and control of the renal artery will be established with vessel loops.

Zone III is the pelvic area. Exploring this area occurs only in the instance of a penetrating wound. It is not recommended that this region needs to be explored in the presence of blunt trauma. In many instances, control of bleeding can be accomplished through the use of external compression.

CONTROLLING CONTAMINATION

Another primary concern is contamination from an injured bowel. The surgeon will run the bowel to identify and control any damage that may lead to future infection. Using the first two fingers of each hand, the surgeon will start at the pyloric junction and inspect both sides of the small intestines for any injuries. The surgical technologist needs to have a number of Babcock clamps on the Mayo stand along with 3-0 stitches loaded on needles holders. The surgeon, upon coming to a laceration, can apply the Babcock clamps to temporarily control the bleeding. The surgeon will continue to inspect the bowel until the ileocecal valve is reached. Next, the ascending, transverse, descending and the sigmoid colon will be visually inspected for damage. Temporary control can be accomplished either through the use of more Babcock clamps, or through the use of a skin stapler.

Once the bowel has been inspected, the surgeon will perform more definitive repairs to any damaged portions. The surgical technologist will need either an appropriate number of 3-0 absorbable gut sutures and 3-0 pop-off sutures available or a linear stapler with reloads in order for the surgeon to do a small bowel resection if necessary. For many injuries to the small intestine, the surgeon may only need to sew over the damaged area with silk sutures. If the damage to the colon is too large to repair, the surgeon will most likely remove the damaged portion during a temporary colostomy.[1]

During this phase of surgery, the aorta will be inspected for signs of injury or laceration. The surgeon may use manual compression to help control hemorrhaging until a vessel loop can be wrapped around the aorta proximal to the injury. Many surgeons will use the left lateral rotation or Mattrox maneuver, which allows for direct access to the lateral aspect of the aorta. The Mattox maneuver mobilizes the splenic flexure and permits the kidney, pancreas and spleen to be retracted medially. This approach also exposes the celiac trunk as well as the superior and inferior mesenteric arteries.

Exposure of the Inferior Vena Cava (IVC) can be accomplished through a technique known as the Cartell-Braacch maneuver. This technique involves dissecting the cecum. Ascending colon and hepatic flexure allows the medial shifting of the colon to expose the bifurcated aorta and the IVC.[3]

While the surgical team is performing their role, the anesthesia provider is constantly evaluating the patient's hemodynamic stability. Unstable patients are not candidates for more definitive reconstruction of damaged tissue or organs. These patients are prepared for closure.

In many instances, due to the nature of the rapid and aggressive resuscitation methods used during the procedure, the patient will be temporarily closed. Studies have shown that approximately 45% to 70% of penetrating trauma patients are unable to endure a primary closure of the fascia.[9] There are a number of ways to temporarily close the abdominal incision. Of primary concern to the team is that the viscera have been contained and that there will be a limited chance of further contamination. One of the methods available is to pack the wound with either wet laparotomy sponges or wet towels. The wound is left open and one or two antimicrobial incise drapes are placed over the incision. Another method is to use a Vacuum-Assisted Closure System (VAC dressing) is placed and secured in the wound. No matter which method is used, the surgical technologist will need to inform the circulating nurse if there was anything left packed in the wound. This is especially important when lap sponges are packed and left in the abdominal cavity. The circulator will verify this with the surgeon and note it in the operative record. When the patient does return to the operating room these sponges will need to be accounted for to ensure the sponge count has been reconciled.

COMPLICATIONS

Postoperatively, the patient will be sent to an Intensive Care Unit (ICU) where the patient will be more fully stabilized. Complications can include uncontrollable hemorrhaging, hypothermia, coagulopathy, acidosis and fatal infections.[8] Once the patient has been cleared of any acidosis or coagulopathy issues, he can be returned to the operating room for a more definitive inspection and repair of damaged tissues. This will usually take place within 48 hours from the initial surgical procedure.

CONCLUSION

Damage control surgery has proved to be an efficient and rapid method of controlling profuse bleeding as a result of a penetrating injury. The surgical technologist will need to use all his/her skills and experience to ensure the surgical team has all the instruments and supplies needed to successfully tasks necessary for the procedure. Since damage control surgery is a fast-paced and chaotic event that pushes all members of the surgical team to their limits, the surgical technologist needs to maintain the highest level of surgical conscience to ensure the patient receives the optimal care he or she deserves.

ABOUT THE AUTHOR

Tony Forgione, CST, LPN, has almost 40 years of experience as a surgical technologist. His career has spanned from the US Navy to the Massachusetts General Hospital, where he continues to work. Tony is also the Supervisory Operating Room Nurse for the International Medical Surgical Response Team (IMSuRT), a federally mandated disaster team. In his capacity with IMSuRT, Tony has deployed to Ground Zero in New York City, New Orleans, and Galveston, Texas, for Hurricanes Katrina and Ike. He also has been deployed to earthquake-damaged areas in Iran and Haiti.

Tony is currently the surgical technology instructor at Quincy College, where he enjoys introducing and preparing students to a career he has found incredibly rewarding.

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TRAINING AS A NAVAL TECH

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Training as a surgical technologist in the US Navy was an intensive, hands-on, high-energy affair. We spent long hours in class learning theory and practicing new skills. Our introduction to the operating room involved hand washing instruments, folding linen drapes and gowns and wrapping items to be sterilized. We also learned how to run the autoclaves and even how to make and sterilize saline. When we got to scrub, we had our instructor with us for the first procedure to make sure we knew our duties. Then we were on our own.

One of the early procedures I scrubbed, alone, on my very first day was an elective general surgery procedure that rapidly evolved into an emergency situation. While the surgeon was rapidly evacuating blood clots and controlling bleeding, I learned very quickly that as the surgical technologist I had to control my emotions and anxieties and channel all my efforts to ensure that the surgeon had instruments and supplies he needed to deal with the situation at hand.

During the Vietnam era, when I was stationed at Bethesda Naval Hospital, there was no concept of damage control surgery. Current practice, at that time, had the surgeon and his team not only attempting to control bleeding, but also attempting to definitively repair damaged tissue. The results were not always positive.

Our operating room team was involved in many cases of wounded sailors and soldiers who were returned to the states to receive more definitive care for their injuries. Many of them were repeat visitors to the operating room.

One soldier I remember vividly. He experienced extensive abdominal injuries as a result of combat. He repeatedly came to our operating room for debridement of a large gaping abdominal wound. The goal of the surgeons was to progressively reduce the open wound to a size more conducive for skin grafting. Our team worked many hours during repeated visits to help this young man. He had numerous setbacks with infections, but he always remained positive and was very thankful for all our efforts. Unfortunately, I was transferred to another facility before his surgical interventions were completed. I always have wondered if our efforts proved to be successful.