Gunshot wound to big red

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HISTORY
A 22-year-old man presented to the trauma center with a single gunshot wound to the right upper quadrant. The patient’s systolic blood pressure was reported to be 80 mm Hg in the field.

EXAMINATION
The patient was alert and responsive on arrival. His initial vital signs were a heart rate of 120 beats per minute, a systolic blood pressure of 138 mm Hg, and a respiratory rate of 20/min. His abdominal examination was significant for a gunshot wound approximately 10 cm inferior to the right costal margin and 6 cm lateral to the midline. In addition, his abdomen was distended and diffusely tender to palpation.

MANAGEMENT
After blood was drawn for type and cross-match, the patient was moved to the operating room. A massive transfusion protocol was initiated, and a cephalosporin antibiotic was administered. After intubation, a midline exploratory laparotomy was performed. A significant hemoperitoneum was evacuated. At this point, the anesthesiologist stated that the patient’s systolic blood pressure had dropped to 80 mm Hg. On rapid inspection of the abdominal cavity, through-and-through wounds to the prepyloric gastric antrum, through-and-through wounds to the head of the pancreas, and a large midline supramesocolic hematoma were noted. Division of the gastrocolic omentum allowed for exposure and suture repair of the anterior and posterior holes in the prepyloric antrum. A few peripancreatic bleeders were ligated as the head of the pancreas was inspected. The location of the through-and-through wounds in the head of the pancreas suggested that neither the common bile duct nor the main pancreatic duct of Wirsung was injured.

QUESTION
The most appropriate management of the large laceration in the posterior supraceliac abdominal aorta is resection and:
A. Insertion of a thoracostomy tube as an intravascular shunt
B. Insertion of a nonporous vascular prosthesis
C. Insertion of a spiral vein graft constructed from the greater saphenous vein
D. Insertion of a borrowed segment of the infrarenal inferior vena cava

MANAGEMENT
The celiac axis was divided between clamps and ligated. The injured segment of the supraceliac abdominal aorta was then resected between the aortic clamps. A 16 mm polytetrafluoroethylene (PTFE) tube graft was sewn in place with 3-0 polypropylene sutures. Before the distal anastomosis was completed, proximal and distal flushing of the aorta was performed. The distal DeBakey aortic clamp was not replaced to allow for evacuation of air from under the suture line before the final knot in the anastomosis was tied down. After gradual removal of the proximal DeBakey aortic clamp, arterial flow to the lower half of the body was re-established. Unfortunately, the patient’s systolic blood pressure dropped from 90 mm Hg to 60 mm Hg at this point. Rapid infusion of packed red blood cells, crystalloid solutions, and 200 mEq of sodium bicarbonate over
An intact supramesocolic hematoma allows for more time to obtain proximal aortic control using the left medial mobilization maneuver. Originally described as part of a thoracoabdominal approach to elective repair of four thoracoabdominal aneurysms by DeBakey et al., this technique has now been widely used in elective and trauma vascular surgery to expose the proximal abdominal aorta for 65 years. Disadvantages of the left medial mobilization maneuver have been well described and include the following: (1) 5–7 min time period to perform the maneuver; (2) risk of iatrogenic injury to the spleen, left kidney, or posterior renal artery during mobilization of these structures; (3) creation of a fold in the visceral abdominal aorta caused by anterior rotation of the left kidney. In the patient described, the area of injury was in the supraceliac abdominal aorta. Therefore, there was no need, in retrospect, to mobilize the left kidney during the medial mobilization.

Division of the left side of the aortic hiatus of the diaphragm as was performed in the patient described is a useful adjunct. It allows for visualization of the distal descending thoracic aorta proximal to the celiac ganglia and extensive lymphatics that cover the supraceliac aorta. One helpful technical point is to mark the midpoint of the phrenotomy on either side with a metal clip. This will aid in the repair of the hemidiaphragm when the patient is hemodynamically stable.

As most penetrating injuries to the celiac axis are managed with ligation, the choice of intentional division and ligation of this vessel for improved exposure was appropriate in the patient described. This option should always be considered when there are wounds to the immediately adjacent proximal superior mesenteric artery or the visceral abdominal aorta.

The combination of an injury to the gastrointestinal tract and any major abdominal artery increases the risk of a postoperative infection of the vascular repair, particularly if an interposition graft has been inserted. Options to avoid the use of a plastic graft in the suprarenal or infrarenal abdominal aorta described in the literature over the past 25 years include the following: (1) handmade spiral vein graft from the greater saphenous vein; (2) borrowed segment of infrarenal inferior vena cava; (3) a patch of bovine pericardium tailored to form a tube graft. Unfortunately, all of these options are very time consuming in the middle of a major trauma laparotomy with the abdominal aorta clamped. With time a factor, almost all patients have had woven Dacron, albumin-coated Dacron, or PTFE graft insertion into the suprarenal or infrarenal abdominal aorta during trauma laparotomies over the past 45 years. The graft infection rate is unknown as there are so few survivors of graft repair of the abdominal aorta in the American literature. In addition to perioperative antibiotics, operative maneuvers to decrease the risk of a postoperative suture, patch, or graft infection include the following: (1) clamping, stapling, or isolating injuries to the gastrointestinal tract under folded laparotomy pads during the vascular repair; (2) antibiotic irrigation of the operative field around the injured vessel before and after the vascular repair; (3) closure of the retroperitoneum over the abdominal aorta no matter what type of repair has been performed. Absence of adequate retroperitoneum to cover a graft in the suprarenal or infrarenal abdominal aorta should prompt coverage with a mobilized viable pedicle of gastrocolic omentum. This pedicle can be placed “backwards” into the lesser sac and then through the transverse mesocolon or passed laterally around the ligament of Treitz into the retroperitoneum.

After declamping and restoring arterial flow through the newly inserted PTFE prosthesis, the patient had a period of hypotension. One reason for this would be rapid redistribution of intravascular fluid to the splanchnic bed.
of the available blood volume. Another would be the “washout acidosis” or “hyperkalemia-acidosis” syndrome well known to all elective aortic surgeons. This syndrome is presumably due to the death of cells from ischemia in tissues distal to the aortic cross-clamp, the release of potassium from these cells, and a metabolic acidosis from ischemia and hyperkalemia. This syndrome is minimized in emergent or elective open aortic surgery by the infusion of blood or crystalloid solutions and ampules of sodium bicarbonate prior to gradual release of the aortic cross-clamp.

The survival rate after injuries to the suprarenal aorta during the 1970s to the 1990s was 35%.7 10 In one review in 2001, the survival rate was only 8.3%.11 Another review of 24 patients from 2007 noted a survival rate of 24% if patients dead on arrival were excluded.12

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**REFERENCES**