

Minimally invasive surgery?

Alejandro Chavarriaga,¹ Amy Wyrzykowski,¹ David V Feliciano²

¹Department of Surgery, WellStar Atlanta Medical Center, Atlanta, Georgia, USA
²Shock Trauma Center/ Department of Surgery, University of Maryland School of Medicine, Baltimore, Maryland, USA

Correspondence to

Dr David V Feliciano, Shock Trauma Center/Department of Surgery, University of Maryland School of Medicine, Baltimore, Maryland, USA; davidfelicianomd@gmail.com

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HISTORY

A 43-year-old woman with a body mass index of 35.1 presented to an ambulatory surgery center for a laparoscopic sleeve gastrectomy. A Veress needle was used to access the peritoneal cavity. When the laparoscopic camera was inserted, massive hemorrhage was noted. Laparoscopic control of the bleeding was attempted but was unsuccessful, and the patient was converted to a laparotomy. Because of the massive hemorrhage, the source was unable to be identified. A total of eight non-vascular clamps were placed in the abdomen in an attempt to control bleeding. The estimated blood loss at the outside facility was reported to be 5 L. The patient's abdomen was packed, she was transfused 2 units of packed red blood cells and fresh frozen plasma, and then transferred to a level 1 trauma center.

QUESTION

The most appropriate first step in the management of this patient in addition to resuscitation at the center is:

- Thoracotomy/X-clamp descending aorta.
- Call an endovascular surgeon.
- REBOA in the emergency room.
- Perform thromboelastography.

MANAGEMENT

The patient arrived at the center on an intravenous drip of norepinephrine at 16 µg/min and with intermittent intravenous infusions of 1 mg epinephrine. As retrograde endovascular occlusion of the aorta (REBOA) was not available at the center at the time, the patient was taken directly from the ambulance bay to the operating room and the massive transfusion protocol was initiated. The patient's blood pressure was 80/50, her arterial pH was 6.93, and the base deficit was -24.

At laparotomy, there was obvious hemorrhage from the distal infrarenal abdominal aorta just above the bifurcation. There was maceration of approximately 1 cm of the anterior aorta encompassing 50% of the circumference, as well as a through-and-through injury of the posterior wall.

QUESTION

The most appropriate management of the injury in the distal abdominal aorta is:

- Insert a thoracostomy tube as a shunt.
- Ligate the aorta proximal and distal to the injury.
- Patch aortoplasty with thin-walled polytetrafluoroethylene (PTFE).
- Insert a Dacron tube graft.

MANAGEMENT

Although a temporary endoluminal shunt would have been appropriate in this "damage control" situation, the shunt would have had to be in a "Y" conformation to maintain inflow into the common iliac arteries. Therefore, an infrarenal aortic cross-clamp and two vascular clamps on the common iliac arteries were placed. During a 64 min clamp time, the injured distal aorta was dissected out, excised, and a 16 mm woven double velour tube graft (Hemashield, Maquet Getinge Group, Rastatt, Germany) was inserted with 3-0 polypropylene sutures. At this point the patient's arterial pH was 6.71, with a base deficit of -29. A vacuum-assisted coverage device was placed over the open abdomen, and the patient was transferred to the intensive care unit.

The patient initially did well, but then had evidence of significant blood loss 12 hours later and was returned to the operating room. She was found to have Veress needle-sized holes on both the anterior and posterior aspects of the abdominal aorta approximately 2 cm proximal to the interposition graft. These were each closed with a single figure-of-8 suture. During the course of the first two operations, the patient had an estimated blood loss of 9 L. During the first 16 hours of her hospital stay, she received 47 units of packed red blood cells, 47 units of fresh frozen plasma, 9 platelet packs and 3 cryoprecipitate, as well as 16 units of Cell Saver blood (Haemonetics, Braintree, MA).

After rewarming, correction of the acidosis, and reversal of her coagulopathy, the patient was returned to the operating room on postoperative day 2 for exploration, washout, and fascial closure. Her subsequent hospital course was complicated by acute kidney injury secondary to acute tubular necrosis. This was initially managed with continuous renal replacement therapy, and eventually with hemodialysis. She was extubated on postoperative day 5, transferred to the floor on postoperative day 9, and then went to a rehabilitation facility on postoperative day 17. She was discharged home 27 days after the index operation. The patient has been seen in the clinic since discharge and has palpable pulses in her dorsalis pedis and posterior tibial arteries bilaterally. Her renal function has recovered and she is off dialysis. She ambulates without difficulty in her neighborhood with her husband and suffered no permanent sequelae.

DISCUSSION

Entry into the peritoneal cavity is reported to be the most dangerous step in laparoscopy, where 88% of major vascular injuries occur.¹ The Veress needle and optical trocar techniques involve closed entry

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into the peritoneum.^{2,3} In a meta-analysis of over 760 000 closed laparoscopies, there were major vascular and visceral injury incidences of 0.044% and 0.067%, respectively.⁴ In comparison, the Hasson technique involves open entry into the peritoneum via a mini-laparotomy with direct visualization using a blunt as opposed to a sharp obturator.⁵ This technique had incidences of major vascular and visceral injury of 0% and 0.049%, respectively, in over 22 000 open laparoscopies.⁴ In this meta-analysis by Larobina and Nottle⁴, the difference in major vascular injuries in open versus closed laparoscopy was statistically significant, whereas there was no difference in visceral injury.

Within the bariatric patient population, Sundbom *et al*⁶ reported an overall incidence of aortic injury of 0.043% during 11 700 laparoscopic gastric bypasses. Of those, the optical trocar, Veress needle, and Hasson entry techniques carried an aortic injury incidence of 0.091%, 0%, and 0%, respectively.⁶ Of the five aortic injuries reported in this study, one patient required bilateral lower extremity amputations due to massive lower extremity thrombosis and one died due to cerebral anoxia, yielding a morbidity and mortality rate of 20%.⁶

Sundbom *et al* have also documented that bariatric patients are at an equivalent risk for a laparoscopic major vascular injury (0.043%) when compared with the general population (0.044%) despite the perceived protection due to their larger size.^{4,6} It has been hypothesized that this is due to the fact that it is the subcutaneous tissue that is deeper and not the peritoneal cavity in obese patients when compared with non-obese individuals.⁶ In fact, an argument could be made that bariatric patients are at increased risk of injury as traversing their deeper subcutaneous tissues would mandate much more force than is required otherwise. This could increase theoretically the risk for uncontrolled entry into the peritoneal cavity and therefore injury.

In terms of prevention, laparoscopic surgeons should adopt recognized techniques for safe laparoscopy. First, whenever possible, the open Hasson technique should be used. If a Veress needle must be used, it should be inserted at an oblique 45° angle while the abdominal wall is lifted.^{1,6} Next, if an optical trocar is to be used, it should be inserted 1 cm away from the midline and angled cephalad toward the left shoulder or at Palmer's point.⁶ Lastly, all other trocars should be placed after establishment

of the pneumoperitoneum, without significant force, and in a controlled fashion.^{1,6}

Despite the adoption of these techniques, major vascular injuries unfortunately still occur. Once an injury occurs, immediate conversion to a laparotomy is needed for vascular control.^{3,7} This may be obtained initially by direct pressure with a finger, hand, laparotomy pad, or sponge stick immediately over the vascular injury.⁷ This allows the surgeon and anesthesia team time to “catch up” hemodynamically, obtain proximal and distal vascular control, gather vascular instruments and grafts, and if needed call a vascular surgeon. After proper exposure and control, primary repair, a patch angioplasty, or insertion of an interposition graft is performed.^{3,6,7} A temporary intraluminal vascular shunt may be needed in a “damage control” setting in a patient with hypothermia, acidosis, and coagulopathy after initial resuscitation.

Competing interests None declared.

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