Improving Results for rAAAs Through a Systematic Approach

Dr. Frank Arko interviews Dr. Benjamin Starnes regarding the protocols used in the University of Washington hospital system for treating ruptured abdominal aortic aneurysms.

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Dr. Arko: How would you describe the intake process when a patient with a ruptured abdominal aortic aneurysm (rAAA) enters the University of Washington hospital system at your location?

Dr. Starnes: Any patient with an rAAA presenting to our institution can come from a variety of places: a referring provider at an outside institution situated across a five-state region, paramedics responding to a call in the city of Seattle where the index of suspicion for an rAAA is high, or even from our own network of hospitals within a 15-mile radius where the resources do not exist to treat the patient efficiently at that site.

All patients come through the emergency department. If the patient has clearly been diagnosed with an rAAA with some form of imaging study (either CT or ultrasound), the patient pauses in the emergency department for placement of an identifying arm wristband with a medical record number. He or she is then taken immediately to the operating room by the paramedics and then handed off directly to the operating room staff. Sometimes, this handoff occurs in the operating room if the patient is unstable. If the patient has not had a definitive diagnosis made, he or she undergoes CT angiography (if he or she is hemodynamically stable with blood pressure > 70 mm Hg and positive mentation) or rapid ultrasound (if he or she is unstable) in order to confirm the diagnosis.

Dr. Arko: How were your protocols for intake and throughput initially established? What did this require in terms of internal networking?

Dr. Starnes: Our protocols were initially established one patient at a time. After establishing a large inventory of endografts and all of the requisite supplies, we began shifting the culture at the Vascular Surgery Clinic at Harborview. The anesthesiologists were the most affected team members. What was once the "biggest" case the anesthesiologists did turned into (at times) a local procedure with minimal or no sedation. This became the buzz around the hospital, and after the anesthesiologists bought into the philosophy, the stage was set to establish more robust protocols for the management of all patients with rAAAs using endovascular techniques. That means even patients who were anatomically unsuitable for endovascular aneurysm repair (EVAR) would have a temporary

aortic occlusion balloon placed under local anesthesia before induction of general anesthesia and open repair. This measure prevented the typical crash associated with induction and kept the anesthesiologists from overreacting with too much volume resuscitation, which we all know can lead to an increased rate of abdominal compartment syndrome (ACS).

Dr. Arko: One clearly critical hinge point in your algorithm is when to treat endovascularly versus when to go with an open surgical approach. What characteristics would put a patient firmly into the surgical approach group?

Dr. Starnes: This all relates to the proximal aortic neck. We have found that when patients who are not EVAR candidates are treated with EVAR, they don't do well. Type I endoleaks are uniformly fatal in our experience with this patient subset.

Iliac anatomy is rarely, if ever, a contraindication to EVAR. More recently, we have begun to treat patients with rAAAs and short infrarenal necks with physician-modified grafts and have had impressive results. Our goal is to eventually treat every one of these patients with an endovascular method. If the anatomy is simply too hostile for rapid and efficient EVAR, we will still use endovascular techniques with remote balloon occlusion prior to induction of anesthesia and open repair.

Dr. Arko: What would indicate that a patient is ideal for endovascular repair? Do you have a specific point at which an endovascular approach must be abandoned for open repair?

Dr. Starnes: I think this all relates again to the quality of the infrarenal neck. We have been burned by trying to treat large (> 32 mm) and short (< 10 mm) necks with conventional devices. After a recent review of more than 300 rAAA cases at our institution, the average neck diameter was 27 mm, and the average length was 17 mm.

As for open conversion, our patient selection is so good now that we rarely convert to open repair unless we cannot select the contralateral gate quickly, in which case we will rapidly proceed to an aorto-uni-iliac construct with crossover femoral-femoral bypass and contralateral iliac plug occlusion. If a patient continues to be unstable even after EVAR (whether standard EVAR or aorto-uni-iliac/femoral-femoral), this is typically due to either an on-table myocardial infarction or ACS. Both are fairly easy to figure out. Decompressive laparotomy for ACS usually resolves the hemodynamic instability.

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Dr. Arko: Are open and endovascular procedures performed in the same setting, or do you have rooms specifically configured and ready for each, separately?

Dr. Starnes: We use a state-of-the-art hybrid operating room, which is set up after hours and on weekends to specifically manage aortic emergencies. All of the aortic occlusion balloon sets and case carts are in the room and ready to go. During the weekdays, if this room is being used, we default to any available room with an imaging table and a C-arm. Every room has the capability of handling standard open procedures.

Dr. Arko: Describe what the room needs to have in order to be fully prepared for a ruptured EVAR (rEVAR) case. What absolutely must be in it or nearby, from imaging to staff to devices?

Dr. Starnes: Imaging capability and a power injector, for sure. As for supplies, we believe that simple is the best way to go. We have a standard open AAA surgical set; a set for placement of an aortic occlusion balloon to include an access needle; a CODA balloon (Cook Medical); a 12-F, 55-cm Flexor sheath (Cook Medical); two each of the Starter Bentson wires (Boston Scientific Corporation); exchange-length Glidewires (Terumo Interventional Systems); and Lunderquist Stiff wires (color coded as "green, black, and grey" wires to simplify; Cook Medical). We also have two each of 6-F sheaths and 11-F sheaths, dilute contrast preloaded into 10-mL syringes, heparinized saline preloaded into 20-mL syringes, and a 60-mL syringe loaded with 50% contrast/saline for inflating the aortic occlusion balloon on hand in the room. A pigtail catheter and a Kumpe catheter (Cook Medical) should be available as well. Percutaneous closure devices are a luxury.

Dr. Arko: What are the immediate postprocedural tasks that ensure the patient is safely stabilized and ready for recovery? How might these differ from post-EVAR in a nonrupture case?

Dr. Starnes: One of the first patients I ever treated with rEVAR at Harborview was profoundly unstable at 5 AM one morning in 2007. We crashed him to the operating room and performed an expeditious EVAR. I finished my set of cases for the rest of that day

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and checked on him 12 hours later. He was sitting up and eating a hamburger and asked, "When can I go home, doc?" This is the exception, though. Although the rEVAR patients appear stable after endovascular repair, they are significantly underresuscitated and can be just as sick as the rAAA patient undergoing open repair. They need fluid resuscitation to push urine output to 0.5 to 1 mL/kg/hr. This should be done with blood products to correct existing coagulopathy and minimize the use of vasopressors, if possible. We do not hesitate to intubate these patients after initially securing their aorta with an aortic occlusion balloon if they become even the slightest bit unstable during the course of the operation. We also make sure pulmonary artery pressures are normal and the abdomen is not tense at the end of the case. We do not use bladder pressures but liberally open the abdomen for placement of a vacuum-assisted closure dressing (not decompression of the retroperitoneal hematoma) if suspicion of ACS exists.

Dr. Arko: How do the demands of an rAAA setting change the use of imaging before, during, and after the procedure?

Dr. Starnes: One needs to have access to rapid CT angiographic imaging in the prehospital setting. Recently, the trend in our hybrid operating room has been to perform DYNA CT at the end of each rEVAR to confirm a secure repair with absence of type 1 endoleak. If a patient with a challenging proximal neck (ie, reversed funnel, short, angulated, heavily calcified) has been treated with attempted EVAR, one must be absolutely sure there is no type I endoleak at the end of the case. This means using either DYNA CT, as we do, or oblique imaging at 45° left anterior oblique and 45° right anterior oblique with standard aortography.

Dr. Arko: Is the long-term follow-up significantly different?

Dr. Starnes: Some of these patients who undergo EVAR will require reintervention for minor issues, but I believe the long-term outcomes are better. Time will tell, though, because we are only 8 years into this strategy. I firmly believe that if we can get 4 or 5 cm of good seal (meaning use of fenestrated devices), the outcomes will be superior for EVAR over open repair in the long run. I rarely use snorkels or chimneys, as I don't believe in their durability.

Dr. Arko: In terms of staffing a procedure, how would you describe the specific training the treating physician must have in order to meet the demands of an rAAA on the table? Is there a unique level of training that must be reached by the vascular specialist on call due to the demands of this procedure?

Dr. Starnes: First, they must be absolutely capable of performing both open and endovascular repair. The use of an aortic occlusion balloon before laparotomy for open repair certainly decreases the stress associated with open repair, because it essentially converts this into a somewhat elective procedure. As for EVAR, it must be performed in < 1 hour. Interventionists and surgeons who take a long time to perform standard EVAR (ie, > 1 hour) will have marginal success with implementation of a rEVAR program.

Dr. Arko: Perhaps as much or more than any procedure, having all staff on the same page must be critical in the setting of rupture. How are the nonphysician staff members trained for this specific setting?

Dr. Starnes: This is a great question. After hours, we sometimes have circulating nurses and scrub techs who are unfamiliar with EVAR or have not scrubbed a case in some time. We have created a set of short videos (4 minutes each) that detail the back-table setup to include flushing of sheaths and catheters. The nurses love this addition, as they know that all they have to do to refresh their memory is to watch this video while setting up the room to prepare for an rAAA case. I am happy to make these videos available to anyone. ■

PREPARING FOR A RUPTURED ABDOMINAL AORTIC ANEURYSM

To view a video by Dr. Starnes on the six steps of back-table setup for rAAA, please visit:

bit.ly/rAAAtablesetup