Endovascular Repair of a Large Ruptured Abdominal Aortic Aneurysm Using Monitored Anesthesia Care and Local Anesthesia

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Int J Angiol 2014;23:121–124.

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Abstract

Keywords

- ruptured abdominal aortic aneurysm
- endovascular aortic repair
- endovascular aneurysm repair

Over the last decade, there has been a paradigm shift in the treatment of ruptured abdominal aortic aneurysm (AAA) from open repair to endovascular aneurysm repair (EVAR). Regardless of the method used during emergent rupture, open versus endovascular repair, the overall mortality remains high. Recent studies have compared patient outcomes using different types of anesthesia during elective EVAR procedures. The data show that during an elective EVAR, monitored anesthesia care (MAC) with local anesthesia is not only just as safe as general anesthesia, but it offers other potential benefits as well. There is limited data in regards to patient outcomes using MAC and local anesthesia during cases of large ruptured aneurysms that are treated with EVAR. This case report discusses the treatment of a patient who presented with a large 13 cm ruptured AAA which was successfully repaired using EVAR with MAC and local anesthesia.

Emergent open repair of ruptured abdominal aortic aneurysm (AAA) carries a high morbidity and mortality rate. The overall mortality rate from aneurysm rupture is difficult to determine because of the number of sudden deaths in elderly patients due to ruptured aneurysms. As governed by Laplace's law, the risk of rupture increases with an increase in diameter of the aneurysm. At 7 cm, the annual risk of rupture is > 10% and the 5-year risk approaches 100%.¹ Because of this the mortality can range anywhere from 50 to 85%. Of the deaths attributed to ruptured aneurysm, approximately 50% did not survive long enough to reach the hospital. Of those who survived the initial period, the mortality rate from emergency open surgical treatment was between 30% and 70%.² With regards to ruptured AAA and endovascular surgery, Rayt et al did a collective review showing that the overall mortality rate for treating a ruptured AAA with endovascular aneurysm repair (EVAR) is 24% compared with 48% mortality with the open procedure.² One challenging factor, regardless of open versus endovascular, is the hypotension that occurs during induction of anesthesia. By using monitored anesthesia care (MAC) during the procedure, the patient's own catecholamines help to maintain their

blood pressure at a perfusing level until access is gained and the rupture can be controlled. There are a few techniques to assist the surgeon in the hemodynamically unstable patient. "Hypotensive hemostasis," helps to slow hemorrhage by maintaining a low blood pressure by restricting resuscitation. An aortic occlusion balloon can also be inserted through the sheath and insufflated in the supraceliac aorta.³

In the elective setting, a study by Franz et al demonstrated that MAC and local anesthesia during EVAR was not only a safe method of anesthesia, but it also allowed for better hemodynamic stability.⁴ Principals and methods from this study were used to successfully treat a ruptured 13 cm AAA under MAC and local anesthesia with an endovascular technique.

Case Presentation

A 70-year-old woman was sent from an outlying community hospital to our facility because of a ruptured AAA. The patient complained of abdominal pain that radiated to her left flank and straight through toward her back. Her known medical history included arthritis, hypertension, and acid reflux.

Fig. 1 Computed tomographic scan with ruptured 13-cm abdominal aortic aneurysm.

Surgical history was limited to only an abdominal hysterectomy. She did admit to smoking one and a half to two packs of cigarettes per day over the last 45 to 50 years. At the outside hospital, a non-contrast-computed tomography (CT) was performed and it demonstrated a ruptured AAA that was $\sim 12.5 \text{ cm} \times 13.0 \text{ cm}$ ($\rightarrow$ Fig. 1). Her vitals were reported to be stable for transfer. However, en route she became hypotensive with systolic pressures reported to be in the range of 50 to 60 mm Hg. Dopamine was started as per the outside hospital. Once at our facility, the dopamine was discontinued and her systolic pressures were approximately 90 mm Hg. Oxygen saturation was 98% on 2 L of O_2 via nasal cannula with pulse of 90 bpm. Her exam demonstrated an alert and appropriate 70-year-old female with diffuse abdominal pain and a palpable mass to palpation. The remainder of her exam was unremarkable.

At that time, large-bore peripheral IV access was obtained. The patient had laboratories drawn and was also type and crossed for blood products. Her hemoglobin was 9.0 g/dL, total leukocyte count 25.3 K/ μL , lactic acid 1.6 mmol/L, bicarbonate 22 mmol/L, BUN 40 mg/dL, creatinine 1.4 mg/dL, and glucose 136 mg/dL.

MAC with local anesthesia was used as the method for anesthesia for the procedure. In brief, approximately 20 to 30 mL of 1% lidocaine without epinephrine was used for local anesthesia. Fentanyl and midazolam were administered at the discretion of the anesthesiologist. Femoral cut-downs and common femoral artery dissections were performed bilaterally starting with the right side first. Proximal and distal control was obtained with vessel loops. After wires were placed and confirmed, a 20-French sheath was placed on the right and left. Proximal control was obtained with a compliant balloon. An Endurant II (Medtronic, Santa Rosa, CA) 36 mm $\times$ 16 mm $\times$ 166 mm main body endograft was inserted through the left common femoral artery and the contralateral limb (Medtronic) 16 mm $\times$ 13 mm $\times$ 124 mm was placed through the right. An aortic extension (Medtronic) 36 mm

$\times$ 36 mm $\times$ 49 mm cuff and bilateral iliac extension limbs (Medtronic) 16 mm $\times$ 16 mm $\times$ 124 mm were also placed due to the extremely long length needed to treat such a large and tortuous AAA. Completion angiogram demonstrated good positioning of the graft and no associated endoleak. At that point, the patient was converted to general anesthesia as the patient had received large amounts of blood products, was in respiratory distress, and was hemodynamically unstable. Finally, the femoral access sites and subcutaneous tissue were closed in a standard fashion. In the intensive care unit (ICU), the lack of increased bladder pressures confirmed the absence of abdominal compartment syndrome. These measurements are taken routinely for patients with intra-abdominal hematomas.

The patient did have a prolonged ICU stay which was complicated by hypotension requiring vasopressors, renal failure requiring hemodialysis, atrial fibrillation, bacteremia, respiratory failure requiring tracheostomy and percutaneous endoscopic gastrostomy tube placement. Imaging revealed contrast within the renal pelvis and obvious hydronephrosis due to occlusion of the ureter from mass effect of the aneurysm ($\rightarrow$ Fig. 2). For treatment bilateral ureteral catheters were placed. Throughout her stay, she received a total of 10 units of packed red blood cells (PRBCs), nine packs of platelets, and two units of fresh frozen plasma. Overall, the patient was hospitalized at our facility for 21 days. After which, she was transferred to a Long-Term Acute Care (LTAC) facility where she was weaned from the vent and completed her course of IV antibiotics. She presented to the office for a 1 year follow-up. A follow-up CT angiogram of the abdomen and pelvis was ordered to evaluate the aneurysm and graft ($\rightarrow$ Fig. 3).

Discussion

Parodi completed the first successful endovascular aortic repair in 1991. Since that time, great strides have been

Fig. 2 Abdominal aortic aneurysm with endograft in place. Hydro-nephrosis visualized.

Fig. 3 Postoperative computed tomographic scan showing abdominal aortic aneurysm and repair.

made in endovascular procedures and EVAR has become the standard therapy for an AAA.¹ However, there is still controversy about its use in a ruptured AAA. Rayt et al reviewed 31 studies over 982 patients. This review concluded that the overall mortality using EVAR for a ruptured AAA is 24%.² Similarly, a recent 2013 retrospective study of 283 patients by Mehta et al showed that the 30-day mortality (24 vs. 42%) and 5-year survival (37 vs. 26%) rates were better for patients with ruptured AAAs who were treated with EVAR compared with open repair.⁵ On the contrary, Brown et al did a meta-analysis spanning 50 years evaluating the mortality of open repair for a ruptured AAA which demonstrated an overall mortality of 48%.⁶ Giles et al reviewed 567 ruptured AAA cases from 2005 to 2007. Seventy-nine percent were repaired in an open fashion and 21% were repaired endovascularly. Preoperative hemodynamic status was similar in both groups based on preoperative transfusion requirements. There was 24% mortality associated with EVAR versus 36% mortality in open repair. There were also decreased operative times, 2.6 hours with EVAR versus 3.3 hours; less blood transfusion requirements, 2 units versus 8; and less postoperative complications, 47 versus 62%.⁷ Foster et al reviewed the findings of 24 different studies comparing 30-day mortality rates of endovascular versus open repair of ruptured AAAs. The mortality rate of endovascular repair ranged from 18.5 to 24.5%, while with open repair it ranged from 36.3 to 54.2%.⁸

The most common acute medical complication following AAA repair is cardiopulmonary, regardless of which procedure is performed. A study comparing both techniques found that pulmonary complications are statistically more significant with an open procedure, but cardiac complications are roughly the same.⁹ To further decrease the risk of significant morbidity, especially for patients with multiple cardiopulmonary comorbidities, newer studies are looking at performing EVAR under MAC with local anesthesia instead of general

anesthesia (GA). So far, the consensus for MAC and local versus GA for elective EVAR is mixed. Virgilio et al did a retrospective review of 229 patients who underwent elective endovascular repair. They found that of the 158 that had GA versus 71 that had MAC and local, there was really no significant difference in cardiopulmonary complications. They actually found that patients with two or more cardiac risk factors were more likely to have a cardiac event regardless of the type of anesthesia.⁹ While the overall mortality and cardiopulmonary advantage may be similar, several studies have shown a benefit toward MAC and local in other areas.^{4,8,10–14} Verhoeven et al published a prospective cohort study of 239 patients. They demonstrated an overall lower incidence of complications compared with GA. Furthermore, they showed that operating time and length of stay in the intensive care were shorter in the local and regional anesthesia groups than in the GA group. As well as the length of stay in hospital, the time to ambulation, and regular diet were shorter in the local group compared to the regional and GA groups.¹⁰

There are several disadvantages associated with EVAR compared with open repair of an AAA including abdominal compartment syndrome and endoleak. The incidence of abdominal compartment syndrome in ruptured AAA in a study by Mehta was 18%. Increased hemodynamic instability was associated with an increased incidence. Furthermore, the presence of abdominal compartment syndrome increased the risk of mortality from 10 to 67%.³ Our patient was monitored closely for this possible complication. There was a 24% incidence of endoleak documented during meta-analysis.¹ An endoleak can result in the need for additional procedures and surveillance.

While there are set criteria defining anatomic variables such as a minimal aortic diameter, the size, length, shape, and angle of the aneurysm's neck, and various iliac artery features help surgeons decide if EVAR is a suitable option for those candidates. However, there are no randomized control studies addressing if there is a maximum diameter where EVAR is still considered safe and effective in the setting of both an emergent or elective repair. Further, these studies mainly looked at elective repairs, not emergent ones. Intravascular anatomy is important to determine the feasibility of an EVAR for AAAs. The aneurysm should have an infrarenal aortic neck diameter of 18 to 32 mm, length of at least 15 mm, angulation of less than 45 degrees, mural calcifications, and thrombus of less than 50% circumference. These are all important to have an adequate landing zone for the proximal portion of the graft. The iliac arteries should be 8 to 20 mm in diameter and greater than 20 mm in length. They will serve as the distal landing zone of the graft. Finally, the common femoral or external iliac arteries must be at least 7 mm in diameter to serve as the access point.¹ Mehta et al found that 60 to 80% of ruptured AAA cases met the anatomic criteria to be considered for EVAR.⁵ One of the biggest limitations of performing an endovascular repair in the setting of hemodynamic instability is the need for a preoperative CT scan to obtain imaging of the anatomy of the aorta to evaluate ability to perform the repair. However, according

to Lloyd et al, 88% of patients with ruptured AAA lived for more than 2 hours after diagnosis, indicating that there usually is time for a CT scan.¹ Although the need for a preoperative CT scan can limit the usefulness of EVAR in the case of a ruptured aneurysm, most patients do have enough time to undergo this fairly rapid scan.¹ This was the case in the described patient. In fact, she obtained a CT scan at an outside hospital and was transferred to a more capable facility prior to her repair. When a patient is transferred from an outside hospital one must call the referral radiologist to obtain aortic and iliac measurements to facilitate repair, that is distance of aneurysm below the renal arteries, proximal aortic and common and external iliac size, and any other anatomical information.

Conclusion

This was a case report in which a patient presented with a 13-cm, ruptured AAA and successfully underwent endovascular repair while only receiving MAC and local anesthesia. After several months of recovery, the patient improved overall and remains without any evidence of endoleak or other technical complications at 1 year postoperatively. There are few reported cases of successful ruptured AAA repairs using this type of anesthesia, let alone an aneurysm of this size. More studies looking at various outcomes and methods of anesthesia in patients undergoing EVAR for a ruptured AAA still need to be performed.

References

- 1 Brunicki F, Andersen D, Billiar T, Dunn D, Hunter J, Matthews J, Pollock RE. Schwartz's Principles of Surgery. 9th ed. Ch. 23. Available at: <http://accesssurgery.com/popup>; Accessed September 2012
- 2 Rayt HS, Sutton AJ, London NJ, Sayers RD, Bown MJ. A systematic review and meta-analysis of endovascular repair (EVAR) for ruptured abdominal aortic aneurysm. *Eur J Vasc Endovasc Surg* 2008; 36(5):536–544
- 3 Sicard GA, Zwolak RM, Sidawy AN, White RA, Siami FS; Society for Vascular Surgery Outcomes Committee. Endovascular abdominal aortic aneurysm repair: long-term outcome measures in patients at high-risk for open surgery. *J Vasc Surg* 2006; 44(2):229–236
- 4 Franz R, Hartman J, Wright M. Comparison of anesthesia technique on outcomes of endovascular repair of abdominal aortic aneurysms: a five-year review of monitored anesthesia care with local anesthesia vs. general or regional anesthesia. *J Cardiovasc Surg (Torino)* 2011;52(4):567–577
- 5 Mehta M, Byrne J, Taggart J. Endovascular aneurysm repair as a mean of treatment for ruptured abdominal aortic aneurysms. *Chinese Medical Journal* 2013;126(3):558–564. Available at: www.cmj.org/Periodical/paperlist.asp; Accessed March 2013
- 6 Bown MJ, Sutton AJ, Bell PR, Sayers RD. A meta-analysis of 50 years of ruptured abdominal aortic aneurysm repair. *Br J Surg* 2002; 89(6):714–730
- 7 Giles KA, Pomposelli FB, Hamdan AD, Wyers MC, Schermerhorn ML. Comparison of open and endovascular repair of ruptured abdominal aortic aneurysms from the ACS-NSQIP 2005–07. *J Endovasc Ther* 2009;16(3):365–372
- 8 Foster J, Ghosh J, Baguneid M. In patients with ruptured abdominal aortic aneurysm does endovascular repair improve 30-day mortality? *Interact Cardiovasc Thorac Surg* 2010;10(4):611–619
- 9 De Virgilio C, Romero L, Donayre C, et al. Endovascular abdominal aortic aneurysm repair with general versus local anesthesia: a comparison of cardiopulmonary morbidity and mortality rates. *J Vasc Surg* 2002;36(5):988–991
- 10 Verhoeven EL, Cinà CS, Tielliu IF, et al. Local anesthesia for endovascular abdominal aortic aneurysm repair. *J Vasc Surg* 2005;42(3):402–409
- 11 Ruppert V, Leurs LJ, Rieger J, Steckmeier B, Buth J, Umscheid T; EUROSTAR Collaborators. Risk-adapted outcome after endovascular aortic aneurysm repair: analysis of anesthesia types based on EUROSTAR data. *J Endovasc Ther* 2007;14(1):12–22
- 12 Ruppert V, Leurs LJ, Steckmeier B, Buth J, Umscheid T. Influence of anesthesia type on outcome after endovascular aortic aneurysm repair: an analysis based on EUROSTAR data. *J Vasc Surg* 2006; 44(1):16–21, discussion 21
- 13 Parra JR, Crabtree T, McLafferty RB, et al. Anesthesia technique and outcomes of endovascular aneurysm repair. *Ann Vasc Surg* 2005; 19(1):123–129
- 14 Edwards MS, Andrews JS, Edwards AF, et al. Results of endovascular aortic aneurysm repair with general, regional, and local/monitored anesthesia care in the American College of Surgeons National Surgical Quality Improvement Program database. *J Vasc Surg* 2011;54(5):1273–1282