Endovascular Repair of Ruptured and Symptomatic Abdominal Aortic Aneurysms Using a Structured Protocol in a Community Teaching Hospital

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Background: Open abdominal aortic aneurysm (AAA) repair has gradually been replaced by endovascular aneurysm repair (EVAR). The primary objective of this study is to establish baseline mortality data and compare our institutional mortality rates for ruptured AAA patients with published rates from institutions using similar approaches.

Methods: This study is a retrospective review of 49 patients treated using a structured ruptured AAA (rAAA) protocol in a community teaching hospital. Variables examined include demographics, repair type, device used, presenting systolic blood pressure, presenting glomerular filtration rate, initial hematocrit, transfusions required, and development of postoperative abdominal compartment syndrome.

Results: Forty-nine patients were treated using the rAAA protocol and 48 underwent repair. The 30-day mortality for rAAA and symptomatic AAA (sAAA) was 36.4% (12/33) and 20.0% (3/15), respectively, with a mean mortality of 31.2% (15/48). Mortality for rAAA treated by EVAR was 32.0% (8/25). Mortality for rAAA in the open repair group was 33% (2/6). Conversion from EVAR to open procedure (3/48) or 6% resulted in 100% mortality ($P = 0.266$). The development of abdominal compartment syndrome was an absolute predictor of death as mortality was 100% ($P < 0.001$). Other significant predictors of death include the following: (1) blood transfusion received during operation required in 10/14 deaths (71%) ($P = 0.005$) and (2) transfusion received anytime during hospitalization required in 12/14 deaths or 86% ($P = 0.017$).

Conclusions: The management and endovascular repair of sAAA or rAAA can be improved at the community hospital level by the implementation of standardized protocols. Blood transfusions and development of postoperative abdominal compartment syndrome significantly increase mortality. Individual institutional knowledge of results is critical to effective process improvement and optimal patient outcomes.

INTRODUCTION

Ruptured abdominal aortic aneurysm (rAAA) remains a source of considerable morbidity and mortality.[1] Historically, open surgical repair (OSR) was the standard for rAAA. Endovascular aneurysm repair (EVAR) of symptomatic AAA (sAAA) or rAAA is rapidly replacing OSR.[2,3] Many institutions now practice an ''EVAR-first'' approach to rAAA.[4–9]

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Although there is no uniform agreement,[10] there is increasing data that EVAR of rAAA has led to improved outcomes.[4,11–17]

As medical and surgical practices become more data driven, the adoption of system-based approaches incorporating standardized protocols becomes increasingly important.[18] Such standardization mandates multidisciplinary communication and cooperation. There is evidence for improved outcomes for the management of rAAA at institutions using such standardized protocols.[8,19–21] Exempla Saint Joseph Hospital is a 400-bed inner city teaching hospital which performs 50 elective EVAR and averages 10 rAAA per year. Before 2009, all patient care was documented in paper charts. Tracking of morbidity and mortality of rAAA patients was inconsistent. The hospital converted to an electronic medical record in 2009. The vascular surgeons requested accurate data regarding outcomes and device selection for rAAA patients. They perceived a need for a standardized approach to rAAA. Dr. Norman Hertzer's Presidential Address to the Society of Vascular Surgery in 1995 emphasized the need to know your own results.[22] Our institutional knowledge with respect to rAAA mortality was incomplete and not readily available for outcome analysis. This retrospective review is our initial attempt to rectify this paucity of accurate data. The authors wished to compare results with previously published data from similar-sized institutions. In addition, the lack of a modern hybrid operating room (OR) early in this series contributed to confusion during triage as to which venue (interventional suite versus OR) was most appropriate for each circumstance. The standardized protocol created a system that streamlined triage to the appropriate venue.

In the summer of 2009, a standardized rAAA protocol adapted to the constraints of our hospital with an EVAR-first approach was implemented. Emergency physicians, housestaff, vascular surgeons, OR, and interventional personnel were all involved in the development of the protocol. The responsibility for notification was given to the on-call nursing supervisor freeing the surgeon to focus on the patient's resuscitation, device, and venue selection. A mandatory debriefing process was incorporated into the protocol and a database of demographics and outcomes was established.

PATIENTS AND METHODS

This database includes 49 patients for which the Exempla Saint Joseph Hospital's rAAA protocol was activated from August 7, 2009 to August 13, 2013. Essential tenants of the protocol included the following: (1) permissive hypotension, (2) appropriate resuscitation using blood components preferentially over crystalloid, (3) use of peripheral large-bore IV access in lieu of central venous catheters initially, (4) activation of massive transfusion protocol in all patients, (5) expansion of aortic occlusion balloon use to both open and EVAR cases, (6) use of local anesthesia for establishing femoral access to avoid vasodilation of general anesthesia, (7) early recruitment of additional vascular surgeons, anesthesiologists, and support personnel, and (8) debriefing sessions after each incident.[6,8,19,23,24] The protocol is based on principles and approaches well supported in the literature and tailored to our hospital's capabilities[6,8,19,22,23] (Fig. 1).

The protocol is activated by the on-call vascular surgeon after notification by the on-site emergency department (ED) physician or outside referring physician. Although computed tomography (CT) with contrast in azotemic patients is a risk for postoperative renal failure,[23] all patients in this cohort received CT scan preoperatively. The decision to withhold contrast was individualized by the triaging physician based on renal function testing and hemodynamic stability. The vascular surgeon uses the available information to determine if the patient will go for EVAR or OSR. As experience with EVAR increased, most attendings adopted an ''EVAR-first'' paradigm. Before construction of a hybrid OR in 2012, the most critical decision was whether to triage the patient to an interventional suite or the OR. To facilitate rapid availability of vital equipment at the appropriate location, sterile carts were utilized with open and endovascular equipment available to bring to either venue. Since the autumn of 2012, the availability of a hybrid OR has simplified this decision process.

Aneurysms were classified as ruptured, contained rupture, or symptomatic based on the radiologic interpretation of the emergent CT generated by a board-certified radiologist on call. For statistical analysis, ruptured and contained ruptured aneurysms were combined into a single ''Ruptured'' group. Hemodynamic instability was defined as systolic blood pressure less than 80 mm Hg on arrival. A transfusion requirement was defined as any event that required more than 2 units of packed red blood cells. Transfusion was subcategorized into 2 groups: (1) products received during the procedure and (2) total transfusion requirements during hospitalization. Mean hematocrit on presentation was recorded. The median estimated glomerular