Morbidity and Mortality in Patients with Ruptured Abdominal Aortic Aneurysms, Improving Outcomes with a Modified Approach

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The Harborview Experience

Harborview Medical Center is the only Level 1 Trauma Center in the Pacific Northwest and covers a five-state region (Washington, Wyoming, Alaska, Montana and Idaho). This wide geographic area represents 25% of the land mass of the United States and roughly 15 million people. Abdominal Aortic Aneurysm (AAA) disease is the 12th leading cause of death in the United States; more than 15,000 Americans die from ruptured abdominal aortic aneurysms each year (Figure 1). Furthermore, mortality from open repair of this disease process has not significantly changed over the past two decades. Harborview treats between 30 and 50 patients with ruptured abdominal aortic aneurysm (rAAA) per year, with a historical mortality rate between 48 and 70%. In a review of the five-year period spanning 2003 to 2007, the average mortality rate for all patients with rAAA was 61.5% (Figure 2).

New Technology

In 1991, Juan Carlos Parodi performed the first human endovascular AAA repair using a covered stent, and ushered in an era of minimally invasive “Endovascular Aneurysm Repair” or EVAR, which has revolutionized the care of patients with aortic aneurysms.1 These procedures can often be performed using a totally percutaneous approach under local anesthesia.2 For patients with non-ruptured aortic aneurysms, two prospective, randomized controlled trials exist, showing superiority in 30-day mortality rates of EVAR over conventional open repair.3,4

A Modified Approach

Intrigued by the opportunity to offer these patients a minimally-invasive alternative to major surgery—which many of these patients cannot tolerate—our group implemented a new protocol in September 2007 designed to treat rAAA patients with a preference for EVAR under local anesthesia when feasible (Figure 3).

Before now, few studies existed evaluating the use of EVAR for the management of ruptured aortic aneurysms (rEVAR). This is mostly because there are few institutions with a robust experience in managing these patients. Published mortality rates for rEVAR are between 24 and 46%.5,6,7 In a recent meta-analysis of published series of rEVAR, mortality rates for people who underwent rEVAR were found to be lower than
in historical reports of unselected people undergoing open repair. At Harborview we use the rAAA protocol with continuing success. Currently, 80–90% of patients presenting at Harborview with rAAA are treated using an EVAR approach. We foresee the gradual diminishment in the use of open rAAA surgical repair except when patients present with anatomical features ruling out the rEVAR option.

During our study period, 187 patients with rAAA presented to our institution. Before implementation of the algorithm, 131 patients with rAAA presented and 128 were treated. The 30-day mortality rate was 57.8%. After implementation of the protocol, 56 patients with rAAA were managed. Twenty-seven patients (48%) underwent successful EVAR, and 24 patients (43%) underwent open repair. Five patients (9%) underwent comfort care only. In the post-protocol period, 5 patients in the EVAR group (18.5%) and 13 patients in the open group (54.2%) died during the follow-up period, for an overall 30-day mortality rate of 35.3% (P = .008 vs 57.8% pre-protocol).

After implementation of a structured protocol for managing rAAA, there was a relative risk reduction in 30-day mortality of 35% compared to the time before implementation of the protocol (95% confidence interval [CI], 14%–51%) corresponding to an absolute risk reduction of 22.5% (95% CI, 6.8%–38.2%) (Figure 4).

**Scope of the Problem**

An abdominal aortic aneurysm (AAA) is defined as a >50% dilation or widening of the normal aorta over time. There are defined risk factors associated with the development of AAA, and persons at risk are typically male with a history of hypertension and tobacco abuse. Aortic aneurysms are most often asymptomatic and are typically only incidentally detected when an individual has an imaging study of the abdomen for some other clinically indicated reason. Aortic aneurysms can often progress to rupture without elective surgical or endovascular management. Given the non-trivial size of the US population currently defined by these known risk factors, and who may be harboring asymptomatic aneurysmal disease, efforts to diagnose and treat this patient population early in the course of their disease have recently become a high priority public health issue.
With a new protocol in place, we have reduced mortality for patients with ruptured aortic aneurysms by 50% for the first time in over twenty years.

**Summary**

A routine endovascular approach for ALL ruptured infrarenal abdominal aortic aneurysms is feasible. Streamlined protocols improve outcomes for patients presenting with rAAA. With this protocol in place at Harborview, we have reduced mortality for patients with ruptured aortic aneurysms by roughly 50% for the first time in over twenty years. Our group has begun to define variables affecting outcome for an endovascular approach, and we have partnered with several manufacturers to define those aortic stent grafts that prove most beneficial.

**Future Directions**

Our clinical research focuses on identifying those underserved patients who lack sufficient screening to detect aneurysms prior to progression to rupture. There is also a large subset of AAA patients with asymptomatic disease (and who come from all walks of life) who may be eligible for elective EVAR procedures, thereby avoiding the stresses of an emergency open operation. Modification of stent grafts for unique patients, in order to preserve critical branch vessels, is now under study and may become an important new direction as EVAR therapy becomes more widespread. Finally, we are also interested in defining those variables that are predictive of a 100% mortality rate—including, for example, the effect of hypothermia on the patient’s chances for survival—thereby improving the efficiency with which we manage these desperately ill patients.

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