# Improved Survival Post-introduction of Emergency Endovascular Therapy Protocol for Ruptured Abdominal Aortic Aneurysms

*Randy D. Moore, MD, Calgary, AB, Canada; Mark Nutley, MD, Calgary, AB, Canada; Peter Faris, PhD, Calgary, AB, Canada; Paul Petrasek, MD, Calgary, AB, Canada; Greg Samis, MD, Calgary, AB, Canada; Leonard Tse, MD, Calgary, AB, Canada; Mathew Smith, MD, Calgary, AB, Canada; J. Wong, MD, Calgary, AB, Canada*

NOTES

**Background**

A recent meta-analysis of the past 50 years demonstrates that open surgical repair of ruptured abdominal aortic aneurysms (rAAAs) continues to be associated with surgical mortality rates of 45 to 50% despite advances in aortic grafts and open surgical technique.[1] Numerous authors have demonstrated a strong correlation between the employment of emergency endovascular aneurysm repair (EVAR) and improved 30-day mortality outcomes as compared with standard open repair for the treatment of rAAAs. These studies have suggested that EVAR is a viable treatment option in patients with rAAA and appropriate anatomy. However, an analysis that restricts the comparison of EVAR following its introduction date to open procedures prior to the introduction date of EVAR might be misleading. Endovascular surgery cannot be performed on all patients, and the superior performance of endovascular procedures might come at the expense of EVAR-suitable patients who received an open procedure prior to EVAR initiation. In addition, selection bias may result in these two patient groups being dissimilar.

We compared surgical outcomes prior to the introduction of an intention-to-treat EVAR protocol to overall surgical outcomes following the EVAR protocol introduction date (regardless of the type of procedure performed) to demonstrate improved overall 30-day mortality.

**Methods**

We performed an analysis of 115 consecutive surgical repairs in the setting of rAAA confirmed by computed tomography or intraoperative angiography to determine whether the introduction of an EVAR protocol had an impact on 30-day mortality rates. Of these surgeries, 40 occurred following the introduction of the EVAR protocol and 19 were done using EVAR. Perioperative patient data were captured prospectively. Hemodynamic stability, defined as a state of consciousness with a systolic blood pressure > 80 mm Hg, was used in a diagnostic and therapeutic algorithm to manage the patients after presentation.

Analysis was performed by using information from pre-endovascular protocol patients to develop a risk-adjustment model that had very good discrimination in predicting 30-day mortality (C-statistic = 0.84). Variables in this model included systolic blood pressure and glomerular filtration rate. Another seven variables included in the Vascular Biochemistry and Hematology Outcome Model were also analyzed and found not to be predictive of mortality.[2]

We used the risk adjustment model to predict outcomes in patients receiving surgery after the introduction of the protocol. We compared the observed number of deaths (O) with the expected number of deaths (E) based on the predicted scores. We also used a highly sensitive risk-adjusted cumulative sum (CUSUM) chart to evaluate shifts in surgical performance following the introduction of the protocol.

**Results**

Prior to the introduction of the protocol, the 30-day mortality rate was 29%, with a 95% CI of 20 to 40%. Following the introduction of the protocol, the 30-day mortality rate was 13% (95% CI 5.5 to 26%). Without adjustment for patient risk factors, there was evidence of a difference in rates (p = .0491). The mortality rate among those receiving endovascular repairs was 11% (2 of 19; 95% CI 2.9 to 31%). The O/E ratio for all procedures following the introduction of the endovascular protocol was 0.32 (95% CI 0.09 to 1.157). The results of the risk-adjusted CUSUM chart for all repairs demonstrated that surgical performance following the introduction of the protocol was superior to that expected on the basis of the risk-adjustment model (p = .049) (Figure 1). The O/E ratio for endovascular repairs was also calculated and shown to be 0.31 (95% CI 0.055 to 1.76).

**Conclusions**

In our study, the repair of elective AAAs with EVAR has demonstrated that this technology results in significant reductions in mortality and morbidity in both patients who are well enough and those who are too ill to withstand traditional open AAA repairs. The successful extension of this technology to the treatment of patients in extremis with rAAA has already been described. Since the employment of an EVAR protocol for the management of rAAA at our institution, we have demonstrated an overall reduction in 30-day mortality. Appropriate patients with rAAA who are undergoing treatment in experienced vascular centers should be offered EVAR as the treatment of choice.

Figure 1. Risk-adjusted cumulative sum (CUSUM) plot for all repairs. Vertical dashed line indicates the introduction of the new protocol for ruptured abdominal aortic aneurysm repair. The surgical performance post-protocol was "better than expected," demonstrating a "superior" level.

**References**

1. Bown MN, Sutton AJ, Bell PR, Sayers RD. A meta analysis of 50 years of ruptured abdominal aortic aneurysm repair. Br J Surg 2002;89:714-30.
2. Prytherch D, Ridler B, Ashley S. Risk-adjusted predictive models of mortality after index arterial operations using a minimal data set. Br J Surg 2005;92:714-8.