Preoperative Transthoracic Echocardiography in Abdominal Aortic Aneurysm
A New Thermometer

Daniel Muñoz, MD, MPA; Joshua A. Beckman, MD, MS

Abdominal aortic aneurysm (AAA), a common condition estimated to affect 4% to 7% of adults older than the age of 65 years, will likely remain a common clinical problem given the evolving demographics of the United States and world populations. The adverse clinical significance of AAA, as well as the ramifications should rupture ensue, have been well established. In the United States alone, AAA rupture is responsible for an estimated 10,000 deaths per year. Although rupture carries mortality exceeding 90%, perioperative mortality associated with a surveillance-based approach with endovascular or surgical elective repair is <3%.1

In stable patients undergoing elective AAA repair, perioperative morbidity and mortality have been favorably affected by a transition from traditional open surgical repair to an increasing reliance on endovascular repair of the abdominal aorta (EVAR). Recent national data indicate that >70% of AAA cases lend themselves to an endovascular approach.2,3 Despite technical advances in reducing short-term 30-day (ie, perioperative) risk, by 2 years, the mortality trend in this patient population is similar independent of repair technique and remains disappointingly high.4 From clinicians’ recognition of the natural history, efforts have emerged to improve the method and manner of risk assessment in patients slated for elective EVAR to mitigate this risk. Indeed, the diagnosis of AAA is associated with a higher risk of death from causes other than aneurysmal disease in patients diagnosed in the prerupture setting.5 Ideally, improvements in risk assessment would offer opportunities for risk reduction and enhanced patient outcomes specific to this population.

The approach to risk assessment and modification in the pre-EVAR setting has traditionally focused on the examination of conventional cardiovascular risk factors, particularly given historic evidence that many post-EVAR complications were and are cardiovascular in nature.6,7 Risk prediction that relies exclusively on atherosclerotic risk factors has inherent limitations of specificity, including in the specific scenario of AAA and EVAR. However, the causes of death stretch beyond current risk assessment models’ ability to predict outcomes post-EVAR. To date, the evidence in support of additional testing to reduce intermediate and long-term morbidity and mortality is limited.

In this issue of Circulation: Cardiovascular Imaging, O’Driscoll et al8 seek to extend previous work on risk assessment by evaluating the prognostic value of transthoracic echocardiography (TTE) in patients slated for elective EVAR. Using a retrospective cohort design, the authors studied 273 consecutive patients undergoing elective EVAR between January 2008 and September 2010. All patients were enrolled at a single tertiary care center in the United Kingdom and each patient underwent a comprehensive TTE in the weeks before elective EVAR. The primary outcome assessed was long-term all-cause mortality with a mean follow-up of 3.2 years. For each patient, data were collected to comprehensively characterize their demographic characteristics, clinical comorbid history, current medications, and baseline laboratory values (including complete blood count, renal function, lipid profile, troponin, and C-reactive protein). In addition, data were captured on a broad array of TTE parameters for each enrolled patient. Multivariable-adjusted Cox proportional hazard models were used in the assessment of predictors of all-cause mortality.

Seventy-eight deaths occurred during the overall study period, with a mean time to death of ≈15 months. Of the 78 deaths, only 1, attributed to a myocardial infarction in a 91-year-old subject, occurred in the perioperative setting, with 9 additional deaths occurring in the first 30 days after EVAR. As described by the authors, after accounting for demographics, clinical history, medications, and laboratory measures, 3 TTE indices—of 26 reported—were found to be significant predictors of long-term outcome (ie, mortality). These indices included: dilated tubular ascending aorta (hazard ratio [HR], 5.6; 95% confidence interval [CI], 2.77–11.33), presence of mitral regurgitation (HR, 8.13; 95% CI, 4.09–12.16), and reduced left ventricular ejection fraction (HR, 0.96; 95% CI, 0.93–0.98). Non-TTE factors predictive of mortality included: younger age (HR, 0.97; 95% CI, 0.95–0.99) and presence of diabetes mellitus (HR, 1.46; 95% CI, 1.24–1.89). Further examination of patients with mitral regurgitation revealed a step-wise pattern, with both mild mitral regurgitation (HR, 4.84; 95% CI, 2.8–13.92) and moderate/severe mitral regurgitation (HR, 7; 95% CI, 3.52–13.92) each qualifying as predictors of mortality. On the basis of their analysis, the authors report that echocardiography provides key long-term...
prognostic information in patients undergoing elective EVAR, with TTE indices appearing more important than standard risk factors at predicting outcome. They conclude, "Thoracic echocardiography provides important long-term prognostic information in patients undergoing EVAR... and may serve as a useful tool for guiding clinical management."

Using a carefully collected and analyzed data set from a single center, O’Driscoll et al10 have provided informative insights into the assessment of long-term risk assessment in patients slated to undergo elective EVAR. We congratulate the authors for taking this first step into AAA risk assessment. The parameters identified provide a significant hazard and suggest that an AAA population segment is at particular risk of death. However, the unresolved question is a particular risk of death from what? Like a thermometer, a TTE in this setting indicates illness but not its cause. The unclear pathogenesis of the heightened mortality limits the value in this setting indicates illness but not its cause. The unclear pathogenesis of the heightened mortality limits the value of testing. One can generate multiple hypotheses to explain the results that may not provide direction for patient care: for example, patients with diffuse aortic dilation may have a greater sensitivity to cigarette smoking. One may then speculate that the increased rate of death may be smoking related and include an increase in malignancy, aneurysm rupture, myocardial infarction, infection, or obstructive pulmonary disease. More recent data suggest a progressive decline in the proportion of post-EVAR deaths attributable to cardiovascular causes.6 Long-term outcomes from the United Kingdom Small Aneurysm Trial and the endovascular versus open repair studies, Dutch-Randomized Endovascular Aneurysm Management (DREAM), EndoVascular Aneurysm Repair (EVAR) 1, and Open Versus Endovascular Repair (OVER) trials, offer an important clue: there has been a significant reduction in cardiovascular deaths and >50% of post-EVAR deaths in each of the recent trials were because of noncardiovascular causes (Table).6,9,11,12 The changes in the patterns of mortality are mirrored in cardiovascular disease—driven outcomes in general, which have declining for decades.13 The causes of death predicted by TTE in the work by O’Driscoll et al10 takes on a heightened importance in this setting, as current causes of death in their study are unknown. Indeed, many of these limitations are noted by the authors.

We disagree with the authors’ conclusion that TTE may be a reasonable tool to use for routine risk assessment at this time. The information derived from formal echocardiographic evaluation provides no direction of care to avoid mortality and generates a considerable amount of data that may not be relevant to the patients’ care. In addition, there is no apparent short-term benefit obtained from this test for the procedure for which it was performed. For now, based on the data available, TTE seems to offer a window into the notion that patients with more comorbidities are sicker and more likely to die in the long run. At best, these findings may inform the accuracy with which physicians characterize risk and counsel their patients accordingly in the pre-EVAR setting for the years to come, but study results do not provide the information clinicians or patients need to avoid the outcome.

We applaud the investigators for beginning the process of intermediate-term risk assessment in patients with AAA. We think further efforts are worthwhile and necessary now that perioperative outcomes are excellent and the causes of the death over time are broad.3 We look forward to prospective studies, more granular data, and treatment recommendations on the basis of the findings. At this time, we would recommend clinically driven use, rather than routine use, of TTE—at least until there is evidence that we can provide more targeted treatment advice to our patients.

Disclosures
None.

References
8. Muñoz and Beckman TTE, AAA, and Risk

Table. Long-Term Outcomes After EVAR for AAA: Causes of Death

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>UK Small Aneurysm Trial; 714 Deaths</th>
<th>OVER Trial; 146 Deaths</th>
<th>DREAM Trial; 57 Deaths</th>
<th>EVAR 1 Trial; 248 Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aneurysm related</td>
<td>51 (7.1%)</td>
<td>10 (6.8%)</td>
<td>0 (0.0%)</td>
<td>28 (11.3%)</td>
</tr>
<tr>
<td>Cardiovascular (not related to aneurysm)</td>
<td>335 (46.9%)</td>
<td>39 (26.7%)</td>
<td>16 (28.1%)</td>
<td>94 (37.9%)</td>
</tr>
<tr>
<td>Cancer</td>
<td>156 (21.8%)</td>
<td>39 (26.7%)</td>
<td>18 (31.6%)</td>
<td>60 (24.2%)</td>
</tr>
<tr>
<td>Pulmonary disease</td>
<td>NA</td>
<td>20 (13.7%)</td>
<td>6 (10.5%)</td>
<td>25 (10.1%)</td>
</tr>
<tr>
<td>Other</td>
<td>131 (18.3%)</td>
<td>38 (26.0%)</td>
<td>17 (29.8%)</td>
<td>41 (16.5%)</td>
</tr>
</tbody>
</table>

When possible, excluded preoperative deaths (DREAM and EVAR 1). AAA indicates abdominal aortic aneurysm; DREAM, Dutch-Randomized Endovascular Aneurysm Management; EVAR, endovascular aortic repair; NA, not applicable; and OVER, Open Versus Endovascular Repair.


**Key Words:** Editorials ▪ abdominal aortic aneurysm ▪ aorta ▪ echocardiography ▪ endovascular repair ▪ mortality
Preoperative Transthoracic Echocardiography in Abdominal Aortic Aneurysm: A New Thermometer
Daniel Muñoz and Joshua A. Beckman

doi: 10.1161/CIRCIMAGING.116.004505

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circimaging.ahajournals.org/content/9/2/e004505

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation: Cardiovascular Imaging can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation: Cardiovascular Imaging is online at:
http://circimaging.ahajournals.org/subscriptions/