Ruptured Abdominal Aortic Aneurysm: Prediction of Mortality From Clinical Presentation and Glasgow Aneurysm Score

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Objective: To examine association of presenting clinical acuity and Glasgow Aneurysm Score (GAS) with perioperative and 1-year mortality.

Design: Retrospective chart review.

Setting: Major tertiary care facility.

Participants: Patients with ruptured abdominal aortic aneurysm (rAAA) from 2003 through 2013.

Interventions: Emergency repair of rAAA.

Measurements and Main Results: The authors reviewed outcomes after stable versus unstable presentation and by GAS. Unstable presentation included hypotension, cardiac arrest, loss of consciousness, and preoperative tracheal intubation. In total, 125 patients (40 stable) underwent repair. Perioperative mortality rates were 41% and 12% in unstable and stable patients, respectively ($p < 0.001$). Unstable status had 88% sensitivity and 41% specificity for predicting perioperative mortality. Using logistic regression, higher GAS was associated with perioperative mortality ($p < 0.001$). Using receiver operating characteristic analysis, the area under the curve was 0.72 (95% CI, 0.62-0.82) and cutoff GAS $\geq$96 had 63% and 72% sensitivity and specificity, respectively. Perioperative mortality for GAS $\geq$96 was 51% (25/49), whereas it was 20% (15/76) for GAS $\leq$95. The estimated 1-year survival (95% CI) was 75% (62%-91%) for stable patients and 48% (38%-60%) for unstable patients. Estimated 1-year survival (95% CI) was 23% (13%-40%) for GAS $\geq$96 and 77% (67%-87%) for GAS $\leq$95.

Conclusions: Clinical presentation and GAS identified patients with rAAA who were likely to have a poor surgical outcome. GAS $\geq$96 was associated with poor long-term survival, but >20% of these patients survived 1 year. Thus, neither clinical presentation nor GAS provided reliable guidance for decisions regarding futility of surgery.

KEY WORDS: aged patients, aortic aneurysm, abdominal/mortality/surgery, aortic rupture/mortality/surgery, Glasgow Aneurysm Score, modified, postoperative complications/mortality, sensitivity and specificity

RUPTURED ABDOMINAL aortic aneurysm (rAAA) is a critical and time-sensitive emergency with outcomes dependent on rapid diagnosis and definitive surgical treatment. Despite significant improvements in surgical techniques, anesthetic management, and postoperative care, the 30-day mortality rate of rAAA remains between 40% and 50%.[1]

No single preoperative clinical characteristic predicts survival of rAAA with high reliability; yet the ability to prognosticate outcomes is appealing for both ethical and resource implications.[2] Thus, in the past 2 decades, clinicians have attempted to identify characteristics associated with poor outcome for patients with rAAA. Specifically, efforts were made to develop tools to identify patients who likely would not survive treatment. These assessment prognosticators consist of composite scores determined by various clinical variables.[3,4] The Glasgow Aneurysm Score (GAS), designed in 1994 for predicting outcomes after repair of intact or rAAA,[3,5] calculates risk of death on the basis of patient age, preoperative shock, and myocardial, cerebrovascular, and renal disease.[3,5] The Vancouver score calculates risk on the basis of age, loss of consciousness, and/or presence of preoperative cardiac arrest.[4,6] The definitions of parameters used differ between different tools. For example, GAS defines shock as systolic blood pressure <80 mmHg,[3] whereas the Edinburgh Ruptured Aneurysm score uses a threshold value of 90 mmHg.[7] Loss of consciousness, an independent predictor of mortality, is used in both the Hardman index and the Vancouver score[6,8] but not GAS. Finally, definitions of stable versus unstable vary, and whereas most studies used a decrease in systolic blood pressure below certain limits, some used a combination of falling blood pressure and/or altered consciousness, and others included the presence of cardiac arrest before surgery.[9]

The use of GAS or other prediction scores requires calculations that incorporate knowledge of specific comorbidities and sometimes laboratory values.[10] This information may not be readily available in the emergency setting, which limits the practical use of such tools. In contrast, clinical instability at presentation is a readily identifiable state. In this study, the authors tested the hypothesis that simple clinical assessments of instability may serve as a valuable predictor of outcome after repair of rAAA. The authors defined an unstable patient as an individual with an rAAA and profound hypotension, preoperative cardiac arrest, loss of consciousness, and/or the need for preoperative tracheal intubation; these 4 clinical conditions are easily identifiable and are suggestive of profound shock or circulatory collapse. In this study, the authors aimed to evaluate the association between the clinical assessments of instability with death after rAAA. In addition, they examined the ability of GAS to predict death after rAAA. Specific outcomes of interest were intraoperative mortality, perioperative mortality, and 1-year survival.

MATERIALS AND METHODS

This study was approved by the authors' institutional review board. Consistent with state laws, they included only patients who authorized use of their medical records for research.

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Study Design, Setting, and Population

The authors performed a retrospective study comparing the perioperative course and hospital outcomes (intraoperative and in-hospital mortality) and 1-year survival of patients admitted with rAAA. Only patients who survived initial resuscitation and transfer to the operating room were included.

This study was performed at a large, academic, tertiary care facility. An institutional electronic records search was performed from January 1, 2003 through December 31, 2013 to identify adult patients who presented with an rAAA and underwent surgical repair.

Data Abstraction

Electronic medical records were reviewed; abstracted data included demographic variables, body mass index, comorbid conditions (cardiac disease [documented coronary artery disease, congestive heart failure, or severe surgically untreated valvular disease], vascular disease [prior major vascular surgery or documented claudication], history of stroke or transient ischemic attack, respiratory disease [chronic obstructive lung disease, use of home oxygen, or any other functionally significant pulmonary disease], diabetes mellitus [defined by use of insulin or oral hypoglycemic medications], and chronic kidney disease [serum creatinine level >160 µmol/L or a creatinine clearance <50 mL/minute, or a history of acute or chronic renal failure]), and rAAA characteristics (contained rupture and infrarenal *v* suprarenal). Preoperative clinical presentation was reviewed; the authors noted any loss of consciousness, cardiopulmonary resuscitation, lowest hemoglobin concentration, lowest systolic blood pressure, and transfusions administered before the surgery (en route to the hospital or in the emergency department). The patient was considered unstable if any of the following occurred before surgery: (1) shock, defined as systolic blood pressure <80 mmHg, (2) loss of consciousness, (3) cardiopulmonary resuscitation, or (4) tracheal intubation. The cutoff value of systolic blood pressure <80 mmHg was selected because it was the same value used to define hypotension in other studies.[3,5,11] A patient was considered stable if the rAAA was symptomatic (eg, pain) but the patient otherwise showed no signs of instability. GAS was calculated using the following formula: GAS = age in years + 17 for shock (systolic blood pressure <80 mmHg) + 7 for myocardial disease (documented myocardial infarction or angina pectoris) +10 for cerebrovascular disease (prior stroke or transient ischemic attack) +14 for renal disease (serum creatinine level >160 µmol/L or a creatinine clearance <50 mL/minute, or a history of acute or chronic renal failure).[3] In addition, the authors calculated a modified GAS in which the definition of shock was modified to include all patients meeting the authors' criteria for being unstable.

The anesthetic and surgical records were reviewed for surgeon, anesthesiologist, surgical approach, intraoperative hemodynamic stability, vasopressors used, and blood products transfused. The postoperative course was reviewed for perioperative major morbidity (eg, stroke, myocardial infarction, renal failure requiring dialysis, multiorgan failure, and/or acute respiratory distress syndrome, disseminated intravascular coagulation), duration of postoperative mechanical ventilation, and intensive care unit and hospital lengths of stay. The authors categorized disposition as discharge to a residential home versus rehabilitation unit or special skills nursing home. The date of last follow-up and vital status (alive/dead) were determined from review of all medical records and correspondence.

Outcomes

The outcomes of interest were intraoperative and postoperative clinical course, mortality (intraoperative, perioperative, 1-year), and type of postdischarge disposition (residential home *v* skilled care facility). For the authors' analysis, perioperative death was defined as death within 30 days or during the index hospitalization.

Statistical Analyses

Data are summarized using frequency percentages for categorical variables and mean (SD) or median (interquartile range [IQR]) for continuous variables. Baseline patient characteristics were compared between presentation groups (unstable *v* stable) using the χ^2 test or Fisher exact test for categorical variables and the 2-sample *t* test or rank sum test for continuous variables. When assessing survival outcomes, in addition to defining clinical presentation as stable versus unstable, the authors also determined GAS as defined above. To assess the association of GAS with perioperative mortality, logistic regression and receiver operating characteristic (ROC) curve analyses were performed. Survival after rAAA was estimated using the Kaplan-Meier method and compared between groups using the log-rank test. Because this report reflected an 11-year timeframe during which improvements in perioperative management could influence outcomes, a series of exploratory post hoc analyses were performed to assess potential associations between year of surgery and 30-day or in-hospital mortality rates. In all cases, 2-tailed p values ≤ 05 were considered statistically significant. Analyses were performed using SAS statistical software (version 9.2; SAS Institute Inc).

RESULTS

From January 1, 2003 through December 31, 2013, 125 patients presented with rAAA and survived long enough for transfer to the operating room. Of these patients, 85 were unstable, and 77 unstable patients (91%) were in shock. Of patients with shock, 28 were unconscious, and 9 required chest compressions. Eight (9%) unstable patients did not meet criteria for shock: 6 were unconscious, and 2 were tracheally intubated before transfer to the operating room (1 was in the intensive care unit for myocardial infarction and was intubated for progressive dyspnea, subsequently diagnosed with rAAA, and transferred to surgery; the other was intubated in the emergency department because of a tense abdomen and known diagnosis of rAAA). During the study period, 11 surgeons treated a median of 6 cases (IQR, 4-19 cases). However, 5 surgeons treated 104 cases (83%); these high-volume surgeons were active throughout the study period. Forty-eight anesthesiologists treated a median of 2 cases (IQR, 1-3 cases).

Table 1 shows demographic characteristics and preoperative comorbidities for unstable and stable patients. The incidence