The Age Effect in Increasing Operative Mortality following Delay in Elective Abdominal Aortic Aneurysm Repair

Isibor J. Arhuidese, Aitua Salami, Tammam Obeid, Umair Qazi, Christopher J. Abularrage, James H. Black, Bruce Perler, and Mahmoud B. Malas, Baltimore, Maryland

Background: Elective repair of large abdominal aortic aneurysms (AAAs) is associated with the risk of significant perioperative mortality. When abdominal aneurysm repair is delayed, patients with asymptomatic large AAAs face the risk of death from rupture. In addition to the risk of rupture, the advancing age of the patients adds a future operative risk. This risk has been historically documented in age groups. However, a more accurate representation of the increasing operative risk with age is needed.

Methods: We analyzed all patients in the American College of Surgeons National Surgical Quality Improvement Program database who underwent endovascular or open repair for asymptomatic infrarenal AAA between 2005 and 2012. Multivariable logistic regression was used to evaluate the effect of increasing age and operative delay on 30-day postoperative mortality.

Results: There were 27,576 patients who underwent AAA repair during the study period (mean age 73.5 years, standard deviation 8.6, 80% male, 24% open repair). There was a linear relative increase of 5% (odds ratio [OR] 1.05, 95% confidence interval [CI] 1.04–1.06, $P < 0.001$) in the odds of operative death after AAA repair with each year of operative delay irrespective of treatment approach. There was a linear relative increase of 4% for endovascular aneurysm repair (OR 1.04, 95% CI 1.02–1.05, $P < 0.001$) and 6% for open repair (OR 1.06, 95% CI 1.04–1.08, $P < 0.001$) with each year of delay in repair.

Conclusions: Because of increasing age, delay in surgery is associated with uniform increase in the risk of perioperative mortality in asymptomatic patients who meet criteria for AAA repair. It is important for surgeons to incorporate this more accurate estimation of operative risk into discussions with patients who qualify for treatment yet decide to forgo surgery for the repair of their AAA.

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Department of Surgery, The Johns Hopkins Medical Institutions, Baltimore, MD.

Correspondence to: Mahmoud B. Malas, MD, MHS, FACS, Division of Vascular Surgery, Department of Surgery, Johns Hopkins Medical Institution, 4940 Eastern Avenue, A 547, Baltimore, MD 21401, USA; E-mail: bmalas1@jhmi.edu

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INTRODUCTION

Patient's autonomy provides the ethical basis to a patient's right to accept or reject any form of care offered to them. However, it is the responsibility of the healthcare provider to ensure that the patient's decision is well informed by relevant and the most accurate information. The evaluation of the benefits and risks associated with elective surgery is a crucial contributor to the decision-making process for patients and their surgeons. With regards to the elective repair of asymptomatic abdominal aortic aneurysms (AAA), one such risk is perioperative mortality. Adverse events in the perioperative period are important because they drive the long-term risk/survival experience for these patients.[1–3]

Yearly, an estimated 37,000 patients undergo elective repair of AAAs in the United States.[4] Open aneurysm repair has been the gold standard since its introduction in 1952.[5,6] However, over the past decade, endovascular aneurysm repair (EVAR) has become an increasingly popular alternative to open repair.[6,7] Neither approach is free of postoperative complications as it is estimated that 1400 perioperative deaths occur yearly because of complications of aneurysm repair.[4] However, elective repair of large AAAs remains widely practiced because in its absence, patients face a significant risk of rupture and associated mortality. The mortality rate associated with ruptured AAA is estimated at 80% including patients who do not survive to operation, and accounts for 9000 deaths yearly and is the 15th leading cause of death in the elderly in the United States.[8–10]

The guidelines for screening and repair of AAAs have been the subject of intense debate aimed at delineating evidence for competing criteria. By general consensus and as recommended by the American Association for Vascular Surgery and Society for Vascular Surgery as well as the European Society for Vascular Surgery, there is a clear therapeutic benefit for the repair of aneurysms >5.5 cm.[11,12]

As the US population ages, the prevalence of AAAs is expected to increase. Patients who meet the criteria for repair but choose to defer intervention merit study. Estimates of the number of patients who defer repair at any point in time vary across practices. However, even the most conservative estimates point to a significant number. When a patient who qualifies for repair opts not to have surgery and then decides on a later date to undergo surgical treatment, the exact overall mortality risk is unknown; this risk should include the chances of AAA rupture as well as the future perioperative mortality. Previous studies that examined the effect of age on perioperative mortality categorized patient age in groups of 10 or 5 years. While this approach may be valid if evidence suggests a categorical nature of perioperative mortality, it quickly becomes outdated if a better linear model represents the relationship. This study is designed to examine the nature of the relationship between increasing age and perioperative mortality, while attempting to provide a more accurate measure of the overall risk incurred should a patient choose to delay their surgery.

MATERIAL AND METHODS

The Johns Hopkins Medicine Institutional Review Board determined that this study qualified for exemption under the Department of Health and Human Studies regulations.

Database and Patient Selection

The study cohort was derived from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) Participant Use Data Files from 2005 to 2012. The NSQIP is a nationally validated, risk-adjusted dataset that contains data collected prospectively from over 400 academic and community medical centers across the United States. Clinical reviewers from each site collect data that capture preoperative and intraoperative variables, mortality and morbidity outcomes for inpatients and outpatients undergoing major surgical procedures. Patients were selected using the Current Procedural Terminology codes for elective endovascular (34800, 34802, 34803, 34804, and 34805) and open repair (35081 and 35102) of isolated nonruptured infrarenal aortic and aortoiliac aneurysms.

Covariates

The demographic variables assessed were age, gender, and race. Comorbidities included in the analyses were history of myocardial infarction 6 months before surgery, diabetes requiring medication, hypertension requiring medication, chronic obstructive pulmonary disease (COPD), and congestive heart failure. A history of smoking in the year before surgery, angina 1 month before surgery, cardiac surgery, percutaneous coronary intervention, disseminated malignancy, acute or chronic renal failure requiring treatment, and the American Society of Anesthesiologists (ASA) classification of physical status were also included. These variables were analyzed as binary variables with categories defined as presence or absence of the risk factor.

Outcome

The primary outcome was mortality within 30 days of operation.

Statistical Analyses

Chi-squared test and Student's *t*-test were used to compare binary and continuous variables, respectively. Logistic regression models were built to identify useful predictors. Likelihood ratio tests were used to test the predictive value of each covariate