

Relation of Mitral Valve Surgery Volume to Repair Rate, Durability, and Survival

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ABSTRACT

BACKGROUND Degenerative mitral valve repair rates remain highly variable, despite established benefits of repair over replacement. The contribution of surgeon-specific factors is poorly defined.

OBJECTIVES This study evaluated the influence of surgeon case volume on degenerative mitral valve repair rates and outcomes.

METHODS A mandatory New York State database was queried and 5,475 patients were identified with degenerative mitral disease who underwent mitral valve operations between 2002 and 2013. Mitral repair rates, mitral reoperations within 12 months of repair, and survival were analyzed using multivariable Cox modeling and restricted cubic spline function.

RESULTS Median annual surgeon volume of any mitral operations was 10 (range 1 to 230), with a mean repair rate of 55% (n = 20,797 of 38,128). In the subgroup of patients with degenerative disease, the mean repair rate was 67% (n = 3,660 of 5,475), with a range of 0% to 100%. Mean repair rates ranged from 48% (n = 179 of 370) for surgeons with total annual volumes of ≤10 mitral operations to 77% (n = 1,710 of 2,216) for surgeons with total annual volumes of >50 mitral operations (p < 0.001). Higher total annual surgeon volume was associated with increased repair rates of degenerative mitral valve disease (adjusted odds ratio [OR]: 1.13 for every additional 10 mitral operations; 95% confidence interval [CI]: 1.10 to 1.17; p < 0.001); a steady decrease in reoperation risk until 25 total mitral operations annually; and improved 1-year survival (adjusted hazard ratio: 0.95 for every additional 10 operations; 95% CI: 0.92 to 0.98; p = 0.001). For surgeons with a total annual volume of ≤25 mitral operations, repair rates were higher (63.8%; n = 180 of 282) if they operated in the same institution as a surgeon with total annual mitral volumes of >50 and degenerative mitral valve repair rates of >70%, compared with surgeons operating in the other institutions (51.3%; n = 580 of 1,130) (adjusted OR: 1.79; 95% CI: 1.24 to 2.60; p < 0.001).

CONCLUSIONS This study suggests that individual surgeon volume is a determinant of not only mitral repair rates, but also freedom from reoperation, and survival. The data from this study support the guideline's concept of reference referral to experienced mitral surgeons to improve outcomes in patients with degenerative mitral valve disease. (J Am Coll Cardiol 2017;69:2397-406) © 2017 Published by Elsevier on behalf of the American College of Cardiology Foundation.

Mitral valve repair is favored over valve replacement for the treatment of severe mitral valve regurgitation in patients who have degenerative valve disease with mitral valve prolapse (1,2). Both U.S. and European guidelines strongly recommend valve repair whenever possible, and they also emphasize the importance of a durable and long-lasting repair, particularly when intervening



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**ABBREVIATIONS
AND ACRONYMS****CI** = confidence interval**HR** = hazard ratio**ICD-9-CM** = International
Classification of Diseases-Ninth
Revision-Clinical Modification**OR** = odds ratio

on an asymptomatic patient (1,2). Mitral valve replacement unfortunately remains relatively common in patients with degenerative valve disease, and studies have highlighted wide variation in mitral surgical volume and repair rates when looking at “all-comer” study groups (3-10). The influence of mitral surgical volume on perioperative mortality and repair rates is becoming established, but less is known regarding the impact of volume on 1-year survival and the need for early reoperation. Most large database reports have also included a broad range of causes of mitral valve disease.

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To understand the effect of case volume on clinical outcomes in patients likely to have isolated degenerative disease more clearly, we analyzed a cohort drawn from all patients undergoing mitral valve operations in New York State. We sought to determine the effect of surgeon-specific factors on repair rates, survival, and long-term freedom from repeat mitral valve surgery.

METHODS

PATIENTS. This study was an analysis of adult patients, 18 years of age or older, who underwent primary mitral valve operations in New York State between January 1, 2002 and December 31, 2013. Patients were identified using the Statewide Planning and Research Cooperative System, an all-payer, administrative database that prospectively collects data on every hospital discharge, ambulatory surgery, and emergency department visit in New York State, with longitudinal data available from 1995 to 2014. We reviewed all available pre-operative patient data to identify patients’ baseline characteristics and followed up patients for at least 12 months post-operatively. Patients undergoing mitral valve replacement were identified using the International Classification of Diseases-Ninth Revision-Clinical Modification (ICD-9-CM) procedure codes 35.23 and 35.24; patients undergoing mitral valve repair were identified using ICD-9-CM codes 35.12 and 35.33. Through exclusion of other causes, we identified a subgroup of patients with presumed degenerative mitral valve disease. Exclusion criteria were other possible mitral valve causes, including any history of coronary artery disease, myocardial infarction, rheumatic valve disease, infective endocarditis, congenital heart disease, and cardiomyopathy. Patients who underwent concomitant surgery on the aortic valve, pulmonary valve, coronary arteries, or the left

ventricle and patients with prior replacement or repair of any valve, prior coronary revascularization, prior heart transplantation, and prior ventricular assist device placement were also excluded. Additionally, we excluded patients with out-of-state residency to ensure complete follow-up using the Statewide Planning and Research Cooperative System. Patients who did not have identifiable surgeons were also excluded (Online Figure 1, Online Table 1 [ICD-9-CM codes]). Baseline comorbidities were identified using present-on-admission diagnosis codes from the index hospitalization and all diagnoses from hospitalizations before the index hospitalization (Online Table 2). We compared repair rates, long-term survival, and risk of post-repair reoperation in the subgroup of patients with degenerative disease according to total annual surgeon volume, which was defined as any mitral valve operation for any cause during the study period (see definitions). This study was approved by the Data Protection Review Board of the New York State Department of Health, as well as by the Program for Protection of Human Subjects at the Icahn School of Medicine at Mount Sinai in New York City. The approval included a waiver of informed consent.

DEFINITIONS. Total annual surgeon volume for the surgeon who performed the operation on each patient was calculated as the number of mitral valve operations for any causes (repair or replacement) performed by the patient’s operating surgeon in the 365 days immediately before surgery, to reflect the recent experience of each surgeon at the time of surgery. Next, the experience of each surgeon across the entire study period was quantified as mean total annual surgeon volume. Degenerative mitral valve repair rate was calculated as the number of repairs divided by the total number of operations for degenerative mitral valve disease a surgeon performed. Surgeons were considered eligible for the study when they practiced for at least 365 days.

STUDY ENDPOINTS. The study endpoints were all-cause mortality, degenerative repair rates, and post-repair mitral valve reoperation. Reoperation was defined as any mitral valve operation, either replacement or repair, on subsequent admissions. Patients with no documented reoperation were censored on December 31, 2014. Deaths were identified using the full national Social Security Death Master File (current as of May 29, 2015) and by searching all hospital admissions and ambulatory or emergency department visits for patients’ deaths. For 1-year mortality and reoperation, time to events was

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