Heart, Lung and Circulation (2017) xx, 1–7
1443-9506/04/$36.00
https://doi.org/10.1016/j.hlc.2017.10.009

REVIEW

Heart Valve Surgery Performed by Trainee Surgeons: Meta-Analysis of Clinical Outcomes

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Received 10 August 2017; accepted 16 October 2017; online published-ahead-of-print xxx

Background Cardiac surgical units must balance trainee education with the duty to provide optimal patient care. This is particularly challenging with valvular surgery, given the lower volume and increased complexity of these procedures. The present meta-analysis was conducted to assess the impact of trainee operator status on clinical outcomes following valvular surgery.

Methods Medline, Embase and CENTRAL databases were systematically searched for studies reporting clinical outcomes according to the training status of the primary operator (consultant or trainee). Data were extracted and meta-analysed according to pre-defined endpoints.

Results Eleven observational studies met the inclusion criteria, reporting on five patient cohorts undergoing mitral valve surgery (n = 3975), six undergoing aortic valve replacement (AVR) (n = 6236) and three undergoing combined AVR and coronary artery bypass grafting (CABG) (n = 3495). Perioperative mortality was not significantly different between trainee and consultant cases for mitral valve surgery (odds ratio [OR] 0.92; 95% confidence interval [CI], 0.62–1.37), AVR (OR 0.67; 95% CI, 0.37–1.24), or combined AVR and CABG (OR 1.07; 95% CI, 0.40–2.85). The incidences of perioperative stroke, myocardial infarction, arrhythmias, acute renal failure, reoperation or wound infection were not significantly different between trainee and consultant cases. There was a paucity of mid-term survival data.

Conclusions Valvular surgery cases performed primarily by trainees were not associated with adverse perioperative outcomes. These findings suggest the rigorous design of cardiac surgical trainee programs can sufficiently mitigate trainee deficiencies. However, studies with longer follow-up duration and echocardiographic data are required to assess long-term durability and safety.

Keywords Education • Mitral valve repair • Mitral valve replacement • Aortic valve replacement • Statistics • Meta-analysis

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Please cite this article in press as: Saxena A, et al. Heart Valve Surgery Performed by Trainee Surgeons: Meta-Analysis of Clinical Outcomes. Heart, Lung and Circulation (2017), https://doi.org/10.1016/j.hlc.2017.10.009

Introduction

Surgical units are increasingly facing the challenge of balancing the need to train junior staff with the duty to provide the highest standard of patient care. In recent years, the level of exposure and quality of education provided to cardiac surgical trainees in particular has come under considerable scrutiny. In the context of increasingly complex patients, restrictions on trainee working hours and greater public reporting of outcomes, concerns have been raised about learning opportunities for trainees being potentially compromised [1–3].

In most cardiac surgical training programs, coronary artery bypass graft (CABG) surgery comprises the majority of operations. A number of large studies have demonstrated equivalent outcomes following CABG performed by consultants and supervised trainees [4–10]. However, the impact of trainee operator status on outcomes following valvular surgery is less clear given the lower volume and increased complexity of these procedures. Given the perceived conflict between trainee education and patient safety, it is imperative that surgical training policies be guided by robust clinical data and high-level evidence. The present systematic review and meta-analysis was thus conducted to assess the impact of trainee operator status on mortality and morbidity following valvular surgery.

Methods

Search Strategy and Study Selection

Electronic searches were performed using Ovid Medline, Embase and Cochrane Central Register of Controlled Trials from their dates of inception to January 2017. The search terms (''mitral'' OR ''aortic'' OR ''pulmonary'' OR ''tricuspid'') AND ''valve'' were combined with ''education, medical'' OR ''residency'' OR ''resident'' OR (''clinical OR surg*'' AND ''trainee OR training'') as keywords and MeSH terms. This was supplemented by hand searching the reference lists of key reviews and all potentially relevant studies.

Two reviewers independently screened the title and abstract of records identified in the search. Full-text publications were subsequently reviewed separately if either reviewer considered the manuscript to be potentially eligible. Disagreements regarding final study inclusion were resolved by discussion and consensus.

Eligibility Criteria

Eligible studies were those reporting on clinical outcomes of valvular surgery according to the training status of the primary operator (consultant or trainee). To be eligible for inclusion, studies were required to report on the primary endpoint of perioperative (30-day) mortality. Non-comparative studies, and those that only compared outcomes between trainees themselves, were excluded. Studies presenting mixed data for different cardiac surgeries were only included if clinical outcomes for specific cohorts were separately reported.

All publications were limited to those involving human subjects and written in English. Abstracts, case reports, conference presentations, editorials and expert opinions were excluded. Review articles were omitted because of potential publication bias and duplication of results. When institutions published duplicate studies with accumulating numbers of patients or increased lengths of follow-up, only the most complete reports were included for quantitative assessment.

Data Extraction

All data were independently extracted from text, tables and figures by two investigators. The final results were reviewed by the senior reviewer. For each study, the following information was extracted: study period, institution, study design, number of trainee and consultant cases, patient characteristics and risk factors, operative details and clinical outcomes.

The pre-determined primary endpoint was perioperative all-cause mortality. Secondary endpoints included perioperative stroke, myocardial infarction, reoperation for bleeding, reoperation, acute renal failure, wound infection, arrhythmias requiring permanent pacemaker implantation, aortic cross-clamp and cardiopulmonary bypass (CPB) durations, mid-term survival and freedom from reoperation.

Statistical Analysis

The odds ratio (OR), hazards ratio (HR) or mean difference (MD) were used as summary statistics, and reported with 95% confidence intervals (CI). When available, adjusted ratios were used from individual studies. Otherwise, unadjusted ratios were computed from the exposure distribution given in the papers. When studies stratified results based on seniority of trainees, an overall estimate for trainees was obtained using the combined distributions.

Meta-analyses were performed using random-effects models to take into account the anticipated clinical and methodological diversity between studies. The I^2 statistic was used to estimate the percentage of total variation across studies due to heterogeneity rather than chance, with values exceeding 50% indicative of considerable heterogeneity.

Publication bias was assessed using funnel plots comparing log risk ratios with their standard error. Egger's linear regression method and Begg's rank correlation test were used to detect funnel plot asymmetry [11,12]. If publication bias was detected, the Trim-and-Fill method was used to explore the impact of potentially missing studies [13]. Statistical analysis was conducted with Review Manager Version 5.1.2 (Cochrane Collaboration, Software Update, Oxford, UK) and publication bias assessed using Comprehensive Meta-Analysis v2.2 (Biostat Inc, Englewood, NJ, US). All p-values were two sided, and values <0.05 were considered statistically significant.

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