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The Changing Face of Cardiac Surgery: Practice Patterns and Outcomes 2001-2010

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ABSTRACT

Background: Advances in cardiac surgical care have allowed for successful surgery in high-risk elderly patients. Advances in percutaneous coronary intervention (PCI) techniques and expanded indications for PCI have resulted in a decrease in referrals for coronary artery bypass grafting (CABG). Our objective was to document changes in practice patterns and outcomes in a single tertiary cardiac surgery centre serving a large geographic area.

Methods: For all cardiac surgery cases performed from 2001-2010 we examined its use, patient clinical characteristics, and outcomes. Frailty was assessed using a measure we have previously demonstrated to be associated with adverse outcomes.

Results: During the study period, annual case volume decreased by 13%. The number of isolated CABG cases declined, and valve surgery

RÉSUMÉ

Introduction : Les progrès réalisés en soins de chirurgie cardiaque ont permis de réussir des chirurgies chez des patients âgés exposés à un risque élevé. Les progrès techniques dans le domaine de l'intervention coronarienne percutanée (ICP) et l'étendue des indications d'ICP ont entraîné une diminution de l'orientation des patients vers le pontage aortocoronarien (PAC). Notre objectif était de documenter les changements des modèles de pratique et les résultats d'un seul centre de chirurgie cardiaque tertiaire desservant une vaste zone géographique.

Méthodes : Pour l'ensemble des chirurgies cardiaques réalisées de 2001 à 2010, nous avons examiné leur utilisation, les caractéristiques cliniques des patients et les résultats. La fragilité a été évaluée par une mesure qui a précédemment été associée à des résultats indésirables.

Advances in surgical and anaesthetic techniques, along with continuous quality improvement efforts in cardiac surgery, reduced mortality and morbidity rates through the 1990s and early 2000s.[1-4] This has expanded indications for cardiac surgical intervention to increasingly elderly patients with complex conditions, and multiple publications reflect good success in this patient group.[5-10] At the same time, the median age of global and North American populations is increasing.[11]

Advances in stent technology and interventional cardiology techniques have expanded indications for percutaneous coronary intervention (PCI) in a larger proportion of patients with coronary disease. These developments in PCI have resulted in a marked drop in referral of patients for isolated coronary artery bypass grafting (CABG).[12] Taken together, these events have resulted in a commonly acknowledged shift in referrals for cardiac surgical intervention away from isolated CABG and toward more complex interventions in older and sometimes frail patients.

This shift has been studied on the European continent, but to date no study has systematically examined the change in practice pattern in a North American context. The goal of our study was to document changes in practice patterns and outcomes in the single tertiary cardiac surgery centre that serves the entire province of Nova Scotia. As the sole provider of cardiac surgical services in Nova Scotia, our experience reflects broader trends in cardiac surgical practice in our province and is not subject to variation based on perceived expertise or access to care. Previously we found that frail patients undergoing cardiac surgery were at increased risk of mortality and prolonged institutional care.[13] In this study, we examined changes in the proportion of patients undergoing cardiac surgery who were frail and elderly, and we reported outcomes in these groups.

Methods

Data source

The Maritime Heart Center Cardiac Surgery Registry database is a detailed clinical registry that has prospectively collected pre-, intra-, and postoperative data on all adult patients undergoing cardiac surgery at this centre since 1995.

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and other complex procedures increased. The proportion of patients aged $\geq$ 80 years rose from 7%-12%, and the proportion of frail patients increased from 4%-10%. Although unadjusted in-hospital mortality remained relatively unchanged, intensive care unit (ICU) stays and prolonged institutional care increased. Older age and frailty were associated with mortality, prolonged ICU stays, prolonged institutional care, and a composite of mortality and major morbidities.

Conclusions: Our findings showed a decline in CABG, an increase in more complex operations, and an increase in prolonged ICU stays and prolonged institutional care. The proportion of frail and elderly patients increased over time and these patient groups were at higher risk of adverse postoperative outcomes. Particular attention is required in the decision for surgery and perioperative management of these patients.

Résultats : Durant la période de l'étude, le volume annuel de cas a diminué de 13 %. Le nombre de cas isolés de PAC a baissé, et la chirurgie valvulaire et les autres interventions complexes ont augmenté. La proportion de patients âgés $\geq$ 80 ans a augmenté de 7 % à 12 %, et la proportion de patients fragiles a augmenté de 4 % à 10 %. Bien que la mortalité intrahospitalière non ajustée soit demeurée relativement inchangée, les séjours à l'unité de soins intensifs (USI) et les soins prolongés en établissement ont augmenté. L'âge avancé et la fragilité ont été associés à la mortalité, aux séjours prolongés à l'USI, à des soins prolongés en établissement, et à un critère combiné de mortalité et de morbidités importantes.

Conclusions : Nos résultats ont montré une baisse des PAC, une augmentation des interventions plus complexes, des séjours prolongés à l'USI et des soins prolongés en établissement. La proportion de patients fragiles et âgés a augmenté au fil du temps, et ces groupes de patients ont été exposés à un risque élevé de résultats postopératoires indésirables. Une attention particulière est requise pour prendre la décision de procéder à une chirurgie et à la prise en charge périopératoire de ces patients.

Age distribution of the population in Nova Scotia and Canada during the study period was obtained from Statistics Canada 2001 and 2011 census reports. This study was fully approved by the Capital District Health Authority Research Ethics Board with a waiver of consent.

Use of cardiac surgery and patient characteristics

Cardiac surgery use rates and patient clinical characteristics from 2001-2010 were examined, and trends over time were assessed. All cardiac surgery cases were included. Procedure categories of primary interest were isolated CABG, isolated valve surgery, combined valve/CABG procedures, and other cardiac procedures. Other cardiac procedures were defined as those excluding isolated CABG, isolated valve procedures, and combined valve/CABG procedures. Nonindex cardiac procedures were reported separately from index cardiac procedures. The index procedure was the first procedure performed during the hospital admission; nonindex procedures, if any, were those performed subsequent to the index procedure during the same hospital admission.

Frailty

Frailty was defined as any loss of independence in activities of daily living (Katz Index of Independence in Activities of Daily Living) or ambulation or a documented history of dementia.[14] Frailty data have been available in our registry since 2005. Using this definition of frailty, we have previously demonstrated a strong association with both mortality and prolonged institutional care.[13]

Urgency of surgery

Urgency was categorized as emergent (proceeding to the operating suite with no delay), urgent (surgery required within 24 hours to minimize risk of further clinical deterioration), in-house (hospitalization required until surgery), or elective (patient clinically stable and waiting at home).

Outcomes

Outcomes occurring postoperatively during the same hospital admission as the cardiac surgery were examined, and all outcomes were ascribed to the index procedure. In-hospital mortality was defined as death from any cause during the index hospital admission. A composite outcome (COMP) was defined as 1 or more of the following in-hospital events: mortality, stroke (neurologic deficit, persistent or resolved at hospital discharge), septicemia (positive blood culture result), deep sternal wound infection (involving muscle, mediastinum, bone, or a combination), pneumonia (positive sputum culture result or clinical findings of pneumonia, or both), or acute renal failure (postoperative serum creatinine level $>$ 176 μmol/L and $>$ 50% higher than preoperative serum creatinine levels). Intensive care unit (ICU) length of stay was recorded as the total number of postoperative hours the patient spent in the ICU, including readmission to that unit. ICU stays $>$ 72 hours were examined as a discrete variable. Readmission to the ICU was defined as a return from the ward during the same hospital admission (data recorded since 2002). For patients discharged alive, prolonged institutional care was defined as discharge to another hospital, rehabilitation centre, restorative care facility, or nursing facility.

Predictive models

Logistic EuroSCORE II was used to calculate predicted mortality.[15] We also reported the predicted mortality from a model we developed previously that includes frailty as well as age, sex, urgency of surgery, surgical procedure, and comorbidities as independent predictors.[13]

Statistical analysis

Continuous data were reported as mean and standard deviation or median and interquartile range, and discrete data were reported as frequency and percent. The Cochran-Armitage test was used to report trends. All statistical analysis was performed using SAS, version 9.3 (SAS Institute, Cary NC).