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Clinical Research

Congenital Heart Disease Hospitalizations in Canada: A 10-Year Experience

Sunjidatul Islam, MBBS, MSc,[a] Yutaka Yasui, PhD,[a] Padma Kaul, PhD,[a,b] Ariane J. Marelli, MD, MPH,[c] and Andrew S. Mackie, MD, SM[a,d,e]

[a] School of Public Health, University of Alberta, Edmonton, Alberta, Canada
[b] Department of Medicine, University of Alberta, Edmonton, Alberta, Canada
[c] McGill Adult Unit for Congenital Heart Disease Excellence, McGill University, Montreal, Quebec, Canada
[d] Stollery Children's Hospital, Edmonton, Alberta, Canada
[e] Department of Pediatrics, University of Alberta, Edmonton, Alberta, Canada

ABSTRACT

Background: The effect of the growing population of children and adults with congenital heart disease (CHD) on inpatient services in Canada is not known. We sought to assess temporal changes in hospitalizations of CHD patients.

Methods: We identified all patients with a CHD diagnosis who received inpatient care in Canada between fiscal years 2003 and 2012 according to the Discharge Abstract Database of the Canadian Institute for Health Information. Poisson regression was performed to assess temporal changes in the annual hospitalization rate. Hospitalization rates were indexed to the general population and the estimated CHD population.

Results: A total of 103,034 hospitalizations occurred in 61,051 patients from fiscal years 2003 to 2012. The absolute number of hospitalizations increased by 4.0% per year in adults and 1.3% per year in children. The greatest increase was in patients aged ≥ 65 years

RÉSUMÉ

Introduction : L'incidence de la population croissante d'enfants et d'adultes atteints de cardiopathie congénitale sur les services hospitaliers canadiens est inconnue. Nous avons cherché à évaluer les variations temporelles en matière d'hospitalisation chez les patients atteints de cardiopathie congénitale.

Méthodes : À l'aide de la base de données sur les congés hospitaliers de l'Institut canadien d'information sur la santé, nous avons recensé tous les patients atteints de cardiopathie congénitale ayant été hospitalisés au Canada entre les années financières 2003 et 2012. Une régression de Poisson a été effectuée afin d'évaluer les variations temporelles des taux d'hospitalisation annuels. Ces taux d'hospitalisation ont été indexés en fonction de la population générale et de la population estimée de patients atteints de cardiopathie congénitale.

Résultats : Entre les années financières 2003 et 2012, il y a eu au total 103 034 hospitalisations pour 61 051 patients. Le nombre

With improvements in survival,[1] the prevalence of congenital heart disease (CHD) has increased rapidly in adults, and adults with CHD now outnumber children with CHD.[2,3] In addition, the distribution of CHD has changed with an increased prevalence of severe CHD among adults relative to children.[2-4] Adult patients with CHD are at risk of development of late cardiac complications, which sometimes require repeat interventions.[4-6] Moreover, they might acquire other comorbid conditions with aging. The effect of this changing demographic characteristic on the number of adult CHD clinic visits has been previously described in Canada.[7] However, the effect on inpatient care is not known. Therefore, the objectives of this study were: (1) to determine temporal changes in the hospitalization rate among CHD patients in Canada, overall and according to age, sex, and severity of CHD; (2) to determine temporal changes in length of hospital stay, overall and among specific patient subgroups; and (3) to identify predictors of length of stay (LOS) > 14 days.

Methods

Study design and data source

We conducted an observational retrospective cohort study using the Discharge Abstract Database from the Canadian Institute for Health Information, which consists of hospitalization records from all acute care hospitals in Canada, except

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Corresponding author: Dr Andrew S. Mackie, Division of Cardiology, Stollery Children's Hospital, 4C2 Walter C. Mackenzie Center, 8440-112th St NW, Edmonton, Alberta T6G 2B7, Canada. Tel.: +1-780-407-8361; fax: +1-780-407-3954.
E-mail: andrew.mackie@ualberta.ca

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followed by those 40-64 years. However, the hospitalization rate in adults varied between 39 and 55 per 1000 CHD population with a reduction of 4% per year (95% confidence interval, 0.95-0.96; $P < 0.001$). The hospitalization rate in children ranged from 79 to 87 per 1000 CHD population and did not change significantly over time (rate ratio, 1.00; 95% confidence interval, 1.00-1.01; $P = 0.035$). Men accounted for 53.5% of hospitalizations.

Conclusions: The absolute number of hospitalizations of patients with CHD increased over time in children and adults. However, the hospitalization rate relative to the CHD population decreased among adults, possibly reflecting improved outpatient management. The absolute increase in CHD hospitalizations will pose a financial burden on health care systems.

absolu d'hospitalisations s'est accru de 4 % par année chez les adultes et de 1,3 % par année chez les enfants. La plus forte augmentation a été enregistrée chez les patients âgés de 65 ans et plus suivie des patients âgés de 40 à 64 ans. On a toutefois observé un taux d'hospitalisation variant entre 39 et 55 par 1000 patients adultes atteints de cardiopathie congénitale et une réduction de ce taux de 4 % par année (intervalle de confiance à 95 % 0,95 à 0,96; $P < 0,001$). Chez les enfants, le taux d'hospitalisation se situait entre 79 et 87 par 1000 patients atteints de cardiopathie congénitale et n'a pas varié de manière significative au fil du temps (ratio des taux, 1,00; intervalle de confiance à 95 % 1,00 à 1,01; $P = 0,035$). Les hommes ont fait l'objet de 53,5 % des hospitalisations.

Conclusions : Au fil du temps, le nombre absolu d'hospitalisations de patients atteints de cardiopathie congénitale a augmenté tant chez les adultes que chez les enfants. On a toutefois observé une diminution du taux d'hospitalisation chez les adultes atteints de cardiopathie congénitale, ce qui pourrait s'expliquer par une meilleure prise en charge ambulatoire. Il est à noter que l'augmentation absolue du nombre d'hospitalisations chez les patients atteints de cardiopathie congénitale imposera un fardeau financier au système de santé du pays.

those from the province of Quebec. The database includes data on admission and discharge dates, patient demographic variables, diagnoses (a primary and up to 24 secondary diagnoses), diagnostic and therapeutic procedures (up to 16 procedures), and discharge disposition. Multiple hospitalizations for the same patient can be tracked with the use of a unique anonymous patient identification number.

Study population

Inclusion criteria. Our study population consisted of all patients, irrespective of their age, with a diagnosis of CHD who received inpatient care during the fiscal years 2003-2012 in Canada, less the Yukon, Northwest Territories, Nunavut, and Quebec. CHD was identified based on *International Classification of Disease* (ICD) Revisions 9 and 10, from any of 25 diagnostic fields.

Exclusion criteria. We excluded patients with isolated patent ductus arteriosus and those who lived in the Yukon, Northwest Territories, Nunavut, or Quebec even if they received care in hospitals of other provinces. We also excluded patients who were discharged alive on the same day of admission, with the assumption that they were admitted for a day procedure. Hospitalizations within 24 hours of discharge were considered hospital-to-hospital transfers and therefore counted as single hospitalizations.

Outcome measures

Our primary outcome of interest was the annual number and rate of hospitalizations with CHD as a primary or secondary diagnosis and the annual number and rate of hospitalizations according to age group, sex, severity of CHD, and therapeutic intervention. For each year, we calculated the hospitalization rate by dividing the number of hospitalizations by the population size of Canada (less the Yukon, Northwest Territories, Nunavut, and Quebec) in the given year. The same procedure stratified according to age, sex, and severity of CHD was applied to the calculation of annual hospitalization rates according to age, sex, and severity of CHD. In addition, we indexed the annual hospitalization rate to the CHD population of Canada (less the Yukon, Northwest Territories, Nunavut, and Quebec), which was estimated using recent Quebec CHD prevalence data, published by Marelli et al.[3] They reported the prevalence of CHD in Quebec for the years 2005 and 2010 for children and adults. We estimated the size of the CHD population on an annual basis using CHD prevalence data from 2005 and midyear general population statistics from Statistics Canada for fiscal years 2003-2007, and prevalence data from 2010 for fiscal years 2008-2012. The CHD population for children and adults were estimated separately using the same method.

LOS was the secondary outcome of interest. In the event of a hospitalization within 24 hours of discharge, the LOS was measured as the duration between the first admission date and the second discharge date. We also assessed the total LOS, defined as the total duration of hospital days (over multiple hospitalizations) per person over the 10-year study period.

Independent variables

CHD lesions were grouped into 3 complexities: simple, moderate, and complex, defined according to the 32nd Bethesda conference.[8] We classified patients with multiple CHD diagnoses based on the hierarchies of complexities. For example, if a patient had complex lesions and moderate or simple lesions, the patient was classified as a complex CHD patient. Similarly, patients with moderate and simple CHD diagnoses were categorized as moderate CHD patients. For patients having multiple hospitalizations during the study period, all CHD diagnoses coded across the multiple hospitalizations were used in classifying the patient as simple, moderate, or complex. Age was categorized into 6 categories: infants (< 1 year), 1-4 years, 5-17 years, 18-39 years, 40-64 years, and ≥ 65 years.

We used Canadian Classification of Health Interventions codes corresponding to ICD-10 codes and Canadian