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Hospital Readmission of Patients With Congenital Heart Disease in Canada

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See editorial by Mertens, pages xxx-xxx of this issue.

ABSTRACT

Background: Risk factors for hospital readmission in children or adults with congenital heart disease (CHD) are poorly understood. We assessed readmission rates among patients with CHD stratified by age, sex, and severity of CHD and identified risk factors associated with hospital readmission.

Methods: A retrospective cohort study was conducted among patients with CHD identified from the Discharge Abstract Database of the Canadian Institute for Health Information from fiscal years 2003-2013. Index hospitalizations were identified and patients followed to identify readmissions. Poisson regression was used to analyze readmission rates by age, sex, and severity of CHD. Logistic regression analysis was performed to identify risk factors associated with readmission within 1 month after discharge.

Results: There were 67,940 index hospitalizations. The readmission rate per 1000 patients with CHD was 48 within 2 weeks, 83 within 1 month, 163 within 3 months, and 351 within 1 year. Patients

RÉSUMÉ

Introduction : Les facteurs de risque de réadmission à l'hôpital des enfants ou des adultes atteints d'une cardiopathie congénitale (CC) sont peu connus. Nous avons évalué les taux de réadmission des patients atteints de CC stratifiés selon l'âge, le sexe et la gravité de la CC, et déterminé les facteurs de risque associés à la réadmission à l'hôpital.

Méthodes : Nous avons mené une étude de cohorte rétrospective auprès des patients atteints d'une CC qui étaient inscrits dans la Base de données sur les congés des patients de l'Institut canadien d'information sur la santé des années financières 2003 à 2013. Nous avons déterminé les hospitalisations de référence et suivi les patients pour déterminer les réadmissions. Nous avons utilisé la régression de Poisson pour analyser les taux de réadmission selon l'âge, le sexe et la gravité de la CC. Nous avons réalisé l'analyse de régression logistique pour déterminer les facteurs de risque associés à la réadmission dans un délai de 1 mois à compter du congé.

The prevalence of congenital heart disease (CHD) is rapidly increasing, particularly in adults and those with complex lesions.¹ In Canada, it was estimated that the number of survivors with adult CHD increased by 70% from 2000-2010.² Although many of these patients undergo surgical or catheter intervention (or both) in the early stage of life, the potential for hemodynamic residua and other complications developing are high in later life in this population,

particularly among those with complex defects.^{3,4} A population-based case-control study showed a higher prevalence of comorbid conditions such as atrial fibrillation, heart failure, stroke, and chronic renal failure in patients with CHD compared with age- and sex-matched controls.⁵ Consequently, hospital admissions are more common in the CHD population compared with the age- and sex-matched general population.⁶

Hospital admissions and readmissions represent a vast burden on health care resources and have been the subject of investigation among adults with congestive heart failure and coronary artery disease.⁷⁻¹⁰ In Canada, hospital readmissions cost approximately \$1.8 billion in 2010.¹¹ Readmissions are in many cases avoidable through an understanding of risk factors and adopting appropriate strategies and therefore warrant further investigation.¹²⁻¹⁵ However, little is known about hospital readmission in children or adults with CHD.

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aged ≥ 65 years had the highest readmission rate at 1 month (12.6%) followed by 40- to 64-year old adults (8.5%), and infants (8.3%). Readmission rates were 2.3-4.1 times higher in patients with complex CHD ($P < 0.001$) and 1.3-1.8 times higher in patients with moderate CHD ($P < 0.001$) than in simple patients with CHD. Risk factors for readmission were age ≥ 40 years, age < 1 year, male sex, longer index hospitalization stay, and complex CHD. Increasing Charlson comorbidity score was a risk factor for readmission among adults.

Conclusions: Greater than one third of hospitalized patients with CHD were readmitted within 1 year. Age, sex, and CHD complexity influence readmission risk. Future studies should investigate the reasons for unplanned readmission.

Increasing hospitalizations within the CHD population over time warrants evaluation of risk factors for readmission in this population.^{16,17} Therefore we sought to (1) assess the readmission rate of patients with CHD in Canada between 2003 and 2013 and (2) identify risk factors for 1-month hospital readmission.

Methods

Study design and data source

We conducted a retrospective cohort study to assess readmissions of children and adults with CHD. We identified hospitalizations with a primary or secondary diagnosis of CHD between fiscal years 2003 and 2013 inclusive from the Discharge Abstract Database of the Canadian Institute for Health Information (CIHI). This national database includes all acute care hospitalizations in Canada except the province of Quebec. We identified multiple hospitalizations per patient using an anonymous unique patient identifier.

Study population

Patients with CHD, regardless of their age, receiving inpatient care in Canada between fiscal years 2003 and 2013 were included. Exclusion criteria were patients with isolated patent ductus arteriosus; patients residing in Quebec, Nunavut, Yukon, or the Northwest Territories; and hospitalizations with discharge dates that were the same as the admission date. We also excluded patients who died during the index hospitalization (ie, the first hospitalization of each patient in the study period), because they were not at risk of readmission. Hospitalizations within 24 hours of discharge were considered hospital-to-hospital transfers and therefore a single hospitalization event. To assess the proportion readmitted within a given time length (eg, 2 weeks) after the day of discharge for the index hospitalization, we excluded index hospitalizations for which discharge dates were within the given time length (eg, 2 weeks) of the end of fiscal year 2013, because

Résultats : On comptait 67 940 hospitalisations de référence. Le taux de réadmission par 1000 patients atteints de CC était de 48 en 2 semaines, 83 en 1 mois, 163 en 3 mois et 351 en 1 an. Les patients de ≥ 65 ans montraient le taux de réadmission le plus élevé à 1 mois (12,6 %), après quoi suivaient les adultes de 40 à 64 ans (8,5 %) et les nourrissons (8,3 %). Les taux de réadmission étaient de 2,3 à 4,1 fois plus élevés chez les patients atteints d'une CC complexe ($P < 0,001$) et de 1,3 à 1,8 fois plus élevés chez les patients atteints d'une CC modérée ($P < 0,001$) que chez les patients atteints d'une CC simple. Les facteurs de risque de réadmission étaient le fait d'être âgé de ≥ 40 ans, de < 1 an, de sexe masculin, d'avoir un séjour plus long à l'hôpital de référence et une CC complexe. Un score de comorbidité de Charlson plus grand était un facteur de risque de réadmission chez les adultes.

Conclusions : Plus d'un tiers des patients hospitalisés atteints d'une CC ont été réadmis dans un délai de 1 an. L'âge, le sexe et la complexité de la CC influencent le risque de réadmission. Les études subséquentes devraient examiner les raisons de réadmission non planifiée.

readmissions within the given time length were not fully recorded in our database.

Outcome measures

Our primary outcome was the rate of readmission within a given time length after discharge from the index hospitalization. Readmission was defined as hospital admission within 2 weeks (14 days), 1 month (31 days), 3 months (90 days), and 1 year (365 days) after the index hospitalization discharge date. Factors associated with 1-month readmission were identified. To calculate the readmission rate within one of the specific time intervals, which is a cumulative outcome, we included all CHD readmissions after the discharge from the index hospital admission.

Independent variables

The independent variables examined were age, sex, neighborhood median household income, severity of CHD, Charlson comorbidity index for adult patients only,^{18,19} index hospitalization length of stay (LOS), and day of week at discharge. Age, LOS, Charlson comorbidity index, and day of week at discharge were defined at the time of index hospitalization. Age was categorized into 6 categories: infants (< 1 year), 1-4 years, 5-17 years, 18-39 years, 40-64 years, and ≥ 65 years. CHD lesions were grouped into 3 complexities: simple, moderate, and complex, as previously defined.²⁰ 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, he or she was classified as a patient with complex CHD. Similarly, patients with moderate and simple CHD lesions were categorized as patients with moderate CHD. We hypothesized that patients with a longer index LOS would be at risk of readmission. LOS during the index hospitalization was divided into 3 groups: ≤ 2 weeks, > 2 weeks-1 month, and > 1 month. Median household income was determined using the forward sortation area (FSA), defined as the first 3 digits of the patient's home postal code, and was used as a surrogate of socioeconomic status.^{21,22} This information was obtained from Statistics Canada. We divided our study population into quartiles of

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