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Comparing pyloromyotomy outcomes across Canada

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ABSTRACT

Background: Changing patterns of referral and management of hypertrophic pyloric stenosis (HPS) in North America have recently been described. Comfort with perioperative management, anesthesia, and corrective surgery have been cited as reasons for these changes. Our primary objective was to assess pyloromyotomy outcomes between different hospital types across Canada. The secondary objective was to geospatially map all pyloromyotomies to identify regions of higher HPS incidence across Canada.
Methods: Data of all pyloromyotomies done between 2011 and 2013 were acquired from Canadian Institute for Health Information (CIHI). Complication rates and length of hospital stay (LOS) were analyzed. Postal codes for each patient were used to geospatially map regions of higher HPS incidence.
Results: A total of 1261 pyloromyotomies were assessed. There was no difference in LOS or complication rates between different hospital types or surgeon group. Open pyloromyotomies were done in 75% of the cases. Several regions of higher HPS incidence were identified across Canada.
Conclusion: This study found no difference in complication rate or LOS stay between hospital type and surgeon type across Canada. This may reflect a previously identified referral trend in the United States towards pediatric centers. Several regions of higher HPS incidence were identified, and may aid in identifying genetic elements causing HPS.
Level of evidence: 2c

Hypertrophic pyloric stenosis (HPS) is a common infantile condition managed by both pediatric and general surgeons. At the beginning of the 21st century, several studies suggested infants with HPS treated by pediatric surgeons in pediatric hospitals had better outcome; measured by lower complication rates and shorter length of hospital stay (LOS) [1–4]. Furthermore, recent trends in referral patterns to pediatric centers may reflect a decreased comfort level in peripheral hospitals with managing resuscitation, infantile anesthesia, primary surgical management, and dealing with post-operative complications [3,5]. Many of these studies included American or British centers, with relatively few studies examining a Canadian population. In 2004, Langer et al. found infants treated by pediatric surgeons had a shorter LOS, yet no statistically significant difference in complication rate between general surgeons and pediatric surgeons performing pyloromyotomies in the province of Ontario [3]. A more recent study by Ednie et al. evaluating similar outcomes across the Maritime Provinces between 2001 and 2010, found that pediatric surgeons had significantly better outcomes compared to general surgeons [6]. In addition, there was a trend of increasing referrals of HPS cases to the pediatric centre in the Maritime Provinces [5,6].

The benefits of referral to specialty pediatric hospitals must outweigh the negative aspects, especially in Canada where travel distances can be vast: Families may travel up to several hundred kilometers for surgical care, which can be associated with family stress, financial costs, and lack of social and community support [7,8].

While the management of HPS is relatively straightforward, the underlying etiology and genetic risk factors are still being elucidated. Ednie et al. found several regions of higher incidence of HPS throughout the Maritime Provinces, suggesting that similar regions may exist across Canada, and may help identify underlying genetic associations [6].

To our knowledge, no recent Canadian study has compared the outcomes of pediatric surgeons and hospitals versus general surgeons and community hospitals in the management of HPS across the country. Furthermore, there has been no recent analysis of national trends in referral patterns of cases of HPS to pediatric centers versus local community hospitals. This information would be useful for coordinating triage and transfer of HPS patients, as well as organizing surgical needs and perioperative resources.

The primary objective of this study is to determine whether a difference in HPS outcomes exists, as reflected by complication rates and LOS, between different hospital types across Canada (pediatric compared to regional and community hospitals). The secondary objective

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is to geospatially map all cases of HPS across Canada between 2011 and 2013 to determine regions of higher incidence in order to inform future work on its etiology and epidemiology in Canada [6].

1. Methods

Data on all infants with HPS who underwent a pyloromytomy in Canada (excluding Quebec and the territories) between 2011 and 2013 were obtained from the Canadian Institute for Health Information (CIHI). Infants diagnosed with HPS who did not undergo a pyloromyotomy were excluded. Demographics collected included age, gender, and the three first digits of residential postal code for geographical mapping, which represents the geographic forward sortation area (FSA). Complication rates were calculated based on ICD-10 codes grouped into surgical site infection, sepsis, and bowel injury. If more than one complication was recorded for an individual case, those cases were analyzed in detail; if no clear association with the pyloromyotomy could be made, that complication case was excluded from complication rate analysis. Hospitals of treatment were grouped into pediatric hospitals (pediatric surgical staff only), regional hospitals (including both general surgeons and pediatric surgeons), and community hospitals (general surgeons only). The type of surgeon performing the pyloromyotomy was provided by CIHI.

Outcomes of interest included complication rates related directly to the surgery and LOS. Complication rates were calculated using Fisher-exact test (due to the low complication rate) and unadjusted odds ratio calculated using standard logistic regression models for confidence intervals of 95%, where p-value < 0.05 were considered statistically significant.

Confounding variables used for control included: age, gender, low birth weight, and travel distance to the nearest pediatric or regional hospital. Complication rates comparing pediatric surgeons and general surgeons working within the same hospital (regional hospitals) were compared to remove potential support staff bias.

In order to ensure confidentiality and non-identification of specific hospitals, the country was divided up into 4 regions: West (British Columbia and Alberta), Prairie (Saskatchewan and Manitoba), Ontario, Atlantic (New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland and Labrador).

To adjust for the large distribution of LOS for all hospital types, with extreme right-sided skewness, a Gamma model was used, while controlling for confounding variables including age, gender, and driving time.

Geospatial mapping was done using the first 3 digits of each individual case using Geopoint software. Driving distances to the nearest pediatric or regional hospital were calculated using the ODMatrix function in the Network Analyst tool in ArcGIS 10.1 software from the centre point of the Patient's FSA to the nearest pediatric hospital. Provincial incidence rates were calculated based on patient number per 100 k population aged 0–4 years old. All statistical analyses were performed using software R version 3.2.3. Approval for the study was obtained from the Research Ethics Board at the IWK Health Centre.

2. Results

A total of 1261 infants who underwent pyloromyotomies for HPS between 2011 and 2013 across Canada were included in this study. During the study period, pediatric surgeons performed 100%, 41.1%, and 1.56% of pyloromyotomies in pediatric hospitals, regional hospitals, and community hospitals, respectively, while general surgeons performed the remainder (Table 1). Overall, 90.6% of pyloromyotomies were performed by pediatric surgeons over the study period.

In terms of geographic variation in incidence of HPS, Newfoundland and Labrador had the highest, while British Columbia had the lowest incidence (Table 2). Further details are provided in Fig. 1, where clusters of higher incidence can be seen across Atlantic Canada and northeastern Quebec.

Table 1
HPS case characteristics, management and outcomes.

	Hospital Type			All cases
	Pediatric	Regional	Community	
N cases	1102	95	64	1261
% of cases	87.4	7.5	5.1	
% < 1 month of age	36.3	43.6	41.3	37.1
%male	81.6	83.2	84.4	81.8
Region				
West	91.8	5.5	2.6	27.2
Prairie	55.4	40	4.6	10.3
Ontario	90.4	4.0	5.7	47.7
Atlantic	91.9	0	23.4	27.2
Mean driving time (of patient to nearest children's or regional hospital) (min)	106 +/− 198	79 +/− 80	270 +/− 149	112 +/− 193
Median Driving Time (min)	40	39	257	48
% of patients >2 h driving from nearest pediatric or regional hospital	23.0	31.6	82.8	26.7
% of patients >4 h driving from nearest pediatric or regional hospital	12.8	3.2	54.7	14.2
% of out of region patients	1.1%	0	0	-
% performed by a Pediatric Surgeon	100	41	1.6	90.6
% laparoscopic	26.8	20.0	3.1	25.1
Mean LOS (days)	4.7 +/− 12.1	5.6 +/−15.2	5.9 +/− 14.8	4.9 +/−12.5
Median LOS (days)	3	3	4	3
% Complication rate	3.7	1.1	4.8	3.6

The complication rate across all hospital types was 3.6% (Table 1). There was no statistically significant difference in complication rate between pediatric hospitals and regional hospitals (OR = 0.288, p-value 0.222) or community hospitals (OR = 1.357, p-value 0.622). Low birth weight was associated with increased complication rate (OR = 3.433, p-value = 0.0269), while age, gender, driving time and mode of procedure (laparoscopic versus open) were not. There was no statistically significant difference in complication rate between pediatric surgeons and general surgeons (OR = 1.007, p-value = 0.9902) while controlling for age, gender, and birthweight.

In Canadian regional hospitals, 41% of pyloromyotomies were performed by pediatric surgeons (Table 1). Only 1 complication was recorded in the entire 3 year period of analysis; therefore no statistically significant difference in complication rate between pediatric and general surgeons operating within the same type of hospital could be determined.

Length of hospital stay varied across all hospital types with average LOS for pediatric, regional, and community hospitals being 4.7, 5.6, and 5.9 days, respectively. A gamma model was used to correct for right-sided skewness in the data, which found no statistically significant difference in LOS between pediatric hospitals compared to regional and community hospitals (p = 0.27 and p = 0.34), respectively. Patient age

Table 2
Incidence of HPS managed by pyloromyotomy across Canada, per 100 k children less than 4 years old.

Province	Population (ages <4 years old)	Number of Cases	Patient/100 K
Newfoundland and Labrador	24,435	52	212.8
New Brunswick	3860	7	181.3
Nova Scotia	43,830	58	158.5
Prince Edward Island	7345	9	122.5
Ontario	701,212	583	83.1
Manitoba	75,801	69	91
Saskatchewan	69,928	54	77.2
Alberta	243,937	203	83.2
British Columbia	218,862	130	59.4