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Impact of Hospital Transfer on Surgical Outcomes of Intestinal Atresia

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Abstract

Background—Examine effects of hospital transfer into a quaternary care center on surgical outcomes of intestinal atresia.

Methods—Children <1 yo principally diagnosed with intestinal atresia were identified using the Kids' Inpatient Database (2012). Exposure variable was patient transfer status. Outcomes measured were inpatient mortality, hospital length of stay (LOS) and discharge status. Linearized standard errors, design-based F tests, and multivariable logistic regression were performed.

Results—1,672 weighted discharges represented a national cohort. The highest income group and those with private insurance had significantly lower odds of transfer (OR:0.53 and 0.74, $p<0.05$). Rural patients had significantly higher transfer rates (OR: 2.73, $p<0.05$). Multivariate analysis revealed no difference in mortality (OR:0.71, $p=0.464$) or non-home discharge (OR: 0.79, $p=0.166$), but showed prolonged LOS (OR:1.79, $p<0.05$) amongst transferred patients.

Conclusions—Significant differences in hospital LOS and treatment access reveal a potential healthcare gap. Post-acute care resources should be improved for transferred patients.

Keywords

Atresia; Pediatrics; Regionalization; Surgery

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Presentation Information

This study will be presented as an oral presentation during the Midwest Surgical Association Annual Meeting, Mackinac Island, MI August 7–10, 2016.

BACKGROUND

The estimated incidence of small intestinal atresia is approximately 1 to 2.9 per 10,000 live births, affecting both males and females equally (1)(2). Newborns typically present with symptoms within 48 hours, which include emesis, abdominal distention, lack of bowel movement and trouble with oral feeding (2). In infants with a confirmed diagnosis of intestinal atresia, surgery must be performed expeditiously with specialized perioperative care.

Given the complex needs of infants with small intestinal atresia, a potential strategy to improve outcomes is regionalization of healthcare. The objective of utilizing a regionalized hospital network is to improve patient outcomes by centralizing specialized care and facilitating coordination of care for an illness or injury within a geographic region (3)(4)(5). Over the last decade, pediatric surgical care has undergone significant regionalization, a trend that will continue to increase (6). By centralizing specialized care for a geographical region, a population of patients born at community hospitals must undergo transfer to receive optimal surgical care (5). Surgical outcomes for these transferred patients must be studied in order to ensure quality care for patients transferred in is equivalent to that received by patients born at the treating hospital. Surgical repair of intestinal atresia represents a procedure affected by regionalization due to the necessity of a specialized surgeon, especially when utilizing the laparoscopic approach (3). Many pediatric surgeons still debate the benefits of regionalizing children's healthcare due to lack of substantial evidence on the subject (7). This study focuses on measuring patient transfer as a component of regionalization in order to assess the efficiency of centralizing specialized pediatric surgical care.

The aim of this study was to provide evidence on how regionalization can impact outcomes by studying infants undergoing surgery for intestinal atresia that were either transferred into or born at the treating hospital. Additionally, this study seeks to highlight challenges associated with regionalizing pediatric surgical care, including geographic barriers, financial incentives, and hospital and patient resources

METHODS

Data Sources

This study used the Kid's Inpatient Database (KID) for the year 2012 to identify patients with a principle diagnosis of intestinal atresia. KID, a software tool developed for the Healthcare Cost and Utilization Project (HCUP) is a public U.S. database that includes all pediatric inpatient cases, regardless of insurance status (8). This study was deemed exempt from IRB review based on the use of de-identified, publicly available patient records.

Patient Inclusion

A national cohort of patients less than one year old with a principal diagnosis of small intestinal atresia and an associated surgical intervention met our analytic criteria. Each inpatient observation was classified using the *International Classification of Diseases, Version 9, Clinical Modification (ICD-9-CM)* diagnosis code 751.1(atresia and stenosis of

small intestine). We identified surgical intervention using ICD-9-CM procedure codes 44.39, 45.01, 45.02, 45.31, 45.32, 45.33, 45.61, 45.62, 45.63, 45.03, 45.26, 45.72, 45.73, 45.74, 45.75, 45.76, 45.79, 46.01, 46.03, 46.11, 46.13, 46.20, 46.21, 46.39, 46.51, 46.52, 47.91, 45.91, 45.93, 45.94, 45.95, 46.79, 46.81, 47.99, 54.11, 54.51, 54.59, 54.95.

Outcomes and Exposure Variables

Our primary outcome was inpatient mortality between patients who were born at the treating hospital and those transferred in for surgical repair of intestinal atresia. Secondary surgical outcomes included hospital LOS, time to the operating room and discharge status. Hospital LOS was defined as the time at which the patient was admitted preoperatively to the time of discharge postoperatively. The principle exposure variable was transfer status of patients classified using the KID 2012.

Explanatory Variables

In order to account for variations in demographics and socioeconomic level, this study analyzed baseline characteristics of the study population from our dataset. Demographic analyses included gender, race, income, patient origin and insurance status (Medicaid, private, self-pay/other). Hospital characteristics included bed size, teaching status (urban nonteaching vs urban teaching), region and ownership.

Statistical Analysis

We compared surgical outcomes to assess the effect of transfer on pediatric surgery patients undergoing repair of intestinal atresia. Weighed continuous and categorical variables were compared using linearized standard errors and design-based F tests. Multivariable analysis was conducted using logistic regression based on estimation sample with standard errors based on all included strata. Statistics were performed in STATA version 13.

RESULTS

A total of 1,218 observations were identified using KID 2012 representing 1,672 patient discharges. Of these, 752 (45.0%) were patients transferred in to the treating hospital. Characteristics of patients with hospital transfer compared to those without transfer are shown in Table 1. There was no difference in transfer status based on gender, race or time of admission (weekend vs weekday). Patients transferred into the treating hospital were more likely to reside in rural regions (OR: 2.73, $p < 0.05$), while those born in the treating hospital were more likely to have incomes $> \$63,000$ (OR: 0.53, $p < 0.05$) and have private insurance (0.74, $p < 0.05$). There were no significant hospital differences found in patients transferred based on the region of hospital and ownership/profit status of hospital. In univariate comparison of surgical outcomes, there were no significant differences found (Fig 1). However when controlling for hospital factors, number of diagnoses, income, and location of patient origin using multivariable analysis, a prolonged length of stay was found for patients transferred in to treating hospital ($p < 0.005$). (Fig 1C). Inpatient mortality was found to be similar for both groups and there was no significant delay in time to operating room for transferred-in patients (Fig 1A, Fig 1D).

DISCUSSION

This study investigates the impact of regionalization on treatment of small intestinal atresia by comparing surgical outcomes of transferred patients to those who were inborn. Mortality was found to be similar in patients who were transferred into a hospital compared to those inborn, which indicates quality surgical care is maintained for both patient groups. It appears that efficient preoperative triage functions are in place, as time to operating room was not significantly different for either group. This indicates that the prolonged length of stay occurs post-op. While the mean LOS was similar between groups, though statistically significantly different, following adjustment the likelihood of having a prolonged length of stay was 1.8 times greater for transferred patients. This likely does represent a clinically meaningful difference. Potential explanations for prolonged LOS include administrative delays, post-operative complications, inadequate post-acute care resources and comorbidities.

Another finding of this study was the positive association between transfer and rural residence. Patients transferred for surgical care of intestinal atresia are more likely to come from rural areas, while those least likely to be transferred have been shown to have either a greater (>\$63,000) income or private insurance. Hence, rural patients and their families seem to be disproportionately impacted by transfers to a treating hospital. There should be a focus on maintaining continuity of quality care for patients of lower socioeconomic status and those from rural areas. One challenge facing rural patients is the travel time and distance to receive quality care at a quaternary care center. As regionalization increases, more resources are removed from local areas, so mothers in rural areas may not have access to high level prenatal care to identify intestinal atresia in the prenatal period. By regionalizing pediatric surgical care, there may be an increased burden carried by families that travel longer distances (7). Traveling further from home or local hospitals may impact health outcomes, especially preoperative education of family members and continuity of postoperative care (9).

An alternate explanation for prolonged LOS for transferred patients is the presence of comorbidities. Intestinal atresia is often associated with low birth weight, while duodenal atresia is specifically associated with congenital anomalies, with 25–40% of patients presenting with Down's Syndrome (2). Patients transferred in to the treating hospital may have represented a sicker cohort of infants, requiring a longer period of observation. Our study can contribute to the current knowledge on regionalization of pediatric care by highlighting this prolonged LOS period for transferred patients, prompting physicians to make changes in managing these patients. Patients may need early identification of discharge needs on admission, which is discussed in research by Statile et al as a crucial element to ensure timely discharge of patients (10). By setting discharge goals on admission, a physician can enlist all members of the care team to help meet this goal and prevent delayed LOS and associated medical costs. It had been shown that pediatric patients with a prolonged LOS incur larger medical costs, as opposed to patients who undergo timely discharge (11). Prolonged length of stay may also be an indicator of increased complications (11).

One major concern regarding regionalization of pediatric surgical care is the re-allocation of resources away from already underserved populations. One potential explanation for the prolonged LOS in the transferred patients is that they require additional coordination to ensure the setting they are returning to is equipped to handle their complex needs. Infants diagnosed with intestinal atresia require an integrated care team that includes neonatal intensivists, Pediatric surgeons and a high-level NICU with resources to care for all possible complications. The healthcare facility must also provide neonatal TPN and be comfortable with handling possible co-morbid conditions and congenital anomalies. With this trend towards centralization of care, pathways should be created whereby a large hospital has partnerships with smaller healthcare facilities to improve and maintain access to quality pre and post-natal care.

Since mortality rates for pediatric surgery are low, future studies on the regionalization of pediatric surgical care should investigate postoperative complications and readmissions. There should be additional research done on travel time in pediatric surgery and the interplay of family support, psychological stress, financial barriers and coordination of postoperative care (9). The care-delivery macroenvironment surrounding intestinal atresia must be better defined in order to understand how to fill pre and post-natal gaps in care. One limitation to our study was the inability to assess the baseline risk-elements of patients that contributed to the severity of disease. For patients who underwent transfer, we could not assess how long they had been treated at the first hospital or measure the quality of care given at this hospital. In addition, the use of an administrative database presents limitations, which have been well described in previous literature (12). Some of these limitations present in our study include the use of weighted national estimates and an inability to analyze continuity of care before and after transfer.

CONCLUSION

Patients transferred into the treating hospital with intestinal atresia are at risk for having prolonged LOS. This is a disparity that may indicate a need for improved post-acute resources and discharge planning.

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REFERENCES

1. Best KE, Tennant PW, Addor MC, et al. Epidemiology of small intestinal atresia in europe: A register-based study. *Arch Dis Child Fetal Neonatal Ed.* 2012; 97(5):F353–F358. [PubMed: 22933095]
2. Morris G, Kennedy A Jr, Cochran W. Small bowel congenital anomalies: A review and update. *Current Gastroenterology Reports.* 2016; 18(4) 16-016-0490-4.
3. van der Zee DC. Laparoscopic repair of duodenal atresia: Revisited. *World Journal of Surgery.* 2011; 35(8):1781–1784. [PubMed: 21604051]

4. Institute of Medicine, Committee on the Future of Emergency Care in the United States Health System. Emergency medical services at the crossroads. Washington,DC: National Academies Press; 2007.
5. Lorch SA, Myers S, Carr B. The regionalization of pediatric health care. *Pediatrics*. 2010; 126(6): 1182–1190. [PubMed: 21041285]
6. Salazar JH, Goldstein SD, Yang J, Gause, et al. Regionalization of pediatric surgery: Trends already underway. *Annals of Surgery*. 2016; 263(6):1062–1066. [PubMed: 26855367]
7. Salazar JH, Goldstein SD, Yang J, Douaiher J, et al. Regionalization of the surgical care of children: A risk-adjusted comparison of hospital surgical outcomes by geographic areas. *Surgery*. 2014; 156(2):467–474. [PubMed: 24953271]
8. Agency for Healthcare Research and Quality. [Retrieved July, 2016] HCUP databases. healthcare cost and utilization project (HCUP). 2016 Feb. from <https://www.hcup-us.ahrq.gov/kidoverview.jsp>
9. Chou S, Deily ME, Li S. Travel distance and health outcomes for scheduled surgery. *Medical Care*. 2014; 52(3):250–257. [PubMed: 24374426]
10. Statile AM, Schondelmeyer AC, Thomson JE, et al. Improving discharge efficiency in medically complex pediatric patients. *Pediatrics*. 2016
11. Pasquali SK, He X, Jacobs ML, et al. Excess costs associated with complications and prolonged length of stay after congenital heart surgery. *The Annals of Thoracic Surgery*. 2014; 98(5):1660–1666. [PubMed: 25201725]
12. Memtsoudis SG. Limitations associated with the analysis of data from administrative databases. *Anesthesiology*. 2009; 111(2):449. author reply 450-1. [PubMed: 19625813]

Summary

This study evaluates the effects of patient transfer on surgical repair of intestinal atresia by comparing surgical outcomes to those born into the treating hospital. Patients from rural areas and those of lower socioeconomic status are more likely to undergo transfer for surgical repair of intestinal atresia, but there is no difference in mortality compared with patients inborn. Regionalization serves as a potential strategy to improve surgical outcomes of complex conditions, however a prolonged length of stay for transferred patients indicates that policymakers should focus on improving post-acute care resources to facilitate coordinated care.

Figure I.

Multivariable analysis of surgical outcomes in the treatment of intestinal atresia (controlling for hospital factors, number of diagnoses, income by zip code). A. Inpatient Mortality; B. Discharge Status; C. Prolonged length of Stay; D. Delay to Operating Room.

Table 1

Baseline characteristics of study population and odds of transfer into treating hospital.

Characteristic	No Transfer (n=920)	Transfer (n=752)	P value	Odds of Transfer (OR)	p value
Gender			0.8478		
Male	474 (51.5%)	383 (51.0%)		Ref	
Female	446 (48.5%)	369 (49.0%)		1.02	0.078
Race			0.0577		
Caucasian	433 (47.1%)	294 (39.0%)		Ref	
African-American	110 (11.9%)	83 (11.0%)		1.11	0.606
Hispanic	168 (18.3%)	154 (20.6%)		1.35	0.110
Asian	39 (4.2%)	18 (2.4%)		0.68	0.240
Other	170 (18.5%)	203 (27.0%)		1.78	0.038
Income			0.0092		
\$0–38,999	263 (28.6%)	263 (35.0%)		Ref	
\$39,000 – 47,999	205 (22.3%)	187 (24.9%)		0.93	0.673
\$48,000 – 62,999	249 (27.1%)	195 (25.9%)		0.80	0.193
\$63,000+	203 (22.0%)	107 (14.2%)		0.53	0.001
Insurance			0.0624		
Medicaid	478 (52.0%)	435 (57.9%)		Ref	
Private	399 (43.3%)	270 (36.0%)		0.74	0.017
Self-Pay/Other	43 (4.7%)	47 (6.3%)		2.19	0.133
Weekend Admission			0.0758		
Yes	188 (20.4%)	185 (24.6%)		1.27	0.076
No	732 (79.6%)	567 (75.4%)		Ref	
Patient Location (Origin)			0.0316		
>=1 million (central)	307 (33.4%)	226 (30.3%)		Ref	
>=1 million (fringe)	229 (24.9%)	171 (22.7%)		1.01	0.952
250,000 – 999,999	219 (23.8%)	149 (19.8%)		0.92	0.725
50,000 – 249,999	57 (6.2%)	87 (11.6%)		2.05	0.004

Characteristic	No Transfer (n=920)	Transfer (n=752)	P value	Odds of Transfer (OR)	p value
Metropolitan	84 (9.1%)	71 (9.4%)		1.15	0.570
Rural	24 (2.6%)	48 (6.4%)		2.73	0.004
Number of Diagnoses (mean, SE)	13.5 (0.33)	12.0 (.31)	0.0008	0.97	0.001
Number of Procedures (mean)	8.1 (0.24)	7.6 (0.28)	0.1405	0.98	0.146