



## Practice variation in gastroschisis: Factors influencing closure technique



Jennifer Stanger, Noosheen Mohajerani, Erik D. Skarsgard  
Canadian Pediatric Surgery Network (CAPSNet)

Division of Pediatric Surgery, Department of Surgery, BC Children's Hospital, University of British Columbia, Vancouver, BC, Canada

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### ABSTRACT

**Background:** Little is known about the factors influencing surgical practice variation in newborns with gastroschisis. The purpose of this study was to correlate prognostic variables with the intended and actual abdominal closure technique and assess related outcomes.

**Methods:** GS cases were abstracted from a national database. Variables evaluated included GA, BW, bowel injury severity (GPS), neonatal illness severity (SNAP-II), inborn status, center volume and training status, and admission time. Evaluated outcomes by closure method included duration of TPN, LOS, and complications. Descriptive, univariate and multivariable regression analyses were conducted.

**Results:** The cohort consisted of 679 patients. A total of 372 (55%) underwent attempted PR, of which 300 (81%) were successful, while 307 (45%) had a silo placed intentionally. Patients undergoing attempted PR were more likely to be inborn, have daytime admissions, and higher SNAP-II scores. Successful PR was predicted by low risk GPS and high volume center. With the exception of higher rates of SSI in the planned silo group, outcomes in the successful PR and planned silo groups were comparable.

**Conclusion:** Practice variation related to type of closure is predicted by situational and institutional factors (outborn, nighttime admission, and center volume), while outcome variation is attributable to patient factors rather than practice variation.

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Surgical decision-making regarding the timing and type of abdominal closure in newborns with gastroschisis (GS) is potentially influenced by patient, situation and hospital-specific factors. In an era when primary repair was the preferred method of abdominal closure, a hand sewn silo followed by delayed closure was recognized as an important rescue technique when abdominal wall closure could not be obtained owing to visceroperitoneal disproportion and the risk of development of abdominal compartment syndrome [1]. With the advent of the spring-loaded silo, routine, nonselective silo placement has been advocated as a technique yielding comparable outcomes with the added advantage of avoiding out of hours surgery [2,3]. Little is known about the factors which determine choice of closure technique, and the comparability of the outcomes achieved.

Significant practice variation exists in the perinatal care of newborns with GS which may be a contributing factor to outcome variation [4]. Protocol-driven patient care in gastroschisis is rare [5]. While most modern series report survival rates of greater than 90%, the associated morbidities are less well reported [6–8]. Efforts to standardize patient care are limited by a lack of appropriately risk-adjusted studies to predict which management strategies are associated with superior

outcomes. With the rates of GS increasing and the potential increased burden of disease and associated costs of care, improved predictive models leading to standardized care pathways are needed [1].

The purpose of this study was to use the population-based CAPSNet database to analyze the factors involved in the surgical management of newborns with GS, with an intent of understanding the determinants of surgical practice variation and identifying factors (if any), that contribute to outcome variation.

### 1. Methods

The Canadian Pediatric Surgery Network (CAPSNet) consists of 17 perinatal/surgical centers that provide population-based care for GS in Canada. The CAPSNet database captures prospective data that describe prenatal diagnosis and postnatal treatment and outcome up to the point of hospital discharge. The database was designed specifically for outcomes research and contains fields that allow discrimination of risk variables and treatment, timing and type of surgical management, as well as relevant clinical outcomes. Details of data collection, privacy protection, and use of aggregate data for research purposes have been described previously [6]. For the purpose of this study, the CAPSNet GS database was interrogated for all “completed” cases (i.e. those who survived or died to index hospitalization discharge) accrued between May 2005 and December 2011.

\* Corresponding author at: Division of Pediatric Surgery, BCCH, K0-110 ACB, 4480 Oak Street, Vancouver, BC V6J 4K7. Tel.: +1 604 875 2548; fax: +1 604 875 2721. E-mail address: [eskarsgard@cw.bc.ca](mailto:eskarsgard@cw.bc.ca) (E.D. Skarsgard).

Data abstracted included neonatal risk factors (gender, gestational age {GA}, birth weight {BW}), delivery factors (mode of delivery, inborn status, time of admission) and surgical factors (closure intent/success, GS case volumes of the treating center, and whether the treating center hosts a pediatric surgical training program). Patient risk stratification was also performed using the validated Score for Neonatal Acute Physiology-II (SNAP-II) and the Gastroschisis Prognostic Score (GPS) [9,10]. GPS uses a standardized visual assessment of the intestine by the surgeon at initial consultation to categorize the baby as low or high risk for adverse outcome. Time of day of admission was classified as daytime if the baby arrived between 0800 h and 2000 h. Outcomes of interest included length of stay (LOS), timing of enteral feeding, duration of total parenteral nutrition (TPN), duration of mechanical ventilation and complications including culture-proven bacteremia and surgical site infection (SSI).

The primary study cohort compared patients that underwent primary repair (PR) (defined as patients undergoing attempted abdominal closure within 6 hours) to those for whom a silo was placed to facilitate delayed closure. This comparison sought factors that were predictive of choice of one closure technique over the other, as well as a comparison of outcomes. A subset analysis was conducted on patients in whom PR was attempted: Patients undergoing successful PR were compared to those for whom attempted PR was unsuccessful, to see if there were variables which predicted success, and to observe outcome differences between groups.

Data were analyzed using SPSS version 21 for Windows software (IBM software Inc, Chicago, IL). Descriptive, univariate and multivariable regression analyses were performed. Student's t test was employed for continuous variables, and the chi-squared test for categorical variables. A double sided p-value of <0.05 was considered significant.

**2. Results**

Between May 2005 and December 2011, 694 babies with gastroschisis had “completed” entries in the CAPSNet database, of which 679 were included in the study cohort. Fifteen patients were excluded owing to missing data. The average GA of all patients was 35.8 weeks and the average BW 2557 grams. Males comprised 52.1%

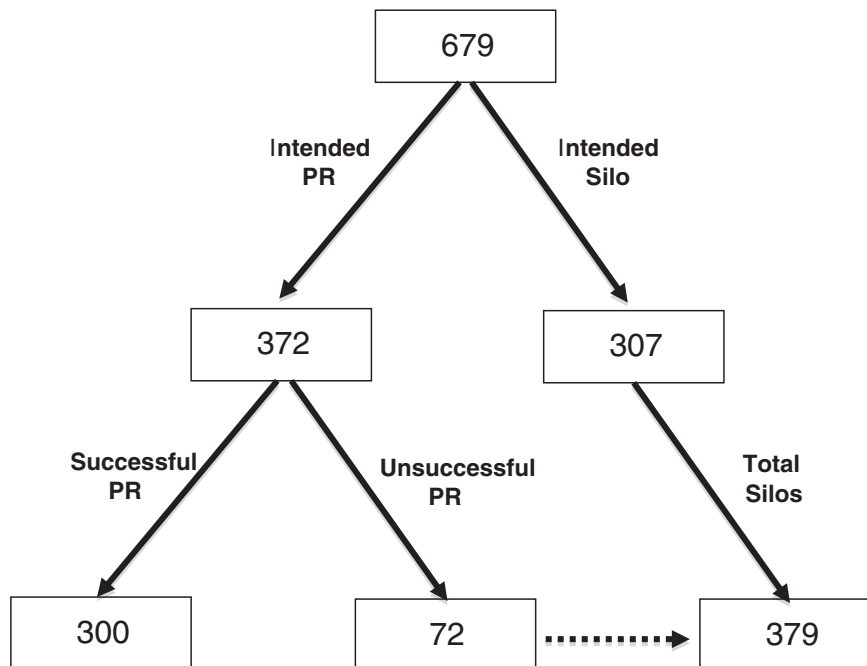
(n = 360) of the study population. Over half of the patients were classified as inborn (n = 398, 57.6%) and 52.8% (n = 365) were managed in high volume centers (defined as a center that treats 9 or more patients with gastroschisis each year). Time of day of admission was only available for patients treated between 2005 and 2010 (n = 540), with 54.4% (n = 294) being born during the daytime.

The 679 patient study cohort was classified according to the intended and actual surgical technique used to achieve abdominal closure, as summarized in Fig. 1. Closure intent was PR in 372 patients, and of these, closure was successful in 300 (81%). A total of 379 patients underwent silo placement and delayed abdominal closure, and of these, 72 had failed initial attempts at PR. Comparison of the groups according to actual closure technique demonstrated similarities in GA, BW, gender, mode of delivery and GPS (Table 1). Patients undergoing PR had a higher mean SNAP-II score (11.1 vs. 7.21, p < 0.001). Silo placement was more likely if patients were born at night (OR 1.49; 1.06–2.1), managed in a high volume center (OR 1.39; 1.03–2.0) or were outborn (OR 8.41; 5.9–11.9). On multivariate regression analysis, SNAP-II score (p = 0.04), outborn delivery (p ≤ 0.001) and admission at night (p = 0.02) remained significant predictors of closure technique.

Comparison of clinical outcomes between PR and silo groups was comparable except for the SSI rates (Table 2). The SSI rate was 14.2% in the delayed closure group compared to 5.6% in the PR group (OR = 2.7; 1.6–4.6). Total ventilator days, LOS, days to enteral nutrition, days of TPN and culture-proven bacteremia were equivalent between the 2 groups.

A subset analysis was completed to determine factors that were predictive of successful PR. Patients who were managed with the surgical intent for PR (n = 372) were stratified based on success (n = 300) or failure (n = 72) of this technique, and compared with respect to their risk (Table 3) and outcome (Table 4) variables. Variables predictive of successful PR included low risk GPS (OR = 3.7; 1.9–7.4), treatment in a pediatric surgical training center (OR = 3.2; 1.7–6.0), and inborn status (OR = 2.1; 1.2–3.6).

Not surprisingly, patients for whom attempted PR was successful had significantly better clinical outcomes, than did those who failed attempted PR. Both SSI (OR = 0.17; 0.07–0.42) and culture-proven bacteremia (OR = 0.49; 0.26–0.94) were less frequent in patients



**Fig. 1.** Intended and actual surgical closure of 679 gastroschisis patients. Flow diagram illustrates the distribution of gastroschisis patients according to intended and actual surgical treatment received.

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