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Spontaneous onset of labor, not route of delivery, is associated with prolonged length of stay in babies with gastroschisis

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ABSTRACT

Background/Purpose: We studied obstetric delivery practices for fetal gastroschisis and correlated this with neonatal outcomes. Our objectives were to identify changes in delivery practices over time and to determine if these changes resulted in improved neonatal outcomes.

Methods: After IRB approval, maternal and neonatal records from 219 gastroschisis births between 1990 and 2008 were reviewed. Obstetrical data and neonatal data were collected. Univariate comparisons were made between maternal delivery variables and neonatal outcomes. Significant and clinically relevant obstetrical variables were combined for multivariate linear regression modeling.

Results: The practice of elective cesarean delivery (ELCS) shifted to spontaneous vaginal delivery (sVD) over time ($p < 0.001$). Babies born by sVD had longer hospitalization than those born by ELCS (median 36.0 vs 21.6 days, $p < 0.05$). Gestational age (GA) and birth weight were similar between groups. Babies born by induced VD (iVD) had short hospitalization (median 22.5 days). A linear regression model demonstrated that spontaneous onset of labor (SOL) and GA were independently related to LOS.

Conclusions: Over nearly two decades, delivery of gastroschisis babies shifted from ELCS to sVD, a practice associated with a significantly longer LOS. Regression models suggest that shorter LOS could be achieved if elective delivery modes are utilized prior to SOL.

Many retrospective studies have tried to determine if there is any relationship between the mode of delivery, gestational timing of delivery, and neonatal outcomes in gastroschisis. These are very difficult questions because many clinical variables are interrelated, affecting each other and neonatal outcomes. For example, most early studies which examined the effect of cesarean delivery (CS) on gastroschisis outcome did not stratify patients according to the medical indication for CS [1–6]. Gastroschisis babies born after emergency CS could have very different neonatal outcomes in comparison to babies born after elective CS. Similarly, early studies did not stratify vaginal delivery (VD) into those which were spontaneous (sVD) and those which were induced (iVD) [2,6–8]. For these reasons, meta-analyses have questioned the quality of prior studies [9].

The optimal timing of delivery has been another area of controversy. It is clear that babies with gastroschisis deliver prematurely at an average gestation of about 36 weeks [10–12]. Earlier gestational delivery is also associated with worse outcomes in terms of time to feeding and length of stay [10,13]. But there is also a higher risk of stillbirth in fetuses with gastroschisis [14], and there is suspicion that term gastroschisis babies have a greater degree of intestinal peel [15,16]. It is with this background that at least 20 studies have tried to examine whether preterm delivery of babies with gastroschisis could improve neonatal outcome. As summarized elsewhere [17], most of the studies have been small, retrospective, and often compared different modes of delivery along with different gestational ages. Not surprisingly, about half of the studies which examined length of stay showed benefit for early delivery and half did not [17].

We have previously examined a large cohort of babies with gastroschisis [11] and incidentally noted that there had been a change

Abbreviations: LOS, length of stay; ELCS, elective cesarean delivery; SOL, spontaneous onset of labor; sVD, spontaneous vaginal delivery; iVD, induced vaginal delivery; GA, gestational age; CS, cesarean delivery; VD, vaginal delivery; BW, birth weight; NRFS, non-reassuring fetal status; NELCS, non-elective cesarean delivery; NEL-iVD, non-elective induced vaginal delivery; sVD-NELCS, failed spontaneous vaginal delivery followed by non-elective cesarean delivery; iVD-NELCS, failed induced vaginal delivery followed by non-elective cesarean delivery; sELCS, elective cesarean delivery after spontaneous onset of labor.

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in delivery mode practice over time. We reviewed the same cohort of patients with focus on delivery practices. We wished to understand how obstetric practices had changed over time and whether these changes in practice resulted in improved neonatal outcomes. We also aimed to further elucidate how clinical variables, such as induction of labor, SOL, and gestational age could affect neonatal LOS.

1. Methods

The study design was approved by the Institutional Review Board (#040701) at Vanderbilt University. We performed a retrospective chart review of all mothers with fetal gastroschisis who were cared for at Vanderbilt University and their resulting inborn babies over the period of 1990 to 2008.

For every mother, all obstetric documentation was examined. This included all outpatient and inpatient obstetric, attending physician, resident, nursing, and student notes. Maternal data were not considered complete unless clear documentation of decision-making was evident. Data were collected on the fetal gastroschisis diagnosis, the intended route of delivery (vaginal or cesarean), complications forcing a change in the planned route of delivery, and the eventual delivery mode. The delivery mode specified whether the delivery was elective or non-elective and whether the delivery was spontaneous or induced.

Neonatal data were collected on birth year, GA in weeks, birth weight (BW), surgical closure, time to first feed, time on TPN, and length of stay (LOS). Time to first feed was the number of days from birth to the first enteral feeding. Time on TPN was the number of days from birth to the day when the TPN was discontinued. Only patients with complete maternal and neonatal data collection were included in the study.

For statistical analysis, patients were grouped by spontaneous onset of labor (SOL), initial intended route of delivery, and final delivery mode as shown in Fig. 3. We defined SOL as presentation to the hospital in labor, without having received medical induction and delivery was imminent. We then grouped patients by what route of delivery (vaginal or cesarean) was intended at the time of hospital presentation for delivery. After this, patients were grouped according to the final delivery mode outcome. Patients intended for vaginal route of delivery were grouped into those having spontaneous vaginal delivery (sVD), induced vaginal delivery (iVD), and non-elective iVD (NEL-iVD) if non-elective indications were present. Patients who failed sVD or iVD and then had a non-elective CS were labeled as sVD-NELCS and iVD-NELCS. Patients intended for cesarean route of delivery were grouped into those having elective CS (ELCS) and non-elective CS (NELCS) if non-elective indications were present. Some patients presented with SOL but were intended to have cesarean route of delivery and then had an ELCS (sELCS). Patients were labeled as having non-reassuring fetal status (NRFS) for any of the following reasons: low biophysical profile, poor non-stress test, or worrisome fetal heart tracing.

Data were statistically analyzed using PASW (SPSS) v.18.0 or SAS v9.2 at a significance level of 0.05. Due to the skew of the data medians and interquartile ranges (IQR) are used to describe the continuous variables, GA, BW, and LOS. The Mann–Whitney U test and Kruskal–Wallis test for non-parametric samples were performed on data comparing 2 groups or more than 2 groups respectively on the continuous outcomes. Chi-square tests were conducted on the categorical outcomes. Multiple linear regression was used to examine predictors of LOS.

2. Results

2.1. Trends in delivery route

Between 1990 and 2008, there were 248 gastroschisis babies cared for at Vanderbilt Children's Hospital. Of these, 219 were inborn and had complete maternal and neonatal data collection. Due to low patient numbers, patients born between 1990 and 1997 were combined into one time group. We initially sought to understand how the delivery route for fetal gastroschisis changed over time. Examining VD versus CS, there was a significant trend over time towards VD (Fig. 1, Linear by linear $\chi^2_{(11)} = 31.93$, $p < 0.001$). The major point of change appeared to occur in between the years 2000 and 2001. Before 2001 the ratio of VD to CS patients was 9%:91% (n = 5:50). However, in 2002 and thereafter, the VD: CS ratio was 65%:35% (n = 96:51, $\chi^2_{(1)} = 50.6$, $p < 0.001$).

2.2. Breakdown of delivery modes

Because these trends in delivery route were likely due to changes in practice pattern, we further analyzed whether the practice of elective versus spontaneous delivery for gastroschisis changed over time. The mode of delivery was retrospectively determined for each patient and the percentage of patients delivered by ELCS, sVD, and iVD in each time period was graphed over time. As shown in Fig. 2, ELCS deliveries decreased significantly over time whereas both sVD and iVD increased over time. This suggested that the practice of delivering gastroschisis babies by ELCS had shifted to iVD or expectant management and sVD over the study period (Fisher's exact χ^2, $p < 0.001$, obtained via SAS v9.2).

The breakdown of patients according to labor presentation, initial intended mode of delivery and actual delivery outcome is shown in Fig. 3. Note that about half of the patients presented with SOL (n = 107, 49%). Within this group, 10 patients (9%) were not allowed to labor and had a cesarean delivery. The indications for this mode of delivery included the diagnosis of gastroschisis, preterm labor, spontaneous rupture of membranes, and patient choice. At the time of this analysis, these diagnoses were not absolute indications for CS, so the 10 patients were labeled as having an ELCS after SOL (sELCS). The remaining 97 patients were allowed to progress through labor to intended vaginal delivery, but only 63 of 97 (65%) eventually succeeded in vaginal delivery outcome. Thirty-four patients (35%) required non-elective cesarean (sVD-NELCS) for reasons as shown in Table 1. The vast majority of sVD-NELCS were performed for NRFS (82%).

In those patients who delivered without presentation in spontaneous labor, 47 of 112 (42%) were delivered for non-elective indications (NELCS and NEL-iVD). Again, the predominant indication for non-elective delivery was NRFS (Table 1). One third of the patients in this group had an iVD for non-elective reasons and the other two thirds had a NELCS.

Of the remaining 65 (58%) patients who were intended to deliver electively, 31 delivered by ELCS. The remaining 34 patients had attempted iVD and 30 were successful. Only 4 patients (12%) failed iVD and required non-elective cesarean (iVD-NELCS). Thus, the success rate with induction of labor in achieving VD was significantly better than that after SOL, since in the latter group 35% of patients required NELCS after attempted sVD (sVD-NELCS, 34 of 97, $\chi^2_{(1)} = 6.63$, $p = 0.01$).

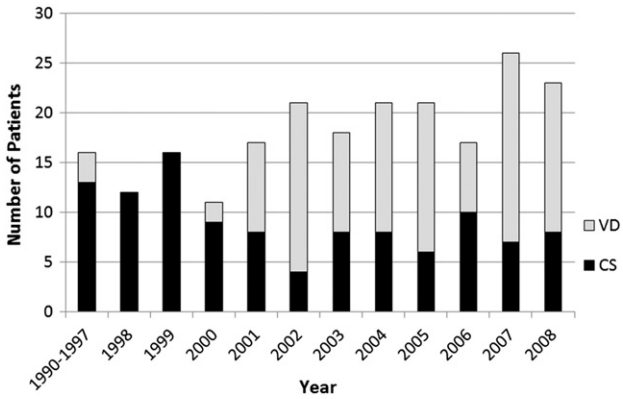

Fig. 1. Changes in delivery route over time. Patients with fetal gastroschisis delivered more frequently by vaginal delivery as time passed. VD: vaginal delivery (gray), CS: cesarean delivery (black).