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Mode of delivery and mortality among neonates with gastroschisis: A population-based cohort in Texas

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Abstract

Background: Mode of delivery is hypothesized to influence clinical outcomes among neonates with gastroschisis. Results from previous studies of neonatal mortality have been mixed; however, most studies have been small, clinical cohorts and have not adjusted for potential confounders.

Objectives: To evaluate whether cesarean delivery is associated with mortality among neonates with gastroschisis.

Methods: We studied liveborn, nonsyndromic neonates with gastroschisis delivered during 1999–2014 using data from the Texas Birth Defect Registry. Using multivariable Cox proportional hazards regression, we separately assessed the relationship between cesarean and death during two different time periods, prior to 29 days (<29 days) and prior to 365 days (<365 days) after delivery, adjusting for potential confounders. We also updated a recent meta-analysis on this relationship, combining our estimates with those from the literature.

Results: Among 2,925 neonates with gastroschisis, 63% were delivered by cesarean. No associations were observed between cesarean delivery and death <29 days (adjusted hazard ratio [aHR] 1.00, 95% confidence interval [CI] 0.63, 1.61) or <365 days after delivery (aHR 0.99, 95%

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CI 0.70, 1.41). The results were similar among those with additional malformations and among those without additional malformations. When we combined our estimate with prior estimates from the literature, results were similar (combined risk ratio [RR] 1.00, 95% CI 0.84, 1.19).

Conclusions: Although cesarean rates among neonates with gastroschisis were high, our results suggest that mode of delivery is not associated with mortality among these individuals. However, data on morbidity outcomes (e.g. intestinal damage, infection) were not available in this study.

Keywords

gastroschisis; mode of delivery; cesarean section; vaginal delivery; mortality

BACKGROUND

Gastroschisis is associated with substantial perinatal mortality (ranging from 4% to 17%).^{1–3} Neonates with gastroschisis require surgical repair of the defect and may require parenteral feeding⁴ and extended hospitalization.^{5, 6} It has been suggested that mode of delivery may influence outcomes.⁷ Because high rates of prenatal gastroschisis detection are expected (up to 90%),⁸ the opportunity exists to select the optimal delivery method for affected neonates. However, the relatively low overall prevalence of gastroschisis (2–4 cases per 10,000 livebirths)⁹ makes it challenging to assemble large cohorts at individual centers in order to evaluate the associations between mode of delivery and health outcomes of affected neonates. Thus, most studies that have evaluated these associations have been very small and underpowered (e.g., < 100 subjects delivered by cesarean). Most of these small studies have also been subject to potential selection bias related to clinical cohort recruitment at a single center. Consequently, results have been mixed, with few studies reporting associations.^{7, 10} Two systematic reviews with meta-analyses have reported no statistically significant associations between the mode of delivery and death or other health outcomes among these neonates,^{7, 10} but few of the individual studies investigating these associations utilized large, population-based samples or evaluated potential confounding factors. Thus, it remains relatively unclear if vaginal or cesarean deliveries are preferable for optimizing health outcomes in affected neonates.

Despite this lack of clarity, the cesarean delivery rates among neonates with gastroschisis are high. In a prior report from Texas, 59% of neonates with gastroschisis were delivered by cesarean, compared with 25% among total births between 1999 and 2005,¹¹ and similar rates have been reported among national U.S. samples.^{12, 13} The higher cesarean rate among neonates with gastroschisis may be related to many factors, including the notion that cesarean might improve clinical outcomes. It is hypothesized that a cesarean delivery may: 1) limit exposure to the compressive and potentially traumatic forces associated with a vaginal delivery, reducing the risk for intestinal damage during delivery in these neonates;^{14–16} 2) eliminate exposure to vaginal bacterial flora, thereby reducing risk for postoperative infections;¹⁴ and 3) reduce *in utero* harm from amniotic fluid to the exposed bowel in case of an early (e.g., elective cesarean) delivery.¹⁷ However, there is a lack of evidence supporting all of these hypothesized benefits. Thus, in the current study, we analyzed statewide data from Texas, and used secondary analyses and meta-analysis to evaluate the robustness of our estimates.

METHODS

Study Subjects

We used the Texas Birth Defects Registry to identify neonates with gastroschisis delivered between 1999 and 2014. The Texas Birth Defects Registry is overseen by the Birth Defects Epidemiology and Surveillance Branch at the Texas Department of State Health Services. Individuals with birth defects are identified through medical records by Texas Birth Defects Registry staff who conduct active surveillance at all birthing centers, hospitals, and midwife facilities throughout Texas, as previously described.¹⁸ Individuals with birth defects are included in the Texas Birth Defects Registry when a documented structural birth defect or chromosomal abnormality is present in the medical records, diagnosed prenatally or within one year of delivery. Each of these conditions is assigned a standard 6-digit modified British Pediatric Association code.¹⁹ Texas Birth Defects Registry records are routinely linked to corresponding birth, fetal death, and death data files, obtained from the Center for Health Statistics of the Texas Department of State Health Services. In order to be included in the registry, mothers of cases must have been residents of Texas at the time of delivery.

Using the Texas Birth Defects Registry, we identified neonates delivered in Texas between 1999 and 2014, with a 756.710 British Pediatric Association code for gastroschisis and a “definite” as opposed to a “possible or probable” diagnosis recorded in the Texas Birth Defects Registry. To reduce heterogeneity, we limited our analyses to liveborn neonates without chromosome abnormalities or malformation syndromes. These neonates were further classified as being isolated or non-isolated, respectively, based on the absence or presence of additional major birth defects other than gastroschisis.

For our analyses, the exposure of interest was mode of delivery by cesarean and the outcome of interest was mortality. The mode of delivery was defined based on data from the birth certificate. This information was collected slightly differently on birth certificates during two time periods. For 1999–2004 deliveries, the mode of delivery was recorded on the birth certificate based on four categories: vaginal, vaginal after previous cesarean, primary cesarean, and repeat cesarean. For 2005–2014 deliveries, the mode of delivery was recorded based on the following categories: vaginal/spontaneous, vaginal/forceps, vaginal/vacuum, and cesarean. For comparability, we collapsed categories for both time periods into two modes of delivery: vaginal delivery or cesarean delivery.

For each neonate, death status was determined during two overlapping time periods: prior to 29 days (<29 days) after the delivery date listed on their birth certificate and prior to one year (<365 days) after that date (deaths prior to 29 days were included in both outcome definitions). We analyzed two separate follow up periods due to potential differences in causes and frequency of death, and consequently potential differences in the association with mode of delivery, between the periods.^{20, 21} Deaths in the first 28 days of life are more likely to be due to intrapartum complications and prematurity than infant deaths after the neonatal period.²⁰ Infants without a Texas death certificate were assumed to be alive at both time points and censored at the end of the follow up period. Those with a death certificate were assigned the appropriate vital status at each time point, based on the date of death listed, and length of survival was calculated in days. Additionally, we reviewed the primary cause of

death listed on the certificate. In a few rare instances, when the primary cause indicated that the neonate had a malformation syndrome or chromosome abnormality (i.e., those not previously identified by the registry, perhaps due to incomplete medical records), the neonate was excluded from our analyses. Similarly, in a few instances, the neonate was excluded when the primary cause of death was due to an accident likely unrelated to the presence of gastroschisis (e.g., car accident). This study was approved by Institutional Review Boards of UTHealth at Houston and the Texas Department of State Health Services.

Statistical Analysis

We tabulated counts and proportions among neonates across several characteristics by mode of delivery (cesarean and vaginal). Differences in these characteristics by mode of delivery were assessed using chi-square tests. To analyze the relationship between mode of delivery and mortality (alive/deceased), we used Cox proportional hazards regression. We conducted separate analyses for death <29 days and death <365 days to estimate the hazard ratio (HR) and 95% confidence interval (CI). In addition to univariable analyses, we conducted multivariable analyses, adjusted for the following potential confounders (selected *a priori* from the literature): breech presentation, preterm delivery (<37 weeks), low birthweight (<2500 g), maternal race/ethnicity, and maternal education. Except for preterm delivery and low birthweight, which were abstracted from medical records, all of these co-variables were abstracted from birth certificates. All of these variables were modeled based on the categories listed in Table 1; women in the “other” race/ethnicity category were removed from Cox regression analyses due to small numbers of neonates in this subgroup. Additionally, infants with a gestational age less than 24 weeks were removed from regression analyses since obstetric interventions are not routinely recommended prior to this point in pregnancy.²²

In addition to our analyses among the full group of all nonsyndromic neonates with gastroschisis, we also repeated analyses separately among those with isolated gastroschisis (i.e., no other major birth defects present) and non-isolated gastroschisis (i.e., additional major birth defects present). Since early preterm infants (<32 weeks) have an increased risk of death compared to moderate or late preterm infants,²³ we conducted a post-hoc analysis adjusting for early preterm birth (<32 weeks gestational age). Due to observed differences in the distributions of birth year, maternal residence in a county bordering Mexico at delivery, and maternal birthplace in the U.S. by mode of delivery, we conducted a post-hoc secondary adjusted analysis, adjusting for these three variables in addition to the other variables in the main adjusted model. Finally we assessed inclusion of payment method in adjusted models to assess potential confounding. All analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC).

Combined analysis

To combine our results with previously published estimates, we retrieved 29 articles included in a recent systematic review and meta-analysis on this association,⁷ which was based on a search of literature published between 1980–2017. In addition, we used a similar search strategy (1980–March 2018)⁷ to identify four additional articles that evaluated this relationship. Using the frequencies and estimates reported in these 33 articles and the effect

estimates from our analyses in Texas, we conducted a meta-analysis. For this analysis, we used our estimate from the comparisons for death <29 days in Texas, because most of the prior estimates were based on death during the early neonatal period (e.g., by hospital discharge). Thus, we conducted three different meta-analyses, using our Texas estimates among all neonates, neonates with isolated gastroschisis, and neonates with non-isolated gastroschisis. Adjusted association estimates from prior studies were used when provided. Otherwise we used the effect estimate reported in a previous meta-analysis,¹⁰ if available, or calculated the crude risk ratio (RR) from the data provided. Odds ratio estimates were converted to risk ratios using the methods described in the Cochrane Handbook.²⁴

We evaluated potential heterogeneity between studies using the Q statistic. If the results suggested homogeneity across studies (i.e., heterogeneity $p \geq 0.1$), we calculated effect estimates using the inverse-variance fixed effects method. If the heterogeneity test was rejected (2 sided $P < 0.1$), we used a random effects model based on the DerSimonian and Laird method.²⁵ The following formula was used if the standard errors were not reported for an estimate: $[\ln(\text{upper 95\% CI}) - \ln(\text{lower 95\% CI})]/3.92$. All meta-analyses were performed using the “metan” user-program in STATA version 14.1 (StataCorp. 2017. Stata Statistical Software: Release 14. College Station, TX: StataCorp LLC).

RESULTS

Texas Analyses

During 1999–2014, there were 2,925 liveborn neonates with nonsyndromic gastroschisis. Of these, 1,837 (62.8%) were delivered by cesarean and 1,088 by vaginal delivery. There were no differences between the following characteristics and mode of delivery (Table 1): isolated versus non-isolated gastroschisis, maternal race/ethnicity, maternal marital status, 1-minute Apgar score, 5-minute Apgar score, initiation of prenatal care in the first trimester, or maternal age. Women who had a cesarean delivery were more likely to have been born in the US, resided in a county along the Mexican border, and paid by Medicaid or private insurance compared to women who delivered vaginally. Infants delivered by cesarean were more likely to be female, breech, preterm, and low birthweight compared to infants delivered vaginally.

After excluding infants with gestational age <24 weeks, there were a total of 92 deaths <29 days and 158 deaths <365 days (5.5%). In over 40% of cases, the cause of death was unknown or listed as “gastroschisis” ($n=67$; 42%). The most commonly listed cause of death in the first year was sepsis ($n=7$; 4%). The remaining 84 deaths (53%) cited 60 different causes, with no more than 5 cases sharing the same cause. While cause-specific analyses were planned, there were insufficient numbers to examine cause-specific mortality by mode of delivery.

Among the full group of neonates with gastroschisis (i.e., both isolated and non-isolated), there were no associations between mode of delivery and death <29 days (adjusted hazard ratio [aHR] 1.00, 95% CI 0.63, 1.61) or death <365 days (aHR 0.99, 95% CI 0.70, 1.41) (Table 2), after adjusting for breech presentation, preterm delivery, low birthweight, maternal race/ethnicity, and maternal education. Among 2,065 neonates with isolated gastroschisis, results were similar (Table 2). Results were also similar for neonates with non-isolated

gastroschisis (N=860); however, there were relatively few deaths in this subset of neonates (15 among those with vaginal deliveries and 30 among those with cesarean deliveries; Table 2).

In post-hoc analyses with preterm birth analyzed as <32 weeks, the results were similar to the main analyses (data not shown). Due to the observed differences in the distributions of birth year, maternal residence in a county bordering Mexico at delivery, and maternal birthplace in the U.S. by mode of delivery (Table 1), we also conducted a post-hoc secondary adjusted analysis, further adjusting for these three variables in addition to the other variables in the main adjusted model. Finally we included payment method in the adjusted model in the full group. The results of these comparisons were similar to the main results (data not shown).

Combined analysis

In addition to 29 articles reported in the recent meta-analysis,^{15, 26–53} we identified 4 more articles from the literature (e.g., published after the prior review was conducted).^{17, 54–56} We then combined results from the 29 individual studies included in the prior meta-analysis, the 4 additional studies we found, and the current study from Texas (34 total studies, eTable 1, Online Supporting Information). Because the *Q* statistic did not suggest heterogeneity in our three meta-analysis comparisons (2 sided $P>0.1$), we used fixed effects models for all of these analyses (Table 3). First, we used our adjusted estimate for risk of death prior to 29 days from our Texas analysis among all subjects. In this comparison, mode of delivery was not significantly associated with mortality among neonates with gastroschisis (combined RR 1.00, 95% CI 0.84, 1.19; Table 3; Figure 1). Results were similar in the meta-analyses for which we used our adjusted estimate from our Texas analysis among neonates with isolated and non-isolated gastroschisis, respectively (Table 3).

COMMENT

Principal findings

Based on our study results and combined results with prior studies, no association was observed between mode of delivery and mortality among neonates with gastroschisis. Our updated meta-analysis represented data from a total of 16,677 neonates with gastroschisis across 34 studies. While death was not associated with mode of delivery in our study or in two prior meta-analyses, it is possible that death represents an extreme outcome; we cannot rule out the possibility that there are clinically beneficial aspects of a cesarean delivery that might be noticeable for less severe outcomes. Unfortunately, data for other neonatal health outcomes (e.g., sepsis, time until initiation of enteral feeding) were not available for our Texas data. However, the two prior meta-analyses did not find statistically significant associations between mode of delivery and the following outcomes: length of hospitalization, sepsis, primary repair, necrotizing enterocolitis, secondary repair, sepsis, short gut syndrome, and duration until enteral feeding.^{7, 10} It is noteworthy that these outcomes have been evaluated in far fewer studies than has mortality (e.g., the most recent meta-analysis for short gut syndrome was based on only three studies),⁷ and therefore many

of these relationships are not well understood. Further, we are unaware of any studies that have assessed maternal health outcomes by mode of delivery among this population.

Strengths of the study

Our results are drawn from one of the largest population-based studies to assess the relationship between mode of delivery and death among infants with gastroschisis. Using the extensive data collected by the Texas Birth Defects Registry in addition to vital records, we were able to adjust for a number of confounding variables, remove syndromic cases, and separate cases with isolated gastroschisis from gastroschisis in the presence of multiple major defects. Finally, our combined analyses incorporated data from several additional large population-based studies to more comprehensively evaluate this relationship.

Limitations of the data

Our analyses of Texas data had several limitations. First, we could not determine whether cesarean delivery was elected as a first delivery option or not (e.g., performed after a failed vaginal delivery). Further, we also did not have information about the medical indication for the cesarean, if any. These analyses were also limited by a lack of data on the severity of the gastroschisis and a lack of data for additional health outcomes that may be clinically relevant in making decisions about delivery method. Finally, gastroschisis cases may have been lost to follow-up if a death occurred in another state, however, migration of Texas residents to another state is expected to be small (e.g. an estimated 98.3% of people living Texas in 2016 were living in Texas in 2017)⁵⁷ and would not be expected to differ by mode of delivery.

The studies included in our meta-analysis were also limited in several ways. Nearly all previous studies did not adjust for confounding. There may have been differences in characteristics between the neonates or their mothers with vaginal deliveries versus delivery by cesarean that may have affected the results and were not considered. For example, characteristics related to better health care access might be expected to be associated with both cesarean access and improved postnatal care (i.e., improved health outcomes). Furthermore, most previous studies had very small sample sizes (e.g. <50 neonates in a delivery group). There were also differences in the gastroschisis inclusion criteria between studies in our meta-analyses, such as including neonates with simple versus complex gastroschisis, neonates born in a tertiary hospital only versus neonates born in other facilities, preterm versus term neonates, and neonates with other additional congenital malformations (e.g., congenital heart defects) versus neonates with isolated gastroschisis. While this heterogeneity may have biased our meta-analysis findings, this limitation is common among systematic reviews with meta-analyses.

Interpretation

The majority of published studies evaluating the relationship between mode of delivery and mortality among infants with gastroschisis have been small and underpowered (e.g., 26 included < 100 subjects with cesarean deliveries), have not been population-based (28 studies), have not accounted for potential confounders (33 studies), and/or were based on deliveries from before the year 2000, which may not represent current trends and practices related to delivery of neonates with gastroschisis (16 studies). In fact, many of these studies

simply reported counts of subjects by mode of delivery and death status but did not evaluate the relationship between these variables as the primary research question. Our current analyses of data from Texas did not have any of these limitations, yet we did not find any statistically significant association in any of our analyses in Texas. We conducted several secondary analyses that supported the robustness of these findings.

Despite the converging consensus that cesarean delivery is not associated with improved survival (or other outcomes) among neonates with gastroschisis, the cesarean delivery rate has remained much higher among these neonates (63% in Texas in our analyses) than in the general population (e.g., 25% among total births in Texas between 1999 and 2005¹¹). We did not have data to evaluate the presence of medical indications for cesarean deliveries in our dataset. However, given the extremely high rate of cesarean deliveries for neonates with gastroschisis, it seems likely that many of these procedures were elective. In fact, in the past, some birthing centers seem to have systematically offered elective cesarean as the preferred delivery method when there is a prenatal diagnosis of gastroschisis,^{2, 11} despite the lack of evidence to support this practice. Because cesarean deliveries are associated with maternal complications, such as maternal death and postpartum infection,⁵⁸ it would be concerning if mothers of neonates with gastroschisis are having unnecessary cesarean deliveries. Future research may be helpful in better understanding why the cesarean rate is so high for these neonates and possibly to identify patient subgroups that could be targeted to reduce this rate.

In our combined analysis, the results were particularly driven by results from our findings in Texas and three additional large studies (N>2,000),^{50, 55, 56} including one recent study that was not represented in the prior meta-analyses.⁵⁶ In fact, these four sources of data combined represented 64% of the neonates in the meta-analyses and 40% of the weight in the combined effect estimate. Based on the magnitude and precision of our meta-analysis effect estimates, it seems unlikely that data from future studies would result in a meaningful change to the meta-estimate.

CONCLUSIONS

Based on both a large population-based sample and an updated meta-analysis, we found no association between mode of delivery and mortality among neonates with gastroschisis. Given the accumulation of a large number of studies that have not supported benefits to performing cesareans for these neonates, future research may focus on better understanding why cesarean deliveries are so common for these neonates.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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SOCIAL MEDIA QUOTE

Based on data from the Texas Birth Defects Registry and an updated meta-analysis representing 16,677 neonates with gastroschisis across 34 studies, no association was found between mode of delivery and mortality among neonates with gastroschisis.

SYNOPSIS

Study Question: Is cesarean delivery associated with mortality among neonates with gastroschisis?

What's already known: Results from previous studies vary widely, however, the majority of studies have been small, based on patients in a single clinical center, and unadjusted for potential confounders.

What this study adds: After adjusting for a number of potential confounders, we found no association between mode of delivery and mortality in a large, population-based study of infants with gastroschisis in Texas and when combining our results with prior studies.

Figure 1.
Combined analysis of mode of delivery and mortality among neonates with gastroschisis.

Table 1.

Characteristics of neonates with gastroschisis by mode of delivery in Texas, 1999–2014

Variable	Vaginal Delivery N (%)	Cesarean Delivery N (%)
Total	1,088 (100%)	1,837 (100%)
Maternal characteristics		
Age		
< 20	466 (42.8%)	736 (40.1%)
20 – 24	453 (41.6%)	767 (41.8%)
25 – 29	123 (11.3%)	249 (13.6%)
30 – 34	35 (3.2%)	62 (3.4%)
35	11 (1.0%)	23 (1.3%)
Race/ethnicity ^a		
White non-Hispanic	379 (34.9%)	630 (34.3%)
Black non-Hispanic	73 (6.7%)	127 (6.9%)
Hispanic	609 (56.0%)	1,045 (56.9%)
Other	26 (2.4%)	35 (1.9%)
Education ^a		
< High school	440 (40.8%)	681 (37.2%)
High school	397 (36.8%)	674 (36.8%)
> High school	241 (22.4%)	478 (26.1%)
Married ^a		
Yes	375 (34.5%)	620 (33.8%)
No	713 (65.5%)	1,216 (66.2%)
Born in U. ^a		
Yes	831 (76.7%)	1,524 (83.1%)
No	252 (23.3%)	311 (17.0%)
Resided along Mexican border ^c		
Yes	69 (6.3%)	318 (17.3%)
No	1,019 (93.7%)	1,519 (82.7%)
First trimester prenatal care ^a		
Yes	596 (60.8%)	1,037 (62.5%)
No	385 (39.3%)	622 (37.5%)
Type of payment for delivery ^{a,b}		
Medicaid	497 (66.3%)	938 (69.5%)
Private insurance	111 (14.8%)	256 (18.9%)
Self-pay	94 (12.5%)	83 (6.2%)
Other	48 (6.4%)	73 (5.4%)
Neonatal characteristics		
Sex ^a		

Variable	Vaginal Delivery N (%)	Cesarean Delivery N (%)
Male	590 (54.2%)	927 (50.5%)
Female	498 (45.8%)	906 (49.3%)
Birth year		
1999–2002	231 (21.2%)	273 (14.9%)
2003–2006	226 (20.8%)	461 (25.1%)
2007–2010	317 (29.1%)	613 (33.4%)
2011–2014	314 (28.9%)	490 (26.7%)
Isolated gastroschisis ^{d,e}		
Yes	787 (72.3%)	1278 (69.6%)
No	301 (27.7%)	559 (30.4%)
Breech presentation		
Yes	11 (1.0%)	137 (7.5%)
No	1,077 (99.0%)	1,700 (92.5%)
Preterm delivery (<37 weeks) ^d		
Yes	525 (48.3%)	1,068 (58.1%)
No	563 (51.8%)	769 (41.9%)
Low birthweight (<2500 grams) ^d		
Yes	618 (56.8%)	1,118 (60.9%)
No	470 (43.2%)	719 (39.1%)
1-minute Apgar Score <7 ^{a,d}		
Yes	219 (20.7%)	416 (23.0%)
No	839 (79.3%)	1,390 (77.0%)
5-minute Apgar Score <7 ^{a,d}		
Yes	75 (7.1%)	111 (6.1%)
No	985 (92.9%)	1,698 (93.9%)

^aTotal for this covariate does not add up the total due to missing values

^bReported only for neonates delivered during years for which this variable was present on Texas birth certificates (2005–2014)

^cResided in a county bordering Mexico at the time of delivery

^dData abstracted from medical records (the source of other variables was from birth certificates)

^eNo other major birth defects present

Table 2.

Unadjusted and adjusted hazard ratios for the relationship between cesarean section delivery and death by <29 days and <365 days among neonates with gastroschisis in Texas, 1999–2014

Analytic Group	Death ^a				Crude HR (95% CI)	Adjusted HR ^b (95% CI)
	No		Yes			
	Vaginal delivery	Cesarean Section delivery	Vaginal delivery	Cesarean Section delivery		
Full group						
<29 days	1,028	1,735	28	64	1.38 (0.88–2.17)	1.00 (0.63, 1.61)
<365 days	1,006	1,695	50	104	1.24 (0.88–1.74)	0.99 (0.70, 1.41)
Isolated ^c						
<29 days	750	1,217	13	34	1.72 (0.89, 3.32)	1.18 (0.60, 2.35)
<365 days	740	1,206	23	45	1.25 (0.75, 2.08)	0.94 (0.55, 1.60)
Non-isolated ^d						
<29 days	278	518	15	30	1.06 (0.57, 1.96)	0.82 (0.43, 1.57)
<365 days	266	489	27	59	1.15 (0.73, 1.81)	0.97 (0.61, 1.55)

HR, hazard ratio; CI, confidence interval

^aInfants with gestational age <24 weeks excluded from analyses

^bAdjusted for breech presentation, preterm delivery (<37 weeks), low birth weight (<2500 g), maternal race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic), and maternal education (<high school, high school, >high school)

^cNo other major birth defects present

^dOne or more other major birth defects present

Table 3.

Combined risk ratio from 34 studies comparing mode of delivery and death among neonates with gastroschisis based on a fixed effects model

	Combined RR ^a (95% CI)	Heterogeneity <i>p</i>
Full group	1.00 (0.84, 1.19)	0.40
Isolated ^b	1.02 (0.85, 1.22)	0.39
Non-isolated ^c	0.99 (0.83, 1.18)	0.39

RR, risk ratio; CI, confidence interval

^aCesarean section delivery was modeled as the exposed category

^bNo other major birth defect present

^cOne or more other major birth defects present