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The association between gestational age at delivery, closure type and perinatal outcomes in neonates with isolated gastroschisis

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Abstract

Objective: The objective of this study was to examine the association between gestational age at delivery and closure type for neonates with gastroschisis. In addition, we compared perinatal outcomes among cases of gastroschisis based on the following two factors: gestational age at delivery and abdominal wall closure technique.

Methods: This was a retrospective cohort study of all fetuses with isolated gastroschisis that were diagnosed prenatally and delivered between September 2000 and January 2017, in a single tertiary care center. Neonates were compared based on the gestational age at the time of delivery: early pre-term (less than $35^{0/7}$ weeks), late pre-term ($35^{0/7}$ – $36^{6/7}$ weeks), and early term ($37^{0/6}$ -$38^{6/7}$ weeks), using bivariate and multivariate analyses. The primary outcome was the type of abdominal wall closure: primary surgical closure or delayed closure using spring-loaded silo. Secondary outcomes included length of ventilatory support, length of parenteral nutrition, , and length of hospital stay.

Results: The analysis included 206 pregnancies complicated by gastroschisis. In univariate analysis, no differences were detected in primary closure rates of gastroschisis among the gestational age at delivery groups (67.4%, at <35 weeks, 70.8% at $35^{0/7}$ – $36^{6/7}$ weeks, 73.7% at $37^{0/6}$ -$38^{6/7}$ weeks, p=0.865). However, for every additional 100 grams of neonatal live birth weight there was an associated 9% increased odds of primary closure (OR 1.09, 95% CI 1.14-1.19, *P*=0.04). Delivery in the early preterm period compared to the other two groups, was associated with longer duration of ventilation support and longer dependence on the parenteral nutrition.

Neonates who underwent primary closure had shorter ventilation support, shorter time to initiation of enteral feeds and to discontinue parenteral nutrition, and shorter length of stay. In multivariate analyses, controlling for gestational age at delivery and presence of bowel atresia, primary closure continued to be associated with shorter duration of ventilation (by 5 days), earlier initiation of enteral feeds (by 7 days), shorter hospital stay (by 17 days) and lower odds of wound infection (OR=0.37, 95% CI 0.15 - 0.97).

Conclusions: Our study did not find an association between gestational age at delivery and the rates of primary closure of the abdominal wall defect; however later gestational age at delivery was associated with shorter duration of ventilatory support and parenteral nutrition dependence. In addition, we found that primary closure of gastroschisis, compared with delayed closure technique, was associated with improved neonatal outcomes, including shorter time to initiate enteral feeds and discontinue parenteral nutrition, shorter hospital stay, and lower risk of surgical wound infection. Therefore, postponing delivery of fetuses with gastroschisis until 37 weeks may be considered. Other factors besides the gestational age at delivery should be explored as predictors of primary closure in neonates with gastroschisis.

Introduction

The prevalence of gastroschisis, defined as a congenital paraumbilical abdominal wall defect with evisceration of the fetal intestines, has been increasing over the last two decades both in Europe and in the United States.[1-2] Despite advances in prenatal diagnosis and post-delivery medical care of neonates with this condition, significant morbidity and mortality remain associated with gastroschisis in the newborn period. Affected neonates can endure long hospitalizations due to complications of prematurity, bowel ischemia or atresia, sepsis, prolonged ventilator support, and dependence on total parenteral nutrition.[3]

There are several controversies in the management of gastroschisis including timing of delivery and neonatal abdominal closure techniques. In-utero, fetuses with gastroschisis may experience growth restriction, significant bowel inflammation, and fetal demise.[4-7] In light of these prenatal risks, several studies recommended earlier delivery in order to decrease in-utero intestinal exposure to the toxic environment of the amniotic fluid, thought to be contributing to bowel injury , while other studies found improved perinatal outcomes when postponing delivery until the early (37 weeks) and full (39 weeks) term period.[8-13]Currently, the best possible timing of delivery of these neonates remains controversial.

Optimal abdominal closure technique is another controversy that surrounds management of gastroschisis. With the advent of the spring-loaded silo, staged closure technique has been utilized more frequently, with few studies reporting comparable outcomes to the primary closure technique.[14-15] However, the latter remains the treatment of choice both in Europe and in North America, achieving the closure in one procedure, leading to earlier introduction of enteral feeding and decreased length of hospitalization.[16-19]

The purpose of this study was to examine the association between gestational age at delivery and closure type for neonates with gastroschisis at a single center where elective late preterm delivery is routinely practiced. In addition, we compared perinatal outcomes among cases of gastroschisis based on the following two factors: gestational age at delivery and abdominal wall closure technique.

Materials and Methods

This was a retrospective cohort study of all fetuses with isolated gastroschisis that were diagnosed prenatally and delivered between September 2000 and January 2017 at the Medical College of Wisconsin and Children's Hospital of Wisconsin. Neonates with incomplete prenatal or postnatal records and those confirmed to have omphalocele were excluded. Medical College of Wisconsin and Children's Hospital of Wisconsin Institutional review board approvals were obtained before initiation of this study (PRO00016648). Neonates were compared based on the gestational age at the time of delivery: early pre-term (less than $35^{0/7}$ weeks), late pre-term ($35^{0/7}$ – $36^{6/7}$ weeks), and early term ($37^{0/6}$ -$38^{6/7}$ weeks). At the study institution, routine practice is to deliver fetuses with gastroschisis between 35 and 37 weeks. The surgical practice at our institution is to attempt primary closure when possible in all patients. Silos are placed if there is a concern for the viability of the bowel or for inadequate abdominal domain.

Demographic and baseline clinical data, including gestational age at delivery, maternal age, smoking status, induction of labor, presence of fetal growth restriction and administration of antenatal corticosteroids were abstracted from the clinical records. Neonatal data collected included birth weight, gender, abdominal closure type, length of ventilator support, length of parenteral nutrition, length of hospital stay, and the presence of the following adverse neonatal outcomes: necrotizing enterocolitis, bowel atresia, short gut syndrome, defined as the requirement to have parenteral nutrition after discharge, parenteral nutrition-associated cholestasis, surgical site infection, sepsis, respiratory distress syndrome and rates of perinatal death. Type of abdominal closure was defined as either primary or delayed with silo placement. Time to full enteral feeding was defined as achieving 150mg/kg/day feeds. Short gut syndrome was defined as a >50% loss of small intestine. Necrotizing enterocolitis was defined as either surgically identified or pneumatosis intestinalis on imaging. parenteral nutrition - associated cholestasis was defined as direct hyperbilirubinemia >2mg/dL. Sepsis was defined as culture-proven cases only. Primary outcome was defined as the type of abdominal wall closure. Secondary outcomes included length of ventilatory support, length of parenteral nutrition, and length of hospital stay.

All data was analyzed using Stata version 14.0 (StataCorp College Station, TX). Univariable analysis was performed using the Kruskall-Wallis test or Fisher's Exact test. Multivariable regression was performed on outcomes reaching statistical significance in the univariate analysis. In addition to examining the association between gestational age at delivery and closure type, we also assessed the association between neonatal birth-weight and closure tpe with a multivariable linear regression. Student's t-test was used to compare mean outcomes based on closure type. One-way analysis of variance (ANOVA) was used to determine differences in outcomes between the three groups of gestational age with Scheffe multiple comparison test when appropriate. Tukey's honestly significant difference test was used for post-hoc analysis of the ANOVA results. Statistical significance was set at $P<0.05$.

Results

During the study period a total of 206 pregnancies met inclusion criteria. Table 1 depicts overall maternal and neonatal characteristics comparing the groups by gestational age at delivery. The groups differed by administration of antenatal corticosteroids, induction of labor, and neonatal birth weight. The remaining demographics were similar between the groups.

Table 2 describes neonatal outcomes by gestational age at delivery. Cesarean delivery was more frequent during the early and late preterm groups than during the term group. When comparing groups by gestational age at delivery alone, no differences were detected in primary closure rates among the gestational age groups. However, for every additional 100 grams of neonatal live birth weight there was an associated 9% increased odds of primary closure (OR 1.09, 95% CI 1.14-1.19, P=0.04). The duration of ventilation support continued to decrease as gestational age at delivery increased. Time to initiation of enteral nutrition was significantly longer among neonates delivered in the early preterm period compared to the other two groups, and time to discontinue parenteral nutrition was shorter as gestational age at delivery increased. Similarly, the length of stay was inversely associated with gestational age at delivery (Figure 1).

There were a total of 5 cases of intrauterine fetal demise in this cohort, all occurring during the late preterm period group, $35^{0/7} – 36^{6/7}$ weeks. In addition, there were 11 cases of neonatal death, 3 in the early preterm period (6.8%) 7 during the late preterm group (5.0%), and 1 at term (5.0%) (p=0.890).

In multivariable analyses, controlling for potential confounders, including administration of corticosteroids and indication for induction of labor, mode of delivery was not associated with gestational age at delivery (Table 3). In contrast, duration of ventilation support and time to discontinue parenteral nutrition were significantly shorter among neonates delivered during the later preterm and term groups, compared to the early preterm period group (Table 3).

A separate analysis was performed comparing neonatal outcomes by the closure type, after exclusion of 5 fetuses due to in-utero demise and 2 neonates who never underwent gastroschisis closure (n=199) (Table 4 and 5). In univariate analysis, neonates who underwent primary closure had shorter ventilation support, shorter time to initiation of enteral feeds and to discontinue parenteral nutrition, and shorter length of stay. In multivariate analyses, controlling for gestational age at delivery and presence of bowel atresia, primary closure continued to be associated with shorter duration of ventilation (by 5 days), earlier initiation of enteral feeds (by 7 days), shorter time to discontinue parenteral nutrition (by 11 days) shorter hospital stay (by 17 days) and lower odds of wound infection (Table 5).

Discussion

In this study we did not find an association between gestational age at delivery and closure types of gastroschisis. However, the primary closure rate was associated with neonatal birth-weight.

As expected, we found that delivery at <35 weeks, compared with delivery at a later gestation, was associated with longer duration of ventilation support but also with longer time to discontinue parental nutrition. In addition, we found that primary closure of gastroschisis, compared with delayed closure technique, was associated with improved neonatal outcomes, including shorter time to initiate enteral feeds and discontinue parenteral nutrition, shorter hospital stay, and lower risk of surgical wound infection. Interestingly, neonatal outcomes of fetuses delivered during late preterm and term periods were similar, and we did not see an increase in the number of stillbirth or neonatal death in the term group.

The optimal timing of delivery for fetuses with gastroschisis remains unknown. Due to increased risk of stillbirth and bowel injury, delivery during the late preterm period is being practiced by certain medical centers. The delivery strategy at our institution is similar and pregnancies affected by gastroschisis are being delivered between $35^{0/7}$- $36^{6/7}$ weeks. A single randomized trial of elective delivery at 36 weeks showed that compared to expectant management, earlier delivery was not associated with shorter time to full enteral feeding or a shorter hospital stay but was underpowered (n=42).[20] A recent retrospective cohort review of 217 cases of gastroschisis from the U.K also demonstrated that delivery at 34-36 weeks, compared to ≥ 37 weeks, was associated with delay in reaching full enteral feeds, prolonged hospitalization and a higher incidence of sepsis.[10] In addition, a 2015 analysis of the Canadian Pediatric Surgery Network database did not find a difference in neonatal outcomes (including length of stay, parenteral nutrition duration, ventilation days, stillbirth and newborn infant death) between planned delivery at 36-37 weeks versus ≥38 weeks.[12] Our analysis of a large U.S. cohort of neonates born with gastroschisis is in line with these recent international publications and did not show a significant benefit for delivery at $35^{0/7}$- $36^{6/7}$ weeks, compared to 37-$39^{0/7}$ weeks.

When evaluating the outcome data as a function of closure type, our results show that neonates who had primary closure had better outcomes compared to those undergoing delayed closure. There is still a debate within the pediatric surgical community regarding the preferred closure technique.[21-23] A recent meta-analysis demonstrated that when neonates were randomly assigned to a closure technique, delayed closure with silo was associated with reduction in ventilation days, time to first feed and infection rates.[24] However, when all studies of gastroschisis closure type included (i.e., closure technique selected based on the institutional/temporal practice preference), then primary closure was associated with better clinical outcomes.[24] At our institution, the decision regarding closure type based on surgical judgment, with primary closure being the preferred method. Although the surgeons used the same criteria, it is likely that patients with lesser degree of intestinal peel and larger abdominal domain would have been assigned to undergo primary closure. In a few cases (N=10) the decision to pursue delayed closure was done after findings of dilated extra-abdominal intestines or bladder.We attempted to control for this bias by adjusting the analysis of closure type and neonatal outcomes for bowel complications, such as bowel artesia. However, there may still be unmeasured confounders that influenced clinical outcomes that were associated with closure type in our analysis. One of these confounders may stem from the call structure in our hospital. Currently, only pediatric surgery fellows are in-house after hours, and the attending physicians take call from home. Since we did not control for the time in the day delivery occured, there could be a potential bias of neonates delivering during night time receiving more frequently delayed closure, which can be placed without the attending physician.

In addition to the selection bias that occurred at assignment of the neonates to primary versus delayed closure type, additional limitations of our analysis should be noted. This study spanned over 17 years, and improvements in pediatric surgical and medical care over this period may account for some of the differences detected in our study as opposed to the gestational age at delivery or closure type alone. Another limitation is overall small sample size in order to detect differences in the adverse outcomes of stillbirth and neonatal death. Finally, we included all fetuses with gastroschisis and did not perform sub analyses for more complex cases such as additional organ prolapse or dilated bowel and thus we are unable to prognosticate prenatally which fetuses with gastroschisis may have worse neonatal outcomes.

There are several strengths to this study. The data were collected at a single tertiary care center with consistency in neonatal management during the entire duration of the study period. Second, our study provides important information on outcomes at a very specific gestational age of delivery during the late preterm period, $35^{0/7}$- $36^{6/7}$ weeks. Overall, the outcomes of neonates delivered at that time were similar to neonates delivered at term (≥37 weeks), including similar number of neonatal death.

In conclusion, our study shows that elective delivery of neonates with gastroschisis during $35^{0/7}$- $36^{6/7}$ weeks was associated with improved neonatal outcomes when compared to deliveries < 35 weeks; however, with similar outcomes to deliveries at ≥37 -$39^{0/7}$ weeks. No increase was seen in the rates of stillbirth or neonatal death between the late preterm and the term groups. Therefore, based on the results of our cohort, we recommend to avoid delivering neonates with gastroschisis prior to 35 weeks. We did not find an association between gestational age at delivery and the rates of primary closure of the abdominal wall defect, however, our data showed that primary closure of gastroschisis, compared with delayed closure technique, was associated with improved neonatal outcomes, including shorter time to initiate enteral feeds, shorter hospital stay, and lower risk of surgical wound infection. Therefore, primary closure should be pursued when the procedure is technically feasible Additional factors besides the gestational age at delivery, such as estimated fetal weight should be explored as predictors of primary closure in neonates with gastroschisis.

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Table 1. Demographic and clinical data for neonates with gastroschisis by gestational age group

Variable	Early preterm ($31^{0/7}$ - $34^{6/7}$weeks) (n=44)	Late preterm ($35^{0/7}$-$36^{6/7}$weeks) (n=142)	Term (≥$37^{0/7}$-$39^{6/7}$weeks) (n=20)	P-value
Maternal age	23.1 ± 4.3	22.8 ± 4.7	21.6 ± 4.0	0.609
Nulliparity	24 (54.6)	84 (59.2)	15 (75.0)	0.294
Maternal smoking	11 (25.0)	32 (22.5)	7 (35.0)	0.437
Antenatal corticosteroids	14 (31.8)	14 (9.9)	1 (5.0)	<.0001*
Fetal growth restriction	3 (6.8)	14 (9.9)	1 (5.0)	0.678
Induction of labor	15 (34.9)	111 (78.7)	16 (80.0)	<.0001**
Indication for induction of	7 (15.9)	86 (60.6)	15 (75.0)	<0.001**
labor	6 (13.6)	14 (9.8)	1 (5.0)	
Elective	21 (47.7)	14 (9.8)	2 (10.0)	
Non-reassuring FHTs	4 (9.1)	6 (4.2)	0 (0.0)	
Preterm labor/PPROM	1 (2.3)	13 (9.2)	1 (5.0)	
Dilated fetal extra-	4 (9.1)	4 (2.8)	0 (0.0)	
abdominal	0 (0.0)	2 (1.4)	1 (5.0)	
intestines or bladder	1 (2.3)	2 (1.4)	0 (0.0)	
Severe fetal growth	0 (0.0)	1 (0.7)	0 (0.0)	
Restriction				
Preeclampsia				
Labor				

Oligohydramnios				
Bleeding from placenta previa				
Birth weight, g	2,083 ± 460	2,351 ± 427	2,369 ± 547	0.002**
Gender	22 (51.2)	75 (53.2)	11 (55.0)	0.955
Bowel atresia	6 (13.6)	15 (10.6)	2 (10.0)	0.839

All data presented as mean standard deviation or N (%)
* Denotes significant difference between all three groups
**Denotes significant difference between the early preterm group and the other two groups, whereas p value between later preterm and term groups was non-significant

Table 2. Outcomes of neonates with gastroschisis by gestational age group

Outcome	Early preterm ($31^{0/7}$ - $34^{6/7}$weeks) (n=44)	Late preterm ($35^{0/7}$- $36^{6/7}$weeks) (n=142)	Term (≥$37^{0/7}$- $39^{6/7}$weeks) (n=20)	P-value
Mode of delivery	17 (56.7)	72 (77.4)	14 (82.4)	0.040*
Spontaneous vaginal	19 (43.2)	32 (22.9)	3 (15.0)	
Cesarean				
Closure type	29 (67.4)	97 (70.8)	14 (73.7)	0.865
Primary	14 (32.6)	40 (29.2)	5 (26.3)	
Staged				
Necrotizing enterocolitis	2 (4.6)	10 (7.2)	1 (5.0)	0.705
Short gut syndrome	2 (4.6)	4 (2.9)	0 (0.0)	0.609
TPN cholestasis	9 (20.5)	20 (14.1)	4 (20.0)	0.639
Wound infection	6 (13.6)	13 (9.5)	2 (10.0)	0.735
Sepsis	3 (6.8)	13 (9.5)	1 (5.0)	0.752
Respiratory distress syndrome	2 (4.6)	3 (2.2)	1 (5.0)	0.616
Ventilation support, days	8.1 ± 10.6	5.4 ± 5.5	4.4 ± 9.2	<0.001**
Time to initiate enteral feeds	24.1 ± 18.9	18.9 ± 33.2	19.3± 16.5	0.045

Time to stop TPN	37.3 ± 32.6	35.4 ± 62.1	31.3 ± 24.2	<0.001
Length of stay, days	45.9 ± 34.8	43.0 ± 38.5	35.3 ± 23.7	0.050
Stillbirth	0 (0.0)	5 (3.5)	0 (0.0)	0.315
Postnatal death	3 (6.8)	7 (5.0)	1 (5.0)	0.890

All data presented as mean standard deviation or N (%)
* Denotes significant difference between all three groups
**Denotes significant difference between the early preterm group and the other two groups, whereas p value between later preterm and term groups was non-significant
TPN, total parenteral nutrition

Table 3. Multivariable analyses for the association between gestational age at the time of delivery and perinatal outcomes

	Cesarean delivery (Adjusted odds ratio with 95% confidence interval)	Duration of ventilation support (Adjusted hazard ratio with 95% confidence interval)	Time to initiate enteral feeds (Adjusted hazard ratio with 95% confidence interval)	Time to discontinue parenteral nutrition (Adjusted hazard ratio with 95% confidence interval)	Length of hospital stay (Adjusted hazard ratio with 95% confidence interval)
Term	1 (Referent)	1 (Referent)	1 (Referent)	1 (Referent)	1 (Referent)
Later preterm delivery	1.37 (0.32 – 5.84)	1.60 (0.96 – 2.63)	1.33 (0.80 – 2.21)	1.06 (0.65 – 1.73)	1.01 (0.62 – 1.65)
Early preterm delivery	1.30 (0.26 – 6.60)	1.92 (1.08 – 3.76)	1.31 (0.68 – 2.56)	1.73 (1.01 – 3.16)	1.23 (0.64 – 2.36)
Administration of BMTZ	0.55 (0.19 – 1.62)	0.68 (0.42 – 1.11)	0.68 (0.44 – 1.08)	0.85 (0.53 – 1.33)	0.72 (0.46 – 1.12)
Indication for IOL					
Elective	1 (Referent)	1 (Referent)	1 (Referent)	1 (Referent)	1 (Referent)
Non-reassuring FHTs	16.36 (5.36 – 49.94)	0.62 (0.37 – 1.02)	0.58 (0.36 - 0.94)	0.58 (0.36 - 0.94)	0.52 (0.32 – 0.84)
Preterm labor/ PPROM	8.42 (3.09 – 22.92)	0.54 (0.33 – 0.87)	0.61 (0.38 – 1.17)	0.74 (0.47 – 1.17)	0.62 (0.39 – 0.98)
Dilated fetal extra-abdominal intestines or bladder	3.34 (0.73 – 15.22)	0.37 (0.19 – 0.74)	0.27 (0.14 – 0.54)	0.40 (0.21 – 0.79)	0.36 (0.18 – 0.71)
Severe fetal growth restriction	1.38 (0.27 – 6.98)	0.92 (0.50 – 1.69)	0.97 (0.56 – 1.67)	0.68 (0.40 – 1.17)	0.56 (0.32 - 0.98)
Preeclampsia	31.49 (2.50 - 396.60)	1.55 (0.52 – 4.64)	0.94 (0.32 - 2.82)	0.73 (0.25 - 2.16)	0.60 (0.20 – 1.78)

Labor	-	10.61 (1.36 – 82.57)	1.29 (0.17 – 9.76)	2.16 (0.28 – 16.33)	2.56 (0.34 – 19.37)
Oligohydramnios	3.68 (0.30 – 44.58)	1.12 (0.34 - 3.61)	2.03 (0.62 – 6.64)	1.39 (0.42 – 4.66)	1.43 (0.43 – 4.77)
Bleeding from placenta previa	-	0.97 (0.14 – 7.01)	8.92 (1.18 – 67.34)	83.01 (7.50 – 919.03)	0.37 (0.05 – 2.71)

*Adjusted for antenatal corticosteroids, indications for induction of labor.
IOL, induction of labor, BMTZ bethamethazone, PPROM, preterm premature rupture of membranes

Table 4. Demographic and clinical data for neonates with gastroschisis by closure type analysis

Variable	Primary Closure (n=140)	Delayed Closure (n=59)	P-value
Gestational age, weeks	35.4 ± 1.7	35.2 ± 2.4	0.554
Maternal age	22.8 ± 4.4	22.5 ± 5.0	0.693
Nulliparity	81 (57.9)	39 (66.1)	0.278
Maternal smoking	33 (23.6)	14 (23.7)	0.981
Antenatal corticosteroids	18 (12.9)	11 (18.6)	0.291
Fetal growth restriction	13 (9.3)	5 (8.5)	0.855
Induction of labor	96 (69.1)	40 (70.0)	<.0001
Birth weight, g	2,335 ± 441	2,224 ± 482	0.184
Gender	68 (49.3)	34 (57.6)	0.283
Bowel atresia	12 (8.6)	11 (18.6)	0.042

All data presented as mean standard deviation or N (%)

Table 5. Univariable and multivariable analyses for the association between gastroschisis closure type and neonatal outcomes.

Variable	Primary Closure (n=140)	Delayed Closure (n=59)	P-value	Unadjusted hazard ratio or odds ratio (95% confidence interval)*	Adjusted hazard ratio or odds ratio (95% confidence interval)*
Ventilation support (days)	4.3 ± 6.8*	10.5 ± 6.7	<0.001	**1.99 (1.46 – 2.72)**	**2.07 (1.51 – 2.84)**
Time to initiate enteral feeds (days)	17.2 ± 14.7	27.2 ± 15.3	<0.001	**1.91 (1.39 – 2.61)**	**2.03 (1.47 – 2.79)**
Time to discontinue parenteral nutrition(days)	32.7 ± 23.1	51.2 ± 42.1	0.003	**1.97 (1.45 – 2.70)**	**2.05 (1.49 – 2.81)**
Length of stay (days)	35.7 ± 30.5	60.2 ± 43.7	<0.001	**1.99 (1.46 – 2.72)**	**2.07 (1.51 – 2.84)**
Wound infection	11 (7.9)	10 (17.2)	0.051	0.41 (0.16 – 1.02)	**0.37 (0.15 – 0.97)**
Respiratory distress syndrome	2 (1.4)	3 (5.1)	0.132	0.27 (0.04 – 1.66)	0.22 (0.04 – 1.42)
Necrotizing enterocolitis	11 (7.8)	2 (3.4)	0.192	2.67 (0.58 – 12.33)	3.72 (0.74 – 18.79)
Sepsis	8 (5.7)	8 (13.4)	0.058	0.38 (0.13 – 1.06)	0.49 (0.16 – 1.50)

All data presented as mean standard deviation or N (%)
*Adjusted for gestational age at delivery, induction of labor, bowel atresia

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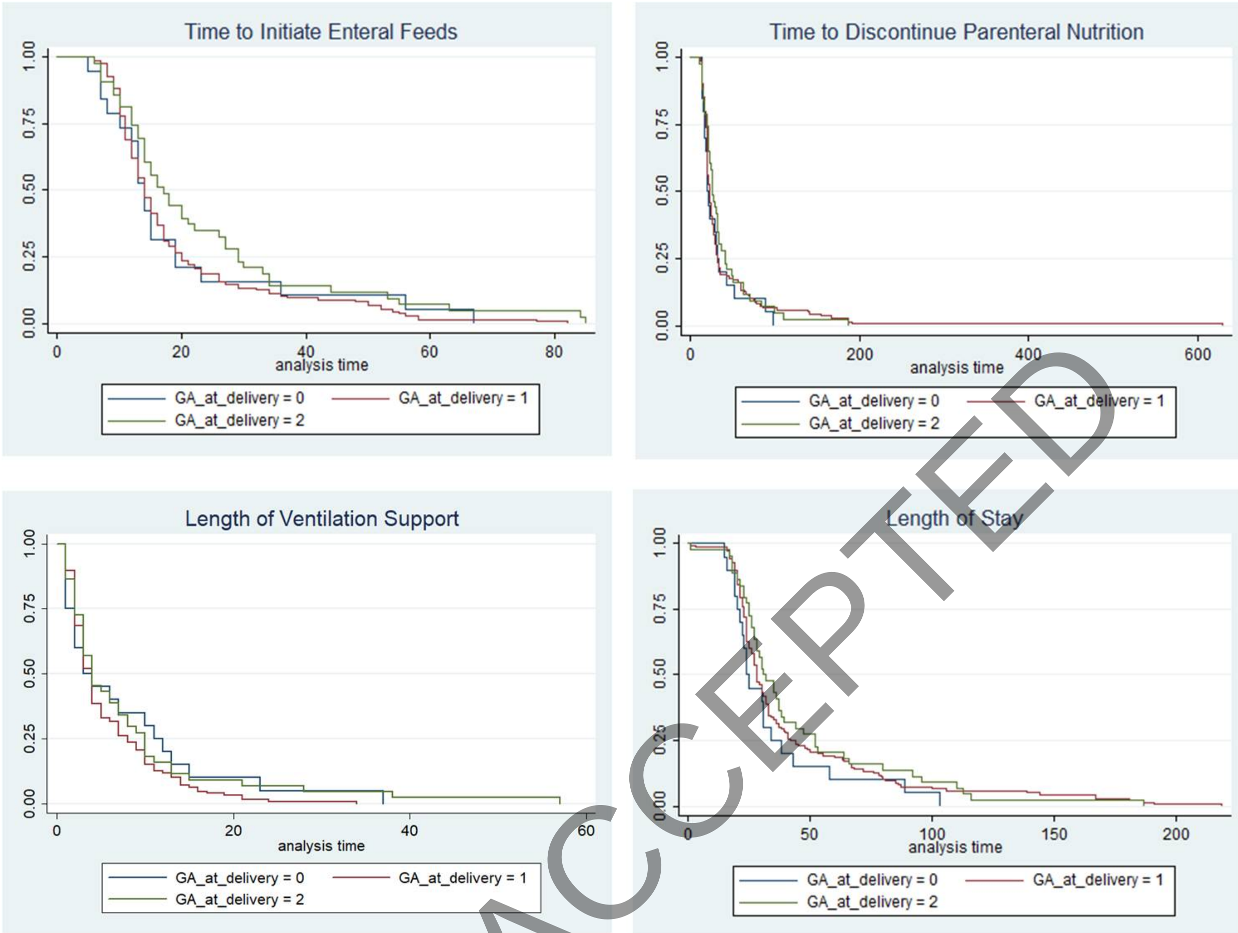
Time to Initiate Enteral Feeds
0.00
0.25
0.50
0.75
1.00
0
20
40
60
80
analysis time
GA_at_delivery = 0
GA_at_delivery = 1
GA_at_delivery = 2
Time to Discontinue Parenteral Nutrition
0.00
0.25
0.50
0.75
1.00
0
200
400
600
analysis time
GA_at_delivery = 0
GA_at_delivery = 1
GA_at_delivery = 2
Length of Ventilation Support
0.00
0.25
0.50
0.75
1.00
0
20
40
60
analysis time
GA_at_delivery = 0
GA_at_delivery = 1
GA_at_delivery = 2
Length of Stay
0.00
0.25
0.50
0.75
1.00
0
50
100
150
200
analysis time
GA_at_delivery = 0
GA_at_delivery = 1
GA_at_delivery = 2