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Perinatal Outcome in the Liveborn Infant with Prenatally Diagnosed Omphalocele

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Abstract

Objective: To compare perinatal outcomes between liveborn non-isolated and isolated omphaloceles diagnosed during a prenatal ultrasound.

Study Design: Fetuses (n=86) with omphalocele were identified between 1995-2007 at a single institution. Inclusion criteria were an omphalocele >14 weeks gestation, available fetal and/or neonatal karyotype, and a liveborn infant (n=46). Perinatal outcomes were compared in non-isolated (n=23) and isolated omphaloceles (n=23).

Results: For all omphaloceles, the majority delivered after 34 weeks by cesarean. Mean birth weight (2782 vs. 2704g), median length of stay (27 vs. 25 days), and mortality (2 in each group) was not different between the non-isolated and isolated groups, P>0.05. In the non-isolated group, 7 major anomalies were not confirmed postnatally. Of the prenatally diagnosed isolated omphaloceles, 8(35%) were diagnosed with a syndrome or other anomalies after birth.

Conclusion

The outcomes were similar in non-isolated and isolated prenatally diagnosed omphaloceles, but ultrasound did not always accurately determine the presence or absence of associated anomalies.

Key Words: omphalocele; prenatal diagnosis; perinatal outcome

Introduction

Omphaloceles are congenital midline abdominal wall defects associated with increased perinatal morbidity and mortality. Most cases are sporadic and an isolated omphalocele occurs in approximately 1:5,000 births. Prenatal diagnosis of these anomalies is now occurring at earlier gestations and detection rates have improved over the past several decades.(1) Concurrent malformations usually are the most significant predictor of fetal and neonatal death in most (2,3,4,5,6), but not all studies (7).

Interpretation of outcome data such as mortality depends on the database used for analysis. For example, studies based on prenatal databases report a wide range in neonatal mortality (0-55%),(4, 8-10) compared to those based on neonatal databases (19-34%).(11-13) However, 33-52% of gravidas have a termination of pregnancy, though this occurs predominantly in non-isolated omphaloceles and those with aneuploidy.(14-17) Furthermore, spontaneous abortions and fetal demises occur in 5.5-10% of omphaloceles.(6,16) Therefore, it is important to sort out these differences when counseling patients about both short and long term perinatal outcomes.

Determining morbidity associated with omphaloceles is equally important as the mortality. Kamata et al reported that the presence of other anomalies was not associated with increased morbidity in euploid fetuses.(18) In 15 liveborn isolated omphaloceles, a single stage procedure was possible in 67% but short and long-term complications (hypoglycemia, jaundice, incisional hernias, diaphragmatic hernias, bowel obstruction, and infections) were common.(17) Furthermore, the mean hospital length of stay for an

infant with an omphalocele was 32 days, incurring hospital costs of $141,724 in 2003.(19)

Given the discrepancy in outcomes with concurrent malformations and the mixture of inclusion criteria in other studies, the purpose of this study was to compare the perinatal outcomes between liveborn non-isolated and isolated omphaloceles diagnosed during a prenatal ultrasound.

Study Design

This study included non-isolated and isolated omphaloceles diagnosed by prenatal ultrasound from 1995 to 2007 at Indiana University Hospital. Omphalocele was defined as a congenital herniation of viscera into the base of the umbilical cord, with a covering membranous sac of peritoneum-amnion. A keyword search of the Prenatal Diagnosis Ultrasound Database at Indiana University identified subjects with "omphalocele," "gastroschisis," "abdominal wall defect," and "umbilical hernia," all of which were reviewed as potential study cases. Inclusion criteria were a sonographically diagnosed omphalocele at 14 weeks gestational age or later, available fetal and/or infant karyotype results (from amniocentesis, chorionic villus sampling, or postnatal/postmortem studies), and a liveborn infant at our institution. Subjects were excluded if another type of abdominal wall defect besides omphalocele was determined to be present after review of the subject's record. An isolated omphalocele was diagnosed when there were no other major or minor anomalies or soft markers for fetal aneuploidy present on the prenatal ultrasound. Definitions of major and minor malformations included holoprosencephaly, cardiac defects, cleft palate, duodenal atresia, ectopia cordis, amniotic band syndrome, anencephaly, spina bifida, club feet, and diaphragmatic hernia. Soft markers (choroid plexus cysts, single umbilical artery, pyelectasis, intracardiac echogenic focus, ventriculomegaly, echogenic bowel, nuchal thickness, shortened long bones) associated with aneuploidy were also reviewed. The majority of subjects had more than one prenatal ultrasound, however, it was the initial ultrasound that was used to determine the isolated vs. non-isolated categories. A cytogenetics and neonatal database provided information for all karyotypes and neonatal outcomes, respectively. An abnormal

karyotype was defined as one known to be phenotypically significant. Data collection included demographic information (maternal age, gravidity, parity, race), gestational age at diagnosis, ultrasound findings (sac contents, presence of ascites, liver location, oligohydramnios, polyhydramnios), fetal echocardiogram results, karyotypes, neonatal hospital stay, neonatal diagnoses and syndromes, primary (reduction of all contents and abdominal wall closure with a single operation) vs. staged closure, days until enteral feeding, days of mechanical ventiliaton, days until surgery, and neonatal mortality (death ≤ 28 days of life). We also reported neonatal outcomes that occurred beyond the neonatal period when the data were available.

Statistical analysis included comparisons of perinatal outcomes (those occurring prior to birth and up to 28 days of life) in non-isolated (cases) to the isolated (controls) omphaloceles via the student's t-test for continuous data, the chi-square test for categorical data, and the Mann-Whitney test for data not distributed normally (e.g. hospital length of stay). A P-value less than 0.05 was considered statistically significant and odds ratios (OR) with 95% confidence intervals (CI) were generated. The Indiana University-Purdue University at Indianapolis Institutional Review Board approved this study.

Results

Of the 86 fetuses identified as having an omphalocele, 7 had incomplete data, 14 had terminations, 14 delivered at an outside facility, and 1 had a fetal demise. Of the 14 terminations, the mean maternal age was 24.1 years, the mean gestational age at diagnosis was 15.6 weeks and 4 had abnormal karyotypes. All of the terminations were non-isolated and examples of associated defects included anencephaly, ectopic cordis, myelomeningocele, and holoprosencephaly. We were not able to follow-up on the deliveries that occurred outside our institution, but four of them were isolated and 10 had karyotypes (5 with trisomy 18). The fetal demise occurred in a fetus with other anomalies and trisomy 18. Of the remaining 50 cases, 4 did not have a karyotype. Half of the 46 eligible cases had a non-isolated omphalocele. Most karyotypes were diagnosed via amniocentesis 36/46 (78.3%) followed by neonatal blood 9/46 (19.6%), and chorionic villus sampling 1/46 (2.2%). The majority had a fetal echocardiogram, 37/46 (80.4%). There were no statistically significant differences between maternal age, gravida status, gestational age at diagnosis, and abnormal karyotype between the non-isolated and isolated omphaloceles, respectively, as shown in Table 1. The one abnormal karyotype (trisomy 18) was in the non-isolated group. Non-isolated omphaloceles were less likely to contain liver only in the sac during the prenatal imaging compared to the isolated group. However, there was no difference in the presence of ascites or an extracorporeal liver in the non-isolated and isolated groups, respectively. The types of anomalies seen in the non-isolated group are presented in Table 2.

For non-isolated and isolated omphaloceles, the majority delivered after 34 weeks, by cesarean, and with similar 5 minute Apgar scores (as shown in Table 3). There was a trend towards less birth weight extremes in the non-isolated (median 2949g with interquartile range 585g, 1 infant <1500g, none >4000g) compared to the isolated omphaloceles (median 2650g with interquartile range 1690g, 2 infants <1500g, 3 infants >4000g), respectively, P=0.17 for the medians. The median length of infant hospital stay was 27 days (interquartile range 64 days) for non-isolated and 25 days (interquartile range 50 days) for isolated omphaloceles, P=0.43. In the non-isolated group, 7 of the cardiac anomalies (either suspected atrial septal defects or ventricular septal defects) were not confirmed postnatally (Table 2). In addition, 3 cases of cloacal exstrophy and imperforate anus along with one Beckwith-Wiedemann Syndrome (BWS) were diagnosed postnatally in the non-isolated group. Of the prenatally diagnosed isolated omphaloceles, 8 infants (34.8%) were either diagnosed with a syndrome (2 BWS) or had other anomalies (4 atrial septal defects, 3 hydronephrosis, and 1 cleft palate) found after birth.(Table 4) A primary omphalocele closure occurring after 7 days, >10 days until enteral feeds, and >14 days of mechanical ventilation were not significantly different between the non-isolated and isolated omphaloceles, respectively (Table 4). The two neonatal deaths in the non-isolated group occurred with one trisomy 18 infant, and another with Pentalogy of Cantrell with Tetralogy of Fallot. The two neonatal deaths in the isolated group occurred in two preterm infants (<32 weeks), one of whom had a ruptured omphalocele. Deaths occurring up to one year of life were reported in an additional 4 non-isolated (lipid storage disease/primary myopathy at 30 days in a preterm neonate, sepsis and respiratory failure at 32 days in a term neonate, bronchopulmonary

dyplasia and sepsis at 315 days in a term neonate, and respiratory failure/pulmonary hypoplasia at 300 days in a preterm neonate) and 1 isolated omphaloceles (renal and respiratory failure at 132 days in a term neonate).

Comment

Most studies suggest that perinatal outcomes in isolated omphaloceles are usually improved compared to omphaloceles with associated anomalies (2,3,4,6,20), however, in our work the outcomes including gestational age at delivery, birth weight, delivery route, neonatal respiratory and surgical morbidity, and neonatal hospital stay were not different between the liveborn non-isolated and isolated prenatally diagnosed omphaloceles. Neonatal mortality was 9% in each group, which is in agreement with more recent prenatal studies and lower than most neonatal reports.(4, 8-13) Improvements in neonatal care may account for the decreased mortality overall and similar outcomes between the groups in our study. Mortality causes were multifactorial, but could primarily be attributed to complications of prematurity and multi-organ failure.

Extracorporeal liver location was also common in both groups which coincides with the low occurrence of fetal aneuploidy in the current study. However, an omphalocele sac containing liver only was more common in the isolated group. Previous investigators reported differing outcomes with respect to liver location and sac contents. An extracorporeal liver had a worse prognosis in two reports with survival rates of 44-48% vs. 82-86% for an intracorporeal liver.(5,21). However, Mabogunje et al. reported no difference in prognosis for an extracorporeal liver in 57 cases (18% vs. 21% mortality for intracorporeal and extracorporeal liver, respectively).(11) Conversely, deaths occurred in 60% (12/20) with an intracorporeal liver compared to 33% (6/18) for those with an extracorporeal liver.(6) With the exception of primary closure, outcomes including mechanical ventilation, hospital length of stay, neonatal morbidity and mortality for 9

infants with intracorporeal liver were similar to 27 with an extracorporeal liver in a neonatal database.(6) In summary, liver location and neonatal morbidity and mortality have inconsistent outcomes and sac contents alone on a prenatal ultrasound may not be able to predict neonatal outcomes, but liver only in the sac may provide reassurance on the diagnosis of an isolated omphalocele.

It is not surprising that twice as many infants were diagnosed with additional anomalies or syndromes in the non-isolated group, but one-third of presumed isolated cases of omphalocele on prenatal ultrasound had additional diagnoses confirmed postnatally. Similarly, not all anomalies seen prenatally (especially cardiac septal defects) were confirmed postnatally in the non-isolated group. An older study also had a lower detection rate whereby only 50% (29/58) of additional anomalies were correctly identified with prenatal ultrasound including 8/14 cardiac anomalies while six cardiac defects (4 ventricular septal defects, 1 bicuspid aortic valve, and 1 atrial septal defect) were not detected prenatally.(4) This highlights the continued difficulty in prenatal diagnosis of cardiac anomalies. Some defects (i.e. small cardiac septal defects) may resolve during the course of the pregnancy or close spontaneously in the first couple days of life. As such, counseling regarding associated anomalies and outcome depends on the type of cardiac defect and its appearance throughout the pregnancy. In addition, a prenatal ultrasound cannot diagnose all abnormalities. A seemingly isolated omphalocele may have additional associated anomalies or syndromes diagnosed after birth.

Beckwith-Weidemann syndrome (classically defined by a large for gestational age infant with an abdominal wall defect and macroglossia) is typically diagnosed in the neonatal period and occurs among 3-22% of infants with omphalocele.(22) Prenatal diagnosis has been described (22,23) primarily in the third trimester but molecular genetic testing is also available. There were three cases (6.5%, 1 non-isolated and 2 isolated) of BWS in this study and only one was suspected prenatally, but none were confirmed with molecular testing prenatally. BWS is a very complicated genetic condition that can have cytogenetic abnormalities (11p15 deletion), loss or gain of methylation, uniparental disomy for chromosome 11p15, and mutations in the CDKN1C gene. Testing for this condition should be considered prenatally when it is suspected on a prenatal ultrasound and individualized on a case by case basis in conjunction with a genetic counselor. Nearly 50% of BWS has been associated with polyhydramnios and fetal macrosomia.(24) This further highlights the importance of a follow-up ultrasound during the pregnancy to provide additional counseling to patients regarding the possibility of additional diagnoses.

Although most literature suggests no benefit to cesarean delivery, this remains the predominant delivery route with 80% undergoing a cesarean overall with 50% specifically undergoing a primary cesarean for the indication of an omphalocele. The reasons for this practice may relate to the ability to co-ordinate neonatal care with a scheduled cesarean. In addition, it is the opinion of some authors to have a cesarean for a "giant" (>5cm) omphalocele and those with extracorporeal liver.(25-30) However, there is no conclusive evidence that cesarean is beneficial for fetuses with omphalocele.

With our objective to compare outcomes in liveborn infants with omphalocele, the terminated pregnancies with multiple anomalies and/or aneuploidy were excluded. Other authors have acknowledged this exclusion as a limitation and report that <10% of all cases of antenatally diagnosed omphalocele reach an operative stage.(31) As such, these neonates are a highly selected group and this is likely an important factor in their high survival statistics. In addition to all terminated cases having major associated findings, the other main difference we noted between the terminated and liveborn cases was an earlier diagnosis in the former (15 vs. 23 weeks) which might also explain the patient's pregnancy decisions. We acknowledge that the inclusion of all gestational ages at diagnosis (15-36 weeks) enters bias into the study as omphaloceles diagnosed later in gestation would be more likely to have associated anomalies and thus increase the number of non-isolated omphaloceles, however, the mean and median gestational age.at diagnosis was similar in both groups. Only 4 subjects (2 non-isolated and 2 isolated) did not have available karyotypes. We repeated all the analyses (data not shown) placing these 4 subjects in their appropriate categories, and the findings were unchanged with the exception that there were more Caucasians in the isolated group, P=0.048. Other limitations of this study include the small sample size which may account for the lack of significant differences between the groups with respect to neonatal outcomes and the difficulty in making conclusions with confidence.

Although one can ultimately confirm the diagnosis and better determine the prognosis during the neonatal period, the obstetrician has only the prenatal ultrasound

characteristics with which to counsel gravidas regarding outcomes for infants with omphalocele. This information significantly impacts prenatal ultrasound performance and counseling of patients with a fetal omphalocele. In counseling our patients about the diagnosis of fetal omphalocele, we emphasize the limitations of ultrasound in pregnancy, the need for follow-up prenatal ultrasounds, the role of liver location in predicting neonatal outcomes, and the importance of additional neonatal evaluation. Given the information in this study, we also review the 10% neonatal mortality for a liveborn infant with this anomaly as well as a hospital length of stay of approximately 1-2 months.

References

1.Mann S, Blinman TA, Wilson DR. Prenatal and postnatal management of omphalocele. Prenat Diagn 2008;28:626-632.

2.Nyberg DA, Fitzsimmons J, Mack LA, et al. Chromosome abnormalities in fetuses with omphalocele: the significance of omphalocele contents. J Ultrasound Med 1989;8:299-308.

3.Benacerraf BR, Saltzman DH, Estroff JA, Frigoletto FD Jr. Abnormal karyotype of fetuses with omphalocele: prediction based on omphalocele contents. Obstet Gynecol 1990;75:317-9.

4.Hughes MD, Nyberg DA, Mack LA, Pretorius DH. Fetal omphalocele: prenatal us detection of concurrent anomalies and other predictors of outcome. Radiol1989;173:371-376.

5.St-Vil D, Shaw KS, Lallier M, et al. Chromosomal anomalies in newborns with omphalocele. J Pedatr Surg 1996;31:831-834.

6.Heider AL, Strauss, RA, Kuller JA. Omphalocele: Clinical outcomes in cases with normal karyotypes. Am J Obstet Gynecol 2004;190:135-41.

7.Nicholas SS, Stamilo DM, Dicke JM, Gray DL, Macones GA, Odibo AO. Predicting adverse neonatal outcomes in fetuses with abdominal wall defects using prenatal risk factors. Am J Obstet Gynecol 2009;201:383.e1-383.36.

8.Brantberg A, Blaas HG, Haugen SE, Eik-Nes SH. Characteristics and outcome of 90 cases of fetal omphalocele. Ultra Obstet Gynecol 2005;26:527-37.

9.Hidaka N, Tsukimori K, Hojo S, et al. Correlation between the presence of liver herniation and perinatal outcome in prenatally diagnosed fetal omphalocele. J Perinat Med 2009;37:66-71.

10.Boyd PA, Bhattacharjee A, Gould S, Manning N, Chamberlain P. Outcome of prenatally diagnosed anterior abdominal wall defects. Arch Dis Child Fetal Neonatal Ed 1998;78:209-213.

11.Mabogunje OOA, Mahour GH. Omphalocele and gastroschisis: trends in survival across two decades. Am J Surg 1984;148:679.

12.Mayer T, Black R, Matlak Me, Johnson DG. Gastroschisis and omphalocele. Ann Surg 1980;192:783-787.

13.Kirk EP, Wah R. Obstetric management of the fetus with omphalocele or gastroschisis: A review and report of 112 cases. Am J Obstet Gynecol 1983;146:512.

14.Stoll C, Alembik Y, Dott B, Roth MP. Risk factors in congenital abdominal wall defects (omphalocele and gastroschisi): a study in a series of 265,858 consecutive births. Ann Genet 2001;44:201-208.

15.Fratelli N, Papageorghiou AT, Bhide A, et al. Outcome of antenatally diagnosed abdominal wall defects. Ultrasound Obstet Gynecol. 2007;30:266-270.

16.Garne E, Loane M, Dolk H. Gastrointestinal malformations: impact of prenatal diagnosis on gestational age at birth. Paediatr Perinat Epidemiol 2007; 21:370-375.

17.Calvert N, Damiani S, Sunario J, Bower C, Dickinson JE. The outcomes of pregnancies following a prenatal diagnosis of fetal exomphalos in Western Australia. Aust New Zealand J Obstet Gynaecol 2009;49:371-375.

18.Kamata S, Ishikawa S, Usui N, et al. Prenatal diagnosis of abdominal wall defects and their prognosis. J Pediatr Surg 1996;31:267–271.

19.Hospital stays, hospital charges, and in-hospital deaths among infants with selected birth defects--United States, 2003. Centers for Disease Control and Prevention (CDC) - MMWR Morb Mortal Wkly Rep - 19-JAN-2007; 56(2): 25-9.

20.Wladimiroff JW, Molenaar JC, Niermeijer MF, Stewart PA, vanEyck J. Prenatal diagnosis and management of omphalocele. Eur J Obstet Gynecol Reprod Biol 1983;16:19-23.

21.Schwaitzenberg SD, Pokorny WJ, McGill CW, et al. Gastroschisis and omphalocele. Am J Surg 1982;144:650.

22.Wilkins-Haug L, Porter A, Hawley P, Benson CB. Isolated fetal omphalocele, Beckwith-Wiedemann syndrome, and assisted reproductive technologies. Birth Defects Res 2009;85:58-62.

23.Williams DH, Gauthier DW, Maizels M. Prenatal diagnosis of Beckwith-Wiedemann syndrome. Prenat Diagn 2005;25:879-884.

24.Elliott M, Maher ER. Beckwith-Wiedemann syndrome *J Med Genet.* 1994; 31: 560–4.

25.Kirk EP, Wah RM. Obstetric management of the fetus with omphalocele or gastroschisis: a review and report of one hundred twelve cases. Am J Obstet Gynecol 1983;146:512-518.

26.Lewis DF, Towers CV, Garite TJ, et al. Fetal gastroschisis and omphalocele: is cesarean section the best mode of delivery? Am J Obstet Gynecol 1990;163:773-775.

27.Lurie S, Sherman D, Bukovsky I. Omphalocele delivery enigma: the best mode of delivery still remains dubious. Eur J Obstet Gynecol Reprod Biol 1999;82:19-22.

28.Moretti M, Khoury A, Rodriquez J, et al. The effect of mode of delivery on the perinatal outcome in fetuses with abdominal wall defects. Am J Obstet Gynecol 1990;163:833-838.

29.Sermer M, Benzie RJ, Pitson L, et al. Prenatal diagnosis and management of congenital defects of the anterior abdominal wall. Am J Obstet Gynecol1987;156:308-312.

30.Sipes SL, Weiner CP, Sipes DR, et al. Gastroschisis and omphalocele: does either antenatal diagnosis or route of delivery make a difference in perinatal outcome? Obstet Gynecol 1990;76:195-199.

31.Lakasing L, Cicero S, Davenport M, Patel S, Nicolaides KH. Current outcomes of antenatally diagnosed exomphalos: an 11 year review. J Ped Surg 2006;41:1403-1406.

Table 1. Demographics and Ultrasound Data

Variable	Total (n=46)	Non-isolated (n=23)	Isolated (n=23)	P value or OR (95%CI)
Age				
Mean, SD, range (years)	25.5±5.7 (17-45)	25.0±4.5 (18-36)	26.1±6.7 (17-45)	P=0.52
>35 years (n,%)	3 (6.5%)	1 (4.3%)	2 (8.7%)	OR 0.48 (0.06-4.0)
Race (n,%)				P=0.08
Caucasian	41 (89.1%)	20 (87.0%)	21 (91.3%)	
African-American	3 (6.5%)	3 (13.0%)	0	
Hispanic	2 (4.3%)	0	2 (8.7%)	
Primigravida (n,%)	19 (41.3%)	9 (39.1%)	10 (43.5%)	OR 0.84 (0.26-2.7)
Abnormal Karyotype (n,%)	1 (2.2%)	1 (4.3%)	0	P=1.0
Gestational age at diagnosis				
Mean, SD, range (weeks)	22.9±6.1 (15.6-36.0)	22.2±5.7 (15.4-34.3)	23.8±6.4 (15.9-36.0)	P=0.38
<20 weeks	17 (37.0%)	8 (34.7%)	9 (39.1%)	OR 0.83 (0.26-2.7)

Variable	Total (n=46)	Non-isolated (n=23)	Isolated (n=23)	P value or OR (95%CI)
<24 weeks	29 (63.0%)	15 (65.2%)	14 (60.9%)	OR 1.2 (0.37-3.9)
Female gender (n,%)	23 (50.0%)	14 (60.9%)	11 (47.8%)	OR 1.70 (0.53-5.4)
Source of karyotype (n,%)				P=0.54
Amniocentesis	36 (78.3%)	19 (82.6%)	17 (73.9%)	
Chorionic villus sampling	1 (2.2%)	0	1 (4.3%)	
Neonatal blood	9 (19.6%)	4 (17.4%)	5 (21.7%)	
Contents of sac (n,%)				
Liver only	10 (21.7%)	2 (8.7%)	8 (34.8%)	OR 0.18 (0.04-0.87)
Ascites	9 (19.6%)	6 (26.1%)	3 (13.0%)	OR 2.35 (0.55-9.9)
Extracorporeal liver	32 (69.6%)	15 (65.2%)	17 (73.9%)	OR 0.66 (0.19-2.3)

SD standard deviation

Table 2: Anomalies Diagnosed on Prenatal Ultrasound (Non-isolated group)

Gestational Age at First Ultrasound	Description of Anomaly Detected on Prenatal Ultrasound	Postnatal Diagnosis
27.1	ASD [a]	Isolated omphalocele
16.9	VSD [a] Choroid plexus cyst	Isolated omphalocele
31.0	Meningomyelocele	Meningomyelocele, Bladder exstrophy, Imperforate anus
26.9	Pelviectasis	Bilateral hydronephrosis
15.6	VSD [a]	Isolated omphalocele
20.9	Single umbilical artery	Cloacal exstrophy, Imperforate anus
21.7	Bilateral club feet, Single umbilical artery	Velocardiofacial syndrome, Bilateral club feet
21.0	VSD [a], Single umbilical artery	Single umbilical artery
21.1	Pentalogy of Cantrell	Pentalogy of Cantrell
20.7	VSD [a]	Isolated omphalocele
15.4	VSD [a]	Microcephaly
30.0	Macroglossia, Polyhydramnios, Pelviectasis	Beckwith-Wiedemann Syndrome

Gestational Age at First Ultrasound	Description of Anomaly Detected on Prenatal Ultrasound	Postnatal Diagnosis
16.6	VSD	Data not available
17.7	Choroid plexus cyst	Isolated omphalocele
34.3	Left club foot	Hydrocephalus
25.4	Rocker bottom feet, Skeletal dysplasia, Polyhydramnios	Lipid storage disease/unclassified primary myopathy
30.6	Pentalogy of Cantrell, Ascites	Pentalogy of Cantrell with Tetralogy of Fallot
16.9	VSD	VSD
16.0	Single umbilical artery	Single umbilical artery
26.3	Clubbed foot, Growth restriction, VSD, ASD	Trisomy 18 (diagnosed via amniocentesis)
20.0	Bilateral club feet [a], VSD [a]	Isolated omphalocele
17.0	Meningomyelocele	Bladder exstrophy, Meningomyelocele
21.0	Ambiguous genitalia, Meningomyelocele	Bladder exstrophy, Meningomyelocele, Imperforate anus, Abnormal kidney, Ambiguous genitalia

ASD atrial septal defect, VSD ventricular septal defect; [a] Resolved prenatally or not confirmed postnatally

Table 3. Neonatal Outcomes

Variable	Total (n=46)	Non-isolated (n=23)	Isolated (n=23)	P value or OR (95% CI)
Gestational age at delivery				
Mean, SD, range (weeks)	35.6±3.2 (26-39.1)	36.0±3.0 (28.1-39.1)	35.3±3.4 (26-38.9)	P=0.46
>37 weeks (n,%)	20 (43.5%)	11 (47.8%)	9 (39.1%)	OR 1.43 (0.45-4.5)
>34 weeks (n,%)	37 (80.4%)	19 (82.6%)	18 (78.3%)	OR 1.32 (0.32-5.3)
Delivery route (n,%)				OR 2.35 (0.55-9.9)
Vaginal	9 (19.6%)	6 (26.1%)	3 (13.0%)	
Cesarean	37 (80.4%)	17 (73.9%)	20 (87.0%)	
Primary cesarean for omphalocele	23 (50%)	12 (52.2%)	11 (47.8%)	OR 1.2 (0.38-3.7)
Weight				
Mean, SD, range (g)	2736±824 (884-4460)	2782±625 (1420-3845)	2704±977 (884-4460)	P=0.75
<2500g (n,%)	15 (33.3%)	5 (22.7%)	10 (43.4%)	OR 0.38 (0.1-1.3)

Variable	Total (n=46)	Non-isolated (n=23)	Isolated (n=23)	P value or OR (95% CI)
<1500g (n,%)	3 (6.7%)	1 (4.5%)	2 (8.7%)	OR 0.5 (0.06-4.2)
5 min Apgar				
Mean, SD, range	7.6±1.8 (2-9)	7.6±1.9 (2-9)	7.6±1.7 (2-9)	P=0.85
5 min Apgar <7 (n,%)	7 (15.2%)	4 (17.4%)	3 (13.0%)	OR 1.4 (0.30-6.4)
Length of stay (days)				
Mean, SD, range	50.9 ± 65.7 (4-315)	63.5 ± 79.8 (4-315)	36.6 ± 38.0 (3-132)	P=0.17
Median	25	27	25	P=0.43 [a]
<30 days (n,%)	24 (58.5%)	10 (50.0%)	14 (66.7%)	0.50 (0.14-1.7)
Associated syndrome or anomaly diagnosed postnatally (n,%)	20 (47.6%)	14 (66.6%)	7 (33.3%)	4.0 (1.1-14.1)
Type of abdominal closure (n,%)[b]				0.61 (0.18-2.1)

Variable	Total (n=46)	Non-isolated (n=23)	Isolated (n=23)	P value or OR (95% CI)
Primary Staged	21 (51.2%) 20 (48.8%)	9 (47%) 11 (55%)	12 (57%) 9 (42.8%)	
> 10 days until enteral feeds (n,%)	12 (40.0%)	6 (42.9%)	6 (37.5%)	1.25 (0.3-5.2)
>14 days of mechanical ventilation (n,%)	13 (37.1%)	7 (43.7%)	6 (35.3%)	1.25 (0.3-5.2)
>7 days until surgery (n,%)	9 (21.4%)	4 (20%)	5 (22.7%)	0.85 (0.21-3.5)
Neonatal Mortality (n,%)	4 (9.1%)	2 (9.1%)	2 (9.1%)	1.0 (0.16-6.3)

SD standard deviation

[a] Mann-Whitney test for medians

[b] Number of infants is 41 (2 did not have an attempt at closure, 3 had missing data)

Table 4: Anomalies Not Diagnosed on Prenatal Ultrasound (Isolated group)

Gestational Age at First Ultrasound	Postnatal Diagnosis
30.9	Beckwith-Wiedemann Syndrome
22.7	Atrial-septal defect
19.4	Beckwith-Wiedemann Syndrome, Cleft Palate
22.8	Bilateral hydronephrosis, Bilateral inguinal hernias
36.0	Atrial-septal defect
34.0	Atrial-septal defect
18.0	Bilateral hydronephrosis, Atrial-septal defect
27.9	Bilateral hydronephrosis