Perinatal outcomes of antenatally diagnosed omphalocele and gastroschisis: a survey from a university hospital

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Abstract

Objective: To evaluate the clinical features and perinatal outcomes of antenatally diagnosed fetuses with omphalocele and gastroschisis.

Material and Methods: This was a retrospective, single-center, cohort study of prenatally diagnosed fetuses with omphalocele and gastroschisis followed-up and delivered at a university hospital. Demographic, pregnancy, birth and perinatal outcomes were compared between gastroschisis and omphalocele.

Results: A total of 75 fetuses with omphalocele and 21 cases with gastroschisis were evaluated. The mean maternal age of women carrying a fetus with omphalocele was significantly higher than the women with gastroschisis ($p=0.001$). Associated structural anomalies were found in 53.3% and 4.7% of fetuses with omphalocele and gastroschisis, respectively ($p<0.001$). The rate of chromosomal anomaly was 8.3% in pregnancies with omphalocele. In liveborn pregnancies, the mean gestational age at delivery and birth weight did not differ between the study groups. Time to postoperative oral intake, duration of parenteral nutrition and length of hospital stay were significantly longer in babies with gastroschisis than omphalocele ($p<0.01$). Rates of termination, intrauterine, neonatal and infant death of fetuses with omphalocele were 25.3%, 6.7%, 10.7% and 2.7% respectively. Time to postoperative oral intake, duration of parenteral nutrition and duration of hospitalization were significantly longer in babies with complex compared to simple gastroschisis ($p<0.01$). Survival rates were 95.2%, 82.9% and 20% in fetuses with gastroschisis, isolated and non-isolated omphalocele, respectively.

Conclusion: Associated structural and chromosomal anomalies were significantly more common in fetuses with omphalocele compared to those with gastroschisis. Prognosis of fetuses with omphalocele depended on the associated structural and chromosomal anomalies, whereas bowel compromise was the main determining factor in gastroschisis. (J Turk Ger Gynecol Assoc. 2024; 25: 152-8)

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Introduction

Omphalocele and gastroschisis are the two most common congenital malformations affecting the anterior abdominal wall, occurring in 1 out of every 4,000 live births (1). Omphalocele results from a defect in the midline of the abdominal wall, with compromised containment of the intestines and segments of other abdominal visceral organs. These components are enveloped by amnion, Wharton's jelly, and peritoneum (2). In contrast, gastroschisis is due to a flaw primarily situated to the right of the umbilical ring. This results in the protrusion of the intestinal tract and occasionally the urogenital tract into the amniotic cavity, without the presence of a surrounding membrane (2).

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The main prognostic factor for omphalocele is associated structural or chromosomal anomalies, with a reported incidence ranging between 27% and 63% (3). However, for gastroschisis prognosis is primarily determined by the underlying bowel viability and degree of bowel injury (4). Gastroschisis has a favorable outcome with an overall survival rate of 90-95% (5). Both omphalocele and gastroschisis are commonly diagnosed prenatally (4). Prenatal diagnosis is important for these defects as it helps to define associated abnormalities, allows for close follow-up of unfavorable prognostic signs, enables multidisciplinary management, and allows for adequate preparation for the postnatal period.

Postnatal management of neonates with these conditions is primarily conducted by pediatric surgeons and neonatologists, with other specialists sometimes attending to the management, depending on the presence of additional anomalies. The main goal of postnatal period management is to perform surgery with an appropriate technique at the optimal time, provide adequate nutrition using hepatoprotective novel lipid formulations, and start full enteral feeding as soon as possible (1). However, even with comprehensive care, neonates can still be affected by short- and long-term sequelae, such as necrotizing enterocolitis, extensive intestinal loss, and short bowel syndrome, which may require multiple surgeries (1,6).

This study aimed to examine the clinical features and perinatal outcomes of antenatally diagnosed abdominal anterior wall defects in a single tertiary center. In addition, the factors that may affect the prognosis of fetuses with omphalocele and gastroschisis was investigated.

Material and Methods

This retrospective, cohort study included pregnancies diagnosed prenatally with fetal omphalocele and gastroschisis, and the subjects were followed up and delivered at a perinatology clinic of a university hospital between January 2015 and December 2022. Permission for the study was obtained from the İstanbul University-Cerrahpaşa Clinical Research Ethics Committee (approval number: E-83045809-604.01.01-692089, date: 22.05.2023). Informed consent was obtained from all mothers of fetuses included in this study. Omphalocele was defined as protrusion of the intestines, liver, and/or additional organs into the intact umbilical cord and encased by amniotic membrane, Wharton jelly and peritoneum. Gastroschisis was defined as evisceration of the bowel through a paraumbilical abdominal wall defect with an intact umbilical cord and intestines floating freely in the amniotic fluid and lacking a covering membrane.

Ultrasound assessments were performed using a Voluson E10 (GE Medical Systems, Zipf, Austria) device with 3.5- or 5-MHz curvilinear transducers. The gestational age was established using the first day of the last menstruation and subsequently validated through the measurement of crown-rump length during the first trimester ultrasound. A detailed ultrasound examination and anatomic survey of the fetuses were performed, and additional structural anomalies were recorded. Karyotype analyses of the fetuses whose parents accepted the prenatal invasive tests were recorded.

Pregnancies diagnosed as gastroschisis or omphalocele were followed by a multidisciplinary team including perinatologists, pediatric surgeons, and neonatologists. Management plans were formulated by this multidisciplinary team, including follow-up ultrasound scans, decision concerning mode of delivery and conversation with parents regarding possibilities for pregnancy termination. Fetal biometry, Doppler measurements, and amniotic fluid assessment using the vertical measurement of the single deepest pocket were evaluated during the scans. Small for gestational age (SGA) was determined as birth weight falling below the 10th percentile for both gender and gestation (7). For fetuses with gastroschisis, maximal intra-abdominal bowel dilation (IABD) and extra-abdominal bowel dilation (EABD) were evaluated during the scans. Cut-off values of 10 mm for IABD and 18 mm for EABD were used to define complex gastroschisis (8,9). All infants were delivered at our clinic, and neonatal care was provided at the neonatology department within our hospital. Surgical procedures were carried out at the pediatric surgery department within the same hospital. Parameters, such as hospitalization duration, neonatal outcomes, surgical approach (primary repair or mesh utilization), length of postoperative parenteral nutrition, and time until postoperative oral intake were assessed for newborns who underwent surgery.

Variables, including gestational age at diagnosis, parity, maternal age, karyotype results, coexisting fetal abnormalities, birth weight, gestational week at delivery, delivery method, postnatal confirmed diagnosis, and pregnancy outcomes were subjected to analysis. The cases were categorized into six groups based on pregnancy outcome: termination of pregnancy (TOP), abortus, intrauterine fetal death, neonatal death (NND), death in infancy, and survivors. The decision for TOP was made by the official "Termination of Pregnancy Council" within our institution in accordance with national regulations. In order to confirm the diagnosis, fetal autopsy was conducted for all terminated cases. Abortion was defined as intrauterine death before 24 weeks of gestation, NND was defined as death within the initial 28 days of life, and infant death referred to death within the first year. Data regarding surviving infants were gathered through telephone interviews with the parents.

Statistical analysis

Statistical analysis was conducted using the SPSS, version 20.0 for Windows (SPSS Inc., Chicago, IL., USA). Categorical variables are presented as frequencies and percentages, while continuous variables are expressed as mean and standard deviation. Parametric data were assessed using an independent two-sample t-test and One-Way ANOVA. Non-parametric data were compared using the chi-square test, Kruskal-Wallis and subsequent Mann-Whitney U test.

Results

The study population consisted of pregnancies with prenatally diagnosed omphalocele (n=75) and gastroschisis (n=21) in the fetus. Table 1 displays the clinical characteristics and outcomes of the study group. The mean maternal age and incidence of primiparous women for pregnancies with omphalocele and gastroschisis were 30.3±5.9 years and 52% and 25.7±4.5 years and 71.4%, respectively. The mean maternal age of women carrying a fetus with omphalocele was significantly older than the women with fetuses with gastroschisis (p=0.001). The mean gestational age at the initial observation and/or diagnosis was 16.9±3.7 weeks (range; 12-24 weeks) and 16.7±2.6 weeks (range; 13-21) for omphalocele and gastroschisis respectively (p>0.05). Incidence of SGA was significantly higher in pregnancies with gastroschisis than omphalocele (40% vs. 14.9%, p=0.001). Associated structural anomalies were found in 53.3% (40/75) of fetuses with omphalocele and 4.7% (1/21) of fetuses with gastroschisis (p<0.001). Prenatal karyotype analysis was performed in 60 (80%) and 8 (38.1%) pregnancies with omphalocele and gastroschisis, respectively. The rate of chromosomal anomaly was 8.3% in pregnancies with omphalocele whereas fetuses with gastroschisis all had normal karyotype. The mean gestational age at delivery and birth weight of liveborn pregnancies were 36.7±2.8 weeks and 2658±700 grams for omphalocele and 37.4±1.3 weeks and 2464±472 grams for gastroschisis (p>0.05). For newborn babies, time to postoperative oral intake, length of parenteral nutrition and length of hospital stay were significantly longer in babies with gastroschisis than omphalocele (p<0.01).

Table 1. The clinical characteristics and the outcomes of the study group

	Omphalocele	**Gastroschisis**	**p**
n	75	21	
Maternal age (years)	30.3±5.9	25.7±4.5	0.001
Nulliparity, n (%)	39 (52)	15 (71.4)	0.115
Gestation age at diagnosis (weeks)	16.9±3.7	16.7±2.6	0.873
Associated structural anomalies, n (%)	40 (53.3)	1 (4.7)	0.001
Chromosomal abnormality	**(Subgroup size was 60) n=5 (8.3)**	**(Subgroup size was 8) n=0 (0)**	
Trisomy 21	1 (1.7)	-	
Trisomy 18	4 (6.6)	-	
Small for gestational age	7/47 (14.9)	8/20 (40)	0.001
Gestational age at delivery	**(n=47) 36.7±2.8**	**(n=20) 37.4±1.3**	**0.032**
<37 weeks	14 (29.8)	5 (25)	
<34 weeks	5 (10.6)	-	
Birth weight (g)	**(n=47) 2658±700**	**(n=20) 2464±472**	**0.519**
Caesarean section	47/47 (100)	20/20 (100)	
Neonatal			
Parenteral nutrition duration (days)	7.7±4.7	19.5±11.1	0.001
Time to postoperative oral intake (days)	6.7±3.3	11.8±9.2	0.002
Duration of hospitalization (days)	19.5±15.7	31.2±24.3	0.023
Termination of pregnancy	19 (25.3)	-	
Abortion	4 (5.3)	1 (4.7)	0.917
Intrauterine death	5 (6.7)	-	
Neonatal death	8 (10.7)	-	
Infant death	2 (2.7)	-	
Live birth	37 (49.3)	20 (95.2)	0.001
Data are presented as mean ± standard deviation or n (%)			

Of the 75 pregnancies with omphalocele, 19 women (25.3%) terminated their pregnancy and all the terminated fetuses had additional structural anomalies. Rates of abortion were similar in both pregnancies with omphalocele and gastroschisis (5.3% vs. 4.7%, p>0.05). There were no intrauterine, neonatal and infant deaths in the gastroschisis group. The rates of intrauterine, neonatal and infant death of fetuses with omphalocele were 6.7%, 10.7% and 2.7%, respectively. The overall survival rates of fetuses with omphalocele and gastroschisis were 49.3% and 95.2%, respectively (p<0.001).

The distribution of associated structural anomalies of 40 (53.3%) of the fetuses with omphalocele are illustrated in Table 2. The most frequent structural anomaly was cardiac anomalies (52.5%) followed by central nervous system anomalies (20%). All of the fetuses with chromosomal abnormality had an additional structural anomaly [cardiac anomalies (n=3), holoprosencephaly (n=1), hydrops fetalis (n=1)] other than omphalocele. There was one fetus with Beckwith-Wiedemann syndrome (BWS) that was diagnosed after delivery with genetic testing in fetuses with omphalocele. Perinatal and obstetric outcomes of fetuses with isolated and non-isolated omphalocele are shown in Table 3. The incidence of SGA was significantly lower and mean gestational age at delivery, birth weight and survival rate were significantly higher in pregnancies with isolated omphalocele compared to non-isolated omphalocele (p<0.01). The mean gestational age at delivery was 37.4±1.7 weeks and survival rate was 82.9% in pregnancies with isolated omphalocele. There were three abortions (at 16, 22 and 23 weeks of gestation), two intrauterine deaths (at 25 and 26 weeks of gestation) and one infant death (at 4.5 months of age) in pregnancies with isolated omphalocele. Of the 40 pregnancies with non-isolated omphalocele, 19 women (47.5%) terminated their pregnancy and the survival rate was 20%. There were one abortus (at 23

Table 2. The distribution of associated structural anomalies of fetuses with omphalocele

(n=40)	
Cardiac	21 (52.5) (3 Trisomy 18 and 1 Trisomy 21)
Central nervous system	8 (20) (1 Trisomy 18)
Vertebral and/or scoliosis	3 (7.5)
Skeletal	3 (7.5)
Esophageal atresia	2 (5)
Diaphragmatic hernia	2 (5)
Anal atresia	1 (2.5)
Venous system	1 (2.5)
Beckwith-Wiedemann syndrome	1 (2.5)
Data are presented as n (%)	

Table 3. Perinatal and obstetric outcomes of fetuses with isolated and non-isolated omphalocele

	Isolated	**Non-isolated**	**p**
n	**35**	**40**	
Chromosomal abnormality	-	5 (12.5)	
Liver in the sac	32 (91.4)	38 (95)	0.539
Small for gestational age	2 (5.7)	5 (12.5)	0.001
Gestational age at delivery	**(Subgroup size was 30) 37.4±1.7**	**(Subgroup size was 17) 35.6±3.9**	**0.033**
<37 weeks	7 (23.3)	6 (35.3)	
<34 weeks	-	5 (29.4)	
Birth weight (g)	2822±472	2367±930	0.031
Termination of pregnancy	-	19 (47.5)	
Abortion	3 (8.6)	1 (2.5)	0.917
Intrauterine death	2 (5.7)	3 (7.5)	0.307
Neonatal death	-	8 (20)	
Infant death	1 (2.8)	1 (2.5)	0.924
Alive	29 (82.9)	8 (20)	0.001
Data are presented as mean ± standard deviation or n (%)			

weeks of gestation), three intrauterine deaths (at 27, 28 and 30 weeks of gestation), eight NNDs and one infant death (at 7 months of age) in pregnancies with non-isolated omphalocele. All of the newborns with omphalocele had primary closure of the abdominal wall defect.

Of the 21 pregnancies with gastroschisis, eight (38.1%) and 13 were determined to be complex and simple, respectively, based on prenatal ultrasound criteria. Neonatal outcomes of complex and simple gastroschisis cases are shown in Table 4. Time to postoperative oral intake, duration of parenteral nutrition and duration of hospitalization were significantly longer in babies with complex gastroschisis compared to simple gastroschisis ($p<0.01$). All of the newborns with gastroschisis underwent primary closure of the abdominal wall defect within the first day of life. There was no NND in pregnancies affected by gastroschisis.

Discussion

In the present study, the mothers of fetuses with gastroschisis were significantly younger than mothers of fetuses with omphalocele, which is consistent with previous studies (4,10,11). For abdominal wall defects, the rates of successful prenatal diagnosis have risen over the past two decades, reaching levels as high as 100% (3). The average gestational age at the first observation and/or diagnosis of omphalocele and gastroschisis were 16 weeks in our study group, which is similar to those reported in other series (11,12). The mean gestational age at delivery and birth weight of liveborn pregnancies were not significantly different in our omphalocele and gastroschisis cases. However, in the majority of previously reported series, pregnancies with gastroschisis were born earlier and with lower birthweight than those with omphalocele (11-13). The rates of preterm delivery of about 30% and 25% for omphalocele and gastroschisis in our study population are similar to previously reported rates (10,12). All babies with omphalocele and gastroschisis were delivered by Caesarean section (CS). This high rate of CS can primarily be attributed to the strategic choice of delivering in a tertiary care center, where access to suitable neonatal and pediatric surgical services facilitated by CS compared to vaginal delivery. Despite various studies showing no superiority of CS over vaginal delivery for neonates with gastroschisis and omphalocele, similar high rates of CS have been reported in other studies (10,12,14). Pregnancies with omphalocele are reported to be associated with higher incidences of intrauterine, neonatal, and infant deaths than gastroschisis (1,11,12). This was also the case in the present study consistent with previous studies, our findings confirmed that survival rates of offspring in pregnancies affected by gastroschisis is significantly higher than omphalocele (1,11,12). Incidences of chromosomal anomaly and co-existing structural anomalies were significantly higher in pregnancies with omphalocele than gastroschisis in the present study. This finding is in accordance with previous studies (2,3,11,12). The rate of chromosomal anomaly was 8.3% in pregnancies with omphalocele whereas fetuses with gastroschisis all had normal karyotype in our study population. The reported incidences of chromosomal anomalies for omphalocele range widely from 8% to 57% (1,15). Trisomy 13, 18, and 21 were frequently found to coexist with omphalocele, with Trisomy 18 being the most prevalent (15,16). Trisomy 18 was also the most frequent associated chromosomal anomaly in cases of omphalocele in the present series. All of the fetuses with omphalocele and chromosomal abnormality had additional cardiac or central nervous system anomalies. The incidence of associated structural anomalies in fetuses with omphalocele was 53.3% overall. The previously reported incidences of associated structural anomalies in fetuses with omphalocele varies between 25% to 97% (1,15). The most frequent structural anomaly was cardiac (52.5%) followed by central nervous system anomalies (20%) in our series. The distribution of associated structural anomalies in fetuses with omphalocele is similar to those reported by other series (3,11,17). There was one case of BWS, which was diagnosed after delivery with genetic testing in our omphalocele group. BWS is an autosomal dominant condition occurring in 5%-25% of fetuses diagnosed with an omphalocele. Additional findings include macrosomia, macroglossia, organomegaly, placentomegaly, and polyhydramnios (15). Since many features of BWS manifest late in gestation or postnatally, prenatal diagnosis is challenging and only a few cases can be diagnosed prenatally

Table 4. Neonatal outcomes of complex and simple gastroschisis cases

	Simple Gastroschisis	Complex Gastroschisis	p
n	13	8	
Mean parenteral nutrition duration (days)	11.5±2.9	31.4±6.9	0.001
Mean time to postoperative oral intake (days)	5.3±2.9	21.5±6.2	0.001
Mean duration of hospitalization (day)	18.6±7.6	50.1±29.1	0.002
Data are presented as mean ± standard deviation			

(18). The prenatal diagnosis of BWS can be achieved through amniocentesis by employing a multi-tiered approach involving chromosomal microarray, methylation testing, and sequence analysis (15).

Survival and overall prognosis of fetuses with omphalocele depends on the associated genetic, structural and chromosomal anomalies (1,15). The incidence of TOP in non-isolated omphalocele cases was 47.5% in our study. Survival rates of 82.9% and 20% were observed in fetuses with isolated and non-isolated omphalocele respectively, in the present study. Similar survival rates for isolated and non-isolated omphalocele cases have been reported by other studies (11,19,20). As survival of isolated omphalocele fetuses are favorable, thorough evaluation, including detailed anatomic assessment, fetal echocardiogram, prenatal diagnostic testing, and genetic counseling is recommended for pregnancies with omphalocele (15). Prenatal diagnosis will allow parental counseling, the possibility of TOP, assistance with pregnancy management and delivery under optimal conditions.

In cases of gastroschisis, survival rates greater than 90% have been reported (5,11,21). Our data corroborates this finding, and the survival rate of our gastroschisis group was 95.2%. There was one abortus at 21 weeks gestation in fetuses with gastroschisis. Chromosomal abnormalities or additional structural anomalies are rarely seen in fetuses with gastroschisis and prenatal invasive testing is not routinely recommended (2,22). Fetuses with gastroschisis all had normal karyotype and one fetus (4.7%) had muscular ventricular septal defect in the present study. The most severe prenatal complication associated with gastroschisis is the infrequent but unpredictable occurrence of fetal death (23). This could result from an in utero midgut volvulus or, more likely, from the sudden impairment of umbilical blood flow due to the eviscerated bowel (2). Fortunately, we did not observe in utero fetal death in our study population.

The postnatal prognosis of newborns with gastroschisis primarily hinges on the prenatal extent of intestinal damage and the subsequent functional state after birth (5). Bowel compromise is likely due to prolonged exposure of the intestines to amniotic fluid, as well as the compression of bowel and vasculature near the abdominal wall defect (6). Mainly due to impaired bowel function, time to postoperative oral intake, length of parenteral nutrition and length of hospital stay were significantly longer in babies with gastroschisis than omphalocele in our study population. Our findings align with previous studies, indicating that newborns with gastroschisis typically experience a more complex neonatal course compared to those with omphalocele (12,24).

In the neonatal period gastroschisis is commonly divided into two groups: simple and complex. Neonatal complex gastroschisis is defined as gastroschisis accompanied by intestinal atresia necrosis, perforation, and/or volvulus, whereas in the simple form these anomalies are absent (25). Neonatal complex gastroschisis thus includes infants which present with severe bowel injury at birth, and have the highest risk of unfavorable outcome, including sepsis, NND, short bowel syndrome, prolonged reliance on mechanical ventilation, extended hospital stays, and an extended duration of parenteral nutrition (6). There exists a multitude of contradictory perspectives regarding the role of ultrasound assessment in predicting complex forms of gastroschisis and which features are useful prognostic indicators. We have defined >10 mm for IABD and >18 mm for EABD for complex gastroschisis (8,9). Among patients diagnosed with gastroschisis in our cohort, 38% had prenatal ultrasound findings of complex gastroschisis. We had no neonatal mortality and short bowel syndrome in our study group. However, time to postoperative oral intake, duration of parenteral nutrition and duration of hospitalization were significantly longer in babies with prenatal ultrasound findings of complex rather than simple gastroschisis. These findings are consistent with findings from other studies (12,21,25).

Study limitations

The limitations of this study included its retrospective design and the relatively small number of cases. Despite these limitations, we conducted a comparison of various parameters in our patients and compared our findings with the existing literature. Our study reflects the perinatal and neonatal outcomes of pregnancies with omphalocele and gastroschisis managed in a tertiary care center. Further studies should investigate the long-term outcomes of offspring to gain a better understanding of their health and development.

Conclusion

Associated structural and chromosomal anomalies were significantly more common in fetuses with omphalocele compared to those with gastroschisis. Survival rates were 95.2%, 82.9% and 20% in fetuses with gastroschisis, isolated and non-isolated omphalocele, respectively. Prognosis of fetuses with omphalocele depends on the associated structural and chromosomal anomalies, whereas bowel compromise is the main determining factor in gastroschisis.

Ethics Committee Approval: *Permission for the study was obtained from the İstanbul University-Cerrahpaşa Clinical Research Ethics Committee (approval number: E-83045809-604.01.01-692089, date: 22.05.2023).*

Informed Consent: *Informed consent was obtained from all mothers of fetuses included in this study.*

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