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EVIDENCE-BASED CLINICAL DECISIONS IN A FETAL GASTROSCHISIS CASE

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SUMMARY:
Introduction: Gastroschisis (laparoschizis) is a congenital defect that affects all layers of the abdominal wall, located paraombilically, almost always on the right side, relatively small in size (2-4 cm), through which the small intestine, the colon, the stomach, portions of the genitourinary system (rare) or the liver (very rare) can herniate.
Case presentation:20 years primigravida presentsfor first morphological ultrasound at 23 weeks of gestation. During this examination a fetal gastroschisis is revealed. Pregnancy was actively monitorized - clinically, with laboratory tests and ultrasound scans - and its state remained within physiological parameters. The pediatric surgery clinic was notified and a caesarean section was performed at 37 weeks, with no labor and no signs of fetal distress, after correlating gestational age with fetal intestine diameter. A normal live female fetus weighing 2500 g, AS = 5 at 1', AS = 7 at 5 ' was extracted and clinical diagnosis confirmed prenatal ultrasound findings, as the small intestine and colon freely protruded through a parietal defect of 3 cm. After neonatal resuscitation and first aid were performed in the operating room and neonatal department, the newborn was transferred to the department of pediatric surgery for an emergency operation, the surgical team successfully correcting the abdominal wall pathology. On the eighth postoperative day, the newborn had a first spontaneous stool and was breast-feeded.Discussion: The described case demonstrates once again the importance of competent morphological screening in detecting and treating malformations compatible with life. Best available research evidence must be integrated with individual clinical practice and expertise in the diagnosis, investigation and management of such cases.Directing them to medical centers with opportunities for multidisciplinary therapy is a prerequisite for their successful resolution.
Keywords: *gastroschisis, prenatal diagnosis, multidisciplinary approach*

DECIZII CLINICE BAZATE PE DOVEZI ÎNTR-UN CAZ DE GASTROSCHIZIS FETAL
REZUMAT:
Introducere: Gastroschizisul (laparoschizisul, paraomfalocelul sau abdominoschizisul) este un defect congenital ce interesează toate straturile peretelui abdominal, localizat paraombilical, aproape întotdeauna în dreapta, de dimensiuni relativ mici (2-4 cm), prin care pot hernia ansele intestinale, colonul, stomacul, porţiuni ale aparatului genito-urinar (rar) sau ficatul (foarte rar).
Prezentare de caz: Gravidă de 20 ani, primipară, se prezintă pentru prima ecografie morfologică la 23 de săptămâni. Cu ocazia acestei examinări se decelează un gastroschizis fetal. Sarcina dispensarizată activ - clinic, paraclinic şi ecografic - decurge în continuare în parametrii fiziologici. Corelând vârsta gestaţională cu diametrul intestinului fetal, la 37 de săptămâni, fără travaliu şi fără semne de suferinţă fetală, se anunţă clinica de chirurgie pediatrică şi se efectuează operaţia cezariană. Se extrage un făt viu de sex feminin de 2500g, IA=5 la 1', IA=7 la 5' şi se confirmă clinic diagnosticul ecografic prenatal, prin defectul parietal de 3 cm exteriorizându-se instestinul subţire şi colonul. După reanimare şi primele îngrijiri neonatale (acordate în sala de operaţie cezariene şi în secţia de neonatologie),

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nou-născutul se transferă de urgenţă în secţia de chirugie pediatrică, unde echipa operatorie intervine cu succes în rezolvarea patologiei malformative. În ziua a opta postoperator, nou-născutul are primul scaun spontan şi se alăptează la sân.
Discuţii: Cazul descris demonstrează încă o dată importanţa screeningului morfologic fetal de perfomanţă în depistarea şi tratarea malformaţiilor compatibile cu viaţa. Este necesară integrarea celor mai calitative dovezi de cercetare disponibile cu practica şi expertiza clinică individuală în diagnosticul, investigarea şi gestionarea unor astfel de cazuri. Dirijarea lor în centre medicale cu posibilităţi de terapie multidisciplinară este o condiţie obligatorie pentru rezolvarea cu succes a acestora.
Cuvinte cheie: *gastroschizis, diagnostic prenatal, abordare multidisciplinară*

INTRODUCTION

Gastroschisis is a full thickness defect in the abdominal wall usually just to the right of a normal insertion of the umbilical cord into the body wall. A variable amount of intestine and occasionally parts of other abdominal organs are herniated outside the abdominal wall with no covering membrane or sac (9).Worldwide, gastroschisis has become a growing concern and in the last three decades there has been a steady increase in the prevalence of gastroschisis. More worryingly is the unexplained increase in incidence of gastroschisis in the last 10 years from 8.9 to 24.4 per 10,000 live births among mothers younger than 20 years of age (17).

The etiology of gastroschisis is subject to some debate. It is commonly held that the pathogenesis involves an in-utero vascular accident and, along these lines, two major theories have been advanced. One theory suggests that involution of the right umbilical vein causes necrosis in the abdominal wall leading to a right-sided defect; a second theory posits that the right omphalomesenteric (vitelline) artery prematurely involutes causing a weakening in the abdominal wall through which the intestinal contents subsequently rupture. These theories are supported by the observation that gastroschisis is associated with intestinal atresia, a condition that is also thought to be associated with an ischemic etiology. More recent epidemiological and scientific data suggest that these explanations may be insufficient. Feldkamp et al. note that both umbilical veins degenerate, which does not explain the predominant right-sided occurrence of gastroschisis. Moreover, the body wall derives arterial supply from a rich arcading network of vessels arising from the dorsal aorta that is neither dependent upon nor intersects with the umbilical or vitelline vessels. Nonvascular explanations for the origin of gastroschisis include failure of incorporation of the vitelline duct into the umbilical cord and abnormal development of the ventral abdominal wall resulting in the failure of midline fusion of the lateral folds. In-utero rupture of an omphalocele has also been proposed as a mechanism of gastroschisis formation (5).

There are several data in the literature that evaluate the risk factors for gastroschisis. Young maternal age is one consistent risk factor that has been shown in all epidemiological studies. This correlation suggests that environmental factors are involved. Other studies highlight genitourinary infection as a new risk factor for gastroschisis, and also change of paternity. A large population based case-control study in the United Kingdom found significant adjusted odds ratios for the use of aspirin, history of gynaecological infection, low body mass index, unmarried status, and cigarette smoking. A study published in 2008 concluded that recreational drug use is a significant risk factor for gastroschisis. Short interpregnacy interval was associated with an increased risk for gastroschisis, particularly among women whose preceding pregnancy resulted in a miscarriage or termination and among those who resided in northern study areas with winter/fall conception. The overall pattern of findings from all of these studies suggests that the risk for having an infant with gastroschisis is highest in young women, mainly teenagers, with one or more of the following characteristics-have low socioeconomic status, smoke cigarettes, eat too little, drink alcohol, use illicit drugs, have early and unprotected sexual intercourse, and have genitourinary infection (4, 6, 7, 15).

Assumption of gastroshisis can be made if the pregnant woman has elevated levels of alpha fetoprotein (AFP). AFP is the fetal analog of albumin, and maternal serum AFP reflects the level of AFP in amniotic fluid. Testing was developed to evaluate the fetus for chromosomal abnormalities and neural tube defects, but AFP is also usually elevated with abdominal wall defects. In gastroschisis, maternal serum AFP is usually markedly abnormal, with an average elevation of more than nine multiples of the mean (MoM) (13).

The diagnosis is based on ultrasound examination and can be madebyabdominalultrasoundbefore20 weeks, orvaginal examinationbeginning at 12 weeks and3 days,

noting that until 12 weeks the small intestine is normally herniated in the base of the umbilical cord. The typical echo sign is the presence of multiple intestinal loops free floating in the amniotic fluid. The free intestinal mass in the amniotic fluid isdisproportionately highcompared tothe abdominal cavity. Because the abdomen cavity has a small mass, an abnormal proximity between the bladderand stomach can be found. Almost always, only small intestines are eviscerated and can be recognized by specific ultrasound appearance and peristaltic movements. Occasionally, the large intestine, the stomach, the gallbladder, the uterus, or the urinay bladder can herniate. The umbilical cord is normally inserted and usually situated to theleft of the gastroschisis. Color Doppler is a useful examination to prove this disposal and the fact that its vessels never cross the mass represented by the intestinal loops. A study that evaluated the correlation between prenatal ultrasound findings (small-for-gestational-age, intra-abdominal and extra-abdominal bowel dilatation >6 mm, thickened intestinal wall and stomach dilatation) and postnatal outcome in neonats with gastroshisis concluded that intra-abdominal bowel dilatation is the only ultrasound marker predictive of complex gastroschisis (associated with bowel complications). Magnetic resonance imaging can provide an overall perspective of the fetus with a ventral wall defect, and may be useful in cases that are hard to image with ultrasound (10, 16, 18).

There is a lower incidence of associated anomalies with gastroschisis compared with other abdominal wall defects. A 10-year review of infants with gastroschisis found a 30% incidence of associated anomalies, intestinal atresia, cryptorchidism or undescended testes being the most common. Intestinal atresia was noted in 22% of affected infants, while cryptorchidism was noted in 55%. In a second 10-year review of infants with gastroschisis, ileal atresia occurred in 5.4% of affected infants and cryptorchidism occurred in 24%. Anotherstudy publishedin 2005, conducted on 627 infantswithgastroschisisfound asignificant association between gastroschis and congenital heart defects. Detailed antepartum and/or postnatal evaluations are indicated in fetuses identified with gastroschisis (11, 21).

CASE REPORT

20-year-old primigravida presented in a small center for a first ultrasound exam at 23 weeks of gestation. She had not attended antenatal care prior to this moment, but described no problems during pregnancy. She did use vitamin or mineral supplements and reported no smoking or use of alcohol during pregnancy. On ultrasonography of the abdominal region, the examinator found a defect in the anterior abdominal wall of the fetus. Bowel loops were seen herniating into the amniotic cavity, floating without any covering membrane. Gastroschizis was suspicioned and the pacient was sent to a tertiary center, in this case "Bega" University Clinic of Obstetrics and Gynecology Timişoara, Romania, where the diagnosis was indeed confirmed at a new investigation (Figures 1, 2). Calculated gestational age by ultrasonography was 24 weeks and 2 days (EFW = 603 81 g), significantly shorter than the one calculated using the date of the last menstrual period, which was 26 weeks and 1 day. Gestational age calculated using just the abdominal circumference (AC = 142.1mm) was even shorter, corresponding to 22 weeks and 0 days (EFW = 481 g) (Figure 3). Taking into account this findings, the mother was counseled in a reassuring and encouraging manner considering: the gestational age of detection, generally favorable prognosis (90% survival rate) with immediate surgery, absence of other malformations and absence of other obstetric risk factors. Weekly monitoring from 30 weeks included: ecographic examination for tracking intestinal wall thickness, bowel dilatation and increased peristaltism, potential appereance of intraabdominal dilatation or change in bladder position; intestinal vascularization via Doppler velocitometry of the superior mesenteric artery; determination of fetal biophysical profile scoring; monitoring fetal growth, more precisely the eventual presence of a intrauterine growth restriction (IUGR) and tracking fetal lung development. In spite of some protocols, amnioinfusions to reduce amniotic fluid toxicity were not performed, considering the state of the bowels and risk-benefit analysis. At 37 weeks, the last ultrasound, conducted in the presence of the pediatric surgeon, clearly showed a degree of intestinal malrotation and extra-abdominal bowel dilatation of 10 mm. Taking into account these findings, the gestational ageand the fact that a cardiotocography (CTG) performed exactly the same day showed rare uterine contractions, cezarian section was indicated as elective procedure for termination of pregnancy. After the pediatric surgery clinic was informed, the procedure was carried on and a normal live female fetus was extracted. Clinical diagnosis confirmed prenatal ultrasound findings, as the small intestine and colon freely protruded through a parietal defect of 3 cm. The birthweight was 2.5 kg, her length was 49 cm and her head circumference 34 cm. Apgar score was 5 at 1', respectively 7 at 5 '.

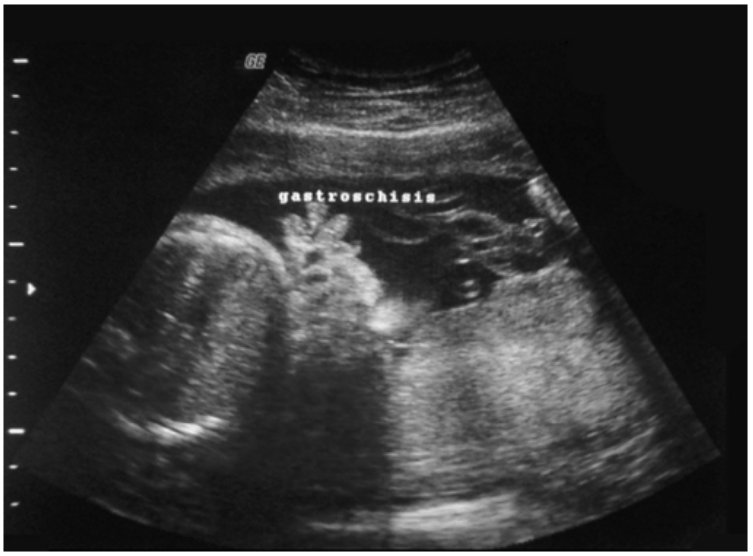

Fig. 1. First ultrasound examination in our center: diagnosis of gastroschisis (gestational age using last menstrual period - 26 weeks)

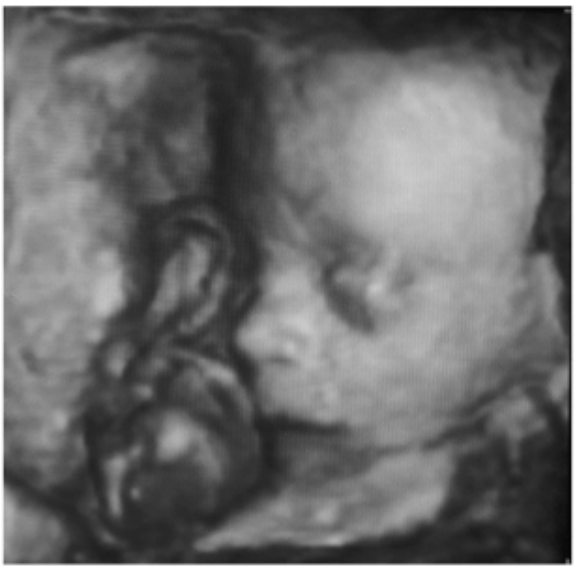

Fig. 2. First ultrasound examination in our center: 4D rendering.

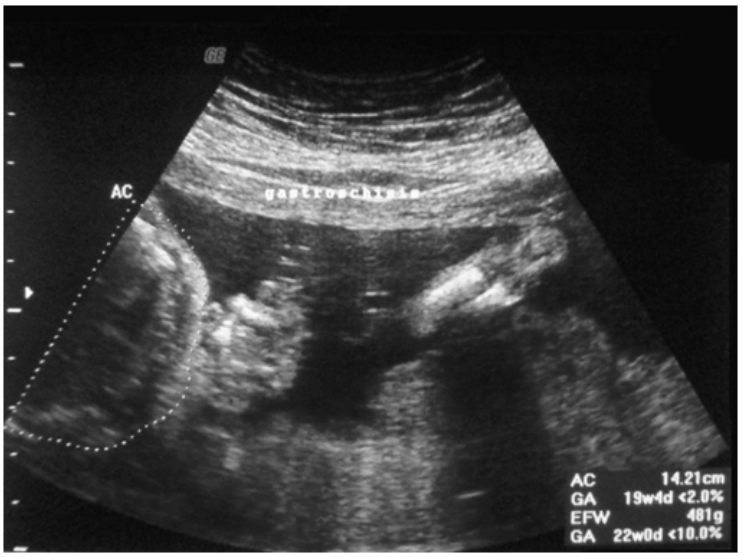

Fig. 3. First ultrasound examination in our center: gestational age (GA) calculated using just the abdominal circumference (AC)

Neonatal resuscitation and first aid were carried out in the operating room and in the Division of Neonatology of "Bega" Clinic Timişoara. The newborn was intubated, ventilated and a central venous pressure (CVP) line inserted, while the intestine was placed in mid line and isolated to prevent thermal shock and infection. Blood culture, CBC, CRP were done and IV fluids were administered. She was tranported by ambulance to the pediatric surgery devision of "Louis Turcanu" Emergency Hospital for Children Timişoara and in less than 1 hour from birth, the reparatory operation could start. Intraoperatively, the question of viability arose: after injection of lidocaine, loops seemed viable without atresia and without perivisceritis phenomenon. There was no need for partial bowel resection. Reinstatement of the loops in the abdmonial cavity was performed, followed by laparorrhaphy with ombilicus preservation and drainage placement through counterincision. Postoperatively, the question of functionality arose, with delayed resuming of instestinal transit (even more than 3 weeks) being specific for gastroschizis. Screening for other associated malformations that could have escaped in-utero examinations was conducted: transfontanelar ultrasonography, as well as echocardiography and multiple abdominal ultrasound revaluation showed no abnormalities. On day 10 postoperatively (10th day of life), with per primam surgical wound healing, the newborn had her first spontaneous stool and started breast-feeding. Minimal enteral feeding and controlled increase of nutrients was further established.

DISCUSSION

In order to correctly evaluate and manage the above case, we took into consideration and carefully analyzed all of the presented findings. A fetusdiagnosed withgastroschisisshould be takeninto evidence by a pediatric surgery unit, in order to quickly solve the defect in the neonatal period.

Doppler velocimetry of the superior mesenteric artery and its branches is not predictive of poor neonatal outcome in fetuses with gastroschisis. A bowel diameter >10 mm between 28 and 32 weeks appears to be the best predictor of poor neonatal outcome (2). Weekly monitoring of such cases should start at30 weeks and should include:

- ultrasoundto assessthe thickness ofthe intestinal wall, intestinaldilationand increasedperistaltic,
- determining the biophysicalscore,
- monitoring fetallung development (18).

Gastroschisis occurred more often in younger mothers (<21 years), was more frequently associated with preterm labor and delivery, and more low-birth-weight babies. The mean gestational age at spontaneous labor was 36.6 weeks. In those patients who labored spontaneously, there were no significant differences in the operative delivery rates for fetal distress; however, there was a trend to lower Apgar scores in babies born at 37 weeks or more (12, 18).

Preterm delivery of infants with gastroschisis was recommended by some researchers to avoid the intestinal damage that may occur due to prolonged exposure to the amniotic fluid, which contain inflammatory factors that lead to intestinal ischemia or damage. In contrary, Maramreddy et al. reported that there is no benefit of preterm delivery in reducing the morbidities in patients with gastroschisis. In addition, preterm delivery increased complication rate in those infants with regard to sepsis, longer hospital stay, and prolonged period to establish feeding and to tolerate full feeding.

Regarding the pathof birth,it seemsthat thereare not significant differences between the vaginal and caesarean-birth, but the obstetricianmust take into accountthe conditionof the fetus with possible intrauterine growth restriction. If in the pastthere was a group of doctorsthat recommendcesarean delivery, most currentstudieshave shown thatvaginal deliveryisas safeas the c-section one (1, 18). Conversely, Hadidi A. et al demonstrates in a study published in 2008 that elective cesarean delivery before 36 weeks allows earlier enteral feeding and is associated with less complications and higher incidence of primary closure (statistically significant).

Complications of gastroschisis include prolonged ileus, sepsis, associated intestinal atresias, malabsorption, wound infection, and necrotizing enterocolitis. Exposure of the fetal intestine to amniotic fluid can cause inflammation and damage, and significant gastrointestinal problems occur during the neonatal period after closure of the defect. The classification proposed by Molik et al divides cases of gastroschisis into "simple" and "complex" groups based on the presence or absence of intestinal atresia, perforation, or necrosis at delivery or presentation. Infants with complex gastroschisis are significantly more likely to develop intestinal failure and liver disease associated with intestinal failure compared with infants with simple gastroschisis. They also take twice as long to achieve full enteral feeding (47 versus 24 days, respectively). In addition, infants with complex gastroschisis are more

likely to require an unplanned reoperation and a prolonged stay in hospital. The time to full tolerance of enteral feeding is an important outcome measure as it determines the duration of parenteral nutrition and hence the risk of complications, including central line sepsis, hepatic dysfunction associated with parenteral nutrition, and liver transplant. A metaanalysis published in 2013 concluded that the overall incidence of intrauterin fetal death (IUFD) in gastroschisis is much lower than previously reported and the risk for IUFD should not be the primary indication for routine elective preterm delivery in pregnancies that are affected by gastroschisis (3, 14, 19).

Surgical management of gastroschisis varies from center to center and has evolved over the past several decades, particularly with the introduction of the spring-loaded silo. The primary goal of every surgical repair is to return the viscera to the abdominal cavity while minimizing the risk of damage to the viscera due to direct trauma or increased intra-abdominal pressure. Options include: (i) primary reduction with operative closure of the fascia; (ii) silo placement, serial reductions, and delayed fascial closure; (iii) primary or delayed reduction without fascial closure. In addition, the timing and location of surgical intervention is controversial, ranging from immediate repair in the delivery room, to reduction and closure in the neonatal intensive care unit, to surgical closure in the operating room. In all cases, inspection of the bowel for obstructing bands, perforation, or atresia should be undertaken. Bands crossing the bowel loops should be divided before silo placement or primary abdominal closure to avoid subsequent bowel obstruction. Consideration should be given to the early establishment of central venous access, as intestinal hypomotility is invariably present. Early minimal enteral feeding and controlled increase of nutritional elements after bowel reintegration significantly improved outcome of gastroschisis in newborns (5, 20).

The prognosisof children withgastroschisisis generally good, with asurvival rateof over 90%due to surgical treatment and neonatal intensive care. The main causes of neonatal deathare represented by prematurity, infectious complications and intestinal complications (18).

The most important prerequisite for successful resolution of such cases is directingthem to medical centers where the best opportunities for multidisciplinary therapy are available.

References:

1. Abdel-Latif ME, Bolisetty S, Abeywardana S, Lui K - Mode of delivery and neonatal survival of infants with gastroschisis in Australia and New Zealand. J Pediatr Surg. 2008 Sep;43(9):1685-90.
2. Abuhamad AZ, Giancarlo M, Cortina RM, et al. Superior mesenteric artery Doppler velocimetry and ultrasonographic assessment of fetal bowel in gastroschisis: a prospective longitudinal study. Obstet Gynecol 1997;176:985 - 90.
3. Bradnock TJ, Marven S, Bradnock TJ, Marven S, Owen A, - Gastroschisis: one year outcomes from national cohort study,BMJ 2011;343:d6749
4. Chambers CD, Chen BH, Kalla K, Jernigan L, Jones KL, - Novel risk factor in gastroschisis: Change of paternity. American Journal of Medical Genetics Part A143A (7): 653-659. doi:10.1002/ajmg.a.31577. PMID 17163540, 2007
5. Christison-Lagay ER, Kelleher MC, Langer CJ - Neonatal abdominal wall defects.Seminars in Fetal & Neonatal Medicine 16 (2011)
6. Draper ES, Rankin J, Tonks AM, - Recreational Drug Use: A Major Risk Factor for Gastroschisis? Obstetrical & Gynecological Survey, June 2008 - Volume 63 - Issue 6 - pp 356-35
7. Getz KD, Anderka MT, Verler MM, Case AP - Short interpregnancy interval and gastroschisis risk in the National Birth Defects Prevention Study, Birth Defects Res A Clin Mol Teratol. 2012 Sep;94(9):714-20
8. Hashish AAE, Elhalaby E, - Evolution of management of gastroschisis, Annals of Pediatric Surgery 2011, 7:10-15
9. Kayasta P, Paudel S, Ghimire R.K, Ansari MA, - Gastroshisis and Omphalocele: A case report. NJR, Vol 2, Issue, Jan-June, 2012.
10. Kuleva M, Khen-Dunlop N, Dumez Y, Ville Y, Salomon LJ, - Is complex gastroshisis predictable by prenatal ultrasound?, International Journal Of Obstetrics and Gynaecology 2011, DOI: 10.1111/j.1471-0528.2011.03183.x
11. Kunz LH, Gilbert WM, Towner DR, - Increased incidence of cardiac anomalies in pregnancies complicated by gastroschisis. Am J Obstet Gynecol. 2005 Sep;193(3 Pt 2):1248-52.
12. Lausman YA, Langer JC, Tai M, - Gastroschisis: what is the average gestational age of spontaneous delivery?, Journal of Pediatric Surgery (2007) 42, 1816-1821
13. Ledbetter JD, - Gastroschisis and omphalocele, Surg Clin N Am 86 (2006) 249-260

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References (continued):

14. Lund KH, Bauer K, Berrios M, Gastroschisis: incidence, complications, and clinical management in the neonatal intensive care unit. J Perinat Neonatal Nurs. 2007 Jan-Mar;21(1):63-8.
15. Mastroiacovo P. - Risk factors for gastroschisis, BMJ. Jun 21, 2008; 336(7658): 1386-1387.
16. Nyberg DA, McGahan JP, Pretorius DH, Pilu G,- Diagnostic imaging of fetal anomalies. Walsworth Publishers, 2003
17. Owen A.D., Marven S., Bell J. Gastroschisis: Putting the bowel back safely. Infant 2009; 5(2): 40-44
18. Pelinescu Onciul D, Vladareanu R, - Anomalii fetale: diagnostic ?i conduit?. Editura Medicala Antaeus, Bucuresti 2007.
19. South AP, Stutey KM, Meinzen-Derr J - Metaanalysis of the prevalence of intrauterine fetal death in gastroschisis. Am J Obstet Gynecol. 2013 Aug;209(2):114.e1-13.
20. Walter-Nicolet E, Rousseau V, Kieffer F, Fusaro F, - Neonatal Outcome of Gastroschisis Is Mainly Influenced by Nutritional Management, Journal of Pediatric Gastroenterology & Nutrition: May 2009 - Volume 48 - Issue 5 - p 612-617
21. Williams T, Butler R, Sundem T, - Management of the Infant With Gastroschisis: A Comprehensive Review of the Literature, NAINR. 2003;3(2)