The clinical-paraclinical profile and the spectrum of concomitant morbid states in congenital defects of the anterior abdominal wall (gastroschisis and omphalocele)

Negru I., Pisarenco A., Malai A.

PHI Institute of Mother and Child
Natalia Gheorghiu National Scientific and Practical Center of Pediatric Surgery

Abstract

Profilul clinico-paraclinic și spectrul stărilor morbide concomitente în defectele congenitale ale peretelui abdominal anterior (gastroschizis și omfalocel)

Scopul studiului a fost evaluarea rezultatelor clinico-paraclinice ale afecțiunilor malformative ale peretelui abdominal cu identificarea factorilor de risc congenitali și dobândiți care au influențat prognosticul bolii.
MATERIAL ȘI METODE. Evaluarea clinico-epidemiologică a pacienților din lotul general de studiu și analiza rezultatelor tratamentului medico-chirurgical aplicat a fost efectuată în baza datelor extrase din fișele medicale de staționar ale copiilor cu defecte congenitale ale peretelui abdominal internați în staționar pe perioada anilor 2005-2016 în secția de chirurgie a nou-născutului a IMSP Institutul Mamei și Copilului, fiind selectate 64 cazuri clinice de gastroschizis și 59 cazuri de omfalocel.
REZULTATELE studiului au permis de a constata că defectele congenitale ale peretelui abdominal (gastroschizis și omfalocel) au fost întâlnite mai frecvent la nou-născuții de sex masculin, cazurile de gastroschizis fiind asociate predominant cu vârsta de gestație prematură și greutatea mică a nou-născuților, comparativ cu lotul de pacienți cu omfalocel unde au predominat nou-născuții la termen cu greutate normală. Au fost stabilite rate semnificativ sporite ale malformațiilor congenitale asociate atât în lotul bolnavilor cu gastroschizis (53,12%), cât și în cel cu omfalocel (61,02%), spectrul acestora fiind dominat de malformațiile tractului digestiv și cele *cardiovasculare.*
CONCLUZIE. Malformațiile congenitale concomitente împreună cu prematuritatea, greutatea mică la naștere, sindromul de compartiment și generalizarea procesului infecțios-septic au influiențat semnificativ evoluția și prognosticul nefavorabil al bolii.

Cuvinte cheie: gastroschizis, omfalocel, nou-născuți, malformații congenitale asociate, prognostic

Abstract

The aim of the study was to evaluate the clinical-paraclinical results of the abdominal wall malformations (gastroschisis and omfalocel) with the identification of congenital and acquired risk factors that influenced the prognosis of the disease.
MATERIAL AND METHODS. The clinico-epidemiological evaluation of the patients from the general study group and the analysis of the results of the applied medical-surgical treatment was performed based on the data extracted from the stationary medical files of the children with congenital defects of the abdominal wall hospitalized during the period 2005-2016 in the Newborn Surgery Department of the IMSP Institute of the Mother and Child, being selected 64 clinical cases of gastroschisis and 59 cases of omphalocele.
THE RESULTS of the study allowed us to find that congenital defects of the abdominal wall (gastroschisis and omphalocele) were more common in male neonates, gastroschisis being predominantly associated with premature gestation age and low weight of newborns compared to the group of patients with omphalocele where predominated term newborns with normal birth weight. There was established the significantly increased rates of congenital malformations associated with both the gastroschisis (53.12%) and the omphalocell (61.02%) patients, dominated by malformations of the digestive tract and cardiovascular ones.
CONCLUSION. Concomitant congenital malformations, which together with prematurity, low birth weight, compartment syndrome and generalization of the infectious-septic process, have significantly influenced the progression and unfavorable prognosis of the disease.
Keywords: gastroschisis, omphalocele, newborn, associated congenital malformations, prognosis

Correspondence to: E-mail: ionnegru@yahoo.com; Mob. +37361055112, +37369241779

Introduction

The interest of clinicians and pediatric surgeons worldwide in the congenital defects of the anterior abdominal wall in neonates is justified, these being some of the most serious pathologies, as the complications that accompany them present a serious, sometimes fatal danger to the child [22, 40]. The most common types of these congenital defects are laparoschisis (gastroschisis) and omphalocele.

Gastroschisis is a congenital structural defect of the anterior abdominal wall, located adjacent to and usually on the right of the insertion of the umbilical cord, through which abdominal viscera herniate [13, 31]. Although in most cases the parietal defect is located on the right side of the umbilicus [3, 9]. The abdominal parietal defect can rarely be found on the left side of the cord inserted normally [19, 31], sometimes casuistically supraombilical or infraombilical [25]. Eviscerated organs are not covered by any embryonic membrane or intrauterine sac, being exposed to amniotic fluid, which determines the development of morphopathological changes (edema, shortening of intestinal loops and so on) [25].

The incidence of gastroschisis varies from 0.5 to 7.0 cases per 15000 births, with an average of 1/2700 births [25, 30], the incidence of this malformation is increasing [12]. More commonly it appears as an isolated defect (83.3 - 93%), and in 12.2 - 35% of cases it may be part of some chromosomal syndromes and abnormalities (trisomy 13, 18, 21 etc.) [16, 30].

The incidence of omphalocele is 1-3 cases in 5000-10000 newborns [2, 26], the overall mortality rate in this pathology exceeding 25% [15].

The omphalocele can be found isolated or as a component part of some polimalformative syndromes, the syndromal omphalocele having a remarkable frequency in all the cases of omphalocel [38]. The associated malformations are found in 30-80% of the cases of omphalocele, their severity determining the prognosis of the disease [5, 32].

The aim of the study was to evaluate the clinical-paraclinical results of the abdominal wall malformations (gastroschisis and omfalocel) with the identification of congenital and acquired risk factors that influenced the prognosis of the disease.

Material and Methods

The clinico-epidemiological evaluation of the patients from the general study group and the analysis of the results of the applied medical-surgical treatment was performed based on the data extracted from the stationary medical files of the children with congenital defects of the abdominal wall hospitalized during the period 2005-2016 in the Newborn Surgery Department of the IMSP Institute of the Mother and Child, being selected 64 clinical cases of gastroschisis and 59 cases of omphalocele. Selection criteria: living newborns, who were diagnosed with various forms of gastroschisis, which were later transferred to the Newborn Surgery Department. The study did not include cases of gastroschisis with lethal end occurring during the early intranatal or postnatal periods, which did not benefit from medical-surgical treatment.

The research of the study group focused on the analysis of the following parameters: maternal age, gestational age at birth, body weight, prematurity.

The conventional laboratory examination included the hemoleucogram, the coagulogram, the biochemical analysis of the blood, the evaluation of the acid-basic balance, the microbiological investigations. Diagnostic methods included ultrasound of internal organs (fig. 1), ultrasound of the heart, neurosonography and radiological examination (fig. 2).

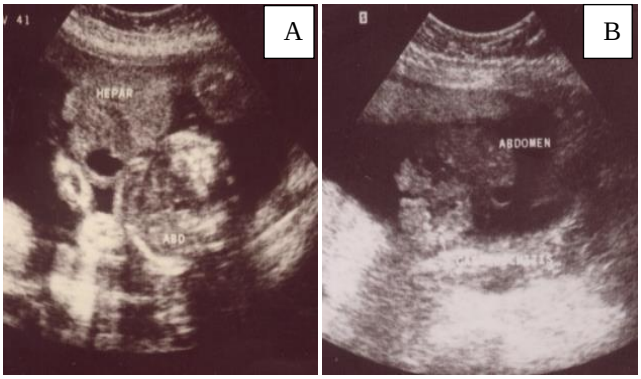

Fig. 1. USG of pregnancy: ultrasound appearance of omphalocele (A) and gastroschisis (B) at 18-19 weeks of gestation

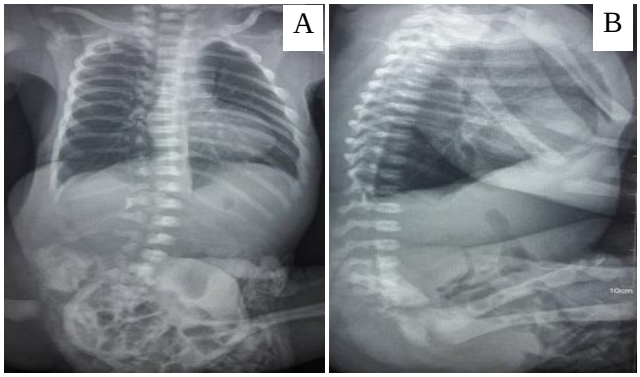

Fig. 2. Thoracic-abdominal panoramic radiography (A - anteroposterior; B - lateral to the right): appearance of aerated intestinal loops located in the embryonic sac in a newborn with omphalocele

The diagnosis of gastroschisis was established prenatally and confirmed immediately after birth. In most cases, after a quick evaluation, with the installation of a nasogastric tube and administration of intravenous fluids and antibiotics, the child was transferred quickly to the neonatal surgery service. Usually, the mothers of these children were monitored during the prenatal period with regular ultrasound examinations, paying attention to the dilation of the intestine, the thickness of the abdominal wall, the motility of the intestine, the amount of amniotic fluid during the gestation period. In 18 cases the birth occurred naturally, the rate of cesarean interventions constituting 4 cases.

The analysis of the medical files allowed to find that the average maternal age in the group of morphopathologically investigated patients was 23.06 + 0.91, the minimum age being 17 years, the maximum age - 32 years.

The results of the study were processed on the Pentium computer in the Microsoft Office Excel 7.0 program, using the statistical processing package according to the Student criterion, the differences p <0.05 being considered statistically conclusive.

Results

The study found that most cases of gastroschisis (10 cases) were recorded in 2006 and 2015, with the lowest number of patients (2 children) being recorded in 2012. The maximum number of cases of omphalocele was found in 2005 and 2008 (10 cases), while in 2007 only one child with this malformation was hospitalized, and in 2012 and 2014 - 2 cases (fig. 3).

The distribution by gender allowed us to determine that these malformations were more common in boys (gastroschisis - 59.37%, omphalocel - 64.41%) (table 1).

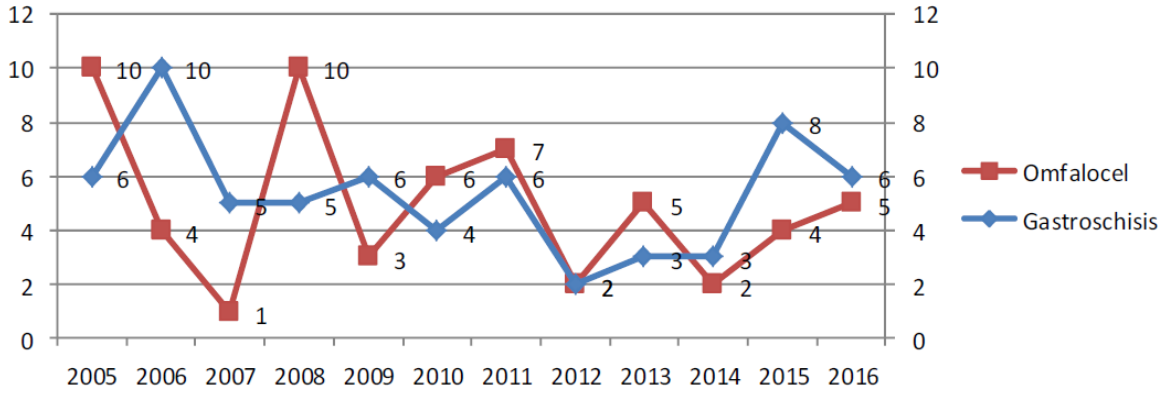

Fig. 3. Graphical representation of the annual frequency of cases of gastroschisis and omphalocele for the period 2005-2016

***Table 1.* Distribution of patients by gender**

	Gastroschisis		Omphalocele	
Gender	Nr.	%	Nr.	%
Male	38	59,37	38	64,41
Female	26	42,63	21	35,59

In this study, preterm infants with gastroschisis with a medium gestational age of 33.74 ± 0.43 weeks (40 cases - 62.50 %) and medium weight of 2022.45 ± 82.78 g predominated with a range from 720 g (26 weeks) to 3,200 g (36 weeks). The mean weight of term neonates (38.23 ± 0.19 weeks) with gastroschisis (26 cases) was significantly higher and consisted of 2673.04 ± 73.48 g (p <0.001), in 6 cases the weight was up to 2500 g, with an intrauterine growth retardation of the fetus. In 30 cases (45.45%) was determined gastroschisis with significant viscero-abdominal disproportion. In the group of patients with omphalocele predominated male neonates (64.41%), born in term (38.96 ± 0.15 weeks) - 45 children, mean weight (3241.00 ± 63.95 g) being significantly higher compared to the patients with gastroschisis born in term (p <0.001). The preterm group consisted of 14 children (34.64 ± 0.66 weeks) with an average weight of 2476.18 ± 207.27 g, significantly lower compared to term newborns (p <0.001), premature infants with omphalocele having a higher weight compared to those with gastroschisis (p <0.05). The number of patients with gastroschisis hospitalized in serious and extremely serious condition was 89.06% and 72.88% - in the group of children with omphalocele (tab. 2).

Depending on the size, the small size omphalocele was found in 33 (55.93%) newborns, medium omphalocele - 17 (28.81%) cases, the major and giant omphlocele in 9 (15.25 %) cases.

Complicated forms of malformation (inflammation, infection or rupture of the embryonic leaves) were determined in 25 (42.37%) cases, of which 20 with minor and medium omphalocele and 5 patients with major omphalocele.

The hemoleucogram of patients with congenital defects of the abdominal wall (tab. 2) did not find statistically significant differences of the selected indices between the group of children with gastroschisis and those with omphalocele (p> 0.05), the results of the average values obtained being within the conventionally normal limits. The mean values of the biochemical indices in the blood of infants with gastroschisis and omphalocele at the time of hospitalization, the evaluation of which showed that in the group of patients with gastroschisis the general protein values were actually lower (48.83 ± 1.27) compared to the values of the children with omfalocel (56.39 ± 2.04) (p <0.01), while the difference between the values of urea and creatinine level was insignificant (p> 0.05) (tab. 3).

***Table 2.* Parameters of hemoleucogram in neonates with congenital defects of the abdominal wall (M ± m)**

Parameters	Gastroschisis n=30	Omphalocele n=30
Hb, g/l	188,3 ± 5,74	191,33 ± 6,6
Er x 10^{12}/l	5,8 ± 0,17	5,8 ± 0,19
Le x10^{9}/l	10,4 ± 1,25	12,21 ± 0,81
ESR, mm/h	3,7 ± 0,8	4,27 ± 0,63

***Table 3.* Preoperative biochemical analysis of blood in children with congenital abdominal wall defects at the time of hospitalization (M ± m)**

Parameters	Gastroschisis n=30	Omphalocele n=30
Protein (g/l)	48,83±1,27	56,39±2,04**
Urea (mmol/l)	4,82±0,45	4,56±0,41
Creatinine (mcmol/l)	54,51±3,39	63,84±5,18
Total bilirubin (mcmol/l) Conjugated bilirubin (mcmol/l) Free bilirubin (mcmol/l)	39,41±6,72 1,69±0,64 30,76±6,52	101,33±13,92*** 4,4±2,34 84,11±22,28***
ALT	46,71±6,32	36,31±4,35
AST	59,32±6,42	54,94±7,75
Prothrombin index (%)	86,3±2,15***	81,54±2,08
Fibrinogen (g/l)	4,28±0,44	3,28±0,28
K^{+} (mmol/l)	4,95±0,25	5,25±0,12
Na^{+} (mmol/l)	136,88±4,55	139,04±1,56
$Ca2^{++}$ (mmol/l)	2,05±0,04	1,99±0,05

Note: * P <0.05; ** p <0.01; *** p <0.001 (as in all the tables)

In children with omfalocel the total bilirubin level was significantly higher with about 2.5 times compared to the group of children with gastroschisis ($p<0.001$), an insignificant increased level being characteristic for conjugated bilirubin ($p>0.05$) and veridically increased - for free bilirubin ($p<0.001$). We note that the study did not find statistically reliable differences in the blood levels of transaminases in these 2 groups of patients ($p>0.05$), although these values were slightly higher in patients with gastroschisis, who also had a comparatively higher level of prothrombin index ($p<0.001$), fibrinogen values being insignificantly high ($p>0.05$). The estimation of the serum level of potassium, sodium and calcium did not determine a statistically true difference of the values obtained between these 2 groups ($p>0.05$), the indices being within the range of normal conventional values (Na^+: 133-146 meq/L; K^+: 3.2-5.5 meq/L).

The average values of the basic indices of the acid-basic balance (tab. 4), the maintenance of which is a considerable challenge for the newborns with congenital defects of the abdominal wall. At the time of hospitalization, the average pH values in neonates with gastroschisis (7.27 $\pm$ 0.03) were insignificantly lower compared to the values recorded in cases of omphalocele (7.31 $\pm$ 0.03) ($p> 0.05$) , while the values of PCO_2 in the group of patients with gastroschisis (38.75 $\pm$ 3.53) really exceeded the values of the group with omphalocele (30.78 $\pm$ 1.74), the indices of both groups being in the normal range (35 - 45 mm Hg). The level of PO_2 in both groups did not significantly exceed the range of normal values (50 - 70 mm Hg) without finding a statistically significant difference ($p> 0.05$), the rule also valid for the O_2 level. The values of BE (excess of bases) in the group of children with gastroschisis constituted -10,62 $\pm$ 0,98, in those with omfalocel - they were of -11,1 $\pm$ 1,2 ($p<0,01$), whereas the serum indices of HCO_3^- in neonates with gastroschisis was 16.17 $\pm$ 1.31, and in those with omphalocele 15.89 $\pm$ 0.73, with no statistically significant difference ($p>0.05$), the results being suggestive for an acidosis of metabolic origin, characteristic for newborns in the first days of life.

We note that in the evaluated group the pH values <7.2 were found in 2 cases, and pH <7.0 were observed in 4 cases of gastroschisis, the range of values was 6.84 - 6.99 , whereas in the group of patients with omphalocele pH <7.2 was found only in one case (pH = 6.67).

In these cases, PCO_2 indices exceeded the conventional limits (<50 mmHg), in children with gastroschisis, a range of values of 50.6 - 88.3 mmHg was found, and in the only case of omphalocele, this index constituted 109.9 mmHg, at the same time the BE indices ranged from -7.2 to -23.6 mmol/l in children with gastroschisis and -26.2 mmol/l in the case of omphalocele. PH values >7.4 were found in 5 cases of gastroschisis with a range of values of 7.41-7.47 and in 4 cases of omphalocele with a range of values of 7.42-7.59. The incidence of congenital malformations in neonates with gastroschisis constituted 53.12% (34 patients), coexisting anomalies in neonates with omphalocele being found in 36 patients (61.02%) (tab. 5.).

Analysis of morbidity structure in neonates with gastroschisis allowed to highlight the predomination of digestive tract malformations (65.62%) and cardiovascular malformations (43.75%), followed by urogenital malformations (28.12%), bronchopulmonary malforma-tions (7.81%) and neurosurgical malformations (3.12%), 28 patients (43.75%) being diagnosed with 2 or more congenital malformations at the same time.

***Table 4.* Comparative values of acid-base balance indices in children with congenital abdominal wall defects at the time of hospitalization (M $\pm$ m)**

Parameters	Gastroschisis n=30	Omphalocele n=30
pH	7,27±0,03	7,31±0,03
pCO_2 mm Hg	38,75±3,53*	30,78±1,74
pO_2 mm Hg	72,66±10,19	73,22±6,6
O_2 %	80,08±4,43	87,25±2,35
BE mmol/l	-10,61±0,98	-11,1±1,2**
HCO_3- mmol/l	16,17±1,31	15.89±0,73

***Table 5.* Frequency of congenital malformations associated in neonates with gastroschisis and omphalocele**

Coexisting malformations	Gastroschisis		Omphalocele	
	Nr.	Incidence (%)	Nr.	Incidence (%)
1. Cardiovascular malformations	**28**	**43,75**	**18**	**30,51**
- atrial septal defect	5	7,81	3	5,08
- patent ductus arteriosus	8	12,5	6	10,17
- bicuspid aortic valve	1	1,56	-	-
- congenital aortic valve stenosis	3	4,69	-	-
- persistent foramen ovale	7	10,94	5	8,47
- ventricular septal defect	3	4,69	2	3,39
- coarctation of the aorta	1	1,56	-	-
- dextrocardia	-		2	3,39
2. Urogenital malformations	**18**	**28,12**	**7**	**11,86**
- Renal cystic dysplasia	7	10,94	2	3,39
- abdominal ectopia of the testis	1	1,56	-	-
- congenital hydronephrosis	3	4,69	1	1,69
- ureteral stenosis with ureteral geniculation	6	9,37	-	-
- vaginal atresia	1	1,56	-	-
- hypospadias	-	-	1	1,69
- persistence of the hurricane	-	-	1	1,69
- bladder extrusion	-	-	1	1,69
- cloaca extrusion	-	-	1	1,69
3. Malformations of the digestive tract	**42**	**65,62**	**30**	**50,85**
- severe intestinal and fixative disorders	20	31,25	6	10,17
- pancreatic cystic fibrosis	1	1,56	-	-
- atresia of the small intestine	2	3,12	-	-
- segmental stenosis of the small intestine	3	4,69	-	-
- colon atresia	4	6,25	-	-
- segmental colonic stenosis	2	3,12	-	-
- duplication of the gallbladder with stenosis of the colleague	1	1,56	-	-
- gallbladder hypoplasia	1	1,56	-	-
- congenital megaduodenum	1	1,56	-	-
- vascular malformations of the mesenter and intestine	1	1,56	-	-
- agenesis of the cecum, vermicular appendix	2	3,12	1	1,69
- anal atresia et recti	1	1,56	-	-
- incomplete annular pancreas	2	3,12	-	-
- duplication of the small intestine	1	1,56	18	30,51
- the Meckel diverticulum	-	-	2	3,39
			1	1,69
			2	3,39
4. Neurosurgical malformations	**2**	**3,12**	**1**	**1,69**
- microcephaly	1	1,56	-	-
- cerebral vascular malformations	1	1,56	-	-
- spina bifida	-	-	1	1,69
5. Bronchopulmonary malformations	**5**	**7,81**	**1**	**1,69**
- Lobar pulmonary agenesis	3	4,69	-	-
- Lobar pulmonary hypoplasia	2	3,12	1	1,69
6. Disembryogenetic stigmas	**2**	**3,12**	**2**	**3,39**

The coexisting congenital malformation spectrum in neonates with omphalocele was represented by malformations of the digestive tract (50.85%), congenital cardiovascular defects (30.51%), urogenital malformations (11.86%), neurosurgical and bronchopulmonary malformations found casuistically (fig. 4). In 24 cases (48.68%) of omphalocele, multiple malformations were detected. In 4 (6.78%) cases, syndromal omphalocele was diagnosed in neonates with arthro-griposis (2 cases), Cantrel pentas (1 case) and Beckwith-Wiedermann's syndrome (1 case).

According to the anatomopathological findings, together with the associated prematurity and malformations, the unfavorable evolution of the disease was influenced by other pathological conditions, including (table 6): congenital peritonitis (aseptic and septic-infectious), encountered in all cases of gastroschisis, sepsis (59,37%), hypoxic-discirculatory encephalopathy (35.94%), intrauterine infection with the generalization of the inflammatory-septic process (32.81%), amniotic fluid aspiration with the development of focal atelectasis and pneumonia (23.44%), the development of enterocolitis (25%), obstetrical trauma (7.81%).

These pathological conditions on the background of tissue immaturity of the internal organs, determined the development of polyorganic insufficiency with an unfavorable exodus of the disease. In most cases 2 and more of these nozological entities were found.

The analysis of the anatomopathological protocols allowed us to find that in the cases of omphalocele, along with the concomitant pathological conditions described above, the nozological entities that determined the unfavorable exodus of the omphalocele were: natal trauma with intraventricular haemorrhage and cerebral edema - 2 cases, hypoxic-discirculatory encephalopathy - 5 cases, intrauterine infection - 6 cases, aspiration of amniotic fluid with the development of atelectasis and pneumonia - 7 cases, enterocolitis - 6 cases, progressive peritonitis - 11 cases. In most cases with unfavorable development (12 cases), 2 or more of the listed pathologies were found.

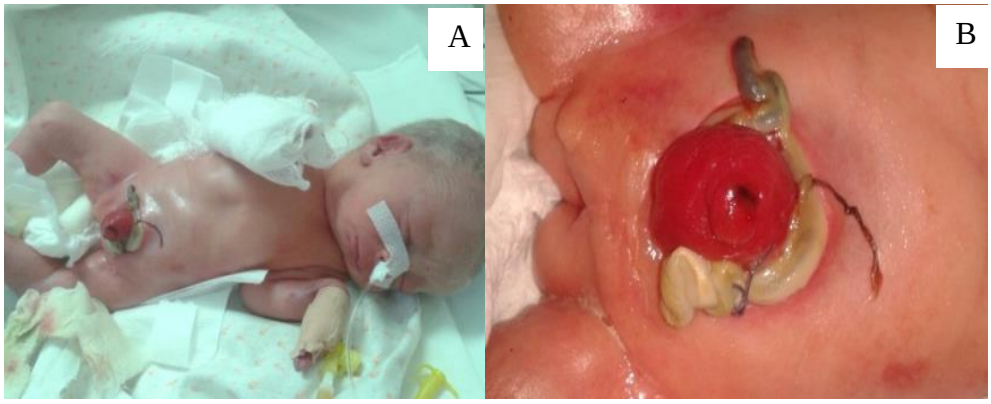

Fig. 4. The appearance of a newborn with omphalocele complicated with the rupture of the embryonic leaves associated with arthrogryposis, bladder extrusion and bladder.

***Table 6.* Frequency of pathological conditions that influenced significantly the evolution of the disease in the cases of gastroschisis**

Nozological entity	Nr.	%
Hypoxic-discirculatory encephalopathy	23	35,94
Amniotic fluid aspiration with the development of focal atelectasis and pneumonia	15	23,44
Enterocolitis	16	25
Intrauterine infection with the generalization of the inflammatory-septic process	21	32,81
Obstetrical trauma	5	7,81
Congenital peritonitis (aseptic and septic-infectious)	64	100
Sepsis	38	59,37

Discussion

Although the strategies of surgical correction of congenital defects of the anterior abdominal wall have evolved considerably in recent decades, their prognosis remains severe [33]. Hypothermia, fluid loss, sepsis, low birth weight, gestational age has a significant influence on the risk of death in case of congenital defects in the abdominal wall [27, 34]. Some authors reported an index of 5.9 – 23.4% of postnatal mortality in the case of congenital defects of the abdominal wall [1, 15], in some countries the values of this index reaching 28 % [17] or even 80%. A significant survival of 90-97% is recorded in the simple gastroschisis [16, 35], versus 10% in complex gastroschisis [29]. The incidence of congenital malformations in gastroschisis patients is about 15-35%, depending on the inclusion criteria [8, 16]. At the same time, some studies indicate that 48.1% - 68% of neonates with gastroschisis have one or more associated abnormalities, including intestinal atresia, cryptorhidia, persistence of fetal circulation, etc., multiple congenital malformations constituting about 32% from cases [5, 11]. Thus, intestinal malformations occur in 5-20% of cases, urinary tract malformations - in 6%, heart defects - in 1% [10]. It was determined that fetuses with gastroschisis have an increased risk of prematurity (22-40%), oligohydroamnios (36%), intrauterine retardation (38-77%) or miscarriage (7%) [1, 27]. Associations of gastroschisis with cardiac malformations have been reported, such as septal defects, tetralogy Fallot, Ebstein anomaly, aortic coarctation, major artery transposition, etc. [24], facial, musculoskeletal [28], chromosomal, including trisomies and Turner syndrome [28], neural tube defects [20], hydrocephalus [14], Hirschsprung disease [4], anorectal malformations [28], diaphragmatic hernia [21], cholecyst cyst [37].

The associated malformations are found in 30-80% of the cases of omphalocele, their severity determining the prognosis of the disease [5, 32]. Cardiac abnormalities were recorded in 50% of patients with omphalocele, gastrointestinal - in 40%, the chromosomal ones in 10-40%, the most frequent being trisomies 13, 14, 15, 18, 21, Turner syndrome (45, X), Klinefelter syndrome (47, XXY), triploidy (69, XXX). Genetic syndromes associated with omphalocele are the Beckwith-Wiedemann syndrome, the Goltz syndrome, the Marshall-Smith syndrome, the Cantrell pentalogy, bladder and cloacal extrofia, Toriello-Carey syndrome, Carpenter syndrome, etc. [7, 18, 23, 39].

Conclusions

1. The results of the study allowed us to find that congenital defects of the abdominal wall (gastroschisis and omphalocele) were more common in male neonates, gastroschisis being predominantly associated with premature gestation age and low weight of newborns compared to the group of patients with omphalocele where predominated term newborns with normal birth weight.
2. There was established significantly increased rates of congenital malformations associated with both the gastroschisis (53.12%) and the omphalocell (61.02%) patients, dominated by malformations of the digestive tract and cardiovascular ones.
3. Concomitant congenital malformations, which together with prematurity, low birth weight, compartment syndrome and generalization of the infectious-septic process have significantly influenced the progression and unfavorable prognosis of the disease.

REFERENCES

1. Akakpo-Numado G.K., Gnassingbe K., Boume M.A. et al. Emergency treatment of a ruptured huge omphalocele by simple suture of its membrane. Ann. Surg. Innov. and Research. 2012. 6:2.
2. Akhtar J., Skarsgard E.D. Associated malformations and the "hidden mortality" of gastroschisis. J. Pediatr. Surg. 2012; 47:911.
3. Aldridge B., Ladd A.P., Kepple J., Wingle T., Ring C., Kokoska E.R. Negative pressure wound therapy for initial management of giant omphalocele. Am. J. Surg. 2016; 211:605-9.
4. Allin B.S.R., Irvine A., Patni N., Knight M. Variability of outcome reporting in Hirschsprung's disease and gastroschisis: a systematic review. Sci. Rep. 2016; 6:38969. doi: 10.1038/srep38969.
5. Benjamin B., Wilson G.N. Anomalies associated with gastroschisis and omphalocele: Analysis of 2825 cases from the Texas Birth Defects Registry. J. Pediatr. Surg.2014; 49: 2014. 514-9.
6. Calcagnotto H., Muller A.L., Leite J.C. et al. Associated factors for perinatal mortality in gastroschisis. Rev. Bras. Ginecol. Obstet. 2013; 35(12):549-53.
7. Chen C.P. Syndromes and disorders associated with omphalocele (III): single gene disorders, neural tube defects, diaphragmatic defects and others. Taiwan J. Obstet. Gynecol. 2007; 46(2):111-20.
8. Christison-Lagay E.R., Kelleher C.M., Langer J.C. Neonatal abdominal wall defects. Semin. Fetal & Nenat. Med. 2011; 16:164.
9. Ciobanu O., Stoica A., Zavate A. ş.a. Laparoschisis – Consideraţii clinico-terapeutice. Craiova Medicală. 2007; 9(4):314-7.

10. Corey K.M., Hornik C.P., Laughon M.M., McHutchison K., Clark R.H., Smith P.B. Frequency of anomalies and hospital outcomes in infants with gastroschisis and omphalocele. Early Human Develop. 2014; 90:421-4.
11. Corona-Rivera J.R., Nieto-Garcia R., Lopez-Marure E. et al. Associated congenital anomalies in infants with isolated gastroschisis: a single-institutional experience. Am. J. Med. Geenet. A. 2016; 170(2):316-21.
12. Dalton B.G., Gonzalez K.W., Reddy S.R., Hendrickson R.J., Iqbal C.W. Improved outcomes for inborn babies with uncomplicated gastroschisis. J. Pediatr. Surg. 2017; 52:1132-4.
13. de Buys Roessingh A.S., Damphousse A., Ballabeni P. et al. Predictive factors at birth of the severity of gastroschisis. World J. Gastrointest. Pathophysiol. 2015; 6(4):228-34.
14. Dribin T., McAdams R.M. A neonate with gastroschisis and hydrocephalus complicated by central diabetes insipidus. J. Ped. Surg. Case Rep. 2014; 2:366-8.
15. Eamer G.J., Alfraih Y., Stein N., Bailey K. Splenic and pancreatic torsion after giant omphalocele repair. J. Ped. Surg. Case Rep. 2017; 25:40-3.
16. Feldkamp M.L., Botto L.D., Byrne J.L. et al. Clinical presentation and survival in a population-based cohort of infants with gastroschisis in Utah, 1997-2011. Am. J. Med. Genet. A. 2016; 170(2):306-15.
17. Feldkamp M.L., Bowles N.E., Botto L.D. AEBP1 gene variants in infants with gastroschisis. Berth Defects Res. A Clin. Mol. Teratol. 2012; 94(9):738-42.
18. Heider A.L., Strauss R.A., Kuller J.A. Omphalocele: Clinical outcomes in cases with normal karyotype. Am. J. Obst/ Gynecol. 2004; 190:135-41.
19. Hombalkar N.N., Rafe A., Prakash G.D. Left-sided gastroschisis with caecal agenesis: a rare case report. Afr. J. Paediatr. Surg. 2015; 12(1):74-5.
20. Hwang P.J., Kousseff B.G. Omphalocele and gastroschisis: an 18-year review study. Genet. Med. 2004; 6:232-6.
21. Inoue S., Odaka A., Muta Y. et al. Coexistence of congenital diaphragmatic hernia and abdominal wall closure defect with chromosomal abnormality: two case reports. J. Med. Case Rep. 2016; 10(1):19.
22. Ionescu S., Mocanu M., Andrei B. ș.a. Diagnosticul diferențial al defectelor de perete abdominal – omfalocel versus gastroschisis. Chirurgia (Bucur.). 2014; 109(1):7-14.
23. Karaman A., Aydin H., Goksu K. Concomitant omphalocele, anencephaly and arthrogryposis associated with trisomy 18. Genet. Couns. 2015; 26(1):77-9.
24. Kunz L.H., Gilbert W.M., Towner D.R. Increased incidence of cardiac anomalies in pregnancies complicated by gastroschisis. Am. J. Obstet. Gynecol. 2005; 193:1248-52.
25. Ledbetter D.J. Congenital abdominal wall defects and reconstruction in pediatric surgery: gastroschisis and omphalocele. Surg. Clin. North Am. 2012; 92:713-27.
26. Marshall J., Salemi J.L., Tanner J. P. et al. Prevalence, correlates, and outcomes of omphalocele in the United States, 1995-2005. Obstet. Gynecol. 2015; 126(2):284-93.
27. Marshall Niles S.G., Mitchell-Fearon K., Gill M. I., DeSouza C. J., Fearon I. C., Abel C. A. et al. Mortality-related factors in gastroschisis – a Jamaican perspective. J. Pediatr. Surg. 2017; 52:530-3.
28. Mastroiacovo P., Lisi A., Castilla E.E. et al. Gastroschisis and associated defects: an international study. Am. J. Med. Genet. A 2007; 143:660-71.
29. Masui D., Fukahori S., Asagiri K., Ishii S., Saikusa N. et al. Wandering spleen associated with omphalocele in a neonate: An unusual case with non-operative management. J. Pediatr. Surg. Case Rep. 2017; 24:8-11.
30. Materna-Kiryluk A., Wieckowska B., Wisniewska K. et al.Geospatial clustering of gastroschisis in Poland: data from the Polish Registry of congenital malformations (PRCM). Int. J. Occup. Med. Environ. Health. 2016; 29(3):461-70.
31. Nam N.F., Kaneko J.S., Intelizano P.M., Ferreira R.M., Oliveira N.M. et al. Left-sided gastroschisis associated with situs inversus totalis. J. Ped. Surg. Case Rep. 2018; 28:6-8.
32. Peters N.C.J., Vissert Hooft M.E., Ursem N.E., Eggink A.J., Wijnen R.M.H. et al. The relation between viscero-abdominal disproportion and type of omphalocele closure. Eur. J. Obstetr. Gynecol. Reprod. Biol. 2014; 181:294-9.
33. Puligandla P.S., Baird R., Skarsgard E.D., Emil S., Laberge J.M. Outcome prediction in gastroschisis – The gastroschisis prognostic score (GPS) revisited. J. Pediatr. Surg. 2017; 52:718-21.
34. Riggle R.M., Davis J.L., Drugas G.T., Riehle K.J. Fatal Clostridial necrotizing enterocolitis in a term infant with gastroschisis. J. Ped. Surg. Case Rep.2016; 14: 29-31.
35. Risby K., Husby S., Qvist N., Jakobsen M.S. High mortality among children with gastroschisis after the neonatal period: A long-term follow-up study. J. Pediatr. Surg. 2017; 52:431-6.
36. Sangkhathat S., Patrapinyokul S., Chiengkriwate P. et al. Infectious complications in infants with gastroschisis: an 11 year review from a referral hospital in southern Thailand. J. Pediatr. Surg. 2008; 43:473-8.
37. Serber J., Stranzinger E., Geiger J.D., Teitelbauma D.H. Association of gastroschisis and choledochal cyst. J. Pediatr. Surg. 2009; 44:E23-E26.
38. Țârcă E., Aprodu S.G., Straticiuc-Ciongradiu I., Goția D.G. Aspecte clinico-evolutive în cazul omfalocelului sindrom. Rev. Rom. Pediatr. 2013; 2:171-5.
39. van Eijck F.C., Wijnen R.M., van Goor H. The incidence and morbidity of adhesions after treatment of neonates with gastroschisis and omph.: a 30-year review. J. Pediatr. Surg. 2008; 43(3):479-83.
40. Watanabe S., Suzuki T., Hara F., Yasui T., Uga N., Naoe A. Omphalocele and gastroschisis in newborns: Over 16 years of experience from a single clinic. J. Neonatal. Surg. 2017; 5;6(2):27. doi:10.21699/jns.v6i2.530.