VAGINAL BIRTH VS CAESAREAN DELIVERY: IMPACT ON GASTROSCHISIS ANATOMY IN NEWBORNS (A 33-YEAR EXPERIENCE)

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BACKGROUND

In 2015, we hypothesized the possible impact of the delivery mode on gastroschisis (GS) anatomy, based on clinical data consisting of 100 newborns with this malformation, born naturally or by caesarean section (CS) between 1987 to 2015 years. Over the past 5 years, our experience has increased by 35 children with GS born by CS, which gave the opportunity to refuse or confirm the results of our previous studies.

In addition, the entire clinical data of 135 newborns with GS were adapted to the anatomical and physiological classification of GS developed by prof. O.K. Sliepov in 2019 (Table 1) [1], which provided new opportunities for research.

Research objective: to determine the impact of the delivery mode on the features of GS anatomy in newborns.

MATERIAL AND METHODS

A retrospective analysis of medical data of 135 pregnant women and their newborns with GS (n = 135), born naturally (n = 55) or by CS (n = 80), between 1987 and 2020 was performed. Newborns with GS are divided into 3 clinical groups, depending on the method and place of birth, prenatal diagnosis, transportation, location and duration of surgical treatment of the defect. Group I included 83 newborns with GS, who were born in the SI "O.M. Lukyanova Institute of Pediatrics, Obstetrics and Gynecology of the NAMS of Ukraine" (in utero transfer group), for the period from 2006 to 2020. In 100% of cases GS was diagnosed prenatally.

The vast majority of children (96.4%, n = 80) were born by CS. Maternal age ranged from 16 to 36 years (23.07 ± 4.2). Scheduled premature CS was performed in 45% (n = 36) of women at term of 36–38 (36.7 ± 0.54) weeks of gestation; planned term CS in 20% (n = 16) of women at 38–39 (38.2 ± 0.36) weeks of gestation; unplanned (emergency) CS was conducted in 35% (n = 28) of women at 32–38 (35.8 ± 1.34) weeks of gestation. Most children (66.2%, n = 53) were firstborn.

Table 1. Classification of GS (O.K. Sliepov, 2019)

I. Isolated GS (simple GS)	Associated GS (GS with other congenital malformations or intrauterine pathology:
	a) simple
	b) complex
II. By localization of the anterior abdominal wall defect (AWD):	
a) typical	b) atypical
III. By the presence of a communication between the amniotic and abdominal cavities:	
a) open GS	b) closed GS (closing GS with vanishing midgut syndrome)
IV. By the volume of eventrated organs:	
a) midgut	
b) midgut + gaster	
c) midgut + gaster (or without) + other organs (liver, gallbladder, pancreas, duodenum, bladder, uterus and/or its appendages (in girls), testicles (in boys)	
d) atypical eventration (appendix)	
V. By bowel damage degree:	
a) non-inflamed (intact)	b) with bowel inflammation: • moderate (bowel matting) • severe (peels formation)
VI. By the presence of intrauterine growth restriction (IUGR):	
a) without IUGR	b) with IUGR (grade I, II, III)
VII. By degree of visceral abdominal disproportion (VAD):	
a) GS without VAD	b) GS with VAD: • moderate • high

The course of pregnancy was complicated in 57.5% (n = 46) of women: threatened miscarriage in 32.6% (n = 15), maternal extragenital diseases in 21.7% (n = 10), infection in 32.6% (n = 15), fetoplacental insufficiency in 19.6% (n = 9), anemia in 10.9% (n = 5) of women. In total, 41 (51.3%) girls and 39 (48.7%) boys were born after the CS. Premature babies predominated (78.7%, n = 63). The body weight of newborns ranged from 1760 to 4020 g, on average 2524 ± 460.5 g. Apgar score was 4.21 ± 1.52 for 1 min, and 4.62 ± 1.27 for 5 min. IUGR of various degrees (I–III) was detected in 36.2% (n = 29) of cases. Isolated GS was in 55% (n = 44) of cases and prevailed over associated GS (45%, n = 36). Associated GS was complicated in 17.5% (n = 14) of cases. VAD was found in 82.5% (n = 66) of infants: moderate degree in 56.2% (n = 45) and severe degree in 26.2% (n = 21). In all newborns of this group surgical management of GS was performed in the first minutes of life ("surgery of the first minutes").

Group II consisted of 27 newborns with GS, treated at the SI "O.M. Lukyanova Institute of Pediatrics, Obstetrics and Gynecology of the NAMS of Ukraine" between 1987 and 2005. Some children of this group (51.9%, n = 14) were born in our institute (in utero transfer), and other (48.1%, n = 13) children were transported from another hospitals. GS was diagnosed prenatally only in 1/3 of cases (29.6%, n = 8). Most women (92.6%, n = 25) had vaginal delivery at 34–40 weeks of gestation, averaging 37 ± 0.2 weeks. Maternal age ranged from 15 to 30 years, with an average of 19.7 ± 0.5 years. 77.8% (n = 21) women were first childbirth. The pregnancy course was complicated in 63% (n = 17) of women: threatened miscarriage in 6 (22.2%), infection in 4 (14.8%), anemia in 4 (14.8%), maternal extragenital diseases in 3 (11.1%), fetoplacental insufficiency in 2 (7.4%). There were 15 (60%) girls and 10 (40%) boys. There were 44.0% of premature infants (n = 11). Body weight ranged from 1480 to 3400 g (2568.5 ± 91.2 g). IUGR was diagnosed in 6 (24%) children. Isolated GS (88%, n = 22) prevailed over associated (12%, n = 3). Associated complicated GS was diagnosed in 2 (8%) children. VAD was found in 21 (84%) children: moderate in 7 (28%), severe in 14 (56%). All newborns of this group underwent delayed surgical correction of the defect in 1.5 to 48 h (13.9 ± 2.1 h) after birth.

Group III included 30 newborns with GS, who were treated in the Mykolaiv Regional Children's Hospital between 1987 and 2005. All children were transported to a surgical clinic from Maternity Hospitals of Mykolaiv city and Mykolaiv region. All children were born naturally at 32–40 weeks of gestation (36.6 ± 0.3 weeks). GS was diagnosed prenatally only in 3 (10%) cases. Maternal age ranged from 16 to 27 years (20.7 ± 0.5 years). The vast majority of children (70%, n = 21) were firstborn. The pregnancy course was complicated in 23 (76.7%) mothers: infections in 8 (26.7%), fetoplacental insufficiency in 5 (16, 7%), threatened miscarriage in 3 (10.0%), anemia in 3 (10.0%). There were 13 (43.3%) girls and 17 (56.7%) boys. Body weight ranged from 1700 to 3400 g (2434.3 ± 77.9 g). IUGR was detected in 36.7% (n = 11) of cases. Premature babies were predominated (73.3%, n = 22). GS was isolated in most cases (66.7%, n = 20). Associated GS was complicated in 23.3% (n = 7) of cases. VAD was detected in all cases: moderate in 14 (46.7%), severe in 16 (53.3%). All newborns of this group underwent delayed surgical management of the defect in 1 to 64 h (9.7 ± 2.5 h) after birth.

The study included children with GS from each group born exclusively by vaginal delivery (group II (n = 25) and group III (n = 30)) or by CS (group I (n = 80)). In the studied children the following anatomical features of the defect were investigated: localization and size of the AWD, connection with the abdominal cavity, nature and frequency of eventrated organs. Prenatal and postnatal ultrasonography, laboratory and radiological findings, data of intraoperative revision and morphological examination (at autopsy) were studied.

Statistical significance was assessed by Mann – Whitney U-test and Chi-squared test. P values < 0.05 were considered statistically significant.

The study was conducted in accordance with the principles of the Declaration of Helsinki. The research protocol was approved by the local Ethics Committee of the institution. The informed consent of the child's parents was obtained for the research. The level of evidence of this study is III.

RESULTS

The results of a long-term study presented in Table 2 and show the anatomical features of GS in newborns depending on the delivery mode.

It was found that the AWD localization was typical in all groups, regardless of the delivery method. The frequency of open GS was also high and almost the same in all groups. Closed GS was detected in 3.7% of cases in group I.

The AWD size was significantly smaller in children born by CS (group I) than in those born by vaginal delivery (groups II and III). In newborns of group I it was 3.02 ± 0.58 cm, while in groups II and III they were 4.17 ± 0.3 cm ($p < 0.01$) and 4.7 ± 0.29 cm ($p < 0.01$), respectively. Thus, we confirmed in the literature for the first time our hypothesis about the impact of the delivery mode on the size of the AWD defect in patients with GS.

In addition, it was found that the delivery mode affected the frequency of eventration of the duodenum and pancreas. Frequency of the duodenum (52%) and pancreas (63.3%) eventration after vaginal delivery in groups II and III was significantly higher than in patients of group I (20.0%) born by CS ($p < 0.01$).

There was no significant difference in the frequency of eventration of other abdominal organs, both after CS and after vaginal delivery.

DISCUSSION

Until the beginning of the XXI century, and even until now, there is a controversy in the literature about the best way of childbirth in women who are prenatally diagnosed with fetal GS. Some clinicians promote natural vaginal birth as the safest and physiological for women [2, 3]. Others argue that vaginal birth is dangerous for a newborn with GS, due to infection and, most importantly, injury of eventrated organs during uterine contractions and their passage through the birth canal [3, 4].

Some researchers emphasize that in natural childbirth, as a result of uterine contractions, blood plasma is released from the capillaries of the exposed intestine which leads to peels formation [4, 5]. However, numerous studies by other authors

Table 2. Comparative characteristics of anatomical variants of GS depending on the mode of delivery

Anatomical features of GS	I group (CS), n = 80	II group (vaginal delivery), n = 25	III group (vaginal delivery), n = 30
Localization of the AWD defect			
• typical, % • atypical, %	100 –	100 –	100 –
Communication between the amniotic and abdominal cavities			
• closed GS, % • open GS, %	3.7 96.3	– 100	– 100
Size of AWD, cm	3.02 ± 0.6*	4.17 ± 0.3*	4.7 ± 0.29**
The frequency and volume of eventrated organs			
• midgut, %	37.5	40.0	30.0
• midgut + gaster, %	15.0	4.0	6.7
• midgut + gaster (or without) and other organs, %:	47.5	56.0	63.3
- duodenum, %	20.0*	52.0*	63.3**
- pancreas, %	20.0*	52.0*	63.3**
- liver and/or gallbladder, %	5.0	20.0	13.3
- bladder, %	5.0	8.0	–
- uterine appendages (in girls) and testicles (in boys), %	30.0	12.0	–

* significant difference between groups I and II
** significant difference between groups I and III

report that inflammatory damage of the eventrated bowel develop in utero before the onset of labor and are well diagnosed during fetal ultrasonography at 32–34 weeks of gestation [5–7].

In fetuses and newborns with GS, typically, the AWD is perforating, located to the right of the umbilical cord and is accompanied by splitting of the umbilical ring [1–6]. Rare forms include "closed" GS and GS with atypical localization of the defect [1]. "Closed" GS (vanishing GS) is a specific form of this malformation in which strangulation of the eventrated midgut in a stenotic AWD develops due to its strong narrowing, without splitting of the umbilical ring and connection between the amniotic and abdominal cavities [8]. According to the results of our study location of the defect was typical (right-sided) in all newborns, and "closed" GS was found in only 3.7% of infants born by CS, with no significant difference between the compared groups. This is due to the fact that the formation of a AWD occurs during fetal development, i.e. does not depend on the delivery mode, and can be diagnosed by prenatal ultrasound of the fetus after 10–11 weeks of gestation [8–10].

There is a wide range of abdominal organs eventration in patients with GS: from the isolated loop of the midgut (or appendix only) to the complete eventration of the midgut with the stomach, duodenum, liver, gallbladder, pancreas, bladder, uterus and its appendages (in girls) or testicles (in boys) [1, 11].

However, midgut and stomach eventration is the most common unlike parts of the liver with gallbladder, bladder, uterine appendages or testicles (Table 2). Eventration of these organs occurs in utero, therefore, does not depend on the mode of delivery, which is reflected in the results of our study. Moreover, inflammatory injuries of the eventrated organs occur only in those parts of them that are located extra-abdominal in the amniotic fluid. Intra-abdominal organs have a normal appearance of the serous membrane, soft and elastic. This indicates that inflammatory bowel damage develop only as a result of prolonged intrauterine interaction with amniotic fluid [7, 11].

Eventration of the duodenum and pancreas was significantly more common in patients born by vaginal delivery (Table 2). This is due to increased intra-abdominal pressure of the fetus, during uterine contractions and the passage of the fetus through the birth canal of a woman [11–14]. According to our observations, the duodenum and pancreas have no inflammatory lesions, indicating the absence of prolonged contact with amniotic fluid during fetal development. This means that their eventration occurs during natural childbirth.

According to data of our study, due to natural childbirth and intranatal eventration of an additional number of abdominal organs through the AWD, a significant increase in the size of the defect was found (Table 2). This is confirmed by the fact that the size of the defect is significantly smaller in babies born by CS, compared with those born naturally. Such data indicate that the natural birth of babies with GS leads to additional trauma to the abdominal organs [15–20]. In turn, this bowel damage lead to a significant increase in the duration of intestinal paresis, the duration of total parenteral nutrition, achieving of complete enteral autonomy, increasing the incidence of sepsis and central line associated complications [11, 21–25].

CONCLUSIONS

Thus, on a much larger amount of data, compared with previous studies, it can be reliably stated that the delivery mode affects the GS anatomy, namely changes the size of the abdominal wall defect, as well as frequency of the abdominal organs eventration.

Conflict of interest

The authors declare no conflict of interest.

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Background. Despite the existence of numerous studies on the optimal delivery mode in gastroschisis (GS), their results remain controversial. Therefore, the presented study is focused on establishing the delivery mode impact on GS anatomy in newborns.
Research objective. The study was conducted to determine the impact of the delivery mode on the features of GS anatomy in newborns.
Materials and methods. A retrospective analysis of medical records of 135 pregnant women and 135 their newborns with GS born between 1987 and 2020 was conducted. All newborns are divided into 3 groups. Newborns delivered by caesarean section are included in group I ($n = 80$); children born exclusively naturally are included in groups II ($n = 25$) and III ($n = 30$). The following anatomical features of GS in newborns were studied: localization and size of the anterior abdominal wall defect, confluence with the abdominal cavity, the nature and frequency of the eventrated organs.
Results. The size of the anterior abdominal wall defect was significantly smaller in children with GS delivered by caesarean section (3.02 ± 0.58 cm; $p < 0.01$) than in children born naturally (4.17 ± 0.3 cm in group II, 4.7 ± 0.29 cm in group III). The frequency of retroperitoneal organs eventration was significantly less (20.0%; $p < 0.01$) in caesarean delivery grope than in II and III groups (52% and 63.3%, respectively). There was no significant difference in frequency of other abdominal organs eventration, localization of the anterior abdominal wall defect and confluence with the abdominal cavity. Level of evidence – III.
Conclusions. The mode of delivery affects the size of abdominal wall defect and frequency of the abdominal organs eventration in newborns with GS.

Keywords: gastroschisis, delivery, vaginal delivery, caesarean section, gastroschisis anatomy.

ПРИРОДНІ ПОЛОГИ VS КЕСАРІВ РОЗТИН: ВПЛИВ НА АНАТОМІЮ ГАСТРОШИЗИСУ В НОВОНАРОДЖЕНИХ (33-РІЧНИЙ ДОСВІД)

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Обґрунтування. Незважаючи на наявність численних досліджень, спрямованих на виявлення оптимального способу розродження при гастрошизисі (ГШ), їхні результати залишаються суперечливими. Тому представлене дослідження сфокусоване на встановленні впливу способу розродження на анатомію ГШ у новонароджених дітей.
Мета дослідження: дослідити вплив способу розродження на анатомічні особливості будови ГШ у новонароджених.
Матеріали та методи. Проведено ретроспективний аналіз медичних карток стаціонарних хворих – 135 вагітних і 135 їхніх новонароджених дітей із ГШ, народжених за період від 1987 до 2020 р. Усіх немовлят було розділено на 3 групи. До I групи зараховано малюків, народжених за допомогою кесаревого розтину ($n = 80$), до II ($n = 25$) та III груп ($n = 30$) – народжених винятково природним шляхом. У дітей із ГШ трьох клінічних груп досліджували такі анатомічні особливості вади: локалізацію та розмір дефекту передньої черевної стінки; зв'язок із черевною порожниною; характер і частоту евентрованих органів.
Результати. Величина наскрізного дефекту передньої черевної стінки була достовірно меншою в дітей із ГШ, народжених за допомогою кесаревого розтину ($3,02 \pm 0,58$ см; $p < 0,01$), ніж у народжених природним шляхом ($4,17 \pm 0,3$ см у II групі, $4,7 \pm 0,29$ см у III групі). При народженні шляхом кесаревого розтину частота евентрації органів заочеревинного простору була достовірно нижчою (20,0%; $p < 0,01$), ніж після природних пологів (52 і 63,3% у II і III групах відповідно). Достовірної різниці в частоті евентрації інших органів черевної порожнини, локалізації дефекту та зв'язку з черевною порожниною не встановлено. Рівень доказовості дослідження – III.
Висновки. Спосіб розродження впливає на розмір дефекту передньої черевної стінки та характер і частоту виявлення евентрованих органів черевної порожнини в малюків із ГШ.

Ключові слова: гастрошизис, спосіб розродження, природні пологи, кесарів розтин, анатомія гастрошизису.

ЕСТЕСТВЕННЫЕ РОДЫ VS КЕСАРЕВО СЕЧЕНИЕ: ВЛИЯНИЕ НА АНАТОМИЮ ГАСТРОШИЗИСА У НОВОРОЖДЕННЫХ (33-ЛЕТНИЙ ОПЫТ)

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Обоснование. Несмотря на наличие многочисленных исследований, направленных на выявление оптимального способа родоразрешения при гастрошизисе (ГШ), их результаты остаются противоречивыми. Поэтому представленное исследование сфокусировано на установлении влияния способа родоразрешения на анатомию ГШ у новорожденных детей.
Цель исследования: исследовать влияние способа родоразрешения на анатомические особенности строения ГШ у новорожденных.
Материалы и методы. Проведен ретроспективный анализ медицинских карт стационарных больных – 135 беременных и 135 их новорожденных детей с ГШ, родившихся за период с 1987 по 2020 г. Все новорожденные были разделены на 3 группы. К I группе отнесены дети, рожденные с помощью кесарева сечения ($n = 80$), ко II ($n = 25$) и III группам ($n = 30$) – рожденные исключительно естественным путем. У детей с ГШ трех клинических групп исследовали следующие анатомические особенности порока: локализацию и размер дефекта передней брюшной стенки; связь с брюшной полостью; характер и частоту эвентрированных органов.
Результаты. Размер сквозного дефекта передней брюшной стенки был достоверно меньше у детей с ГШ, рожденных с помощью кесарева сечения ($3,02 \pm 0,58$ см, $p < 0,01$), чем у рожденных естественным путем ($4,17 \pm 0,3$ см во II группе, $4,7 \pm 0,29$ см в III группе). При рождении путем кесарева сечения частота эвентрации органов забрюшинного пространства была достоверно ниже (20,0%, $p < 0,01$), чем после естественных родов (52 и 63,3% во II и III группах соответственно). Достоверной разницы в частоте эвентрации других органов брюшной полости, локализации дефекта и связи с брюшной полостью не установлено. Уровень доказательности исследования – III.
Выводы. Способ родоразрешения влияет на размер дефекта передней брюшной стенки, характер и частоту выявления эвентрированных органов брюшной полости у новорожденных с ГШ.

Ключевые слова: гастрошизис, способ родоразрешения, естественные роды, кесарево сечение, анатомия гастрошизиса.