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TREATMENT OUTCOMES FOR NEWBORNS WITH CONGENITAL DIAPHRAGMATIC HERNIA

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The purpose of the study was to assess the results of surgical treatment of newborns with congenital diaphragmatic hernia based on a set of clinical, cardiological and quality of life indicators. The study included 70 newborns diagnosed with congenital diaphragmatic hernia. Depending on the method of surgical intervention, the children were divided into 2 groups. The comparison group consisted of 44 newborns operated on using the traditional open method, and the main group consisted of 26 newborns operated on using a new minimally invasive surgical technique – endosurgery. The study showed that the method of surgical intervention proposed by us allows to reduce the length of stay in the clinic, quickly improve the condition of children, and return quality of life indicators to normal.

Key words: congenital diaphragmatic hernia, newborns, surgery, quality of life, clinic.

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РЕЗУЛЬТАТИ ЛІКУВАННЯ НОВОНАРОДЖЕНИХ ІЗ ВРОДЖЕНОЮ ДІАФРАГМАЛЬНОЮ ГРИЖЕЮ

Метою дослідження була оцінка результатів хірургічного лікування новонароджених з вродженою діафрагмальною грижею за комплексом клінічних, кардіологічних показників та показників якості життя. До дослідження було включено 70 новонароджених з діагнозом вроджена діафрагмальна грижа. Залежно від методу хірургічного втручання, діти були розподілені на 2 групи. Групу порівняння склали 44 новонароджених, прооперованих традиційним відкритим способом, а основну групу – 26 новонароджених, прооперованих з використанням нової малоінвазивної хірургічної методики – ендосурджі. Дослідження показало, що запропонований нами метод хірургічного втручання дозволяє скоротити терміни перебування в клініці, швидко поліпшити стан дітей, повернути показники якості життя до норми.

Ключові слова: вроджена діафрагмальна грижа, новонароджені, хірургія, якість життя, клініка.

Today, congenital diaphragmatic hernia is a developmental defect incompatible with life without surgical correction [11]. Despite the fact that medicine is developing every day, many issues remain unresolved. Some say that the traditional method of operations is a proven method, while others say that the use of endoscopes not only simplifies operations, but also makes them safer and more reliable, as evidenced by statistics [1, 2]. In children, congenital hernias are mainly detected with other organ developmental defects, such as: pulmonary aplasia, pulmonary hypoplasia, cardiac and respiratory failure, esophageal atresia, etc. However, with high-quality and immediate diagnostics, it is possible to carry out effective treatment and preventive measures. According to research, congenital diaphragmatic hernia (CDH) occurs in 1 in 2000–5000 newborns [3]. The main cause of mortality in CDH is respiratory failure due to parenchymal hypoplasia of the lungs with a decrease in their mass and excessive development of the muscular layer of the pulmonary artery branches, which contributes to the development of persistent pulmonary hypertension. This serves as a trigger for persistent fetal blood flow syndrome, leading to severe hypoxemia and hypercapnia due to right-to-left shunting of blood.

False CDH-s are more common; bilateral CDHs are extremely rare, and left-sided defects in the diaphragm predominate among unilateral ones [5, 8, 12]. It is possible that right-sided congenital defects of the diaphragm are much less common than left-sided ones, but defects on the right are often covered from below by a large organ (the liver), which prevents the movement of abdominal organs into the pleural cavity, and such conditions can accompany a person for many years of life without clinically manifesting themselves. According to some researchers, left-sided VDG is 4–5 times more common than right-sided CDH, while others believe that it is 8–9 times more common [6].

The goal of surgical intervention in CDH is to close the diaphragmatic defect by bringing its edges together and applying individual nodal sutures. Difficulty arises with significant defect sizes, for example, with aplasia of the dome of the diaphragm, when even after careful mobilization of the posterior section it is not possible to bring the edges together and implants must be used [4]. In the study, the survival rate of children after surgery for diaphragmatic aplasia was 57 %, and for small defects, 95 % [7].

The purpose of the study was to evaluate the results of surgical treatment of newborns with congenital diaphragmatic hernia using a set of clinical, cardiological and quality of life indicators.

Materials and methods. The studies from the Department “General and Plastic Surgery” of Azerbaijan State Advanced Training Institute for Doctors named after A. Aliyev (Baku, Azerbaijan) included the results of 70 newborns operated for correction of CDH (Congenital Diaphragmatic Hernia) admitted to the “Central Clinic” (Baku city) between January 1, 2012 and December 31, 2024.

Depending on the method of surgical intervention, 70 children were divided into 2 groups. The 1st group consisted of 44 newborns with congenital diaphragmatic hernia, operated on by the traditional open method. The 2nd main group included 26 newborns with similar pathology, operated on using a minimally invasive new type of surgical technique – endosurgery. Concomitant malformations, weight and growth indicators of newborns, assessment of the condition according to the Apgar scale at the 1st and 5th minutes were analyzed. In the first control group of patients, preference was given to laparotomy.

In the laparotomic approach, a subcostal incision is made on the corresponding half from the side of the defect. After incision of the skin, subcutaneous fat, superficial fascia and muscles, access to the abdominal organs is obtained. All organs were gradually brought down into the abdominal cavity through the diaphragm defect and positioned correctly in accordance with their anatomical location, after which the diaphragm was revised. Starting from the medial edge of the defect, 7–9 non-absorbable sutures of silk or Etibond suture material were applied. The outermost (lateral) suture is applied through the adjacent rib to avoid suture rupture and potential relapse. Before the layer-by-layer “anatomical” suturing of the laparotomic defect, a silicone drainage tube is left in the chest cavity. In case of large defects, due to possible significant tension of the wound edges and possible complications (rupture of sutures and high risk of hernia recurrence), synthetic materials were used to strengthen the hernia defect area during its suturing, in particular, synthetic monofilament thread – polypropylene. Previously used polypropylene materials (despite the fact that they can be used for tissue restoration, it was often noted that they subsequently form adhesions with the adjacent internal organs of the abdominal cavity) were later replaced by synthetic hernia implants made of porous polytetrafluoroethylene. After the operation, the wound was covered with a sterile dressing.

Thoracoscopy began with the patient positioned on the operating table on his side (depending on the side of the defect). A 3 mm trocar was inserted alternately along the posterior axillary line, and a trocar with a diameter of 3 and 5 mm was inserted into the 6th intercostal space along the subcapsular line. Then, under thoracoscopic control, the organs that have penetrated the chest cavity through the diaphragm defect are brought down into the abdominal cavity. Then, starting from the medial edge of the defect, about 7–9 non-absorbable silk or Etibond sutures are placed. All knots are tied intracorporeally. The last lateral suture is placed through the edges of the diaphragm defect using fixation around the nearby rib to avoid suture rupture and potential relapse. A pleural drainage tube is inserted into the chest cavity through a 5 mm port opening. When suturing other trocar openings, intradermal sutures were applied with vicryl thread – VICRYL 5/0 suture material. After the operation, the wound was covered with a sterile dressing. For diagnostic purposes, the most informative instrumental and physical examination methods were used: ECG, ultrasound of the brain, abdominal organs and pleural cavity on both sides, as well as plain chest radiography.

The lung-to-head circumference ratio (LHR) is a sonographic measure proposed to identify fetuses with CDH that have a poor prognosis [2]. The Apgar score is a quick test performed on newborns at 1 and 5 minutes after birth to assess their physical condition and need for immediate medical care. It evaluates five characteristics: heart rate, respiratory effort, muscle tone, reflex irritability, and color. Each characteristic is assigned a score of 0, 1, or 2, with a total score ranging from 0 to 10 [10]. One of the main objectives of this work was to study the characteristics of the quality of life (QoL) of children before and after surgery. The QoL was studied using the QUALIN scale (S. Manificat, 1997) – a questionnaire for assessing the quality of life of children aged 3 months to 3 years.

This research followed critical international ethical guidelines: the Declaration of Helsinki (World Medical Association) and the Universal Declaration on Bioethics and Human Rights (UNESCO), requiring voluntary, informed consent from parents and prioritizing participant well-being over science, ensuring ethical standards were met. Declaration on Bioethics and Human Rights, ensuring patient consent, protecting dignity, and prioritizing welfare over science, using the CONSORT Group (Schulz K.F., Altman D.G., Moher D for the CONSORT Group, 2010) citation as a methodological reference for transparent reporting.

The data obtained were processed and calculations were performed using MS Excel version 2010 spreadsheets and the SPSS Statistics 20 statistical package (a sophisticated piece of software used by social scientists). Quantitative variables are given as the mean value \pm standard error of the mean. To compare independent samples and determine the reliability of quantitative differences, Student's t-test was used. Values were considered reliable at $p < 0.05$.

Results of the study and their discussion. There were 19 (73.1 %) boys in the main group, 7 (26.9 %) boys in the comparison group, 29 (65.9 %) boys in the comparison group, and 15 (34.1 %) girls in the comparison group. The average age of children in the main group was 95.0 ± 51.49 days, and in the comparison group – 200.2 ± 43.45 days ($p=0.1319$). Weight and height indicators of newborns, assessment of the condition according to the Apgar scale at 1 and 5 minutes were analyzed. Laparotomy was used in patients of the control group. The average body weight of children in the main group was 3400.0 ± 387.18 g, and in the comparison group – 3832.0 ± 307.77 g ($p=0.3910$). In the main group, the duration of the operation, the length of the incision, the volume of blood loss, the duration of antibiotic administration were statistically significantly lower than in the comparison group. The proposed method of surgical treatment is characterized by a low frequency of intraoperative complications and rapid recovery of the newborn's condition.

The LHR index was determined in newborns before surgery. This index allows to assess the severity of pulmonary hypoplasia and determine the expected prognosis for survival in a newborn with a hernia. The results were interpreted as follows: if the LHR is greater than 1.4, the prognosis is better; if the LHR is between 1.0 to 1.4, extracorporeal membranous oxygenation (ECMO) is often needed.; if the LHR is 1 or less, the prognosis is poor. Such patients may be candidates for prenatal intervention. Before the operation, 6 (23.1 %) children in the main group and 11 (25 %) children in the comparison group had $LCS < 1.0$ (Table 1).

Table 1

Quantitative indicators of important parameters before surgery

Groups	LHR <1.0	Tracheal intubation	Before operation pH <7.3	Before operation PaCO ₂ >60
Main group (n=26)	6 (23.1 %)	24 (92.3 %)	19 (73.1 %)	15 (57.7 %)
Control group (n=44)	11 (25 %)	39 (88.6 %)	34 (77.3 %)	28 (63.6 %)

Protecting the airway and ensuring adequate air flow to the lungs are important tasks of the anesthesiologist-resuscitator. Maintaining airway patency is performed using various methods, the leading one being tracheal intubation. These children had a high probability of pulmonary hypoplasia, which is life-threatening for infants. Intubation was performed in 24 (92.3 %) children in the main group and in 39 (88.6 %) children in the comparison group before surgery.

Before surgery, 15 (57.7 %) children in the main group and 28 (63.6 %) children in the comparison group had a blood saturation level >60. This indicates that the condition of these children before the operation was extremely serious.

There was no statistically significant difference between the groups for the parameter “Behavior and communication” ($p=0.4542$, $t=0.75$) (Table 2).

Table 2

Indicators of quality-of-life parameters according to doctors in the main and control groups after surgery

Aspects of QoL	Main group (n=26)	Control group (n=44)	p	t
Behavior and communication (BC),	4.26 ± 0.07	4.18 ± 0.08	0.4542	0.75
Ability to remain alone (ARA)	4.04 ± 0.04	3.28 ± 0.04	0.0000	13.27
Family environment (FE)	4.85 ± 0.02	4.75 ± 0.07	0.1775	1.36
Psychological and somatic well-being (PSWB)	4.56 ± 0.03	4.56 ± 0.05	0.9960	0.00
The total score (TS)	4.40 ± 0.04	4.25 ± 0.03	0.0012	3.38

Also, in the opinion of the doctors, the parameters “Family environment” ($p=0.1775$, $t=1.36$) and “Neuromedical development and physical health” ($p=0.9960$, $t=0.00$) did not statistically differ between the groups. However, for the parameter “Ability to be alone”, the difference between the indicators of the main group (4.04 ± 0.04) and the control group (3.28 ± 0.04) was statistically significant ($t=13.27$, $p<0.001$).

Thus, the LHR is a sonographic measure proposed to identify fetuses with CDH that have a poor prognosis. Maintaining the airway and ensuring adequate airflow to the lungs are important tasks of the anesthesiologist-resuscitator. Maintaining airway patency is achieved by various methods, among which tracheal intubation is the leading one [12]. These children have a high probability of developing pulmonary hypoplasia, which is life-threatening for the infants.

Important postnatal predictors and criteria for the functional state of children are their body weight at birth and the assessment of the newborn's body condition using the Apgar scale, which is also emphasized by some foreign authors [13]. Apgar scores, especially at 5 minutes, are important early predictors for babies with CDH, signaling better function with higher scores, but modern assessments combine this with LHR [14].

The study showed that, in the opinion of pediatricians, the quality of life of the examined children before treatment was significantly lower for all indicators of the QUALIN scale than the data before treatment – $p < 0.05$. A thorough statistical analysis of the obtained data demonstrated certain advantages

of minimally invasive thoracoscopic surgery over traditional methods of open surgery. There were no statistically significant differences between the doctor's indicators. In both cases, statistically significant differences were revealed in the parameters ARA and PSWB.

Thus, a comparison of the questionnaire indicators obtained on the basis of the responses of doctors showed that the quality of life of children after surgical treatment of diaphragmatic hernia, both by the total score and by all scales, was significantly higher than before the treatment of the pathology ($p < 0.05$), with the exception of the data of the parental form of the ARA scale ($p > 0.05$). In conclusion, it should be noted that minimally invasive treatment of diaphragmatic hernia, in particular, using safe and effective endoscopic methods, remains a problem for many specialists due to the complexity of mastering such technologies [1].

A thorough statistical analysis of the data we obtained demonstrated certain advantages of minimally invasive thoracoscopic surgery over traditional methods of open surgery. The videothoracoscopy used in these studies, i.e. the method of minimally invasive surgery, allows us to eliminate some risks typical of traditional surgery and significantly improve the quality of life of children, which is confirmed by the data of previously conducted scientific studies [9].

Conclusion

As a result of the description of the surgical technique and early results of thoracoscopic repair of CDH in children, it was possible to achieve positive dynamics in the quality of life.

Thus, according to the results of the QUALIN questionnaire, an improvement in all indicators in the postoperative period was noted in the main and control groups. Also, in the main group, the indicators were high for all parameters according to both parents and doctors. However, statistical reliability was achieved for ARA and PSWB parameters.

The obtained results demonstrate the need to monitor quality of life indicators as a criterion for surgical outcome assessment for children born in critical condition, and can serve as a basis for consensus recommendations for improving the quality of surgical care for this category of patients.

The study revealed that the surgical intervention method we proposed allows us to reduce the length of stay in the clinic, achieve rapid improvement in the condition of children and return quality of life indicators to normal values.

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