Advances in Health Sciences Research, volume 42
Proceedings of the Conference on Health and Wellbeing in Modern Society (CHW 2021)

Complications After Esophageal Anastomosis in Newborns

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ABSTRACT
Esophageal atresia is a congenital anomaly in which the oral end of the esophagus ends in a pouch. Its frequency is 1 in 2500–4500 newborns. Esophageal atresia is considered a complex malformation; the results of its treatment are used to judge the level of surgical care provided by the medical institution. With this malformation, the operation of choice is to perform a primary esophageal anastomosis. Primary anastomosis may be accompanied by severe early and late complications, such as anastomotic leakage, recurrent tracheo-esophageal fistula, esophageal stenosis, the development of reflux esophagitis, etc. However, according to many authors, large diastasis between the segments of the esophagus, concomitant anomalies and body weight less than 1,500 g are obstacles for primary anastomosis. In such situations, the implementation of a delayed esophageal anastomosis or replacement of the esophagus with a large intestine or stomach is recommended. Currently, with the introduction of thoracoscopically performed esophageal anastomosis in newborns, there is an improvement in the results of treatment with esophageal atresia. According to the authors, approximately 75 % of operations for esophageal atresia can be performed thoracoscopically with good results. Progress in thoracoscopic treatment of esophageal defect has significantly improved the quality of life of children after surgical correction of the anomaly.

Keywords: *esophageal atresia, newborns, primary anastomosis, complications*

1. INTRODUCTION

Materials and Methods: for 10 years from 2010 to 2019, 43 newborns with esophageal atresia were admitted to the Surgical Department of the Pediatric Center of Republican Hospital No. 1 –National Center of Medicine. The diagnosis of malformation in most cases was established antenatally at the second ultrasound of the fetus at 20–22 weeks of gestation; microgastria and polyhydramnios were detected, other concomitant malformations were excluded for these fetuses [1]. 23 % of patients had concomitant malformations: anus atresia was detected in 6 patients, in 2 a combination of anorectal atresia with malformations of the skeletal system (foot and spine), hydronephrosis, congenital heart diseases (ductus arteriosus, atrial septal defect, ventricular septal defect), that is, VACTERL association was observed. In most cases, 95 % of newborns had a typical form of esophageal atresia with a lower tracheoesophageal fistula. According to the Waterston classification, newborns were distributed as follows: Group A (full-term newborns weighing more than 2,500 g, without pneumonia and concomitant malformations) – 11 % (5 patients), Group B (newborns weighing from 1,800 to 2,500 g without concomitant defects or weighing more than 2,500 g, but with pneumonia or concomitant malformations) – 50 % (21 patients), Group C (newborns weighing less than 1,800 g or more than 1,800 g, but with pneumonia or with concomitant malformations) – 39 % (17 patients).

The diagnosis of esophageal atresia at the stage of the maternity hospital was clarified by conducting a test through a probe installed in the blind-ended pouch of the esophagus, with air supplied with a syringe and coming out of the nose with a noise. At the stage of surgical resuscitation, all patients underwent contrasting

of the oral segment of the esophagus with water contrast followed by its evacuation, echocardiography, ultrasound of the abdominal cavity and kidneys, neurosonography, and laboratory tests.

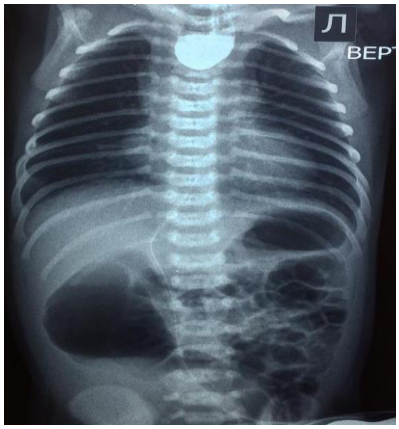

Figure 1. Typical atresia of the esophagus with lower tracheo-esophageal fistula

2. RESEARCH RESULTS

The mechanisms of pathological disorders in a newborn child during the formation of esophageal atresia are multifaceted. At the early stage of embryogenesis, the trachea and esophagus communicate with each other, as they develop from the cranial section of the primary intestine. Violation of recanalization, lacing of the esophagus from the respiratory tube, and fast growth of the trachea and esophagus can lead to esophageal atresia. The upper segment of the esophagus is stretched by the swallowed amniotic fluid and presses on the developing trachea, resulting in poor development of cartilaginous rings — tracheomalacia. Due to the lack of patency along the esophagus, antenatal coordinated peristaltic movements of the esophagus are not formed, and the cortico-visceral swallowing reflex is impaired. But the most important is the presence of a direct communication between the stomach and the tracheobronchial tree through the distal tracheoesophageal fistula, which causes the overstretching of the stomach with air during the child's cry. In addition, gastric contents move through the distal tracheoesophageal fistula directly into the tracheobronchial tree, causing chemical pneumonia, which can be complicated by bacterial pneumonia [2,3].

The newborns were operated on the 2nd day of life after preoperative preparation, 3 newborns with respiratory failure syndrome were on artificial lung ventilation before the operation. Esophageal anastomosis was performed in 35 (81.4 %) patients, in 8 (18.6 %) newborns with extended diastasis between the segments of the esophagus, the tracheo-esophageal fistula was sutured, a gastrostomy was placed, and a cervical esophagostomy was removed. 2 esophageal anastomosis was applied on a delayed basis due to severe prematurity of the newborn [4].

Since 2014, esophageal anastomosis has been performed thoracoscopically; a total of 15 endoscopic anastomoses have been performed.

Among the postoperative complications that may accompany the period after introducing esophageal anastomosis, three main ones should be highlighted:

- Stenosis of the anastomosis;
- Anastomotic leakage;
- Recanalization of the tracheo-esophageal fistula.

These complications can occur with both open and thoracoscopic interventions.

In the studied group of patients, postoperative complications were observed in 17 (48 %) newborns in the forms of: failures of the esophageal anastomosis in 5 cases (14 %), stenosis of the anastomosis zone – 12 cases (34 %), esophageal perforation against the background of balloon dilatation of the stenosis zone – 1 case, and 1 child had gastroesophageal reflux with severe reflux esophagitis.

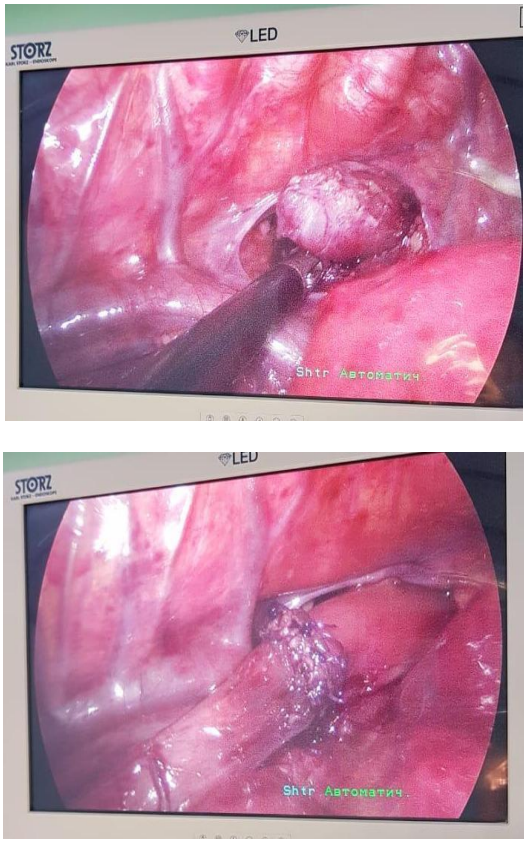

Figure 2. Stages of thoracoscopic correction of esophageal atresia – isolation of the atresia oral segment of the esophagus, the appearance of a completed esophageal anastomosis with a single-row interrupted suture with an absorbable suture (5/0)

In all cases, the esophageal anastomosis was applied with biodegradable suture material (5/0–6/0) as single-row interrupted suture. Anastomosis was possible with diastasis between the segments of the esophagus at no more than 1.5–2.0 cm. In recent years, there have been attempts to preserve the child's native esophagus, if possible, since long-term results while preserving their own esophagus are definitely better. For this purpose, modifications are made to lengthen the oral segment of the esophagus when introducing an esophageal anastomosis with large diastasis — the technique of circular myotomy according to Livaditis, and the Foker process – lengthening the atresized ends of the esophagus by introducing traction sutures with a delayed anastomosis [5,6].

In the postoperative period, the newborns were on extended ventilation for an average of 7–8 days with myorelaxation. In cases of an uncomplicated course of the early postoperative period, X-ray control of the anastomotic zone using a water-soluble contrast agent was performed on postoperative days 9–10. Enteral tube feeding was started from the 10th postoperative day (after the restoration of the sucking reflex), from about 12–14 days, they were switched to breastfeeding. In premature infants, introducing primary esophageal anastomosis is impossible due to the severity of the condition, while in 2 cases delayed anastomoses were performed 2–3 weeks after applying draining gastrostomy, and relative stabilization of the condition.

Table 1. Postoperative complications depending on the type of operation

Complications	Thoracotomy, esophageal anastomosis n = 20	Thoracotomy, esophageal anastomosis n = 15	Total:
Failure of the anastomosis	4 (20 %)	1 (6 %)	5 (14 %)
Stenosis at the anastomosis zone	8 (40 %)	4 (26 %)	12 (34 %)
Perforation of esophagus against background of balloon dilatation of stenosis	1	0	1
Reflux — esophagitis against background of gastroesophageal reflux	1	0	1

The complexity of performing surgical operations on the esophagus is mainly due to the fact that esophageal anastomoses are often untenable [7]. There are several reasons that explain this phenomenon. The esophagus does not have a serous membrane, which plays an important role in the healing of digestive anastomoses, due to its high plastic and adhesive properties. All operations on the esophagus are accompanied by violating the integrity of the structures of the mediastinum with risk of developing postoperative mediastinitis. The blood supply to the esophagus is worse than the blood supply to the intestines. The esophagus is constantly contracting. Peristalsis causes its lengthening or contraction with each inhalation, while peristaltic movements pushing food subject the suture line to additional stress.

Cases of failed esophageal anastomosis were diagnosed on the 6–8th postoperative day with the release of saliva through the drainage of the posterior mediastinum. Since 2012, in most cases of esophageal anastomosis failure, conservative tactics have been undertaken [8,9], including the introduction of a gastrostomy tube to decompress the stomach and prevent reflux of the contents into the esophagus, the installation of additional drainage in the posterior mediastinum, the connection of active aspiration through the drains, and the change of antibiotic therapy (Fig. 3). On the 16–20th day of conservative management, secondary healing was achieved in the zone of esophageal anastomosis, which was confirmed by X-ray contrast study. Rough stenoses were not observed in cases of secondary healing in the anastomotic area.

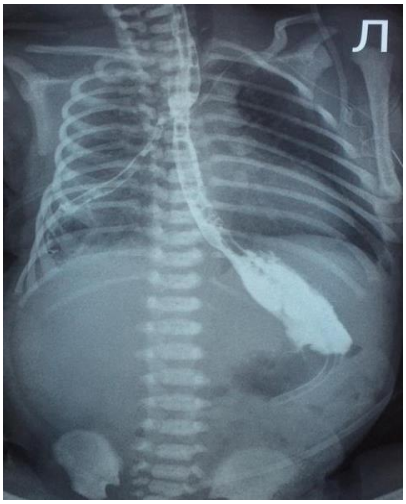

Figure 3. Failure of esophageal anastomosis

One of the most common reasons for reoperations after reconstruction of esophageal atresia is narrowing in the anastomotic area. Many factors can contribute to the formation of a stricture: anastomotic leak in the

early postoperative period, gastroesophageal reflux, using non-absorbable sutures instead of absorbable ones. Narrowing usually occurs between 2 weeks and 6 months after surgery and is manifested by impaired food transit time. Dysphagia is accompanied by choking and coughing. The diagnosis is confirmed by contrast X-ray examination or fibroesophagoscopy (Fig. 4).

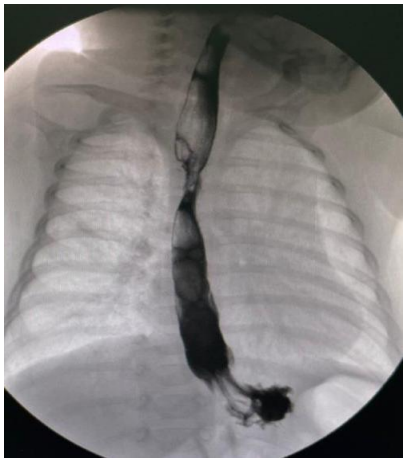

Figure 4. Stenosis of esophageal anastomosis

To restore the patency of the lumen, it is necessary to expand the esophagus in the narrowing zone, which can be performed using bougienage or balloon hydrodilation. These techniques can be performed blindly or under X-ray or endoscopic guidance. Endoscopic methods of bougienage and balloon dilation have certain advantages over similar interventions. The main condition for ensuring the safety of endoscopic bougienage is to conduct dilating bougie only along the guide wires (Fig. 5).

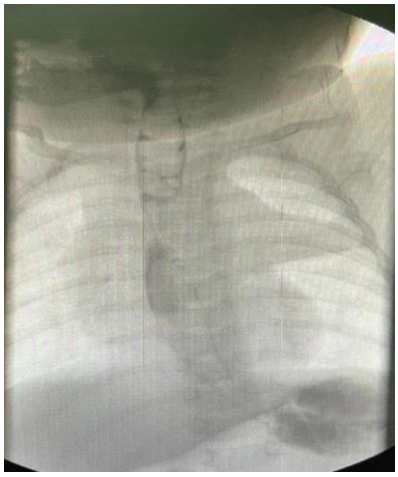

Figure 5. Condition after bougienage of esophageal stenosis along the guide wire

In 1/3 of patients after esophageal anastomosis, bougienage of the esophagus was performed due to the onset of symptoms of dysphagia. It should be noted that until 2012, calibration bougienage of the esophageal anastomosis zone was performed for prophylactic purposes before the patients were discharged. But practice has shown that invasive manipulations in the zone of esophageal anastomosis should be carried out only according to absolute indications. In cases with stenoses we performed bougienage along the wire — in most cases briefly, only in 1 child in the postoperative period we observed lasting stenosis of esophageal anastomosis, the child received a second thoracoscopic esophageal anastomosis at 3 months of age. In 3 cases, balloon dilatation of the esophageal stenosis zone was performed, in 1 case, this procedure resulted in a complication in the form of a rupture of the esophageal wall, rethoracotomy and suturing of the esophageal defect with the introduction of a preventive gastrostomy were performed. In this patient, in the delayed period, we observed persistent reflux esophagitis with mucosal ulceration of the lower third of esophagus; at the age of 3 years, the patient underwent a Nissen fundoplication as antireflux surgery.

In cases of large defects in the zone of insolvency of the esophageal anastomosis and pronounced phenomena of mediastinitis, a rethoracotomy was performed with the destruction of the esophageal anastomosis, ligation of the distal segment of the esophagus, and the removal of the proximal section to the neck on the left, forming an esophagostomy, while a gastrostomy was applied. Later, these patients underwent colon esophagoplasty at the age of 1 year (Fig. 6).

The main advantages of a colonic graft over other segments of the intestinal tube are:

- more pronounced magistral blood supply;
- insignificant effect on digestion when turning off large sections of the colon;
- direct form of the graft;
- high resistance to aggressive gastric juice and hypoxia;
- option to cut out a graft of any required length with a good stable blood supply.

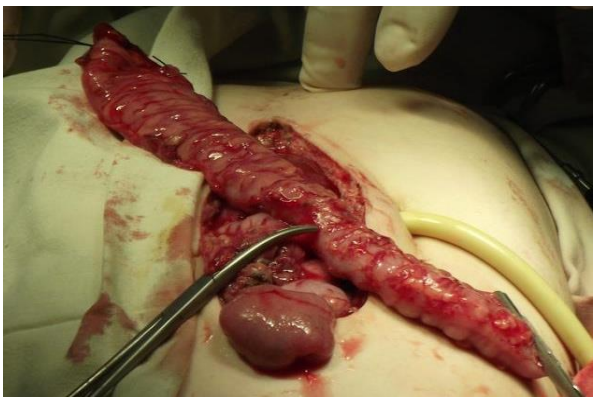

Figure 6. Stage of colonic graft formation

Colon esophagoplasty was performed in 5 (12 %) patients, in all cases a graft of the left half of the colon on the left colon artery was used; operation was carried out in the anterior mediastinum retrosternally, with the introduction of an antireflux modification using Stepanov E.A. method. 1 patient was operated on in Moscow using the method of moving the sternum of the stomach. But in recent years, of all the methods of plastic surgery of the esophagus, with the impossibility of preserving the patient's own esophagus, the best delayed clinical results were obtained with the method of colon esophagoplasty (Fig. 7).

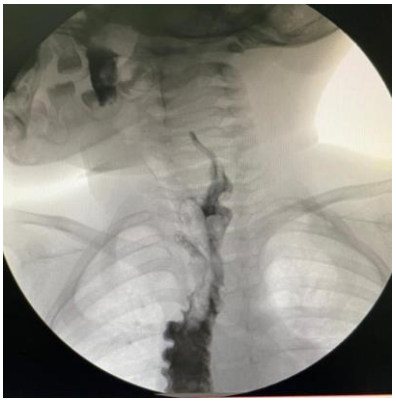

Figure 7. X-ray with contrast on the 10th postoperative day after colon esophagolplasty.

Mortality in esophageal atresia during the study period was 14 % (6 newborns). The main causes of death were severe concomitant malformations and extreme prematurity.

3. CONCLUSIONS

After the introduction of thoracoscopic esophageal anastomosis in newborns with esophageal atresia, the number of postoperative complications, including such acute ones as anastomotic leakage, significantly decreased.

Striving to preserve patients' own esophagus with anastomotic leakage is justified. Conservative tactics without destroying the esophageal anastomosis showed encouraging results.

Postoperative stenosis in the area of the esophageal junction in most cases can be eliminated by the safest method of bougienage of the esophagus along the guide wire.

In persistent course of reflux disease in patients after esophageal anastomosis, introduced for esophageal atresia, it is advisable to carry out antireflux fundoplication using Nissen fundoplication in a timely manner to prevent the formation of metaplasia of the esophageal mucosa.

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