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ESOPHAGEAL ATRESIA – A RETROSPECTIVE STUDY

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Abstract: *Among congenital malformations of the gastrointestinal tract, the most frequent pathology is the esophageal atresia. The subsequent implications are impairment of physiological processes, such as feeding or swallowing, followed by various complications. We performed a retrospective study for ten years at the Clinical Hospital of Obstetrics and Gynecology "Dr. I.A. Sbârcea" in Braşov. There were registered 42751 newborns, of which 23 have been diagnosed with esophageal atresia. We found that those infants with an antenatal diagnosis and proper pregnancy care were associated with better outcomes. Factors such as the technical advances in ultrasonography and appropriate routine prenatal follow-up during pregnancy have a potentially significant influence on the prognosis of these patients.*

Key words: *esophageal atresia, congenital malformation, antenatal diagnosis*

1. Introduction

Esophageal atresia (EA) is one of the most common congenital malformations of the digestive tract. The incidence of esophageal atresia is 1:3000-4500 births, esophageal atresia with distal tracheoesophageal fistula being the most frequent type encountered [7], [21], [29].

This malformation can be associated with one or more fistulae between the malformed esophagus and the trachea. As a result, the physiological process of feeding is altered due to the lack of esophageal patency, and standard functions such as swallowing cannot be achieved [4]. Moreover, these infants are at risk of aspirating the esophageal content. In the case of tracheoesophageal fistula (TEF) saliva or gastric secretions may flow into the tracheobronchial tree. The presence of TEF can lead to the development of aspiration pneumonitis [16].

Typically, esophageal atresia is diagnosed during the pregnancy based on the ultrasound signs. One of the important ultrasound parameters in the diagnosis of a

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digestive malformation is the amniotic fluid index. Polyhydramnios is the result of the absence or impairment of the amniotic fluid through the fetus. Fetuses with esophageal atresia may have a smaller gestational age, and their overall dimensions may be lower than their gestational age [9].

New techniques in ultrasonography allow observation of anatomic features and conformation of the fetus esophagus, especially the thoracic portion [9],27]. It has been postulated that antenatal diagnoses of esophageal atresia may be linked with a worse prognosis [27].

Postpartum, excessive oropharyngeal secretion and the presence of respiratory difficulties may raise suspicion or directly lead to the diagnosis of EA [3], [8].

Mortality is closely related to the association with other congenital anomalies, low birth weight and prematurity. Morbidity is influenced by the presence of postoperative complications (anastomotic leaks and strictures, gastro-esophageal reflux, recurrent tracheo-esophageal fistula), abnormalities of the respiratory tract and association of additional congenital malformations [19], [26].

2. **The objective of the study**

The purpose of the study was to establish common patterns of occurrence and evolution of esophageal atresia. Developing an algorithm for diagnosing this pathology as early as possible can lead to an improvement in the prognosis of infants suffering from this disease.

3. Material and methods

The retrospective study was performed in the Clinical Hospital of Obstetrics and Gynecology "Dr.I.A. Sbârcea" Braşov, over a period of ten years, between 01.01.2009-31.12.2018.

Data has been obtained from the birth logs and the patient charts, being compiled into a database used for this study. Statistical results and graphic representations have been completed with the use of Microsoft Excel and MedCalc.

4. **Results**

During the study, 42407 births were registered in the Clinical Hospital of Obstetrics and Gynecology "Dr.I.A. Sbârcea" Braşov, with a total number of 42751 newborns.

Out of these infants, in 94 of the cases, the diagnosis of malformation of the digestive tract was confirmed either in the antenatal or postnatal period, and 23 infants had esophageal atresia.

The maternal age of the patients included in the study was between 18 and 35 years, with a mean value of 26.30 years. Regarding the residence area, more than a half of the patients came from rural areas (56.52%)

In the management of these pregnancies it is essential to establish the delivery method. Therefore, in the studied group, we noticed that 69.57% required cesarean section, and in 30.43% of the total cases, vaginal birth was chosen. In the 23 cases included in the study, 12 males and 11 females were born.

We also measured the gestational age and the weight at birth of the babies born with EA. We noticed that the gestational age was between 26 and 39 weeks of gestation and the average value of weight was 2158 g, ranging from 1280 g to 3000 g (Figure 1).

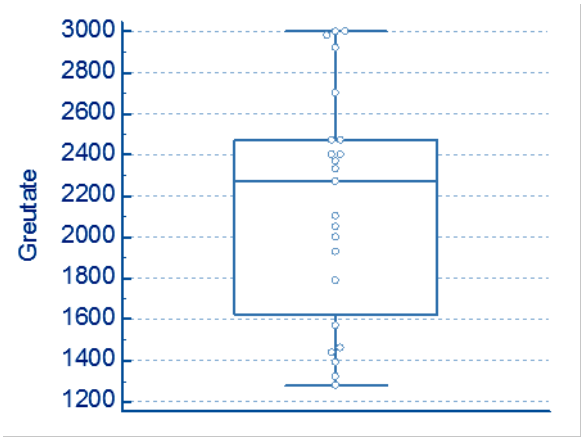

Fig. 1. *Distribution of the cases with esophageal atresia according to the birth weight*

Another parameter analyzed was the Apgar score received at birth, the distribution of cases being as follows: 30.43%, received an Apgar score 9, 4.35% - score 8, 17.39% - score 7, 13 .04% - score 6, 4.34% - score 5, 8.7% - score 4, 13.04% - score 2, 8.7% - score 1.

The presence of eso-tracheal fistula is a prognostic factor of esophageal atresia, an essential parameter in the management of these cases. Therefore, of the 23 cases diagnosed with esophageal atresia, 52.17% had a tracheoesophageal fistula. As, for the prenatal evaluation, we observed that 43.48% of the women did not receive any prenatal care checkup. Starting from the moment of establishing the diagnosis, we divided the study into two groups and compared it: prenatal diagnosis and postnatal diagnosis.

It is well known that the mother's age can influence the evolution of pregnancy in one way or another. Thus, we noticed that in the group where the diagnosis of esophageal atresia was established antenatally, the average age of the mothers was 25.5 years, while in the group diagnosed postnatal, the average age was 27.18 years.

Regarding the residence of the mothers, in the group diagnosed antenatally, the majority came from urban areas (9 out of 12 cases), those diagnosed postnatally, mostly had as a residence in the rural area (7 out of 11 cases).

Mothers whose fetuses were diagnosed in the antenatal period had mostly graduated high school (5 cases out of 12) or higher education (4 cases out of 12). In opposition, the women who received the diagnosis postnatally, either had no studies, or graduated maximum elementary school. We also observed that mothers in the group with a prenatal diagnosis, proper pregnant care and follow-up was performed (9 cases out of 12), while in the group diagnosed postnatally, the majority of the patients did not present at any obstetrical assessment during pregnancy (8 cases out of 11).

Gestational age is an essential predictive factor. In the analyzed group, the average gestational age of fuses diagnosed before birth was 33.83 weeks, while the average gestational age of infants diagnosed after delivery was 34.63 weeks.

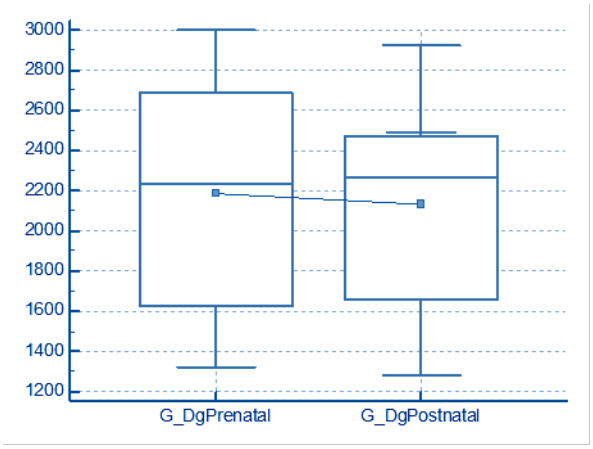

Fig.2. *Comparison of birth weight in the groups diagnosed with esophageal atresia before and after birth*

Regarding the type of birth reported in the two groups, we concluded that most fetuses diagnosed with esophageal atresia following birth were delivered by cesarean section (9 cases out of 12) and those diagnosed postnatally were delivered through vaginal birth (7 cases out of 11).

Also, when comparing the birth weight for the fetuses in the two identified groups, in the antenatal group, the mean value was 2184.16 g. For the infants from the postnatal group, the average value was 2130g (Figure 2).

We compared the mean values of the Apgar score in the two groups included in the study, noting the following: the mean Apgar score for fetus diagnosed antenatally is higher compared to those diagnosed postnatally. Following the neonatal evolution of these infants, we noticed that 75% of them showed a favorable evolution in the neonatal period. Unfortunately, in 25% of cases, death occurred in our hospital.

Of the 12 cases of esophageal atresia diagnosed antenatally, 58.33% of infants had esophageal atresia with tracheoesophageal fistula, and 41.67% were without tracheoesophageal fistula.

During the ultrasound, it is necessary to evaluate the presence of the gastric bubble, which could be an indirect sign of a congenital malformation. In 58.33% of cases, the absence of the gastric bubble was noticed, while in 41.67% of cases, the gastric bubble was present, but smaller sizes of the fetal stomach were reported.

Another ultrasound parameter that has particular importance in the antenatal diagnosis is the presence of polyhydramnios. It is appreciated when the amniotic fluid index has values higher than 18. Therefore, we found that the association of polyhydramnios was present in 66.66% of cases. Also, at ultrasound neck pouch sign can be visualized, and it was present in 58.33% of cases.

We selected some ultrasound parameters that were followed over time, namely, at the time of establishing the diagnosis of esophageal atresia and subsequently at a reassessment at three weeks. These parameters are Fetal Stomach circumference (SC), Fetal Abdominal Circumference (AC), Stomach circumference (SC) / Abdominal circumference (AC) ratio.

As we reported, the presence of the gastric

bubble is a valuable parameter in the suspicion or even diagnosis of a congenital malformation, such as esophageal atresia. Thus, in the studied group, at the time of diagnosis we noticed that in the 5 cases where the gastric bubble was present, the maximum value of the fetal stomach circumference was 34.00 mm. In the other 7 cases where the gastric bubble was absent, a fetal stomach circumference value of 0.10 mm was assigned. Thus, the average value of the fetal stomach circumference was 13.08 mm.

At three weeks after diagnosis, a reassessment of this parameter was performed, obtaining the following data: for cases where the gastric bubble was absent, the same value of 0.10 mm was discovered, and the maximum value of fetal stomach circumference remained the same as the one from the time of diagnosis, 34.30 mm. The only parameter that was modified at the two ultrasound examinations was the average value of the fetal stomach circumference, of 11.38 mm.

Table 1

Summary of the parameters analyzed in the group of patients diagnosed antenatally with esophageal atresia

PARAMETER	DESCRIPTION	NO. OF CASES	PERCENTAGE
ESOPHAGEAL ATRESIA	With TEF	7	58.33%
	Without TEF	5	41.67%
FETAL STOMACH	Absent gastric bubble	7	58.33%
	Small gastric size	5	41.67%
POLYHYDRAMNIOS	Yes	8	66.66%
	No	4	33.34%
NECK POUCH SIGN	Present	7	58.33%
	Absent	5	41.67%

The stomach circumference (SC) / Abdominal circumference (AC) ratio was analyzed in two ultrasound examinations. At the time of diagnosis, the values of this ratio varied from 0.00 to 0.1030, with an average value of 0.0365. At the revaluation, the following data were observed: the minimum value was the same, but the maximum value of the SC/AC ratio increased, to 0.1320, with an average of 0.0449.

5. Discussion

Congenital malformations represent a variety of pathologies that are an intensely approached subject, both in terms of incidence and treatment, but also regarding the prognosis of newborns. In this study, we found that 10.81% of infants had congenital anomalies, and only 1.01% of them associated a malformation of the digestive tract.

A recent study conducted in Albania in 2019 [2], which included children with congenital anomalies that required postpartum surgery, indicated a total incidence of 0.69-1.18 / 1000 live births. Another study from 2019 supervised in Ireland [22] included a group of 13414 patients, with a prevalence of birth defects of 0.84%.

The EUROCART study [18], classifies the abnormalities of the digestive tract at the end of the ranking, these having a prevalence of 16.26 / 10,000 live

newborns. Moreover, the number of cases of esophageal atresia was 2.17 / 10000 newborns. Therefore, analyzing and comparing the data obtained in our study with those described in the literature, we can confirm that digestive tract malformations are indeed a health problem, but do not have an increased incidence among newborns.

The pregnant women included in the study had an average age of 26.30 years, and the ages ranged between 18 years and 35 years. A study by Robert et al. [24], which included 2693 infants with esophageal atresia, showed that maternal age does not influence the risk of malformations. Instead, multiparity, regardless of maternal age, is a risk factor for the occurrence of this type of abnormality of the digestive tract. In our study, when analyzing birth rate and parity, we observed that a significant percentage of the mothers -52.17% were primiparous, 13.04% second-rous, and in the 34.78% of cases, they were multiparous. But the disadvantage of our study may be that although the analyzed period is a decade, the number of cases is relatively small. Another Egyptian study by Shawky et al. [25], which investigated about 3 million children with birth defects, concluded that the main risk factors that negatively influence the onset of birth defects are: multiparity, associated maternal diseases, toxic use, increased levels of exposure to physical and chemical pollutants, and lastly, maternal age. Regarding origin of residence, we observed in our study that most pregnant women came from rural areas, in a percentage of 56.52%. Also, this justifies the reduced educational and socio-economic level, the low degree of care, and medical services applied during pregnancy. Regarding the socio-economic level, a study was conducted in 2013 by the National Institute of Health of Women, Children and Adolescents [30], the results of this report showed that out of 3440 pregnant women included in the study, most of them, 62.6% reported salary incomes less than or equal to the minimum wages. At the same time, it was found that there is a close degree of association between low family income and an increased incidence of congenital malformations of any kind. Low socio-economic status and nutritional deficiency have been associated with an increased prevalence of congenital gastrointestinal defects [5].

Numerous studies have shown that there is a link between the gender of fetuses and the occurrence of congenital malformations. In our study, we observed that out of the 23 newborns diagnosed with esophageal atresia, the male gender predominated in a percentage of 56.52%, and the female is 43.38%. In 2020, a study by Black et al [5] showed that males are more affected by malformations of the digestive tract compared to females.

The timing of the diagnosis of a congenital malformation can be decisive in the therapeutic approach, which involves closer monitoring of pregnancy, and the postnatal care of these newborns must be different compared to the healthy newborns. Analyzing this parameter in the patients included in our study, we noticed that in 12 cases out of 23, the diagnosis was established antenatally, at a gestational age of approximately 28 weeks, while in the other 11 cases, the diagnosis of newborns was established postnatally. A study by Garabedian et al. in 2018, which included 1118 newborns diagnosed with esophageal atresia, had an

antenatal diagnosis rate of 84.8% [12]. Comparing these data and other data obtained by different studies with those found in our research, where the diagnosis rate antenatal was 52.17%, we can say that the prenatal diagnosis rate is low. Unfortunately, this is due to non-compliance to a strict obstetric control program both before conception and during pregnancy.

Delayed diagnosis leads to an unfavorable postnatal prognosis of these newborns because they cannot immediately benefit from surgical treatment as soon as possible that can save or improve their well-being.

When the diagnosis is established as early as possible, preferably before delivery, the multidisciplinary medical team can determine the best approach. Given that newborns suffering from a congenital malformation, such as esophageal atresia labor and expulsion may cause additional stress, obstetricians choose to end the birth by cesarean section. In our study, we observed that 69.57% were delivered by cesarean section, 9 cases were diagnosed antenatally, and 4 cases diagnosed postnatally. One of the indications for performing surgery was acute fetal distress, which occurred in 39.13% of the total.

A study conducted in Saudi Arabia by Khorshid et al. [15] over five years, analyzed all the births of children with congenital malformations, 78 of them being diagnosed with esophageal atresia with or without tracheoesophageal fistula. The results obtained indicated that the survival rate was 68% in those born through the vaginal path, and 60% for those through cesarean section. The conclusion of this study showed that the cesarean section does not necessarily provide a better prognosis compared to newborns born naturally.

The birth weight of the newborns is an important parameter that can influence postpartum prognosis. We obtained the following results: the average birth weight of the 23 newborns included in the study was 2158g; they had birth weights between 1280 g and 3000 g. Also, when comparing the group of newborns diagnosed antenatally and those diagnosed postnatally, we noticed that in the first group, the average birth weight was 2184.16 g. In the second group, the average birth weight was 2130 g.

A study by Hall et al. [13] describes the role of amniotic fluid. This study shows that fetuses who have a congenital malformation of the upper digestive tract associate lower birth weight. Also, another aspect that influences the birth weight of newborns is their gestational age, premature babies having a lower birth weight compared to those born at term.

Regarding the Apgar score received at birth, we found that newborns diagnosed antenatally had a higher value of the Apgar score higher than those diagnosed postnatally. However, comparing our data with the information in the literature, a favorable Apgar score suggests that they did not suffer any fetal distress in the intrauterine life and problems caused by congenital malformation occur postpartum [10, 11], [15].

In our study, we found that polyhydramnios was present in 66.66% of cases. A survey conducted in 2019 [23], showed that approximately 58% of patients with tracheoesophageal fistula associated polyhydramnios. Another study by Pardy et al [23] showed that 56.3% of cases with esophageal atresia have an

increased amniotic fluid index and associated a small or absent gastric bubble. Analyzing the data obtained in our study, we found that out of the 12 cases diagnosed antenatally with esophageal atresia, in 7 cases, the gastric bubble was absent. In the other 5 cases, the size of the fetal stomach was reduced. Comparing this information with the data published in the literature, we observed similar results [14].

Another ultrasonographic parameter analyzed was the neck pouch sign, which was present in 58.33% of cases. At the same time, the presence of this ultrasonographic sign suggestive for esophageal atresia was very strongly correlated with the type of esophageal atresia. It was a reliable model for predicting fetal death, with a sensitivity and specificity of 75% and 50%, respectively. A recent study illustrated the results of the ultrasound evaluation of 75 women with fetuses affected by esophageal atresia. Of these, only 36% presented the Pouch sign suggesting that the hypopharyngeal distension evaluated by MRI is a more specific and sensitive sign for the detection of esophageal atresia, compared to the pouch sign [28].

The presence of tracheoesophageal fistula negatively influences the prognosis of newborns with esophageal atresia. In our study, 58.33% of newborns associated tracheoesophageal fistula. Compared to a survey conducted for five years, in the period 2009-2014 [17] that included 396 cases of esophageal atresia, 85% of newborns associated tracheoesophageal fistula.

A study by Dall'Asta et al. [6] concluded that the size of the fetal stomach and the absence of the gastric bubble could not be an element of certainty in establishing the diagnosis of esophageal atresia. In this study, 91 fetuses were included, and 89 of them had typical dimensions of the gastric bubble. Pardy et al. [23] described in their research the absence of gastric bubble in 50% of the cases. These fetuses also associated polyhydramnios. The specificity and the sensitivity of the diagnosis of esophageal atresia was 99.6%, respectively 89.9%. Stringer et al. [27] reported a predictive value of 56% in the cases of absent gastric bubble associated with polyhydramnios and a sensitivity of 42% for the diagnosis of esophageal atresia. In our study, we obtained a specificity of 62.5% and a sensitivity of 50% for the ultrasound appearance of the fetal stomach in the prediction of the fetal prognosis.

A significant percentage of the babies, 75% of them showed a favorable postpartum evolution. Nevertheless, when comparing the data with those in the literature, a substantial difference in mortality rate is observed by Al-Jahdi et al. [1]. The mortality rate was only 7.8%. Another study by Malakounides et al. [20], which included 200 children with esophageal atresia and reported a survival rate of 93%. The explanation behind the differences in the results can be motivated by the early establishment of the diagnosis of esophageal atresia, as well as by the postpartum nutritional support. Likewise, as soon as the diagnosis is established, the medical team can determine which is the correct therapeutic approach, and they can also perform the surgical interventions that the newborn needs as early as possible.

6. Conclusion

Our study concluded that antenatal diagnosis provided a more favorable

outcome in infants with esophageal atresia due to more efficient pregnancy care. The multidisciplinary team comprised of obstetricians, neonatologists and pediatric surgeons could assess the fetal status and decide upon the adequate therapeutic management.

A critical prognostic factor in choosing the proper moment of delivery, following which the infant could be rapidly directed towards the pediatric surgery department and benefit from the reparatory surgery, provides an excellent survival and well-being improvement.

To achieve an antenatal diagnosis, which will influence the subsequent events, future mothers should consider proper prenatal care and follow-up.

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