

*ESOPHAGEAL ATRESIA WITH DISTAL TRACHEOESOPHAGEAL FISTULA:  
SURGERY TREATMENT AND A LONG TERM FOLLOW UP*

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**Abstract.** A study carried out at the Paediatric Surgery Units in Siena and Toulouse evaluated the long term follow-up of patients treated for esophageal atresia (EA), between 1988 and 2007. We analyzed the long term follow-up of 57 patients with III type EA. We evaluated the residual symptoms in three time intervals: in 1<sup>st</sup> years, between 2<sup>nd</sup> to 5<sup>th</sup> year and over 5<sup>th</sup> years from surgery. The considered parameters were: feeding difficulties, respiratory problems, gastro-esophageal reflux, growth impairment, chest anomalies. Feeding difficulty appeared in 26 patients in the 1<sup>st</sup> year of life, in 28 between the 2<sup>nd</sup> and 5<sup>th</sup> year and in 6 after the 5<sup>th</sup> year. Respiratory problems occurred in 35 children in 1<sup>st</sup> year, in 30 between the 2<sup>nd</sup> and 5<sup>th</sup> year and in 17 after the 5<sup>th</sup> year. Gastro-esophageal reflux occurred in 30 patients in 1<sup>st</sup> year, in 22 between the 2<sup>nd</sup> and 5<sup>th</sup> year and in 8 over the 5<sup>th</sup> year. Defects of growth were detected in 17 patients in 1<sup>st</sup> year of life, in 16 between the 2<sup>nd</sup> and 5<sup>th</sup> year and in 5 after the 5<sup>th</sup> year. Chest anomalies were diagnosed in 7 children. Our analysis established a time limit (5<sup>th</sup> year postoperatively) over which an undeniable improvement of life quality can be expected.

**Key words:** Esophageal atresia, tracheo-esophageal fistula, dysphagia, gastro-esophageal reflux, Follow-up.

## INTRODUCTION

Esophageal atresia (EA) and/or tracheo-esophageal fistula is a congenital anomaly with an incidence of 1:2,500/1:4,500 alive newborns. It is more frequently in prematures and it does not show any predilection for either sex gender or race [1].

After several therapeutic attempts by other Authors, in 1941 Haight and Towslet achieved the first success in surgery of EA in terms of survival [2-3]. Surgery and postoperative management has continuously progressed ever since. Despite corrective surgery has been practiced for the last 50 years, few data are available on long-term results. As survival rate rises, the number of subjects reaching adult age increases, and among them the number of those suffering from long-term complications of the gastrointestinal tract is high [4-8].

We report the experience of two European centers in long-term follow-up of patients undergoing surgery for esophageal atresia.

## MATERIALS AND METHODS

A study was carried out at the Units of Paediatric Surgery in Siena (Italy) and Toulouse (France) to evaluate long-term follow-up of 81 patients operated for

esophageal atresia of III type (50 males, 56,8%, and 38 females, 43,2%) (EA) between 1988 and 2007.

The time limit of 2007 was set to obtain a temporal gap of at least 6 years from surgery, for follow-up. The protocol is based on analysis of residual symptoms or postoperative complications occurred in these children during infancy, school age, adolescence through post-operative controls and through direct interviews or questionnaires sent to parents who responded about growth, surgery, complications, history, food and meals. Patients were followed regularly at the Pediatric Surgery Services, Pediatric Gastroenterology, Pediatric Pulmonology and Pediatric Otolaryngology for a variable time and according of regression of symptoms, with clinical, instrumental (endoscopy, pH-metry, RX chest, barium meal) and laboratory tests (blood test for possible allergens, etc.).

Evolution of symptoms was assessed postoperatively in relation to 3 different time intervals: during the 1<sup>st</sup> year, between 2<sup>nd</sup> and 5<sup>th</sup> year and over 5 years from surgery. The parameters evaluated were: feeding difficulties, respiratory problems and upper airways infections, growth disturbances and morphological chest anomalies.

Data obtained in our study were analyzed by Mc Nemar's test comparing values of 1<sup>st</sup> year with period 2<sup>nd</sup>-5<sup>th</sup> year and 1<sup>st</sup> year with that 5<sup>th</sup> year. Data were considered significant with a value of " $p < 0.05$ ".

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## RESULTS

In our series 81 patients (92%) had esophageal atresia of type III, 3 (3.4%) of type I, 3 (3.4%) of type II, 1 (1.2%) of type IV and 1 (1.3%) showed a fistula and no atresia (according to Robert's classification). In 41 cases (46.6%) associated anomalies were present.

79 patients (89,7%) with esophageal atresia of III type underwent to primary end-to-end anastomosis.

Surgical access to the chest cavity was obtained through a right lateral thorachotomy at the level of the IV-V intercostal space with extrapleural access preserving the dentatus muscle.

Surgery was carried out in the period between 0 and 37 days of life (for Cailas syndrome) (1.76 days on average).

In 25 patients (28,4%) short-term complications were found: 13 stenoses (7 treated with pneumatic dilation and 1 underwent reoperation for stricture), 7 fistulas (which required in 4 cases re-operation), 1 enterocholitis, 1 pulmonary abscessus with bronchopleural fistula, 1 case of ab ingestis and 1 case of wound infection (Table 1).

Only 57 patients with esophageal atresia of III type were included in the long-term follow-up study, 31 children were excluded from the study (35,2%) because 5 died (5,7%) (1 of these patients died in another hospital, during surgery for laryngeal anomalies), 23 were lost at follow-up (26,1%) and 3 have not yet reached the minimum age for follow-up (cut-off 5 years) (3,4%).

Feeding difficulties (dysphagia for solids or liquids, esophageal obstruction, vomiting, cough during feeding) appeared in 26 patients (45.6%) during the first postoperative year, in 28 (49.1%) between 2<sup>nd</sup> and 5<sup>th</sup> postoperative year and in 6 (10.5%) patients after the 5<sup>th</sup> postoperative year (Figure 1).

The statistical analysis showed that:

- a comparison between 1<sup>st</sup> year and period 2<sup>nd</sup> -5<sup>th</sup> year is not statistically significant:  $p=0.7948$
- a comparison between the 1<sup>st</sup> year and 5<sup>th</sup> year is statistically significant:  $p=0.0000$ .

Respiratory problems and airways infections (productive or non-productive cough, bronchial or upper airways obstruction, bronchitis and bronchopneumonia) were diagnosed in 35 (61.4%) patients in the first postoperative year, in 30 (52.6%) between 2<sup>nd</sup> and 5<sup>th</sup> postoperative year and in 17 (29.8%) after the 5<sup>th</sup> postoperative year (Figure 1).

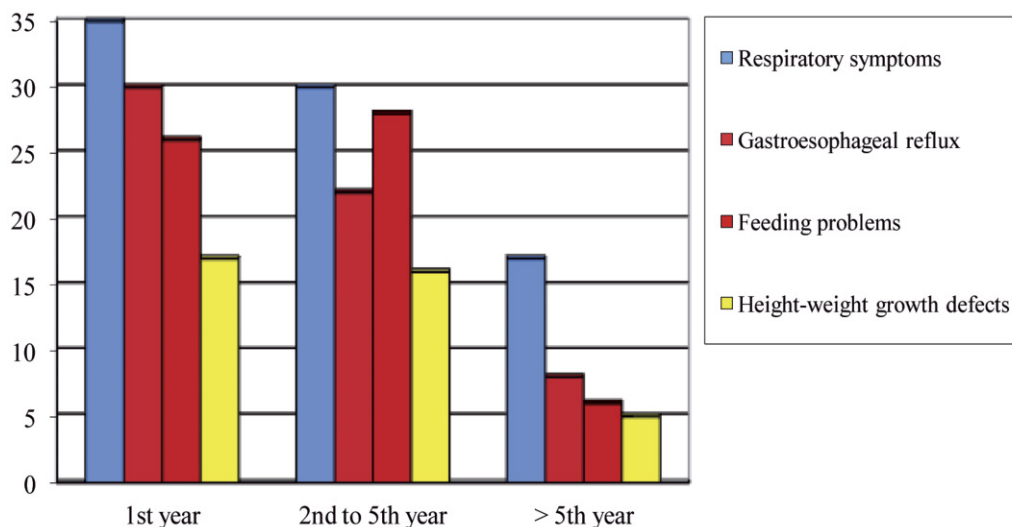
The statistical analysis showed that:

- a comparison between 1<sup>st</sup> year and period 2<sup>nd</sup> -5<sup>th</sup> year is statistically significant:  $p=0.03317$
- a comparison between the 1<sup>st</sup> year and 5<sup>th</sup> year is not statistically significant:  $p=0.5224$ .

Gastroesophageal reflux (regurgitation, night or irritative cough and pyrosis) affected 30 patients (52.6%) during the first postoperative year, 22 (38.5%) between

**Table 1.** Short term complications identified in our patients.

Stenosis	13
Fistulae	7
Enterocholities	1
Pulmonary abscessus with bronchopleural fistula	1
Pneumonia "Ab ingestis"	1
Surgical wound infection	1



**Figure 1.** Features of patients analyzed in the follow-up periods examined.

2<sup>nd</sup> and 5<sup>th</sup> postoperative year and 8 (14%) after the 5<sup>th</sup> postoperative year (Figure 1). Control EGDS didn't show Barrett's esophagus in these children. Seven patients with reflux (12.2%) needed anti-reflux surgery (anterior emivalve according to Thal).

The statistical analysis showed that:

- a comparison between 1<sup>st</sup> year and period 2<sup>nd</sup> -5<sup>th</sup> year is not statistically significant:  $p=0.5682$
- a comparison between the 1<sup>st</sup> year and 5<sup>th</sup> year is statistically significant:  $p=0.00019$ .

The height-weight growth defects were reported in 17 patients (29.8%) during the first postoperative year, in 16 (28%) between 2<sup>nd</sup> and 5<sup>th</sup> postoperative year and in 5 (8.7%) after the 5<sup>th</sup> postoperative year (Figure 1).

The statistical analysis showed that:

- a comparison between 1<sup>st</sup> year and period 2<sup>nd</sup> -5<sup>th</sup> year is statistically significant:  $p=0.0018$
- a comparison between the 1<sup>st</sup> year and 5<sup>th</sup> year is statistically significant:  $p=0.0000$ .

Chest anomalies, asymmetries, scoliosis, retracting scars and costal synostosis were diagnosed in 7 (12.2%) children.

16 patients (28%) showed tracheomalacias and 12 (21%) cardiobulbar malposition.

## DISCUSSION

In the 1<sup>st</sup> year from surgery respiratory symptoms were present in 61.4% of patients, and a minimal decrease was observed (52.6%) between the 2<sup>nd</sup> and 5<sup>th</sup> years and a further decrease after the 5<sup>th</sup> year (29.8%). The decreasing trend associated to respiratory problems does not seem to be in direct ratio with the modifications of the other parameters examined.

Our data are in agreement with similar studies recently performed; Ure et al asserted that approximately 60% of patients operated for EA showed immediate postoperative symptoms and these diminished over time though with a very gradual decline [9-11]. Different factors appear to be responsible of these symptoms: recurrent inhalations of esophageal and gastric content for reflux, tracheo-bronchial structural instability (tracheomalacia) and anomalies in the epithelium of the airways.

Gastro-esophageal reflux, in particular, would promote gastric content inhalation and consequently bronchial hyperactivity, lower airways infections and an eventual permanent bronchial damage; moreover, bronchial constriction may also be a vagus nerve-mediated consequence, though in the absence of inhalation.

Tracheomalacia seems to be responsible of cyanosis crisis, respiratory wheezing, typical chronic cough and lower airways recurring infections: these could be caused by ineffective cough and, subsequently, they would damage the activity of vibratile lashes, with a consequent retention of bronchial secretions. [10-11-

12]. These studies also state that patients with gastroesophageal reflux are most frequently hospitalized for respiratory problems and this aspect is also supported by our results. This kind of problems in 61,4% of the cases could be in part due to tracheomalacia [13-14], diagnosed in 16 patients (28%) and in part to gastroesophageal reflux and atresic esophagus dysmotility. After 5 years from surgery a decrease of respiratory symptoms was observed, even though it is not so relevant as the gastroesophageal reflux and dysphagia. A study by Soto *et al.* in 2000 stated that only a percentage of 25% of long-term respiratory problems in these patients was caused by reflux; in our patients a clinically evident reflux was diagnosed in 7 (41,4%) of the 17 subjects presenting respiratory problems with a higher rate after the 5<sup>th</sup> year; only in 9 of them (52,9%) were diagnosed tracheomalacia. [15]

After EA surgical reparation, evidence of long-term complications is very common in the gastroesophageal tract, such as dysphagia or reflux; several studies defined the necessity of some re-hospitalization periods, so the patients could undergo both invasive instrumental investigations and surgical re-interventions. [16]

1 year after surgical treatment, a percentage of 5,6% (40 subjects) was diagnosed with dysphagia; between the 2<sup>nd</sup> and the 5<sup>th</sup> postoperative year, there was an increase of its incidence up to 49,1%; these results were followed by a large decrease (10,5%) after the 5<sup>th</sup> postoperative year; this decrease depended on correct medical approach and both from esophageal surgery for the management of closed stenosis (performed in two patients only). Some of similar studies (Chetcuti *et al.*) showed dysphagia seems to be more common in older children as a consequence of their major ability to describe symptoms. [16] In our series, this may equally explain the increase of dysphagia between the 2<sup>nd</sup> and the 5<sup>th</sup> year after surgery. Dysphagia, whose frequency is equal until the 5<sup>th</sup> postoperative year, improves with growth.

The aetiology of this condition is due to the presence of a peptic esophageal stenosis, commonly found on the anastomosis; this is caused by excessive tension of the suture, surgical manipulation of the stumps and eventual dehiscences from the suture.

Cardiobulbar malposition, gastroesophageal reflux and esophageal dysmotility may also induce this symptomatology [17-18]. Anomalies in gastric and esophagus innervation observed in after-death studies and a motility disorder between the proximal and the distal esophageal stump may suggest an intrinsic cause of this condition. Only a percentage of 26,3% of our patients had a stenosis with a significant correlation with dysphagia. The sudden decrease observed in the rate of dysphagic patients after the 5<sup>th</sup> postoperative year could be due in part to treatments (pneumatic dilation and reflux control), but mostly to esophageal maturation and improvement of its motility.



Gastroesophageal reflux has been documented in more than a half of the analyzed patients (52,6%) in the first postoperative year, with a percentage of decrease reaching 38,5% between 2<sup>nd</sup>-5<sup>th</sup> year and a further decrease (14,5%) after the 5<sup>th</sup> year (in our study, invasive ph-metric and esophagogastroduodenoscopic investigations were only performed in presence of clinical symptoms).[19] This complication is suggested to be directly related to the traction exerted on the lower stump; this complication is also related to the consequent cardiobulbar malposition (which was reported in only 12 patients of our series, 21%), to esophageal alterations linked to ineffective clearance and to lesions of the vagus nerve with a consequent altered gastric emptying. [20] Improvement of the symptoms after the 5<sup>th</sup> year may be due to successful medical or surgical treatment (performed only in 7 of our patients, 12,2%); growth defects were observed in most of our patients, in agreement with other studies (Chetcuti *et al.*). [16] Our patients showed a retarded growth ranging from -3 to -0,5 DS, with a rate of 29,8% during the first postoperative year. Undoubtedly, these patients had serious feeding difficulties especially in the first years after surgery, but this aspect is linked to typical EA gastrointestinal symptoms. With the decrease of dysphagia and gastro-esophageal reflux an evident recovery in terms of growth clearly occurred; height and weight impaired only in the patients who had a relapse of symptomatology referred to the gastrointestinal tract after the 5<sup>th</sup> year. In any case, long-term children's growth can be referred as excellent [16].

Aesthetic defects from surgery only occurred in 7 patients (12,2%) of our series. This result was achieved for the correct performance of the surgical procedure and, in particular, the correct dissection of the dentatus muscle whose wrong incision may lead to aesthetic defects linked to the abnormal chest development (scoliosis, asymmetries).

## CONCLUSIONS

According to the results exposed, we can state that long-term evaluation in children undergoing surgical procedure for EA and/or esophageal fistula are satisfying, despite the respiratory and gastrointestinal disorders occurring in the first phase.

The patients surgically treated have a very good life quality, including the ones with some residual symptoms they successfully succeed in handling with various "tricks".

Our analysis also establishes a time limit (the 5<sup>th</sup> year postoperatively) after which a remarkable improvement of life quality can be expected. Several studies assert the importance of psychological and technical support groups for parents and patients in order to minimize trauma after frequent hospitaliza-

tions, invasive investigations or, even worse, surgical interventions as children grow up. Undoubtedly, follow-up of these patients is a field worth of further investigations with the help of larger retrospective studies for the evaluation of residual symptoms, life quality after years from surgery and achievement of a homogeneous procedure for the assessment of the short and long-term follow-up.

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