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A prospective study of gap length in esophageal atresia with tracheoesophageal fistula, and comparison of outcome of patients in long gap and short gap lengths

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Abstract
Purpose: In this study our purpose is to measure the gap length between esophageal atresia and tracheoesophageal fistula and to identify weather different gap lengths play any role in outcome of the patients.
Introduction: Tracheoesophageal fistula is an abnormal fistula communication between the oesophagus and trachea. Tracheoesophageal fistula is common surgically correctable congenital anomaly for which newborn admitted in hospital. Outcome of TEF repair depends on many factor like maturity, birth weight, and age at time of presentation, general condition, presence or absence of pneumonia, associated anomaly and gap length. One of such factor is gap length between EA and TEF. We were studding the outcome of the patients with corresponding gap lengths.
Material and Method: A total no. of 50 cases were studied during the period of 2 years from November 2017 to November 2019. The cases were divided into two groups according to the measured gap lengths Group A gap length <2 cm (short gap length) total 28 of total 50 case, and Group B gap length >2 cm (long gap length) total 22 of total 50 cases. The gap between the two oesophageal pouches was meticulously measured with the help of a Vernier calliper and divider scale intra operatively before ligating the TE fistula and before upper pouch mobilization. The final outcome was recorded as the proportion of survivors in these two gap length groups at the time of discharge from the hospital.
Result: Most of the reported cases were full term (68%), low birth weight beby (76%) presented at pnd 1(56%) and male to female ratio is nearly equal. Associated anomaly were arm(55%).outcome were assessed, In group A mortality rate is 64.28% and survival rate is 35.71% while in group B mortality rate 90.99%and survival rate is 9.09% Overall survival rate found to be significantly higher in patients with short gap length as compared to long gap length. Post-operative complication were also studied like sepsis, anastomotic leak, vomiting, respiratory distress, dysphagia, recurrent pneumonia and failure to thrive.
Conclusion: Mortality rate was found to have a direct proportional relationship with the gap length... Overall mortality found to be higher in patients with long gap length as compared to short gap length, thus concluded that gap length is an important predictor of the outcome of treatment or survival of the patients in cases of oesophageal atresia with tracheoesophageal fistula.

Keywords: Esophageal astreisa, treacheoesophageal fistula, gap length

Introduction
TEF is an abnormal fistula communication between the oesophagus and trachea. Tracheo esophageal fistula is common surgically correctable congenital anomaly for which newborn admitted in hospital. Outcome of TEF repair depends on many factor like maturity, birth weight, age at presentation, general condition, presence or absence of pneumonia, associated congenital anomaly and gap length. One of such factor is gap length between EA and TEF. We were studding the outcome of the patients with corresponding gap lengths.

Materials and Methods
A total of 50 cases were studied during the period of 2 years from November 2017 to November 2019. When presence of oesophageal atresia and tracheaesophageal was suspected, a careful clinical examination of patient is done, diagnosis was confirmed using a red rubber tube of 8 FG. It was pass through the mouth into the oesophagus till the blockage is felt, and a digital x-ray (chest + abdomen) antero-posterior and lateral view is obtained. Coiling of tube at the upper thoracic level was considered as confirmatory for presence of oesophageal atresia.

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The thoracic vertebral level of the arrest of the distal end of the orogastric tube was noted. This corresponds to the lower end of the upper oesophageal pouch. The cases were divided into two groups according to the measured gap length as Group A gap length <2cm (short gap length) total 28 of total 50 case, Group B gap length >2cm (long gap length) total 22 of total 50 cases. The gap between the two oesophageal pouches was meticulously measured with the help of a Vernier calliper and divider scale intra operatively before ligating the fistula and upper pouch mobilization. The final outcome was recorded as the proportion of survivors in the two gap length groups at the time of discharge from the hospital.

Results
Total numbers of cases were 50. There were 28 females and 22 males (M:F =1:1.3), a female preponderance is observed. The average birth weight was 2.216 kg. The mean age of presentation was 2 day. Prematurity found to be high in group-B patient 45.45% (10/22), compared to group-A patient 14.28% (4/28). The associated malformation present in 36% (18/50) cases. Anorectal malformation found to be the most common associated anomaly 55.55% (10/18).

Overall survival rate was 24% (12/50). Survival rate found to be highest 35.71% (10/28) in group A and lowest 9.09% (2/22) in group B (table-I).

Overall mortality in this study was 76% (38/50). Mortality found to be 90.90% (20/22) in Group B and 64.28% (18/28) in Group A (table-I).

Post-operative sepsis equally present in both group A and B, respiratory distress and anastomotic leak was 86.33% and 81.81% in group B and 57.14% and 17.85% in group a patient respectively. Respiratory distress and anastomotic leak was very high in group-B patient. 25% of group A patient followed with the complaint of dysphagia, vomiting and recurrent pneumonia as most common postoperative late complications, Whereas 8.33% of Group B Patient who discharged, followed with complaint of dysphagia and recurrent pneumonia as most common postoperative late complications.

Discussion
Oesophageal atresia is a complex congenital anomaly with significant associated long term and short term morbidity. Ultimate goal in the management of oesophageal atresia is to achieve a primary tension free oesophageal anastomosis. The distance between the two ends of the oesophagus is a major risk factor in determining the outcome [1]. Increased tension at anastomotic site embarrasses the circulation. Blood supply of the proximal oesophageal segment arises from the thyrocervical trunk and runs downwards in the submucosal plane [2]. Therefore, extensive mobilization of upper pouch is safe [3] compared to lower oesophagus. A gap of up to 2cm can be overcome by local mobilization alone [4].

Mortality rate is 17.85% in short gap length and 81.81% in long gap length respectively. Results of the present study shows that mortality increases as the gap length increases.

Anastomotic leak is the life threatening post-operative complication of oesophageal anastomosis. In the present study anastomotic leak is found in 46% of cases among which in 17.85% leak present in short gap length and 81.85% leak present in long gap length High mortality in the present study is due to the fact that most of the patients presented with low birth weight and chest infection which belongs to the Waterston category type B or C. These categories carry high mortality. However in the present study, this factor is almost the same for all sub types of gap length.

Gap length is a better predictor of the outcome than the Waterston classification due to improvement in the care of neonates with low birth weights and respiratory problems[5].
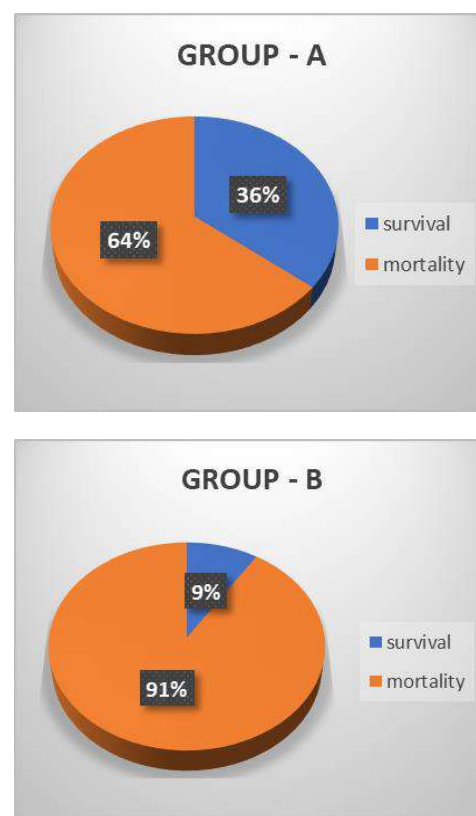
Conclusion
Mortality rate was found to have a direct proportional relationship with the gap length. Intraoperative measurement of gap length using Vernier callipers correlates with postoperative mortality. Overall mortality found to be higher in patients with long gap length as compared to short gap length, thus concluded that gap length is an important predictor of the outcome of treatment or survival of the patients in cases of oesophageal atresia with tracheoesophageal fistula. High success rate can be expected in gap length up to 2 cm whereas above that mortality and morbidity increases proportionately.

Statistical Analysis, Tables and Graph

Table 1: Distribution of cases on the basis of survival and death

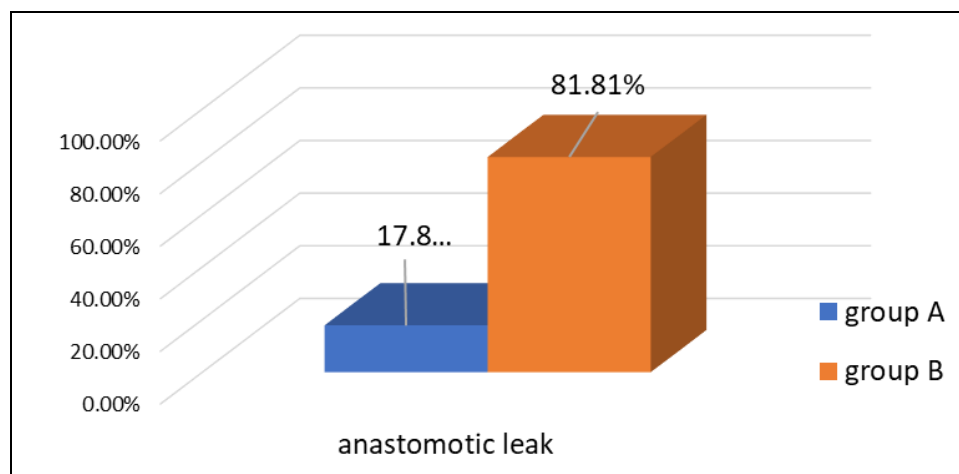| Outcome	Group-A (short gap length)	Group-B (long gap length)	Total no. of Cases
survived	10/28 (35.71%)	2/22 (9.09%)	12/50 (24%)
died	18/28 (64.28%)	20/22 (90.90%)	38/50 (76%)
Total	28	22	50 (100%)

In this study overall survival rate is 24% (12/50), and overall mortality rate is 76% (38/50).

Graph 1: Percentage of survival and mortality in group A and B.

Table 2: Distribution of cases according to postoperative anastomotic leak

Gap length	Anastomotic leak
Short gap length (group A)	5/28 (17.85%)
Long gap length (group B)	18/22 (81.81%)
Total	23/50 (46%)

Graph 2: Percentage of post-operative immediate or early complications in group A and B.

Figures and Diagram: Photographs were taken during surgical repair.

Fig 1: Measuring gap length between esophageal atresia and tracheoesophageal fistula using divider scale.

Fig 2: Vernier calliper and divider scale.

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5. Choudhry SR, Ashcraft KW, Sharp RJ, Murphy JP, Synder CL, Sigalet DL. Survival of patients with esophageal atresia: influence of birth weight, cardiac anomaly and late re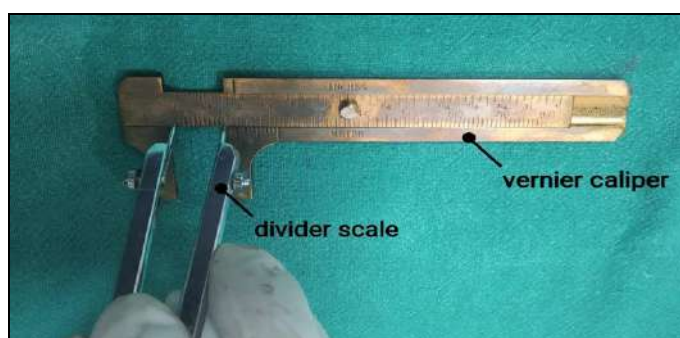spiratory complications. J Pediatr Surg. 1999; 34:70-3.