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Repair of Esophageal Atresia with Tracheoesophageal Fistula through Modified Transpleural Approach by Delivering Lung Out of Main Wound.

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Introduction

Esophageal atresia with Tracheoesophageal fistula is one of the most challenging surgical problem in neonates. The overall incidence is approximately 1 in 3500 to 4500 livebirths[1]. The estimated incidence of EA in India is 18000 per year[2]. The commonest is Esophageal atresia with distal Tracheoesophageal fistula[3].

Other congenital anomalies are frequently associated with Esophageal atresia and Tracheoesophageal fistula like cardiovascular anomalies, VACTREL anomalies, gastro-intestinal, genito-urinary and limb anomalies. Other less frequent conditions like Tracheo-malacia, spina-bifida and exomphalus are also associated anomalies[2].

In 1939, almost simultaneously, Dr. William Ladd of Boston and Dr. Logan Levin of St. Paul got the first complete surgical success[6]. In 1941, Dr. Cameroon Height of An Arbor performed first successful primary anastomosis[7]. Since that time due to improved paediatric nursing care and anaesthetic technique, intensive care units, better ventilator support, better antibiotics and suture materials, the results have improved dramatically.

There has been many approaches for repair of TEF+EA like conventional extrapleural approach[8], transpleural route [9,11,22], end to side anastomosis[12], thoracoscopic repair of TEF+EA[21], and more recently efforts like tissue engineering. The result of repair of TEF+EA depends upon birth weight, associated congenital anomaly, underlying pneumonia and more importantly duration of surgery which has direct bearing on post operative morbidity and mortality[16,17]. Most advocate extrapleural approach but it has certain disadvantages like

- Retraction of lung and mediastinum causing difficulty in operation in deeper areas.

- Frequent interruption of surgery for ventilation by anaesthetist
- Hypoxemia
- Increased operation time

Survival following repair of TEF+EA varies from 24% to 75% in different groups[8,9,10]. The co-morbid conditions especially pneumonia worsen the survival rate. As because of availability of better antibiotics, suture materials, anaesthetic drugs, extrapleural and transpleural approaches in experienced hands produce comparable results. In this study a different maneuver to the usual steps is added in transpleural approach[11,12,13] which only makes the dissection and anastomosis easy and reduces the operative time.

This maneuver is a modification of transpleural approach[11] in which the three lobes of right lung are delivered into the main wound one after another and retracted by a tape made of wet gauze that is held just distal to hilum. The following are the advantages of this maneuver

- It brings the mediastinal structures more superficial to the wound.
- Allows the surgeon to complete the dissection and the anastomosis of the esophageal ends without interruption.
- The anaesthesiologist is at ease as he/she can watch the lobes being inflated all the time along with oxygen saturation above 95%.
- Postoperative lung problems are fewer as operation is smooth and reduce the operative time.

Aims and Objectives

The present study is carried out to assess the morbidity, mortality, ease of operation and post operative complications in this modification of transpleural approach and compare it with conventional extrapleural approach.

Materials and Methods

The study is a prospective study conducted over a period of two years from November 2009 to December 2011 at the Department of Paediatric Surgery of S.V.P Post Graduate Institute of Paediatric, SCB Medical College and Hospital, Cuttack. 20 cases were enlisted for the study and the cases are selected arbitrarily on alternate basis for modified transpleural and extrapleural approach.

Subjected for Study:

The patients with classical esophageal atresia with distal Tracheoesophageal fistula (Type C) managed by primary anastomosis were enrolled for the study.

Criteria for inclusion

All patients with esophageal atresia with distal Tracheoesophageal fistula having birth weight 1.5 kg or more.

Exclusion criteria

The patients who had a body weight less than 1.5 kg, major cyanotic cardiac disease, other type of esophageal atresia (Type A,B,D,E) and long atresia were excluded from this study.

Preoperative Assessment

All patients were subjected to detailed history and a thorough clinical examination. Attention was given to find out the associated anomalies. All patients were kept nil per orally with Intravenous fluid containing an adequate glucose concentration (ie, 10% glucose) and Prophylactic broad-spectrum antibiotics (eg, ampicillin, gentamycin).

The neonate is kept warm by using an incubator or overhead warmer and is positioned supine in the Fowler

position, with the head elevated by approximately 45°. A 10F feeding tube is placed nasally or orally well into the upper pouch and is connected to a continuous suction device. Every 30 minutes, the tube is checked for patency.

Laboratory tests like Hb%, Serum electrolytes, Serum bilirubin, plain X-ray showing recoiling of feeding tube, infantogram to detect vertebral/limb anomaly, USG for other congenital anomaly and echocardiography were preformed.

The parents were fully briefed about the nature of the congenital anomaly. Their consent for treatment was obtained, and the discussion with them was documented in appropriate details on the baby's medical record.

Plan of Surgery

All the patients were under gone primary oesophagesophageal anastomosis under general anaesthesia. Duration of operation (Starting from skin incision upto wound closure), type of operation (modified transpleural/extrapleural), intra-operative complication were noted.

Post operative care

Postoperatively the intubated neonate is transported to the neonatal intensive care unit. The endoTracheol tube should remain until weaning from ventilation is ensured, usually after 1-2 days. Antibiotics are continued until the chest drain is removed.

Chest radiography is obtained first and third post operative day for possibility of pneumothorax. Under water seal bag of chest tube and wound were evaluated by the surgeon every day for any discharge and wound infection. Oral feed started at the 8th Post-operative day of surgery, if there is no feature of leakage of anastomosis. A contrast study was done in cases suspicion of leakage of anastomosis before beginning oral feeding. The patients were discharged after removing the chest tube.

Follow up assessment

In the follow up, patients were assessed at 1 month, 3 months and thereafter at yearly intervals. Assessment was made for child's general condition, growth, healing at the surgical site, swallowing functions and respiratory issues.

Statistical analysis

The outcome in study groups are compared using SPSS software version 6.1 to calculate student's "t" test and Chisquare test. The value is considered significant, when 'p" value is less than or equal to 0.05.

Observation and Results

During the two years period total number of indoor patients were 3456, out of which 39 cases were esophageal atresia with or without Tracheoesophageal fistula. Out of it 20 cases were enrolled in this study and treated. Among 20 cases that underwent primary esophageal anastomosis, 11 cases (55%) present from 3rd to 5th day of life whereas 3 cases (15%) presented during 1st day of life and rest of the cases presented late (average 8th day). The cases presented late had lower respiratory tract infection. Average birth weight in this study is 2.35kg. Only 3 cases were having birth weight more than 3 kg whereas 5 cases were having birth weight less than 2 kg. Rest of the cases had birth weight between 2 kg to 3 kg.

Sex incidence

The sex incidence in this study showed male preponderance. 14 cases (70%) are males whereas only 6 cases (30%) were females.

Associated Anomalies

Among the 20 cases enrolled in this study 8 cases (40%) had associated anomalies. Most commonly associated anomalies were gastrointestinal (3cases, 15%), Cardiovascular (2 cases, 10%), 1 case of hypospadias, 1 case of limb anomaly and 1 case of cleft palate.

Out of 20 cases arbitrary selection was done on alternate basis for modified transpleural and extapleural approach. Duration of operation was significantly shorter in the modified transpleural group. The mean duration of operation in the extrapleural group was 121.4 minutes (range from 120 to 130 minutes) whereas in this modified transpleural approach, it was 98.6 minutes(range from 90 to 110 minutes).

Post operative complications

Among 20 cases operated, 3 cases (15%) had wound infection, all of whom were in extrapleural group and all are managed conservatively. Three patients (15%) developed right sided pneumothorax; 2(10%) of whom were in modified transpleural group and 1 (5%) was in extrapleural group. 1 patient died due to prolonged hypoxia in modified transpleural group. The other 2 cases were managed by tube thoracostomy.

Four patients (20%) developed leakage of anastomosis, 2 of whom were in extrapleural group and 2 were in modified transpleural group. There was no significant statistical difference in the rate of anastomotic leakage between the two surgical techniques. 2 patients, 1 from extrapleural group and 1 from modified transpleural group, developed major anastomotic leakage and died in account of aspiration pneumonia, hypoalbuminemia and sepsis.

Six patients (30%) developed stricture, of whom 4 patients (20%) were from extrapleural group and 2 patients (10%) were in modified transpleural group. All patients responded to gum-elastic bougie dilation except 1 case which required stricturoplasty.

Three patients (15%) died after surgery, 2 (10%) of whom were in modified transpleural group and 1 (5%) was in extrapleural group.

Two patient received total parenteral nutrition, one patient died on the course due to major anastomotic leak in transpleural group. Patients started orally at an average 13.8 days(range from 8 to 15 days) post operatively, of whom extrapleural group started at 13.3 days whereas in transpleural group, started at 14.3 days. There is no significant statistical differences between two groups.

Two patient of associated high anorectal malformation had transverse loop colostomy. One patient of jejunal atresia underwent resection and end to end anastomosis.

Among the 10 cases who had undergone modified transpleural approaches, 7 cases (70%) were in regular follow-up, where as in extrapleural group 7 patients (70%) were in regular follow-up. 1 case (10%) in modified transpleural group and 2 patients (20%) in extrapleural group were lost to follow-up after 1st month check up.

Duration of hospital stay ranged from 10 to 40 days with a mean of 15.8 days. Five patients stayed more than 20 days in the hospital. The reason for prolonged hospital stay was post operative morbidity and subsequent TPN therapy.

Discussion

In the past, the mortality following repair of esophageal atresia with Tracheoesophageal fistula rate was very

high because of non availability of advanced care units, experienced anaesthetists, better anaesthetic drugs, neonatal surgical care, suture materials and more importantly better antibiotics. Now the scenario is different as because of advance intensive care units for newborn, experienced anaesthetists, better surgical approach and better knowledge about the patho-physiology of Tracheoesophageal fistula with esophageal atresia[1].

In this study it is concluded that transpleural approach with taking out right lung out of main wound is well comparable with the conventional extrapleural approach and this approach has advantages like

- It brings the mediastinal structures more superficial to wound.
- Allows the surgeon to complete the dissection and the anastomosis of the esophageal ends without interruption.
- The anaesthesiologist is at ease as he/she can watch the lobes being inflated all the time along with oxygen saturation above 95%.
- Post operative lung problems are fewer as operation is smooth.
- Reduced operative time.

Though there are not many studies in this modified transpleural approach. Jadhav et al[11] published a large series with this procedure. There are other studies [13] done with comparable results between extrapleural and transpleural approaches for treatment of Tracheoesophageal fistula with esophageal atresia.

Prematurity is still a major problem for developing countries. Additional physiological handicaps in these babies are the increased susceptibility to sepsis and the low survival amongst the pre-terms. Therefore it does not indicate failure of operative technique used rather it is a result owing to multiple of factors.[14].

Male to female ratio in the present series is 2.33:1 which is showing male preponderance. These findings are similar to other studies in India[1,15]. The probable cause might be the fewer enrolments attributed to low importance being given to female child in our society. In most series studied abroad, sex incidence is nearly equal[2].

Associated anomalies were found in 8 cases (40%). According to other studies they reported 60%, 47%, 59%, associate anomalies [16,17,18].

Four of 20 patients developed leakage of anastomosis (20%). Among these 4 patients two patients had major leak. Both died due to aspiration pneumonia, hypoproteinemia and sepsis. The patient died in the modified transpleural group had associated cardiovascular anomaly. There was no significant statistical difference in the leakage of anastomosis between both surgical techniques. Similoarly other also reported anastomotic leak in 20-25% cases[18,19]. Sarin et al[20] reported poor results with anastomotic leaks with only 20% survival rate amongst the leak group.

In this study, out of 20 cases who underwent primary repair, six patients (30%) developed stricture of whom 4 patients (20%) were from extrapleural group and 2 patients (10%) are in modified transpleural group. The incidence of stricture development is significantly lower in the modified transpleural group. The results are well comparable to other studies having 18%, 17% stricture[4,18].

In this study, three patients (15%) developed right sided pneumothorax; 2 of whom were in modified transpleural group and 1 was in extrapleural group. 1

patient died due to prolonged hypoxia in modified transpleural group. The other 2 cases were managed by tube thoracostomy. The rate of pneumothorax was higher in modified transpleural group. Others described the rate of pneumothorax is 20% & 14% in their studies[13,20].

The operative time in this study had statistically significant difference between both the groups. The operative time in the modified transpleural group was considerably reduced. The average modified transpleural operative time was 98.6 minutes whereas the mean duration of operation in the extrapleural group was 121.4 minutes.

Present series(Minutes)		Koop et al (Minutes)		Shahnam et al (Mintues)	
Extrapleural Group	Modified transpleural group	Extrapleural Group	Transpleural Group	Extrapleural Group	Transpleural group
121.4	98.6	124	100	135.3	102.33

Table 1: Comparision of duration of surgery in different studies

The shortest 'skin to skin" operation in modified transpleural group was 56 minutes and 6 operations in the modified transpleural group were performed in less than 100 minutes. Koop et al[13] studied a large series with retropleural operative time of 2 hours and 4 minutes while in transpleural group it was 1 hour and 40 minutes. Similarly Shahman et al[23] mentioned extrapleural operative time was 135.3 minutes while transpleural operative time was 102.33 minutes.

In the present study, 17(85%) out of 20 patients survived following repair of esophageal atresia with Tracheoesophageal fistula as compared with 80%, 36%, 35-50% survival rate in the other series conducted in India[20]. Among the total 3 cases who died in which 2 patients died in modified transpleural group and1 patient was in conventional extrapleural group. The 2 patient in modified transpleural group probably died because both the cases had associated cardiovascular anomalies as well as low birth weight and may not be due to the technique itself. According to Shahman et al[23], there were no significant difference in mortality rates between the surgical techniques.

This study also showed that group A and B (according to Waterston classification) were of comparable outcome with other series[1], but survival in group C are lower as compared with other studies for which the reason might be the higher incidence of lower birth weight, delayed diagnosis, low socioeconomic status and lack of advanced neonatological backup.

The popularity of the extrapleural approach instead of transpleural approach is due to more possibility of emphysema followed by anastomotic leakage in the transpleural approach. Another significant problem in transpleural approach is increased rate of pneumothorax according to Shahman et al[23]. In this series there are 2 cases of pneumothorax in modified transpleural group out of which 1 expired and the other managed with tube thoracostomy. As because of availability of better antibiotic and with aid of tube thoracostomy and respiratory physiotherapy, this problem can be handled.

Treatment of esophageal atresia with Tracheesophageal fistula by this modified transpleural approach is better comparable with conventional extrapleural approach. Complication seen in this study does not show any significant difference with conventional extrapleural approach,. It had certain advantages like duration of surgery is significantly low, it brings the mediastinal structures more superficial to wound which made the anastomosis easy and without interruption. The results

in this modified transpleural approach is very much encouraging and well comparable with conventional extrapleural approach and this approach permits increased facility of surgery with shorter duration, hence it is recommended as a proper technique of surgery for neonates with esophageal atreasia with Tracheoesophageal fistula.

Conclusion

In conclusion, the modified transpleural approach in comparision to conventional extrapleural approach is less time consuming, easier fistula identification and esophageal anastomosis. Possess less hindrance during intra-operative ventilation. Postoperative complications are comparable with extrapleural approach, however in this small series, mortality rate is higher than conventional extrapleural approach. It is recommended that modified transpleural approach is an alternate and better technique for repair of tracheoesophageal fistula in new born.

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