Special Article

Use of one lung ventilation during repair of oesophageal atresia (OA) with tracheoesophageal fistula (TOF) in neonates to improve survibility

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Abstract:

Background *Oesophageal atresia (OA) and tracheo-oesophageal fistula (TOF) is one of the surgical emergencies in newborn. Survival rate after corrective surgery is not encouraging in our country.*

Objective *To describes a new technique of airway and ventilatory management during surgical repair of oesophageal atresia and tracheo-oesophageal fistula in neonates.*

Methods *A total number of 12 neonates both male (10) and female (02) with Type- C oesophageal atresia have been operated to correct the anomaly since 2007. The patient's age range was 1 to 17 days, weighing 1.7 to 3.04 kg, maturity range 32 wks to 40 weeks having congenital cardiac anomalies in 8 cases. One lung (left lung) ventilation by inserting 2.5 to 3mm internal diameter uncuffed Endo Tracheal Tubes (ETT) into left main stem bronchus were used in all cases.*

Results *Out of 12 patients having single lung ventilation, 7 patients (55%) survived. 8 out of 12 (66%) needed ventilator support to a variable extent after surgery. Most of the mortality is due to prematurity, postoperative sepsis and associated congenital anomalies.*

Conclusion *Result of OA surgery is still not encouraging in our country. In a tertiary hospital, we have studied this surgery since 2007. The rate of survival in this hospital is 55%. One lung ventilation is one of the prime factors for this result. So, it should be the choice in any form of oesophageal atresia and tracheoesophageal fistula repair in neonates.*

Key words *Oesophageal atresia with tracheo-oesophageal fistula, newborn, one lung ventilation.*

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Introduction

Oesophageal atresia (OA) with tracheo-oesophageal fistula (TOF) is one of the common congenital anomalies in newborn. OA is often associated with prematurity, aspiration pneumonitis and other congenital anomalies. These patients are candidates for early thoracotomy, division of the fistula and primary oesophageal repair. Surgical approach is usually right thoracotomy. One lung ventilation (left) using traditional uncuffed ETT facilitates good surgical exposure and prevents right lung injury. The treatment of esophageal atresia and TOF can be both challenging and satisfying for the anesthesiologist due to intimate relationship between pulmonary and gastrointestinal tract. Tracheo-oesophageal fistula occurs in about 1 in every 3000 to 1 in 4500 births and remains one of the major challenges in neonatal surgery[1]. Advancements in pediatric anesthetic techniques and monitoring, neonatology, and pediatric surgery have reduced mortality figures and survival is now higher than 90%[1] in advanced countries. Prematurity and severe associated congenital abnormalities continue to be the biggest contributors to mortality associated with TOF[2].

There are several classification systems of OA and TOF have been developed based on the presence

of atresia and the relation of the fistula location to the atresia. The Gross classification system describes OA with and without TOF, types A through F[3] (Fig 1).

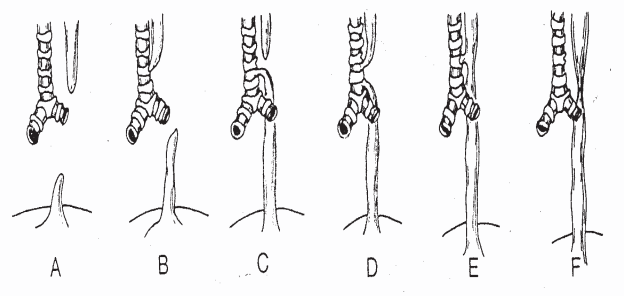

Fig-1 *Gross's classification of esophageal atresia without fistula (A), esophageal atresia with proximal fistula (B), esophageal atresia with distal fistula (C), esophageal atresia with proximal and distal fistula (D), tracheoesophageal fistula without atresia (E), and esophageal stenosis (F).*

The two main pathological entities in the neonate with TOF are dehydration and aspiration pneumonitis. Saliva and secretions accumulate in the upper esophageal pouch and normal swallowing is disturbed. Contamination of the lungs as a result of spillage from the pouch and/or aspiration of gastric contents through distal TOF results in atelectasis and pneumonitis[6].

Methods

A total number of 12 neonates both male (10) and female (02) with Type C Oesophageal Atresia (Fig-2) have been operated to correct the anomaly .The preoperative assessment of upper pouch was done with plain X-ray chest (posterior-anterior and lateral view). The diagnosis of associated congenital anomalies was performed on the basis of careful systemic examination, radiological and sonographical investigations. The patients's age range was 1 to 17 days, weighing 1.7 to 3.04 kg, maturity range 32 wks to 40 weeks having congenital cardiac anomalies in 8 cases. One lung (left lung) ventilation by inserting 2.5 to 3mm internal diameter uncuffed Endo Tracheal tubes (ETT) into left main stem bronchus were used in all cases. All surgeries were performed using general anesthesia and patients were extubated right away postoperatively unless they had respiratory distress, associated cardiac anomalies or marked tension at the anastomotic site. All patient was on an endotracheal tube or not he or she was shifted to neonatal intensive care unit for ventilatory support and further management. Before starting feeding a routine Ba-swallow has been done in all cases usually 7th or 8th post operative day. All stabilized before surgical correction. An isotonic fluid 0.9% normal saline used to correct hypovolamia followed by maintenance fluids containing glucose (5% dextrose in ¼ normal saline) at 4 ml/kg/hour. Acid-base abnormalities respiratory impairment treated appropriately. Prophylactic antibiotics were administered to reduce the risk of perioperative respiratory infection[3]. Standard monitoring including ECG, SpO2, EtCO2, noninvasive blood pressure, temperature and chest auscultation. Permission had been taken from the concerned authority before starting the study.

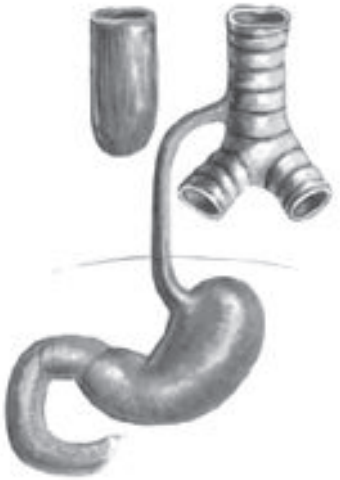

Fig-2 *Type C oesophageal atresia with tracheo-oesophageal fistula*

Anaesthetic technique and surgical management focuses on ventilating the lungs without ventilation of the fistula to avoid gastric distension. Hence reduce risk of aspiration and hypoxia. Common difficulties encountered during anesthetic management include ineffective ventilation due to the endotracheal tube being placed in the fistula, massive gastric dilation, severe pre-existing lung disease from previous aspiration of gastric contents and/or respiratory distress syndrome of prematurity, and associated anomalies, particularly cardiac. Awake with local anaesthetic spray and inhalational technique with without muscle relaxant can be used..

The infants were kept in supine with slight head up tilt. Suction was applied to the upper esophageal pouch and oropharynx , stomach decopressed, a stethoscope fixed on the left axilla and other monitors.

Induction of anaesthesia was done with inhalational technique (oxygen & sevoflurane) Intubation was facilitated under inhalational induction with atracurium 0.5mg/kg.Selective left bronchial intubation was achieved by rotating the tube in the trachea 90º before advancing it down into the left main bronchus. The endotracheal tube was secured in position. The intubation was confirmed by chest auscultation and unilateral chest movement. The tube was secured in position and ventilation was controlled manually via modified T piece (F). Positioning was left

lateral for a right thoracotomy to ligate the fistula and perform oesophageal anastamosis. Anaesthesia was continued with 2.5-3% sevoflurane in 100% O2 with muscle relaxant. Fentanyl 1-2µg/kg was administered for per-operative analgesia. At the end of repair, the ETT was withdrawn from the left bronchus into the trachea above the carina to achieve both lung ventilation as well as to check any leakage from fistula site. At the end of operation Sevoflurane anesthesia was discontinued. After resuming spontaneous breathing, 5 babies were extubated & 7 babies with ETT in situ were sent to neonatal intensive care unit(NICU) for elective ventilation.

Result

Out of 12 patients having single lung ventilation, 7 patients (55%) survived. 8 out of 12 (66%) needed ventilator support to a variable extent after surgery. Most of the mortality is due to prematurity, postoperative sepsis and associated congenital anomalies.

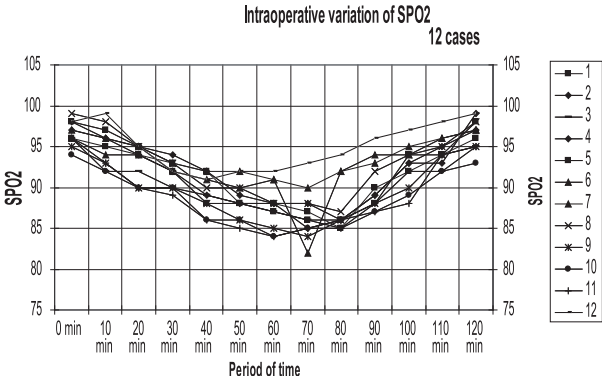

Fig 3 *Graph showing intraoperative variation of SpO2*

Table 1 *Patient criteria and associated anomalies*

Case	Sex	Maturity	Age	Weight (grams)	Associated cong. anomalies	Survival
1	Male	38 weeks	6 days	2600	Nil	No
2	Female	39 weeks	3 days	3000	ASD	Yes
3	Female	32 weeks	1 day	1800	PDA	No
4	Male	38 weeks	3 days	1700	Nil	Yes
5	Male	35 weeks	3 days	2300	ASD+PDA	Yes
6	Male	38 weeks	4 days	2500	Nil	Yes
7	Male	35 weeks	2 days	1900	MR+PDA	Yes
8	Male	39 weeks	17 days	2500	ASD+PDA	Yes
9	Male	35 weeks	2 days	1800	Nil	No
10	Male	38 weeks	1 day	2700	ASD+PDA	No
11	Male	34 weeks	6 days	2000	PDA	No
12	Male	39 weeks	1 day	2000	ASD	Yes

Discussion

Tracheoesophageal fistula manifests in the neonate within hours to days of life. The knowledge and ability of the anesthesiologist to anticipate the challenges in managing neonates presenting for repair, plays an important role in their treatment and survival The world wide incidence of OA with TOF is 1 in3000 to 4500 births with no particular preponderence of sex or race[1] in our study we found that 83% of cases were males.. The reason perhaps lies in the social realm, given the strong anti-female bias existed. Parents perhaps, shy away from bringing their daughters with congenital anomalies to the hospital, and are reluctant to incur the expenses and hardships associated with the anomalies.

Patients of OA with TOF are prone to have other associated congenital anomalies-the presence of which adversely affects the outcome. A particular combination of anomalies called VATER assocation[2] consists of Vertebral defect, Anal defect, Esophageal atresia and Radial anomalies (V also indicate Ventricular septal defect whereas R may also indicate Renal anomalies).

Prior to the first successful staged repair in 1939, oesophageal atresia and associated TOF were uniformly fatal. Advancements in pediatric anesthetic techniques and monitoring, neonatology, and pediatric surgery have reduced mortality figures and survival is now higher than 90%[3] in the developed world.

Although low birth weight, presence of other associated congenital anomalies and presence of pneumonia are all risk factors in their individual right, relating each of them alone with mortality may not be a good idea as they are often co-existent. Waterston's criteria[4] to classify risk factors includes weight, presence and severity of congenital anomalies and pneumonia which is very relevant to the developing world. Further risk stratification has been done by Splitz et al [5] excluding pneumonia.

Several authors[6,7,8] still advocate use of awake intubation in cases of OA with TOF, but a struggling infant can regurgitate from the stomach into the trachea by way of distal fistulous tract[8,9] awake intubation in neonates causes hypertension, that may pre-dispose to intra-ventricular haemorrhage which is still a major cause of mortality in premature infants[8,9] This claim of hypertensive response has its opponents too, there is a study.[10]

Both lung ventilation requires proper positioning of the endotracheal tube tip just avobe the carina but below the fistula. Patient movement or surgical manipulation may lead to subtle changes in the position of the tube and problems with ventilation such as hypoxia ,and gastric distension.

We have described the use of one lung ventilation by inserting 2.5 mm-3mm ETT into left mainstem bronchus which isolate the right mainstem bronchus & TOF that existed near to carina[11,12]. These approaches afforded a "quiet" right lung as well as prevent gastric distension [13]. This approach greatly facilitated surgery and minimized trauma to the right lung[14]. Occurance of desaturation during one lung ventilation need to be slightly withdrawn ETT to ventilate both lungs. Traditional use of both lung ventilation has been used in many centers. But during OA/TOF repair retraction of right lung may cause trauma to the right lung. Gastric distention may also occur through fistula tract when fistula is near to carina[13]. Use of two embolectomy catheters to simultaneously isolate the right mainstem bronchus and TOF that existed near the carina has also been described but requirement of fibreoptic bronchoscopy and complexity make it unsuitable for the procedure[15]. The disadvantages of embolectomy catheters also include the possibility of retrograde migration of either blocker into tracheal lumen, resulting in partial or complete airway obstruction; and insufficient blockade of mainstem bronchus leading to partial ventilation of the collapse lung; and bronchial rupture[16].

S. Mehta et al. studied 25 cases of OA/TOF repair. They used both lung ventilation and there survival rate was 36% (9 cases) [17]. In our experience by using one lung ventilation our survival rate is 55% (7 cases). Although we have done small number of cases (12) by using OLV; this experiences may improve survival rate in future.

Conclusion

Result of OA surgery is still not encouraging in our country. The rate of survival in this hospital is 55%.Early referral and proper NICU support may improve survival rate. One lung ventilation

is one of the prime factors for this result. This appears to be a viable technique and may be considered when TOF is too proximal to the carina to be easily blocked by ETT. So, it should be the choice in OA/TOF repair in neonates.

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