Case Report

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Endotracheal tube blockage during tracheo-oesophageal fistula surgery: A case report

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Abstract

The multifarious anaesthetic challenges associated with tracheo-oesophageal fistula surgery are difficult tracheal intubation, continuous air leakage during positive pressure ventilation, gastric distension, sharing of the airway with surgeons, intraoperative desaturation due to surgical retractors and maintaining anesthetic depth. These challenges are managed properly only when pathophysiology of the fistula is well understood. In this case report we present an anaesthetic management with a near miss situation during repair of tracheo-oesophageal fistula in a neonate. Intraoperatively, the patient's oxygen saturation decreased which did not improve despite correcting all possible reasons. Before the worst could have occurred, we identified endotracheal tube blockage as the cause and changing the tube on time saved the neonate.

Key words: Endotracheal tube; Neonate; Tracheo-oesophageal fistula.

INTRODUCTION

Tracheo-oesophageal fistula (TOF) occurs in 1 in 3,000 – 4,500 live births[1]. It is due to imperfect division of the foregut into anteriorly placed larynx, trachea and posteriorly placed esophagus. The fistula may be accompanied with or without an oesophageal atresia (OA). The commonest type, Type C, is a proximal esophageal pouch with a distal trachea-oesophageal fistula. This distal fistulous connection can be mid-tracheal (64%), 1 cm above carina (23%), true carinal (10%) or right main stem bronchus (1.5%)[2]. Correct placement of the tip of the endotracheal tube beyond the fistula, one of the most important and essential anaesthetic manoeuvres, can be challenging even to the most experienced anaesthesiologist. Despite correct positioning of the endotracheal tube (ETT), plugging due to tracheobronchial secretions or gastric content may necessitate emergency reintubation. We present a case of tracheal tube blockage with difficulty in ventilation creating a near miss situation intraoperatively, which was managed by changing the ETT. Thus, we want to emphasize that ETT blockage should be suspected early if desaturation with difficulty in ventilation is encountered during TOF surgery.

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CASE DESCRIPTION

A 3.5 kg male neonate was delivered via spontaneous vaginal delivery with a cry at birth. After two and a half hours, the neonate was breastfed for the second time following which acrocyanosis with frothy secretions coming out from the mouth was noticed necessitating

frequent suctioning. On auscultation, crepitations were heard all over the chest. Tracheo-oesophageal fistula (TOF) was suspected and the neonate was admitted in the neonatal intensive care unit (NICU) for further evaluation and management. Oxygen was supplemented immediately and antibiotics were started.

Chest X-ray was suggestive of Gross Type C, Vogt Type IIIB TOF with coiled nasogastric tube in esophageal pouch and large gastric shadow. Echocardiographic evaluation of the neonate revealed acyanotic congenital heart disease with a small ostium secundum type atrial septal defect of 4.8 mm with left to right shunt. On the 5th day of his birth, he was subjected to surgical repair of TOF.

In the operating theatre, bilateral crepitations were still persistent on auscultation of chest and SpO_2 reading of 93 - 94% which increased to 98 - 99% with oxygen given via anaesthetic circuit. Before induction, the nasogastric tube of the patient was suctioned. Then, intravenous (IV) 0.3 mg of morphine, 10 mg propofol and 0.3 mg vecuronium was given. After 3 minutes of manual ventilation with low tidal volume and high frequency, the trachea was intubated with 3.5 mm cuffed ETT without any difficulty. The ETT was initially placed endobronchial which was slowly withdrawn till clear bilateral air entry was heard on chest auscultation so that the tip of the ETT supposedly remained below the fistula. Then the neonate was attached to a ventilator via a circle system in pressure control mode with set inspiratory pressure of 12 cm H_2O generating tidal volume of about 20 ml, frequency of 28 and an inspiratory: expiratory ratio of 1:3. The FiO_2 was set at 50%. A Central Venous Pressure (CVP) catheter of 5F was inserted in the right internal jugular vein under ultrasonographic guidance. The chest piece of the stethoscope was attached at the left axilla for intraoperative monitoring of breath sounds.

The neonate was kept in the left lateral and auscultation of the chest was done to reconfirm bilateral equal air entry. Right thoracotomy was done to expose the fistula. Intraoperatively, during the ligation of the tracheal fistula, SpO_2 suddenly dropped below 90% which normalized to 100% after releasing the lung retractors by the surgeons. Close monitoring of the surgical field, intermittent auscultation of the chest with the precordial stethoscope and intermittent recruitment maneuver were continued while observing frequent ups and downs in SpO_2. However, after an hour, such attempts were of little help to effectively ventilate and improve the SpO_2. The FiO_2 was increased to 100% and surgical retractors were removed. Only minimal air entry was heard and the manual ventilation was becoming harder and harder with the capnograph becoming shallower. The surgeons were also asked to check the surgical site but they could not find obvious kinking or dislodgement of the ETT. The SpO_2 could not be maintained further (reached 60%) and the heart rate started to drop. The blood pressure also dropped from 70/50 mmHg to 60/30 mmHg. Injection atropine 0.1 mg was given intravenously (IV) for bradycardia. Excluding other possible conditions like gastric distension, gurgling, obvious cardiovascular event, ETT block was suspected and the patient was made supine immediately. The ETT was removed and the trachea was reintubated with another ETT of the same size following which the ventilation was comfortable and the SpO_2 increased to 100%.

On inspection of the tube, a long segment of the tip was completely blocked with yellowish brown inspisssated secretions (Figure 1). Thereafter, the surgery was completed unremarkably. After completion of the surgery, the neonate was shifted to the neonatal intensive care unit with the ETT in place and mechanical ventilation was continued as per the protocol of the unit. The trachea was extubated on the fourth postoperative day. However, he developed respiratory distress after starting the feeds so was reintubated again. The neonate was weaned off the ventilator on the 5th postoperative day and kept in CPAP (continuous positive airway pressure). On the 9th postoperative day feeding was tolerated and was uneventful thereafter. He was shifted to the nursery ward on the 10th postoperative day and discharged on the 16th postoperative day.

Figure 1: Blocked ETT with inspissated secretion in the tip

Table 1: Gross and Vogt classification of TOF[3]

Types Gross Classification Vogt Classification	A II	B IIIa	C IIIb	D IIIc	E
Description	True OA with no fistula	OA and proximal TOF	OA and Distal TOF	Proximal and Distal TOF	Isolated TOF (H shaped fistula)
Incidence (%)	7%	2%	86%	1%	4%

DISCUSSION

According to the Gross Classification there are 5 types of TOF with commonest being the Type C, 86% (Table 1)[3]. In Type C of TOF there is a high risk of ETT blockage as the upper airway is spilled with secretions from the oesophageal pouch while lower airways get contaminated on aspiration of gastric contents through the distal fistula[4]. In this case the secretion that clogged the tubal opening was brownish in color, which could be either the mucus plug or refluxed gastric content.

Many intraoperative factors can lead to delay in detecting the tubal blockage in TOF. The multiple episodes of ups and downs in SpO_2 due to retraction of the lung may delay in identifying the ETT blockage. Moreover, difficulty in ventilation is gradual as partial occlusion of the tube may occur at first. The lateral position of the patient leaves us with little space to manage the airway efficiently. The other tubal or non-tubal causes of desaturation may also delay in determining ETT blockage.

Tube related causes are tube kinking, tube migration into fistula, accidental extubation and unintentional endobronchial intubation. Non-tubal causes are bronchospasm, pneumothorax and hypotension leading to fault in detection by pulse oximetry. Of the possibility of cardiac causes, the neonate had a small ostium secundum type of atrial septal defect which is unlikely to account for the acute drop in SpO_2.

Perioperative desaturation has variable incidence as low as 0.37% to very high of 53%[5]. However, no studies report incidence of intraoperative desaturation in TOF. In order to decrease the incidence of desaturation we need meticulous monitoring and rapidity in identifying the cause of desaturation.

Although the threshold for duration and severity of hypoxemia with clinical impact is not known[6], hypoxemia with decreased cardiac output has detrimental effects on almost every end organ. When arterial oxygen tension falls below 30 – 40 mmHg / SpO_2 75%, it causes bradycardia and circulatory crisis further leading to death if hypoxemia is allowed to persist[7]. Other effects of hypoxia are pulmonary hypertension, acute renal failure, decreased cognitive function and unplanned intensive care unit admission[6]. So, the question lies when to alert surgeons if the SpO_2 drops and ask them to release the retractors. The oxygen-hemoglobin dissociation curve shows that below 90% saturation when the oxygen tension is 60 mmHg, there is little reserve and hence this is generally viewed as the point to release retractors to prevent end organ damage[6]. But in case of neonates, as in our case, the safety window is further narrower warranting earlier (i.e., at an SpO_2 of around 93%—our suggestion) alerting the surgeons. Further, while working in resource limited settings, availability and use of appropriately sized monitoring gadgets such as SpO_2 probes and blood pressure cuffs must be ensured.

We lacked a paediatric fiberoptic bronchoscope which could have been of tremendous help in finding out the cause of desaturation in our patient. The fiberoptic bronchoscope is considered the best airway assessment tool perioperatively[8]. With its help we can identify the type of fistula, its size and location and it can be used as a guide in the placement of the tracheal tube. The ideal position of the tip of the endotracheal tube is below the fistula to prevent gastric distension and to provide effective positive pressure ventilation. Direct laryngoscopy and auscultation were done to confirm its placement in our case. However, it is not confirmatory. Other techniques to manage airway in TEF, like Fogarty catheter to block the fistula, one lung ventilation with an endotracheal tube or bronchial blocker have also been used successfully[8,9].

CONCLUSION

In conclusion, we want to emphasize that during surgical repair of TOF endotracheal tube blockage with oral or gastric secretions must be born in mind early in the event of desaturation. Proper communication and coordination are essential for prompt identification of the problem to avoid near miss situations as in the present case.

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