Arise Tube- A Novel Double-Lumen Suction Tube for Oesophageal Atresia

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Abstract

Background: Airway compromise is a major criterion that determines the outcome of care in oesophageal atresia (OA). The maintenance of dry throat through suction of the airway and throat is a vital step to the survival of neonates with OA. This prevents aspiration of saliva and mucus plugging of the airway which can compromise pulmonary function. Pre-operative aspiration pneumonitis increases the morbidity and possible mortality of neonatal OA. The Replogle® tube is usually not readily available and costly for caregivers in most centres in the low-income countries. **Objective:** To introduce a local adaptation of suction tubing for clearance of the airway in OA. **Method and Case Series:** The Abdur-Rahman Ilorin Suction oEsophageal (ARISE) suction tube is constructed with a size 6 Fr feeding tube which was tunnelled from a side opening into the lumen of a 10 Fr feeding tube. The distance of the pouch from the incisor is first measured and multiple fenestrations (1 cm apart) are made on the wall of the outer tubes sparing about 2 cm from the measured length near the incisor. Three side fenestrations are made 1.5 cm apart from the tip on the side of the inner tube. The ARISE tube is placed in the upper OA pouch to suck saliva and prevent aspiration in the neonate. The tip of tube is positioned about 0.5 cm above the blind end of the oesophageal pouch. The inner (small lumen) tube is connected to a low-pressure suction machine at 0.2KPa (−15 to −35 cm H_2O) for continuous drainage of saliva and the outer (big lumen) tube functions as air vent and irrigation channel. This protects the mucosal from being sucked into the inner tube lumen. Irrigation of tube is done with 2–3 ml of 0.9% saline every 4 h and as necessary. **Result:** This ARISE suction tube allowed adequate and continuous suction of the pouch and throat with the baby being calm, and caregivers also stress free. The patient maintained good arterial oxygen saturation and there was no aspiration into the airway. **Conclusion:** The ARISE double-lumen suction tube can easily be constructed in many resource-poor health institutions where OA is managed. This will improve the pre-operative management of neonatal OA in such environment making the baby's condition optimal for surgical intervention.

Keywords: Abdur-Rahman Ilorin suction oesophageal tube, aspiration, neonatal oesophageal atresia, pneumonia, suction tube

Introduction

The incidence of neonatal oesophageal atresia (OA) in UITH is 2–3 per annum. Often, there is a challenge of the use of passive single-lumen aspiration tube (SLAT) which required care giver and parents to be extraordinarily alert to suck the tube repeatedly even at odd times of the night. Pre-operative management of neonates with OA is very challenging because of the inability of the neonate to swallow the continuously secreted saliva which tends to overflow into the airway, plugging it and causing the baby to choke. The saliva is also contaminated by oropharyngeal microorganisms. Aspiration pneumonitis has been a common presentation in neonates with OA. Some neonates with OA even aspirate when they are given supposedly optimal care by active and regular SLAT suction of the airway[1] This regular SLAT suctioning is usually stressful to the neonate, caregivers and health-care workers who must remain alert and awake to fulfill this role. Compromise of the airway is a major criterion that determines the outcome of care in OA.[1] Pre-operative aspiration pneumonitis increases the morbidity and possible mortality of neonatal OA.[1,2]

The Replogle® double-lumen suction tube and other sump drainage tubes were designed to assist with continuous

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suction of the blind oesophagus to prevent spillage of the contaminated saliva into the airway.[1,3] However, these tubes are expensive and not readily available in our locality and most low- and middle-income countries. The Replogle® tube also has restriction for use as only neonates who are more than 35 weeks gestation with a weight above 2 kg could permit insertion of the Replogle® tube.[1,4]

We aim to introduce a novel design of double-lumen suction tube named Abdur-Rahman Ilorin Suction oEsophageal (ARISE) suction tube for effective preoperative management of the airway of neonatal with OA.

Method

Construction of novel suction tube

Materials

Size 10 Fr and 6 Fr nasogastric (NG) tubes, lubricating gel (K-Y gel), scissors, suction machine with regulator unit, 0.9% saline, sterile water for injection, 5 ml needle and syringe, latex glove, plaster, galipot, kidney dish, [Figure 1] chart paper, pulse oximeter, timer and assistant.

Procedure

Using a stitch scissors, six (6) additional fenestrations (to prevent mucosa suctioning) are made 1 cm apart from the tip of the NG tube on the size 10 Fr NG tube. Another single fenestration is made on the size 10 Fr NG tube 10 cm from the already measured upper oesophageal pouch length (from the oesophageal pouch to the tip of nostril). Additional three fenestrations are made 1.5 cm apart from the factory-made fenestration on the Size 6 Fr tube. Then, the size 6 Fr NG tube is inserted via the proximal fenestration on the size 10 Fr tube until it reaches the tip of the size 10 Fr Ng tube. Apply an airtight adhesive plaster on the Y junction between the inner size 6 Fr and outer size 10 Fr tube [Figure 2].

The patient should be positioned at 30°–45°recumbent position and must remain on close monitoring and the maintenance of optimal neonatal care. Lubricate the ARISE suction tube and pass it gently via one nostril until the floor or tip of the upper oesophageal pouch is reached, then withdraw it 0.5–1.0 cm to free the tips from being blocked and secure it with plaster on the nostril. The small size 6 Fr tube is connected to a suction regulation machine with short length tube (30–50 cm) at 0.2 KPa (low pressure). The size 10 Fr tube cover at its base is left open to serve as a vent for air and irrigation channel [Figure 3].



Figure 1: Materials for constructing the novel OA suctioning tube and the suction machine. OA: Oesophageal atresia

Observe the inner size 6 Fr tube sucking the saliva and mucus with the neonate achieving good dryness of the oropharynx and nasopharynx. The open end of the 10 Fr tube should be irrigated every 4–6 h with water or saline and when needed if there is drooling of saliva by the neonate is observed (which may indicate that the tube is block).

How To Irrigate The Suction Tube

The suction machine tube should be disconnected from the inner tube. The outer tube is irrigated with 2–3 ml of sterile water for injection or 0.9% saline while the double-lumen tube is still in the upper oesophageal pouch. The inner tube is then reconnected to the low suction regulator unit and switched on, maintaining the pressure at 0.2 KPa (−15 to −35 cm H_2O). Also ensure a spare double-lumen tube is always at the bedside. The low pressure suctioning with the novel double-lumen tube should be continued until the neonate is operated when a transanastomotic tube is passed to replace it.

Case 1

Baby A. O presented to our health facility at 36 h of life with frothing of saliva, choking on breast-feeding, cough and chest retraction. The baby was delivered at term via spontaneous vertex delivery (SVD) by a 28-year-old now Para2 +(0) (2 Alive). The birth weight was 2.6 kg. There was fine crepitation in both lung fields and oxygen saturation was 80%–84% on room air. Vital signs were heart rate: 163 bpm, respiratory rate: 68 bpm and temperature: 37.2°C. Oesophagogram [Figure 4] confirmed an oesophageal blind-ending pouch at level of T2. The patient was nursed in 30° head-up positions and a size 10 Fr feeding tube was passed via the nostril until a resistant was felt (indicating the upper oesophageal pouch) and the distance was measured to the tip of the nostril (10 cm length) and was marked and secured with a plaster. The baby intermittently struggled for breath despite the mandatory intermittent suction of the tube which was blocked by saliva and mucous. The baby was distressed from the irritation of the throat with the suction tube during

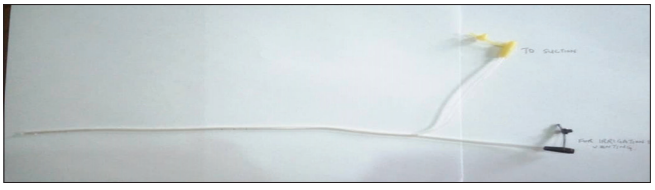


Figure 2: Constructed novel tube

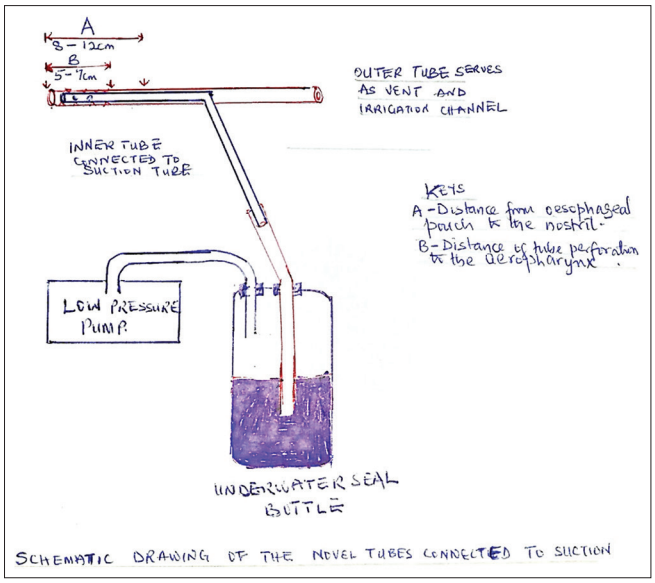


Figure 3: The working of the novel OA tubing system. OA: Oesophageal atresia



Figure 5: Distressed neonates with OA drooling saliva before novel suction tube was constructed. OA: Oesophageal atresia

suction and cries in reaction to this suctioning [Figure 5]. There was also desaturation of the partial arterial oxygen saturation, retraction of the chest and increased heart rate with lip cyanosis.

This ARINE suction tube was passed into the proximal oesophageal pouch and connected to low-pressure suction machine. The tube was irrigated with saline and sucked every 4 h to remove mucous plugs and ensure patency. The neonate remained dry and had effective good airway maintenance evident by oxygen saturation between 96% and 99% [Figure 6]. The neonate subsequently had primary repair of the OA and was discharge home after 3 weeks for clinic follow-up.

Case 2

Baby H. K was presented on the 4th day of life at the second specialist facility Federal Medical Centre Looja with feed



Figure 4: Oesophagogram of the patient with OA. OA: Oesophageal atresia



Figure 6: Calm patient after novel tube was applied

intolerance and frothing of saliva. He was 2.7 kg and delivered at 38th-week gestation via SVD. Antenatal was uneventful. Examination and Investigations confirmed Gross Type C OA with a pneumonia. A gastrostomy was done, and the ARISE tube was used to keep the oesophageal pouch dry to prevent further spillage and while the pneumonia was treated. The baby was confirmed fit for surgery on the 18th day of life and had a successful trans-thoracic primary oesophageal repair.

Result

The division of Paediatric Surgery in UITH Ilorin and Federal Medical Centre, Lokoja Nigeria have successfully used this novel suction tube for the preoperative management of six (6) Gross Type C OA and one patient Gross Type A who aspirated postgastrostomy. There was immediate relief of obstructive features (calm and quiet breath, resolution of chest retraction, disappearance of peripheral cyanosis and return of pink skin colour) and resolution of pneumonitis or pneumonia. About 4–6 h dryness was obtained before irrigation of the tube of the double-lumen suction tube.

Discussion

The surgical outcome of neonatal OA depends on many factors that usually affect the prognosis.[5,6] Suctioning of saliva overflowing from the upper oesophageal pouch remains a constant concern. Most studies have recommended the use of continuous upper pouch suction to reduce the risk of aspiration.[7,8] Adequate preoperative continuous suctioning of the OA pouch will aid in preventing aspiration of the saliva and mucus, and blockage of the airway. The double-lumen suction tube works with similar principle of the Pooles suction tube in abdominal procedures. Replogle® tube suction drainage is used for neonates with OA with or without trachea-oesophageal fistula who are >35 weeks gestation with a weight >2 kg to enable insertion of the expensive Replogle® tube.[1] The patient will require a continuous cardiorespiratory and oxygen saturation close monitoring. In contrast, the advantage of our novel double-lumen tube is that they are readily available, and cheap and the sizes can be varied during construction to match the size of the baby.

Conclusion

This novel double-lumen suctioning tube named ARISE tube ensures effective preoperative airway clearance, prevents aspiration pneumonitis and pneumonia, and assists in the treatment of pneumonia in OA patients. This ensured optimal preparation for good surgical outcomes in neonatal OA. The ARISE tube is cheap and can easily be constructed in many resource-poor health institutions where OA patients are managed.

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Conflicts of interest

There are no conflicts of interest.

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