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CASE REPORT

INTRALUMINAL OBSTRUCTION OF ARMOURED ENDOTRACHEAL TUBES-ARE REUSED TUBES KINKFREE BUT OBSTRUCTION PRONE!

***Shivanand L. Karigar**

BLDUE'S Shri B.M Patil Medical College, Hospital and Research Centre, Bijapur, India

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ABSTRACT

Armoured tubes are used to facilitate kink free access to airway. We report a case of airway obstruction and difficult ventilation soon after intubation due to retained mucus/material in a reused armoured tube. Several cases of intraoperative obstruction and high airway pressures have been reported with armoured tubes. This article highlights the propensity of armoured tube inner wall for dissection and intraoperative obstruction with its reuse and suggests clinical and manufacturing measures to reduce the chances of obstruction.

INTRODUCTION

Case Report

A 60 year old male patient was scheduled for lower lumbar discectomy. Preanaesthetic evaluation was unremarkable. After establishing non invasive monitoring, premedication with midazolam 1 mg, glycopyrrolate 0.2 mg, pentazocine 30mg was administered. General anaesthesia was induced with propofol 100 mg and suxamethonium 100 mg IV . Trachea was intubated with no.8 armoured endotracheal tube (ETT) and fixed at 22 cm. The anaesthetist felt the reservoir bag was tight and difficult to ventilate. A second anaesthetist checked air entry and commented diffuse reduction in breath sounds in all lung fields and no signs of bronchospasm. Endotracheal tube position was further checked by ETCO2 and repeat auscultation . Obstruction and kinking of breathing circuit was ruled out by thorough checking from the machine end to the portex connector. Endotracheal suction did not reveal any mucus or blood. Although SpO2 remained 95-96%, resistance to bag ventilation persisted and endotracheal tube obstruction or block was suspected. The armoured tube was removed and ventilation by mask revealed good chest rise and decreased resistance. Patient was reintubated with another no 8 portex ETT and adequate ventilation without tight bag was achieved. Surgery continued uneventfully in prone position.Close inspection of armoured tube revealed circumferential reduction in the diameter near distal end due to presence of glistening white crust material (Fig. 1).

Fig. 1. Circumferential narrowing and obstrcution by mucus or local anaesthetic jelly

This could be removed in parts. Armoured endotracheal tubes are commonly reused after sterilization (Gurumurthy *et al.,* 2012). Although blockade of armoured tubes with external factors like mucus and patient bites have been reported, several cases of intraoperative obstruction due to inherent inner tube wall malfunctioning have also been noted

****Corresponding author: Shivanand L. karigar,***
BLDUE'S Shri B.M Patil Medical College, Hospital and Research Centre, Bijapur, India.

(Balakrishna *et al.,* 2010). Marcanoglu *et al*. have reported a tear of internal wall of the armoured tube leading to intraoperative obstruction.This was caused by the dissection of the wall in between the spiral rings (Mercanoglu *et al.,* 2013). Paul *et al.* reported an unusual case of armoured tube obstruction caused by a flap-like detachment of the inner coating from the spiral of a reinforced tube which acted like a valve. This was even undetectable by fibreoptic examination. Dissection of inner lumen, dislodgement of spiral rings and detachment of inner wall, internal blistering and bleb formation have all caused malfunctioning of armoured tubes leading to intraoperative obstruction. (Paul *et al.,* 2003; Jeon *et al.,* 2007; Rajkumar *et al.,* 2011; Dubey *et al.,* 2013; Tose *et al.,* 2003 and Rouco Martinez *et al.,* 1984). Although many similar cases like ours have been reported, we took a closer look of the design of the flexometallic tube for the frequent cause of tube blockade and high peak pressure with armoured tubes and inner wall trauma. The tip of the armoured tube differs from that a portex ETT in having thicker edge. This might predispose for retention of mucus secretions. Close inspection of the inner lumen of a flexometallic tube reveals serrations due to the metallic rings (Fig 2).

Fig. 2. The same tube after removal of crusts. Note the serrations in the inner wall and retained material corresponding to circular serrations

Fig. 3. The tip of portex tube and armoured tube compared. Note the thicker edge of armoured tube predisposing for retention of secretions

These serrations produce uneven surface and space for retention of mucus plugs or crusts of local anaesthetic jelly. The serrations might also cause turbulent flow and increased airway resistance .A closer feel reveals actually the outer wall of the armoured tube is more smoother than the inner wall. The serrations may also predispose to trauma to inner wall with suction catheter tips and use of styllet to intubate . Thus , there may be unnoticed trauma to the tube, especially the inner wall and these manifest with subsequent reuse .

Some practical changes can be made to make the armoured tube less obstruction prone while maintaining the kinkfree property. The tip of the flexometallic tube be modified more thinner akin to the portex tube. This would make the armoured tube less prone for secretions to get stuck at the tip. If the spiral embeddings can be incorporated more towards the outer wall, this would make inner surface smooth. This can be safely achieved with additional reinforcement of the tube wall and gaps in between to prevent damage to spiral rings and patient trauma. During manufacturing of the spiral tubes, a rod is dipped in liquid polyvinyl chloride (PVC) creating a thin layer of PVC around the rod .The spiral is then mounted onto the rod and dipping process is repeated several times creating an outer coating on the spiral (Paul *et al.,* 2003).

This makes the inner wall over the spiral thinner than that covering outside. In addition, friction of styllet and catheter over the uneven thinner inner surface and autoclaving diffusion of nitrous oxide makes the inner wall susceptible for dissection and blistering. During manufacturing, more initial dippings over the rod followed by spiral mounting and repeat dippings during the process will achieve the innerwall thicker and smooth. This would make the inner surface smooth and reduce the trauma due to styllet, catheter and propensity to retain secretions and local anaesthetic jelly. Also, instead of using metallic styllet manufacturers must provide for smooth but hard silicon aid for intubating with armoured tube. If the tube is recommended for single use by the manufacturer , a bougie may be a better alternative for reuse. This would reduce the trauma to the inner wall with styllet if the tube is more frequently reused. Also sterilizing by Ethylene oxide may be better than autoclaving. Other low temperature methods like vaporized hydrogen peroxide, vapor phase peracetic acid, gaseous chlorine dioxide, ionizing radiation, or pulsed light may need to be considered. Cleaning and checking armoured tubes before use has been suggested . However, if armoured tubes are to be reused, the best time to clean them is immediately after extubation with forceful jet of water into the lumen. Additionally they need to be checked before use for lumen patency and other defects routinely along with cuff leak checks.

Conclusion

We suggest the tip of the flexomettalic tube be modified more thinner akin to other portex tube and the spiral embeddings can be incorporated more towards the outer wall and make inner surface smooth. If armoured tubes are to be reused, the best time to to clean them thoroughly is immediately after extubation . Of course, this has to followed by regular check before next use.

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