Case Report

Difficult Ventilation in a patient after Endotracheal Intubation: an Unusual Manufacturing Defect in E.T.T. Connecter

M YOUSUF M MASOOD M S TAHIR *M A FAYYAZ S WARIS*
Department of Anaesthesia, Nishtar Hospital, Multan
Correspondence to Dr. Muhammad Yousuf

Summary: Airway resistance depends upon the diameter of endotracheal tube (E.T.T) and other respiratory organs. Actually resistance to flow through a tube increases up to sixteen times if diameter is reduced to half of the original size. Disposable E.T.T which are currently used in anaesthesia practice are made up of P.V.C with a connecter which is fitted on proximal end of endotracheal tube and proximal end of connector is attached with breathing circuit. Usually the internal diameter of connector should be equal to internal diameter of endotracheal tube. In the market, tubes of different manufacturers and of different sizes are available for all age groups. In developing countries like Pakistan, hospital administration usually purchases the endotracheal tubes and other equipments which are relatively cheaper because of lack of funds. Here we present a case where there was a manufacturing defect in E.T.T connector with a very narrow internal diameter that was causing severe respiratory obstruction in a child undergoing laparotomy. We conclude that the anaesthetists must keep in their mind the possibility of E.T.T connector manufacturing defect if they face problem of increased airway resistance in an intubated patient after excluding other possibilities of high airway resistance.

Case report

In paediatric Operation Theatre Nishtar Hospital Multan a child was brought for laparotomy. On preoperative anaesthetic assessment he had no history of respiratory tract infection, cough or fever. On examination there was no signs of dyspnea or any other respiratory problem. Patient was neither anaemic nor had any other cardiac problem. On chest auscultation, he had normal breath sounds without any evidence of crepitations or ronchi. Induction of anaesthesia was done with I.V thiopental sodium 6mg / kg and injection rocuronium 0.9mg / kg was used for muscle relaxation. Then patient was ventilated manually with a mixture of O_2, N_2O and isoflurane through paediatric face mask. After full muscle relaxation an uncuffed endotracheal tube (I.D. 4mm) was passed under direct vision and fixed. Child was started manual ventilation with the same mixture of gases to maintain anaesthesia. But it was noticed that there was an extreme increase in resistance and child was almost unable to be ventilated. Breath sounds were very weak when checked bilaterally. Chest expansion was also negligible. E.T.T was checked for correct position or any kinking. It was perfectly placed and there were no kinking or secretions. N_2O and isoflurane were stopped and gas mixture converted to 100% oxygen. But the situation remained unchanged. Anaesthetic circuit was also checked for any kinking or blockage that was absolutely fine. In the mean time SpO_2 started falling down. Then E.T.T was removed and child was ventilated manually through bag and mask with 100% oxygen. Resistance was immediately relieved and SpO_2 improved. Then another E.T.T of same size and manufacturer was placed. Now there was no resistance and chest expansion was quite normal. Surgery started and the whole procedure was uneventful and child recovered smoothly after the completion of procedure. The removed E.T.T was then examined for any deformity; it was astonishing that the connector attached with the E.T.T had a very narrow internal diameter of about 1mm as compared to the internal diameter of the tube with which it was attached. This was the actual cause of acute increase in resistance during ventilation.

Discussion

Different types of E.T.T are being used in clinical practice now a days like cuffed, uncuffed, red rubber tubes, flexometallic tubes etc. E.T.T has become an important component during general anaesthesia since with the use of neuromuscular blocking agents[1]. Avicenna performed first orotracheal intubation in a patient. suffering from dyspnea. In 1870's trendelendburg performed first endotracheal anaesthesia in man. Regular practice of orotracheal intubation to secure the airway was first started by Kuhn in 1900[2]. Frans kuhn has a great contribution about the use of different types of E.T.T, different techniques to intubate the trachea and he also had the sha in the development of anaesthesia machine, but unfortunately his work gained widespread acceptance about 50 years later[3,4,5]. Previously red rubber tubes w used which have been now replaced by PVC tubes wh are disposable, so eliminating the risk of cross infectio Old metallic connectors have been replaced by plasti connectors. E.T.T are numbered according to I.D. in mm. Tube size is particularly important in paediatric pat. because they have narrow airways[6]. Tube size c roughly estimated with the following formula[7].

Tube size (I.D in mm)

But ideally thr tubes should b
One of estima

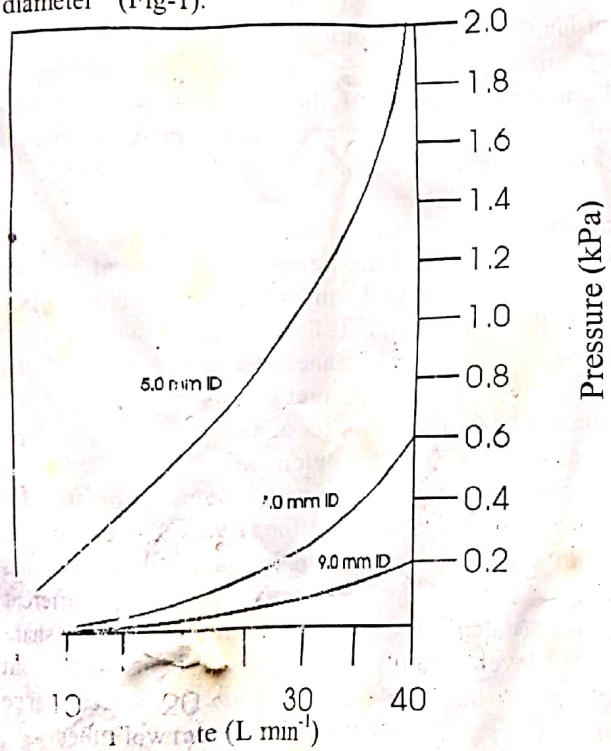
0.5mm I.D. smaller then that estimated size. Airway pressure can be increased due to laryngospasm, bronchospasm, or it may be a manifestation of tube blockage due to kinking, secretions, or bronchial intubation[8]. Occasionally increased airway resistance may be due to defective E.T.T or its connector[9].

Hagen poiseuille equation determines the factors on which flow through a tube depends. It states that[10]

$$Q = \frac{\pi \Delta p r^4}{8 \eta l}$$

Where Q= Flow through the tube
p= Pressure across the tube
r= Radius of the tube
l= Length of the tube
η= Viscosity of fluid

According to this law resistance to flow increases sixteen times if diameter of the tube is decreased to half of the original size. The following figure shows the resistance to gas flow through tracheal tubes of different internal diameter[11] (Fig-1).



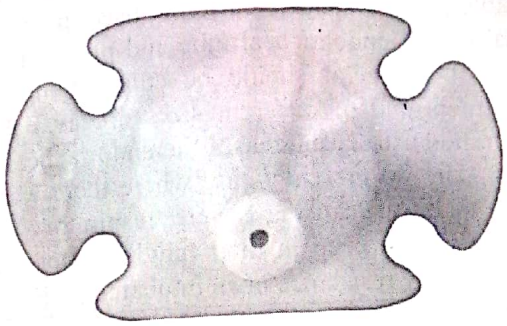
Resistance to gas flow through tracheal tubes of different internal diameter (ID).

Failure to ventilate the patient can cause a wide range of problems, from transient desaturation to irreversible brain damage and even death[12,13].

Although many ventilation associated problems including obstruction and leakage have been reported due to malfunctioning of ventilation equipment[14,15] or manufacturing defects in E.T.T[16,17,18]. Most problems could be easily detected by either the mechanical alarm for gas leakages or with the use of a suction tube or fiberoptic bronchoscope. In this case the defect was difficult to localize in either the pre-use check out or during the event because of its obscure localization.

This case report highlights the importance of awareness among the anaesthetists about airway obstruction due to structural defects. We strongly recommend an additional pre-use check of the connectors also.

(A)



(B)

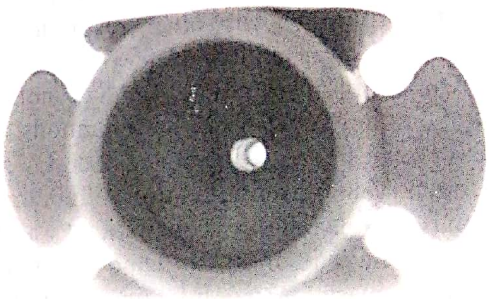


Fig 2: Distal (A) and proximal (B) end of defective connector (ID 4mm)

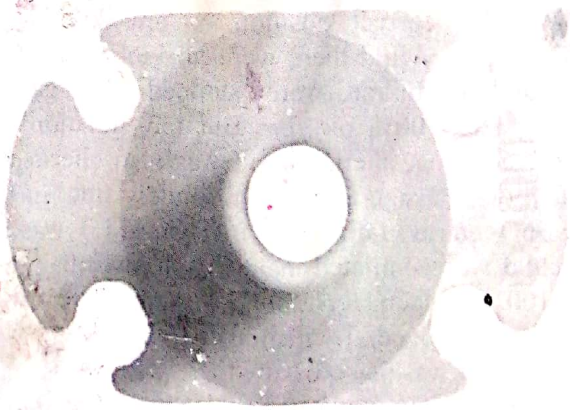


Fig. 3: Distal end of normal E.T.T connector (I.D 4mm).

References

1. Brandt L. The history of endotracheal anaesthesia with special regard to the development of the endotracheal tube. Anaesthetist. 1986 Sep; 35(9):523-30.
2. History of intubation, luckhaupt H, Brusis T. Laryngol Rhinol otol 1986 Sep; 65(9):506-10.
3. Ezri T, Evrons S, Hadad H, Roth Y. Tracheostomy and endotracheal intubation: a short history, hare fuah. 2005 Dec; 144(12):891-3, 908.
4. Franco Grande A, Martinon J M. Historical Evolution of tracheal intubation. Rev Esp Anestesiol Reanim. 1979 May; 26(3):243-54.
5. Franz Kuhn, His contribution to anaesthesia and emergency medicine. Thierbach A. Resuscitation. 2001 March; 48(3):193-7.
6. Anaesthetist. 1986 Sep; 35(9):523-30.
7. Morgan GE, Mikhail MS. Paediatric anaesthesia. In: Clinical Anaesthesiology. 3rd ed. California; 2002. p 861.
8. Aitkenhead AR, Rowbotham DJ, Smith G. Complications during anaesthesia In: Text book of Anaesthesia. 4th ed. London: Churchill Livingstone; 2001. p 501-23.
9. Chua WL, Ng AS. A defective endotracheal tube. Singapore Med J. 2002 Sep; 43(9):476-8.
10. Davis PD, Parbrook GD. Fluid flow In: Basic physics and measurement in anaesthesia. 4th ed. London: Hartnolls Limited; 1997. p 16-8.
11. Aitkenhead AR, Rowbotham DJ, Smith G. Basic physics for the anaesthetist. In: Text book of Anaesthesia. 4th ed. London: Churchill Livingstone; 2001. p 341-2.
12. Utting JE, Gray Tc, Shelley Fc. Human misadventure in anaesthesia. Can Anaesth Soc J 1979; 26:472-8.
13. Caplan RA, Posner KL, ward RJ, cheney FW. Adverse respiratory events in anaesthesia: a closed claims analysis. Anesthesiology 1990; 72:828-33.
14. Pauca AL, Jenkin TE. Airway obstruction by breakdown of a non-rebreathing value: how fool Proof is fool proof? Anaesth Analg 1981; 60:529-31.
15. Beless DJ, Slovis CM. Sudden respiratory deterioration in the positive pressure ventilated patient: an organized approach to diagnosis and therapy. J Emerg Med 1996; 14:573-8.
16. Campbell C, Viswanathan S, Riopelle JM, Naraghi M. Manufacturing defect in a double lumen tube. Anaesth Analg 1991; 73: 825-6.
17. Arai T, Kuzume K. Endotracheal tube obstruction possibly due to structural fault. Anaesthesiology 1983; 59: 480-1.
18. Lewer BM, Karim Z, Henderson RS. Large air leak from an endotracheal tube due to a manufacturing defect. Anesth analg 1997; 85: 944-5.