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CLINICAL INFORMATION

Inappropriate fixation of an endotracheal tube causing cuff malfunction resulting in difficult extubation

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PALAVRAS-CHAVE

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Abstract We discuss a case of difficult extubation, due to inadequate deflation of the tracheal tube cuff, despite collapse of the pilot balloon, on its aspiration. This was caused by inadvertent kinking of the pilot balloon tubing due to inappropriate tape fixation of the endotracheal tube. © 2013 Sociedade Brasileira de Anestesiologia. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Fixação inadequada de tubo endotraqueal, resultando em mau funcionamento do manguito e extubação difícil

Resumo Relatamos o caso de extubação difícil devido à desinsuflação inadequada do *cuff* do tubo traqueal, a despeito do colapso do balão piloto, em sua aspiração. Isso foi causado pela torção inadvertida do tubo com balão piloto devido à fixação inadequada do tubo endotraqueal com fita adesiva.

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Case report

A 65-year-old, 60 kg hypertensive and diabetic male was scheduled for a laparoscopic cholecystectomy after pre-operative optimization of diabetes and hypertension from the pre-anesthesia clinic. The patient was premedicated with intravenous midazolam 1 mg. After pre-oxygenation,

anesthesia was induced with intravenous fentanyl 100 mcg, thiopentone sodium 300 mg and vecuronium 6 mg.

Tracheal intubation was accomplished smoothly using an 8.5 mm cuffed polyvinyl chloride tracheal tube (Apex Endotracheal Tube, Apex Laboratories Ltd., Hospital Products Division, India) and fixed with thin strips of elastic adhesive bandage (Leukoband, Neptune Orthopaedics, India). Anesthesia was maintained with isoflurane, nitrous oxide and oxygen using the circle system. The intraoperative period was uneventful with stable hemodynamics throughout the procedure which lasted for 60 min. On completion of the

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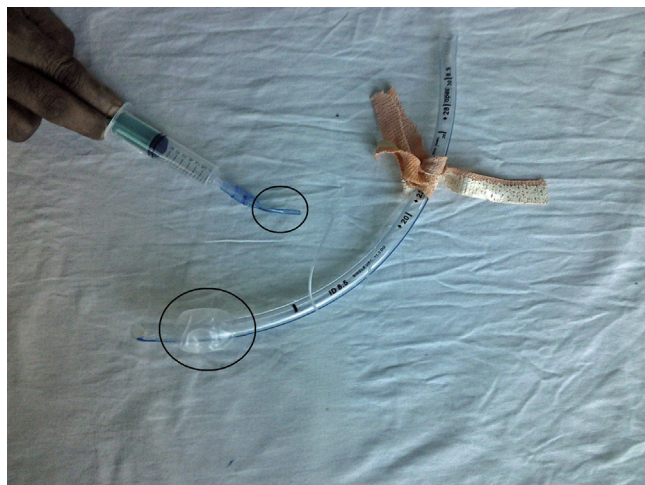


Figure 1 Partially inflated cuff with the collapsed pilot balloon.

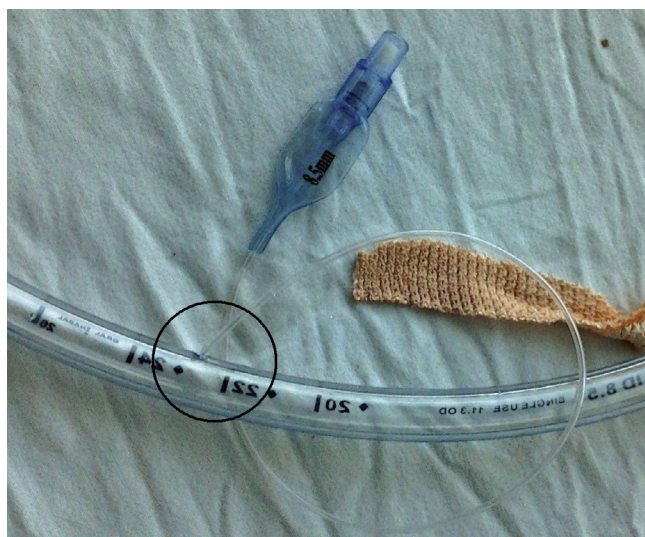


Figure 2 Kink on the pilot tubing at the point of inappropriate fixation.

surgery, the neuromuscular blockade was reversed with glycopyrrolate 0.5 mg and neostigmine 2.5 mg. Five minutes later the patient was awake and responding well to verbal command. Pilot balloon was deflated before attempting extubation. While attempting extubation slight resistance was felt, but the extubation process was completed with additional traction on the tube. Examination of the tube revealed that cuff was only partially deflated although the pilot balloon was completely collapsed (Fig. 1). On further careful examination to identify the reason for this partial deflation, it was noted that the tube connecting the pilot balloon to the cuff was kinked at one point (Fig. 2). This kinking probably had led to partial deflation of the endotracheal tube cuff. Cuff was again fully inflated with air and deflated to confirm recurrence of partial deflation. During this attempt, the pilot balloon again got deflated but cuff remained partially inflated.

The patient had an uneventful recovery without any sore throat and was discharged from the hospital the next day. During follow-up over the next one month at the out-patient

department (OPD), no adverse effect was reported by the patient.

Discussion

Difficult extubation is very rarely encountered problem in anesthesia practice,¹ but forceful extubation has been associated with fatality.² This also has been reported to cause vocal cord edema, dislocation of the arytenoids cartilage and laryngeal trauma.³ Difficult extubation situation therefore should be handled with caution and care.

Multiple factors had been identified as the cause of difficult extubation such as inadvertent fixation of endotracheal tube or pilot balloon tubing with orofacial soft tissues during surgical interventions, tangling of pilot tube with the nasogastric tube and malfunctioning of the cuff assembly.¹ Out of the all the possible causes, cuff malfunction has been reported as the commonest cause of difficult extubation.¹ Improper deflation of the tracheal cuff can result from kinking of the pilot tube distal to the pilot balloon (between balloon and point of attachment to the endotracheal tube) or severed pilot tube at the point of attachment with the endotracheal tube.¹

Kinking of the pilot tube had taken place distal to the pilot balloon in the case reported by us. The kink prevented complete deflation of the endotracheal tube cuff despite an apparently deflated pilot balloon. The negative suction on the pilot balloon allowed the walls of the balloon to come in apposition to each other without complete deflation of the cuff and thus prevented the transmission of the negative pressure to the cuff. This hypothesis was proved when we tried to reinflate the cuff following extubation. Under positive pressure the cuff got inflated, but on applying negative pressure the balloon got deflated completely while the cuff still remained partially inflated.

Further examination of the endotracheal tube revealed that the kink had resulted due to improper fixation of the endotracheal tube with the adhesive tapes. It was identified that the pilot tubing was also fixed with the adhesive tape while securing the endotracheal tube. This caused the kink and cuff malfunction, and similar mechanism had only been reported as the cause of difficult extubation in two cases till date.^{4,5}

Although we had pulled the tube out by applying additional traction on the tube without any adverse effect, multiple measures had been suggested in the literature to overcome such a situation. Examination of the pilot tubing has been suggested as the initial measure to identify kinking of pilot tube.⁶ Insertion of a needle (with an attached syringe) distal to the kinked portion had been advocated as the next corrective measure to deflate the cuff.⁶ This, however, could be difficult to accomplish and possibility of needle stick injury to the operator and patient should always be considered as a possibility. Alternatively, the tube can be pulled out until the cuff is just visible at the under-surface of the vocal cords followed by deflation of the cuff by puncturing it with a sharp object.⁷ This method also carries similar risk of injury to the patient.

Measure adopted by us had been supported by an anecdotal report of intentional extubation of the tracheal with an inflated cuff. The author had claimed beneficial effect of

such measure by mentioning that inflated cuff had helped in removing the secretions from the upper trachea and glottis during the process of extubation.⁸ However, such practice has been criticized for lack of evidence and being "antithetical to the standard practice and teaching of the entire medical community".⁹ We of course had used this technique without realizing the cause of difficult extubation at that point of time.

Retrospectively, we feel that to prevent such complication, the pilot tube should not be fixed with the adhesive tape. However this also had been advocated by certain authors and it is a matter of debate.¹⁰ "Thomas Endotracheal Tube Holder (Laerdal)" had been suggested as alternative measure to ensure proper fixation of endotracheal tube. This probably can avoid use of tape and such complications.¹¹ However, this is not a standard practice and the cost effectiveness of such devices in absence of high level evidence is a concern.

No definite recommendation can be given to manage such situations. Awareness, identification and analysis of problem, however, can help us in taking one of the suggested methods weighing the risk benefit ratio.

Conflicts of interest

The authors declare no conflicts of interest.

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