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Case Report

Anaesthesia Section

Eventful Anaesthesia: Can We Prevent It?

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ABSTRACT

To ensure the utmost safety, it is recommended that prior checking the machine and breathing systems as mandatory. Certain factors beyond the control of the anaesthesiologist lead to the operative room incidences jeopardizing the anaesthetised patient which otherwise cannot be prevented by prior custom checking. Delayed occlusion of a spiral reinforced endotracheal tube during prone position anaesthesia and faulty dual control knob of fresh gas flow of an anaesthesia machine leading to inadequate ventilation are given as examples. In above events, a prior checking the machine or tracheal tube, could not prevent its occurrence. However, use of a deputy of the objects resulted in uneventful anaesthesia.

Keywords: Bi-directional fresh gas flow, Incident reporting, Reinforced endotracheal tube, Tube occlusion

CASE REPORT

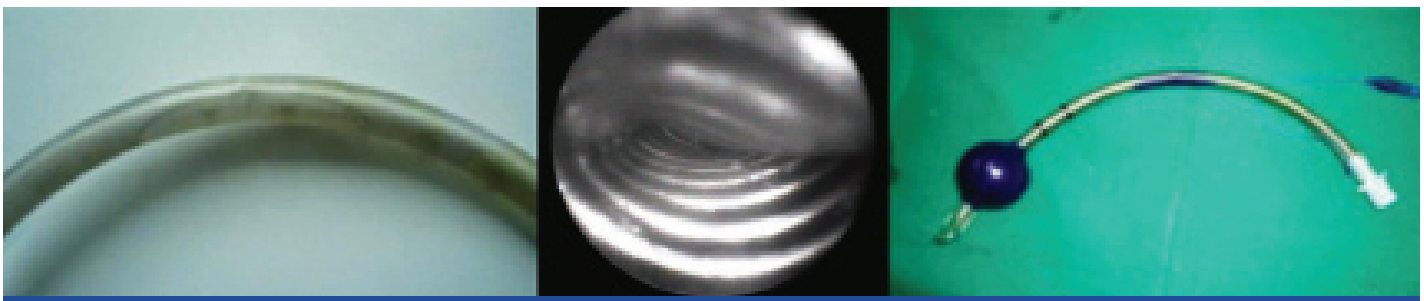
Case 1

A 46-year-old male, weighing 76 kg, ASA 1 classification, without any co morbidity was scheduled for surgery for level 2 (cervical and thoracic) spine surgery in prone position. Anaesthesia was induced with intravenous (IV) propofol 120mg, Inj. fentanyl 200µg, IV, Inj. vecuronium 8mg, IV and intubated with a cuff-pre-tested, ethylene trioxide (ETO) sterilized reinforced endotracheal tube (Safety-Flex™ with Murphy Eye, Mallinckrodt® oralnasal, Reinforced Tracheal Tube, Mallinckrodt Medical, Ireland) 8.0ID, through oral route with an airway in situ. After confirming the position of the tube in the trachea, the tube was secured. Patient monitored with Electrocardiography, Non-invasive blood pressure, SpO_2, $ETCO_2$ and Airway pressure. Low flow controlled ventilation was carried out with use of oxygen, N2O and sevoflurane. Intraoperatively, four hours after surgery began; a progressive increase in airway pressures was observed. The mechanical causes were thought to be responsible for the same. Surgical procedure was interrupted on request; an endotracheal tube suctioning performed which revealed a negative diagnosis for mechanical tube occlusion. Increasing $ETCO_2$ (50mm Hg) with expiratory obstruction capnograph was observed and surgery was allowed to continue since ventilation was possible; even though airway pressure (60cm H_2O) was high.

Deepening of anaesthesia with inhalational agent and additional Inj. Fentanyl, Inj. Vecuronium did not solve the problem. Bronchodilator therapy was considered subsequently. Ten minutes later, surgeons were requested to stop the surgery and a second attempt of endotracheal tube suctioning and oral examination was carried out. It was extremely difficult to pass the suction catheter beyond 12cms and the endotracheal tube obstruction was diagnosed with a negative aspiration. Next, the cuff was deflated anticipating the possible cause of cuff as aetiology for the endotracheal tube obstruction. Immediately following this manoeuvre, adequate ventilation was achieved with a sigh of relief. Since the duration of the anticipated surgical process was approximately five hours further, it was decided to replace the endotracheal tube with another similar sized armored tube. A change of the endotracheal tube in supine position relieved the problem completely and surgery was uneventful. Further analysis confirmed that the endotracheal tube obstruction of the armored tube was in the middle portion of its length rather than at the anticipated patient's end, near the cuff. An endoscopy of the tube's lumen showed intraluminal herniation of the cuff inflation tube, while inflating the cuff and thus causing obstruction of the air passage [Table/Fig-1]. A dye test with methylene blue confirmed the same [Table/Fig-1].

Case 2

A 37-year-old female, weighing 74kg, ASA1 patient was administered general anaesthesia (Datex- Ohmeda-Modulus II, Madison, Datex-Ohmeda, Inc., GE Healthcare Ltd.) for elective, thyroid surgery. After endotracheal intubation, ventilation was carried out through a Bain's circuit after which the patient was positioned for surgery. Subsequently, circle absorber system was used for ventilation and hence, the selector switch on the machine was switched over. While switching over, the switch over knob got trapped and immovable; thus ventilation becomes non-conclusive. Switching over to Bain's circuit confirmed the similar observation with inadequate bag filling. Immediately Ambu bag ventilation was carried out with 100% oxygen administered from a flow meter device. Further anaesthesia



[Table/Fig-1]: Intraluminal cuff inflation confirmed by dye test

[Table/Fig-2]: Faulty switch over knob of anaesthesia machine and demonstration of bi directional flow

was carried out through a new machine which was made available from next operation theatre.

DISCUSSION

To ensure the utmost safety, it is recommended that prior checking of the machine and breathing systems are absolutely mandatory [1]. Certain factors beyond the control of the anaesthesiologist can lead to the operative room incidences which jeopardize the anaesthetised patient; which otherwise cannot be prevented by prior custom checking [2].

The incidences of problems with reinforced tubes are extremely rare. When an anaesthesiologist primarily inserts a reinforced endotracheal tube with the intention of having more protection of the airway than in conventional endotracheal tubes, it is extremely unfortunate that reinforced tubes itself give rise to such problems. Biting, kinking, material in the lumen of the tube with dried secretions, blood, pus, tumour, or other tissue, external compression or a manufacturing defect etc can all cause obstruction [3]. Cuff problems are well known with eccentric cuff expansion, cuff ballooning with compression of the tube lumen but resolves quickly with deflation of the cuff when identified in a timely manner. This armoured tube was reused after ETO (Ethylene Tri Oxide) sterilization which could have damaged the inflating tube and tube itself at its mid-length as discussed earlier. A prior checking of the tube with air inflation before insertion did not reveal the underlying problem. It is also possible that while checking the tube, the least resistance was offered by cuff for the injected air. Therefore, initially the cuff got inflated and remained inflated for a particular volume of air injected. Further inflation would have resulted in cuff damage. Under anaesthesia with concurrent administration of nitrous oxide, the cuff pressure would have mounted further. After four hours of nitrous oxide use, increased cuff pressure might have transmitted to the weak portions of the damaged inflation tube and led to the self inflation of damaged portion (new cuff) with herniation into the lumen of the tube resulting in high airway pressure and obstruction.

With regard to this discussion, three factors need to be addressed. Firstly, in a surgery where there is sharing of the airway and thorax with a surgeon, most common cause of airway events are due to surgery related ones. Initial diagnosis of surgical causes like pneumothorax was excluded. Secondly, a prior checking of the tube cuff did not help in preventing the event. Thirdly, issues related to the use of ETO sterilized tubes. Cost factor of anaesthesia is a serious debatable topic in developing countries. Regular use of new reinforced tubes adds to substantial cost of anaesthesia ETO sterilized reinforced tube is used regularly in our institution as with many others. Use of new endotracheal tubes in the patient could have avoided the problem, as recommended by manufacturer and anaesthesia text books [3].

Manufacturers of anaesthesia machine rarely provide detailed information of any technical related aspects in depth, resulting in inadequate knowledge for practicing anaesthesiologists. Also, owing to the amazing number of various types of anaesthesia machines available in the market, it is almost impossible to know the details of every element and these problems are even worse with electronically operated ones. Problems with older machines were easily identifiable when compared to the newer ones, even though the newer ones are loaded with higher number of safety features. User manuals that are provided by manufactures contain detailed directions for checking, but are often skipped by the user due to its complexity [4]. A faulty ball valve mechanism of the dual control switch was responsible for the event. However, it was observed that the fresh gas outlet was leading to the bidirectional flow (at front and rear outlet, [Table/Fig-2], at its median position, thus leading to inadequate ventilation or bag filling. A timely used AMBU bag avoided [5] the further difficulty in ventilation. For an open circuit, about 2-3 times of the minute ventilation flow rates or for a closed circuit, the existing low flow will maintain the normocarbia for any patient and may solve the problem temporarily with a certain degree of uncertainty.

The ASA 'closed claim analysis' review reveals that the contribution from anaesthesia equipment related events as 10%, though the major source of most common damaging events were of airway or respiratory ones (16%) [6]. However, the cause specific related to anaesthesia gas delivery equipment was seen only in 1% [6]. The source of patient injury was attributed to gas supplies, anaesthesia machines, ventilators or breathing circuits. Though the outcome would not vary with respect to individual patient, for quality improvement, the incident reporting [7] is the tool to be followed as done with us and many others. Cooper and colleagues developed strategies like training and supervision, specific protocol development, additional monitoring instrumentation and equipments, organisation improvement etc help in preventing critical incidents [8]. However, these strategies not always help in preventing above illustrations. Human error was the failure in vast majority of both injurious as well as non injurious critical incidents in previous reports as claimed, not so, conversely with us. David M Gabu and collegues believe that the work experience alone will neither guarantee good performance nor it immunes to the errors caused by systems, and crisis can occur in spite of best efforts [9]. Thus, one may need to approach the each case as if disaster is waiting to happen and with plan to prevent it. Lastly, the skills required for critical incident and crisis management [10] though can be learnt through multiple sessions of comprehensive anaesthesia simulator environment of challenging scenarios, hardly applicable to our incidents.

CONCLUSION

Though it appears as a 'simplistic approach' to claim that prior testing of anaesthesia apparatus cannot always prevent uninterrupted anaesthesia, the cases discussed illustrate that there are pitfalls everywhere and eternal vigilance and thinking on ones feet is definitely the price for safety. Since our hospital is NABH (National

Accreditation Board for Hospitals) accredited hospital, the pre-defined institutional policies with respect to the operative equipment's safety were strictly followed. A second deputy anaesthesia setup, such as a manual resuscitator or a spare anaesthesia machine is always helpful if one is unable to achieve a diagnosis or solve the event.

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