

Intraoperative Endotracheal Tube Cuff Deflation - Stitch in Time Saves Nine!

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An endotracheal tube is an integral part of general anaesthesia especially in long duration head and neck surgeries. Often, in such surgeries, the airway is shared by the surgeon and the anaesthetist. Any damage to the Endotracheal tube cuff may cause improper ventilation and airway contamination. We propose an algorithm through this case to prevent such complications and correct them if they happen.

Keywords: head and neck surgery, shared airway, onco-anaesthesia, endotracheal cuff deflation

Introduction

The endotracheal tube (ETT) is an integral component of general anaesthesia, especially in long-duration head and neck surgeries. Often, in such surgeries, the airway is shared by the surgeon and the anaesthetist. To avoid intraoperative interference, nasal-tracheal intubation is preferred over oral intubation in oral and maxillofacial surgeries. Also, the use of armoured or flexo-metallic tubes is not uncommon to prevent intraoperative tube kinking and compression and exertion of minimal intraoperative pressure on inter-arytenoid cartilages posteriorly and on trachea anteriorly.¹ The cuff of the endotracheal tube is a vital part and is designed to provide a seal to prevent the passage of air or fluids around the endotracheal tube, hence helping effective ventilation and preventing pulmonary aspiration.² Any disruption of this seal shall be deleterious for the patient and intraoperative anaesthetic management

We report a worrisome intraoperative surgical complication which requires a high index of

suspicion and consistent vigilance on part of the anaesthesiologist managing the patient.

Case Report

A 43-year-old male diagnosed with a left maxillary sinus neoplasm was scheduled for wide local excision, left maxillectomy with reconstruction of the defect with a free flap sourced from the anterolateral thigh. He is a chronic tobacco chewer without any systemic comorbidities, was investigated as per institutional preoperative surgical protocol, and was cleared for surgery under general anaesthesia.

On the day of the scheduled surgery, the patient was wheeled into the operating room and standard monitoring applied. Nasal blow test was performed preoperatively to assess nasal patency, which revealed less patent right nostril.

While normal institutional protocol dictated us to perform nasal intubation with a flexo metallic tube from the nostril opposite to the side of surgery, the clinical findings forced us to attempt nasal intubation from the ipsilateral nostril. Post intubation an oro-pharyngeal pack was placed to prevent accumulation and aspiration of blood and oral secretions. Surgery was commenced, and while the primary resection of the malignancy was underway, we detected inadequate tidal volume being delivered to the patient. Suspecting a leak in the circuit or some disconnection, whole breathing circuitry was analysed but the source of the leak could not be localized. A look at the pilot balloon revealed inadequate pressure in the ETT cuff (as

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measured by the cuff manometer). Additional air was injected into the cuff initially as boluses and later continuously through syringe pump and air-filled syringe, but to no avail. Upon reanalysing the ETT we realised that the leak was appearing only when the surgeon was manipulating the ETT in a certain position. A diagnosis of ETT inflation apparatus malfunction was made after ruling out any machine-related issues and checking the pilot balloon. Gum-elastic bougie-assisted ETT replacement was carried out after proper and continuous suctioning of the oral cavity, especially during the tube exchange process.

Checking the ETT inflation apparatus, after removing it confirmed our diagnosis of a defect within the cuff inflation system itself, however, we could not ascertain the modus and site of damage. Upon attempting to inflate the cuff with air while placing the whole tube in the water a small leak from the intra-tubal part of the inflation line of ETT was detected. (Figure 1).

Figure 1: Figure of ETT inflation apparatus with defect



Discussion

Sticking to the age-old teaching of checking the ETT cuff regularly throughout the surgery to rule out any deflation or excessive cuff pressure saved our day, one should be aware about the possibility of ETT being damaged by the

surgeon resulting in intra-operative leaks, especially in head and neck surgeries. However, a leak due to damage to flexo-metallic ETT at this particular site i.e., at the intratubal segment of the inflation line as experienced in our case is rare and less described.

Intra-operative cuff leak is a common problem in the Intensive care unit settings, but is a relatively less commonly encountered problem in the operating rooms. El-Orbany et al described the causes of endotracheal cuff leaks under two headings namely; leaks around an intact cuff and leaks due to a defective ETT cuff system. While the former included Underinflation: initial or delayed, cephalad migration of endotracheal tube (pharyngeal cuff malposition), Tracheal misplacement of nasogastric tubes, Wide discrepancy between the endotracheal tube and tracheal diameters, High peak airway pressure; the latter included conditions like Incompetent inflation valve, Punctured pilot balloon, Punctured inflation line, Defective intramural part of inflation line, Asymmetrical cuff and punctured or torn cuff.(Table 1)³

A review of literature regarding prevention and management of similar problems gave thoughtful insights into the problem. Upon damage to ETT Himarani et al negotiated the Fiber-optic Bronchoscope cable through the glottic opening with the old ETT *in situ* in order to change the damaged tube.⁴ Krishnakumar et al employed continuous cuff inflation with a syringe pump in order to maintain the airway seal to counter damaged ETT cuff apparatus.⁵ Valasareddy et al was the only author who employed an airway exchange catheter similar to ours to change a transected tube in a maxillary sinus neoplasm resection surgery.⁶ However, Valasareddy et al did not face a scenario that threatened contamination of the airway.

This experience led us to formulate and propose a set of protocols for preventing such occurrences (second category of causes of endotracheal cuff leaks as described by El-Orbany et al) and handling them should they occur. First set of protocols included ETT intubation and protection of the Endotracheal tube. In the case of nasotracheal intubation, we

suggest intubation through the contralateral nostril over the ipsilateral one. In the event of intubation via the ipsilateral nostril (in conditions like deviated nasal septum or nasal spur on the preferred side), the ETT should be rotated so as to place the take-off point of the pilot balloon away or towards opposite side from the surgeons' field while carefully avoiding any change in intratracheal cuff position. Along with these precautions, the habit of regularly checking

the cuff pressures intraoperatively will help prevent complications like accidental extubation and aspiration of blood and oropharyngeal secretions. Also, the surgeon should be informed preoperatively to be careful regarding the ETT and place a pharyngeal pack in all cases to minimize the chances of pulmonary aspiration and also to minimize intra-operative damage to ETT.

Table 1: Causes of intra-operative cuff deflation and recommended management

CAUSE OF DEFLATION	MANAGEMENT RECOMMENDED
Leaks around an intact cuff: Definitive management of the cause to be addressed	
<ul style="list-style-type: none"> • Low cuff pressure/ cuff underinflation • Cuff malposition • Ryles tube malpositioning in trachea • Smaller ETT for larger trachea 	<ul style="list-style-type: none"> • Regular checking of cuff pressure and inflating cuff with appropriate amount of air • Under vision either by direct or by video laryngoscopy and reposition the tube after proper oral suction and careful cuff deflation • Look at the pressure volume loops to assess leak before and after Nasogastric tube insertion • Auscultate for Ryles tube location/ confirm with Xray Chest • Withdraw and reposition ryles tube • Replace the smaller ETT with the appropriately sized ETT
Leaks due to defective cuff system: Change the endotracheal tube using tube exchanger/ bougie preferably under direct vision to avoid contamination	
<ul style="list-style-type: none"> • Defective inflation valve • Damaged pilot balloon • Damaged inflation line • Damaged intramural part of inflation line 	<p>Conservative management</p> <ul style="list-style-type: none"> • Apply air syringe connected to port • Use a 3-way connector • Continuous insufflation of air • Use of lidocaine jelly/ saline to insufflate defective cuff <p>Conservative management</p> <ul style="list-style-type: none"> • Intramural part of inflation line if damaged can be attempted to be repaired by a sterile sticking tape. • May use oropharyngeal pack to stem the leak • Use of lidocaine jelly/ saline to insufflate defective cuff

Another protocol involves tackling the airway in the middle of the occurrence of any intraoperative airway compromise, risking airway contamination and ventilation. These include ensuring the availability of a bougie or tube exchanger in all the operating rooms at all times and employing oropharyngeal packing with a ribbon gauze. Also, in such scenarios the surgeon should be informed immediately regarding the damage to the ETT and should be asked to clear the airway immediately and if possible, place a continuous suction to avoid pooling of secretions in the oral cavity. All tube replacements should be Video-laryngoscope assisted as far as possible. Fibre-optic intubations are likely to be difficult due to the shared field of activity with the surgeons, resulting in increased intubation time and putting the patient at risk of desaturation and pulmonary aspiration and hence may be avoided.

We hope the protocols proposed by us to prevent and handle a crisis like this will add depth to the existing knowledge and make our ever-vigilant readers even more vigilant and cautious regarding such a scenario.

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