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Automatic Endotracheal Cuff Pressure Monitor and Controlled Cuff Inflator: A Mechanical Device Which One Can Easily Make and Proved Effective

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Abbreviations: BMI: Body Mass Index; ETT: Endotracheal Tube; PBP: Pilot Balloon Palpation; LOR: Loss of Resistance; ACDF: Anterior Cervical Discectomy and Fusion

Introduction

High-volume low-pressure cuff endotracheal tubes (ETT) have potential complications [1-3] even they are the standard of airway protection. Under inflation increases the risk of air leakage and aspiration of gastric and oral pharyngeal secretions [4,5]. Cuff pressures less than 20 cmH2O have been shown to predispose to aspiration which is still a major cause of morbidity, mortality, length of stay, and cost of hospital care as revealed by the NAP4 UK study. In this cohort, aspiration had the second highest incidence of primary airway-related serious events [6].

On the other hand, over inflation may cause catastrophic complications. It has been demonstrated that, beyond 50 cmH2O, there is total obstruction to blood flow to the tracheal tissues especially mucosal. This has been shown to cause severe tracheal lesions and morbidity [7,8]. However, less serious complications like dysphagia, hoarseness, and sore throat are more prevalent [9-11]. There are a number of strategies that have been developed to decrease the risk of aspiration, but the most important of all is continuous control of cuff pressures. To achieve the optimal ETT cuff pressure of 20–30 cmH2O [3,8,12-14], ETT cuffs should be inflated with a cuff manometer [15,16]. Many anesthesia providers resort to subjective methods like pilot balloon palpation (PBP) which is ineffective [1,2,16-20]. Alternative, cheaper methods like the minimum leak test that require no special equipment have produced inconsistent results. A newer method, the passive release technique, although with limitations, has been shown to estimate cuff pressures better [21-24].

This method has been achieved with a modified epidural pulsator syringe [13,18], a 20ml disposable syringe, and more recently, a loss of resistance (LOR) syringe [21,23,24]. Compared with the cuff manometer, it would be cheaper to acquire and maintain a loss of resistance syringe especially in low-resource settings.

Post intubation sore throat and hoarseness of voices a common side effect of general anesthesia in spite of smooth a traumatic intubation [25-27]. This may partly result from ischemia of the oropharyngeal and tracheal mucosa due to over-inflation of the cuff. In general, in anesthesia practice ETT cuff pressure is assessed by palpation of cuff or cession of audible leak around the cuff is the end point for inflation.

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In order to maintain reliable sealing of the endotracheal cuff and tracheal lumen there has to be very frequent monitoring of the pressure, this is more so with nitrous oxide-based anesthesia. During the Anterior cervical spine decompression and fixation surgery, thyroid surgery there is retraction of trachea increasing cuff pressure as high as 60 CM of water pressure.

Current recommendations are to keep cuff pressure between 20 and 30 cmH_2O, using a manometer [28]. It is advisable to closely monitor cuff pressure monitoring and adjustment of cuff pressure during surgeries around the trachea like ACDF (41), thyroid surgery to avoid post-operative airway complication leading to endotracheal mucosal edema, ischemia of the tracheal mucosa-and airway compromised condition leading to life threatening complication and measures [29].

There is a simple and cheap device that can be easily arranged in any hospital-in intensive care where long term endotracheal intubation and ventilation are done. The following are the components of such device which can automatically controlled and effectively maintain the cuff pressure in an event that under inflation and over inflation are taken care [30].

1. Pressure manometer graduated in Cm of water- like ambu pressure cuff monitor
2. Continuous oxygen supply port-200 ml to 500ml /minute with regulator
3. A spring loaded pop off valve and regulator.
4. Plastic tubes and connectors with Lure lock end for secured connection.

An automatic continuous cuff inflator and pressure maintainer and components (Figure 1).
One four way multifold

1. For the connection to the endotracheal cuff pilot end.
2. For pressure gauge Cm of water.
3. For oxygen source with regulator.
4. For Pop off -spring loaded valve with regulator.

Figure 1: Above figure shows the automatic continuous cuff inflator and pressure maintainer and components.

Working mechanism

A continuous Oxygen supply-100 cc to 300 cc per minute is used to have continuous pressure supplier and inflator. The pop off valve with the regulator keeps the pressure in the system at the endotracheal cuff at a desired pressure level say pressure between 20-30 cm of water.

First connect the oxygen supply with the flow of 200ml/minutes. Next connect the endotracheal cuff pilot balloon then the pop off valve regulate the desired pressure say 22cm of water. For some patients who require higher pressure say 28 cm of water is regulated by adjusting the pressure with the pop off valve. (This device has been tested effective with patient with BMI 20 to 47)

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