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Can we regulate endotracheal tube cuff pressure using an anaesthetic machine?

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To the Editor,

Endotracheal tube obstruction caused by cuff hyperinflation can be a dangerous but preventable complication of airway management [1]. Some authors suggest that a trial focusing on cuff deflation should be considered in algorithms for the management of patients with ventilation difficulty. Although this would be a good strategy, we think that preventive measures, such as the regulation of the endotracheal tube (ETT) cuff pressure, warrant further discussion and should be propagated to a greater degree. It is known that the measurement of ETT cuff pressure has shown to be useful in the prevention of postoperative pain, hoarseness, the aspiration of secretions, subglottic stenosis and tracheal fistulas [2, 3]. However, the routine measurement of cuff pressure is usually difficult given the low availability of the equipment designed for this purpose, the cost of acquisition, the lack of maintenance-calibration and the risk of cross-infection through its use in multiple patients [4].

Recently, we invented a device for the inflation of the ETT cuff, called DUITOM®, which creates a connection between a pilot cuff and the manometer of an anaesthetic machine, in order to inflate the cuff at a precise oxygen pressure provided by the anaesthetic machine pressure

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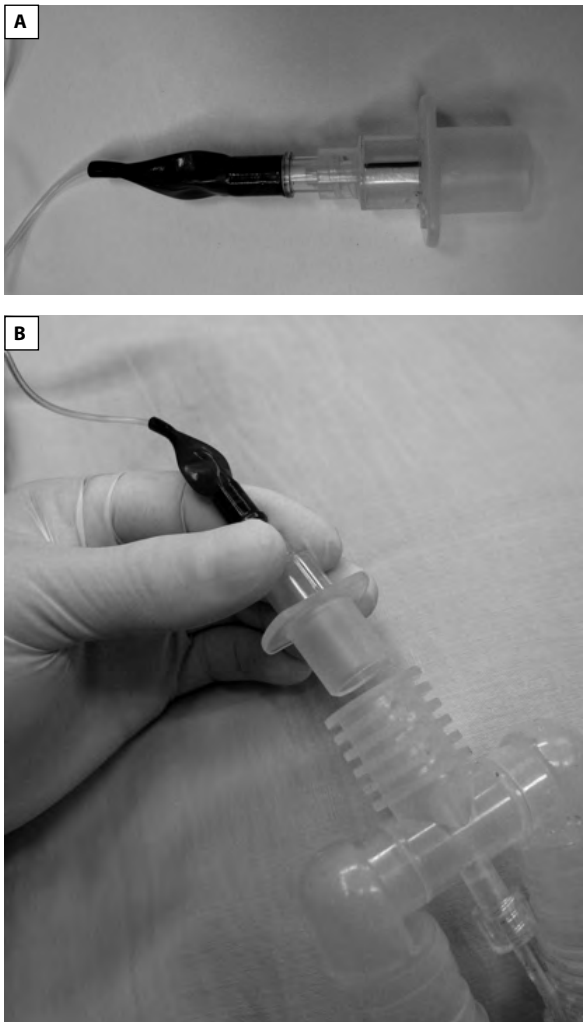

Figure 1. Illustration of the connection between: (**A**) the pilot cuff and the DUITOM, and (**B**) the DUITOM with the breathing system

gauge. This is an easy way to inflate the cuff through the breathing system of the anaesthetic machine, following the basic steps of connecting the DUITOM® to the pilot cuff (Fig. 1A), then connecting it to the breathing circuit (Fig. 1B) and regulating the oxygen pressure through the anaesthetic machine pressure gauge.

A cross-sectional study was carried out with the aim of validating our new instrument compared with the gold standard (Possey Cufflator®) in the measurement of ETT cuff pressure. The following are the steps of the procedure: (1) connect a 3-way stopcock at the end of the pilot cuff, one of which is connected to the DUITOM and the other to the Possey Cufflator®; (2) connect the device to the pilot cuff, as well as to the breathing system of the anaesthetic machine; (3) inflate the cuff according to the anaesthetic machine pressure gauge; (4) open the 3-way stopcock to the Possey Cufflator® to measure the real cuff pressure. Three different cuff pressures within each of the following ranges, 20–30, 31–40 and 41–50 cm of water, were measured in each patient. Patients with anticipated difficult intubation, risk for aspiration, known anatomical laryngotracheal abnormalities, and emergency cases were excluded. The trachea was intubated with a size 8.0 or 8.5 mm and 7.0 or 7.5 mm ETT in male and female patients, respectively. The ETT cuff was inflated with air by an anaesthesiologist using the DUITOM®, while another independent blinded anaesthesiologist measured the cuff pressure using the gold standard manometer. Put in parenthesis (Possey Cufflator manometer). A total of 99 independent measurements were taken from a population of 33 adult patients, ASA I–II, having a mean age of 43.6 ± 16.4 years, a body mass index of 23.7 kg m^{-2}, 58% of whom were males. A Bland & Altman analysis showed that the precision of the DUITOM® was — 0.5 ± 2.1 while Lin's correlation coefficient was 99.6% (Fig. 2).

General recommendations on the ideal ETT cuff pressure vary between 20 and 30 cm H_2O in adults. Lomholt *et al.* [5] recommends a minimum pressure of 25 cm H_2O in order to prevent leaks and avoid aspirations. Seegobin *et al.* [3] shows that the blood flow of the trachea starts to decrease when the cuff pressure is greater than 30 cm H_2O, leading to postoperative complications from the most common, such as hoarseness or throat pain, to the most dangerous, such as necrosis, rupture, stenosis and tracheal fistula.[3]

Endotracheal intubation, as with all medical interventions, has undesirable side effects. The complications of ETT cuff hyperinflation can be potentially deleterious as shown by Zenga *et al.* [1]. Some of these side effects result from inadequate control of the pressure generated of the endotracheal tube (ETT) cuff on the walls of the trachea. Our invention may provide more precise regulation of cuff pressure allowing for safer anaesthesia with lower rates of intraoperative and postoperative complications.

It is noteworthy to state the limitations of this validation study. Firstly, although there could be leakage of air while changing the connection of the DUITOM® to the Possey Cufflator® manometer, we avoided this by using rigid extensions and using a 3-way stopcock. Secondly, while the sample size is very small, we collected three cuff pressures per patient in different ranges of pressure, thereby increasing the validity of our findings. Thirdly, we did not include paediatric patients in whom we consider this invention would have the greatest impact. In summary, the DUITOM® is a disposable and economical instrument that allows for the inflation and measurement of the ETT cuff pressure with sufficient precision.

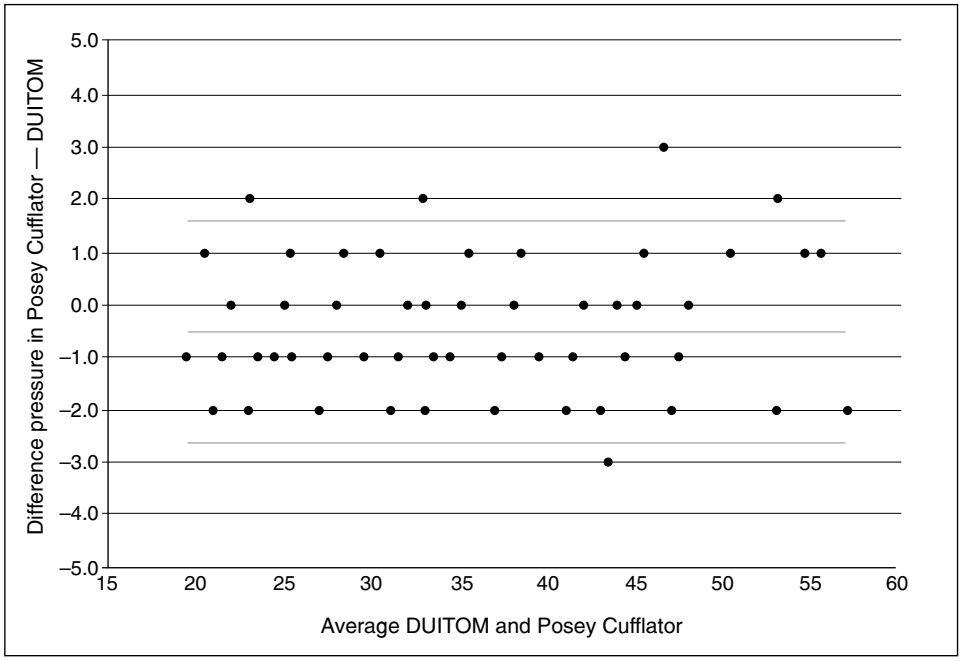

Figure 2. Bland-Altman graph comparing the Posey Cufflator and DUITOM

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