

## Migration of polyurethane high-volume low-pressure cuffed endotracheal tubes after neck flexion and extension

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To the Editor:

In 2007 our hospital converted from standard polyvinyl high-pressure low-volume (HPLV) cuffed endotracheal tubes (ETT) to high-volume low-pressure (HVLP) polyurethane cuffed ETTs. HVLP ETTs feature cuffs that are longer, made of thinner material (10  $\mu\text{m}$ ), and inflate to a lower pressure, compared to traditional polyvinyl cuffed ETTs (Fig. 1) [1]. We have noticed the material of the HVLP polyurethane cuffs allows tube stem migration of

0.5 cm in either direction (up and down) while the cuff stays in place.

The migration of ETTs towards the carina with neck flexion and away from the carina with neck extension has been documented only with HPLV ETTs [2–5]. The thinner material of HVLP cuffs may allow significant tracheal migration; we therefore conducted a prospective, IRB approved study to observe the mobility of these ETTs from their fixed position following flexion and extension of the neck.

One hundred patients (50 males, 50 females) undergoing elective surgery, requiring routine intubation and general anesthesia, signed a written informed consent to participate in the study. All patients' tracheas were initially intubated to a depth of 21 or 23 cm for women and men, respectively. A single anesthesiologist utilized a fiberoptic bronchoscope (Olympus LF-GP, Center Valley, PA, USA) and a standard metric ruler in centimeters to determine the actual tip to carina distances following intubation. The ETTs were then secured and held in place at the incisors by a second anesthesiologist. Following both flexion and extension of the neck, any ETT tip migration observed (fiber-optic evaluation) was recorded in centimeters by research personnel.

Data are expressed as mean  $\pm$  SD and (range) where appropriate. The Wilcoxon signed ranks test was used to calculate the displacements of the ETT. A *P* value of  $\leq 0.05$  was considered statistically significant.

Flexion resulted in movement of the ETT tip inward (towards the carina) in 78 % of patients and extension moved the tip outward (away from the carina) in 81 % of patients. The average migratory distance (cm) of the ETT tip was  $1.2 \pm 1.0$  (0–3.5) away from the carina following extension and  $1.4 \pm 1.4$  (0–5) towards the carina after flexion ( $P < 0.001$  for flexion and extension).

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**Fig. 1** Comparison of cuff dimensions of a high-volume low-pressure ETT (*bottom*) and a high-pressure low-volume ETT (*top*). Both ETTs are size 7. The ruler is in centimeters

Following neck extension we found that some ETT tips migrated beyond 8 cm from the carina. The average measured distance from the carina to the vocal cords was found to be 11.2 cm, similar to other findings [5]. Figure 1 depicts that the proximal end of the HVLP cuff is approximately 6 cm away from the ETT tip and the cuff size is approximately 4 cm in length (in a size 7 ETT). These values suggest an increased risk for vocal cord

impingement should ETTs migrate away from the carina following neck extension.

Our migration values were similar to the results of other studies utilizing HPLV ETTs, however, significant differences in HVLP cuff dimensions may result in more hazardous outcomes if migration occurs with patient movement. Further studies comparing the two ETTs should be carried out to confirm our findings.

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