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SHORT SCIENTIFIC REPORT

Assessment of the paratracheal force required to occlude the oesophagus: is there a sex difference?

A short scientific report

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Editor,

Gastric regurgitation during general anaesthesia induction is rare but can be life-threatening. The Sellick manoeuvre, involving pressure on the cricoid cartilage, has long been used to prevent aspiration. However, its efficacy is debated due to anatomical variations in the oesophagus position relative to the cricoid, rendering the manoeuvre inefficient to occlude it.[1,2] A newer method, the left paratracheal pressure (LPP) method, consists of applying pressure lateral to the left border of the trachea, a few centimetres above the clavicle, to occlude the oesophagus.[3]

We prospectively explored the force needed for effective oesophageal occlusion with LPP, as well as potential sex differences, because understanding the factors influencing LPP could have clinical implications. Indeed, tracheal size in women is smaller than in men.[4,5] We hypothesised that this difference may also be present in the oesophagus and thus affect the required LPP pressure.

Adult patients (18 to 80 years old) scheduled for general anaesthesia with tracheal intubation for all surgery types were included (see Supplementary Material for exclusion and inclusion criteria, http://links.lww.com/EJA/B118). Patients did not receive premedication before surgery. Excluding those with a high aspiration risk or oropharyngeal abnormalities, 110 scheduled adults were recruited by several anaesthesiologists. LPP was applied immediately after general anaesthesia induction. The position of the oesophagus relative to the trachea was first assessed using videolaryngoscopy to obtain optimal visualisation. The force required during LPP to occlude the oesophagus was then measured using a dynamometer by the first author (BJ), the most experienced investigator. Force was applied, starting at 10 N and adjusted by 2 N steps using an 'up-down' method from one patient to the other (Fig. 1). The dynamometer was directly applied on the skin to perform the LPP. Success was defined as the inability to insert under videolaryngoscopy guidance a 16 Fr gastric suction tube through the entire oesophagus during pressure application. Airways were secured after probe insertion.

The study protocol was approved by the Ethics Committee of the Liege University Hospital on 13 April 2022 (reference: 2022/112) and was registered at ClinicalTrials (NCT05214079) before patient enrolment. All participants provided written informed consent. This trial was conducted in accordance with the 1975 Helsinki Declaration and its amendments. Data of 100 patients (50 women and 50 men) were available for analysis. Ten patients were excluded after noticing an oesophageal location on the right side of the neck during videolaryngoscopy. The effective force for occluding the oesophagus in 50 or 95% of subject (50 or 95% effective LPP force) and its 95% confidence interval (CI) was determined using probit regression. For women, the 50% effective LPP force was 24.11 (95% CI, 16.41 to 31.81) N and the 95% effective force was 59.52 (95% CI, 46.31 to 72.74) N. For men, the 50% effective force was 21.30 (95% CI, 15.62 to 26.99) N and the 95% effective force was 47.34 (95% CI, 39.24 to 55.44) N (Fig. 2).

This study indicates that the 50% effective force required to occlude the oesophagus during LPP is lower than for the Sellick manoeuvre, with no significant sex difference.

These findings align with previous studies, although with slight differences. For example, Gautier *et al.* demonstrated that LPP occludes the oesophagus at a force of 30 N, which is close to but higher than our finding.[3] This might be because of the use of a larger suction tube in our study than in the one used by Gautier to assess oesophageal occlusion. Kim *et al.*[6] determined that the force required to occlude the oesophagus with LPP in 50% of subjects was 18.4 N, slightly lower than our findings, which was also the case for 95% LPP force in women in our study. These differences are likely because of the size of the oesophageal stethoscope used in their study, which is larger than the suction tube we used. Women may have greater inter-individual variability regarding soft tissue composition, which will affect pressure transmission and possibly explaining both the higher force required to achieve effective oesophageal occlusion and the wider CIs. Although such applied forces (e.g. 59.5 N) may lead

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Fig. 1 Schematic representation of the study protocol.

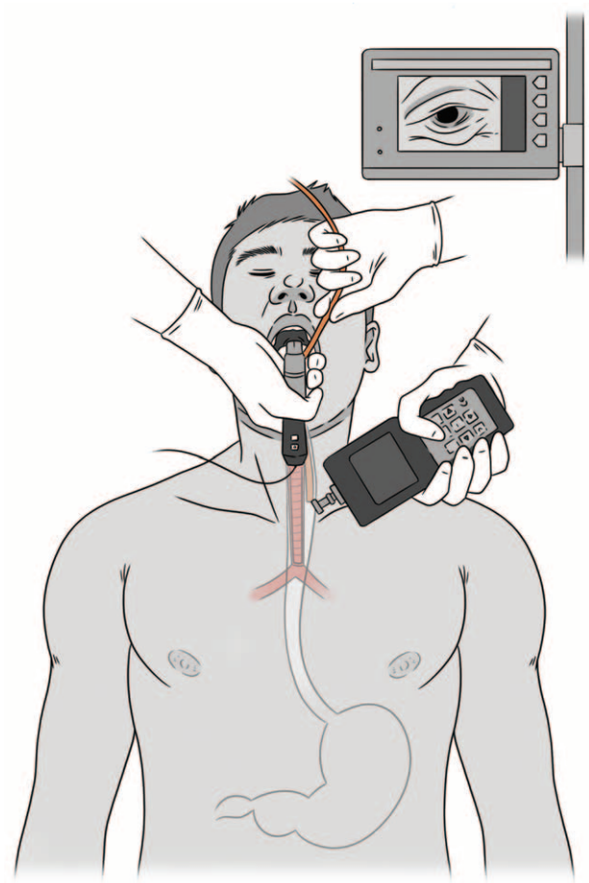
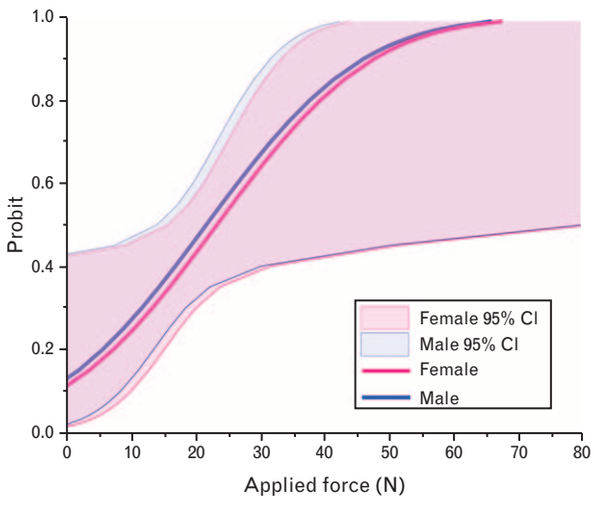


Fig. 2 Relationship between the left paratracheal pressure force and the probability of oesophageal occlusion success as determined by probit regression. Hatched areas correspond to the 95% confidence interval (95% CI) of the curve. N, Newton.



to vascular compression or reduce blood flow, no adverse events occurred, and a previous study in healthy volunteers provided reassuring results regarding this topic.[7] Another explanation, and study limitation, could be that three different anaesthesiologists positioned the suction device and may have applied a different force to insert the device, creating a bias.

The 10% of patients with a right-sided proximal oesophagus we observed, although slightly higher, was in line with studies by Kim *et al.*,[6] reporting this condition in patient subsets: 6.4 and 2.6%. This may be due to methodological differences such as the use of ultrasound vs. video-laryngoscopy to identify the proximal oesophagus. Moreover, our relatively small sample size may have resulted in an apparently higher prevalence due to variability.

Our study is strengthened by its prospective design and the use of a dynamometer to precisely measure the applied force. However, several limitations must be considered. Firstly, the variability in the application of a force through a mechanical device like the dynamometer may differ from the one of traditional thumb compression, potentially leading to overestimation or underestimation of the required force. Secondly, although the same operator performed the LPP to ensure consistency, individuals ($n = 3$) performing the insertion of the gastric suction tube differed, which could bias the assessment of the manoeuvre success or failure. Thirdly, our results indicate the force needed to occlude the oesophagus, not the force required to prevent gastric fluid regurgitation. Studying this in living patients would be challenging because of the risk of gastric fluid aspiration. Fourthly, we used video-laryngoscopy to verify the position of the oesophagus, which may not be as accurate as ultrasound. Future studies should incorporate ultrasound for better assessment, even more as it is important to consider the entire course of the oesophagus when evaluating its position. The proximal position of the oesophagus as assessed by video-laryngoscopy does not necessarily predict its path along its entire course, and variability in its path underscores the ability of determining the optimal approach for oesophageal occlusion. Future research should also focus on the risk of thrombus formation within the carotid artery due to LPP application.[7] Lastly, our study does not assess LPP safety in the case of gastric regurgitation against a closed oesophagus, nor its superiority compared with cricoid pressure.

In conclusion, LPP could be a viable alternative to the Sellick manoeuvre for preventing aspiration during anaesthesia induction. However, further studies are needed to confirm this hypothesis and establish LPP as a standard clinical practice, especially for high-risk patients.

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References

1 Salem MR, Khorasani A, Zeidan A, Crystal GJ. Cricoid pressure controversies: narrative review. *Anesthesiology* 2017; **126**:738–752.

2 Smith KJ, Dobranowski J, Yip G, *et al.* Cricoid pressure displaces the esophagus: an observational study using magnetic resonance imaging. *Anesthesiology* 2003; **99**:60–64.

3 Won D, Kim H, Chang JE, *et al.* Effect of paratracheal pressure on the glottic view during direct laryngoscopy: a randomized double-blind noninferiority trial. *Anesth Analg* 2021; **133**:491–499.

4 Mann LM, Angus SA, Doherty CJ, *et al.* Evaluation of sex-based differences in airway size and the physiological implications. *Eur J Appl Physiol* 2021; **121**:2957–2966.

5 Zeidan AM, Salem MR, Bamadhaj M, *et al.* The cricoid force necessary to occlude the esophageal entrance: is there a gender difference? *Anesth Analg* 2017; **124**:1168–1173.

6 Kim H, Mondal S, Choi CG, *et al.* Assessment of the 50% and 95% effective paratracheal forces for occluding the esophagus in anesthetized patients. *J Clin Monit Comput* 2021; **36**: 335–340.

7 Javillier B, Grandjean F, Ounas K, *et al.* Effect of left paratracheal pressure on left carotid blood flow. *Acta Anaesthesiol Scand* 2024; **68**:51–55.