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A cross-over study of continuous tracheal cuff pressure monitoring in critically-ill children

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Dear Editor,

Recent guidelines have recommended the use of cuffed endotracheal tubes (C-ETT) in children after the neonatal period, with a rigorous monitoring of cuff pressure (CuffPress) that should not exceed 25 cmH₂O [1]. CuffPress can be adjusted manually [2] or using cuff pressure regulators (PR), as reported in an adult intensive care unit (ICU) [3]. Extreme values of CuffPress are a risk for tracheal ischaemic lesions and/or inhalation pneumonia [4]. Our objective was to assess variability in CuffPress when using a PR in Paediatric ICU (PICU).

This study was conducted in the PICU of Robert-Debre Hospital, Paris. Patients eligible were C-ETT ventilated, non-paralysed children weighing less than 15 kg, with a predicted duration of ventilation longer than 48 h. Patients were admitted consecutively. This cross-over study was approved by the Ethics Committee of the French Intensive Care Society. Written consent was obtained from both parents before inclusion.

During the 24-h inclusion period, patients were assigned alternatively

to 12-h periods with conventional nursing (PR-) or with a mechanical PR (Nosten, Leved, France) (PR+) before cross-over. The cuff was initially deflated and reinflated manually by a paediatric intensivist to the lowest CuffPress required to suppress audible air leaks (Initial CuffPress). During PR- and PR+, CuffPress was checked manually every 3 h by a nurse using a manometer and readjusted to the initial value when necessary. CuffPress was recorded continuously (10 Hz) using a calibrated pressure sensor (DV100A Niche Sensor, France). CuffPress variations were characterised by: (1) the relative standard deviation (RSD = 100 × standard deviation/mean) and (2) the percentage of time spent outside of the initial CuffPress ± 2 cmH₂O range. PR- and PR+ variables were reported as medians (IQR) and compared using a Wilcoxon–Mann–Whitney test (R, www.r-project.org).

Thirty children were included; five were excluded due to technical problems during data acquisition. In the remaining 25 children, age was 172 days (84–627) and weight was 5.6 kg (3.9–10.4). The C-ETTs diameter ranged between 3.0 and

4.5 mm. The PICU staff did not report any difficulty using the PR.

The Initial CuffPress was 12.1 cmH₂O (10.8–13.3) in PR- and 13.0 cmH₂O (11.5–14.2) in PR+ ($p = 0.08$). The CuffPress during the entire period of monitoring was 11.6 cmH₂O (9.5–13.9), similar to the 10.6 cmH₂O value reported in children before surgery [5]. CuffPress exceeded 25 cmH₂O only during short periods of time, accounting for 0 % (0–0.02) of time in PR- and 0 % (0–0) in PR+. The use of a PR significantly reduced RSD ($p < 0.0001$; Fig. 1). The percentage of time spent out of range was reduced from 48 % (29.8–67.0) in PR- to 0 % (0–0) in PR+ ($p < 0.0001$).

The main expected advantage of the use of a PR is potentially to prevent weaning failures by reducing the incidence of airway mucosal necrosis and ventilator-acquired pneumonia. These adverse effects could be caused by over- and under-inflation, respectively, and may be exacerbated in PICU. Furthermore, the use of PR may alleviate nursing staff workload and prevent pressure drops caused by manual monitoring of CuffPress [3]. Further investigation is now required in PICU to test the possible benefit of CuffPress regulation.

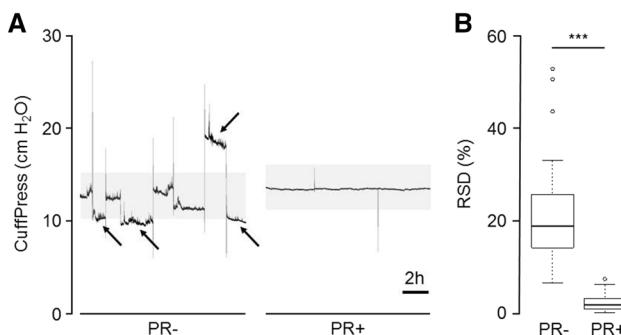


Fig. 1 **a** A representative cuff pressure (CuffPress) individual tracing in a 16-month-old infant (12.2 kg) ventilated with a 4-mm-diameter cuffed endotracheal tube. On the left-hand trace (PR-), CuffPress is influenced by the periodical adjustment by the nurse with a manometer and subsequently by spontaneous ventilation and cough. On the right-hand trace (PR+), these variations were eliminated by the pressure regulator. Shaded areas define initial CuffPress ± 2 cmH₂O range. Note the presence of out-of-range periods in PR- (arrows). **b** CuffPress relative standard deviation (RSD) in 25 children during two consecutive 12 h periods of mechanical ventilation with (PR+) and without (PR-) cuff pressure regulator. *** $p < 0.0001$

Compliance with ethical standards

Conflicts of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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