Endotracheal tube cuff pressures in intensive care – time for renewed attention

Endotracheal intubation is among the most frequently performed interventions in critical care, yet accurate and regular monitoring of endotracheal tube cuff pressure, a fundamental component of airway safety, remains inconsistently applied across intensive care units (ICUs). The consequences of inappropriate cuff pressures are well established. Sustained overinflation compromises tracheal mucosal perfusion, leading to ischaemia, ulceration, post-extubation stridor, dysphonia, and, with prolonged exposure, tracheal stenosis or rupture. Underinflation increases the risk of microaspiration, inadequate ventilation, and ventilator-associated pneumonia. Although largely preventable, these complications remain unacceptably common. Reported rates of airway morbidity after intubation range from 15% to 94%, with early airway complications occurring in up to 62% of patients and tracheal stenosis in ~19% of survivors after prolonged intubation.[1,2]

In this issue of *AJTCCM*, Cretikos *et al.*[3] provide a timely reminder that dangerously abnormal cuff pressures may be the norm rather than the exception. In a prospective evaluation of 300 cuff pressure measurements across four ICU settings (trauma, neurosurgical, and two multidisciplinary ICUs) at a tertiary hospital in South Africa (SA), >90% of measurements exceeded the recommended safe range of 20 - 30 cm H_2O. Cuff pressures differed substantially across ICUs, with the highest median values observed in the trauma ICU (~82 cm H_2O), followed by the neurosurgical (~58 cm H_2O) and multidisciplinary ICUs (~38 cm H_2O). Compliance was notably low: fewer than 5% of trauma and neurosurgical patients and only 22% in the best-performing ICU had pressures within range. Underinflation was strikingly rare, with only a single patient recording a mean cuff pressure below target. This pattern suggests a broader prevailing practice that prioritises air leak prevention over mucosal protection, despite compelling evidence that tracheal capillary perfusion is compromised at pressures exceeding recommended thresholds. Likewise, the continued reliance on pilot balloon palpation, regardless of clear evidence demonstrating its inaccuracy, compounds this problem. In high-acuity environments, audible air leaks prompt rapid correction, whereas cuff-related tracheal injury is silent and often manifests weeks or months after ICU discharge. Without deliberate, objective monitoring, unsafe practices are readily perpetuated.

Crucially, cuff pressures showed no correlation with peak or mean airway pressures, confirming that excessive inflation reflects behavioural and systemic factors rather than ventilatory mechanics. While contributory factors such as staffing, equipment availability and local protocols were not explored in the study, this does not diminish the significance of the findings. This is not a problem of physiology; it is a problem of practice.

The findings of Cretikos *et al.* are consistent with international data, highlighting a systemic failure rather than an isolated institutional issue. In a prospective study at an SA academic hospital, only 25% of 205 patients had cuff pressures within the recommended range, while nearly half (49%) exceeded 40 cm H_2O.[2] Similarly, in a European ICU, 73% of patients experienced elevated cuff pressures at some point during the study period, 54% had episodes of underinflation, and 44% had both, within an 8-hour period.[4] Poor scientific knowledge and limited training among nursing staff, the primary custodians of cuff management, remain critical determinants, with baseline knowledge repeatedly described as 'poor to moderate'.[5] High workload, staffing constraints, inconsistent access to functioning manometers, and the absence of cuff pressure monitoring as a defined nursing or ventilator care standard further entrench this gap.

Despite the importance of cuff management to airway safety, there remains a paucity of regional, national or international guidance defining optimal targets. In the absence of protocolised approaches, cuff pressure management is often left to individual discretion, allowing unsafe norms to persist, even in academic ICUs. Nearly four decades have passed since Seegobin and Van Hasselt[6] demonstrated that cuff pressures exceeding 30 cm H_2O may compromise tracheal mucosal blood flow, yet reported 'safe' thresholds vary widely from 19 to 40 cm H_2O.[7] This uncertainty may reflect the reliance on older animal data, evolving endotracheal tube cuff design, and limited clinical studies reflecting current ICU practice. Adding to this uncertainty, while thrice-daily measurements have been proposed as a minimum to balance patient safety and workload, others advocate more frequent assessment. Eight-hourly checks may fail to detect clinically relevant fluctuations associated with repositioning, suctioning, or changes in ventilatory support, as demonstrated by Memela and Gopalan.[8] In that study, continuous monitoring of the same patients revealed that they were outside the target range for significant portions of the day (underinflated in 37% of patients and overinflated in 77%). Finally, although continuous monitoring may offer superior pressure control and potentially reduce ventilator-associated pneumonia,[9] its cost, logistical complexity, and variable device performance place it beyond the reach of many units. Robust, up-to-date studies are therefore urgently needed to inform credible, evidence-based guidelines.

There is little doubt that routine endotracheal tube cuff pressure monitoring represents a powerful and underused opportunity for improvement. This low-cost, high-impact intervention is feasible and scalable, requiring little more than a reusable manometer and a clear protocol mandating regular measurement. Integration into routine nursing observations or ventilator care bundles and explicit framing as a patient safety intervention analogous to pressure injury prevention or infection control practices are readily achievable. Crucially, structured education substantially improves practice. Sole *et al.*[10] reduced out-of-range cuff pressures from 51.7% to 11.1% through a targeted, structured educational intervention, with pressures remaining within the recommended range nearly twice as often. Similarly, multicentre data demonstrate superior knowledge and performance among nurses exposed to evidence-based education.[11] Education and competency-based training therefore represent essential, modifiable drivers for sustainable quality improvement.

In resource-limited settings, the downstream consequences of preventable airway injury are particularly far-reaching. Tracheal stenosis frequently necessitates specialised diagnostic and interventional services, including bronchoscopy or surgery, which

are costly, scarce, and inequitably distributed in many low- and middle-income countries. For patients, this translates into prolonged morbidity, recurrent hospitalisations, and impaired quality of life. For overstretched health systems, it increases length of stay, reliance on specialised services, and downstream costs. Preventing avoidable morbidity is therefore not only pragmatic, but an ethical imperative.

Endotracheal intubation does not end with tube placement; safe airway management requires ongoing vigilance. Inadequate cuff pressure monitoring contributes to avoidable harm and unnecessary healthcare expenditure, with disproportionate impact in resource-constrained settings. In an era that demands increasing precision in organ support, neglect of such a basic, inexpensive intervention is difficult to justify. Routine cuff pressure monitoring is an evidence-based practice that should be embedded into standard care. When preventable harm persists despite a simple, low-cost solution, inaction is no longer defensible.

Usha Lalla, FCP (SA), Cert Crit Care (SA) Phys, Cert Pulmonology (SA)

Division of Pulmonology, Department of Medicine, Faculty of Medicine and Health Sciences, Stellenbosch University and Tygerberg Hospital, Cape Town, South Africa
usha@sun.ac.za

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