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ESTUDIOS

Effectiveness of the use of subjective techniques to achieve safe cuff pressures in artificial airway devices: a systematic review

Felipe Rosales Lillo
Contacto principal. Centro de Estudios e Investigaciones en Salud y Sociedad, Facultad de Ciencias Médicas, Universidad Bernardo O'Higgins. Chile

Giovanna Monichi Valdenegro
Facultad de Medicina. Clínica Alemana-Universidad del Desarrollo. Chile

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Abstract: In patients with artificial airways, adequate airway sealing is crucial, achieved by managing cuff pressures. Subjective techniques lack measurable values and remain controversial. While objective methods are ideal, resource-limited settings often rely on subjective techniques, which could impact patient safety. This study aims to describe the effectiveness of subjective techniques in achieving safe cuff pressures in artificial airway devices. A systematic review with a qualitative approach was performed, including published evidence between 2024 and 2015 in PubMed, Web of Science and SciELO databases. The keywords 'Techniques', 'Cuff', 'Intubation', 'Pressure' and 'Tracheostomy' were included. Of 3,185 reviewed documents, 14 articles were selected for final analysis. PRISMA guideline was used for the report. Subjective techniques namely by digital palpation, minimal leak, predetermined volume, loss of resistance syringe and the minimal occlusive volume were studied. The evidence shows that these techniques reach a correct cuff pressure range between 4.40% and 76.46% of total cases. The digital palpation technique shows the worst success rate (4.40% to 27.27%). Furthermore, these methods result in both underinflation (2.00% and 26.30%) and overinflation (15.52% and 93.75%), with a stronger tendency towards the latter. In conclusion, subjective techniques are unreliable as they achieve unsafe cuff pressure range, which could be harmful during patient care. It is recommended that hospitals review and update their protocols by investing in and exclusively using manometers to ensure patients' safety. For countries and healthcare settings with limited access, low-cost, safe, and validated alternatives to manometers are urgently needed, instead of continuing the use of traditional subjective methods.
Keywords: Airway Management; Intubation; Intratracheal; Quality Assurance in Health Care; Tracheostomy.

ESP Efectividad del uso de técnicas subjetivas para lograr presiones seguras del cuff en dispositivos de vía aérea artificial: una revisión sistemática

Resumen: En pacientes con vía aérea artificial, el cierre hermético depende del manejo de las presiones del cuff. Aunque las técnicas subjetivas carecen de valores medibles, suelen usarse en entornos con recursos limitados, comprometiendo la seguridad del paciente. Este estudio tiene como objetivo describir la efectividad de las técnicas subjetivas para alcanzar presiones seguras del cuff en dispositivos de vía aérea artificial. Se realizó una revisión sistemática cualitativa, incluyendo evidencia entre 2015 y 2024 en PubMed, Web of Science y SciELO. Se incluyeron las palabras clave: "Técnicas", "Balón", "Intubación", "Presión" y "Tracheostomía". De 3.185 documentos revisados, 14 estudios fueron seleccionados para análisis final. Se utilizó la guía PRISMA. Las técnicas de palpación digital, fuga mínima, volumen predeterminado, pérdida de resistencia de la jeringa y volumen oclusivo mínimo fueron estudiadas, logrando un rango correcto de presión del cuff entre el 4,40% y 76,46% de los casos. La técnica de palpación digital presenta la peor tasa de éxito (4,40% a 27,27%). Estos métodos resultan tanto en subinsuflado (2,00% y 26,30%) como en sobreinsuflado (15,52% y 93,75%), con mayor tendencia a esta última. En conclusión, las técnicas subjetivas son poco fiables, al lograr presiones poco seguras, que pueden ser dañinas durante la atención de pacientes. Se sugiere fomentar la revisión de protocolos en los hospitales, invirtiendo y utilizando exclusivamente cuffómetros para garantizar la seguridad del paciente. Para países con acceso limitado, se requiere urgentemente alternativas a los cuffómetros que sean de bajo costo, seguras y validadas, en vez de continuar utilizando técnicas subjetivas tradicionales.
Palabras clave: Garantía de la Calidad de Atención de Salud; Intubación Intratraqueal; Manejo de la Vía Aérea; Traqueostomía.

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Introduction

Intensive care medicine plays a critical role in the management of critically ill patients. The rising global demand presents challenges for healthcare teams, who must ensure survival and minimise the impact of intensive-care-unit (ICU) stays, optimising patient outcomes and reducing complications (Bench et al., 2024; Chacko et al., 2023; Kellum et al., 2024; Leach, 2023; Romero et al., 2021). In the care of patients who require an artificial airway (AA), it is essential to ensure an adequate airway sealing. This can be achieved by managing the cuff pressures (CP) in endotracheal tubes and tracheostomy cannulas, maintaining optimal pressure levels (Ignatavicius et al., 2018; Mosier et al., 2024; Wright, 2023). Proper cuff management in AA devices is crucial in clinical care, requiring a multidisciplinary approach involving medical, nursing, physiotherapy, and speech therapy teams. The Intensive Care Society in the United Kingdom (2020) emphasises that the team should be knowledgeable about routine cuff care, with deflation timing decided collectively. Whitmore et al. (2020) highlight the benefits of this collaboration in reducing oral intake time, cannula changes, decannulation, hospital stays, and complication rates.

Several techniques are available for the sealing of the airway. Objective techniques involve the measurement of CP, using reference values to guide control. These values are expressed in two units: centimetres of water (cmH_2O) and millimetres of mercury (mmHg). Reports and studies indicate that the CP range should be between 20 and 30 cmH_2O (Brench et al., 2024; Chintamani et al., 2024; Gulanick & Myers, 2021; Harding et al., 2022; Heuer & Stoller, 2024; Menzies Kent, 2021; Kaeley & Sharma, 2024). Applying pressures below recommended values increases the risk of leakage into the lower airway tract, hence, the risk of aspiration pneumonia, while pressures above optimal levels raise the risk of tracheal injury such as mucosal ischemia, necrosis, tracheal stenosis and tracheoesophageal fistula (American Association of Critical-Care Nurses, 2023; Ignatavicius et al., 2018). Subjective techniques, namely by minimal occlusive volume, minimal leak, predetermined volume, loss of resistance syringe and digital palpation, do not provide measurable values, as they do not involve direct CP measurements. Minimal occlusive volume seals the airway with the least cuff inflation; minimal leak allows a small leak at peak inspiration; predetermined volume uses a fixed volume of air; loss-of-resistance syringe detects pressure loss while inflating; and digital palpation estimates pressure by feel of the pilot balloon. Some authors suggest that these techniques are partially effective, as they are exclusively operator-dependent (Félix-Ruiz et al., 2014)

Previous studies on healthcare professionals regarding CP management in adults with AA are unpromising. In Australia, 4% of ICUs monitor CPs using subjective techniques, and nearly 52% of institutions lacks institutional guidelines or protocols for patient management (Talekar et al., 2014). In Chile, 7% of healthcare professionals exclusively use some type of subjective technique (Rosales et al., 2021). A review of protocols for AA management in hospitals in Chile reported that nearly 23% did not specify the use of either objective or subjective techniques during patient management, leaving the procedures followed by healthcare professionals unclear (Rosales et al., 2023). In Nigeria, cuff pressure manometers (CPM) are not permanently available and/or used in hospitals. The most commonly used techniques are digital palpation and predetermined volume, at 64.3% and 28.1%, respectively (Nwosu et al., 2022). In Uganda, despite recognising that the CPM is the optimal method for controlling CP, its unavailability in resource-limited settings leads anaesthetists to rely on subjective methods (Bulamba et al., 2017). In this context, clinician education has been shown to enhance the safety of tracheal cuff management, potentially benefiting airway management in resource-limited settings without CPM (Nwosu et al., 2025). It has been shown that direct interventions in clinical professionals based on education, the availability of manometers in patient rooms, graphical reminders, and alerts achieve safe CPs, statistically verified (Turner et al., 2020). Furthermore, during the patient care, procedures such as secretion suctioning, atomised inhalation, lateralisation as a position change, and oral hygiene cause changes in CP (Xiang et al., 2021).

The effectiveness of subjective techniques in achieving safe CPs in AA devices remains controversial. While objective methods are considered the gold standard, many healthcare settings, particularly those in resource-limited environments, rely on subjective techniques due to the limited resources, which may affect patient safety. There is a need to evaluate the reliability of these subjective techniques, as inadequate CP can lead to serious complications such as tracheal injury (Yin et al., 2019), airway leakage (Mohammed et al., 2021), and ventilator-associated pneumonia (Coelho et al., 2023; Nanao et al., 2025), all of which can worsen patient outcomes and increase healthcare costs. In this context, the present study aims to address the following research question: how effective are subjective techniques in achieving safe CPs in artificial airway devices? The aim of this study is to describe the effectiveness of subjective techniques in achieving safe CPs in artificial airway devices.

Methodology

A systematic review with a qualitative approach was conducted.

Eligibility criteria

Research articles with analytic or observational designs, published between 2024 and 2015 were included (a period of 10 years), in English and Spanish.

Instruments and information sources

Microsoft Excel v.2019 was used to register the search syntax, and Mendeley v.1.10.1 was used for reference management. Literature was searched in PubMed, Web of Science, and SciELO databases. The methodological quality of included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklist, considering study design, clarity of objectives, validity of results, and risk of bias. The Sackett scale was applied to classify the level and grade of evidence based on study type and methodological rigor. Finally, the PRISMA checklist (Page et al., 2021) guided the reporting of this systematic review to ensure transparency and reproducibility.

Searching strategy

The search of evidence was performed in the databases, using keywords to create the syntax. Table 1 shows the keywords used for seeking evidence, their synonyms and acronyms in both English and Spanish.

Table 1. Keywords used for seeking evidence, their synonyms and acronyms in both English and Spanish.

Language	Term	Synonyms	Acronyms
English	Intubation	Intratracheal intubation, Endotracheal intubation	IIT, IET, IOT
	Tracheostomy	Tracheotomy	TQT
	Cuff	-	-
	Pressure	Pressures	-
	Technique	Techniques	-
Spanish	Intubación	Intubación intratraqueal, Intubación endotraqueal	IIT, IET, IOT
	Traqueostomía	-	TQT
	Balón	-	-
	Presión	Presiones	-
	Técnica	Técnicas	-

Selection and data collection process

Documents were sought on the databases using the keywords, their synonyms and acronyms. Then, filters were applied to select the evidence which fitted with the criteria declared. After that, the selected articles were managed on Mendeley. Thereafter, to the selected documents the first filter was applied, consisting in reading titles and abstracts, deleting the articles which were not related to the project. Once that was completed, a second filter was applied, analysing the documents per reviewer, deleting those which did not fit with the inclusion criteria. Two reviewers independently assessed study eligibility and methodological quality using the CASP checklist. Discrepancies were resolved through consensus. Additional articles which met the inclusion criteria were included, as PRISMA recognises the 'identification of studies via other methods' (Page et al., 2021). Subsequently, using the PRISMA diagram model (Page et al., 2021), a summary of the process was performed. Following that, an appendix was completed to resume the documents analysed. Finally, a qualitative analysis was carried out, reporting the results.

Data items

Information of CP subjective techniques were sought, including digital palpation, minimal leak, predetermined volume, loss of resistance syringe, and minimal occlusive volume techniques.

Results

The seeking of evidence was carried out in the databases during January 2025 by the research team. Table 2 shows the searching syntax.

Table 2. Evidence found in databases according to the searching syntax used.

Database	Syntax	N° of evidence
-Pubmed	((((Techniques) AND (Cuff)) AND (Intubation)) AND (Pressure)) AND (Tracheostomy)	3
-Web of Science	Techniques AND Cuff AND Intubation AND Pressure AND Tracheostomy	3,182
-SciELO	(ab:(Techniques)) AND (ab:(Cuff)) AND (ab:(Intubation)) AND (ab:(Pressure)) AND (ab:(Tracheostomy))	0

A total of 3,185 articles were found. After screening titles and abstracts by the research team, 2,389 were excluded. 796 documents were assessed for eligibility per reviewer, excluding 792 due to lack of evaluation of subjective techniques. 36 additional documents, which fitted the inclusion criteria, were identified by the research group via other methods from citation searching, excluding a total of 26. Finally, 14 studies were selected by the team for analysis. Data were extracted from the selected documents and thoroughly analysed by the group. Figure 1 shows a PRISMA diagram with the process of selection of the evidence included for analysis.

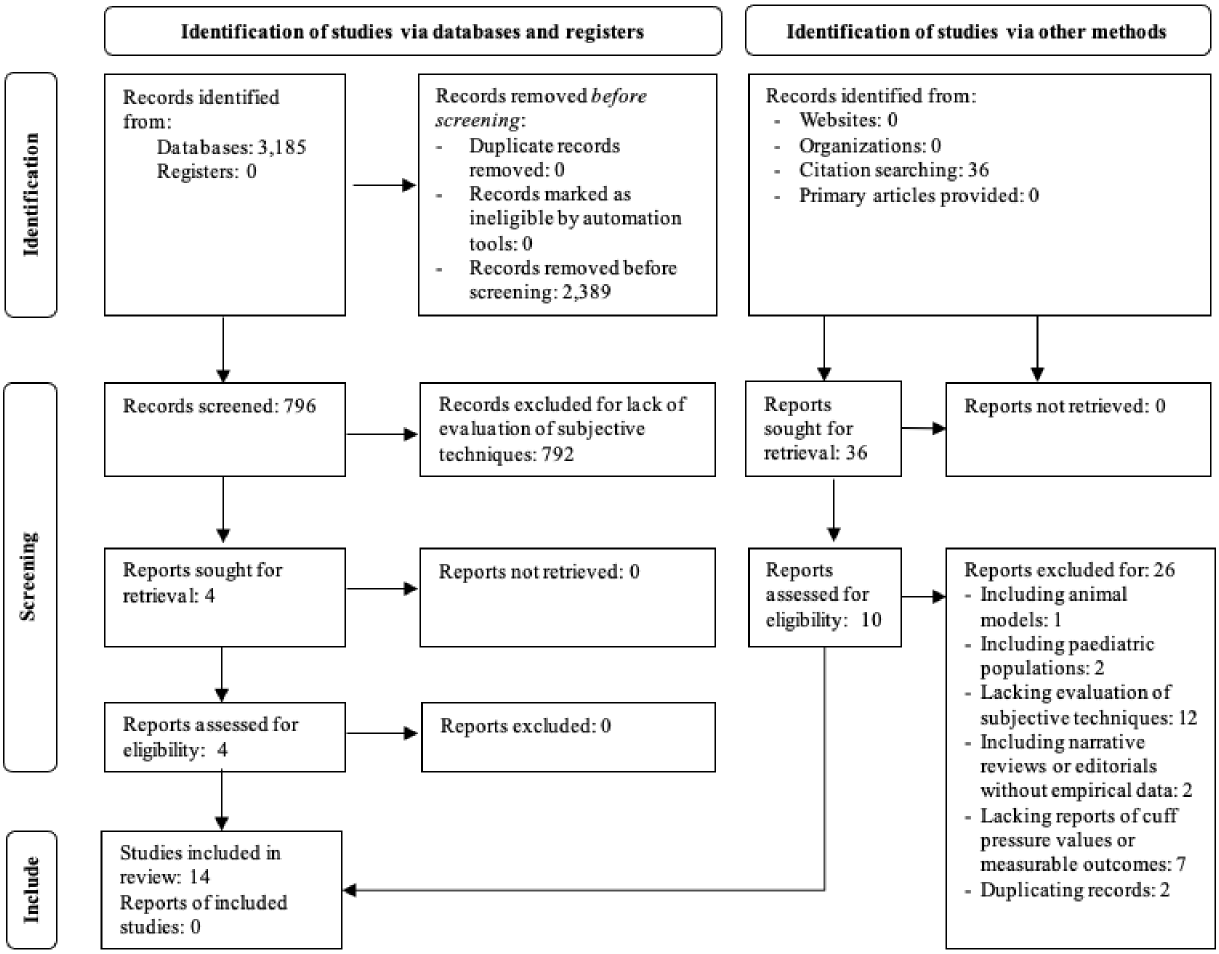

Figure 1. PRISMA diagram with the process of selection of the evidence included for analysis.

The documents included evidence from Australia, Brazil, Ghana, India, Italy, Mexico, Poland, Uganda, Ukraine, United States and South Africa, dated from 2024 and 2015. Five out of the total were randomized control trials (Bulamba et al., 2017; Kampo et al., 2022; Prateek et al., 2023; Sadovyi et al., 2024; Williams et al., 2019), four were observational and cross-sectional studies (Darkwa et al., 2015; Gilliland et al., 2015; Harvie et al., 2016; Lal et al., 2015), other four were observational and prospective research (Delgado Gómez et al., 2017; Duarte et al., 2020; Giusti et al., 2016; Selman et al., 2020) whilst one was a quasi-experimental research (Ilczak et al., 2021). Regarding the grade and level of evidence according to the Sackett scale, nine studies were grade A and level 1b, and five were grade B and level 2b. The sample included in the evidence selected varied between 45 and 384 participants. Table 3 details the documents included and their main aim.

Table 3. Documents included and their main aim.

Name	Main aim
Cuff pressure monitoring by manual palpation in intubated patients.	To evaluate the effectiveness and reliability of palpation method, performed with the operators fingers, for detecting the tube cuff pressure.
Subjective method for tracheal tube cuff inflation: performance of anesthesiology residents and staff anesthesiologists. Prospective observational study.	To assess appropriateness of a subjective method for attaining cuff pressure and the expertise level of manometer handling among anesthesiology staff and residents in a university teaching hospital.
The minimal leak test technique for endotracheal cuff maintenance.	To compare endotracheal tube cuff pressure manometry with the minimal leak test technique, to assess the latter's performance against accepted standards for endotracheal tube cuff maintenance.
Accuracy of the minimal leak test for endotracheal cuff pressure monitoring.	To determine the accuracy of the minimum leak test as a surrogate for target endotracheal cuff pressure of 20-30 cmH_2O in intubated patients.
Subglottic perioperative airway—tube inflation via randomized evaluation with variable syringe size (Spair-Tire) study.	To determine optimal syringe size for recommended endotracheal tube cuff.
Endotracheal tube cuff pressure assessment: expectations versus reality.	To evaluate the actual pressure in the cuffs during surgical interventions, correlate this measure with the subjective assessment of the anesthesiologist, and compare different methods of inflating the endotracheal tube cuff.
Achieving the recommended endotracheal tube cuff pressure: a randomized control study comparing loss of resistance syringe to pilot balloon palpation.	To determine the efficacy of the loss of resistance syringe method at estimating endotracheal cuff pressures.
Comparison of endotracheal tube cuff pressures using three indirect evaluation techniques: a randomized control study.	To evaluate the accuracy of endotracheal tube cuff pressure when inflated with different indirect techniques like fixed volume injection, minimal occlusive volume and pilot balloon palpation method, by using standard cuff pressure manometer.
Accuracy of pilot balloon palpation for cuff pressure assessment in small versus large sized tubes: a prospective non-randomized observational study	To determine whether the size of the tracheal tube influences the accuracy of pilot balloon palpation.
Endotracheal tube cuff pressures in adult patients undergoing general anaesthesia in two Johannesburg academic hospitals.	To determine the endotracheal tube cuff pressures of patients receiving general anaesthesia at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) and Chris Hani Baragwanath Academic Hospital (CHBAH) and to document the cuff inflation techniques that were used to achieve these pressures.
Endotracheal tube cuff pressure - comparison of the two filling methods - simulated test.	To determine the effect of using a manometer inflation device versus a 20ml syringe for inflation of an inserted endotracheal tube cuff on cuff pressure and time to accomplish inflation.
Estimation of endotracheal tube cuff pressure in a large teaching hospital in Ghana.	To assess whether cuff pressures obtained from estimation techniques at Korle-Bu Teaching Hospital differed significantly from the recommended levels of 20-30 cmH_2O and whether it differed significantly between Physician and Nurse Anaesthetists at the Hospital.
Endotracheal tube cuff pressure measurement techniques: safety and reliability: a randomized comparative study.	To examine cuff inflation techniques and corresponding pressure estimations, as well as associated complications, in patients undergoing general anaesthesia with intubation for cesarean delivery at the Tamale Teaching Hospital's obstetric unit.
Endotracheal tube cuff pressures during anaesthesia: safety of estimation techniques.	To evaluate the efficacy of the routinely used cuff inflation estimation techniques to achieve optimal cuff pressures.

CP subjective techniques studied

CP subjective techniques such as digital palpation, minimal leak, predetermined volume, loss of resistance syringe and the minimal occlusive volume were studied by the evidence selected. Eight research reported exclusively a unique CP subjective technique (Darkwa et al., 2015; Delgado Gómez et al., 2017; Duarte et al., 2020; Giusti et al., 2016; Harvie et al., 2016; Ilczak et al., 2021; Selman et al., 2020; Williams et al., 2020), whilst the other six compared multiple techniques (Bulamba et al., 2017; Gilliland et al., 2015; Kampo et al., 2022; Lal et al., 2015; Prateek et al., 2023; Sadovyi et al., 2024). The most studied technique was digital palpation (n= 9), followed by minimal leak and predetermined volume (n= 5 each one), minimal occlusive volume (n= 2) and loss of resistance syringe (n= 1).

Effectiveness of the use of CP subjective techniques

In general terms, all the articles included for analysis concludes that the use of subjective techniques for the management of CP of AAs devices were not safe for patients. These techniques reach safe CP ranges in

4.40% and 76.46% of the cases. Figure 2 shows the minimum and maximum percentage of safe cuff pressure ranges, based on the results of the subjective techniques included in the articles analysed.

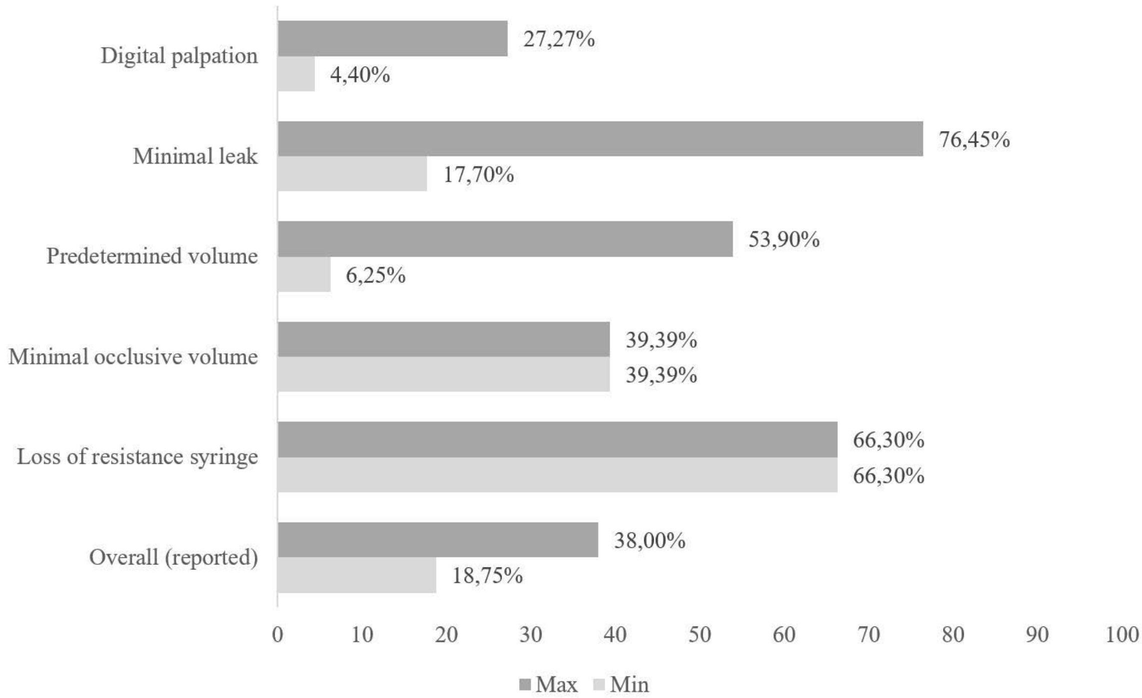

Figure 2. Minimum and maximum percentage of safe cuff pressure ranges, based on the results of the subjective techniques included in the articles analysed.

Furthermore, these methods result in both under inflation (2.00% and 26.30%) and over inflation (15.52% and 93.75%), with a stronger tendency towards the latter (see Appendix), which could increase the risk of serious complications such as tracheal stenosis, tracheoesophageal fistula, and tracheomalacia, potentially requiring surgical intervention. Less severe side effects, such as coughing, sore throat, hoarseness, and blood-streaked expectoration, may also occur. Although side effects are reported in 2.4% of patients managed with objective techniques, the predetermined volume technique causes complications in 53.2%, while digital palpation results in complications in 83.6% (Kampo et al., 2022). Among subjective methods, the digital palpation technique causes the highest complication rate for sore throat (Prateek et al., 2023). Table 4 details the percentage of effectiveness of the use of CP subjective techniques, according to the articles analysed, considering as a safe range a pressure between 20 and 30 cmH$_2$O.

Table 4. Percentage of effectiveness of the use of cuff pressure subjective techniques, according to the articles analysed, considering as a safe range a pressure between 20 and 30 cmH2O.

References	Digital palpation	Minimal leak	Predetermined volume	Minimal occlusive volume	Loss of resistance syringe	Overall
Giusti et al., 2016.	10.00%	-	-	-	-	-
Delgado Gómez et al., 2017.	-	17.70%	-	-	-	-
Duarte et al., 2020.	17.10%	-	-	-	-	-
Harvie et al., 2016.	-	44.00%	-	-	-	-
Selman et al., 2020.	-	76.45%	-	-	-	-
Williams et al., 2019.	-	-	*10.53% ***6.78%	-	-	-
Sadovyi et al., 2024.	4.40%	51.10%	-	-	-	-
Bulamba et al., 2027.	22.50%	-	-	-	66.30%	-
Prateek et a., 2023.	27.27%	-	**30.30%	39.39%	-	-
Gilliland et al., 2015.	-	-	-	-	-	18.75%
Ilczak et al., 2021.	5.56%	-	-	-	-	-
Darkwa et al., 2015.	-	-	****6.25%	-	-	-
Kampo et al., 2022.	26.60%	-	***53.90%	-	-	-
Lal et al., 2015.	-	-	-	-	-	38.00%

* 5 ml
** 7 ml
*** 10 ml
**** not reported

Discussion

The correct maintenance of CP in a safe range is essential for ensuring patient care and improving outcomes, reducing side effects associated to hazardous pressure values (Ignatavicius et al., 2018; Mosier et al., 2024; Wright, 2023). Although subjective techniques are cost-effective and widely accessible, they lack the necessary precision to prevent complications. Countries and health systems that face limited-resource settings are unable to invest in objective devices to ensure safe CP, where subjective methods, such as digital palpation and predetermined volume, are commonly employed (Bulamba et al., 2017; Nwosu et al., 2022). Even in upper-middle income countries, 7% of health professionals use subjective methods, whilst 23% of the protocols for AA management do not outline whether objective or subjective techniques should be used during patient care, causing confusion over the practices followed by healthcare professionals (Rosales et al., 2021; Rosales et al., 2023). In developed countries, 4% of the ICUs monitors CP of AA devices, but 50% of these settings have not established specific protocols for managing patients with AA (Talekar et al., 2014).

This research has demonstrated that subjective methods achieve a safe CP range in only 4.40% to 76.46% of total cases, which could pose a risk to patient care. Underinflation ranges from 2.00% to 26.30%, but the predominant issue is overinflation, ranging from 15.52% to 93.75%, which could increase the risk of side effects linked to tracheal injury. Additionally, the predetermined volume and digital palpation techniques caused complications in 53.2% and 83.6% of cases, respectively, with a significant variation between the groups in the occurrence of cough, sore throat, hoarseness, and blood-streaked expectoration. (Kampo et al., 2022). It is important to discuss the predetermined volume technique, as it has been studied using diverse amount of air (5, 7 and 10 ml). This exhibit that there is no consistence and specific volume used by clinicians, and that it is not possible to establish a universal figure, given the varying physical conditions of patients, underlying pathologies, and the characteristics AA devices.

The scenario is concerning because most of the evidence available of the use of objective and subjective CP range in AA devices has been studied in complex health settings. This represents a methodological limitation, as the findings may not be generalizable to less-studied contexts, such as medium-sized and basic hospitals, home hospitalization, rural hospitals, primary healthcare, and private care environments. In these settings, the use of subjective techniques may be even more widespread, and institutions may lack proper protocols for managing artificial airways or fail to provide accurate information on them. Education and training in CP management can improve safety outcomes even in the absence of CPM. It has been shown that education combined with the availability of CPM, charting reminders, and visual prompts significantly improves the proportion of patients achieving safe CP (Alshawadfy et al., 2022; Turner et al., 2020). Educational interventions are effective in improving and retaining knowledge on safe CPM, with significant gains maintained at 3 and 9 months post-intervention (Murugiah et al., 2021). Interventions using both passive and active strategies, such as printed guidelines, algorithms, and follow-up monitoring visits, have also been shown to improve nurses' knowledge of CPM (Mpasa et al., 2020). For subjective techniques, evidence shows that targeted interventions can improve cuff pressure management and reduce post-operative complications, highlighting their value in enhancing patient safety, especially in resource-limited settings (Nwosu et al., 2025). Inadequate CP can have serious clinical and economic consequences. On one hand, underinflated cuffs increase the risk of ventilator-associated pneumonia (Coelho et al., 2023; Mohammed et al., 2021), which costs approximately US$24,410 per case (Nanao et al., 2025). On the other hand, overinflated cuffs may lead to tracheal stenosis requiring surgical repair, which is associated with a mean treatment cost of US$5,286 (Yin et al., 2019). Despite this evidence, the non-existence of standardized protocols and institutional guidelines remains a significant issue. This highlights a critical gap during patient management, potentially compromising patient safety.

It is important to ensure collaborative-multidisciplinary teams with proper knowledge of CP management (Intensive Care Society, 2020), to reduce oral intake time, cannula changes, decannulation, hospital stays, and complication rates (Whitmore et al, 2020). These results highlight several challenges. There is a particular need to enhance professional training, develop universal and clear protocols, and potentially innovate in cost-effective and widely accessible CP devices, in order to prevent complications. This is especially suggested in healthcare settings with limited resources that are unable to invest in traditional manometers.

A limitation of this research is that most of the studies did not include information on the clinical experience and prior knowledge of healthcare professionals, which could have offered valuable insights. Additionally, comparing the use of subjective techniques across different professions would have been beneficial for further analysis. Another limitation is that no assessment of publication bias was performed, which could influence the interpretation of the available evidence. Moreover, a meta-analysis was not conducted, although not mandatory, it could have provided a more robust synthesis of results. It is essential for healthcare settings, clinicians, and healthcare managers to review their protocols and specific procedures to ensure patient safety. Furthermore, where possible, investment in objective devices should be considered to reduce patient harm and minimise side effects. It is recommended that further research be conducted in this area, focusing on professional training, AA protocols, and the innovation of affordable and widely accessible CP devices.

Conclusion

In conclusion, subjective techniques are unreliable, as they achieve the correct cuff pressure range in in a limited proportion of cases, potentially compromising patient safety due to under or over inflation. Digital palpation and predetermined volume methods are particularly prone to inaccuracies, which can increase the risk of tracheal injury and other complications.

Hospitals are encouraged to review and update their protocols, by investing in and exclusively using manometers to ensure patients' safety. For countries and healthcare settings with limited access to cuff pressure manometers, it is recommended to implement low-cost and alternative solutions to monitor cuff pressures more effectively. Future research should focus on validating alternative techniques, evaluating the impact of professional training programs, and developing affordable and widely accessible cuff pressure monitoring devices.

Reconocimiento de autoría

Felipe Gonzalo Rosales Lillo: Conceptualización del artículo. Curación de datos. Análisis formal. Investigación. Metodología. Administración del proyecto. Recursos. Supervisión. Validación. Visualización. Redacción – borrador original. Redacción – revisión y edición.
Giovanna Monichi Valdenegro: Curación de datos. Análisis formal. Investigación. Recursos. Validación. Visualización, Redacción – revisión y edición.

References

Alshawadfy, A., Alyeddin, W. F., & Elsadany, M. A. (2022). Endotracheal tube cuff inflation pressure varieties and response to education among anesthetists. *Egyptian Journal of Anaesthesia, 38*(1), 174–178. https://doi.org/10.1080/11101849.2022.2056405

American Association of Critical-Care Nurses. (2023). *Procedure manual for progressive and critical care.* Elsevier.

Bench, S., Hill, C., & Credland, N. (Eds.). (2024). *Critical care manual of clinical nursing procedures*. Wiley.

Bulamba, F., Kintu, A., Ayupo, N., Kojjo, C., Ssemogerere, L., Wabule, A., & Kwizera, A. (2017). Achieving the recommended endotracheal tube cuff pressure: A randomized control study comparing loss of resistance syringe to pilot balloon palpation. *Anesthesiology Research and Practice*, 2017, 2032748. https://doi.org/10.1155/2017/2032748

Chacko, J., Pawar, S., Seppelt, I., & Brar, G. (2023). *Controversies in critical care*. Springer Nature Singapore.

Chintamani, L., Gopichandran, L., & Mani, M. (2024). *Lewis's adult health nursing I and II: Assessment and management of clinical problems* (5th ed.) [E-book]. Elsevier.

Coelho, L., Moniz, P., Guerreiro, G., & Póvoa, P. (2023). Airway and respiratory devices in the prevention of ventilator-associated pneumonia. *Medicina (Kaunas, Lithuania), 59*(2), 199. https://doi.org/10.3390/medicina59020199

Darkwa, E., Boni, F., Lamptey, E., Adu-Gyamfi, Y., Owoo, C., Djagbletey, R., Yawson, A., Ayesu, E., & Yaw Sottie, D. (2015). Estimation of endotracheal tube cuff pressure in a large teaching hospital in Ghana. *Open Journal of Anesthesiology, 5,* 233-241. https://doi.org/10.4236/ojanes.2015.512042

Delgado Gómez, F. M., Athié García, J. M., & Díaz Castillo, C. Y. (2017). Evaluación de la presión del globo traqueal insuflado por técnica de escape mínimo en el Hospital Ángeles Mocel. *Acta Médica Grupo Ángeles, 15(1),* 8-12.

Duarte, N. M. D. C., Caetano, A. M. M., Arouca, G. O., Ferreira, A. T., & Figueiredo, J. L. (2020). Insuflação de balonete de tubo traqueal por método subjetivo: desempenho de médicos residentes e especialistas em anestesiologia. Estudo prospectivo observacional [Subjective method for tracheal tube cuff inflation: performance of anesthesiology residents and staff anesthesiologists. Prospective observational study]. *Brazilian Journal of Anesthesiology, 70*(1), 9–14. https://doi.org/10.1016/j.bjan.2019.09.010

Félix-Ruiz, R., López-Urbina, D. M., & Carrillo-Torres, O. (2014). Evaluar la precisión de las técnicas subjetivas de insuflación del globo endotraqueal. *Revista Mexicana de Anestesiología, 37*(2), 71–76. https://www.medigraphic.com/pdfs/rma/cma-2014/cma142b.pdf

Gilliland, L., Perrie, H., & Scribante, J. (2015). Endotracheal tube cuff pressures in adult patients undergoing general anaesthesia in two Johannesburg academic hospitals. *Southern African Journal of Anaesthesia and Analgesia*, *21*(3), 81–84. https://doi.org/10.1080/22201181.2015.1056504

Giusti, G., Rogari, C., Gili, A., & Nisi, F. (2016). Cuff pressure monitoring by manual palpation in intubated patients: How accurate is it? A manikin simulation study. *Australian Critical Care, 30*(4), 234-238. https://doi.org/10.1016/j.aucc.2016.10.001

Gulanick, M., & Myers, J. L. (2021). *Nursing care plans - e-book: Nursing diagnosis and intervention*. Elsevier.

Harding, R., Kwong, J., Hagler, D., & Reinisch, C. (2022). *Lewis's medical-surgical nursing e-book*. Elsevier.

Harvie, D., Darvall, J., Dodd, M., De La Cruz, A., Tacey, M., D'Costa, R., & Ward, D. (2016). The minimal leak test technique for endotracheal cuff maintenance. *Anaesthesia and Intensive Care, 44*(5), 599-604. https://doi.org/10.1177%2F0310057X1604400512

Heuer, A., & Stoller, J. (2024). *Egan's fundamentals of respiratory care.* [E-book]. Elsevier Health Sciences

Ilczak, T., Ćwiertnia, M., Białoń, P., Szlagor, M., Kudłacik, B., Rak, M., Bialka, S., Ubych, A., Stasicki, A., Waksmańska, W., Bujok, J., Mikulska, M., Bobiński, R., & Kawecki, M. (2021). Endotracheal tube cuff pressure - comparison of the two filling methods - simulated test. *Prehospital and Disaster Medicine*, *36*(4), 421–425. https://doi.org/10.1017/S1049023X21000406

Ignatavicius, D. D., Workman, M. L., Rebar, C. R., & Heimgartner, N. M. (2018). *Medical surgical nursing. Concepts for interprofessional collaborative care*. Elsevier Health Sciences.

Intensive Care Society. (2020). *Guidance for: tracheostomy care*. https://www.ficm.ac.uk/sites/ficm/files/documents/2021-11/2020-08%20Tracheostomy_care_guidance_Final.pdf

Kaeley, N., & Sharma, A. (2022). *Current practice updates in emergency medicine.* Notion Press.

Kampo, S., Anabah, T. W., Bayor, F., Buunaaim, A. D. B., Esquijarosa Hechavarria, M., Osman, S., Kuugbee, E. D., & Ziem, J. B. (2022). Endotracheal tube cuff pressure measurement techniques: Safety and reliability: A randomized comparative study. *Journal of Anesthesia and Pain Management, 6*(2), 316-323. https://doi.org/10.36959/377/376

Kellum, J. A., Fink, M. P., & Vincent, J. L. (2024). *Critical illness outside the ICU, an issue of critical care clinics* (1st ed.). Elsevier Health Sciences.

Lal, J., Smriti, M., Hooda, S. (2015). Endotracheal tube cuff pressures during anaesthesia: safety of estimation techniques. *Journal of Applied Research, 5*(11)*,* 322-324.

Leach, R. M. (2023). *Critical care medicine at a glance.* United Kingdom: Wiley-Blackwell.

Menzies Kent, K. (2021). *Adult CCRN® certification review, second edition: Think in questions, learn by rationales*. Springer Publishing Company.

Mohammed, S. H., Shawer, O. A. E. G., Mohammed, M. A., & Mohammed, O. A. (2021). Relation between endotracheal tube cuff pressure measurements and the incidence of ventilator associated pneumonia. *Assiut Scientific Nursing Journal, 9*(26), 140–148. https://doi.org/10.21608/ASNJ.2021.84955.1213

Mosier, J. M., Brown, I. C. A., Parotto, M., Bartz, R. R. (2024). *Manual of airway management in critical care: EBook without multimedia.* Wolters Kluwer Health.

Mpasa, F., van Rooyen, D. R. M., Venter, D., Jordan, P., & Ten Ham-Baloyi, W. (2020). Improving nurses' knowledge of managing endotracheal tube cuff pressure in intensive care units: A quasi-experimental study. Health SA Gesondheid, 25, a1479. https://doi.org/10.4102/hsag.v25i0.1479

Murugiah, U. R., Ramoo, V., Jamaluddin, M. F. H., Yahya, A., Baharudin, A. A., Abu, H., & Thinagaran, R. R. R. (2021). Knowledge acquisition and retention among nurses after an educational intervention on endotracheal cuff pressure. *Nursing in Critical Care, 26*(5), 363–370. https://doi.org/10.1111/nicc.12600

Nanao, T., Ishikawa, K. B., Ikeda, S., & Yamazaki, T. (2025). Clinical and economic impact of ventilator-associated pneumonia in intensive care units in Japan. *Infection Prevention in Practice, 7*(1), 100440. https://doi.org/10.1016/j.infpip.2025.100440

Nwosu, A. D. G., Ossai, E. N., Onyekwulu, F. A., Amucheazi, A. O., Ewah, R., Onwuasoigwe, O., & Akhideno, I. (2022). Knowledge and practice of tracheal tube cuff pressure monitoring: A multicenter survey of anaesthesia and critical care providers in a developing country. *Patient Safety in Surgery*, *16*(1), 4. https://doi.org/10.1186/s13037-021-00311-8

Nwosu, A. D. G., Ossai, E. N., Ejezie, C., & Obodo, O. C. (2025). Educational intervention can improve the pilot balloon palpation method of tracheal tube cuff pressure monitoring: An experimental study. *Journal of West African College of Surgeons, 15*(1), 53–58. https://doi.org/10.4103/jwas.jwas_162_23

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Systematic Reviews, 10*, 89. https://doi.org/10.1186/s13643-021-01626-4

Prateek, Ahuja, K., Bansal, P., Singh, M., & Agrawal, M. (2023). Comparison of endotracheal tube cuff pressures using three indirect evaluation techniques: A randomised control study. *JAMP, 5*(1)*;* 308-312.

Roca, O., Spadaro, S., & Rees, S. (Eds.). (2023). *New developments in mechanical ventilation*. Frontiers Media SA.

Romero, C., Hidalgo, V., & Rivera, C. (2021). *Rehabilitación en unidades de paciente crítico. Una visión transdisciplinaria:* Mediterráneo.

Rosales, F. (2021). Manejo de presión del cuff en usuarios adultos con vía aérea artificial por profesionales de salud en Chile. *Revista Chilena de Fonoaudiología, 20*(1), 1-10. https://doi.org/10.5354/0719-4692.2021.58634

Rosales, F., Marín, F., Monichi, G., & Miranda, F. (2023). A review of clinical protocols for cuff management in adult patients with an artificial airway in Chilean hospitals. *Revista Chilena de Fonoaudiología 22*(1), 1-11. http://dx.doi.org/10.5354/0719-4692.2023.69258

Talekar, C. R., Udy, A. A., Boots, R. J., Lipman, J., & Cook, D. (2014). Tracheal cuff pressure monitoring in the ICU: a literature review and survey of current practice in Queensland. *Anaesthesia and Intensive Care, 42*(6), 761–770. https://doi.org/10.1177/0310057X1404200612

Turner, M. A., Feeney, M., & Deeds, L. J. L. (2020). Improving endotracheal cuff inflation pressures: an evidence-based project in a military medical center. *AANA Journal*, *88*(3), 203–208.

Sadovyi, V., Kuchyn, I., Bielka, K., Horoshko, V., Sazhyn, D., & Sokolova, L. (2024). Endotracheal tube cuff pressure assessment: Expectations versus reality. *Anaesthesiology Intensive Therapy*, *56*(4), 241–245. https://doi.org/10.5114/ait.2024.145411

Selman, Y., Arciniegas, R., Sabra, J., Ferreira, T., & Arnold, D. (2020). Accuracy of the minimal leak test for endotracheal cuff pressure monitoring. *Laryngoscope, 130*(7), 1646-1650. https://doi.org/10.1002/lary.28328

Whitmore, K., Townsend, S. & Laupland, K. (2020). Management of tracheostomies in the intensive care unit: a scoping review. *BMJ Open Respiratory Research, 7*:e000651. https://doi.org/10.1136/bmjresp-2020-000651

Williams, G. W., Jr., Artime, C. A., Mancillas, O. L., Syed, T. A., Burnett, T., Graham, R., Tam, J., & Hagberg, C. A. (2019). Subglottic perioperative airway-tube inflation via randomized evaluation with variable syringe size (Spair-Tire) study. *The Clinical Respiratory Journal*, *13*(1), 66–69. https://doi.org/10.1111/crj.12984

Wright, R. (2023). *Current topics in airway management*. Murphy & Moore Publishing.

Xiang, L., Cao, M., Wang, Y., Song, X., Tan, M., & Zhang, X. (2021). Could clinical nursing procedures lead to tracheal cuff pressure drop? A prospective observational study. *Journal of Clinical Nursing, 31*(5), 623–632. https://doi.org/10.1111/jocn.15920

Yin, L. X., Padula, W. V., Gadkaree, S., Motz, K., Rahman, S., Predmore, Z., Gelbard, A., & Hillel, A. T. (2019). Health care costs and cost-effectiveness in laryngotracheal stenosis. *Official Journal of American Academy of Otolaryngology-Head and Neck Surgery, 160*(4), 679–686. https://doi.org/10.1177/0194599818815068

Appendix

Appendix 1. Resume of the documents included for analysis.

Name	Country	Design	Grade / Level of evidence	Subjective technique evaluated	Sample and procedures	Results (cuff pressure ranges)	Conclusions	References
Cuff pressure monitoring by manual palpation in intubated patients.	Italy.	Observational, descriptive and prospective study.	B/2b.	Digital palpation.	68 intensive care unit nurses. A manikin was used to test the cuff pressure.	Digital palpation technique: -Safe range: 10%.	Digital palpation technique is an inadequate method for cuff pressure management.	Giusti, G., Rogari, C., Gili, A., & Nisi, F. (2016).
Evaluation of the pressure of the tracheal balloon inflated by minimal leak technique at Hospital Ángeles Mocel.	Mexico.	Observational, descriptive and prospective study.	B/2b.	Minimal leak.	339 patients with an artificial airway. The minimal leak technique was used after the intubation.	Minimal leak technique: -Safe range: 17.7%. -Underinflated: 26.3%. -Overinflated: 56.0%.	Minimal leak technique shows a high inaccuracy for cuff pressure management with a tendency to overinflate cuffs.	Delgado Gómez, Fernando M, Athié García, José Manuel, & Díaz Castillo, Carmen Y. (2017).
Subjective method for tracheal tube cuff inflation: performance of anesthesiology residents and staff anesthesiologists. Prospective observational study.	Brazil.	Observational, descriptive and prospective study.	B/2b.	Digital palpation.	48 staff and resident anesthesiologists evaluated cuff pressure of intubated patients who underwent general anesthesia.	Digital palpation technique: -Safe range: 17.1%. -Underinflated:10.6%. -Overinflated: 72.3%.	The digital palpation technique for inflating the tracheal tube cuff resulted in a high rate of inadequate cuff pressures.	Duarte, N. M. D. C., Caetano, A. M. M., Arouca, G. O.Ferreira, A. T., & Figueiredo, J. L. (2020).
The minimal leak test technique for endotracheal cuff maintenance.	Australia.	Cross-sectional study.	B/2b.	Minimal leak.	45 mechanically ventilated patients controlled by nurses using minimal leak technique.	Minimal leak technique: -Safe range: 44%. -Underinflated: 24%. -Overinflated: 32%.	Minimal leak technique leads to both over and underinflation.	Harvie, D., Darvall, J., Dodd, M., De La Cruz, A., Tacey M, D'Costa R., & Ward, D. (2016).
Accuracy of the minimal leak test for endotracheal cuff pressure monitoring.	United States.	Observational, descriptive and prospective study.	B/2b.	Minimal leak.	122 patients were included and 722 minimal leak tests were performed.	Minimal leak technique: -Safe range: 76.45%. -Underinflated: 8.03%. -Overinflated: 15.52%.	Minimum leak technique for cuff pressure adjustment has a high error rate resulting in cuff pressures above or below the safe range.	Selman, Y., Arciniegas, R., Sabra, J. M., Ferreira, T. D., & Arnold, D. J. (2020).

Name	Country	Design	Grade / Level of evidence	Subjective technique evaluated	Sample and procedures	Results (cuff pressure ranges)	Conclusions	References
Subglottic perioperative airway—tube inflation via randomized evaluation with variable syringe size (Spair-Tire) study.	United States.	Randomized controlled trial.	A/1b.	Predetermined volume.	200 patients were randomized to use either 5 mL or 10 ml syringes for cuff pressure management.	Predetermined volume technique 5-ml group: -Safe range: 10.53%. -Underinflated: 5.26%. -Overinflated: 84.21%. Predetermined volume technique 10-ml group: -Safe range: 6.78%. -Underinflated: 1.69%. -Overinflated: 91.53% overinflated.	Predetermined volume technique using both 5- and 10-mL syringes resulted in elevated cuff pressures after intubation.	Williams, G. W., 2nd, Artime, C. A., Mancillas, O. L., Syed, T. A., Burnett, T., Jr, Graham, R., Tam, J., & Hagberg, C. A. (2019).
Endotracheal tube cuff pressure assessment: expectations versus reality.	Ukraine.	Randomized controlled trial.	A/1b.	Digital palpation and minimal leak.	90 patients were randomly divided into minimal leakage group and digital palpation group.	Digital palpation technique: -Safe range: 4.4%. -Out of range: 95.6%. Minimal leak technique: -Safe range: 51.1%. -Out of range: 48.9%.	Digital palpation technique is an unreliable method.	Sadovyi, V., Kuchyn, I., Bielka, K., Horoshko, V., Sazhyn, D., & Sokolova, L. (2024).
Achieving the recommended endotracheal tube cuff pressure: a randomized control study comparing loss of resistance syringe to pilot balloon palpation.	Uganda.	Randomized controlled trial.	A/1b.	Loss of resistance syringe and digital palpation.	178 patients were analysed.	Loss of resistance syringe technique: -Safe range: 66.3%. -Out of range: 33.7%. Digital palpation technique: -Safe range: 22.5%. -Out of range: 77.5%.	Loss of resistance syringe method was superior to digital palpation at administering pressures in the recommended range.	Bulamba, F., Kintu, A., Ayupo, N., Kojjo, C., Ssemogerere, L., Wabule, A., & Kwizera, A. (2017).
Comparison of endotracheal tube cuff pressures using three indirect evaluation techniques: a randomized control study.	India.	Randomized controlled trial.	A/1b.	Predetermined volume, minimal occlusive volume and digital palpation.	198 patients were included, randomly allocated in three groups according to each technique used.	Predetermined volume technique 7 ml: -Safe range: 30.30%. -Out of range: 69.70%. Minimal occlusive volume technique: -Safe range: 39.39%. -Out of range: 60.61%. Digital palpation technique: -Safe range: 27.27%. -Out of range: 72.73%.	All three methods resulted in pressures outside safe range in 60–73% of cases. Digital palpation technique had the highest complication rate for sore throat.	Prateek, Ahuja, K., Bansal, P., Singh, M., Agrawal, M. (2023).

Name	Country	Design	Grade / Level of evidence	Subjective technique evaluated	Sample and procedures	Results (cuff pressure ranges)	Conclusions	References
Endotracheal tube cuff pressures in adult patients undergoing general anaesthesia in two Johannesburg academic hospitals.	South Africa.	Cross-sectional study.	B/2b.	Minimal occlusive volume, predetermined volume and digital palpation.	96 intubated patients	Overall: -Safe range: 18.75%. -Underinflated: 15.67%. -Overinflated: 64.58%.	Most patients were overinflated regardless of technique.	Gilliland, L., Perrie, H., & Scribante, J. (2015).
Endotracheal tube cuff pressure - comparison of the two filling methods - simulated test.	Poland.	Quasi experimental study	B/2b.	Digital palpation.	108 measures by paramedics who used two methods: digital palpation and manometer.	Digital palpation technique: -Safe range: 5.56%. -Underinflated: 4.63%. -Overinflated: 89.91%.	Emergency medical teams should be equipped with manometer devices for inflating endotracheal tube cuffs to avoid overinflation.	Ilczak, T., Ćwiertnia, M., Białoń, P., Szlagor, M., Kudłacik, B., Rak, M., Bialka, S., Ubych, A., Stasicki, A., Waksmańska, W., Bujok, J., Mikulska, M., Bobiński, R., & Kawecki, M. (2021).
Estimation of endotracheal tube cuff pressure in a large teaching hospital in Ghana.	Ghana.	Cross-sectional study.	B/2b.	Predetermined volume.	81 patients were recruited.	Predetermined volume technique: -Safe range: 6.25%. -Overinflated: 93.75%.	Estimation techniques are generally higher than the recommended range. The mean cuff pressure applied by nurses was 69.52 cmH_2O.	Darkwa, E. , Boni, F. , Lamptey, E. , Adu-Gyamfi, Y. , Owoo, C. , Djagbletey, R. , Yawson, A. , Ayesu, E. and Yaw Sottie, D. (2015).

Name	Country	Design	Grade / Level of evidence	Subjective technique evaluated	Sample and procedures	Results (cuff pressure ranges)	Conclusions	References
Endotracheal tube cuff pressure measurement techniques: safety and reliability: a randomized comparative study.	Ghana.	Randomized controlled trial.	A/1b.	Digital palpation and predetermined volume.	384 pregnant women were randomized.	Predetermined volume technique 10 ml: -Safe range: 53.9%. -Overinflated: 46.1%. Digital palpation technique: -Safe range: 26.6%. -Overinflated: 73.4%.	Predetermined volume technique showed side effects in 53.2% of the patients. Manual palpation technique showed side effects in 83.6% of the patients. These side effects included coughing, sore throat, hoarseness and blood streaked expectoration.	Kampo, S., Anabah, T. W., Bayor, F., Buunaaim, A. D. B., Esquijarosa Hechavarria, M., Osman, S., Kuugbee, E. D., & Ziem, J. B. (2022).
Endotracheal tube cuff pressures during anaesthesia: safety of estimation techniques.	India.	Cross-sectional study.	B/2b.	Digital palpation, minimal leak and predetermined volume.	100 patients undergoing elective surgery were included	Overall: -Safe range: 38%. -Underinflated: 2%. -Overinflated: 60%.	Estimation techniques for endotracheal tube cuff inflation cannot be relied upon.	Lal, J., Smriti, M., Hooda, S. (2015).