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Research Article

Comparative Evaluation of Airway Management Devices in ENT Surgery

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ABSTRACT
Background: Airway management in ear, nose and throat (ENT) surgery is unusually demanding because the surgeon and the anaesthesiologist share the same anatomical field, and because the airway itself may be the site of disease, instrumentation or bleeding. The choice of airway device therefore influences surgical access, ventilation, airway protection, haemodynamic stability and quality of recovery.
Objective: To compare the principal airway management devices used in ENT surgery, namely cuffed oral and nasal tracheal tubes, supraglottic airway devices (with emphasis on the flexible reinforced laryngeal mask airway), and laryngoscopic and fibreoptic intubation aids, across clinically relevant domains.
Methods: A structured narrative review of randomized trials, systematic reviews, meta-analyses, audits and national guidelines was undertaken, and the findings were organised within a six-domain comparison framework covering airway security, surgical access, physiological response, complications, recovery, and resource and training requirements. No new patient data were collected.
Results and Discussion: In paediatric adenotonsillectomy, which has the strongest evidence base, the flexible reinforced laryngeal mask is an effective alternative to the tracheal tube in experienced hands, with comparable overall adverse events, less blood soiling of the airway and a smoother emergence, but also a longer operative time, a small rate of conversion to intubation, and device-specific problems of kinking and displacement. For predicted difficult airways, videolaryngoscopy improves the glottic view and reduces failed intubation relative to direct laryngoscopy, and awake techniques remain central where airway patency is threatened. Evidence outside tonsillectomy is thinner and more heterogeneous. A device-selection framework linking patient, procedure and team factors is proposed.
Conclusion: No single device is superior across ENT procedures. Device selection should be individualised, guideline-concordant and supported by training, and adequately powered trials in non-tonsillar ENT surgery are needed.

Keywords: Airway Management, ENT Surgery, Laryngeal Mask Airway, Tracheal Intubation, Videolaryngoscopy, Adenotonsillectomy.

INTRODUCTION

Ear, nose and throat (ENT) surgery covers a broad range of operations, from otological procedures and septoplasty to functional endoscopic sinus surgery, adenotonsillectomy, microlaryngoscopy, tracheostomy and major head and neck resections. What unites these procedures, from the anaesthesiologist's point of view, is that the operative field and the

airway are anatomically intertwined. The surgeon requires unobstructed access to the nose, pharynx or larynx, frequently with the patient's head turned away from the anaesthesia machine, while the anaesthesiologist must keep that same airway patent, protected from blood and debris, and connected to a reliable ventilation circuit throughout the procedure and during emergence.

This shared-airway problem is compounded by several features that are characteristic of ENT practice. Surgical retractors and mouth gags, such as the Boyle–Davis gag used in tonsillectomy, can compress, kink or displace the airway device after it has been correctly positioned. Bleeding and secretions are directed towards the larynx, so protection of the lower airway is a constant concern. Electrocautery, coblation and laser use introduce the hazard of airway fire in an oxygen-enriched environment. The patients themselves may present with airway-threatening pathology, including tumours, abscesses, obstructive sleep apnoea, previous radiotherapy or congenital anomalies, and a large proportion of ENT surgery is performed in children, whose airways are small, reactive and less tolerant of hypoxia. For these reasons, ENT surgery has long been regarded as a setting in which airway planning must be explicit, rehearsed and communicated to the whole operating team.

The consequences of poor airway management are well documented. The Fourth National Audit Project (NAP4) of the Royal College of Anaesthetists and the Difficult Airway Society collected serious airway complications from all National Health Service hospitals in the United Kingdom over a one-year period and concluded that, although such events are uncommon, they carry substantial morbidity and mortality, and that deficiencies in assessment, planning and judgement contributed to a large proportion of cases [1]. Subsequent reviews of airway complications and failure of airway management have emphasised that adverse outcomes are usually the end result of a chain of decisions, including the choice of device, rather than of a single technical error [2]. In a specialty in which the airway is shared with the surgeon, the selection of the primary airway device is one of the earliest and most consequential links in that chain.

For decades the cuffed tracheal tube has been regarded as the reference standard for securing the airway in ENT surgery, because it isolates the trachea from the operative field, permits controlled ventilation and is not easily displaced by the surgical team. The introduction of the laryngeal mask airway by Brain [3] changed this picture, offering a device that is positioned above the glottis without laryngoscopy, avoids many of the haemodynamic and mucosal effects of intubation, and allows a smooth emergence. The subsequent development of reinforced, flexible variants, together with modern videolaryngoscopes and flexible fibreoptic equipment, has given clinicians a wider range of options than at any previous time. National and international guidelines now provide structured strategies for managing both anticipated and unanticipated difficulty [4], [5], [6], but they are deliberately device-neutral and say little about which primary device is preferable for a given ENT procedure.

The aim of this article is therefore to provide a comparative evaluation of the airway management devices that are in routine use for ENT surgery. The specific objectives are: (i) to describe the principal device categories and their characteristics in the ENT context; (ii) to synthesise the comparative evidence for supraglottic airway devices versus tracheal intubation, with particular attention to paediatric adenotonsillectomy; (iii) to examine the role of videolaryngoscopy and awake techniques in patients with a predicted difficult airway; and (iv) to propose a practical, evidence-informed framework for device selection. The article is organised as follows. Section 2 reviews related work. Section 3 describes the methodology adopted. Section 4 presents and discusses the results. Section 5 concludes the article and indicates directions for future research.

RELATED WORK

Guidelines and Audit Evidence

The modern approach to airway safety is built on national audit data and consensus guidelines. NAP4 provided the first prospective, population-level estimate of the burden of major airway complications in the United Kingdom and identified recurring themes, including failure to plan for difficulty, persistence with failing techniques and delayed recourse to a surgical airway [1]. The Difficult Airway Society guidelines for unanticipated difficult intubation in adults formalised a stepwise sequence of plans A to D, with an emphasis on limiting the number of attempts, optimising oxygenation between attempts and declaring failure early [4]. The American Society of Anesthesiologists practice guidelines for management of the difficult airway, updated in 2022, take a similar approach and explicitly encourage the use of videolaryngoscopy as an initial or rescue strategy and the use of awake intubation when the airway is judged to be at risk [5]. Complementary guidance on awake tracheal intubation addresses patient selection, topical anaesthesia and sedation, and the role of flexible endoscopy and videolaryngoscopy in the awake patient [6]. These documents are directly relevant to ENT surgery because a substantial proportion of ENT patients are at risk of difficult airway management, yet none of them prescribes a particular device for a particular procedure.

Supraglottic Airway Devices

The development of supraglottic airway devices has been reviewed by Hernandez and colleagues, who describe the progression from the original laryngeal mask to second-generation devices with gastric drainage channels and improved seals, and who stress the importance of appropriate patient selection and technique for success [7]. An early meta-analysis comparing the laryngeal mask airway with the tracheal tube or face mask suggested advantages in terms of haemodynamic stability, the need for neuromuscular blockade, and certain postoperative airway complications [8]. A systematic review focused on oral and maxillofacial and related procedures concluded that laryngeal mask airways were associated with a lower risk of airway complications than endotracheal intubation [9]. Taken together, these reviews provide the general rationale for using supraglottic devices in appropriately selected ENT patients, but they also highlight that the devices differ in design and that findings for one device cannot automatically be transferred to another.

Randomized Trials in Adenotonsillectomy

Adenotonsillectomy is the ENT procedure in which the comparison between the laryngeal mask and the tracheal tube has been studied most intensively. In an early randomized trial of 104 patients, Williams and Bailey reported that the reinforced laryngeal mask did not interfere with surgical access, resisted compression by the gag, protected the lower airway from blood and was associated with a less eventful recovery, although a small number of patients had to be withdrawn because of difficulty with placement or distal obstruction when the gag was opened [10]. Webster and colleagues randomized 109 children to an armoured laryngeal mask or a tracheal tube and found that a satisfactory airway was achieved more rapidly in the mask group, with lower heart rate and blood pressure responses, although the mask was abandoned in favour of intubation in about nine per cent of cases [11]. Further randomized comparisons followed, including those of Doksrød and colleagues in Norway [12] and of Ranieri Junior and colleagues in Brazil, who randomized 204 children to a disposable laryngeal mask or a cuffed tracheal tube [13]. More recent trials have addressed laryngospasm as a primary outcome: Peng and colleagues randomized 131 children and found that the incidence of postoperative laryngospasm was similar with the flexible laryngeal mask and the tracheal tube, although the mask had to be exchanged for a tube in ten children because of kinking or poor surgical visualisation [14], and Sierpina and colleagues, in a study of 117 patients aged two to eighteen years, concluded that the laryngeal mask did not appear to have any major disadvantages relative to the tracheal tube [15]. Large observational experience from short-stay and

office-based practice has also been reported [16].

Evidence Synthesis

Several authors have attempted to pool these trials. The most recent systematic review and meta-analysis of randomized trials, which included six studies and 765 participants undergoing adenotonsillectomy, found no difference in total adverse events between the laryngeal mask and the tracheal tube, but a longer surgical time with the mask and a conversion rate from mask to intubation of 4.7 per cent [17]. An older systematic review on airway complications concluded that no clear advantage of the laryngeal mask over the tracheal tube could be demonstrated when heterogeneity precluded pooling, a finding that illustrates how sensitive the conclusions are to the devices and outcomes chosen [9]. Outside tonsillectomy, comparative data are sparser.

Videolaryngoscopy and Difficult Airway Management

A Cochrane review of videolaryngoscopy versus direct laryngoscopy in adults requiring tracheal intubation found that videolaryngoscopes improve the view of the glottis and reduce the number of failed intubations, with benefits that appear greatest in patients with a difficult airway, although the effect on patient-centred outcomes such as mortality remains uncertain [18]. In a cohort with a predicted difficult airway, Aziz and colleagues compared the C-MAC videolaryngoscope with direct laryngoscopy and reported better laryngeal views and a higher success rate of intubation with the video device [19]. The Cormack–Lehane grading system [20] and the Mallampati classification [21] remain the most widely used descriptors of laryngeal view and of oropharyngeal access, respectively, and they provide a common language for reporting difficulty in this literature.

Research Gap

Despite this body of work, three gaps are apparent. First, most comparative trials concern children undergoing adenotonsillectomy; evidence for adults and for nasal, otological, laryngeal and head and neck procedures is far more limited. Second, trials usually compare a single supraglottic device with a tracheal tube and rarely compare the full range of options available to the clinician. Third, guidelines and trials are seldom integrated into a decision process that a clinician can apply at the bedside. This article addresses these gaps by comparing the whole device spectrum within a common framework and by proposing a selection pathway.

METHODOLOGY

Study Design

This work is a structured narrative review with a comparative synthesis. A narrative design was chosen, rather than a quantitative meta-analysis, because the available studies differ substantially in population (children versus adults), procedure (tonsillectomy versus nasal, laryngeal or head and neck surgery), device model, ventilation mode and outcome definitions, and because many relevant sources are guidelines and audits that cannot be pooled numerically. No new patient data were collected, no interventions were performed and no patient-identifiable information was used. Effect estimates quoted in this article are those reported by the original authors.

Information Sources and Search Approach

The literature was explored through the major biomedical databases, namely PubMed/MEDLINE, Embase and the Cochrane Library, supplemented by Google Scholar and by hand-searching the reference lists of key articles and guidelines. The search combined controlled vocabulary and free-text terms describing the airway devices of interest (for example, laryngeal mask airway, supraglottic airway, tracheal tube, endotracheal intubation, videolaryngoscope, fibreoptic intubation) with terms describing the clinical setting (for example, otolaryngology, ENT surgery, tonsillectomy, adenotonsillectomy, nasal surgery, sinus surgery, microlaryngoscopy, head and neck surgery). Searches were restricted to publications in English.

Eligibility Criteria

Sources were considered eligible if they were randomized controlled trials, prospective or

large retrospective comparative studies, systematic reviews or meta-analyses, national audits or professional society guidelines, and if they addressed the selection, performance or safety of one or more airway devices in patients undergoing ENT surgery or in populations to whom ENT practice can reasonably be generalised, such as adults with a predicted difficult airway. Case reports, conference abstracts without full text, studies of airway management exclusively in the intensive care unit or emergency department, and studies that did not report clinical outcomes were excluded. Where several reports described the same trial, the most complete report was used.

Comparison Framework and Data Extraction

To allow devices of different design to be compared on a common footing, a six-domain framework was defined a priori. The first domain, airway security, covers isolation of the trachea, resistance to displacement and protection from blood and gastric contents. The second, surgical access, covers the extent to which the device and its connections leave the operative field unobstructed. The third, physiological response, covers haemodynamic and respiratory changes during insertion, maintenance and removal. The fourth, complications, covers laryngospasm, bronchospasm, desaturation, mucosal trauma, sore throat and device-related events such as kinking or dislodgement. The fifth, recovery, covers emergence quality, cough, time to removal and postoperative comfort. The sixth, resource and training requirements, covers the skill, equipment and team familiarity needed for safe use. For each eligible source, the population, procedure, device(s), comparator, principal outcomes and reported effect estimates were extracted into a structured table by one author and checked by a second.

Appraisal and Synthesis

Randomized trials were appraised narratively for the adequacy of randomization, the possibility of blinding, the completeness of outcome reporting and the precision of estimates, bearing in mind that blinding of the anaesthesiologist to the airway device is generally impossible. Findings were synthesised descriptively within each domain, and the strength of the conclusions was graded as strong, moderate or limited according to the consistency of results across studies, the number of participants and the directness of the evidence to ENT practice. Disagreements between reviewers were resolved by discussion.

Ethical Considerations

Because the review analysed only published literature and involved no human participants, institutional ethical committee approval and individual informed consent were not required. The review was conducted and reported with attention to the principles of transparency and accuracy in the use of published data.

RESULTS AND DISCUSSION

Characteristics of the Principal Airway Devices in ENT Surgery

Six device categories account for the great majority of primary airway management in ENT surgery: the oral cuffed tracheal tube (including preformed oral Ring–Adair–Elwyn tubes), the nasal tracheal tube, the microlaryngeal tube, the supraglottic airway (classic, reinforced and second-generation designs), direct and video laryngoscopes as intubation aids, and the flexible fibreoptic bronchoscope. Their principal characteristics, advantages and limitations in the ENT setting are summarised in Table 1

Table 1. Principal Airway Devices Used In ENT Surgery: Characteristics, Advantages and Limitations.

Device	Key features	Advantages in ENT surgery	Limitations
Oral cuffed or preformed (RAE) tracheal tube	Cuff lies below the vocal cords; preformed tubes direct the circuit away from the field	Isolates the trachea; not easily displaced by retraction; permits controlled ventilation	Needs laryngoscopy and adequate depth of anaesthesia or relaxation; pressor response; mucosal trauma; may be

			kinked or compressed by a gag
Nasal tracheal tube	Cuffed tube passed through the nostril	Leaves the oral cavity free for intra-oral and some head and neck surgery	Epistaxis and turbinate trauma; unsuitable in some nasal or skull base pathology; more difficult insertion
Microlaryngeal tube	Small-bore cuffed tube	Cuffed seal with minimal obstruction of the laryngeal view	High resistance and difficult carbon dioxide elimination; airway fire hazard with laser unless protected
Supraglottic airway (classic, flexible reinforced, second-generation)	Cuff seals the laryngeal inlet; reinforced shaft resists compression	Rapid insertion without laryngoscopy; low pressor response; smooth emergence	Seal may be disturbed by gag or head position; kinking or displacement; conversion to intubation may be needed
Direct or video laryngoscope	Intubation aids, not airway devices	Videolaryngoscopy gives a better glottic view and a shared screen for the team	Hyperangulated blades need a shaped stylet; blood or secretions may obscure the view; training required
Flexible fibreoptic bronchoscope	Endoscopic guidance of the tube	Standard for awake intubation and for limited mouth opening or distorted anatomy	Needs expertise and equipment; secretions or blood degrade the view; slower

Three observations follow from Table 1. First, the devices differ fundamentally in where they sit relative to the larynx, and this location determines their behaviour in the shared airway. A tracheal tube lies beyond the vocal cords and isolates the trachea, so its protective function is independent of the surgeon's manipulation of the pharynx; a supraglottic device sits above the glottis and relies on a seal around the laryngeal inlet, so its function may be altered by retraction, gag placement and head position. Second, the devices differ in the stimulus that they impose. Laryngoscopy and intubation provoke a sympathetic pressor response and require adequate depth of anaesthesia or neuromuscular blockade, whereas supraglottic insertion generally does not, which partly explains the more stable heart rate and blood pressure reported with the mask in early trials [11]. Third, the skill and equipment requirements are different. A supraglottic device can be inserted quickly by a wide range of practitioners, but its safe use for tonsillectomy or nasal surgery depends on experience with the specific device, on recognition of early signs of malposition, and on immediate availability of the means to convert to intubation.

Supraglottic Airway versus Tracheal Intubation in Adenotonsillectomy

The evidence for the flexible reinforced laryngeal mask is summarised in Table 2. Across trials, the mask has repeatedly been shown to provide an adequate airway for the great majority of children undergoing adenotonsillectomy, with surgical access that surgeons accept in most cases [10], [14], [15]. The pooled analysis of six randomized trials found no difference in the total number of adverse events between the two devices, with a risk ratio of 0.98 for the composite and non-significant differences for bronchospasm (risk ratio 0.89), laryngospasm (0.68), desaturation (1.40) and coughing (1.08) [17]. The confidence intervals around these estimates are wide, so the absence of a statistically significant difference should not be interpreted as proof of equivalence for any individual complication; nonetheless, the data do not suggest that the

mask is less safe overall when used by experienced teams.

Table 2. Summary of Key Comparative Evidence for the Laryngeal Mask Airway versus the Tracheal Tube in Paediatric Adenotonsillectomy.

Study	Design and population	Comparison	Principal findings
Williams and Bailey [10]	Randomized trial; 104 patients	Reinforced LMA vs tracheal tube	Surgical access not impaired; lower airway protected from blood; less airway obstruction and better airway acceptance in recovery; four patients withdrawn from the mask group
Webster et al. [11]	Randomized trial; 109 children (55 mask, 54 tube)	Armoured LMA vs tracheal tube	Satisfactory airway achieved more rapidly with the mask; lower heart rate and mean arterial pressure; mask abandoned in 9%
Peng et al. [14]	Randomized trial; 131 children (60 mask, 71 tube)	Flexible LMA vs tracheal tube	Laryngospasm 12.5% vs 9.6% (P = .77); shorter time to extubation with the mask; ten masks exchanged for a tube (kinking or poor visualisation)
Sierpina et al. [15]	Randomized trial; 117 patients aged 2 to 18 years	LMA vs tracheal tube	No major disadvantage of the mask; spontaneous ventilation more common in the mask group
Marques et al. [17]	Systematic review and meta-analysis; six trials, 765 participants	Laryngeal mask vs tracheal tube	Total adverse events RR 0.98; surgical time longer by 3.35 min with the mask; blood aspiration 3.6% vs 17.1%; conversion to intubation 4.7%

Two findings deserve particular comment. The first is airway soiling. In the pooled analysis, blood aspiration was recorded in 3.6 per cent of patients managed with the laryngeal mask compared with 17.1 per cent of those managed with a tracheal tube [17], as illustrated in Figure 1(a). This result is counter-intuitive, because the cuffed tube is traditionally regarded as the superior protector of the lower airway. A plausible explanation is that the reinforced mask seals the laryngeal inlet while the cuff of the tracheal tube is positioned below the cords and blood tracks around the tube into the pharynx, from where it can be aspirated at the time of removal; the mask cuff also provides a barrier between the pharyngeal pool and the larynx during emergence, and the mask is usually removed only when protective reflexes have returned. Direct evidence from the earliest randomized trial is consistent with this interpretation, as the reinforced mask protected the lower airway from contamination with blood [10]. It would nevertheless be unwise to conclude that supraglottic devices are intrinsically superior in protection, since the figures depend on how aspiration was detected and on the surgical technique used.

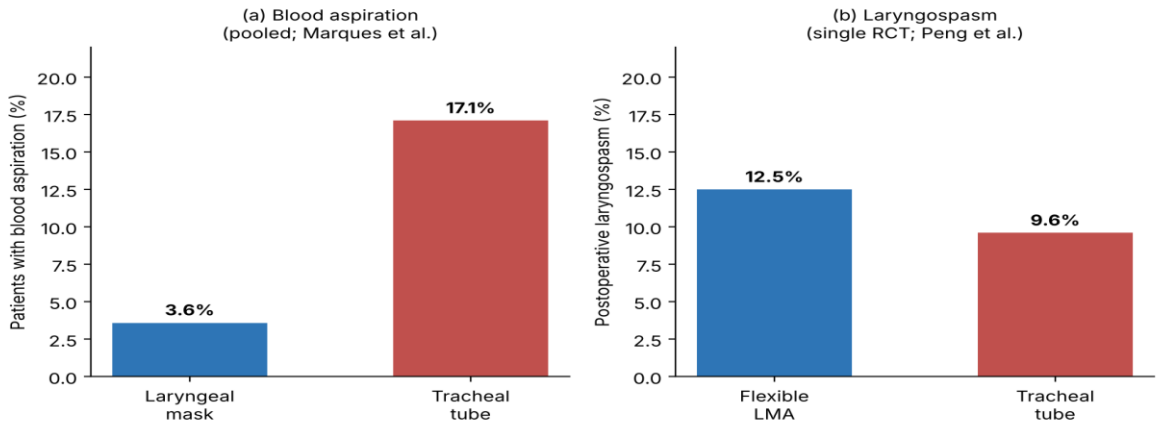


Figure 1. Reported Rates of (A) Blood Aspiration (Pooled Analysis) And (B) Postoperative Laryngospasm (Single Randomized Trial) With the Laryngeal Mask and the Tracheal Tube. Data from [17] and [14].

The second finding is the cost of using the mask in terms of operating conditions. The pooled analysis reported a mean prolongation of surgical time of 3.35 minutes with the mask [17], and every randomized trial that has reported conversions has recorded a proportion of children in whom the mask was abandoned in favour of intubation, whether because of kinking, distal obstruction when the gag was opened, or poor visualisation. In the trial by Webster and colleagues the proportion was about nine per cent [11], in the trial by Peng and colleagues ten of 60 children in the mask group were converted [14], and the pooled rate was 4.7 per cent [17]. These figures are a reminder that the mask is not a universal substitute for the tracheal tube and that conversion must be anticipated in the plan rather than treated as a failure. As shown in Figure 1(b), the incidence of postoperative laryngospasm in the single trial in which it was the primary outcome was numerically higher with the mask than with the tube, but the difference was not statistically significant [14]; the pooled risk ratio of 0.68 points in the opposite direction [17], which illustrates the imprecision of single-trial estimates.

The relative merits of the two devices in recovery are less contentious. Smoother emergence, less coughing and less airway obstruction have been reported with the reinforced mask [10], [15], and time to removal of the device has been shorter with the mask in some trials [14]. These features are valuable in children with obstructive sleep apnoea, in whom airway reactivity at emergence is a recognised concern, although such patients also have a higher baseline risk of desaturation and may be better managed with a tracheal tube in the presence of significant comorbidity. Large series from short-stay practice show that, in selected children and in experienced units, the reinforced mask can be used safely even in a day-care pathway [16].

Nasal, Sinus and Otological Surgery

For nasal and sinus surgery the airway must resist the repeated introduction of endoscopes and instruments into the nasal cavity, blood in the nasopharynx is a constant hazard, and a controlled hypotensive technique is sometimes requested to improve the surgical field. Oral preformed tracheal tubes and reinforced laryngeal masks are both used, with a throat pack being placed by many teams when a tube is used. The reinforced mask has the theoretical advantages of allowing a smoother emergence and avoiding the pressor response to intubation, which may be relevant when bleeding in the surgical field is a concern, but the published randomized evidence is considerably smaller than for tonsillectomy and does not allow firm conclusions about superiority. The general principle established by the systematic review of airway complications with laryngeal masks and tubes, namely that complications differ between devices and procedures and cannot be extrapolated freely, applies with particular force here [9]. Where the risk of significant bleeding into the pharynx

is high, or where the surgeon needs the head to be positioned in a way that threatens the mask seal, a cuffed tube remains the more conservative choice. For short otological procedures in which the airway is remote from the field, the mask offers a simple, low-stimulus option, but the same requirement for access to the airway after draping applies.

Laryngeal, Airway and Head and Neck Surgery

In microlaryngoscopy and in laser or tracheal surgery the airway device must not obstruct the view of the glottis and must be compatible with the surgical energy source. Narrow-bore microlaryngeal tubes provide a cuffed seal with the least obstruction to the view, but their small internal diameter increases resistance and complicates ventilation and carbon dioxide elimination, and they carry the risk of airway fire when lasers are used unless protective measures are taken. Techniques that avoid a tube in the field, including apnoeic oxygenation and jet ventilation, are widely used but require specific expertise and carry their own risks of barotrauma. In major head and neck oncology the airway is often secured by tracheal intubation, frequently by the nasal route, with or without a planned tracheostomy, and the decision is shaped by the extent of resection, the anticipated postoperative swelling and the need for prolonged ventilation. Supraglottic devices have a role principally as a rescue conduit or as a bridge to a definitive airway rather than as a primary device. Evidence in this group is largely derived from case series and local protocols, and the strength of the conclusions that can be drawn is limited.

The Predicted Difficult Airway: Videolaryngoscopy and Awake Techniques

A significant minority of ENT patients present with a difficult airway, either because of the pathology that requires surgery or because of its treatment. Preoperative assessment, using the history, the Mallampati classification [21], assessment of mouth opening and neck mobility, and imaging or nasendoscopy when indicated, remains the starting point, although no single bedside test predicts difficulty reliably. The Cormack–Lehane grade of the laryngeal view obtained at laryngoscopy [20] provides a standard way of documenting the finding for future anaesthetists and should be recorded in the patient's notes.

When difficulty is anticipated, videolaryngoscopy offers an important advantage. The Cochrane analysis indicates that, in comparison with direct laryngoscopy, videolaryngoscopy yields a better view of the glottis and fewer failed intubations [18], and trial data in patients with a predicted difficult airway are in the same direction [19]. For this reason, the 2022 American guidelines encourage consideration of videolaryngoscopy as an initial approach in patients with a difficult airway [5], and the Difficult Airway Society guidance incorporates videolaryngoscopy in the stepwise management of unanticipated difficulty [4]. It is important to recognise, however, that a better view does not guarantee easier tube passage, that hyperangulated blades require a shaped stylet, and that the benefit depends on operator training. In ENT patients with tumours, oedema or distorted anatomy, the view on the screen may also be obstructed by blood or secretions, so suction and a second plan must be at hand.

Where airway patency is genuinely threatened, for example by a supraglottic or laryngeal mass, a deep neck space infection or severe stridor, the safest strategy is frequently to maintain spontaneous ventilation and to secure the airway while the patient is awake. The Difficult Airway Society guidelines for awake tracheal intubation describe the indications, the conduct of topical anaesthesia and sedation, and the choice between flexible endoscopy and videolaryngoscopy in the awake patient [6]. In such cases surgical colleagues should be informed and prepared in advance to perform a front-of-neck access if intubation fails. The corollary for device selection is that a supraglottic device should not be adopted as a primary airway in patients whose upper airway is obstructed by pathology, because it may not bypass the level of obstruction.

Complications, Safety Culture and the Lessons of Audit

Airway complications in ENT surgery fall into three broad groups. The first comprises events related to the device itself: mucosal and dental trauma and sore throat, which are generally more frequent after intubation; laryngospasm and bronchospasm, which occur in both groups; and kinking, dislodgement or malposition of the tube or mask. The second comprises events related to the interaction between device and surgery, such as occlusion of the tube by the gag, extubation of the trachea during repositioning, and soiling of the airway by blood. The third comprises events related to the process of care, including failed or delayed recognition of obstruction, absence of a rescue plan, and equipment unavailability. NAP4 attributed a substantial share of serious events to the latter category, and its authors emphasised that good outcomes depend on assessment, planning, communication and the availability of skilled help [1]. Reviews of failed airway management reach the same conclusion and suggest that attention to human factors is as important as device choice [2].

Several practical implications follow. A formal pre-procedure briefing in which the anaesthesiologist, surgeon and nursing team agree the primary device, the criteria for conversion and the rescue plan reduces the risk that conversion is delayed. Capnography should be used continuously, and its disappearance or deformation should prompt immediate evaluation of the airway irrespective of the device in use. After repositioning of the head or insertion of a mouth gag, the airway should be rechecked, since this is the commonest moment for tube displacement or obstruction. For supraglottic devices, intracuff pressure and seal should be rechecked, and airway pressures should be monitored for trends that suggest malposition. At the end of surgery, the team should agree the conditions for device removal, whether deep or awake, and the immediate postoperative position and suction should be prepared.

A Framework for Device Selection

The synthesis above suggests that device selection should be a structured sequence of questions rather than a default. The framework shown in Figure 2 is proposed as an aid to this process; it is a conceptual synthesis by the authors based on the evidence reviewed, and it is not a substitute for clinical judgement or for local protocols. The first question concerns the patient: whether there is a predicted difficult airway or an obstruction that threatens ventilation. If there is, the priority is a secured-airway plan, which usually means an awake or videolaryngoscope-assisted technique with an agreed surgical back-up [4], [5], [6]. The second question concerns the procedure: whether the shared airway field entails high bleeding, aspiration or laser and cautery risk. If it does, a cuffed tracheal tube of an appropriate type remains the conservative choice. The third question concerns the team and the circumstances: whether the procedure is of short to moderate duration, whether the surgeon is accustomed to working with a supraglottic device and whether conversion equipment is immediately available. When all of these conditions are met, the flexible reinforced mask is a reasonable option, particularly in uncomplicated paediatric adenotonsillectomy [17].

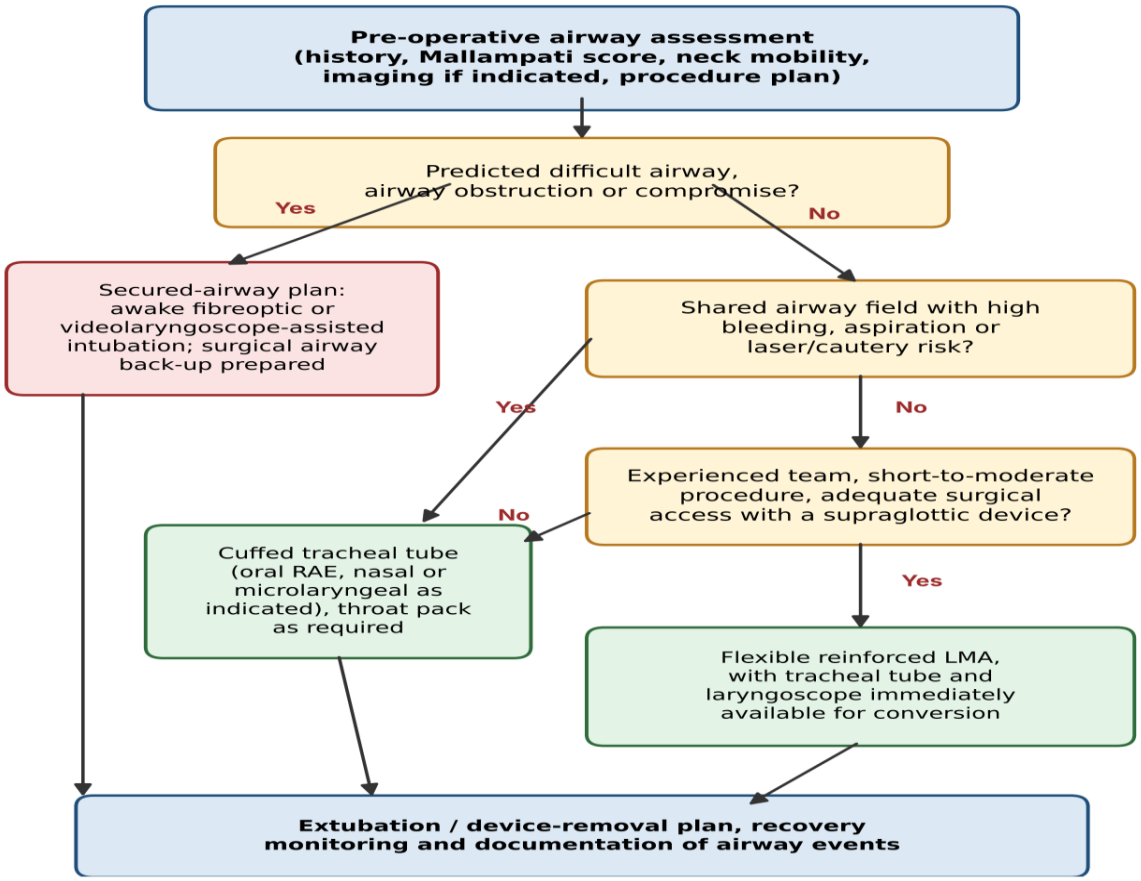


Figure 2. Proposed Framework for Selecting the Primary Airway Device in ENT Surgery (Conceptual Synthesis by the Authors).

The framework deliberately leaves room for local variation. The threshold at which a team accepts a supraglottic device depends on its experience and on the case mix. Teams starting to use the reinforced mask for tonsillectomy would be well advised to begin with low-risk patients, to audit their conversion and complication rates, and to extend the indications only as experience accumulates. The framework also treats extubation as part of the plan, in keeping with guideline recommendations that the whole of the airway pathway, and not only its induction, should be anticipated.

Strengths, Limitations and Implications for Research

The strength of this review is that it compares the whole spectrum of airway devices within a single framework and links the comparative evidence to guideline-based practice. its limitations should also be acknowledged. As a narrative review it is vulnerable to selection bias, despite the use of a defined search approach and eligibility criteria, and it does not provide new pooled estimates. Most of the quantitative comparative evidence concerns children undergoing adenotonsillectomy, which limits generalisability to adults and to other ENT procedures. Trials differ in device model, in the use of neuromuscular blockade, in surgical technique (cold steel versus coagulation or coblation dissection) and in the definitions of outcomes, and the pooled estimates carry wide confidence intervals [17]. The lack of blinding in device comparisons introduces a risk of performance and detection bias, particularly for subjective outcomes such as recovery quality. Finally, the proposed selection framework is based on synthesis of existing evidence and expert reasoning, and it has not been prospectively validated.

Several research priorities emerge. Adequately powered randomized trials are needed in adult tonsillectomy, nasal and sinus surgery and short laryngeal procedures, with standardised,

clinically meaningful outcomes such as conversion, desaturation, airway soiling and quality of recovery. Comparative studies of second-generation supraglottic devices in ENT surgery are scarce. The benefit of routine videolaryngoscopy for ENT patients without a predicted difficult airway, including its effect on trauma and on first-pass success, needs to be examined in ENT-specific populations. Finally, prospective validation of decision aids for device selection, together with registry-based audit of airway events in ENT surgery, would help translate the evidence into safer practice.

CONCLUSION

Airway management in ENT surgery requires a deliberate choice among devices that differ in security, surgical access, physiological effect, complication profile and demands on the team. The evidence is strongest for paediatric adenotonsillectomy, where the flexible reinforced laryngeal mask is an effective alternative to the tracheal tube in experienced hands, with comparable overall adverse events, less blood in the airway and a smoother emergence, offset by a longer operative time, a small but real rate of conversion and device-specific issues such as kinking and displacement [17]. For other ENT procedures, the cuffed tracheal tube remains the conservative standard wherever bleeding, aspiration, laser use or loss of access to the airway are significant concerns. For patients with a predicted difficult airway, videolaryngoscopy improves the view and reduces failed intubation, and awake techniques remain central when patency is threatened [18], [6]. Because no device is universally superior, selection should be individualised, based on structured assessment of patient, procedure and team, accompanied by an explicit plan for conversion and rescue, and supported by training and audit. High-quality trials in non-tonsillar ENT surgery are the most pressing need.

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Author Contributions Statement

D.K. conceptualised the review, designed the comparison framework and drafted the manuscript. K.B. contributed the otorhinolaryngological perspective, surgical considerations and critical revision. S.A. contributed to literature screening, data extraction and editing. P.P. contributed to the anaesthetic and critical-care sections, the figures and critical revision. All authors read and approved the final version of the manuscript.

Conflict of Interest Statement

The authors declare that they have no known financial or personal conflicts of interest that could have appeared to influence the work reported in this article.

Informed Consent

Informed consent was not applicable, as this review analysed published literature and did not involve human participants or identifiable patient data.

Ethical Approval

Ethical approval was not required for this narrative review, since it did not involve human participants, patient records or animals.

Data Availability

No new datasets were generated or analysed. All data discussed are available in the cited published sources.

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