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Review

Local airway anaesthesia for awake fibreoptic intubation

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ABSTRACT

Local airway anaesthesia for awake fibreoptic intubation is generally recommended to improve patient comfort, which will help make the procedure a success. There are multiple approaches in practice and several descriptions of methods in the literature. However, there is limited evidence regarding which method is the most common and which offers the best results. This review presents current data about topicalisation of the airway, including nebulisation, spray-as-you-go techniques and airway nerve blocks. This article aims to help the anaesthesiologist choose the right method, tailored to the individual needs of his patients, after weighing up the advantages and disadvantages of the presented methods.

Contents

1. Introduction

Well-performed awake intubation is a complex interaction of appropriate case selection, good patient preparation and technical expertise in e.g. fibreoptic intubation. It is generally recommended that preparation of the awake patient includes anaesthesia of the airway in order to optimise the patient's comfort, increase compliance and therefore maximise the chance of a successful intubation in the spontaneously breathing patient.

Several ways to administer local anaesthetic to the upper airway have been described, each with its own potential advantages and disadvantages. Surprisingly, there is limited evidence regarding which method of airway anaesthesia is the most commonly used and which offers the best results in terms of effectiveness. Nowadays, awake fibreoptic intubation is less common than video laryngoscopy, being reserved for special airway situations. Therefore, local airway anaesthesia is a rather neglected topic. The method used to anaesthetise the airway depends on institutional standards, often as a result of tradition, and on personal preferences

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and skills. In recent decades only a few new findings and technical developments have been published.

In this review we will give an overview of the current literature focusing on the different methods of local airway anaesthesia for awake fibreoptic intubation (see Table 1).

2. Techniques for supraglottic topical anaesthesia

Data assessing the effectiveness of local anaesthetic, vasoconstrictive and lubricating agents for preparing the supraglottic airway above the vocal cords (nose, mouth and throat) are the result of otolaryngologic scientific research since this area of the airway is also of great interest in otolaryngology. Surprisingly, there is a lack of suitable data for meta-analysis [1]. The absence of an evidence-based effect of nasal sprays (cocaine, lidocaine, co-phenylcaine, tetracaine, ephedrine, phenylephrine, xylometazoline and saline), reported in a review including eight randomised controlled trials (746 participants), even led some authors to suggest that these agents should not be used due to their cost and unpleasant side effects [2]. In clinical practice unwanted side effects such as foul taste, numbness and overall unpleasantness are common in the majority of patients.

Direct application of local anaesthetic into the nose, mouth and throat has been performed using cotton-tipped swabs or nasopharyngeal airways, drops, gel, swish and gargling, aspirating and spraying of local anaesthetic [3]. In our opinion, topicalisation of the supraglottic airway helps the patient to become gradually more familiar with awake intubation. However, airway anaesthesia with regard to awake fibreoptic intubation pays more attention to the deeper airway regions like the hypopharynx, larynx and trachea. For this region three methods have been identified: nebulisation of local anaesthetic, spray-as-you-go techniques and airway nerve blocks.

3. Nebulisation

Only one study comparing nebulisation of local anaesthetic with placebo was in favour of the nebulisation technique. Nebulised lidocaine (4 ml 10%) decreased the discomfort of nasogastric tube insertion of 29 participants in comparison to 21 participants who received normal saline solution [4].

A recent study compared the effectiveness of nebulised lidocaine [5]. Fifty adult patients with cervical spine injury and the need for awake fibreoptic intubation received either airway anaesthesia using ultrasonic nebulisation of 10 ml lidocaine 4% for 15 min or bilateral superior laryngeal nerve block combined with transtracheal injection, each with 2 ml of lidocaine 2% after gargling viscous lidocaine twice beforehand. Orotracheal intubation was performed and showed no differences in haemodynamic parameters, most likely because of a sufficient sedation protocol (midazolam 20 $\mu g^{*}kg^{-1}$ and fentanyl 1 $\mu g^{*}kg^{-1}$ intravenously). Vocal cord visibility, ease of intubation and overall comfort were better in the nerve block group. Additionally, there were fewer coughing and/or gagging episodes in this group. Seven patients in the nerve block group experienced coughing (nebulisation group: 17 patients) and six patients receiving nerve blocks suffered from gagging (nebulisation group: 16 patients). Time taken to intubate was also shorter in the nerve block group (123.0 ± 46.7 s) as compared with the nebulisation group (200.4 ± 72.4 s). Nebulisation itself required 15 min. This study is consistent with previous publications, also demonstrating that nerve blocks are superior to nebulisation of local anaesthetic.

In an observer-blinded study the efficacy of upper airway anaesthesia produced by nebulised lidocaine was compared with combined regional block for awake fibreoptic nasotracheal intubation in 48 patients [6]. Nebulisation was performed using a small volume nebuliser filled with 4 ml of 4% lidocaine driven by a flow of 8 l of oxygen per minute, connected to a facemask strapped over the patient's mouth and nose for 10 min. Patients in the combined regional block group received a combination of bilaterally superior laryngeal nerve blocks performed by the external approach (2–3 ml lidocaine 2% per site) and translaryngeal injection (2 ml lidocaine 4%). In addition, three cotton swabs (soaked in 4% lidocaine solution) were introduced in the selected nostril and kept in place for 3 min in the nerve block group. Fibreoptic intubation was successful in all patients. The total intubation time was comparable between groups (nebulisation group: 5.1 ± 1.2 min, combined nerve block group: 4.5 ± 1.3 min). The patients' own assessment of discomfort did not reveal any significant differences between the methods. Higher grimace scores (0 = no grimace to 5 = very severe grimace) were recorded on insertion of the endotracheal tube through the nostril in the nebulisation group. This is not surprising, since patients who received combined nerve blocks had an additional three lidocaine-soaked cotton swabs in the selected nostril. The simpler method of placing lidocaine-soaked cotton swabs in the nose provided better anaesthesia than nebulisation. The combination of nerve block and translaryngeal injection suppressed the cough response more effectively and provided better haemodynamic stability than nebulisation alone.

A preference for translaryngeal injection was found in comparison to spray-as-you-go and nebulisation techniques for fibreoptic bronchoscopy [7]. Patients indicated better VAS scores and bronchoscopists recorded less coughing and easier intubation. At the same time, most anaesthesiologists preferred translaryngeal injection for topical anaesthesia. However, the study was performed in an unblinded fashion and the dose of lidocaine administered was small. Patients (n = 53) received either 4 ml of 2.5% cocaine by translaryngeal injection (n = 18) or via the working channel of the

Table 1
Overview of different methods for local airway anaesthesia.

	✓	✗
Spray-as-you-go techniques	•Easy to learn and perform •Flexibility by selectively and repetitively anaesthetising the airway •Superiority regarding patient comfort and coughing when using an oxygen flow (vaporisation and Enk technique) in comparsion to bolus technique	•in case of airway stenosis and/or using high oxygen flow: risk of barotrauma and gastric insufflation
Nebulisation	•Easy to learn and perform	•superiority only in comparison with placebo •additional time prior to intubation (15 min) •cooperation of patient
Airway nerve blocks	•Superiority in case of copious secretions and airway swelling (decreased effectiveness of topical anaesthesia) •easy to learn and perform •when glottis opening is so narrowed e.g. by a large tumor and passing the fiberscope is only possible for a few seconds (for intubation)	•Invasiveness: risk of bleeding, emphysema •Risk of accidental intraarterial injection of local anaesthetic - > convulsion •Cooperation of patient •Identification of landmarks and knowledge of anatomy

endoscope (n = 19) or had 4 ml of lidocaine 4% delivered by nebuliser 20 min before the procedure.

The nebulisation technique produced similar results to nerve blocks in a comparative study of awake intubation in neurosurgical patients [8]. The 19 patients sedated with fentanyl and midazolam who received 50 mg lidocaine sprayed directly onto the tongue followed by bilateral glossopharyngeal block and superior laryngeal nerve block (0.5–2 ml lidocaine 2% per injection site) plus transtracheal injection (3 ml lidocaine 4%), showed no difference in perception of discomfort during the procedure compared to 21 patients who received 20 ml nebulised lidocaine 4% (oxygen flow 10 l min^{-1}) plus transtracheal injection of 3 ml lidocaine 4%.

A prospective study examined the effectiveness of mouthpiece nebulisation in combination with nasal swab stick packing for topical anaesthesia prior to awake fibreoptic nasotracheal intubation [9]. In 30 patients with an expected difficult intubation, 5 ml lidocaine 2% was nebulised by a micronebuliser using oxygen 10 l*min^{-1} as a driving gas through a standard mouthpiece. Additionally, 1 ml cocaine 10% on a cotton swab-stick was applied to the selected nostril for 15 min. Awake fibreoptic nasotracheal intubation was performed with a success rate of 100%. Eighty percent of the participants were satisfied with the technique, however 23% required additional spray-as-you-go anaesthesia using 5 ml lidocaine 1%. The mean duration of awake fibreoptic nasotracheal intubation was 119.0 ± 76.8 s.

The combination of nebulisation and spray-as-you-go technique for topical local anaesthesia of the airway produced good conditions for awake nasotracheal fibreoptic intubation in a small group of 25 unsedated anaesthetists [10]. Five ml lidocaine 4% were administered by nebuliser and supplementary lidocaine to a maximum total of 9 mg*kg^{-1} was applied directly and via fibrescope. All 25 anaesthetists reported endoscopy and intubation as “acceptable”; three even found it “enjoyable”. In this study the median lidocaine dose was 8.8 mg*kg^{-1}, and plasma lidocaine concentration measurements were lower than 5 mg*l^{-1}. Four volunteers reported feeling lightheaded with no evidence of hypotension. Two of them recorded the highest peak plasma lidocaine concentrations (4.5 and 3.5 mg*l^{-1}). Subjects noted other symptoms including dysphoria, euphoria, dizziness, nausea and shivering.

3.1. *Nebulisation of atomised lidocaine*

Wieczorek and Woodruff demonstrated the rapidity, effectiveness and safety of a specific nebulisation technique using a modified glass atomizer with an adjustable tip [11], [12]. The modification consisted of an orifice, cut proximal to the atomizer into the tubing that connects the atomizer to the oxygen source (10 l*min^{-1}). This modification facilitates nebulisation of large doses of lidocaine (40 ml) over a short time (5 min). An additional benefit is the adjustable tip, permitting the operator to target the spray on sensitive areas like the tongue, hard and soft palate and pharynx. Atomised lidocaine 2% was compared with 4% [11] and 1% with 2% [12] for topical airway anaesthesia in morbidly obese patients undergoing awake fibreoptic intubation. There were no differences in haemodynamic parameters or patient tolerance between the 2% and 4% lidocaine groups. In a follow-up study, Woodruff found that atomised lidocaine 1% provided inferior airway anaesthesia compared to 2% lidocaine. In both the 2% and 4% group, the total dose of lidocaine administered was greater than the 8.2 mg*kg^{-1} recommended by the British Thoracic Society [13]. However the plasma level in the group using lidocaine 4% was at the lower limit of the toxic range and there were no signs of clinical local anaesthesia toxicity in these studies. The authors assumed that a significant amount of lidocaine was lost to the atmosphere or might have been swallowed. Furthermore, they refer to the known increased plasma volume and its difficult prediction in morbidly obese patients. However, concerns about lidocaine toxicity appear to be justified [14], especially if one considers that plasma lidocaine levels achieved in the individual patient are often unpredictable, even though a safe dosage has been used [10], [15], [16]. Systemic toxicity of lidocaine, ranging from circumoral numbness, metallic taste, auditory changes to seizures, loss of consciousness and complete cardiorespiratory collapse, has been reported for airway anaesthesia [17], [18], [19].

In summary, nebulisation of local anaesthetic requires additional equipment. In its simple form, nebulisation can be achieved with a high oxygen flow (8–10 l*min^{-1}) as the carrier gas using a standard nebuliser. More sufficient nebulisers use ultrasounds to produce an aerosol flow. Nebulisation requires additional time prior to fibreoptic intubation. In general, 15 min is sufficient for nebulisation. Taking into account the recommended local anaesthetic dosages and individual factors like weight and metabolization rate, nebulisation seems a safe method. The clinical safety of nebulisation of atomised lidocaine was only observed in the morbidly obese. Nevertheless, the current literature confirms the superiority of other methods, especially combinations of several approaches for local airway anaesthesia for awake intubation.

4. Spray-as-you-go techniques

The spray-as-you-go technique involves local anaesthetic application while advancing the tip of the fibrescope. Several different variations of this technique have been described.

Classical bolus application of local anaesthetic through the working channel of the fibrescope is a routinely used method [3]. Initial experiences with the spray-as-you-go technique for diagnostic bronchoscopy were published in the 1990s [20], [21]. The spray-as-you-go technique can also provide clinically good conditions for awake intubation [22], [23]. The method can provide flexibility by selectively and repetitively anaesthetising the airway. It is a suitable choice for most awake fibreoptic intubations.

However, injection of several ml of local anaesthetic through the working channel may evoke patient discomfort and can provoke coughing and gagging because of the strong spurt striking the airway mucosa. Several efforts have been made to reduce this limitation.

Use of an epidural catheter (or a long angiographic catheter) cut to the length of the fibrescope and inserted through the suction port is repeatedly recommended in the literature as a modified spray-as-you-go technique [24], [25], [10]. Attached to a three-way tap and an oxygen supply of 1 l*min^{-1}, injected lidocaine is believed to emerge distally as a fine spray. Furthermore, several authors suggest that the fine jet of local anaesthetic can be precisely targeted at areas of mucosa at up to 5 cm distance from the tip of the endoscope. The outcome of this modification has not yet been confirmed due to a lack of prospective, controlled and randomised studies. It has been proposed that the local anaesthetic can be dispersed more efficiently when delivered through an epidural catheter placed in the airway through the working channel [24]. However, a limitation of this technique is that an experienced operator is needed to successfully manoeuvre the local anaesthetic application. Additionally, using an epidural catheter for local anaesthetic application was reported to be costly and time consuming [16], [24].

Both 2% and 4% lidocaine administered topically by this modified spray-as-you-go technique provided acceptable intubating conditions in sedated patients with a difficult airway [16]. Intubating conditions were assessed based on patient reaction (facial expression) and cough severity. Patients were included in this study if a staff anaesthesiologist not involved with the study determined that they would require an awake fiberoptic intubation because of an expected difficult airway. Three ml of either 2% lidocaine or 4% lidocaine were slowly sprayed in three aliquots of 1 ml onto epiglottic vallecula and in the vicinity of the piriform recess. After 5 min, this procedure was repeated. After another 5-min waiting period, the fibreoptic bronchoscope was reinserted to expose the glottis and 0.5 ml of the study drug was sprayed into the laryngeal area. This procedure was repeated at 3-min intervals until adequate anaesthesia of the vocal cords, as evidenced by cessation of the laryngeal response to further lidocaine administration. The fibreoptic bronchoscope was then advanced into the trachea and its tip was positioned 2 cm below the vocal cords. During inspiration, 3 ml of the study drug was sprayed into the trachea. For a comparable effect, 2% lidocaine requires a smaller dosage and results in lower plasma concentrations. The mean dosage of lidocaine was 3.4 ± 0.6 mg*kg^{-1} in the group using lidocaine 2% and 7.1 ± 2.1 mg*kg^{-1} in the group using lidocaine 4%. Peak plasma lidocaine concentrations assayed in all patients were below 5 μg*ml^{-1} [16].

Local anaesthetic injected via the working channel of a fibrescope or by an epidural catheter results in a splash and therefore can potentially cause discomfort and coughing. In a study examining the effect of using a mist for mucosal anaesthesia for fibreoptic intubation the MADgic® atomizer (Wolfe Tory Medical Inc., Salt Lake City, UT, USA) and a fibreoptic bronchoscope were bound together to a unit with an elastic 5 mm lactoprene tube (3 cm in length) [26]. The MADgic® atomizer has the ability to apply atomised topical solution directly onto the airway mucosa [27]. The applicator portion (stylet) is bendable and therefore optimal for positioning for this purpose. The aim of this study was to provide successful topical anaesthesia of the hypopharynx, larynx and trachea before awake tracheal intubation in 15 patients who had a predicted difficult intubation. After topical anaesthesia of the oropharynx using the traditional spray technique and intravenous application of fentanyl (1.5 μg*kg^{-1}) and midazolam (range 1–8 mg), the airway intubator was inserted into the oropharynx and a jaw thrust was performed by an assistant. Three ml lidocaine 2% was sprayed in three aliquots on the piriformis recess and epiglottic vallecula. After a 3-min waiting time an additional 1 ml lidocaine 2% was sprayed onto the vocal cords. This procedure was repeated two or three times until adequate anaesthesia of the vocal cords was observed. Then the unit was advanced 2 cm below the vocal cords and 2 ml lidocaine 2% were sprayed into the trachea during deep inspiration. Fibreoptic intubation was started 5 min after the tracheal spray. In all patients the unit was successfully directed to the different targeted areas using one or two attempts. After the final spray, the mean VAS for pain, anxiety and coughing was 7.8, 6.5 and 5.2 respectively (where 0 indicated awful and 10 enjoyable). All subjects described the spray as acceptable. The time required for the whole procedure ranged from 21 to 28 min. The median lidocaine dose was described as 2.5 mg*kg^{-1} without any side effects. The authors concluded that this technique can provide excellent topical anaesthesia, is well tolerated by the awake patient and is non-invasive and places no restrictions on the patient's head or neck position. The limitation is its inability to anaesthetise the nasal mucosa because of the external diameter (6–8 mm) of the unit [26].

It is generally accepted that the additional application of low oxygen flow (2–4 l*min^{-1}) through the working channel during fibreoptic intubation allows higher inspiratory oxygen delivery, keeps the fibrescope's lens clean, disperses mucous secretions away from the lens, prevents fogging, allows a better view and aids in dispersing the local anaesthetic finely [28], [29]. In comparison to injection of local anaesthetic through the working channel of the fibrescope, it was shown that the supply of 3 l*min^{-1} oxygen flow through the working channel for awake intubation (vaporisation technique) decreases overall intubation time, increases the oxygen saturation of the patient until completion of the intubation and reduces coughing [30]. The vaporisation technique included four applications of 2 ml lidocaine 2%. The control group included the insufflation of 3 l*min^{-1} oxygen via a nasal probe and two applications of 4 ml of lidocaine 2%, each followed by a maximum of 2 min to take effect. The median time from inserting the fibrescope until inflating the cuff was 206 s using the vaporisation technique and therefore 133 s faster than in the control group. Oxygen saturation after having completed the procedure was 100% in the vaporisation group and only 96% in the control group. The incidence of overall coughing in the vaporisation group was 59% compared to 80% in the control group.

A higher flow of oxygen is thought to result in finer dispersal of the injected local anaesthetic. In a prospective, randomised, controlled study, the atomizer technique was compared to the classical bolus application of topical anaesthesia via the working channel for awake fibreoptic intubation. The Enk Fiberoptic Atomizer Set™ (Cook Medical, Limerick, Ireland) is intended for the spray-as-you-go technique using high oxygen flow (10 l*min^{-1}) to atomise the local anaesthetic. The atomizer technique was superior to bolus application of local anaesthesia. Patients who received mucosal anaesthesia with the Enk Fiberoptic Atomizer Set™ reported a better level of comfort (IQR [range]) VAS; 1 ([1–3]) vs. 4 ([2–6]), $p < 0.0001$, experienced fewer coughs (6 [3–10], control: 11 [6–13]; $p = 0.0055$) and fewer distinct coughing episodes (7%, control: 27%; $p = 0.0133$). The atomizer technique was faster (5 min [3–6] vs. control: 6 [4–7]; $p = 0.0009$) and required less topical lidocaine (100 mg [100–100 mg] vs. control: 200 mg [200–200 mg]; $p = 0.0001$) [31].

These results contrast with a study examining the Enk Fiberoptic Atomizer Set™ using a low flow approach to administer local anaesthesia to the airway [32]. In a randomised controlled study the superiority in rapidity of translaryngeal injection was shown compared to the Enk Atomizer technique using low flow oxygen (4 l*min^{-1}) for topical anaesthesia for awake fibreoptic intubation in patients at risk of secondary cervical injury [32]. Mean time for awake intubation (this period included the time required to administer the topical anaesthesia) was shorter using translaryngeal injection (191 s = 3 min) in comparison to the Enk Atomizer technique using low flow oxygen (430 s = 7 min). The study protocol required three applications of local anaesthetic, each followed by a 1 min waiting time with removal of the fibrescope during applications. In contrast, Pirlich et al. did not remove the fibrescope after each application of local anaesthetic and followed the usual approach for a spray-as-you-go technique, which was therefore 2 min faster. The investigators in Malcharek et al.'s study observed no differences in comfort evaluation and topical lidocaine dosage (translaryngeal injection: 4.8 mg*kg^{-1}, Enk Atomizer using low flow oxygen: 4.7 mg*kg^{-1}) between the two groups. The percentage of patients with persistent coughing was 5% in the translaryngeal injection group and 7% in the Enk Atomizer group using low flow oxygen and therefore comparable with the 7% of distinct coughing episodes in Pirlich's Enk Atomizer group using high oxygen flow.

Rare but potential complications of using a constant oxygen flow (3–5 l*min^{-1}) through the working channel of an intubation fibrescope include gastric insufflation and organ rupture [33], [34], [35]. Complications occurred during difficult visualisation of airway structures, a prolonged procedure or accidental oesophageal intubation. Barotrauma of the lung is theoretically possible if the intubation fibrescope is passed through a narrowed glottis and passage of the tracheal tube is delayed because of a narrowed airway. For these reasons, some authors do not recommend applying oxygen through the working channel of an intubation fibrescope [36]. None of the above-mentioned complications was observed in the two studies investigating the Enk Fiberoptic Atomizer Set™ [32], [31]. An explanation for this could be the flow-control opening of the Enk Fiberoptic Atomizer Set, a 2 mm hole placed opposite the injection port of the three-way-sidearm fitting, which allows flow and pressure release if no injection is performed. It is assumed that there is no continuous high oxygen flow and pressure at the distal end of the working channel of the fibrescope, because oxygen can escape through the flow-control opening. Only at the moment of injection, when it is closed, might the subsequent airway structures be under a higher pressure.

5. Airway nerve blocks/regional anaesthesia

Three airway nerve blocks are commonly described: Glossopharyngeal block, superior laryngeal block and translaryngeal block. The so called "translaryngeal block" is in the proper meaning of the word not a nerve block but more correctly describes an injection technique through the cricothyroid membrane. Due to its invasiveness it is therefore often grouped with the nerve blocks [3].

5.1. Glossopharyngeal block

According to the literature, blockade of the glossopharyngeal nerve seems to be reserved for very specific airway situations. A case report of a patient with severe preeclampsia and HELLP syndrome, who required caesarean section, describes the rationale for the use of this unusual technique [37]. Impossibility of regional anaesthesia due to the presence of worsening coagulopathy, known difficult intubation and airway oedema associated with pregnancy, worsened by preeclampsia, forced the authors to perform an awake intubation. The oral approach was chosen to avoid nasal bleeding within the deranged coagulation situation. Assuming that copious secretions and airway swelling due to capillary engorgement would decrease the effectiveness of topical local anaesthetics, they decided to perform bilateral glossopharyngeal block (each side with 3 ml lidocaine 1%) with, on each occasion, 5 ml lidocaine 1% administered via the working channel onto the vocal cords and into the trachea. The authors renounced the use of mucosal vasoconstrictors to prevent changes in the uteroplacental blood flow. As described in this report, this combined technique was safe and effective for performing awake fibreoptic intubation, preventing an exaggerated hypertensive response in this preeclamptic patient. Furthermore, based on the experience of the authors, the block was easy to learn and perform.

To attenuate gagging, which is usually associated with awake LMA insertions, glossopharyngeal nerve blocks were performed bilaterally with the aid of a paediatric GlideScope in a 1-month-old infant with Pierre-Robin syndrome [38]. The background for this is the fact that firm pressure on the base of the tongue (caused also by direct laryngoscopy) elicits a gag reflex, which is mediated by pressure receptors, which are submucosal and hence not susceptible to topical anaesthesia [39]. In this context we see no mandatory need for glossopharyngeal nerve block for fibreoptic intubation.

5.2. Superior laryngeal block

Different case reports presented successful airway anaesthesia achieved with superior laryngeal nerve block [40], [41], [42], [43]. In our opinion, topical anaesthesia could have been a simple and clear alternative in all patients.

One of the first and numerically the largest study described the performance of superior laryngeal nerve block in 135 patients requiring awake endotracheal intubation, bronchoscopy or laryngoscopy [44]. The success rate was 92% and only two complications occurred (a small, well-circumscribed haematoma, which was contained with manual pressure, and a cuff penetration in a previously intubated patient). Convulsion after receiving left superior laryngeal nerve block, probably caused by accidental injection of local anaesthetic into the vertebral artery, was described as another potential complication of superior laryngeal nerve [45]. In the four, above-mentioned case reports, ultrasound was used to help successfully perform the block without diagnosing complications. Therefore, a recent volunteer and cadaver study aimed to develop an anatomical concept for such a technique that is easy to teach, learn and perform. The authors proposed the concept for a new, simpler, consistently reproducible ultrasound-guided block technique, using the thyroid membrane rather than identifying the nerve itself, to define the target plane for low-volume local anaesthetic injection [46].

5.3. Translaryngeal block

There are two recent case reports of translaryngeal injection for awake fibreoptic intubation. One reported a 38-year-old female with a body mass index of 57.4 kg*m^{-2} who was scheduled to undergo a Roux-en-Y gastric bypass. Due to a potential difficult airway an awake fibreoptic was performed. The pharynx was sprayed with a combination of 4% benzocaine and 2% tetracaine. The patient was sedated with midazolam 3 mg and ketamine 20 mg intravenously. An injection of 4 ml lidocaine 4% was given through the side port of the fibrescope. After two failed attempts of blind puncture, the block was performed under ultrasound-guidance [47]. Four ml lidocaine 4% was injected through a 20 G angiocath, inserted through the patient's skin and advanced into the larynx, at the end of exhalation. The fibrescope was then inserted below the vocal cords without triggering a cough reflex followed by the easy placement of the tracheal tube into the trachea. The indication to perform a translaryngeal block in this super morbidly obese patient and the advantage of this technique can be debated in the face of alternative topical airway anaesthesia techniques. However, this and other cases illustrate the value of ultrasound assistance in an upper airway block in a patient whose landmarks could not be identified correctly using traditional palpation [48], [42].

A real advantage of translaryngeal block was clarified in a case where the glottis opening was so narrowed by a large obstructive vocal cord polyp that the spray-as-you-go-technique was not feasible, because passing the fibrescope through the glottis was only possible for a few seconds [49]. The investigated patient presented increased shortness of breath, which required rapid troubleshooting.

As mentioned in the section on spray-as-you-go techniques, a controlled randomised study compared translaryngeal injection and Enk Fiberoptic Atomizer for topical anaesthesia for awake fibreoptic intubations in patients at risk of secondary cervical injury. The only advantage of the translaryngeal injection was the gain of time achieved using this quick technique. In one patient, the attempted translaryngeal injection was abandoned because air could not be aspirated through the injection needle. However, more mucosal bleeding was found in the trachea. One patient receiving acetylsalicylic acid required two attempts at translaryngeal injection and exhibited persistent tracheal bleeding for 3 days [32]. Complications are not insignificant due to the invasiveness of this method, and include intraarterial injection, haematoma formation and tracheal injury such as subcutaneous emphysema that could lead to airway obstruction in the worst case scenario. There are no data on anticoagulation and the safe performance of airway nerve blocks. Overall complications seem to be rare [50], [51]. Considering the contraindications, careful aspiration before injection, small-volume lidocaine, ultrasound guidance and experienced hands minimise the risk.

In another randomised, multicentre clinical comparison between awake fibreoptic and awake videolaryngoscopic tracheal intubation translaryngeal injection was part of the airway anaesthesia concept [52]. The authors decided to perform translaryngeal injection because they thought that awake videolaryngoscopic intubation may not prove as easy as the spray-as-you-go technique. Ninety-three adult patients with anticipated difficult intubation, randomly allocated into the two groups, were given topical lidocaine orally (20 mg 10% metered lidocaine spray) and a translaryngeal injection of 100 mg lidocaine. Investigators found no difference in the primary endpoint, time to tracheal intubation, between the groups (80 s with fibrescope, 62 s with videolaryngoscope). However in seven patients from both groups transtracheal lidocaine injection was impossible as the cricothyroid membrane could not be identified, due to previous neck radiation therapy (two patients), neck obesity (two patients), enlargement of the thyroid gland (one patient) and lateral tracheal displacement (two patients). Five patients had minor bleeding during the procedure requiring no further treatment.

A fundamental condition for an airway nerve block is a cooperative patient and the knowledge of anatomy and the identification of landmarks. This can be difficult especially in the population of patients who require an awake fibrescope (scars, tumours, inflammation, injuries in the neck, status after radiotherapy in the head/neck area, status after operation on pharynx, goitre, limited neck extension, large neck circumference, limited mouth opening, etc.). Often awake intubation is indicated at the same time as there being a limited indication for a translaryngeal block.

In summary, airway nerve blocks should be reserved for special airway situations. Besides, we believe that translaryngeal injection could serve as technical training for emergency needle cricothyrotomy. In addition, rescue oxygenation can be established through the cannula in the case of failed fibreoptic intubation or airway obstruction.

In this context it should not be forgotten, that any form of lidocaine application may cause acute airway obstruction itself, especially in patients presenting a pre-existing stridor. Therefore local airway anaesthesia should always be done under close monitoring.

6. Conclusion

Well-performed awake intubation is a complex interaction of appropriate case selection, good patient preparation, and technical expertise in performing this method of tracheal intubation. Local airway anaesthesia is only one part of the whole concept of awake intubation. Currently available data do not allow for a conclusion on the ideal method for local airway anaesthesia. The heterogeneous clinical situations, and the different outcome parameters of the studies that have evaluated the efficacy of awake tracheal intubation make comparison difficult. It is rather a question of which method fits best to the demands of the individual patient, given a wide spectrum of anatomical variability, perception of discomfort and expectations, and which method is ideally suited to the clinical situation.

Regardless of the selected local airway anaesthesia method, failure rates of awake fibreoptic intubation in previous large-scale studies were 1%–2% [53], [54], [55]. Knowledge about the different methods' advantages and disadvantages can be weighed up and the anaesthesia specialist will find the right way to anaesthetise the airway for awake fibreoptic intubation according to the individual situation.

Competing interest

The authors have no conflicts of interest.

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