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LIDOCAINE 2% AND XYLOCAINE SPRAY AS A COMBINATION IN SUCCESSFUL AWAKE INTUBATION IN DIFFICULT AIRWAY: HOW TO DO IT?

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Abstract

Awake intubation is a technique used to insert an endotracheal tube while maintaining the patient's consciousness. It is particularly beneficial for patients with difficult airway anatomy, as it allows better visualization using a fiber optic bronchoscope, reduces discomfort with local anesthesia, and ensures the preservation of spontaneous breathing. This approach is critical in high-risk procedures such as total thyroidectomy. This case report aims to describe the application of awake intubation in a high-risk patient undergoing total thyroidectomy due to a thyroid mass causing tracheal narrowing. A 47-year-old female with airway management difficulties (LEMON 3/10, MOANS 0/5) was scheduled for a 3–4-hour total thyroidectomy. Preoperative preparation included fasting, informed consent, and ensuring complete anesthesia equipment. Airway preparation involved Xylocaine spray and Lidocaine nebulization, followed by premedication with Dexamethasone, Diphenhydramine, and Midazolam. Induction was achieved using Propofol, and intubation was performed with an endotracheal tube guided by a fiber optic bronchoscope. Maintenance of anesthesia utilized Oxygen, Sevoflurane, and Atracurium. The results show the patient tolerated the awake intubation procedure well, with no episodes of desaturation or significant bleeding during surgery. Postoperative management included analgesia with Fentanyl and Ketamine, as well as respiratory therapy intervention (RTI) during recovery. Awake intubation, combined with effective airway preparation and anesthesia protocols, provides a safe and reliable approach for managing patients with difficult airways, particularly in high-risk procedures like total thyroidectomy. The technique ensured patient comfort, maintained oxygenation, and minimized perioperative complications.
Keywords: awake intubation, lidocaine, xylocaine spray

Introduction

Awake intubation inserts an endotracheal tube directly into the carina while the patient remains fully conscious. The procedure typically uses a flexible fiberoptic bronchoscope guided through the nose or mouth to visualize the vocal cords and trachea. Using local anesthesia and mild sedation helps reduce discomfort without compromising the patient's consciousness or respiratory function. Intubation while awake involves using specialized equipment, usually a fiber optic scope, to visualize the trachea through the patient's vocal cords while awake. This technique ensures continuous monitoring of vital signs and maintains spontaneous breathing throughout the procedure, thereby reducing complications related to respiratory depression or failure during general anesthesia (Ba, 2024; Beneš et al., 2023).

If Lidocaine 4% is unavailable, several alternatives for topical anesthesia during awake intubation may be considered. Although it is less effective, Lidocaine 2% can be used, provided it is given in sufficient volume (approximately 10 ml), although patient comfort may be slightly reduced. Direct application by spraying the anaesthetic into the oropharynx and nasopharynx using a mucosal atomization device (MAD) is also effective. In addition, 10% Lidocaine or co-phenylcaine can numb the nasal passages and oropharynx before intubation. Regional anesthesia, such as trans-tracheal injection into the cricothyroid membrane, provides rapid anesthesia of the larynx and trachea. Nerve blocks, such as superior laryngeal nerve blocks, can increase the effectiveness of total anesthesia by providing additional analgesia. These techniques ensure patient comfort and effectiveness of the intubation procedure (Ahmad, 2023; Ahmad et al., 2020; Hassanein et al., 2020; Kumar et al., 2020).

In awake intubation, a combination of local anaesthetics is often used to ensure adequate airway anesthesia. The combination may include specific formulations such as three cc of 2% Lidocaine, a commonly used local anaesthetic to numb the airway, and one cc of 10% Xylocaine Spray, another local anaesthetic that provides quick and effective topical anesthesia. Lidocaine works by blocking sodium channels, thereby inhibiting the conduction of nerve impulses. A 2% concentration is usually used for mucosal surfaces, while Xylocaine 10% spray provides a more concentrated dose for rapid effect on sensitive areas such as the vocal cords and trachea (Morris et al., 2007; Pirlich et al., 2017).

In cases where the thyroid mass significantly distorts the anatomy around the larynx, it can be challenging to visualize the vocal cords, even with repeated laryngoscopic attempts. Awake intubation provides a way to overcome this problem by inserting an endotracheal tube directly into the trachea under visual guidance using a flexible bronchoscope (Ran et al., 2022). An enlarged thyroid gland can distort the surrounding anatomical structures, making standard intubation techniques difficult. Awake intubation allows for better visualization and manipulation of the airway using a video laryngoscope, which is particularly useful in cases involving significant anatomical distortions (Ortega & González, 2018).

This study focuses on intubation techniques performed while the patient is conscious, which is particularly important for patients with a difficult airway. Total thyroidectomy often involves a high risk of airway compression, requiring a safe and effective approach to ensure adequate ventilation without causing trauma to the patient (Khandelwal et al., 2018). Using Lidocaine in nebulized form as a local anesthetic is an innovation that can improve patient comfort during intubation procedures. Previous studies have shown that using nebulized Lidocaine can reduce discomfort during nasopharyngeal manipulation, and the combination with nerve blockade can improve the quality of anesthesia.(Khandelwal et al. 2018; Madan et al. 2019) This study shows the potential to improve patient experience and clinical outcomes (Khandelwal et al., 2018; Madan et al., 2019).

This study also evaluates various anesthetic techniques for conscious intubation, providing data on the effectiveness and comfort of the combined use of lidocaine nebulization and intramucosal blockade. By comparing various methods, this study may help determine the best technique to achieve optimal intubation conditions with minimal risk of side effects (Khandelwal et al., 2018). The results of this study could have broad clinical implications, including the development of new anesthetic protocols that are more effective and safe for major surgical procedures such as thyroidectomy. These results are essential to improve patient outcomes and reduce complications associated with failed or difficult intubation.

Research Methods

The patient was a 47-year-old female referred from Murni Teguh Hospital with a chief complaint of a neck lump that first appeared five years ago. The lump was initially small, the size of a marble, but it grew to an orange over time. The patient did not complain of pain and had no history of inflammation. The patient's husband admitted that the patient sometimes snored during sleep, although rarely, and the patient herself denied waking up frequently at night. In addition, the patient also denied any weight loss and denied other complaints such as tremors and chest palpitations. The patient had no cough, runny nose, fever, or shortness of breath in the past two weeks. A history of allergy to food and medication was also denied, as well as a history of diabetes mellitus, asthma, hypertension, or other systemic diseases. The patient had no history of previous surgery and also denied smoking or alcohol consumption. As a housewife, the patient was previously able to perform moderate to strenuous activities without experiencing complaints of shortness of breath or chest pain.

The patient weighed 64 kg and was 160 cm tall, resulting in a body mass index (BMI) of 25.22 kg/m². The patient's axilla temperature was recorded at 36.5°C. The Numeric Rating Scale (NRS) scored 0/10 at rest and 1/10 at movement in pain assessment. The APFEL score for the risk of postoperative nausea and vomiting was 3 out of 4, while the METS Score showed that the patient's physical ability was at levels 5-6. Physical examination showed that the patient was compos mentis. Respiration frequency was 16 times per minute with positive vesicular breath sounds and no rhonki or wheezing sounds. Peripheral oxygen saturation was 98% using room air. On cardiovascular examination, the patient's blood pressure was 130/70 mmHg with a heart rate of 73 bpm. Heart sounds were normal, i.e., regular first and second heart sounds, with no murmurs. Abdominal examination showed no distension, with normal bowel sounds and no tenderness. On urogenital examination, the patient reported spontaneous urination. Musculoskeletally, neck flexibility was good with Mallampati III; no loose teeth were found and the dentition was intact. The interspinous cleft was palpable with a warm acral and capillary refill time (CRT) of less than 2 seconds. The patient also did not use dentures.

The result of the LEMON assessment showed a score of 3 out of 10. In the L (Look) aspect, no traumatic deformity or facial fracture was found, but there was a lump in the right neck area. The evaluation showed a score of 3-3-2; on the Mallampati assessment, the patient was categorized as Mallampati III. There was no indication of obstruction or obesity, and the patient's neck movement was not restricted. Furthermore, the assessment results using the MOANS method showed a score of 0 out of 5. The patient's mask seal was declared adequate, with no obesity or obstruction. The patient was also not over 55 years old, had not lost any teeth, and had no rigid lung problems. Finally, the STOP-BANG assessment resulted in a score of 2 out of 8. The patient reported loud snoring but did not feel tired or sleepy during the day and did not appear to stop breathing during sleep. The patient's blood pressure was normal and his body mass index did not exceed 35 kg/m². The patient was below 50 years old, but her neck circumference reached 40 cm, exceeding the standard limit.

On a complete blood workup performed on August 29, 2024, the results showed a white blood cell count (WBC) of 9.97 x 10^3/µL (standard: 4.1 - 11.0), hemoglobin (HGB) of 11.40 g/dL (standard: 12.0 - 16.0), hematocrit (HCT) of 37.40% (standard: 36.0 - 46.0), and platelet count (PLT) of 345.00 x 10^3/µL (standard: 140–440). However, the mean red blood cell volume (MCV) measured only 61.50 fL (standard: 80.0 - 100.0), with hemoglobin per red blood cell (MCH) of 18.80 pg (standard: 26.0 - 34.0) and hemoglobin concentration in red blood cells (MCHC) of 30.50 g/dL (standard: 31–36). Furthermore, in the hemostasis function examination conducted on September 4, 2024, the partial prothrombin time (PPT) was 10.4 seconds (standard: 10 - 12.7), partial thromboplastin activation time (APTT) was 26.7 seconds (standard: 23 - 34.7), and International Normalized Ratio (INR) was 0.90 (standard: 0.9 - 1.1).

In the clinical chemistry examination which was also conducted on August 29, 2024, the results showed a BUN level of 8.9 mg/dL (normal: 7.0 - 18.7), creatinine of 0.59 mg/dL (normal: 0. 57 - 1.11), estimated glomerular filtration rate (e-LFG) of 109.15 mL/min (>=90), TSHs of 0.43 µIU/mL (standard: 0.35 - 4.94), and Free T4 of 0.70 ng/dL (average: 0.70 - 1.48). In the follow-up clinical chemistry examination performed on the same date, SGOT was 16.00 U/L (average: 5.00 - 34.00), SGPT was 11.00 U/L (<55), potassium (K) was 4. 48 mmol/L (normal: 3.50 - 5.10), sodium (Na) of 140 mmol/L (standard: 136 - 145), chloride (Cl) of 111.0 mmol/L (average: 94 - 110), and blood glucose (GDS) of 91 mg/dL (average: 70 -140).

On the PA thorax examination performed on September 4, 2024, it was seen that the heart had a CTR of 48%, and the lungs showed no abnormalities. However, a soft tissue density opacity in the right and left collar region projected as high as CV C7-Th3, constricting and urging the trachea towards the left, with suspicion of a soft tissue mass. An ECG performed on August 5, 2024, showed normo-sinus rhythm with a heart frequency of 79 bpm, normoaxis, and no ST-T changes. The cervical AP/lat photograph on September 5, 2024, also showed soft tissue density opacity in the right and left collar region (with a predominance on the right side) that constricted and pushed the trachea to the left and gave the impression of a soft tissue mass and paracervical muscle spasm.

A CT scan of colli performed on September 2, 2024, revealed a heterogeneous solid mass with central necrosis and macro-calcifications within the right-left lobe of the thyroid (right-sided predominance), which extended to the isthmus and infiltrated the strap muscle and sternocleidomastoideus on the right side. This mass urges and constricts the tracheal lumen as high as CV C2-C7, causing partial obstruction at that level, and urges and constricts the nasopharynx to the left side. In addition, the mass also extended into the thoracic cavity at CV Th2 level as well as into the suitable pharyngeal mucosal space, right-left para-pharyngeal space, right parotid space, and right-left carotid space, and pressed and urged the right external carotid artery laterally with suspicion of a malignant mass. Multiple non-suspicious lymphadenopathy at levels Ia/b, IIa/b, and III on both sides was found. Additional examination revealed rightward deviation of the septum nasi, right maxillary sinusitis, and the left inferior concha nasi hypertrophy.

The actual problem was possible difficulty in airway management (intubation) with a LEMON score of 3/10 and MOANS score of 0/5. The CT scan showed a heterogeneous solid mass with central necrosis and macro calcification in the right-left thyroid lobe, which was more dominant on the right side, extended to the isthmus, and infiltrated the strap and sternocleidomastoideus muscles on the right side. The mass also caused pressure and narrowing of the tracheal lumen at the C2-C7 CV level, resulting in partial obstruction and pressure and narrowing of the nasopharynx to the left side. Endocrinally, the patient was euthyroid with TSH of 0.43 µU/mL (standard 0.35 - 4.94) and Free T4 of 0.70 ng/dL (normal 0.70 - 1.48). The Burch-Wartofsky score was 10, indicating that the likelihood of thyroid storm was unlikely, while the Wayne index showed a value of 3, confirming the patient's euthyroid status. Potential issues include difficulty in airway management (intubation), desaturation, thyroid storm, recurrent N. larynges parse, bleeding, and tracheomalacia. In the context of surgery, the procedure site was in the Colli area, with the patient in a supine position. The duration of surgery was estimated to be 3-4 hours, and some manipulations could potentially cause bleeding. In conclusion, the patient's physical status was assessed as ASA III.

In pre-anesthesia preparation, informed consent was obtained for anesthesia. The patient also underwent preoperative fasting and other preparations that included the use of STATICS, anesthesia machines, and emergency and anesthesia medications. In addition, an infusion warmer and mattress warmer were provided to maintain patient comfort. Prepared equipment includes a video laryngoscope, long boogie, etCO2, and PRC blood component ampoule according to the operator's instructions. In addition, non-kinking ETTs of sizes 6.0, 6.5, and 7.0 and LMAs of sizes 3.0 and 4.0 were prepared. Additional equipment included OPA, NPA, Flexible Intubating Scope, xylocaine spray, NGT, Propanolol, PTU, as well as RTI amps and ventilator to support the anesthesia.

The patient was sprayed with 10% Xylocaine, followed by nebulization using 2% Lidocaine. As premedication, Dexamethasone 10 mg IV, Diphenhydramine 10 mg IV, and Midazolam 1.5 mg IV were given, as well as Xylocaine spray 10% for ten puffs on the posterior wall of the oropharynx and uvula. For analgesics, Fentanyl 100 mcg IV and Lidocaine 2% by 60 mg via intramucosal spray on the oropharynx and valecula were given. Intubation was performed with conventionak laryngoscope then ensuring symmetrical positioning of both lung fields before ETT fixation. Induction was continue with Propofol 2-3 mg/kgBB IV given in titration until the patient was sleep, and this was done after the patient was intubated. For maintenance, Oxygen, Compressed Air, and Sevoflurane were used, as well as Atracurium at a dose of 0.1 mg/kgBB/min every 30-45 minutes and Fentanyl 0.5 mcg/kgBB IV every 30-45 minutes. Other medications were Ondansetron 8 mg IV, Tranexamic Acid 1000 mg IV, and Ibuprofen 400 mg IV.

After undergoing surgery, the patient was given analgesics in the form of Fentanyl as much as 300 mcg and Ketamine 20 mg mixed in 50 ml of NaCl 0.9% at an infusion rate of 2.1 ml per hour. In addition, the patient also received Paracetamol 1000 mg via intravenous route every 8 hours. The treatment was RTI (Respiratory Therapy Intervention) during the recovery period.

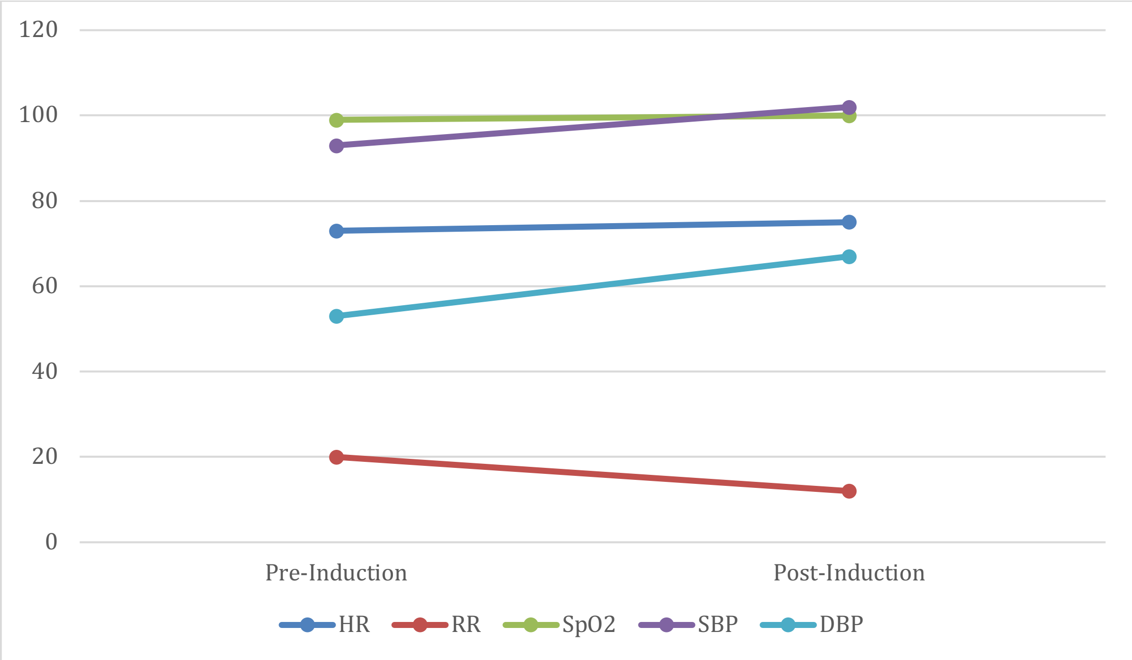

Figure 1. Hemodynamic chart of the patient during action

Results and Discussion

Thyroid gland abnormalities, especially significant thyroid enlargement, can cause several anatomical changes that affect the airway. One such change is tracheal narrowing and displacement, where enlarged thyroid tissue can compress and narrow the trachea. This condition could lead to tracheomalacia or even anterior or lateral displacement of the trachea. This compression reduces the trachea's diameter, increases airflow resistance, and complicates intubation attempts. In addition, in cases where the thyroid gland extends below the sternum, there is an increased risk of substernal goiter, further compromising the space available for the trachea and main bronchus. Patients with marked thyroid enlargement often experience compression symptoms such as dysphonia, dyspnea, and difficulty swallowing due to the external pressure of the enlarged gland on the surrounding structures (McHenry, & Piotrowski, 1994).

These anatomical changes have important implications during anesthetic procedures. The altered anatomy makes traditional endotracheal intubation methods more challenging. Pre-operative assessment usually involves a laryngoscopic examination to predict ease of intubation based on visible landmarks; however, this method may underestimate the difficulties associated with a narrowed or displaced trachea. Given these complexities, alternative techniques such as fiberoptic bronchoscopy may be required to visualize and navigate the compressed airways safely. Nonetheless, many cases report that uncomplicated intubation can be achieved in patients undergoing thyroidectomy without fiberoptic bronchoscopy (McHenry & Piotrowski, 1994).

Although generally safe, thyroidectomy carries risks that can be exacerbated by anesthetic management. One of the significant pre-operative complications is complex airway management. Patients undergoing thyroidectomy often face anatomical challenges due to gland enlargement or associated conditions such as goiter or obesity. These factors can complicate airway management during anesthesia, increasing the risk of difficult intubation in patients with a large goiter. This condition can lead to inadequate ventilation or oxygenation during the procedure. In addition, many patients also have underlying health issues, such as cardiovascular disease or respiratory problems, that can complicate anesthesia. For example, patients with hyperthyroidism may be at risk of a thyroid storm during surgery, a life-threatening condition characterized by an exaggerated response to stress (Berri & Houari, 2013; Salaria & Mehta, 2019).

At the intraoperative stage, airway complications may arise due to different intubation techniques. Although several studies have compared flexible laryngeal mask airways (FLMA) and endotracheal tubes (ETT), there has been no significant difference in complications such as laryngeal spasm or aspiration. However, both methods have inherent risks that require careful consideration from the anesthesiologist (Xu et al., 2016). During thyroidectomy, managing the airway can be challenging. An endotracheal tube poses risks such as tracheomalacia and laryngeal edema, especially in the event of inadvertent tube deviation or improper cuff pressure adjustment (Ryu et al., 2013; Salaria & Mehta, 2019) In addition, tracheal cuff rupture is another unusual but severe complication that can occur during conventional total thyroidectomy (Yilmaz et al., 2022). Intraoperative neuromonitoring (IONM) is increasingly used to prevent nerve injury during thyroid surgery. However, complications may occur related to electrode placement or interference with the endotracheal tube. Awareness of these risks is essential for anesthesiologists to reduce the potential for nerve damage during surgery (Dionigi et al., 2018).

Bleeding is a critical issue during thyroid surgery. Hematoma formation can lead to severe consequences requiring immediate intervention, including reoperation. Therefore, proper hemostasis techniques and careful surgery are essential to minimize this risk. Damage to nearby nerves, such as nervus larynges recurrent, may cause vocal cord paralysis, leading to hoarseness or postoperative voice changes. In addition, accidental devascularization of the parathyroid glands may cause transient hypoparathyroidism, leading to hypocalcemia and associated symptoms such as muscle cramps and seizures (Bajwa & Sehgal, 2013; Berri & Houari, 2013).

After surgery postoperative bleeding is a significant problem after thyroidectomy. Hematomas can cause airway obstruction and require reoperation to evacuate the blood collection. Anesthesiologists should closely monitor bleeding signs and be prepared for potential airway emergencies. Accidental removal or devascularization of the parathyroid glands may cause postoperative hypoparathyroidism, resulting in hypocalcemia and tetany. This condition requires careful postoperative monitoring of calcium levels and may require supplementation. Injury to the recurrent laryngeal nerve (RLN) is a well-documented complication of thyroid surgery that can lead to vocal cord paralysis. Anesthetic techniques that minimize pressure on the neck and careful surgical techniques are essential in reducing this risk (Berri & Houari, 2013; Henry et al., 2021; Salaria & Mehta, 2019).

Thyroid masses, especially those that cause significant tracheal compression or distortion, pose a major challenge in airway management during surgical interventions such as thyroidectomy. One crucial technique to overcome these challenges is awake intubation, especially when traditional methods may fail or be too risky. Patients with large thyroid masses often exhibit severe tracheal compression, making visualization of the glottis impossible with standard laryngoscopic techniques. Under these conditions, an alternative approach is required to ensure safe and effective intubation. Awake fiberoptic intubation allows direct visualization of airway structures despite external obstruction caused by the thyroid mass (Tan & Zhang, 2023). In a reported case, a patient with a giant thyroid developed acute upper airway obstruction and tachycardia due to progressive swelling; in this situation, fiberoptic-assisted nasal intubation was performed while the patient was awake to prevent further complications (Matsushita et al., 2018).

On the other hand, in cases where the thyroid mass significantly distorts the anatomy around the larynx, it can be challenging to visualize the vocal cords, even with repeated laryngoscopic attempts. Awake intubation provides a way to overcome this problem by inserting an endotracheal tube directly into the trachea under visual guidance using a flexible bronchoscope (Ran et al., 2022). An enlarged thyroid gland can distort the surrounding anatomical structures, making standard intubation techniques difficult. In this case, awake intubation allows for better visualization and manipulation of the airway using a video laryngoscope, which is particularly useful in cases involving significant anatomical distortion (Ortega & González, 2018).

In addition, large thyroid tumors that extend into the retropharyngeal space can complicate airway management. This extension can push vital structures out of their usual position, making oral and nasal approaches risky. Awake intubation offers a controlled and precise way to navigate complex anatomical distortions (Baik et al., 2018). Patients with thyroid masses also often have comorbid conditions such as obstructive sleep apnea (OSA), which complicates airway management. In this context, awake intubation helps assess airway patency and ensure that there is little disruption to the patient's natural breathing pattern while asleep (Tan & Zhang, 2023).

A previous history of difficult intubation is also an important consideration; if the patient has such a history related to a thyroid mass or other factors, intubation should be strongly considered to minimize the risk of intubation failure and subsequent complications such as cardiac arrest or neurological injury. Finally, thyroid masses can cause respiratory failure due to compression of the trachea and surrounding structures. In such an emergency, immediate endotracheal intubation, while the patient remains awake, is essential to secure the airway before proceeding with an emergency thyroidectomy. A case report highlights the successful management of acute respiratory failure due to severe thyroid storm through fiberoptic-assisted nasal intubation, followed by emergency total thyroidectomy through a cervical and sternal approach (Matsushita et al., 2018).

The effectiveness of lidocaine as an anesthetic is highly dependent on the concentration used. At lower concentrations, lidocaine can block the more minor, unmyelinated C fibers, which are responsible for transmitting dull pain. However, as the concentration increases, lidocaine also starts to affect the more significant myelinated A-delta fibers, which transmit sharp pain sensations. Molecularly, lidocaine works primarily by blocking voltage-gated sodium channels (VGSCs). These channels have an essential role in generating action potentials in neurons. By inhibiting VGSCs, especially the NaV 1.7 and NaV 1.8 subtypes, lidocaine prevents the entry of sodium ions into neurons, thereby reducing the excitability and transmission of electrical signals responsible for pain perception. Lidocaine also has specificity in binding, specifically to specific sites on the VGSC, especially site-3, which shows high affinity. This selective binding disrupts the normal function of those ion channels, effectively blocking them and preventing the depolarization required to initiate an action potential (Kampo et al., 2024).

In terms of cellular mechanisms, by blocking VGSCs, lidocaine reduces neuronal activity in sensory pathways. When applied topically or locally, lidocaine creates an area without nerve conduction, so painful stimuli cannot reach the brain. This blockade ensures that no pain signals reach consciousness, providing adequate analgesia (Haraguchi-Suzuki et al., 2022; Kampo et al., 2024). In addition, recent studies have shown that lidocaine can also affect tumor cell growth. Research shows that lidocaine can induce growth suppression in cancer cells such as HeLa by altering the expression and localization of proliferation markers such as Ki-67. HeLa cells treated with lidocaine showed decreased nuclear Ki-67 expression and increased cytoplasmic localization, suggesting changes in cellular processes that contribute to suppressed cell division (Haraguchi-Suzuki et al., 2022).

When used for nerve blocks, the dose of lidocaine must be carefully calculated to achieve adequate anesthesia while avoiding toxicity. The concentration of lidocaine usually ranges from 0.25% to 1.00%, depending on the type of nerve block being performed. A concentration of 0.5% to 1% is usually used for peripheral nerve blocks. A volume of 5 mL is often injected per nerve block site; however, this may vary based on specific nerve and anatomical considerations (Song, 2014; Xiong et al., 2017). The maximum recommended dose of lidocaine without epinephrine is generally around 5 mg/kg. Patients weighing 70 kg should receive at most 350 mg of lidocaine. It is critical to ensure that the volume administered sufficiently covers the critical length of the nerve to achieve effective blockade. Studies have shown that the concentration and volume must be adequate to block sodium channels along the nerve effectively (Nakamura et al., 2003).

One of the main benefits of 4% lidocaine nebulization is its effectiveness in achieving adequate airway anesthesia. Studies have shown that 4% nebulized lidocaine provides better patient comfort and easier intubation conditions compared to 2% lidocaine solution. A study published in PMC found that patients undergoing awake fiberoptic intubation with 4% nebulized lidocaine experienced significantly improved tolerance and reduced levels of discomfort, as measured by the Puchner Comfort Scale (Kumar et al., 2020). Another advantage lies in safety and ease of administration. Nebulization allows direct drug delivery to the lower airway, thus reducing systemic absorption and the associated risks. Additionally, this method ensures uniform distribution within the target area, thereby improving overall treatment efficiency. As noted in another study, "nebulization is primarily used for safety and ease of administration to the patient," making it particularly beneficial in clinical settings where rapid onset of action is essential (Prasant et al., 2021).

As with other forms of anesthesia, nebulized lidocaine has potential side effects. These may include a temporary decrease in heart rate and mild allergic reactions. Although generally well tolerated, larger-scale studies are needed to elucidate the long-term implications and rare events fully. Some patients may experience a slight decrease in pulse rate during administration, although this usually does not reach statistical significance (Kumar et al., 2020). Efficacy may vary depending on factors such as age and underlying health conditions. Specially designed pediatric protocols have shown that nebulized lidocaine in doses up to 8 mg/kg is relatively safe and moderately effective for flexible bronchoscopy in infants and children. However, extrapolating these findings directly to the adult population requires caution and a tailored approach (Gjonaj et al., 1997).

A significant advantage of using 4% nebulized lidocaine is its ability to improve patient comfort significantly during awake fiberoptic nasotracheal intubation. Studies have consistently shown that patients receiving 4% nebulized lidocaine experience increased comfort levels as measured by scales such as the Puchner Comfort Scale. A study found that the mean Puchner scale score for patients receiving 4% nebulized lidocaine was 2.23 ± 0.12, which was significantly higher (41.8%) compared to patients receiving 2% nebulized lidocaine (mean score 1.30 ± 0.08). Another critical factor is the establishment of optimal intubation conditions. Higher concentrations of lidocaine, such as 4%, have been shown to provide superior airway anesthesia. This condition leads to an easier and faster intubation process. Specifically, the procedural time for intubation was shorter in the group receiving 4% nebulized lidocaine (mean time 29.67 ± 5.40 minutes) compared to those receiving 2% (mean time 34.93 ± 5.52 minutes) (Kumar et al., 2020).

Stable hemodynamics are essential during intubation to minimize the risks associated with sudden fluctuations in blood pressure. Nebulized lidocaine 2% and 4% showed minimal impact on heart rate, suggesting that lidocaine does not cause significant systemic absorption, leading to adverse hemodynamic responses. However, there may be slight differences in pulse rate reduction, although none reached statistical significance (Kumar et al., 2020). Spray techniques using lidocaine solutions also provide topical anesthesia but differ in their methodological approach. The spray technique involves direct application through a nasal cannula or mucosal atomizer, ensuring targeted delivery to specific areas in the airway. Although this method is effective, nebulized lidocaine allows uniform distribution throughout the upper respiratory tract up to the trachea via inhalation, making it particularly useful for awake fiberoptic intubation (Williams et al., 2005).

The initial step in assessing a patient for awake intubation involves a thorough clinical evaluation. The Mallampati Classification and the Thyromental Height Test (TMHT) are two commonly used clinical predictors. The Mallampati Classification is a widely used classification system to assess the visibility of oropharyngeal structures. A higher Mallampati score correlates with the likelihood of difficult intubation, thus making it a valuable initial screening tool. The test evaluates the visibility of oral structures when patients open their mouths maximally, with classifications ranging from Class I, which shows a full view of the tonsils, uvula, and pillars, to Class IV, where only the hard palate is visible. Although it provides insight into the size of the pharyngeal space, its limitations have prompted researchers to explore additional measures such as TMHT. Recent studies suggest that TMHT may be more effective than the Mallampati test in predicting difficult intubations by showing higher sensitivity and predictive value (Harjai et al., 2023; Swati Chhatrapati, 2021).

The common challenges faced during awake intubation of difficult airways include several essential aspects. First, patient cooperation is one of the fundamental requirements for the success of this procedure. The process of awake intubation largely depends on the patient's ability to remain calm and breathe normally without assistance. However, conditions such as anxiety, pain, or neurological disorders may interfere with the patient's ability to cooperate effectively. In such situations, it may be necessary to explore alternative methods, including sedatives under close supervision, not to compromise airway integrity. Furthermore, effective airway topicalization is essential to minimize discomfort and ensure proper visualization of airway structures. Local anesthetics such as lidocaine are often used, but there must be a balance between achieving adequate analgesia and avoiding overdoses that may lead to airway obstruction. Exceeding the recommended dose of lidocaine increases the risk of side effects, so proper dosing is crucial (Gostelow & Yeow, 2023; Jung, 2023).

Visualization techniques also play a crucial role in awake intubation. Fiberoptic intubation and video laryngoscopy are commonly used tools. While fiberoptic intubation provides a good view of the upper airway, video laryngoscopy offers a wider angle of view, increasing the chances of successful intubation, especially in complex anatomy (Gostelow & Yeow, 2023; Kriege et al., 2023). However, while awake intubation is highly effective, there are inherent risks and complications. Complications can range from minor issues such as epistaxis to serious side effects such as laryngeal spasm or subcutaneous emphysema. Therefore, proper planning and adherence to guidelines are essential to mitigate these risks (Gostelow & Yeow, 2023; Komasawa & Minami, T, 2016). A limited mouth opening also poses challenges in awake intubation. In these cases, nasal intubation may be an option, although it often comes with a higher level of discomfort and risk of epistaxis. Alternative routes, such as transglottic intubation, may also be considered according to the patient's condition (Gostelow & Yeow, 2023).

Hypersensitivity reactions to local anesthetics or other substances should also be noted, as they may lead to complications such as laryngospasm or bronchospasm. Monitoring for early signs of hypersensitivity reactions is essential to prevent the escalation of such problems (Gostelow & Yeow, 2023). Time constraints are also an important factor in complex airway management. Prolonged intubation attempts can increase the risk of desaturation and cardiovascular instability. Guidelines suggest limiting the number of intubation attempts and using supplemental oxygen continuously to minimize such risks (Kriege et al., 2023; Komasawa & Minami, 2016). Another challenging scenario is the presence of nasal polyps, which can be dislodged into the tracheal tract during nasotracheal intubation and cause foreign body obstruction if not detected promptly. This condition emphasizes the need for thorough examination and monitoring during the procedure (Bai et al., 2022). Finally, in situations where fiberoptic bronchoscopes are limited, blind nasal intubation is a safer option despite its risks. Although successful in 90% of patients, there is still a chance of failure and associated complications. These findings demonstrate the importance of careful patient selection and meticulous execution of techniques during awake intubation procedures (Kokate et al., 2024).

Awake intubation procedures have several potential complications that need to be considered. One of the most significant risks is infection, although this occurrence is rare. A study involving 200 anesthesiologists who performed awake fiberoptic intubation showed that two participants experienced symptoms of infection, including one case of lower respiratory tract infection. In addition, airway trauma is also a significant concern. Challenges in maintaining proper visualization of the airway during the procedure can lead to injury to tissues, such as subglottic stenosis, especially if the patient experiences excessive movement or coughing. The use of local anesthetics, such as lidocaine in awake fiberoptic intubation protocols, also carries the risk of systemic absorption that may result in adverse effects. About 36% of participants in one study reported symptoms potentially associated with lidocaine administration, such as dizziness and nausea. In addition, patients undergoing awake intubation often experience high levels of anxiety and discomfort due to their awareness during the procedure. Although attempts are made to calm them through reassurance and minimal stimulation, some individuals still show signs of distress, such as agitation or panic attacks (Woodall et al., 2008).

Technical challenges are also an essential factor in awake intubation. The procedure requires special skills and equipment to visualize the vocal cords, especially in patients with anatomical abnormalities or limited neck mobility. These difficulties may prolong the procedure time and increase the risk of complications. Maintaining adequate oxygen saturation during intubation is crucial; however, unique challenges arise as patients are conscious and may move unpredictably, potentially causing desaturation that requires immediate intervention to secure the airway. Lastly, cardiovascular instability issues may also occur during this procedure. Blood pressure fluctuations, arrhythmias, or even cardiac arrest have been reported, although incidences are rare. This condition emphasizes the importance of close monitoring and preparedness for emergencies during awake intubation (Kriege et al., 2023; Law et al., 2015).

If 4% lidocaine is not available, several alternative techniques can be used to provide adequate topical anesthesia for awake intubation. One option is the use of a lower concentration of Lidocaine; although 4% lidocaine is usually preferred, studies have shown that 2% lidocaine can still provide an acceptable anesthetic effect when cannulated. Adequate airway anaesthesia can be achieved by administering a sufficient volume (such as 10 ml), although this may result in slightly reduced patient comfort compared to higher concentrations (Ahmad et al., 2020; Kumar et al., 2020).

Direct application techniques are also an effective alternative. For example, local anesthetics can be sprayed directly into the oropharynx and nasopharynx using a mucosal atomization device (MAD) or sprayed directly from a container. Techniques such as the McKenzie technique can also be used, where a cannula effectively delivers anesthesia via oxygen flow. In addition, using 10% lidocaine or co-phenylcaine (which contains Lidocaine and phenylephrine) can help numb the nasal passages and oropharynx effectively before intubation (Ahmad, 2023; Hassanein et al., 2020).

Regional anesthesia is also an important solution. Trans-tracheal injection involves injecting local anesthetic directly into the cricothyroid membrane, providing rapid and effective anesthesia of the larynx and trachea. This technique can be particularly useful if other methods are insufficient. Performing a nerve block can complement topical anesthetic methods by providing additional analgesia during intubation. For example, performing a superior laryngeal nerve block can increase the effectiveness of total anesthesia. This block can be performed using lower concentrations of Lidocaine or other local anesthetics (Ahmad et al., 2020; Hassanein et al., 2020).

In awake intubation procedures, a combination of local anesthetics is often used to ensure adequate airway anaesthesia. This combination usually includes certain formulations, such as three cc of 2% Lidocaine, which is a commonly used local anesthetic to numb sensation along the airway, and one cc of 10% Xylocaine Spray, which is another local anesthetic that provides a quick and effective topical anesthetic effect. Lidocaine works by blocking sodium channels, inhibiting the conduction of nerve impulses, thereby reducing pain and discomfort. Generally, a 2% Lidocaine is used for application on mucosal surfaces. In contrast, Xylocaine 10% spray offers a more concentrated dose, providing a faster effect on sensitive areas such as the vocal cords and trachea (Morris et al., 2007; Pirlich et al., 2017).

The main purpose of airway block is to reduce sensory stimulation of the airway during procedures such as endotracheal intubation. Stimulation of the oropharynx and larynx can trigger the cough reflex, increase sympathetic activity, and cause adverse cardiovascular responses. Local anesthetics such as Lidocaine can numb these areas, minimizing discomfort and facilitating smoother intubation (Bader, 2020).

Intramucosal spray application is a minimally invasive technique that allows targeted anesthesia of the oropharyngeal region. The procedure begins with preparing the patient, who is supine with mild neck extension, for easy access to the airway. Next, anesthesia is administered using a mucosal atomization device (MAD) or similar spray mechanism, where 60 mg of Lidocaine (2% solution) is sprayed directly onto the mucosal surface of the oropharynx and vallecula. This method ensures even distribution and optimal absorption of the anesthetic agent. Patients may also be instructed to take deep breaths during nebulization to enhance anesthetic delivery deeper into the airway (Kostyk et al., 2021; Refaat, 2024).

Lidocaine 2% is commonly used due to its rapid onset and effectiveness in local anesthesia. In its administration technique, a typical dose of 60 mg of Lidocaine 2% is recommended for intramucosal application (Huang, 2021). This dose is considered safe and effective for adults. Lidocaine is administered via an atomizer or spray device directly to the mucosal surface of the oropharynx and vallecula, with the spray to be applied evenly to ensure comprehensive coverage of the targeted area. In addition, it is very important to allow sufficient time for the anesthetic effect to be felt before proceeding with intubation; a waiting time of about 5-10 minutes is generally recommended (Kumar, 2019).

In addition to surface anesthesia, targeted nerve blocks can also be performed. One of these is a superior laryngeal nerve block, where a 25 gauge needle is inserted laterally towards the major cornu of the hyoid bone, and 2 mL of 2% Lidocaine is injected after contact with the bone. On the other hand, recurrent laryngeal nerve block involves the trans-tracheal injection of Lidocaine through the cricothyroid membrane, where 4% Lidocaine is injected after tracheal placement is confirmed by aspiration. These techniques provide deeper anesthesia and can be used with topical sprays for a comprehensive approach to airway management (Kostyk et al., 2021; Refaat, 2024).

Intramucosal Lidocaine spray has been shown to reduce airway reflexes during intubation procedures significantly. Studies show that patients receiving this intervention experience less coughing and gagging than those not receiving local anesthesia. In addition, reducing airway stimulation may improve hemodynamic stability during intubation, which is particularly beneficial in patients with cardiovascular comorbidities (Bader, 2020; Huang, 2021).

Studies have shown that using Lidocaine for airway block significantly reduces adverse airway events during procedures such as LMA removal and intubation. For example, one study showed that patients who received topical Lidocaine showed a lower incidence of cough and laryngeal spasm than those who did not receive local anesthesia (Sun et al., 2021). Another study highlighted that patients undergoing airway block reported improved tolerance during procedures involving the laryngeal mask airway, even in the awake state (Refaat, 2024). However, it is imperative to monitor for potential side effects, such as systemic absorption leading to toxicity or allergic reactions, although these are rare if Lidocaine is administered correctly (Chaudhary et al., 2023; Kostyk et al., 2021).

Conclusion

Nebulization of 4% lidocaine has the significant benefit of achieving adequate airway anesthesia, which has been shown to improve patient comfort during endotracheal intubation using conventional laryngoscope. Another advantage of nebulization is its ability to deliver local anesthesia directly to the lower airway, reducing systemic absorption and associated risks, thus making the intubation procedure safer and more accessible. Hemodynamic stability is also maintained during the procedure, with nebulized lidocaine showing minimal impact on heart rate. Although conscious intubation procedures carry the risk of complications such as infection and airway trauma, the use of lidocaine can help reduce patient discomfort. Overall, 4% lidocaine nebulization significantly improves comfort and safety during intubation.

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