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Educational Intervention to Improve the Knowledge of Anesthesia Providers in the Use of Dexamethasone and Ketamine to Prevent Postoperative Sore Throat: A Quality Improvement Project

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Abstract

Background: Postoperative sore throat (POST) is a common adverse effect of tracheal intubation for general anesthesia. Laryngoscopy, the endotracheal tube (ETT) friction during insertion, and the pressure exerted by the cuff can damage the airway mucosa and trigger an inflammatory response that ultimately leads to a sore throat. Postoperative sore throat is considered an expected complication of tracheal intubation, and anesthesia providers do not usually assess or prevent it. However, it can interfere with patients' regular activities, such as eating, drinking, and speaking. It develops in approximately 30% to 70% of patients undergoing tracheal intubation and is ranked as 1 of the highest causes of patient dissatisfaction after surgery. It can lead to dehydration, electrolyte imbalances, impaired wound healing, prolonged discharge, and increased cost of care. This project aimed to educate anesthesia providers about the use of dexamethasone and ketamine to prevent POST based on evidence obtained from a review of the literature.

Method: The literature was systematically searched using the PubMed and CINAHL databases. Ten studies were selected to be included in the review. An educational presentation was created from the results of the literature review. Participants in the project were selected from the Florida International University Nurse Anesthesia Program alumni. Approximately 10-20 providers were emailed an invitation to participate. Those who agreed to participate were emailed a link with a pre-/post-test about the POST and the use of dexamethasone and ketamine for its prevention, as well as an educational presentation. The results were analyzed and compared using percentages.

Results: A single dose of ≥ 0.2 mg/kg IV dexamethasone administered before the induction of anesthesia decreases the incidence and severity of postoperative sore throat. Its effects are more pronounced in the late postoperative period. Nebulized dexamethasone provides an effective alternative to the IV route. A single dose of 20-40 mg of ketamine mixed with saline, administered through gargles before the induction of anesthesia, decreases the incidence and severity of postoperative sore throat. Ketamine gargles provide better outcomes in the immediate postoperative period. Ketamine can also be administered through a nebulizer without compromising its effectiveness. The synergistic effect of combining intravenous dexamethasone and ketamine offers better pain control during the first 24 hours after surgery than each drug administered alone. The most common concepts missed in the pre-educational test were the doses of dexamethasone and ketamine needed to prevent POST, alternative routes for administering these drugs, and the adverse effects associated with ketamine administration. In the post-test, all questions had a higher percentage of correct answers than the pre-test. The significant improvement in the lowest-scoring questions, accompanied by higher scores in the other areas, suggests that the educational intervention properly addressed deficiencies in providers' knowledge.

Discussion: The administration of dexamethasone and ketamine before the induction of anesthesia can prevent the incidence and severity of POST. Combining both drugs offers better outcomes than administering only 1 medication. Anesthesia providers and patients will benefit from their incorporation into clinical practice. Limitations of this project included a small sample of reviewed articles and anesthesia providers surveyed, which could compromise the effectiveness of dexamethasone and ketamine in preventing POST and misinterpret the current knowledge of anesthesia providers about POST and its prevention.

Keywords: Postoperative sore throat, endotracheal intubation, nasotracheal intubation, intubation, general anesthesia, dexamethasone, ketamine.

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Introduction

Purpose

This project aimed to educate anesthesia providers about the risk factors associated with postoperative sore throat (POST) after tracheal intubation and improve their knowledge about the use of dexamethasone and ketamine to minimize its incidence and severity. The effectiveness of dexamethasone and ketamine in preventing POST were presented in this project, and recommendations were provided due to the lack of clinical guidelines and overwhelming information in previous research studies. This project also reviewed the effects of anesthesia techniques on developing POST.

PICO Question

Among anesthesia providers (P), would educational interventions regarding the use of dexamethasone and ketamine in the prevention of POST (I) improve the providers' knowledge (0)?

Population (P): Anesthesia providers

Intervention (I): Educational interventions regarding the use of dexamethasone and ketamine in the prevention of POST

Comparison (C): Pre-educational intervention knowledge

Outcome (O): Improved providers' knowledge about the use of dexamethasone and ketamine in the prevention of POST

Problem Statement

POST is a common adverse effect of endotracheal intubation during general surgery.[1] There is substantial evidence that airway swelling caused by the endotracheal tube is the main contributor to the development of POST.[1-10] Evidence also shows that different anesthetic

techniques can influence the degree of airway swelling and thus impact the severity and incidence of POST.[1] Patient-related factors such as chronic conditions or demographics have also been associated with increased development of POST.[1]

Problem Identification

Tracheal intubation is performed to secure the airway and provide mechanical ventilation to patients under anesthesia.[1] For this purpose, an endotracheal tube (ETT) is inserted past the glottic opening into the trachea.[1] The cuff of the ETT exerts pressure on the airway mucosa, causing irritation.[1] In addition, movement of the ETT down the throat rubs the airway mucosa, creating a potential for abrasions.[1] The insertion of a laryngoscope can also damage the airway and create irritation or abrasions.[1] Damage to the airway mucosa triggers an inflammatory response and the release of the neurotransmitters glutamate and substance P.[1] These neurotransmitters transmit the pain signal through C fibers to the higher brain areas.[1] All these factors combined contribute to the development of POST.

Tracheal intubation for general surgery is often a planned procedure carried out in a controlled environment.[2] Still, despite the provider's good technique, adequate preparation, and optimized environmental factors, it can lead to airway inflammation and the development of sore throat.[2] POST is often dismissed or overlooked by anesthesia providers because it is a temporary complication of tracheal intubation.[2] It is commonly unevaluated and not treated or prevented by anesthesia providers. Anesthesia providers also fail to acknowledge that POST could be a sign of more serious complications, such as nerve damage or severe injury to the airway structures.[2] Even though anesthesia providers consider POST a minor complication, patients have different opinions. They refer to it as 1 of the major contributors to dissatisfaction with anesthesia and surgery.[3] It is ranked sixth among the 10 most undesirable adverse effects of general anesthesia.[3]

Numerous research studies have proposed interventions to minimize the incidence of POST, but there are no standards of care or protocols to prevent this complication.[3-5] Current practices to reduce the incidence of POST include using smaller ETTs, monitoring and limiting cuff pressures, using video laryngoscopy, or using a supraglottic device (SGD) instead of an ETT when applicable.[4] Pharmacological agents are also used to prevent POST. Among the most commonly used ones are ketamine, corticosteroids, non-steroidal anti-inflammatory drugs (NSAIDs), licorice, magnesium, and lidocaine.[4] Despite all the evidence available, most anesthesia providers choose not to prevent this complication and think that informing the patients about its occurrence is enough.

Background

Several risk factors for developing POST have been associated with variability in anesthesia practice. For example, the choice of ETT size depends on the provider's judgment and can significantly affect the incidence of POST. Too large ETTs for patient size have been associated with an increased incidence of POST.[4] In female patients, the use of ETTs with an internal diameter (ID) of 6.0 mm has been shown to decrease the incidence of POST compared to the use of ETTs with an ID of 7.0 mm.[4] Smaller tubes are associated with a better view of glottic opening during laryngoscopy and therefore reduced trauma during insertion through the vocal cords.[4] Double-lumen endobronchial tubes (DLTs) are larger than single-lumen tubes and, therefore, associated with a greater risk of POST.[4] Bronchial blockers are associated with a lower incidence of POST than DLTs.[4]

The cuff pressure is the main ETT component contributing to the development of POST.[4] The ETT cuff is sufficiently inflated to provide a seal, but excessive inflation can injure the airway mucosa, causing inflammation and POST.[4] Trials utilizing manometer to monitor cuff

pressure have demonstrated a decreased incidence of POST when the pressure is kept between 15-25 mm Hg.[4] However, the lack of availability of a manometer limits the provider's ability to limit and monitor cuff pressure.[4]

Another factor influencing the incidence of POST is the time it takes to insert the ETT. Longer time to secure the airway is associated with an increased incidence of POST.[1] Securing the airway quickly can minimize invasion of the airway mucosa and trauma, reducing the risk of POST.[1] The use of a GlideScope during tracheal intubation has proved to reduce intubation time, airway mucosa damage, and the rates of POST.[4] Some studies also regard blood contamination of the ETT during extubation as a risk factor for POST.[1,4-5] They attribute this to the irritation caused by blood in the airway mucosa.[1]

Tracheal intubation is the leading cause of postoperative sore throat.[4] The risk is significantly greater with tracheal intubation than with any supraglottic airway device (SGD).[4] However, it can also occur after the use of SGDs, and it is affected by the choice of device, insertion technique, and device management.[4] Current studies show that inserting a laryngeal mask airway (LMA) with a fully inflated cuff, instead of fully deflated, is associated with lower rates of POST.[4] The most significant factor in preventing POST with LMAs is ensuring the cuff pressure does not exceed 60 mm Hg.[4] For this reason, the most beneficial LMA to prevent POST is the i-gel due to the absence of an inflatable cuff.[4]

Patient characteristics can also influence the incidence of POST. Smoking history, female gender, and young age are the main risk factors in the literature.[1] Smoking causes chronic airway inflammation, predisposing patients to injury during tracheal intubation and POST.[1] According to previous research studies, women tend to evaluate the degree of pain stronger than men and have lower pain thresholds.[1] This increases the incidence of women reporting POST, but various

studies have failed to prove this conclusion, attributing POST in women to a combination of other factors instead of gender.[4] Older adults tend to rate pain lower than younger adults.[4] Pain sensitivity and intensity also decrease with age.[4] For these reasons, young age has been associated with a higher incidence of POST.[4]

Scope of the Problem

Millions of surgeries occur yearly in the United States, with approximately one-third requiring tracheal intubation.[2] Patients requiring general anesthesia with tracheal intubation are at risk of developing POST.[4] Supraglottic devices provide a better alternative when applicable, but these devices also carry a risk of POST if anesthesia providers do not account for risk factors.[4] POST can occur in 30% to 70% of the patients requiring tracheal intubation.[1] It can increase the length of stay in the postoperative care unit and, therefore, the cost of care.[5] Its incidence prolongs the length of stay by 14 minutes in postoperative care units and 25 minutes in ambulatory care units.[5] The average discharge time from a facility for a patient with sore throat is 51 minutes longer than a patient who experiences no symptoms.[1] If 70% of the patients undergoing general anesthesia with tracheal intubation develop POST, the cost of surgery for patients and facilities increases significantly.[5] Patients spend more money on services such as nursing care or pain medications.[5] Healthcare facilities spend more resources to care for these patients and keep staff from assisting other patients.[5] Besides providing increased patient satisfaction, decreasing the incidence of POST can reduce the length of stay, the consumption of pain medications, the use of resources, and the overall cost of care.[5]

Lengthy surgical procedures increase the incidence of POST, and as previously stated, young, female, and smoker patients are most affected by this complication.[1,4] Patients who require nasotracheal intubation also experience higher rates of POST.[6] The incidence of POST

for nasotracheal intubation is 74.6%.[6] This higher incidence is due to the increased difficulty of the procedure, leading to longer intubation time and increased trauma.[6]

POST does not only affect adults but children as well. The incidence of POST is lower in children, but it is difficult to assess for sore throat in this population.[4] The average incidence of POST in children is 26.5%.[7] Children with asthma or upper respiratory tract infections are more susceptible to respiratory complications, including POST.[1] Provider's intubation skills play a major role in preventing POST in children. Visualization of the glottic opening can be more difficult in children than adults, leading to prolonged intubation time and trauma to the mucosa.[1] As in adults, the risk of POST is higher during tracheal intubation and lower with the use of SGDs.[1] The incidence of POST is higher when uncuffed tracheal tubes are used in children than cuffed tracheal tubes.[1] Careful attention must be paid to cuff pressure, as pressures higher than 20 mm Hg increase the incidence of POST to 30%, while pressures higher than 40 mm Hg increase it to 96%.[1] Keeping the tracheal cuff from 11-20 mm Hg decreases the incidence of POST in pediatrics to 4%.[1]

Consequences of the Problem

POST can prolong eating or drinking, interfering with patients' everyday functioning and thus prolonging surgical recovery.[8] Delayed oral intake can negatively impact patients' fluid status and the administration of oral medications. Electrolyte imbalances can occur, which must be treated before discharging the patient. This is more concerning in children than adults. Delayed oral intake in pediatrics due to impaired swallowing can quickly result in dehydration, wound healing, and increased hospitalization.[7] Inability to tolerate oral intake will ultimately result in prolonged discharge from recovery units for both adults and children.

POST is a self-limiting complication that usually resolves within 1 or 2 weeks.[5] However, it is a major cause of patient dissatisfaction and prolonged recovery from surgery.[1] Patient dissatisfaction affects anesthesia providers, surgeons, and healthcare facilities. Unhappy patients will likely fear future surgeries and provide low ratings of the facility and providers. Patients might seek alternative providers or facilities if they require surgery or medical care. The same patients might post negative reviews on the internet available to the general public, which may decrease the number of future customers and revenue for providers and facilities. POST also increases the length of stay and the cost of care for patients and facilities.[5]

POST can be a symptom of more concerning complications such as vocal cord or laryngeal injury.[2] When patients report sore throat, it could be accompanied by dysphagia, hoarseness, pharyngitis, laryngitis, or tracheitis.[4] It has also been associated with aspiration pneumonia.[1] An explanation could be that impaired swallowing due to sore throat leads to aspiration of food or liquid into the lungs. Failure to evaluate the etiology of sore throat can result in neglection of more serious underlying conditions. POST can also interfere with the postoperative management of head and neck surgery, as it can be confounded with surgical pain and erroneously treated. This, in turn, can lead to overprescription of pain medications, including opioids.

POST can range from mild irritation to an incapacitating discomfort that prevents patients from swallowing or speaking.[9] It can cause voice and swallowing alterations that impact patient satisfaction and their ability to engage in activities of daily living after discharge.[9] The recovery from pharyngolaryngeal injury can take months; in some cases, the resulting trauma can lead to infection, mucosal dryness, and airway irritation.[9]

Knowledge Gaps

Patient and anesthesia-related factors can influence the risk of POST, but it is unknown how much these factors contribute individually to the incidence and severity of POST.[1] The literature shows better results when interventions are targeted to minimize a combination of risk factors instead of only one.[1,4,6] In addition, previous research has not considered the influence of factors such as intraoperative blood loss or hypotension.[10] Airway management and surgical approaches vary widely from 1 institution to another.[10] There needs to be more information regarding the incidence and severity of POST in institutions that lack resources to minimize the risk factors.[10] Research has mainly been conducted in developed countries with many resources. Still, further research is required to minimize the incidence of POST in developing countries. In addition, not all healthcare institutions in developed countries have access to the same equipment or drugs to prevent POST.

Pain can have an organic or emotional nature.[1] The tension and fear after surgery can manifest as pain, making it challenging to evaluate the actual presence of POST.[1] In addition, head and neck surgery can cause surgical pain that can be confounded with POST. Anesthesia providers consider POST a common, self-limiting side effect of tracheal intubations that resolves spontaneously. Laryngeal injury from intubation is usually mild and short-lived, but moderate and severe cases have been reported.[2] Patients with moderate or severe laryngeal injuries are at increased risk of developing voice and swallowing impairment.[2] Despite this, there are no standard guidelines for assessing laryngeal injuries post-extubation or differentiating mild from severe forms.[2] It is necessary to develop standardized evaluation tools to differentiate mild laryngeal injuries post-extubation from emotional pain, surgical pain, and moderate/severe

laryngeal injuries. A postoperative screening/assessment would facilitate early recognition and treatment of severe laryngeal injuries.[2]

The literature contains several pharmacological recommendations to prevent the incidence and severity of POST. The most common medications proven effective for this purpose are corticosteroids, lidocaine, NSAIDs, licorice, ketamine, and magnesium.[4] Several routes of administration have been researched, such as intravenous, topical, nebulizer, intra-cuff, gargling, and direct application to the ETT.[11] Despite the variety of agents available, the drug of choice is yet to be identified.[11] The need for standardized protocols in developed or developing countries constitutes an obstacle to preventing postoperative sore throat. Providers' unawareness of its risk factors, consequences, and treatment modalities also contributes to the high incidence.[8] Previous research attempts to synthesize pharmacological prevention of POST have failed to provide effective choices available to anesthesia providers. The selection of a pharmacological agent depends on the provider's judgment, convenience, and institutional availability.[11] Gaps in knowledge of POST prevention and consequences are evident by the high incidence of this complication.[8] To successfully decrease the incidence and severity of POST, educating anesthesia providers and providing a standardized treatment modality available in all healthcare institutions is necessary.

Proposed Solution

Dexamethasone is a glucocorticoid steroid with potent anti-inflammatory and analgesic properties.[12] Given that the nature of POST is inflammation of the airway due to inserting a physical agent, it makes sense to administer dexamethasone to prevent this complication. Dexamethasone exerts its therapeutic effects by inhibiting prostaglandin synthesis, serotonin concentration in the central nervous system, and releasing inflammatory mediators.[12] A dose of

intravenous dexamethasone, given 30 minutes before intubation, can reduce the incidence and severity of POST for up to 24 hours without serious side effects.[12] Potential side effects of long-term use of corticosteroids, such as impaired wound healing, susceptibility to infections, and hyperglycemia, have not been reported in clinical trials.[13] Dexamethasone's most common side effect is an increased blood glucose level in the immediate postoperative period.[12] Other potential benefits of a single dose of intravenous dexamethasone are reductions in postoperative nausea and vomiting, opioid administration, and length of stay in the postoperative care unit.[14]

The adequate dose of intravenous dexamethasone to prevent POST remains controversial, as the literature shows effectiveness in different doses. Clinical trials show that a range of 8 mg to 0.2 mg/kg effectively reduces POST. In adult patients of both genders requiring general anesthesia with tracheal intubation for elective surgery, administering 8 mg of intravenous dexamethasone 30 minutes before induction reduced the incidence of POST for 24 hours postoperatively.[15] The results were similar when the same dose was administered to spine surgery patients.[16] The administration of 10 mg of dexamethasone intravenously, 5 minutes before induction, reduced the incidence of POST in women undergoing thyroidectomy.[17] The same dose was equally successful when administered 30 minutes before induction in patients undergoing urologic procedures.[18] Alternatively, administering 0.2 mg/kg of intravenous dexamethasone effectively reduced POST in 2 randomized clinical trials.[19,20] There are currently no clinical trials regarding the use of dexamethasone to prevent postoperative sore throat in pediatrics; therefore, further research is needed to evaluate its efficacy and dosage in this population.

Dexamethasone offers the advantage of being delivered as a nebulizer. This can benefit patients without intravenous access at the time of induction, such as children. In adult patients,

preoperative administration of 8 mg nebulized dexamethasone effectively reduced POST in patients undergoing laparoscopic sleeve gastrectomy.[21] In patients undergoing bariatric surgery, preoperative administration of 8 mg nebulized dexamethasone was as effective as intravenous administration of 8 mg dexamethasone in reducing the incidence of POST.[22]

Ketamine provides analgesia by inhibiting N-methyl-D-aspartate (NMDA) receptors and the agonism of opioid receptors.[23] Ketamine's analgesic effects can provide pain relief caused by airway instrumentation and, in turn, reduce the incidence of POST.[23] In the past, it has been used topically, through nebulizers or gargles, to reduce the incidence of POST. Low doses of ketamine, administered through these routes, are poorly absorbed systemically and do not pose a contraindication for patients with coronary artery disease or ischemic heart disease.[24] Ketamine causes a dissociative psychological state characterized by delirium and hallucinations postoperatively, but these adverse effects are associated with anesthetic doses of ketamine and are rare with low analgesic doses.[23]

Unlike dexamethasone, which is administered intravenously or nebulized, ketamine gargle is a simple intervention that can be done in any patient able to protect the airway. In the past, it has been used to successfully treat oral mucositis pain caused by radiation, which makes it an excellent candidate to prevent POST.[23] Ketamine mouthwashes usually contain 2040 mg of ketamine mixed in saline.[23] Researchers who conducted a meta-analysis concluded that ketamine gargles (40-50 mg mixed in saline) reduce the incidence of postoperative sore throat for up to 24 hours.[23] Gargling 40 mg of ketamine for 5 minutes before induction decreases the incidence and severity of postoperative sore throat.[24] This method proved superior to applying lidocaine jelly on the ETT to prevent POST.[24] Ketamine gargles containing 20 mg also effectively reduced POST in patients undergoing hysterectomies.[25]

Problems associated with ketamine gargles are the bitter taste of these preparations and the risk of aspiration in patients unable to protect their airways.[26] The nebulizer route offers a safer alternative and is usually accepted among patients and anesthesia providers.[26] In adult patients, 50 mg of nebulized ketamine reduces the incidence of POST for 24 hours postoperatively.[26] Nebulized ketamine has proved to be more productive than nebulized magnesium or lidocaine in preventing POST.[26,27]

Dexamethasone and ketamine are drugs available to anesthesia providers in most surgical units. Both medications effectively prevent the incidence and severity of postoperative sore throat and can be given through various routes without significant adverse effects.[11-27] Dexamethasone can be used in non-diabetic patients with or without intravenous access, as it is also available as a nebulizer.[21,22] Unlike dexamethasone, ketamine does not raise blood glucose levels and can be given to patients with diabetes. Intravenous access is unnecessary, as it is administered topically through gargles or nebulizers.[24] The gargles are simple but require patients who can protect their airways and produce a bitter aftertaste.[23] Unlike gargles, nebulized ketamine can be given to patients at risk of aspiration and does not produce an unpleasant taste.[26]

Methodology of the Literature Review

Search Strategy

The literature was systematically searched using the PubMed and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases. PubMed offers a wide array of medical articles freely accessible to the public.[28] Additionally, it offers medical subject headings (MeSH) to index and categorize the search.[28] Another advantage of PubMed is the use of truncation.[28] This feature broadens the search by searching variations of a word root.[28] It also allows using filters, including Boolean connectors such as AND, OR, and NOT to associate

different terms.[28] Finally, it allows the exporting of article citations in different formats.[28] CINAHL offers the same features as PubMed, but its database emphasizes nursing articles and publications.[29]

Both databases were searched using keywords related to the PICO question. Medical subject headings were used to retrieve relevant information. The connectors AND, OR, and NOT were used to combine different keywords and conduct individual searches. The following keywords were searched: postoperative sore throat, endotracheal intubation, nasotracheal intubation, intubation, general anesthesia, dexamethasone, ketamine.

After identifying potential sources, the articles were filtered using the inclusion and exclusion criteria. A total of 3037 articles were retrieved from the literature. After removing duplicates, and screening them, a total of 10 studies were selected to be included in the review. Refer to Appendix A for a flow diagram depicting the systematic search process. Refer to Appendix B for a table illustrating a summary of the articles included in the review. Inclusion and Exclusion Criteria

Inclusion criteria for the literature review were studies published within the last 10 years, written in English, conducted on human subjects, and involving all age groups. Only randomized controlled trials (RCTs) were accepted. All types of surgeries requiring general anesthesia with tracheal intubation were included. Studies had to include the administration of either dexamethasone or ketamine, and postoperative sore throat had to be 1 of the measured outcomes.

Exclusion criteria included studies older than 10 years, studies written in languages other than English, and studies conducted on non-human subjects. Studies that were not RCTs were also excluded. Studies in which tracheal intubation was not performed, dexamethasone or

ketamine was not administered, and postoperative sore throat was not measured were also excluded.

Study Characteristics

All articles included in this review were randomized controlled trials (RCTs) categorized as level I of evidence.[30] They all involved randomization, control, and manipulation.[30] The subjects were randomly assigned to control or experimental groups; each study provided a control group for comparison, and at least 1 intervention was performed on each subject.[30] The studies were all performed in adults because no trials involving pediatrics were found.[30] Patient demographics and health status were similar in all trials in the experimental and control groups. The trials were performed in American Society of Anesthesiology (ASA) Class I and II patients. A wide variety of surgical procedures were reviewed. Most trials excluded risk factors for postoperative sore throat to limit its incidence.

The trials evaluated the effectiveness of dexamethasone or ketamine either when administered alone or in combination with other drugs. Variations in doses were included to allow for comparison and find an effective dose range. Different routes were reviewed to provide alternatives when available. Most articles used comparable administration times with slight variations. All articles assessed postoperative sore throat incidence and severity at least once after extubation. The researchers used different scales to measure their outcomes. Data were mainly presented as numbers and percentages, illustrated in tables, figures, or both. The researchers used various analytical tools to calculate sample size and analyze and compare the data in all studies.

Results of Individual Studies

Yang et al[17] compared the effect of dexamethasone and ketorolac on the reduction of postoperative sore throat. It included female patients undergoing thyroidectomy. The study was conducted in Korea. Patients were randomly divided into ketamine, ketorolac (Kpre and Kpost), and placebo groups. Each group received the corresponding intervention before induction of anesthesia, except the Kpost group, which received ketorolac thirty minutes before extubation. The incidence and severity of sore throat were assessed using a 4-grade scale based on verbal responses. The researchers measured it at 1, 6, and 24 hours after extubation. The incidence and severity of POST were lower in the dexamethasone at all measured intervals compared to the other groups.[17] This study allowed for comparison between dexamethasone, ketorolac, and no intervention (placebo group). It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST were suitable. The main disadvantage was that it only involved females and 1 type of surgery.

Safavi et al[20] aimed to evaluate the efficacy of intravenous dexamethasone combined with ketamine gargles in reducing the incidence and severity of POST. The study included adult patients of both genders scheduled for surgery requiring one-lung ventilation with a double-lumen ETT. It was conducted in the Kashani Hospital of Isfahan City, Iran. Patients were randomly divided into ketamine, ketamine plus dexamethasone, dexamethasone, and placebo groups. Each group received the corresponding intervention thirty minutes before the induction of anesthesia. The incidence and severity of sore throat were assessed using a 4-grade scale based on verbal responses and measured at 0, 2, 4, 8, and 24 hours after extubation. Ketamine and dexamethasone reduced the incidence and severity of sore throat when administered alone, but the combination of both proved superior.[20] This study measured the efficacy of

dexamethasone and ketamine not only when administered alone but also when administered in combination. It also involved surgeries requiring double-lumen tubes, which are known to have a higher incidence of POST than regular ETTs.[20] It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST were suitable.

Lee et al[18] evaluated the efficacy of intravenous dexamethasone combined with paracetamol in reducing the incidence and severity of POST. The study included adult patients of both genders scheduled for urologic surgery with general anesthesia and endotracheal intubation. The study was conducted in Korea. Patients were randomly divided into groups of dexamethasone plus paracetamol and dexamethasone plus saline. Both groups received dexamethasone before intubation and either paracetamol or saline at the end of surgery. The incidence and severity of sore throat were assessed using a 4-grade scale based on verbal responses and measured at 0, 1, 6, and 24 hours after extubation. The incidence and severity of sore throat were lower in the dexamethasone plus paracetamol group at all measured intervals.[18] This study allowed for evaluating dexamethasone in combination with other drugs. It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST are suitable. The main disadvantage was that it only involved urological procedures.

Eidi et al[31] compared the effect of intravenous dexamethasone before and after intubation on the incidence of sore throat after tympanoplasty surgery. The study included adult patients of both genders scheduled for tympanoplasty with general anesthesia and endotracheal intubation. The study was conducted in the Imam-Reza Hospital, Iran. Patients were randomly divided into groups 1 and 2. The first group received dexamethasone 30 minutes before induction and the second dose 30 minutes after. The incidence and severity of sore throat were assessed using a 4-

grade scale based on verbal responses and measured at 24 hours after extubation. There was no significant difference between the administration of dexamethasone before or after intubation to prevent POST.[31] This study allowed for comparison between different administration times. It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST were suitable. The main disadvantages were that it only assessed for sore throat at 1-time intervals, only urological procedures were included, and dexamethasone was not administered at the end of surgery to allow for further comparison.

Almustafa et al.[21] evaluated the efficacy of preoperative nebulized dexamethasone in reducing symptoms associated with bougie insertion in laparoscopic sleeve gastrectomy, including postoperative sore throat. The study included adult patients of both genders scheduled for sleeve gastrectomy with bougie insertion. The study was conducted in a tertiary referral hospital in Jordan. Patients were randomly divided into nebulized dexamethasone and nebulized saline groups. Both groups received the corresponding intervention 1 hour before the induction of anesthesia. The incidence and severity of sore throat were assessed using a numerical rating scale (0-10) based on verbal responses and measured at 1, 6, and 24 hours after extubation. Preoperative nebulized dexamethasone effectively reduced the incidence and severity of sore throat after sleeve gastrectomy with bougie insertion.[14] This study provided the evaluation of a different route of administration for patients without intravenous access. It also included a high-risk procedure for POST, such as bougie insertion.[21] It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST were suitable. The main disadvantage was that it does not compare nebulized dexamethasone with the intravenous route.

Malik et al[15] aimed to determine dexamethasone's role in improving recovery after general surgery with endotracheal intubation. The study included adult patients of both genders scheduled for general surgery requiring anesthesia with tracheal intubation. The study was conducted in the Ayub Teaching Hospital, Pakistan. Patients were randomly divided into dexamethasone and saline groups. Both groups received the corresponding intervention 30 minutes before intubation. The incidence of sore throat was assessed using yes or no questions based on verbal responses and measured at 2, 12, and 24 hours after extubation. At all measured intervals, the incidence of POST was significantly lower in the dexamethasone group compared to the placebo group.[15] This study included a wide array of surgical procedures and patients to evaluate the efficacy of dexamethasone effectively. The scale and measured intervals used to assess POST were suitable. The main disadvantage was that the severity of POST was not evaluated.

Aigbedia et al[24] compared the efficacy of lidocaine jelly and ketamine gargle in preventing postoperative throat pain. The study included adult patients of both genders scheduled for general surgery requiring anesthesia with tracheal intubation. The study was conducted at the University of Benin Teaching Hospital, Nigeria. The patients were randomly divided into 2 groups. One group gargled ketamine 5 minutes before intubation, and the other had lidocaine jelly applied to the ETT and gargled saline at the same time as the ketamine group. The incidence and severity of sore throat were assessed using a 4-grade scale based on verbal responses and measured at 6, 12, 18, and 24 hours post-extubation. Ketamine gargles proved more efficient than lidocaine jelly in reducing the incidence and severity of POST.[24] This study allowed comparing ketamine gargles with a different drug instead of just a placebo. It also

included a broad range of surgical procedures. It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST were suitable.

Segaran et al[26] compared the efficacy of nebulized magnesium and ketamine in preventing postoperative throat pain. The study included adult patients of both genders scheduled for elective surgery requiring general anesthesia with tracheal intubation. The study was conducted in India. The patients were randomly divided into nebulized magnesium and nebulized ketamine groups. Both groups received the corresponding intervention 5 minutes before intubation. The incidence and severity of sore throat were assessed using a 4-grade scale based on verbal responses and measured at 2, 4, 6, and 24 hours after extubation. Nebulized ketamine, administered before induction, was more effective than nebulized magnesium in preventing POST.[26] This study measured the efficacy of ketamine administered through an alternative route. Additionally, it allowed for the comparison of ketamine with another drug. It also included a broad range of surgical procedures. It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST were suitable.

Faiz et al[25] compared the efficacy of benzydamine and ketamine gargles in preventing postoperative throat pain. The study included adult female patients scheduled for hysterectomy requiring general anesthesia with tracheal intubation. The study was conducted in the Rasool Akram Hospital, Iran. The patients were randomly divided into 2 groups. One group gargled ketamine, and the other gargled benzydamine 5 minutes before intubation. The incidence and severity of sore throat were assessed using a numerical rating scale (0-10) based on verbal responses and measured at 0, 2, and 24 hours after extubation. The incidence and severity of POST were reduced with ketamine or benzydamine gargles, but the effect was more noticeable with ketamine.[25] This study allowed comparing ketamine with another medication administered

through the same route. It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST are suitable. The main disadvantage was that it only includes females and 1 type of surgical procedure.

Prasant et al[27] compared the efficacy of preoperative nebulized ketamine with nebulized lignocaine (xylocaine and lidocaine). The study included adult patients of both genders scheduled for elective surgery requiring general anesthesia with tracheal intubation. The study was conducted in India. The patients were randomly divided into nebulized lignocaine and nebulized ketamine groups. Both groups received the corresponding intervention 5 minutes before intubation. The incidence and severity of sore throat were assessed using a numerical rating scale (0-10) based on verbal responses and measured at 0, 6, and 24 hours after extubation. Nebulized ketamine proved superior to nebulized lignocaine in reducing the incidence and severity of POST.[27] This study measured the efficacy of ketamine administered through an alternative route. Additionally, it allowed for the comparison of ketamine with another drug. It included a broad range of surgical procedures. It measured not only the incidence but also the severity of sore throat. The scale and measured intervals used to assess POST were suitable.

Literature Matrix

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Yang C et al. *Korean J Anesthesiol*. 2017;70(1):64-71.	RCT, double-blinded Purpose: Evaluate the effect of dexamethasone and ketorolac on the reduction of postoperative sore throat (POST) after general anesthesia with endotracheal intubation (GETA) in patients undergoing thyroidectomy. Allocation and intervention: Group C: Received placebo before intubation and at the end of surgery	Enrolled patients: 192 Attrition: 12 patients excluded - 1 was receiving steroids - 1 was allergic to steroids - 2 underwent long surgeries - 1 withdrew from the study - 7 were not followed *N* = 192 Group C: 48 Group Kpre: 48 Group Kpost: 48 Group D: 48 Patient characteristics: Adult female patients, aged 20-65 years, ASA I or II, scheduled for thyroidectomy Excluded: Patients with	Independent variable: IV dexamethasone, ketorolac, and placebo Dependent variables: Sore throat	Assessment of incidence and severity of sore throat: 4-grade scale based on verbal responses to questions: 0 none; 1 mild, 2 moderate, 3 severe. Measurement intervals: Assessed at 1, 6, and 24 hours after extubation Data presentation: Presented as number of patients, using tables Sample size calculation: Calculated through a power analysis based on previous studies Analysis and comparison of variables:	Scale reading 0/1/2/3 0: none 1: mild 2: moderate 3: severe Incidence and severity of sore throat (0/1/2/3): *Group D:* At 1 H: 2/13/6/22 At 6 h: 18/13/5/7 At 24 h: 28/9/6/0 *Group C:* At 1 h: 2/11/13/19 At 6 h: 13/17/5/10 At 24 h: 25/11/5/4 *Groups Kpre and Kpost:*	The incidence and severity of POST were lower in the dexa-methasone at all measured intervals compared to the other groups. Dexa-methasone is more effective at 24 hours after extubation compared to the early postoperative period.[1]	A single dose of 10 mg IV dexa-methasone before induction of anesthesia reduces the incidence and severity of POST, with better results at 24 hours post-operatively.	Level of Evidence: I Weaknesses: - The doses of the drugs used may not be equipotent or sufficient to reduce the inflammatory response of intubation. - Postoperative pain control may affect the incidence or severity of patients after thyroidectomy. - It only involved 1 type of surgery. - Only female patients participated in the study. Strengths: - Utilized statistical analysis to

	Group Kpre: Received ketorolac 30 mg IV before intubation Group Kpost: Received ketorolac 30 mg IV at the end of surgery Group D: Received dexamethasone 10 mg IV before intubation	tracheal or respiratory disease, BMI > 35 kg/m^2, known difficult intubation, allergy to the drugs used, or receiving steroids. Surgeries longer than 180 minutes were excluded, too. <u>Setting:</u> Korea		Researchers used the Kruskal-Wallis test, the Mann-Whitney U test, the X^2 test, and the Fisher exact test as appropriate. <u>Statistical significance accepted:</u> *p*-value < 0.05. Statistical analysis was performed using SPSS version 21. The *p*-value was adjusted using Bonferroni's correction.	At 1 h: 3/18/12/14 and 3/11/10/21 At 6 h: 13/18/13/3 and 12/17/12/4 At 24 h: 26/15/6/0 and 20/16/6/3			calculate sample size and compare results - Excluded risk factors for POST - Anesthesia providers and investigators were blinded. - Evaluates the use of dexamethasone alone and in combination with other drugs <u>Feasibility:</u> - The administration of IV dexamethasone before intubation is a reasonable and cost-effective intervention to prevent POST. <u>Risk assessment:</u> - Researchers obtained approval from the International Review Board.

								- Informed consent was obtained from all participants. - The research was registered at ClinicalTrials.gov. - The adverse effects of the drugs were explained to the patients.

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Safavi M et al. *Adv Biomed Res*. 2014;3:212.	RCT, double-blinded Purpose: Evaluate the efficacy of IV dexamethasone and ketamine gargles in reducing the incidence and severity of POST. Allocation and interventions: Group K: Gargled 40 mg ketamine in 30 ml saline Group D: Were infused 0.2 mg/kg IV dexamethasone. Group KD: Gargled 40 mg ketamine in 30 ml saline plus 0.2 mg/kg IV dexamethasone. Group P (placebo):	Enrolled patients: 152 Attrition: 12 patients excluded - 1 required more than 1 intubation attempt - 1 required mechanical ventilation after surgery *N* =140 Group K: 35 Group D: 35 Group KD: 35 Group P: 35 Patient demographics: Adult male and female patients, aged 15-65 years, ASA I or II, scheduled for elective surgery requiring one-lung ventilation with double lumen tube, with mouth opening of >3.5 cm, and a Cormack and Lehane score lower than 4.	Independent variable: Dexamethasone IV, ketamine gargles, dexamethasone IV plus ketamine gargles, and placebo Dependent variables: Incidence and severity of sore throat	Assessment of incidence and severity of sore throat: 4-grade scale based on verbal responses to questions: 0 none; 1 mild, 2 moderate, 3 severe. Measurement intervals: Assessed at 0, 2, 4, 8, and 24 hours after extubation. Data presentation: Presented as number of patients, using tables. Sample size calculation: Based on previous research studies, researchers used an assurance level of 95% and a power test of 80%. Analysis and comparison of variables: The researchers analyzed the data	Scale reading 0/1/2/3 0: none 1: mild 2: moderate 3: severe Incidence and severity of sore throat (0/1/2/3) *Group D* At 0 h: 28/7/0/0 At 2 h: 27/8/0/0 At 4 h: 28/7/0/0 At 8 h: 29/6/0/0 At 16 h: 28/7/0/0 At 24 h: 27/8/0/0 *Group K* At 0 h: 25/10/0/0 At 2 h: 24/11/0/0 At 4 h: 25/10/0/0 At 8 h: 26/9/0/0 At 16 h: 25/10/0/0	The incidence and severity of POST were always lower in the KD group compared to the other groups.	The combination of ketamine gargle and IV dexa-methasone is more effective in reducing the incidence and severity of POST than each drug alone.	Level of Evidence: I Weaknesses: - Researchers did not measure the plasma levels of ketamine; therefore, they could not evaluate its systemic effects. - The study did not have a large sample size. Strengths: - Utilized statistical analysis to calculate sample size and compare results - Excluded risk factors for POST - Allowed comparison of 2 different medications and their combination

	Received saline (gargle and IV)	<u>Excluded:</u> Surgical time greater than 300 minutes, patients with asthma, history of POST, known difficult intubation, required mechanical ventilation postoperatively, and known difficult intubation. <u>Setting:</u> Kashani Hospital of Isfahan City, Iran		using the Fisher's exact test and compared it using the Mann-Whitney U-test. <u>Statistical significance accepted:</u> *p*-value < 0.05. Researchers used SPSS 16 for windows. The *p*-value was adjusted using Bonferroni's correction.	At 24 h: 24/11/0/0 *Group KD* At 0 h: 34/1/0/0 At 2 h: 34/1/0/0 At 4 h: 35/0/0/0 At 8 h: 35/0/0/0 At 16 h: 35/0/0/0 At 24 h: 35/0/0/0 *Group P* At 0 h: 15/14/3/3 At 2 h: 17/12/4/2 At 4 h: 18/11/4/2 At 8 h: 17/11/6/1 At 16 h: 18/12/5/0 At 24 h: 16/15/4/0			- Involved the use of double-lumen tubes, which are associated with a higher incidence of POST than standard endotracheal tubes <u>Feasibility:</u> - The administration of IV dexa-methasone, combined with ketamine gargles, is a reasonable and cost-effective intervention to prevent POST. <u>Risk assessment:</u> - Researchers obtained approval from the research committee of Isfahan University and informed consent from participants.

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Lee et al. *J Anesth*. 2017;31(6):869-877.	RCT, double-blinded Purpose: Evaluate the efficacy of IV dexamethasone combined with paracetamol in reducing the incidence and severity of POST. Allocation and interventions: Group DP: Received 10 mg of IV dexamethasone before induction and 1000 mg of IV paracetamol at the end of surgery Group D: Received 10 mg of IV dexamethasone before induction and saline at the end of surgery	Enrolled patients: 236 Attrition: 10 patients excluded - 1 had previous neck surgery - 2 had a Mallampati score > 2. - 1 had hepatic disease. - 3 patients per group were not followed up. *N* = 226 Group DP: 113 Group D: 113 Patient demographics: Adult male and female patients aged 18-80 years, ASA I or II, scheduled for urologic surgery under GETA. Excluded: Patients with a history of neck surgery, difficult intubation,	Independent variable: IV dexamethasone and IV paracetamol IV Dependent variables: Incidence and severity sore throat	Assessment of incidence and severity of sore throat: 4-grade scale based on verbal responses to questions: 0 none; 1 mild, 2 moderate, 3 severe. Measurement intervals: Assessed at 0, 1, 6, and 24 hours after extubation. Data presentation: Presented as number of patients, using tables and figures. Sample size calculation: Calculated mathematically to reach statistical significance with $\alpha = 0.05$ and $\beta = 0.20$. Analysis and comparison of variables:	Scale reading 0/1/2/3 0: none 1: mild 2: moderate 3: severe Incidence and severity of sore throat (0/1/2/3): *Group D* At 0 h: 80/26/7/0 At 1 h: 77/26/10/0 At 6 h: 74/27/12/0 At 24 h: 92/16/5/0 *Group DP* At 0 h: 93/13/5/2 At 1 h: 94/14/4/1 At 6 h: 93/17/3/0 At 24 h: 101/11/1/0	The incidence of sore throat was lower in the DP group at all measured intervals. The severity of sore throat was also lower in the DP group.	Combining intravenous paracetamol and dexa-methasone reduces the incidence and severity of postoperative sore throat in patients undergoing urologic surgery.	Level of Evidence: I Weaknesses: - Researchers did not evaluate the efficacy of paracetamol alone. - Only 1 type of surgery was evaluated. Strengths: - Utilized statistical analysis to calculate sample size and compare results - Excluded risk factors for POST - Anesthesia providers and investigators were blinded. - Allowed comparison of 2 different drugs

		multiple intubation attempts, severe cardiopulmonary disease, hepatic disease, and Mallampati score > 2. Setting: Korea		Analyzed and compared using the Chi-square test, the Fisher's exact test, and the *t*-test. Statistical significance accepted: *p*-value < 0.05. Researchers used IBM SPSS Statistics software. The *p*-value was adjusted using Bonferroni's correction.				Feasibility: - The administration of IV dexa-methasone, combined with IV paracetamol, is a reasonable and cost-effective intervention to prevent POST. Risk assessment: - Researchers obtained approval from the Institutional Ethics Committee. - Informed consent was obtained from all participants. - The research was registered at ClinicalTrials.gov.

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Eidi M et al. *Iran J Otorhinolaryngol*. 2014;26(75):89-98.	RCT, double-blinded Purpose: Compare the effect of dexamethasone before and after intubation on the incidence of sore throat after tympanoplasty surgery. Allocation and interventions: Group 1: Received 8 mg of IV dexamethasone 30 minutes before intubation. Group 2: Received 8 mg of IV dexamethasone 30 minutes after intubation.	Enrolled patients: 70 Attrition: 0 *N* = 70 Group 1: 35 Group 2: 35 Patient demographics: Adult male and female patients aged 30-70 years, ASA I or II, scheduled for tympanoplasty under GETA. Excluded: Patients with a history of recent respiratory infection, taking steroids or painkillers, participation in previous intubation trials, and surgeries longer than 300 minutes. Setting: Imam-Reza Hospital, Iran	Independent variable: IV dexamethasone before and after intubation Dependent variables: Incidence and severity sore throat	Assessment of incidence and severity of sore throat: 4-grade scale based on verbal responses to questions: 0 none; 1 mild, 2 moderate, 3 severe. Measurement intervals: Assessed at 24 hours after extubation. Data presentation: Presented as number of patients, using tables and figures. Sample size calculation: The researchers assumed an $\alpha = 0.05$ and 90% potency and used data from previous research studies. Analysis and comparison of variables:	Scale reading 0/1/2/3 0: none 1: mild 2: moderate 3: severe Group 1: 22/6/7/0 Group 2: 20/7/7/1	In group 1, 13 patients (37.1%) reported a sore throat. None reported severe sore throat. In group 2, 15 patients reported a sore throat, including 1 complain of severe pain. No significant difference is seen between the 2 groups.	There is no significant difference between the administration of dexa-methasone before or after intubation to prevent POST.	Level of Evidence: I Weaknesses: - The incidence of sore throat was high in both groups, possibly due to a low dose of dexamethasone. - Even though the sample size was sufficient, it could have included more patients. Strengths: - Utilized statistical analysis to calculate sample size and compare results - Excluded risk factors for POST - Anesthesia providers and investigators were blinded. - Provided comparison of

				Analyzed and compared using the t-test, RAM, X^2, and Fisher exact tests. <u>Statistical significance accepted:</u> *p*-value < 0.05. The analysis was performed using SPSS 13.				dexa-methasone's administration time. <u>Feasibility:</u> - The administration of IV dexamethasone is a reasonable and cost-effective intervention to prevent POST. <u>Risk assessment:</u> - Informed consent was obtained from all participants.

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Almustafa M et al. *Obes Surg*. 2020;30(2):501-506.	RCT, double-blinded Purpose: Evaluate the efficacy of preoperative nebulized dexamethasone in reducing symptoms associated with bougie insertion in laparoscopic sleeve gastrectomy, including postoperative sore throat. Allocation and interventions: Group D: Received 8 mg of nebulized dexamethasone 1 hour before intubation. Group S: Received nebulized saline 1 hour	Enrolled patients: 86 Attrition: 6 - 1 experienced laryngospasm during recovery - 2 experienced allergic reactions intraoperatively - 1 procedure was changed to gastric bypass - 1 required multiple intubation attempts - 1 required bougie insertion time longer than 50 minutes *N* = 80 Group D: 40 Group S: 40 Patient demographics: Adult male and female patients, with a mean age of 35 years, ASA I, II, or III, Mallampati score < 3, scheduled for	Independent variable: Nebulized dexamethasone Dependent variables: Incidence and severity sore throat	Assessment of incidence and severity of sore throat: Numerical rating scale (NRS) 0: no sore throat 1–3: mild 4–7: moderate 8–10: severe Measurement intervals: Assessed at 1, 6, and 24 hours after extubation. Data presentation: Presented as number of patients (only maximum NRS was provided) Sample size calculation: Based on statistics from previous research, the researchers used an α=0.05 and a confidence interval of 95% to calculate the sample size.	Maximum NRS in 24 hours: *Group D:* 0: 29 patients Mild: 10 patients Moderate: 1 patient Severe: 0 patients *Group S:* 0: 5 patients Mild: 26 patients Moderate: 9 patients Severe: 0 patients	The incidence of POST was 27.5% (11 out of 40 patients) in group D. The incidence of POST was 72.5% (35 out of 40 patients) in group S. The severity of sore throat was higher in the S group. No patients experienced severe sore throat in either group.	Preoperative nebulized dexamethasone effectively reduces the incidence and severity of sore throat after sleeve gastrectomy with bougie insertion.	Level of Evidence: I Weaknesses: - The scale used was very subjective. - The researchers did not compare nebulized dexamethasone with the intravenous formulation. Strengths: - Utilizes statistical analysis to calculate sample size and compare results. - Excluded risk factors for POST. - Anesthesia providers and investigators were blinded. - Provides a placebo group for comparison.

	before intubation.	sleeve gastrectomy with bougie insertion. The BMI of patients ranged from 33 to 65 kg/m^2. No significant difference was present between the 2 groups. Excluded: bougie insertion times longer than 50 minutes, patients with upper airway pathologies, difficult airways, recent respiratory infections, and taking steroids. Setting: tertiary referral hospital, Jordan		Analysis and comparison of variables: Analyzed and compared using the Mann-Whitney *U* test and the chi-square test. Statistical significance accepted: P value < 0.05. The analysis was performed using SPSS 21.				- Included a procedure with high incidence of POST. Feasibility: - The administration of nebulized dexamethasone is a reasonable and cost-effective intervention to prevent POST. Risk assessment: - Researchers obtained approval from the institutional review board committee at their tertiary referable hospital. - Informed consent was obtained from all participants. - The study was conducted following the latest declaration of Helsinki.

Citation	Design/Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Malik SH et al. *J Ayub Med Coll Abbottabad*. 2019;31(3):422-426.	RCT, double-blinded Purpose: Determine the role of dexamethasone in improving recovery after general surgery with endotracheal intubation. Allocation and interventions: Group A: Received 8 mg of IV dexamethasone 30 minutes before intubation. Group B: Received 2 mL of saline 30 minutes after intubation.	Enrolled patients: 122 Attrition: 0 *N* = 122 Group A: 61 Group B: 61 Patient demographics: Adult male and female patients, aged 18-60 years, ASA I or II, Mallampati score < 3, scheduled for general surgery with GETA. No significant difference was present between the 2 groups. Excluded: Patients with recent upper respiratory infections, difficult airways, and taking steroids. Surgeries longer than 3 hours were excluded.	Independent variable: IV dexamethasone Dependent variables: Incidence of sore throat	Assessment of incidence of sore throat: Yes or No questions Measurement intervals: Assessed at 2, 12, and 24 hours after extubation. Data presentation: Presented as number of patients (%) Sample size calculation: Based on statistics from similar studies, the researchers used an $\alpha = 0.05$ and a confidence interval of 95% to calculate the sample size. Analysis and comparison of variables: Analyzed and compared using the *t*-test and the Chi-square test.	Incidence of sore throat: *Group A:* At 2 h: 5(8.19%) At 6 h: 6(9.8%) At 24 h: 2(3.27%) *Group B:* At 2 h: 13(21.3%) At 6 h: 15(24.6%) At 24 h: 8(13.1%)	At all measured intervals, the incidence of POST was significantly lower in the dexa-methasone group compared to the placebo group.	Preoperative intravenous dexa-methasone is effective in reducing postoperative complications of GETA, including sore throat.	Level of Evidence: I Weaknesses: - The scale used was very subjective. - The severity of sore throat was not evaluated. - A different drug was not used for comparison. Strengths: - Utilized statistical analysis to calculate sample size and compare results - Excluded risk factors for POST - Anesthesia providers and investigators were blinded. - Provided a placebo group for comparison - Included a broad range of

		Setting: Ayub Teaching Hospital, Pakistan		Statistical significance accepted: *p*-value < 0.05. The analysis was performed using SPSS version 21.				surgical procedures Feasibility: - The administration of IV dexamethasone is a reasonable and cost-effective intervention to prevent POST. Risk assessment: - Researchers obtained approval from the Institutional Ethics Committee - Informed consent was obtained from all participants.

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Aigbedia SO et al. *Niger J Clin Pract*. 2017;20(6):677-685.	RCT, double-blinded Purpose: Evaluate the efficacy of lidocaine jelly and ketamine gargle in preventing postoperative throat pain. Allocation and interventions: Group K: gargled 40 mg of ketamine in 30 mL of saline 5 minutes before intubation Group L: 2% lidocaine jelly was applied to the ETT, and patients gargled 30 mL of saline	Enrolled patients: 150 Attrition: 10 - 10 patients were excluded due to violation of protocol. *N* = 140 Group K: 72 Group L: 68 Patient demographics: Adult male and female patients, aged 18-64 years, ASA I or II, scheduled for general surgery with GETA. No significant difference was present between the 2 groups. Excluded: Patients with a history of POST, asthma, Mallampati grades > 2, and recent NSAID consumption.	Independent variable: Ketamine gargles and lidocaine jelly Dependent variables: Incidence and severity of sore throat	Assessment of incidence and severity of sore throat: 4-grade scale based on verbal responses to questions: none, mild, moderate, or severe. Measurement intervals: Assessed at 6, 12, 18, 24, and after 24 hours post-extubation. Data presentation: Presented as number of patients (%) Sample size calculation: Not reported Analysis and comparison of variables: Analyzed and compared using the *t*-test, chi-square, and Fisher exact test.	Incidence and severity of sore throat: *Group K:* None: 42 (58.3%) Mild: 26 (36.5%) Moderate: 3 (4.2%) Severe: 1 (1.0%) Total: 72 (100%) *Group L:* None: 21 (30.8%) Mild: 1 (1.5%) Moderate: 30 (44.1%) Severe: 16 (23.5%) Total: 68(100%) Incidence and severity of sore throat based on time of occurrence: *Group K:* At 6 h: 2 (6.7%)	More patients reported no sore throat in the ketamine group than in the lidocaine group (42 versus 21). In the ketamine group, most patients complained of mild and moderate sore throat. In the lidocaine group, most patients complained of moderate and severe sore throat. Most of the pain reported in the lidocaine group was at the beginning of surgery, while in the ketamine group, it was	Ketamine gargles, administered 5 minutes before intubation, provide prophylaxis against moderate and severe POST.	Level of Evidence: I Weaknesses: - Systemic effects of ketamine were not evaluated. Strengths: - Utilizes statistical analysis to calculate sample size and compare results. - Excluded risk factors for POST. - Anesthesia providers and investigators were blinded. - Included a broad range of surgical procedures. Feasibility: - The administration of ketamine gargles is a reasonable and cost-effective

		Setting: University of Benin Teaching Hospital, Nigeria		Statistical significance accepted: *p*-value < 0.05 was considered significant. The analysis was performed using SPSS version 18.	At 12 h: 4 (13.3%) At 18 h: 2 (6.7%) At 24 h: 8 (26.7%) After 24 h: 14 (46.7%) *Group L:* At 6 h: 2 (4.3%) At 12 h: 25 (53.1%) At 18 h: 10 (21.3%) At 24 h: 7 (14.9%) After 24 h: 3 (6.4%)	after 24 hours post-operatively.		intervention to prevent POST. - The only limitation was that patients cannot be at risk of aspiration. Risk assessment: - Researchers obtained approval from the hospital research and ethics committee. - Informed consent was obtained from all participants.

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Segaran S et al. *Anesth Essays Res*. 2018;12(4):885-890.	RCT, double-blinded Purpose: Compare the efficacy of nebulized magnesium and ketamine in preventing postoperative throat pain. Allocation and interventions: Group A: Received nebulized magnesium sulfate (250 mg in 5 ml saline) 5 minutes before induction. Group B: Received nebulized ketamine (50 mg in 5 ml saline) 5 minutes before induction.	Enrolled patients: 80 Attrition: 0 *N* = 80 Group A: 40 Group B: 40 Patient demographics: Adult male and female patients, aged 18-65 years, ASA I or II, scheduled for elective surgery with GETA. No significant difference was present between the 2 groups. Excluded: Patients with a history of upper airway pathology, POST, recent respiratory infections, allergy to the drugs used, and known difficult intubation. Surgeries in the	Independent variable: Nebulized magnesium and nebulized ketamine Dependent variables: Incidence and severity of sore throat	Assessment of incidence of sore throat: Yes or no questions. Assessment of severity of sore throat: 4-grade scale based on verbal responses to questions: 0 none; 1 mild, 2 moderate, 3 severe Measurement intervals: Assessed at 2, 4, 6, and 24 hours post-extubation Data presentation: Presented as number of patients Sample size calculation: Calculated based on statistics from similar studies, applying an $\alpha = 0.05$ and a power of 80%	Reports of sore throat in group A: At 2 h: 2 (mild) and 2 (moderate) At 4 h: 7 (mild) and 2 (moderate) At 6 h: 5 (mild) and 1 (moderate) At 24 h: 0 Reports of sore throat in group B: At 2 h: 2 (mild) At 4 h: 4 (mild) and 1 (moderate) At 6 h: 2 (mild) and 1 (moderate) At 24 h: 0	The incidence of POST was 50% in the magnesium group and 25% in the ketamine group. All reports of sore throat were mild and moderate in both groups. The ketamine group showed a lower incidence and severity of POST, but at 24 hours postoperatively, no patient in either group experienced sore throat.	Nebulized ketamine, administered before induction, is more effective than nebulized magnesium in preventing POST.	Level of Evidence: I Weaknesses: - The researchers did not evaluate different doses of ketamine and magnesium. - Only 1 administration time was used in the study; therefore, the efficacy of these drugs when given at other times is unknown. Strengths: - Utilized statistical analysis to calculate sample size and compare results - Excluded risk factors for POST - Anesthesia providers and

		prone position and lasting more than 3 hours were excluded. Setting: India		Analysis and comparison of variables: Analyzed and compared using the Mann-Whitney, Chi-square, *t*-test, and Wilcoxon signed-rank tests. Statistical significance accepted: *p*-value < 0.05 was considered significant. The analysis was performed using SPSS version 20.				investigators were blinded - Included a broad range of surgical procedures Feasibility: - The administration of nebulized ketamine is a reasonable and cost-effective intervention to prevent POST. Risk assessment: - Researchers obtained approval from the Institutional Ethics Committee. - Informed consent was obtained from all participants.

Citation	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Faiz SH et al. *Adv Biomed Res*. 2014;3:216.	RCT, double-blinded Purpose: Compare the efficacy of benzydamine and ketamine gargles in preventing postoperative throat pain. Allocation and interventions: Benzydamine group: Gargled benzydamine HCl, 0.15 g in 19 ml of normal saline, 5 minutes before induction. Ketamine group: Gargled 20 mg of ketamine hydrochloride (50 mg/ml) in 19 ml normal saline 5 minutes before induction	Enrolled patients: 60 Attrition: 0 *N* = 60 Benzydamine group: 20 Ketamine group: 20 Placebo group: 20 Patient demographics: Adult female patients, aged 15-60 years, ASA I or II, scheduled for elective hysterectomy. No significant difference was present between the 2 groups. Excluded: Patients with a history of difficult intubation, allergy to the drugs studied, substance abuse, diabetes, hypertension, liver disease, and recent respiratory infection.	Independent variable: Benzydamine and ketamine gargles Dependent variables: Incidence and severity of sore throat	Assessment of incidence and severity of sore throat: Numerical rating scale (NRS) from 0 to 10. Measurement intervals: Assessed at 0, 2, and 24 hours post-extubation. Data presentation: Presented as the mean numerical rating scale, using tables and figures. Sample size calculation: Calculated based on statistics from similar studies, applying an $\alpha = 0.05$ and a power of 80%. Analysis and comparison of variables: Analyzed and compared using analysis of variance	Mean NRS for the benzydamine group: At 0 h: 0 At 2 h: 1 At 24 h: 0 Mean NRS for the ketamine group: At 0 h: 0 At 2 h: 0 At 24 h: 0 Mean NRS for the placebo group: At 0 h: 1 At 2 h: 2 At 24 h: 2	The mean NRS in the ketamine group was 0 at all measured intervals, meaning no patient complained of sore throat in this group. The mean NRS was higher in the benzydamine group at 2 hours compared to the ketamine group.	The incidence and severity of POST can be reduced with ketamine or benzydamine gargles, but the effect is more noticeable with ketamine.	Level of Evidence: I Weaknesses: - The researchers did not evaluate different doses of ketamine and magnesium. - Only 1 administration time is used in the study; therefore, the efficacy of these drugs when given at other times is unknown. - The study only involved women and 1 type of surgery. - The number of patients and incidence of POST was not reported. Strengths: - Utilized statistical analysis to calculate

	Placebo group: Gargled 20 mL of normal saline 5 minutes before induction.	Setting: Rasool Akram Hospital, Iran		(ANOVA), Kruskal-Wallis one-way analysis of variance test, and *post hoc* tests (Tukey or Scheffe). Statistical significance accepted: *p*-value < 0.05 was considered significant. The analysis was performed using SPSS version 18.				sample size and compare results - Excluded risk factors for POST - Anesthesia providers, investigators, and patients were blinded. - Provided a placebo group for comparison Feasibility: - The administration of ketamine or benzydamine gargles is a reasonable and cost-effective intervention to prevent POST. Risk assessment: - Researchers obtained approval from the Iranian registry of clinical trials hosted by the Tehran University of Medical Sciences (TUMS).

								- Informed consent was obtained from all participants. - The adverse effects of the drugs were explained to the patients.

Citation	Design/Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement And Data Analysis	Findings	Results	Conclusions	Appraisal: Worth to Practice/Level
Prasant NVSV et al. *Anesth Essays Res*. 2021;15(3):316-320.	RCT, double-blinded Purpose: Compare the efficacy of preoperative nebulized ketamine with nebulized lignocaine (xylocaine and lidocaine). Allocation and interventions: Group 1: received nebulized ketamine (50 mg/2 mL of saline) 5 minutes before induction. Group 2: Received nebulized lignocaine 4% (1 mL/2 mL of saline) 5 minutes before induction.	Enrolled patients: 90 Attrition: 0 *N* = 90 Group 1: 45 Group 2: 45 Patient demographics: Adult male and female patients, aged 18-60 years, ASA I or II, scheduled for elective surgery requiring GETA. No significant difference was present between the 2 groups. Excluded: Patients with a history of difficult intubation, POST, cardiovascular, renal, and hepatic disease. Setting: India	Independent variable: Nebulized ketamine and nebulized lignocaine Dependent variables: Incidence and severity of sore throat	Assessment of incidence and severity of sore throat: Numerical rating scale (NRS) 0: no sore throat 1–3: mild 4–7: moderate 8–10: severe Measurement intervals: Assessed at 0, 6, and 24 hours post-extubation Data presentation: The number of patients (%) Sample size calculation: Calculated based on previous studies with confidence level estimated at 95%, Z value of 1.96, and margin of error evaluated at ±12 Analysis and comparison of variables:	Incidence of sore throat in Group 1: At 0 h: 0 (0%) At 6 h: 4 (8.9%) At 24h: 0 (0%) Incidence of sore throat in Group 2: At 0 h: 0 (0%) At 6 h: 13 (28.9%) At 24h: 4 (8.9%) Severity of sore throat in Group 1: Mild: 23 (51%) Moderate: 15 (33%) Severe: 7 (16%) Severity of sore throat in Group 2: Mild: 7 (16%) Moderate:	No patient reported sore throat at 1 hour post-operatively in either group. At 6 and 24 hours post-operatively, the incidence of POST was higher in the lignocaine group compared to the ketamine group. Group 1 reported a higher incidence of mild sore throat, whereas group 2 reported a higher incidence of moderate and severe sore throat.	Nebulized ketamine offers better prophylaxis against POST than nebulized lignocaine in patients undergoing surgery with GETA.	Level of Evidence: I Weaknesses: - The researchers did not evaluate different doses of ketamine and magnesium. - Only 1 administration time was used in the study; therefore, the efficacy of these drugs when given at other times is unknown. Strengths: - Utilized statistical analysis to calculate sample size and compare results - Excluded risk factors for POST - Anesthesia providers, investigators,

				Analyzed and compared using the *t*-test, Chi-square, and Fisher's exact tests. <u>Statistical significance accepted:</u> *p*-value < 0.05 was considered significant. The analysis was performed using SPSS version 20.	16 (36%) Severe: 29 (32%)			and patients were blinded. <u>Feasibility:</u> - The administration of nebulized ketamine is a reasonable and cost-effective intervention to prevent POST. <u>Risk assessment:</u> - Researchers conducted the study according to their Institutional Ethical Standards and the Helsinki Declaration of 1975 - Informed consent was obtained from all participants. - The adverse effects of the drugs were explained to the patients.

Discussion

Dexamethasone Administered Alone

Dexamethasone has been administered alone to prevent POST in previous research studies.[15,17,18,20,21,31] The intravenous route has been most commonly used, and the timing of administration is usually 30 minutes before induction of anesthesia. [15,17,18,20,31] One study proposed to compare the effect of administering it 30 minutes before intubation with doing it 30 minutes after intubation and found no significant difference in the reduction of POST.[31] A standard dose to reduce the incidence and severity of postoperative sore throat has not been established, but across all studies, a range of 8 mg to 0.2 mg/kg yielded positive outcomes, and the researchers concluded that a single dose was sufficient. [15,17,18,20,31] Two studies used 8 mg, 2 used 10 mg, and 1 used 0.2 mg/kg of intravenous dexamethasone. [15,17,18,20,31]

Eidi et al concluded that 8 mg of dexamethasone administered 30 minutes before induction reduces the incidence and severity of sore throat for up to 24 hours postoperatively.[31] In this study, POST was assessed only at 24 hours after extubation.[31] Thirty-seven percent of the subjects experienced a sore throat, but all reported it as mild or moderate, not severe.[31] Unlike the previous study, Malik et al assessed for sore throat at 2, 12, and 24 hours post-extubation, but the researchers did not evaluate the severity, only the incidence of sore throat.[15] Malik et al compared dexamethasone with placebo (saline), while Eidi et al compared dexamethasone at different administration times.[15,31] In Malik et al., the incidence of sore throat was lower in the dexamethasone group than in the placebo group at all times, but the best results were seen at 24 hours postoperatively.[15] Unlike Eidi et al, the incidence of sore throat was much lower (3.27%).[15]

Yang et al evaluated the effectiveness of administering 10 mg of dexamethasone before induction.[17] Dexamethasone was compared with placebo (saline) and ketorolac.[17] Lee et al also

administered 10 mg of dexamethasone preoperatively but compared it to its combination with paracetamol.[18] Both studies evaluated the incidence and severity of sore throat and measured it at 1, 6, and 24 hours postoperatively.[17,18] Lee et al also assessed for sore throat immediately after extubation in the recovery unit.[18] Both studies evaluated sore throat at rest and also during swallowing.[17,18] In Yang et al, the incidence and severity of POST were similar in all groups at all measured intervals, with a slight improvement in the dexamethasone group.[17] During swallowing, the results were also similar at 1 and 6 hours postoperatively; however, a significant improvement was seen at 24 hours.[17] Lee et al did not have a control group to compare dexamethasone with, as its goal was to compare its combination with paracetamol with dexamethasone alone; however, the trends are similar to Yang et al.[18] There was not much change at rest and during swallowing during the first 6 hours postoperatively in the dexamethasone group, but an increase in pain-free reports was observed at 24 hours.[18] POST has shown less severity and incidence in the late postoperative period than early after extubation.[17] The long duration of action of dexamethasone (36-54 hours) might account for the better outcomes at 24 hours post-extubation.[17] A higher dose may be needed for better outcomes in the early postoperative period.[17]

Unlike the previous studies, Safavi et al administered a higher dose of dexamethasone preoperatively (0.2 mg/kg).[20] It measured the incidence and severity of sore throat at 0, 2, 4, 8, and 24 hours postoperatively.[20] At all measured intervals, the percentage of pain-free patients was high and similar (77-83%).[20] Also, no reports of moderate or severe sore throat were recorded at any time.[20] This improvement in outcomes corroborates the conclusion from previous studies that a higher dose might be needed for sore throat prevention immediately after surgery.[15,17,18]

Dexamethasone also offers the advantage of being administered as a nebulizer.[21] This can be particularly useful in patients without intravenous access before induction, such as pediatrics.[21] Almustafa et al evaluated its effectiveness in patients undergoing sleeve gastrectomy with bougie insertion by comparing it to nebulized placebo (saline).[21] As in Yang et al[17] and Eidi et al,[31] dexamethasone proved superior to placebo.[21] Almustafa et al, just like Safavi et al,[20] included a risk factor for POST, the bougie insertion.[21] The incidence and severity of sore throat were measured at 1, 6, and 24 hours postoperatively.[21] At 24 hours, 73% of the patients were pain-free, and only mild and moderate sore throat was reported.[21] These results correlated with the conclusions in the intravenous dexamethasone trials, demonstrating that the nebulized route is not inferior in preventing POST. [15,17,18,20,21,31]

Ketamine Administered Alone

Ketamine is another drug that has been researched and used to prevent POST.[24-27] The most common routes used are gargles and nebulizers.[24-27] A single dose of 20-40 mg mixed with saline before induction has been used for gargles.[24,25] Preoperative nebulizer has been administered as 50 mg of ketamine mixed in 2 mL of saline.[26,27] In this project, 2 studies involving ketamine gargles and 2 studies involving nebulized ketamine were reviewed.

Aigbedia et al and Faiz et al evaluated the efficacy of ketamine gargles in reducing the incidence and severity of POST.[24,25] Aigbedia et al compared it with lidocaine jelly applied to the ETT, while Faiz et al compared it with benzydamine gargles and placebo.[24,25] Both studies included patients with similar characteristics; however, Aigbedia et al studied patients of both genders undergoing general surgery, while Faiz et al studied female patients undergoing hysterectomies.[24,25] Aigbedia measured the incidence and severity of sore throat at 6, 12, 18, and 24 hours post-extubation, while Faiz et al measured them at 0, 2, and 24 hours.[24,25] Aigbedia et al

found that the incidence of sore throat was lower with ketamine gargles than with lignocaine jelly.[24] Faiz et al also concluded that ketamine gargles were more effective than benzydamine gargles or placebo in preventing POST.[25] In Aigbedia et al, the severity of sore throat was predominantly mild and moderate, with a higher incidence in the late postoperative period.[24] Faiz et al also found a lower incidence and severity of sore throat in the immediate postoperative period.[25]

Segaran et al and Prasant et al evaluated the efficacy of ketamine when administered as a nebulizer.[26,27] Segaran et al compared ketamine with magnesium, while Prasant et al compared it with lignocaine.[26,27] Both studies included subjects of both genders with similar characteristics and were scheduled for general surgery with endotracheal intubation.[26,27] Segaran et al measured the incidence and severity of POST at 2, 4, 6, and 24 hours post-extubation, and Prasant et al did it at 0, 6, and 24 hours.[26,27] Both studies concluded that nebulized ketamine was superior to the drugs for preventing postoperative sore throat.[26,27] Similar to ketamine gargles, most patients who reported a sore throat characterized it as mild or moderate in both trials.[26,27] However, in Segaran et al, sore throat was recorded at 4 and 6 hours postoperatively, and no complaints were seen at 0 and 24 hours.[26] This contrasts with the ketamine gargle trials, in which most complaints of sore throat were reported at 24 hours postoperatively.[24,25] Prasant et al also found no incidences of sore throat in the immediate and late postoperative periods.[27] All complaints of sore throat were recorded at 6 hours post-extubation.[27]

Dexamethasone and Ketamine Administered in Combination

Safavi et al administered 40 mg of ketamine gargles and 0.2 mg/kg intravenous dexamethasone to the patients before induction of anesthesia.[20] This combination proved to be more effective in decreasing the incidence and severity of POST for up to 24 hours than each

drug administered alone.[20] In the immediate postoperative period, when dexamethasone had proved less effective in previous studies, the incidence of sore throat was 18% (compared to 29% with dexamethasone alone). [15,17,18,20,21,31] In the late postoperative period, when ketamine gargles had proved to be less effective in previous studies, the incidence of sore throat was 10% (compared to 46.7% in Abigedia et al).[20,24,25]

Hemodynamic and Adverse Effects of Dexamethasone and Ketamine

In order to evaluate the efficacy of dexamethasone and ketamine, it is necessary to assess for potential adverse effects and analyze their safety profile. Long-term administration of dexamethasone is associated with adrenal suppression, impaired wound healing, elevated blood glucose, and an increased risk of infections.[31] However, a single dose is not associated with these side effects and is considered safe.[31] Safavi et al followed the patients to assess for potential complications of dexamethasone administration and found no local or systemic side effects.[20] The other trials involving dexamethasone administration did not mention any complications after administration. [15,17,18,20,21,31] A mild increase in blood glucose was reported in a systematic review, but only in the immediate postoperative period.[12] Further research is needed to evaluate how this complication affects patients with diabetes mellitus. Future studies should include diabetic patients and hourly blood glucose monitoring to assess the effects of a preoperative dose of dexamethasone. Additionally, trials comparing diabetic with non-diabetic patients could be done to determine differences in these 2 populations.

Ketamine causes sedation and a dissociative psychological state characterized by delirium and hallucinations postoperatively, but these adverse effects are associated with anesthetic doses of ketamine and are rare with low analgesic doses.[23] Delirium and hallucinations were not reported in any of the studies reviewed.[24-27] It also increases sympathetic tone, heart

rate, blood pressure, and cardiac output.[27] Safavi et al measured the level of sedation using an alertness/sedation scale (where 0 = awake/alert and 3 = deep sleep) and found no differences in the incidence of sedation among all groups.[20] Prasant et al also measured the level of sedation using the Ramsay scale and found similar levels in patients receiving ketamine and lignocaine.[27] Segaran et al reported a slight increase in heart rate and systolic blood pressure after nebulized ketamine administration.[26] However, Prasant et al, who also administered nebulized ketamine was, reported no changes in these hemodynamic parameters but a drop in heart rate and blood pressure after induction in the group that did not receive ketamine.[27] Faiz et al found no statistically significant changes in heart rate and blood pressure after administering ketamine gargles.[25] Additionally, Prasant et al found no significant hemodynamic differences in the postoperative period.[27] The effect of ketamine usually lasts about 20 minutes, which may account for the slight increase in heart rate and systolic blood pressure in Segaran et al., but once the effect wears off, these parameters are similar to patients who do not receive ketamine.[26]

All patients in the ketamine studies were monitored continuously with standard ASA monitors, but researchers did not use any other interventions to monitor for adverse effects of ketamine.[24-27] None of the studies measured blood levels of ketamine to assess its impact perioperatively and the adequacy of the dose administered. Plasma concentrations ranging between 70 and 160 ng/ml or approximately 0.29–0.67 μM are sufficient to elicit the analgesic effect of ketamine.[32] Obtaining higher concentrations can alert the researchers of possible overdose that might not be detected through vital signs monitoring. Additionally, a Bispectral index measurement (BIS) monitor could have been used to assess the level of sedation in patients receiving ketamine compared to those who did not. The goal of BIS monitoring is to optimize the degree of anesthesia and medication delivery without solely depending on autonomic and

somatic symptoms, which are unreliable indicators of a patient's conscious state under anesthesia.[33] It offers precise and trustworthy estimations of hypnosis during ketamine anesthesia.[33] The use of invasive hemodynamic monitoring in the studies was based on the procedure that precluded accurate estimations of the hemodynamic effects of the ketamine dose administered. An alternative for future studies is using the Acumen IQ cuff by Edward Lifesciences. This non-invasive finger sensor provides automatically calculated, beat-to-beat hemodynamic information and offers access to advanced hemodynamic parameters without needing an arterial line.[34]

Conclusion

A single dose of intravenous dexamethasone administered before the induction of anesthesia decreases the incidence and severity of postoperative sore throat. Eight to ten mg doses are more effective in the late postoperative period but fail to show significant improvement in the early postoperative period. This can be due to the long duration of action of dexamethasone. A higher dose, 0.2 mg/kg, can improve outcomes following extubation. Alternatively, administering nebulized dexamethasone offers the same benefits as the intravenous route. The adverse effects associated with long-term corticosteroid administration are absent with a single dose of dexamethasone. Ketamine gargles are also effective in reducing the incidence and severity of POST. In contrast to low doses of dexamethasone, ketamine gargles offer better outcomes immediately after surgery, and its effects diminish over time. This can be due to the short duration of action of ketamine. Administering ketamine as a nebulizer decreases the incidence and severity of sore throat in the late postoperative period, maintaining the same efficacy early after extubation. Low doses of ketamine used to prevent POST do not significantly contribute to sedation, hallucinations, delirium, and hemodynamic instability. A 40-50 mg dose

of ketamine can effectively reduce sore throat without any significant adverse effects. Ketamine can be combined with dexamethasone to achieve better outcomes, especially in the early postoperative period, when higher doses of dexamethasone may be needed to prevent sore throat. This can benefit patients who cannot tolerate high doses of steroids. The synergistic effect of these drugs offers better pain control during the first 24 hours after surgery than each drug administered alone. Teaching anesthesia providers how to effectively employ dexamethasone and ketamine, either alone or in combination, will improve their knowledge and reduce the incidence and severity of postoperative sore throat at their facility.

DNP Quality Improvement Project

Primary DNP Project Goal

This project aimed to improve anesthesia providers' knowledge about the use of dexamethasone and ketamine to reduce the incidence and severity of POST. Providers were educated about risk factors for sore throat after tracheal intubation to address them and reduce the probability of patients developing sore throat. The consequences of unaddressed POST were discussed to enhance the provider's awareness of the problem. After providing anesthesia providers with background information about postoperative sore throat, the role of dexamethasone and ketamine in addressing the problem was explained. The efficacy and feasibility of these medications were discussed. This project intended to educate graduates from the Florida International University Doctor of Nurse Anesthesia Practice Program about the risk factors and consequences of POST and provide them with evidence-based interventions to reduce the incidence of POST in patients undergoing surgery in their facility.

SMART Objectives

For the purposes of this DNP quality improvement project, the following SMART objectives were identified:

- By the end of the DNP project, anesthesia providers will demonstrate an increased knowledge of risk factors and consequences of postoperative sore throat through post-lecture quizzes and monthly questionnaires.

Specific (S): This project focused on postoperative sore throat in patients undergoing surgery with tracheal intubation. The target population was anesthesia providers. The project intended to educate them about the adverse effects of this complication and provide them with interventions to prevent it.

Measurable (M): Gaps in knowledge will be identified through pre- and post-educational questionnaires. A presentation provided education, and progress was measured through questionnaires.

Achievable (A): By the end of this DNP project, anesthesia providers will demonstrate knowledge by answering a post-lecture quiz correctly. This time frame will allow providers to acquire sufficient knowledge and feel comfortable incorporating the evidence into practice. To achieve this goal, it is essential to ensure the availability of educational opportunities and resources for providers to implement the proposed interventions.

Relevant (R): Postoperative sore throat significantly increases patients' dissatisfaction with surgery and healthcare costs. Educating anesthesia providers on preventing this complication will benefit patients and healthcare facilities by decreasing its incidence.

Time-bound (T): This goal should be achieved by the end of the DNP project. This time frame allows anesthesia providers to acquire knowledge and incorporate the interventions into their practice. It also provides time for the researcher to measure the goals and interventions.

- By the end of the DNP project, anesthesia providers will demonstrate an increased knowledge of dexamethasone and ketamine to decrease the incidence and severity of postoperative sore throat through post-lecture quizzes and monthly questionnaires.

Specific (S): This goal was explicitly targeted to anesthesia providers at a healthcare organization. The purpose was clear: to educate them about the use of dexamethasone and ketamine to prevent postoperative sore throat.

Measurable (M): This goal was measured similarly to the previous goal. Gaps in knowledge were identified through pre-educational questionnaires. Education was provided through a presentation. Progress was measured through a post-educational questionnaire.

Achievable (A): This goal should be achieved by the end of the DNP project, which provided sufficient time for providers to be educated, incorporate dexamethasone and ketamine into their practice, and for the researcher to measure progress. The researcher provided the education, and the anesthesia providers demonstrated knowledge through post-lecture quizzes and by using the medications in their daily practice.

Relevant (R): Dexamethasone and ketamine are affordable medications that have been proven effective in reducing the incidence and severity of POST. Incorporating them into one's practice is beneficial for patients, healthcare institutions, and anesthesia providers.

Time-bound (T): This goal was achieved by the end of the DNP project. This time frame allowed anesthesia providers to acquire knowledge and incorporate the interventions into their practice. It also provided time for the researcher to measure the goals and interventions.

- By the end of the DNP project, the researcher will communicate with the pharmacy staff and obtain feedback from anesthesia providers to identify and address barriers to implementing the researched interventions at this facility.

Specific (S): This goal was intended to identify what resources may preclude the implementation of the researched interventions and how providers' opinions may interfere with translating evidence into practice.

Measurable (M): The medications' availability was assessed by communicating with pharmacy staff and ensuring they were available in every drug station. Providers' opinions about the clinical practicality of the proposed interventions were obtained through monthly questionnaires.

Achievable (A): This goal was achieved by the end of the DNP project, which provides the researcher time to evaluate the consistency of medication availability and gather feedback from all anesthesia providers.

Relevant (R): Lack of dexamethasone and ketamine in the facility precludes providers from incorporating them into practice. Additionally, providers who feel uncomfortable changing their practice or using these medications require additional education and constitute a barrier to change.

Time-bound (T): This goal was achieved by the end of the DNP project. This time frame allows sufficient time for the researcher to address medication shortages and educate providers about the benefits of dexamethasone and ketamine for the prevention of POST.

Description of the Program Structure

A comprehensive assessment of providers' knowledge about POST and the use of dexamethasone and ketamine for its prevention was conducted. This was performed by giving

participants a pre-test before the educational intervention. The pre-test aimed to identify gaps in knowledge and address them to improve clinical practice. Afterward, providers received an educational module covering risk factors for POST and the use of dexamethasone and ketamine to minimize its incidence and severity. A post-test was conducted to evaluate the improvement of providers' knowledge and the efficacy of the educational module.

SWOT Analysis

Strengths

- Experienced anesthesia providers in the management of POST can improve patient satisfaction with surgery and minimize complications associated with this complication. Organizations seeking to improve clinical practice by implementing evidence-based research should establish a cohort of practitioners willing to teach others.
- Conditions for educational delivery are feasible. The delivery of an online educational module is accessible to all the participants, and the presentation is concise.
- Florida International University (FIU) fosters clinical practice improvement through research. Graduates from this institution are open to implementing evidence-based practices as long as they are well-founded and come from reputable sources. This is essential because changing an organization's culture to support change is 1 of the most challenging tasks involving translating research.
- Dexamethasone and ketamine are widely available at the facility, which makes it easier for providers to access and administer them.

Weaknesses

- Anesthesia providers do not see POST as a severe complication that needs to be addressed. They need to be educated about the issue and the consequences of not

addressing it. It will also be challenging for them to incorporate the proposed interventions into their routines; therefore, they might need time to get used to it.

- New anesthesia providers and those not included in this project might be unaware of the risk factors, complications, and management of POST. Educated providers will need to step up and teach incoming providers how to address this complication using the evidence provided in this project.

Opportunities

- Certified Registered Nurse Anesthetists (CRNAs) graduated from FIU practice nationwide in different types of facilities. This project can improve the management of POST in the Miami area and other parts of the country.

Threats

- Ketamine or dexamethasone shortages can threaten the implementation of the recommended interventions. Providers need to be aware of shortages and utilize medications as required.
- The price of ketamine or dexamethasone may increase, leading to higher costs, which may preclude providers from widely using these medications. Stakeholders and policymakers need to weigh the economic benefits of administering these drugs against the consequences of POST and analyze if it is profitable to continue administering them in such a situation.

Theoretical Framework/Conceptual Underpinning

Translating evidence-based practices into an organization is challenging; therefore, it needs to be planned and managed, considering how the changes affect individuals within the organization.[39] The success or failure of new interventions depends on the degree of planning

and effective management of the change process.[39] Theoretical frameworks serve as tools to guide, plan, and manage the change process and translation of evidence into clinical practice.[39] This project utilizes Lippitt's Model of Change to plan and manage the implementation of the research interventions into clinical practice.

Theory Overview

Lippitt's Model of Change is a theoretical framework consisting of 7 steps that can be applied to translate research into practice and introduce change within an organization.[35] In the first stage, the problem is diagnosed, and the need for change is established.[35] During this stage, individuals affected by the problem and those in charge of solving it are identified.[35] The organization's motivation and capability for change are assessed in the second stage.[35] This includes the motivation and ability of staff for change.[35] In the third stage, the organization's resources for change are assessed.[35] It includes determining the staff involved in the process and the materials needed to apply a change.[35] The change process is selected in the fourth stage.[35] In this stage, an action plan and goals are set to implement change and address the issue.[35] The fifth stage includes delineating clear objectives and evaluating alternatives.[35] Roles are assigned during this stage, and expectations from each individual are established.[35] In the sixth stage, the plan is implemented, and strategies are set in motion to maintain the change constant.[35] Feedback and enhanced communication among staff and leadership facilitate the maintenance of the action plan.[35] By the seventh stage, the change agent starts withdrawing from the helper role, the staff becomes more familiar with the change, and the translation of research becomes a standard of care at the facility.[35]

Theory/Clinical Fit

The first step in Lippitt's Model of Change was diagnosing the problem: the increased incidence of postoperative sore throat in patients undergoing surgery with tracheal intubation. The affected population was the patients and the healthcare organization due to the increased cost of care. The individuals responsible for solving the issue were anesthesia providers. Next, the motivation of anesthesia providers to change their practice and address the problem was assessed. This was accomplished through questionnaires and interviews. Evaluating the organization's resources was accomplished by determining if dexamethasone and ketamine are available at the facility. The fourth stage correlates with educating anesthesia providers about POST and the role of dexamethasone and ketamine in its prevention. Next, individuals in charge of providing lectures and collecting feedback were selected. The goal was to improve the knowledge of anesthesia providers about POST, dexamethasone, and ketamine. The plan was implemented, and education was provided through online modules. Individuals in charge of collecting feedback did it through questionnaires to ensure the plan was maintained and addressed concerns among the staff. Once the staff became used to using these medications to prevent POST, educators and feedback collectors slowly withdrew from their roles.

Theory Evaluation

The theoretical framework used fit the purpose of this project, which was educating anesthesia providers to translate evidence-based research into practice. In the past, Lippitt's Model of Change has been used to introduce change into a healthcare organization.[35] A study conducted to analyze the incidence of falls of elderly patients in acute care settings utilized this model.[36] By following the 7 steps provided by Lippitt, the researcher identified risk factors, developed a multidisciplinary fall prevention program, and reduced the number of falls.[39] This

theory addressed identifying a common clinical problem, assessing the organization's capabilities for change, and implementing a solution to the problem.[35] By following Lippitt's steps, anesthesia providers were educated about the use of dexamethasone and ketamine to prevent POST and introduce a change in their clinical practice.

Methodology of the Quality Improvement Project

Setting and Participants

The Florida International University (FIU) Doctor of Nurse Anesthesia Practice Program prepares nurses to become competent and confident anesthesia providers.[37] Students receive a solid educational foundation in science, nursing, and anesthesia care, emphasizing research and service to the community.[37] Graduates from this program become Certified Registered Nurse Anesthetists and obtain a doctorate in nursing practice.[37] They deliver anesthesia to patients across the nation. Nineteen CRNAs, part of the FIU Doctor of Nurse Anesthesia Practice Program alumni, were included in this project.

Procedures

This was a quasi-experimental 1-group study. The intervention was the education of anesthesia providers about the use of dexamethasone and ketamine to prevent postoperative sore throat, and the outcome was translating evidence into practice.

The project began by first assessing providers' knowledge about postoperative sore throat and the use of dexamethasone and ketamine to prevent it. The information was collected through questionnaires sent to the participants via email. A pre-test was used to assess the providers' current knowledge. Providers were questioned about the risk factors for POST, its consequences, strategies to prevent this complication (if applicable), and the use of dexamethasone and ketamine to prevent POST. Basic demographic information was also collected from the

participants. Afterward, a link to the educational module was emailed to the participants. The information presented included risk factors associated with postoperative sore throat, adverse consequences, and the use of dexamethasone and ketamine to decrease its incidence and severity. The participants also received an email with a link to a post-test to evaluate knowledge acquisition and the effectiveness of the education provided. The online survey tool Qualtrics was used to conduct the pre-/post-test.

Participant Recruitment

The participants were selected from the FIU Doctor of Nurse Anesthesia Program Alumni pool. Nineteen graduates were selected. The chosen CRNAs received individual emails with an invitation to participate in the project and a consent form.

Data Collection

The information was collected through online questionnaires. Demographic data, including gender, race, ethnicity, age, title, and years of experience, were collected. No identifiable personal information was collected, and all the responses were kept anonymous. Knowledge about POST risk factors, consequences, and prevention was collected through an online pre-test. Acquired knowledge was evaluated via an online post-test. The online survey tool Qualtrics was used to conduct the questionnaires.

Data Management and Analysis

Statistical analysis was conducted using percentages and mean scores. Demographic data were classified by categories and presented as a percentage of the total of participants. Results from pre/post-lecture quizzes were recorded and compared. The number of correct answers was calculated for each question and compared in the pre and post-test. The information was presented as numbers and percentages of the total of participants. The questions with a higher

number of correct and incorrect answers in both tests were identified. The percent improvement after the educational intervention was calculated for each individual question. The collected data were kept in a password-protected laptop with access only to the primary investigator. All data were collected via the online survey tool Qualtrics.

Protection of Human Subjects

Participants were invited to participate in the project via email. Consent was electronically obtained from all participants via Qualtrics, and the right to withdraw at any time was provided. The consent included the interventions performed and the process of data management. All responses were kept anonymous, and no identifiable personal information was collected. The collected data were kept in a password-protected laptop with access only to the primary investigator. Approval was obtained from the Florida International University Institutional Review Board (IRB). The project included minimal risk to the participants, which included mild emotional stress or mild physical discomfort from sitting on a chair for an extended period. The main benefit to the participants from this research is an increased knowledge about the use of dexamethasone and ketamine to prevent postoperative sore throat.

Results

Demographics

A total of 19 participants consented to participate in the project and completed the survey. The number of male participants (n = 11, 58%) was slightly higher than the number of females (n = 8, 42%). All participants were older than 25 years. The largest ethnic groups were Hispanic (n = 9, 47%) and Caucasian (n = 8, 42%). CRNAs with a Doctor in Nursing Practice (DNP) were the only anesthesia providers included in the project. Most of the providers included

have 1-2 years of clinical experience (*n* = 12, 63%). The following tables provide a details about the demographics of all participants.

Table 1. Number of Participants Included in the Project

Response	Count	%
Completed the survey	19	100
Withdrew from the survey	0	0
Total	19	100

Table 2. Gender of the Participants

Gender	Count	%
Male	11	58
Female	8	42
Total	19	100

Table 3. Age of the Participants

Age	Count	%
Above 25 years	19	100
Below 25 years	0	0
Total	19	100

Table 4. Ethnicity of the Participants

Ethnicity	Count	%
Hispanic	9	47
Caucasian	8	42
African American	1	5
Asian	1	5
Other	0	0
Total	19	100

Table 5. Position of the Participants

Position	Count	%
CRNA	19	100
Anesthesiologist	0	0
Resident	0	0
Anesthesiologist Assistant	0	0
Total	19	19

Table 6. Level of Education of the Participants

Level of education	Count	%
Certificate	0	0
Bachelors	0	0
Masters	0	0
DNP	19	100

PhD	0	0
MD/DO	0	0
Total	19	100

Table 7. Years of Experience of the Participants

Years of experience	Count	%
Over 10 years	1	5
5-10 years	0	0
2-5 years	6	32
1-2 years	12	63
Total	19	100

Summary of the Data

In the pre-test, the most common concepts the participants missed were the doses of dexamethasone and ketamine needed to prevent POST, alternative routes for administering these drugs, and the adverse effects associated with ketamine administration. Only 1 participant (5%) was able to identify the correct dose of dexamethasone, while 8 (42.1%) were able to identify the correct dose of ketamine. Only 4 participants (21.1%) knew that dexamethasone and ketamine could be administered as a nebulizer, and only 3 participants (15.8%) knew the adverse effects of ketamine when administered for POST prevention. A high number of CRNAs correctly identified the mechanism of action of both drugs (n = 18, 94.7%). These 2 questions posed the highest number of correct answers. However, slightly more than half of the participants (n = 11, 57.9%) knew that dexamethasone and ketamine can be used to prevent POST. Additionally, a

high number of participants correctly identified the risk factors for POST and its adverse consequences (*n* = 16, 84.2 % and *n* = 14, 73.7%). These statistics showed that CRNAs were aware of the problem and understood how the proposed medications worked but ignore their usefulness in the prevention of POST. Unfamiliarity with dosing could be the leading cause for not incorporating dexamethasone and ketamine in their clinical practice. Unawareness of the lack of ketamine's adverse effects when used to prevent POST could also influence its exclusion in practice. Only 10 providers (52.6%) were able to recognize that a single dose of dexamethasone was not associated with the adverse effects of long-term administration, which could influence their decision to avoid it in practice. Lastly, CRNAs demonstrated unawareness of their ability to administer these drugs as a nebulizer, further limiting their application in practice.

In the post-test, all questions had a higher percentage of correct answers than the pre-test. This demonstrated that the educational intervention was successful. The number of providers who correctly identified the correct doses of dexamethasone and ketamine increased by 68.4% and 36.8%, respectively. The greatest improvement was seen in the question regarding the adverse effects of ketamine. This question showed an increase of 73.7% of correct answers. Alternative routes for the administration of dexamethasone and ketamine, which was another low-scoring topic in the pre-test, showed an increase of 63.1% of correct answers. Improvement was also seen in the identification of dexamethasone and ketamine as feasible interventions for the prevention of POST. A total of 84.2% of participants identified these medications as effective in the prevention of POST, compared to 57.9% in the pre-test. A high number of participants (*n* = 17, 89.5%) were also able to identify the adverse effects of dexamethasone. The significant improvement in the lowest-scoring questions, accompanied by higher scores in the other areas, suggested that the educational intervention properly addressed deficiencies in providers'

knowledge. The following table shows a detailed comparison of the participants' scores in the pre/post-tests.

Table 8. Pre-Test and Post-Test Responses

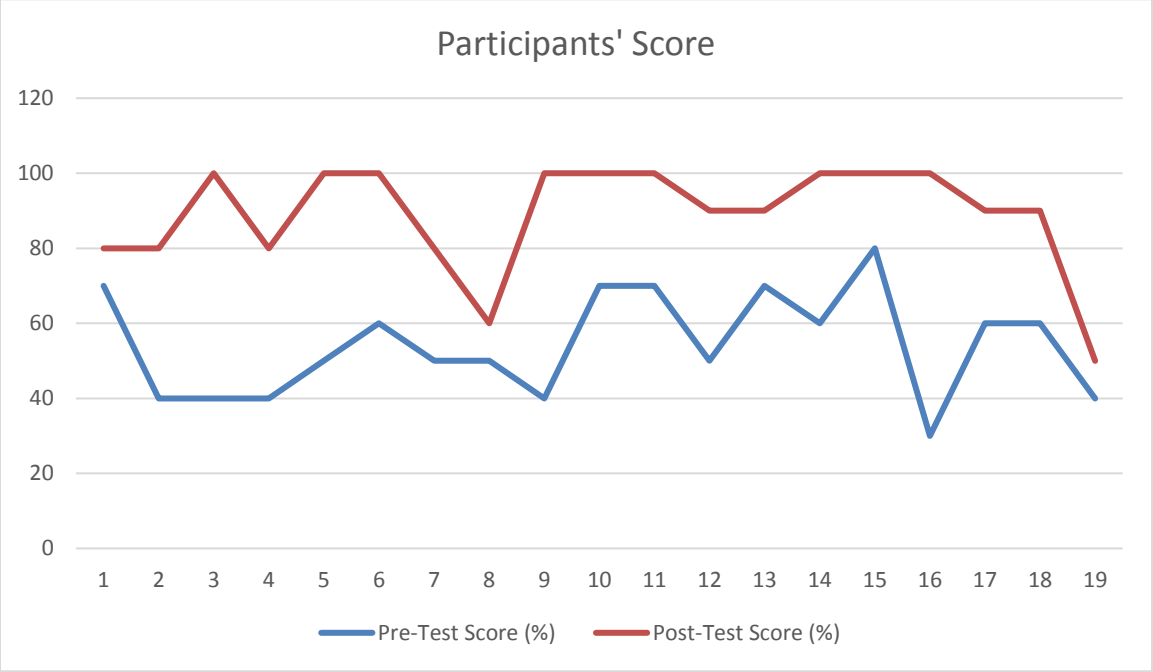
Questions (correct answers are underlined)	Pre-Test correct answers (%) *n* = 19	Post-Test correct answers (%) *n* = 19	Percentage Difference (%)
1. What are the main risk factors for POST development? Select 3. a. Excessively large ETTs and cuff pressures b. Long surgical procedures c. Traumatic intubation d. Urologic surgery	16 (84.2)	19 (100)	+ 15.8
2. What are adverse consequences of POST? Select 3. a. Patient dissatisfaction b. Prolonged oral intake and electrolyte imbalances c. Prolonged recovery stays and increased cost of care d. Increased incidence of throat cancer	14 (73.7)	16 (84.2)	+ 10.5
3. What drugs are effective in preventing POST? Select 2. a. Dexamethasone b. Ketamine c. Acetaminophen d. Hydromorphone	11 (57.9)	16 (84.2)	+ 26.3

4. How does dexamethasone help prevent POST? a. Inhibits prostaglandins synthesis resulting and reduced inflammation and pain relief b. Inhibition of NMDA receptors c. Stimulate the release of endorphins d. Stimulate GABA receptors	18 (94.7)	19 (100)	+ 5.3
5. How does ketamine help prevent POST? a. Inhibits prostaglandins synthesis resulting and reduced inflammation and pain relief b. Inhibition of NMDA receptors c. Stimulate the release of endorphins d. Stimulate GABA receptors	18 (94.7)	19 (100)	+ 5.3
6. What is the minimum dexamethasone intravenous dose needed to prevent POST? a. 0.2 mg/kg b. 2 mg/kg c. 4 mg d. 8 mg	1 (5.3)	14 (73.7)	+ 68.4
7. What is the ketamine dose needed to prevent POST?	8 (42.1)	15 (78.9)	+ 36.8

a. 10-20 mg b. 20-50 mg c. 50-60 mg d. 60-80 mg			
8. What other routes of ketamine and dexamethasone are available to provide coverage against POST? a. Rectal b. Nebulizer c. PO d. Intramuscular	4 (21.1)	16 (84.2)	+ 63.1
9. What adverse effects of dexamethasone when used for POST prevention? a. Immune suppression b. Increased sensitivity to infections c. Swelling and edema d. Mild blood glucose increases early postoperatively	10 (52.6)	17 (89.5)	+ 36.9
10. What adverse effects of ketamine when used for POST prevention? a. Increased sedation b. Hallucinations c. Hemodynamic instability d. No significant effects	3 (15.8)	17 (89.5)	+ 73.7

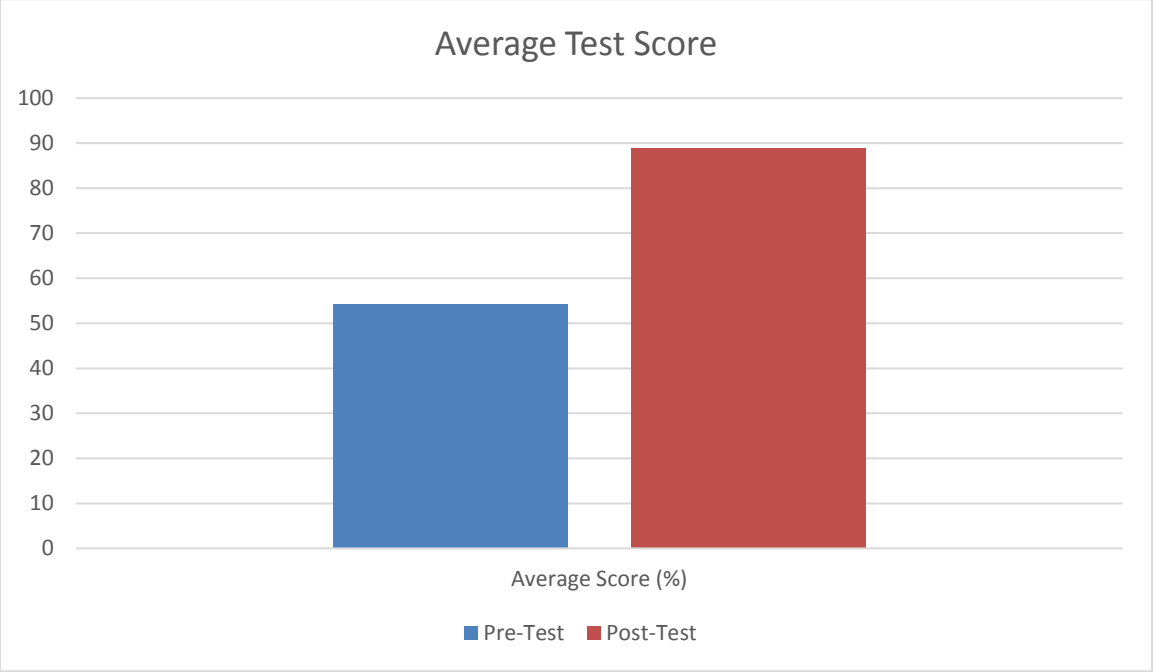
The following figure shows the scores of all the participants in the pre/post-tests. Only 3 participants showed mild improvement in their scores, but the majority of the CRNAs improved their scores by more than 20% after the educational intervention. Additionally, 9 participants scored 100% in the post-test.

Figure 1. Participants' Pre-Test and Post-Test Scores



The following figure compares the average score of all participants in the pre-/post-tests. After the educational intervention, the average score increased from 54.2% to 88.9%.

Figure 2. Average Test Score



Limitations

The main limitation of this project was the small sample size of anesthesia providers included. This could affect the anesthesia community's perceptions of current knowledge about postoperative sore throat management. This project also did not consider the facilities in which FIU Doctor of Nurse Anesthesia Program graduates practice, making it challenging to identify healthcare organizations or anesthesia groups with deficiencies in knowledge about the management of POST.

Discussion of the Results with Implications for Advanced Practice Nursing

Educating anesthesia providers about postoperative sore throat increases their knowledge and improves their practice. Postoperative sore throat is a leading cause of patient dissatisfaction with anesthesia.[3] Despite this, it occurs in 30%-70% of patients requiring tracheal intubation.[1] Providers often overlook it because it is a temporary complication of tracheal intubation, but patients have a different perspective on the problem.[2] Increasing providers' awareness of this

complication can contribute to more pleasant surgical experiences by patients. CRNAs are responsible for ensuring patient safety during surgery and lessening the negative impact of anesthesia on patients' well-being. Including the prevention of POST in the anesthetic care plan ensures that patients are cared for holistically.

POST prolongs oral intake and interferes with patients' everyday functioning.[8] This can result in prolonged surgical recovery, dehydration, electrolyte abnormalities, and increased cost of care.[8] It can also be a symptom of more severe conditions such as injured vocal cords or laryngeal nerve.[2] The lack of provider knowledge about these issues is a contributing factor to the high incidence of postoperative sore throat and associated complications.[8] Educating CRNAs about this topic will enhance their understanding of the problem and raise their concern. Providers can easily prevent the abovementioned complications by addressing POST preoperatively with the recommended interventions. CRNAs will be able to reduce the cost of care without compromising patient safety but instead reducing complications and increasing satisfaction.

There are no current guidelines on preventing POST in patients undergoing surgery. Numerous drugs have been researched for this purpose, but the results are variable, and a definitive treatment remains unclear.[11] Previous literature reviews have failed to provide a detailed strategy to prevent POST. This project offered anesthesia providers effective drugs, doses, and administration time. Sufficient information was provided regarding the effectiveness of dexamethasone and ketamine in reducing the incidence and severity of POST. The education provided in this project will give CRNAs the tools to prevent POST and successfully improve care delivery at their institutions.

Conclusion

The anti-inflammatory effects of dexamethasone reduce the incidence and severity of POST after tracheal intubation. A single dose of 0.2 mg/kg administered before induction of anesthesia is sufficient to exert the desired effect. Ketamine exerts its analgesic effect by blocking NMDA receptors in the central nervous system. Ketamine gargles administered before induction are effective in the prevention of POST. A dose of 20-50 mg of ketamine is sufficient to elicit its analgesic effect without incurring undesirable side effects. Combining both drugs provides better outcomes and more extensive coverage for 24 hours after surgery. Patients who do not have intravenous access at the time of induction or cannot tolerate oral intake can be administered nebulized dexamethasone or ketamine to achieve similar results.

Teaching anesthesia providers how to effectively use dexamethasone and ketamine, either alone or in combination, will improve their knowledge and reduce the incidence and severity of postoperative sore throat at their facility. Evaluating the organization's ability to implement a change is necessary before educating providers. The elaboration of a strategic plan utilizing a theoretical framework will facilitate providers' education and the implementation of an action plan to address the identified problem. Pre-educational questionnaires and quizzes are effective interventions to assess current providers' knowledge. The same tools can be utilized to evaluate the understanding of the material and translation of research into practice.

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Appendix A: Recruitment Letter

Nicole Wertheim College of Nursing & Health Sciences

Educational intervention to improve the knowledge of anesthesia providers in the use of dexamethasone and ketamine to prevent postoperative sore throat: A Quality Improvement Project.

Dear Florida International University Alumni Perioperative Providers:

My name is Luis Diaz Mendez, and I am a student from the Anesthesiology Nursing Program Department of Nurse Anesthesiology at Florida International University. I am writing to invite you to participate in my quality improvement project. The goal of this project is to increase health care providers' awareness on the risk factors associated with postoperative sore throat (POST) after tracheal intubation and the use of dexamethasone and ketamine to minimize its incidence and severity. You are eligible to take part in this project because you are a part of the Florida International University Alumni perioperative provider.

If you decide to participate in this project, you will be asked to complete and sign a consent form for participation. Next, you will complete a pre-test questionnaire, which is expected to take approximately 5 minutes. You will then be asked to view an approximately 15 minutes long educational presentation online. After going through the educational module, you will be asked to complete the post-test questionnaire, which is expected to take approximately 5 minutes. *No compensation will be provided.*

Remember, this is completely voluntary. You can choose to be in the project or not. If you'd like to participate or have any questions about the project, please email or contact me at Luis Diaz Mendez, Phone/Email: 786-378-1171/ldiaz233@fiu.edu

Thank you very much.

Sincerely,

Luis Diaz Mendez,

Phone: 786-378-1171

Email: ldiaz233@fiu.edu

Appendix B: Informed Consent

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CONSENT TO PARTICIPATE IN A QUALITY IMPROVEMENT PROJECT

Educational intervention to improve the knowledge of anesthesia providers in the use of dexamethasone and ketamine to prevent postoperative sore throat: a quality improvement project.

SUMMARY INFORMATION

Things you should know about this project:

Purpose: Educational module to increase providers awareness of the risk factors associated with postoperative sore throat (POST) after tracheal intubation and the use of dexamethasone and ketamine to minimize its incidence and severity.

Procedures: If the participant chooses to participate, they will be asked to complete a pretest, watch a voice PowerPoint, and then a post test.

Duration: This will take about a total of 25 minutes total.

Risks: There will be minimal risks involved with this project, as would be expected in any type of educational intervention, which may include mild emotional stress or mild physical discomfort from sitting on a chair for an extended period.

Benefits: The main benefit to you from this research is increase the participants knowledge on the use of dexamethasone and ketamine to prevent postoperative sore throat.

Alternatives: There are no known alternatives available to the participant other than not taking part in this quality improvement project.

Participation: Taking part in this quality improvement project is voluntary.

Please carefully read the entire document before agreeing to participate.

NUMBER OF PROJECT PARTICIPANTS:

If the participant decides to be in this project, they will be one of 20 people in this research project.

PURPOSE OF THE PROJECT

The participant is being asked to be in a quality improvement project. The goal of this project is to increase providers' knowledge on the risk factors associated with postoperative sore throat (POST) after tracheal intubation and improve their knowledge regarding the use of dexamethasone and ketamine to minimize its incidence and severity. If you decide to participate, you will be 1 of approximately 20 participants.

DURATION OF THE PROJECT

The participation will require about 25 minutes.

PROCEDURES

If the participant agrees to be in the project, PI will ask you to do the following things:

1. Complete an online 10 question pre-test survey via Qualtrics, an Online survey product for which the URL link is provided

2. Review the educational PowerPoint Module lasting 15 minutes via Qualtrics, an Online survey product for which the URL link is provided.

3. Complete the online 10 question post-test survey via Qualtrics, an Online survey product for which the URL link is provided.

RISKS AND/OR DISCOMFORTS

The main risk or discomfort from this research is minimal. There will be minimal risks involved with this project, as would be expected in any type of educational intervention, which may

include mild emotional stress or mild physical discomfort from sitting on a chair for an extended period.

BENEFITS

The following benefits may be associated with participation in this project: An increased participants knowledge on the risk factors associated with postoperative sore throat (POST) after tracheal intubation and the use of dexamethasone and ketamine to minimize its incidence and severity. The overall objective of the program is to increase the providers' knowledge based on the current literature.

ALTERNATIVES

There are no known alternatives available to the participant other than not taking part in this project. However, if the participant would like to receive the educational material, it will be provided to them at no cost.

CONFIDENTIALITY

The records of this project will be kept private and will be protected to the fullest extent provided by law. If, in any sort of report, PI might publish, it will not include any information that will make it possible to identify the participant. Records will be stored securely, and only the project team will have access to the records.

PARTICIPATION: Taking part in this quality improvement project is voluntary.

COMPENSATION & COSTS

There is no cost or payment to the participant for receiving the health education and/or for participating in this project.

RIGHT TO DECLINE OR WITHDRAW

The participation in this project is voluntary. The participant is free to participate in the project or withdraw the consent at any time during the project. The participant's withdrawal or lack of

participation will not affect any benefits to which you are otherwise entitled. The investigator reserves the right to remove the participant without their consent at such time that they feel it is in their best interest.

RESEARCHER CONTACT INFORMATION

If you have any questions about the purpose, procedures, or any other issues relating to this research project, you may contact Luis Diaz Mendez at 786-378-1171/ldiaz233@fiu.edu and Dr. Charles Buscemi at 305-389-5540/cbuscemi@fiu.edu

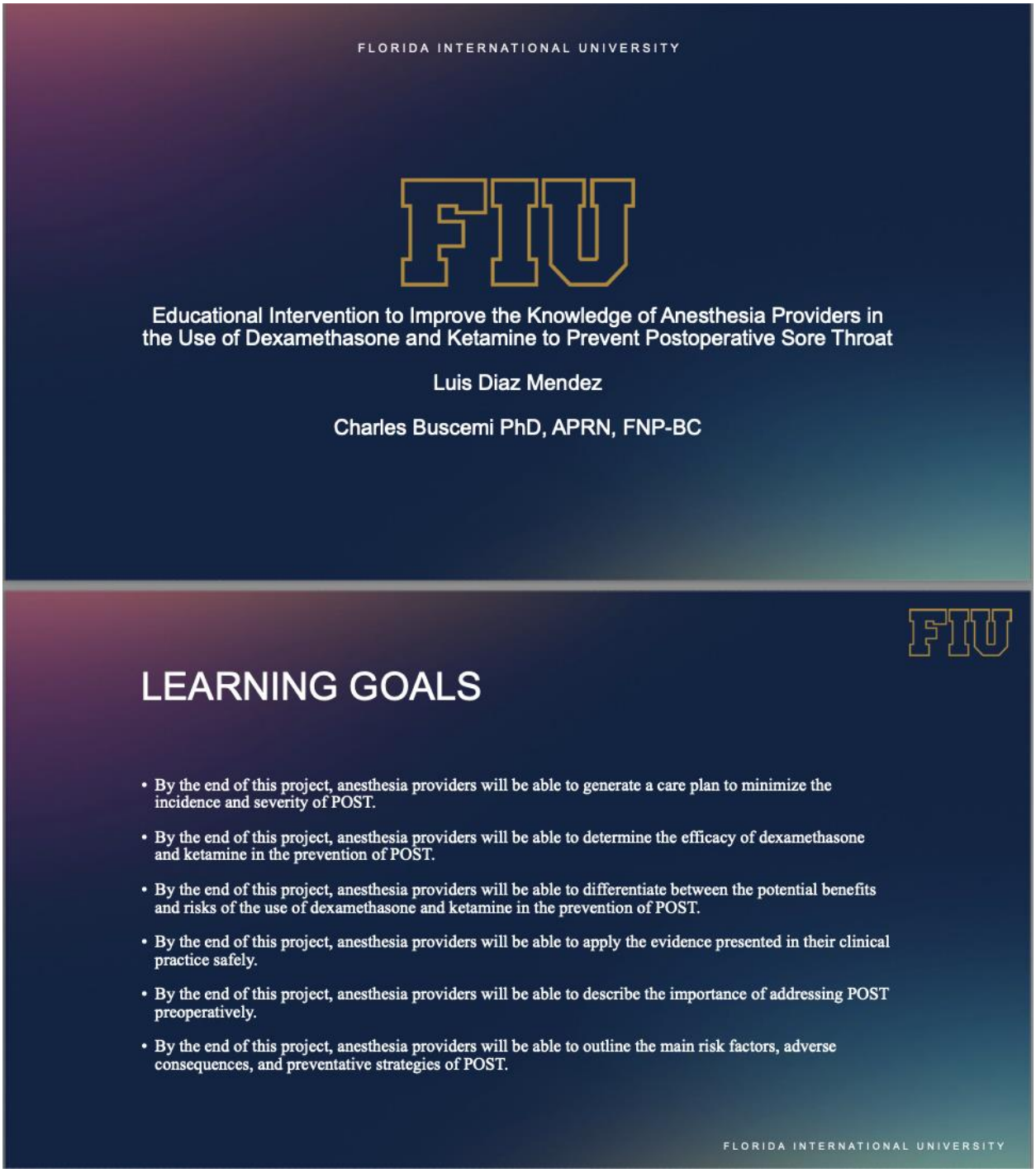
IRB CONTACT INFORMATION

If the participant would like to talk with someone about their rights pertaining to being a subject in this project or about ethical issues with this project, the participant may contact the FIU Office of Research Integrity by phone at 305-348-2494 or by email at ori@fiu.edu.

PARTICIPANT AGREEMENT

I have read the information in this consent form and agree to participate in this project. I have had a chance to ask any questions I have about this project, and they have been answered for me. By clicking on the "consent to participate" button below I am providing my informed consent.

Appendix C: Educational Module



Problem Identification

- Tracheal intubation is performed to secure the airway and provide mechanical ventilation during general anesthesia.[1]
- This procedure causes irritation and inflammation of the airways leading to postoperative sore throat.[1]
- POST is often dismissed or overlooked by anesthesia providers because it is a temporary complication of tracheal intubation.[2]
- Numerous research studies have proposed interventions to minimize the incidence of POST, but there are no standards of care or protocols to prevent this complication.[3-5]

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Background of the Problem

- Different anesthetic techniques can influence the development of POST.[4]
- Large endotracheal tubes (ETTs), excessive cuff pressure, prolonged intubation, multiple attempts, and blood in the airways are associated with an increased incidence of POST.[1-5]
- Smoking, female gender, and young age have also been linked to an increased incidence of POST.[1]
- Tracheal intubation is the leading cause of postoperative sore throat.[4]

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Scope of the Problem

- Millions of surgeries occur yearly in the United States, with approximately one-third requiring tracheal intubation.[2]
- POST can occur in 30% to 70% of the patients requiring tracheal intubation.[1]
- POST increases the length of stay in the postoperative care unit and, therefore, the cost of care.[5]
- The incidence of POST is lower in children, but it is difficult to assess for sore throat in this population, and the provider's intubation skills play a major role in preventing it.[4]

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Consequences of the Problem

- POST can prolong eating or drinking, cause electrolyte imbalances and dehydration, and thus prolong surgical recovery.[6]
- It is a major cause of patient dissatisfaction.[1]
- POST can be a symptom of more concerning complications such as vocal cord or laryngeal injury.[2]
- POST can range from mild irritation to an incapacitating discomfort that prevents patients from swallowing or speaking.[7]

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Dexamethasone
Dexamethasone is a glucocorticoid steroid that reduces inflammation by inhibiting prostaglandin synthesis, serotonin concentration, and the release of inflammatory mediators.8
The anti-inflammatory effect of dexamethasone reduces the edema caused by airway trauma during intubation and, consequently, the incidence and severity of sore throat.8
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Ketamine
Ketamine provides analgesia by inhibiting N-methyl-D-aspartate (NMDA) receptors, which are activated by glutamate, an excitatory neurotransmitter in the brain.9
NMDA receptor antagonism blocks the transmission of pain to the central nervous system.9
Ketamine's analgesic effects can provide pain relief caused by airway instrumentation and, in turn, reduce the incidence of POST.9
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Dexamethasone administered alone

- A single dose of intravenous dexamethasone administered before the induction of anesthesia decreases the incidence and severity of postoperative sore throat.[10-13,15]
- A dose ≥ 0.2 mg/kg is needed to provide coverage for 24 hours postoperatively.[11]
- Lower doses are effective in the late postoperative period but fail to provide relief immediately after extubation.[10-13,15]
- Nebulized dexamethasone provides an effective alternative to the intravenous route.[14]

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Ketamine administered alone

- Ketamine gargles administered before the induction of anesthesia decreases the incidence and severity of postoperative sore throat.[16,18]
- A single dose of 20-40 mg mixed with saline can be used for gargles.[17,19]
- Ketamine gargles provide better outcomes in the immediate postoperative period.[16,18]
- Alternatively, nebulized ketamine provides better relief in the late postoperative period compared to gargles.[17,19]

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Dexamethasone administered in combination with Ketamine

- Ketamine can be combined with dexamethasone to achieve better outcomes, especially in the early postoperative period, when higher doses of dexamethasone may be needed to prevent sore throat.[11]
- The synergistic effect of these drugs offers better pain control during the first 24 hours after surgery than each drug administered alone.[11]
- This can benefit patients who cannot tolerate high doses of steroids.[11]

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Adverse effects of Dexamethasone and Ketamine

Dexamethasone

- A single dose of dexamethasone is not associated with the side effects observed in the long-term administration of corticosteroids.[10-15]
- A mild increase in blood glucose has been reported, but only in the immediate postoperative period.[10-15]

Ketamine

- Low doses of ketamine used to prevent POST do not significantly contribute to sedation, hallucinations, delirium, and hemodynamic instability.[16-19]

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Take home summary

- A single dose of intravenous dexamethasone administered before the induction of anesthesia decreases the incidence and severity of postoperative sore throat.
- Ketamine gargles are also effective in reducing the incidence and severity of POST. In contrast to low doses of dexamethasone, ketamine gargles offer better outcomes immediately after surgery, and its effects diminish over time.
- Ketamine can be combined with dexamethasone to achieve better outcomes. The synergistic effect of these drugs offers better pain control during the first 24 hours after surgery than each drug administered alone.
- The administration of a single dose of these medications is not associated with any significant adverse effects.

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Appendix D: Pre/Post-Test

Pretest and Posttest Questionnaire:

Educational intervention to improve the knowledge of anesthesia providers in the use of dexamethasone and ketamine to prevent postoperative sore throat: a quality improvement project.

INTRODUCTION

The primary aim of this QI project is to increase providers awareness of the risk factors associated with postoperative sore throat (POST) after tracheal intubation the use of dexamethasone and ketamine to minimize its incidence and severity.

Please answer the question below to the best of your ability. The questions are either in multiple choice or true/false format and are meant to measure knowledge on the use of dexamethasone and ketamine to prevent postoperative sore throat (POST).

PERSONAL INFORMATION

1. **Gender:** Male Female Other_____
2. **Ages 25 and above: _____**
3. **Ethnicity:** Hispanic Caucasian African American Asian Other_____
4. **Position/Title:** CRNA Anesthesiologist Resident Anesthesiologist Assistant

5. **Level of Education:** Certificate Bachelors Masters DNP PhD
6. How many years have you been a perioperative provider?

   Over 10 5-10 years 2-5 years 1-2 years

QUESTIONNAIRE

1. What are the main risk factors for POST development? Select 3
   a. Excessively large ETTs and cuff pressures
   b. Long surgical procedures
   c. Traumatic intubation
   d. Urologic surgery
2. What are adverse consequences of POST? Select 3
   a. Patient dissatisfaction
   b. Prolonged oral intake and electrolyte imbalances
   c. Prolonged recovery stays and increased cost of care
   d. Increased incidence of throat cancer
3. What drugs are effective in preventing POST? Select 2
   a. Dexamethasone
   b. Ketamine
   c. Acetaminophen
   d. Hydromorphone
4. How does dexamethasone help prevent POST?

   a. Inhibits prostaglandins synthesis resulting and reduced inflammation and pain relief
   b. Inhibition of NMDA receptors
   c. Stimulate the release of endorphins
   d. Stimulate GABA receptors

5. How does ketamine help prevent POST?
   a. Inhibits prostaglandins synthesis resulting and reduced inflammation and pain relief
   b. Inhibition of NMDA receptors
   c. Stimulate the release of endorphins
   d. Stimulate GABA receptors
6. What is the minimum dexamethasone intravenous dose needed to prevent POST?
   a. 0.2 mg/kg
   b. 2 mg/kg
   c. 4 mg
   d. 8 mg
7. What is the ketamine dose needed to prevent POST?
   a. 10-20 mg
   b. 20-50 mg
   c. 50-60 mg
   d. 60-80 mg
8. What other routes of ketamine and dexamethasone are available to provide coverage against POST?

a. Rectal

b. Nebulizer

c. PO

d. Intramuscular

9. What adverse effects of dexamethasone when used for POST prevention?

a. Immune suppression

b. Increased sensitivity to infections

c. Swelling and edema

d. Mild blood glucose increases early postoperatively

10. What adverse effects of ketamine when used for POST prevention?

a. Increased sedation

b. Hallucinations

c. Hemodynamic instability

d. No significant effects

Appendix E: IRB Exemption

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MEMORANDUM

To: Dr. Charles Buscemi

CC: Luis Diaz Mendez

From: Kourtney Wilson, MS, IRB Coordinator KMW

Date: February 2, 2024

Proposal Title: "Educational intervention to improve the knowledge of anesthesia providers in the use of dexamethasone and ketamine to prevent postoperative sore throat: A Quality Improvement Project."

Approval # IRB-24-0026-AM01

Reference # 113959

The Florida International University Office of Research Integrity has approved the following modification(s):

- Changed start date on the research study.

Special Conditions: N/A

There are no additional requirements in regards to your study. However, if there are further changes in the protocol after you commence your study, then you are required to resubmit your proposal for review. For further information, you may visit the FIU IRB website at http://research.fiu.edu/irb.

KMW