TRANSLARYNGEAL ANESTHESIA: A REVIEW

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The increasing use of endotracheal tubes has been a factor in providing better and safer general anesthesia. Adequate tracheal mucosal anesthesia to facilitate tracheal intubation and to prevent subsequent “bucking” and breath holding is of concern to the anesthesiologist. This is especially true in an era when the maintenance of smooth, “light” anesthesia is no longer a philosophy but a desired practice. Topical anesthesia is even more important for tracheal intubation of conscious patients. The intraoral approach with a nebulizer is commonly used to obtain mucosal anesthesia. There is a small group in this country, however, who employ translaryngeal anesthesia produced by injection of anesthetic solution by means of a needle inserted through the cricothyroid membrane. There is little information in the literature about this controversial procedure; there are many misconceptions. It is our purpose to review the status of translaryngeal anesthesia.

BACKGROUND

Forty years ago, Georges Canuyt, a French otorhinolaryngologist, wrote of his experiences with cocainization of the larynx by means of a needle introduced through the cricothyroid membrane for thyroid, laryngeal or tracheal surgery.1 2 Labat described the technique in his classical “Regional Anesthesia.”3 In the next decade the subject is mentioned in the English literature.4 In the late 1940's, two thoracic surgeons rekindled interest by concisely and accurately describing this approach to the tracheobronchial tract for the purpose of instilling a local anesthetic prior to bronchoscopy.5 The first article in the anesthesia literature on “transstracheal” anesthesia prior to tracheal intubation appeared in 1949.6 There have since been only two articles in American journals of anesthesia,7 8 although isolated papers on the subject have appeared elsewhere.9 Many anesthesia textbooks do not describe the technique.

MISCONCEPTIONS AND CONTROVERSIES

Translaryngeal anesthesia has not been universally accepted, and it is reasonable to wonder why. It is not a nerve block but a method of achieving topical anesthesia with syringe and needle rather than with spray or pledget. It is claimed that the translaryngeal technique does not allow visualization of the larynx as does the oral approach.10 Another area of criticism lies in the complications attributable to the needle puncture.5 7 9 11 12 These deterred the popularity of the procedure, but, as will be shown, the incidence is low.

Other misconceptions prevail, such as the name of the procedure. It has suffered from being misnamed and from having too many names; for example, at least four titles are used in the Quarterly Cumulative Index Medicus. Popularly, it is incorrectly called “transstracheal” anesthesia or analgesia.5 6 9 A needle through the cricothyroid membrane caudad to the thyroid cartilage but superior to the cricoid cartilage lies within the larynx.13 More accurately, it should be labeled “transcricothyroid membrane” anesthesia,8 but this name is onerous. The authors believe that “translaryngeal” anesthesia is an accurate and succinct name for this procedure.

Certain controversial issues which may foster distrust of the technique remain to be settled. Should the patient be awake during needle puncture, or should he be lightly anesthetized? One school insists upon a conscious patient who can control coughing or swallowing and prevent both breakage of a needle and trauma to tissue.7 They also claim that the occasional development of severe laryngospasm in the an-
esthetized patient does not occur in the conscious one.\textsuperscript{9} Such a complication can not be considered minor in a patient with low myocardial reserve. The suggestion has been made that oxygen be administered before and after injection.\textsuperscript{14} Finally, a conscious patient is preferred for bronchoscopy in order that he can sit up and obey instructions.\textsuperscript{5} So far as the latter objection is concerned, one group did cricothyroid punctures in over 4000 cases, 99 per cent of whom were asleep.\textsuperscript{8} Others believe that the patient may be awake or asleep for this procedure, the decision depending on factors such as the patient's apprehension, the anesthesiologist's preference, and concomitant diseases such as decreased myocardial reserve.\textsuperscript{9, 14, 15}

Another unsettled issue concerns the use of unsterile solutions for injection. This has been correctly criticized, since such solutions may be deposited within tissues;\textsuperscript{14} some may be left in the needle's path during hurried withdrawal. Hence, sterile solutions are recommended.

Should a skin wheal be used? One group utilized it for an 18-gauge needle puncture,\textsuperscript{6} and it is advocated by others.\textsuperscript{16} But most do not recommend a wheal since premedicated patients tolerate a single puncture with a small gauge needle.\textsuperscript{8-9, 15}

**Indications and Advantages**

Among anesthesiologists the primary indication for transcricoid puncture is to anesthetize the laryngeal and tracheal mucosa prior to oral or nasal tracheal intubation. Nasotracheal intubation profits most from translaryngeal anesthesia since laryngoscopy prior to blind intubation may be omitted. However, some believe that translaryngeal anesthesia for routine orotracheal intubation is superior to the transglottic route.\textsuperscript{5, 7, 8, 9} The sudden cough after injection of the anesthetic solution sprays it from the carina to the undersurface of the vocal cords; even the hypopharynx is anesthetized.\textsuperscript{16} This allows for more direct and profound topical anesthesia of the larynx and trachea.

Another advantage of translaryngeal anesthesia lies in its facilitating tracheal intubation, since, as seen through the laryngoscope, the cords are relaxed and a tube may be easily inserted without hazard of spasm. Once the tube is inserted, no “bucking” or breath holding occurs, and if anesthesia is complete hypoxia may be avoided. The incidence of reflex cardiac arrhythmias during intubation is probably reduced.\textsuperscript{6, 7} It has been suggested that translaryngeal anesthesia contributes not only to the smoothness of general anesthesia, but allows the patient to be maintained in a lighter plane of anesthesia without excessive use of relaxants.\textsuperscript{9} The enthusiasm of this claim is tempered by the fact that the duration of action of any topical anesthesia is limited. No controlled study has been reported to prove that the translaryngeal route provides any or all of the above stated advantages better than the transglottic route. The superior surface of the cords, the epiglottis, and the pharynx are probably not thoroughly anesthetized by the translaryngeal approach. On the other hand, the latter structures are easily reached with direct laryngoscopy or by a long flexible nasal spray such as described by Macintosh.

A second indication for translaryngeal anesthesia is for bronchoscopy.\textsuperscript{5, 6, 8, 9} This procedure requires good carinal and bronchial anesthesia, an objective which cannot be accomplished by nebulizers as easily or rapidly as by direct introlaryngeal deposition. The latter technique has its detractors.\textsuperscript{10, 12}

Translaryngeal anesthesia has been described for endobronchial intubation.\textsuperscript{17} Laryngotracheal anesthesia is first obtained, and after 3 to 5 minutes a second puncture is made with the patient sitting and leaning to the side of the bronchus to be intubated.

Blind nasotracheal intubation, with patient awake or asleep, represents another indication for translaryngeal anesthesia. The procedure is facilitated, time is saved and less trauma is produced. Less general anesthesia is required for intubation because topical anesthesia renders the intrinsic and extrinsic laryngeal muscles insensitive to reflex stimulation by the tube. The nasal passages and the pharynx, however, must be anesthetized from above.

Other indications for translaryngeal anesthesia mentioned in the literature are of less importance. These include: (1) partial or complete obstruction from laryngospasm during induction of general anesthesia or its maintenance,\textsuperscript{18} (2) operation wherein no mask may
be applied to the patient's face and an endotracheal tube must not be inserted \(^{16}\) (the cough reflex is obtunded and regurgitation may lead to silent aspiration of stomach contents), \(^{16}\) (3) surgery when the neck cannot be flexed as in a fractured cervical vertebra, \(^{16}\) and (4) esophagoscopy wherein severe laryngospasm may be induced by inadvertent stimulation of the larynx, especially if thiobarbiturates are to be given.

The cricothyroid membrane may be punctured for other reasons. Radiologists use this route for instillation of a radiopaque medium for bronchography. \(^{19, 20}\) Translaryngeal puncture has been performed for insufflation of oxygen as a life-saving procedure in the presence of respiratory obstruction during general anesthesia when all commonly used methods of providing a clear airway have been unsuccessful. \(^{21}\)

ANATOMY AND TECHNIQUE

Anatomy. The most accessible portion of the respiratory tract inferior to the glottis is the cricothyroid space. \(^{13}\) This space is defined as the concavity lying between the convex border of the inferior portion of the thyroid cartilage and the superior portion of the cricoid cartilage. If the thyroid notch is palpated and the finger moved caudal in the midline, the cricothyroid space is the first depression. This space is roughly a trapezoid with a cross sectional area approximately 2.9 cm.\(^{2}\). In 51 adults examined, the laryngeal measurements were established as follows: (1) Distance between the anterior inferior border of the thyroid and anterior superior border of the cricoid cartilages ranged from 0.5 to 1.2 cm., averaging 0.9 cm. (2) The width of this space varied from 2.7 to 3.2 cm., with a mean of 3.0 cm. (3) The distance between the true cords and a needle in the midhorizontal plane of the cricothyroid space averaged 1.3 cm.

As the needle in the midline moves from without inward only four structures are pierced: skin, subcutaneous tissue, cricothyroid membrane, and endolaryngeal mucosa. The one major blood vessel in the area is the cricothyroid branch of the superior thyroid artery branching off the external carotid. It communicates with the contralateral cricothyroid artery across the membrane. The veins are small, and no major nerves are present. The thyroid gland and isthmus lie inferior to the cricothyroid space unless abnormally enlarged.

Technique. After premedication, the procedure is explained to the patient and he lies supine with head extended, chin up and mouth closed. The larynx and trachea lie in close proximity to the skin, which is taut over these structures. After this area is cleansed, the left index finger is placed over the cricothyroid space with the right hand holding the syringe containing the local anesthetic. \(^{6, 9, 15, 16}\) A beaded needle (gauge 21 to 23, 1.5 inches long) is recommended. The patient is cautioned not to swallow, talk or cough. Without raising a skin wheal, the needle is driven like a dart perpendicularly through the skin in the midline between the cartilages, then through the cricothyroid membrane until no further resistance is felt. The needle tip now lies in the laryngeal lumen caudal to the vocal cords. Aspiration of air insures proper placement. The patient is again warned not to swallow or cough to avoid breaking the needle or traumatizing tissue. The injection should be performed rapidly. (Interestingly, the original descriptions of the technique described the slow dropping of cocaine into the larynx. \(^{1, 2, 3}\) The needle is rapidly withdrawn, and the patient instructed to cough vigorously. The excess local anesthetic should be expectorated to avoid swallowing with subsequent gastric absorption. It has been claimed that by pressing firmly over the site of injection subcutaneous emphysema \(^{5, 7}\) and formation of hematoma \(^{9}\) can be prevented.

The choice of local anesthetics is varied and many different ones have been used for translaryngeal anesthesia. The addition of adrenalin has not been described often, but it should be considered for its prolonging action. The administration of 20 to 40 mg. of Tetracaine is favored. \(^{5, 6, 7, 9, 15, 16}\) Cocaine, without adrenalin added, has been used in doses of 100 to 200 mg. \(^{6, 9, 15, 16}\) Hexylcaine has been utilized \(^{9, 22}\) as has lidocaine. \(^{15}\) Varying volumes have been used, the most common being 2.0 ml., but as much as 9.0 ml. have been employed for bronchoscopic purposes. \(^{5}\)
CONTRAINDICATIONS

There are some definite contraindications to translaryngeal anesthesia. The most commonly stated one is the presence of enlarged thyroid gland or a tumor overriding the thyroid or cricoid cartilage.\textsuperscript{7, 8, 9} Active disease of the tracheobronchial tract, including infection, especially tuberculosis, or carcinoma constitutes a contraindication. Inability to palpitate landmarks in an obese patient, a history of bleeding tendency, and active bleeding high in the trachea are theoretical contraindications. In the presence of active or recent intracranial or intra-abdominal bleeding or a marginal cardiac reserve, the cough on injection and the subsequent Valsalva maneuver are objectionable.\textsuperscript{14} On the other hand, it seems that for these patients translaryngeal anesthesia might be indicated to prevent "bucking" and allow them to be maintained in a light plane of general anesthesia. Increased intracranial pressure (other than that due to bleeding) is not a contraindication to translaryngeal puncture; on the contrary it is recommended for long neurosurgical procedures where patients should be managed with minimal depression of the central nervous system.\textsuperscript{9}

COMPLICATIONS

The administration of over 17,500 translaryngeal anesthesics have been reported in the collective literature.\textsuperscript{5, 7-9, 11, 14, 17, 22, 28} Complications appear to have been few. They include 2 broken needles, 2 severe laryngospasms, and 4 soft tissue infections of the neck.\textsuperscript{5, 8, 9, 11} No deaths have been reported, although one patient developed an almost fatal cellulitis of the neck.\textsuperscript{11} There is a question, however, whether the severe oral sepsis this patient evidently had should have constituted a contraindication to the procedure.

Many serious though theoretical complications have been discussed, but never actually reported. They are: (1) air leak through the tract produced by the needle with subsequent coughing leading to the production of subcutaneous emphysema and formation of a fistula, (2) injection of solution under the laryngeal mucosa with consequent obstruction of the airway (cannot occur if air is aspirated prior to injection), (3) penetration of the trachea posteriorly with subsequent mediastinitis or mediastinal emphysema, (4) systemic reaction to the local anesthetic from rapid absorption of the drug, and (5) hazard of damage to a vocal cord, which is more mythical than real since the distance between the cords and the midhorizontal plane of the cricothyroid space averages 1.3 cm.

Minor complications do occur in practice and include presence of blood in the trachea or larynx as evidenced by hemoptysis after injection, subcutaneous hematoma, pain and superficial infection at the site of injection.\textsuperscript{5, 9} These are self-limiting phenomena with no residual disability. Prolonged laryngospasm may be considered a complication. It is rarely, if ever, seen in conscious patients\textsuperscript{17} and may be quickly controlled if a syringe containing succinylcholine is kept readily available.

Histopathologic studies have been performed in dogs in whom 13 gauge needles have been utilized for translaryngeal puncture.\textsuperscript{24} Microscopic studies performed from 1 to 7 days after puncture showed "normal healing with no evidence of hemorrhage in the soft tissues of the neck . . . microscopic examination of the trachea showed normal tissue healing at the point of entrance of the 13 gauge needle and cannula." One dog died of mediastinal emphysema because the tip of the cannula had penetrated the posterior tracheal wall and air had been forced into the mediastinum.

SUMMARY

Translaryngeal anesthesia, although first described approximately 40 years ago, has not achieved widespread popularity and, as a form of topical anesthesia, ranks second to the intraoral approach. Many misconceptions and controversial issues prevail concerning this procedure. It is a method of topical anesthetization although a needle and syringe is used. It has been inaccurately called "transtracheal" anesthesia.

The questions whether the patient should be awake or asleep during the puncture, whether or not a skin wheal should be raised, and whether sterile solutions should be used have been discussed and viewpoints expressed in the available literature have been summarized. The indications, advantages, and...
contraindications have been summarized and arguments weighed. The many theoretical complications and the few actual reported occurrences have been listed. The anatomy and accepted techniques for performing translaryngeal anesthesia have been discussed.

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REFERENCES