The Laryngoscope

How I Do It

Percutaneous Transtracheal Needle Insufflation: A Useful Emergency Airway Adjunct Simply Constructed from Common Items Found on Your Anesthesia Cart

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Using material already available in the operating room, we describe the construction and application of a percutaneous transtracheal needle insufflation device to be used in pediatric airway emergencies. Our technique of percutaneous needle insufflation using common materials found in the operating room can be a helpful adjunct in a time of need. Quickly constructed and at a minimal cost, the device can be just one of the many useful tools found in the otolaryngologist's airway armamentarium.

Key Words: Transtracheal, needle insufflation, pediatric airway, emergency airway.

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INTRODUCTION

Evaluation and treatment of a pediatric patient in respiratory distress is one situation most otolaryngologists have faced at one time or another. These encounters can be anxiety provoking to all pediatric healthcare providers, whether the scenario arises in the operating room, an intensive care unit (ICU), the floor, or the emergency ward. More so than our adult patients, pediatric patients have less pulmonary reserve and can quickly decompensate making an urgent situation emergent. Therefore, any airway adjuncts that can be used and added to one's armamentarium are much welcomed if and when these situations arise. One such adjunct is the percutaneous transtracheal needle insufflation technique.

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In our tertiary medical center, the pediatric otolaryngology practice routinely performs airway endoscopy on pediatric patients at least 10 to 20 times a week. For patients we consider to have a tenuous airway, there are several pieces of equipment absolutely necessary to have in the room, open and ready to use. From the simplest to the most complex they include: good bag-valve mask technique, an oropharyngeal airway if there is difficulty with mask ventilation, use of a laryngeal mask airway if the above techniques fail, direct laryngoscopy with endotracheal intubation, and if intubation is not possible, use of a ventilating bronchoscope to establish the airway. If at this point the endoscopist is unsuccessful, we like to have the percutaneous transtracheal needle insufflation device available prior to considering a surgical airway.

The idea behind this device is similar to a needle cricothyroidotomy in adults, except it is performed below the level of the cricoid cartilage. The equipment is readily found in the operating room and takes less than a minute to assemble. The authors also keep such a device on the emergent airway cart in the ICU, on the pediatric floors, and in the emergency ward.

Hardware Necessary

Two 3-mL syringes (Leur lock connector), a 14- or 16-gauge angiocatheter, one vial of sterile saline solution, and a 7.0 endotracheal tube (Fig. 1). It is important to note whether or not your anesthesia service uses angiocatheters equipped with retracting safety needles. At our institution we stock our airway cart with one box

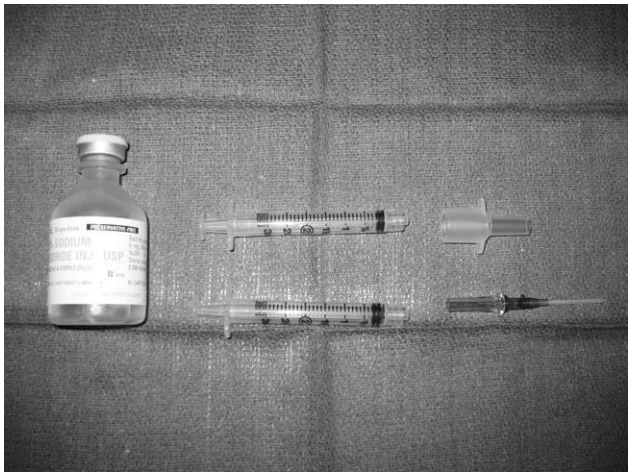

Fig. 1. Equipment necessary for construction. Clockwise from top right: hub from 7.0 endotracheal tube, 14- or 16-gauge angiocatheter, 3-mL Leur lock syringe, sterile saline solution, and a second 3-mL Leur lock syringe.

of the nonretracting angiocatheters in both the 14- and 16-gauge sizes to avoid this issue.

Construction

The first syringe, or seeker syringe, should have 2 mL of saline solution drawn up and the angiocatheter (with needle) secured to the hub using the Leur lock connector. The second syringe will become the anesthesia circuit adapter. This is created by removing the plunger from the second syringe and placing the hub from the 7.0 endotracheal tube onto the distal end of the syringe. The hub fits snugly and may be further secured with tape if desired (Fig. 2).

Application

The first syringe will serve as the seeker, using a bubble chamber to accurately identify the trachea. If a "can't ventilate, can't oxygenate, can't intubate" scenario should arise, this needle is placed perpendicularly into the midline neck below the level of the cricoid. In the pediatric neck, unlike the adult, the cricoid ring is the most prominent palpable landmark of the neck. Additionally, in the pediatric patient the cricothyroid membrane is a rather small target and the proximity to the true vocal folds makes damage to those structures more probable. Once through the skin, the surgeon should draw back on the plunger until bubbles appear, marking entrance into airway. At this point, the needle and syringe are removed, leaving only the plastic angiocatheter in place. The second adapter syringe is then secured onto the angiocatheter using the Leur lock connector. The anesthesia circuit is then connected to the adapter to allow for ventilation.

DISCUSSION

Preparation is paramount when evaluating a pediatric airway in the operating room. The endoscopist should have multiple airway adjuncts at their disposal in case a situation arises where the airway cannot be established or maintained. This goes hand-in-hand with good communication with anesthesia, nursing, and the surgical technicians assisting in the care of the patient.

The principle behind this technique is to provide adequate oxygenation. Because hypercarbia is very well tolerated in children,[1] high-flow oxygen (15–20 L/m) can be provided using the anesthesia circuit with a maximum pressure of 50 cm H_2O pressure. This is different than jet ventilation, which uses significantly higher pressure (~3,516 cm H_2O pressure). This high- flow low-pressure circuit avoids some of the morbidity of jet ventilation discussed below, namely barotrauma.

A couple of commercially available devices similar to our described technique exist. They are Quicktrach baby (CCR Medical, Jacksonville, FL) and the Ravussin cricothyroid cannula (VBM Medizintechnik, Sulz, Germany). One recent animal study shows Quicktrach baby is a viable option with little risk of posterior wall injury.[2] The Ravussin cannula, called Quicktrach I, does have pediatric and infant applications available for approximately $150 per unit. Both units do not use a saline filled chamber but rather just an air chamber. The benefits of our technique are ease of use, construction from materials readily available in the operating room, and improved visualization when locating the airway by using a saline bubble chamber. Additionally, the cost of our technique is negligible because the items are constructed from the anesthesia cart.

Possible complications include bleeding, barotrauma as a result of high-pressure ventilation, subcutaneous emphysema, pneumomediastinum, tearing or injury to the posterior tracheal wall, possible catheter kinking, damage to the thyroid gland, and sequela of incorrect placement.[3,4] As discussed above, using a high-flow low-pressure system helps decrease the risk of barotrauma. It is important to specify this to your anesthesia provider or respiratory therapist to prevent accidental use of jet ventilation while employing this technique. With regard to bleeding, midline placement of the needle will

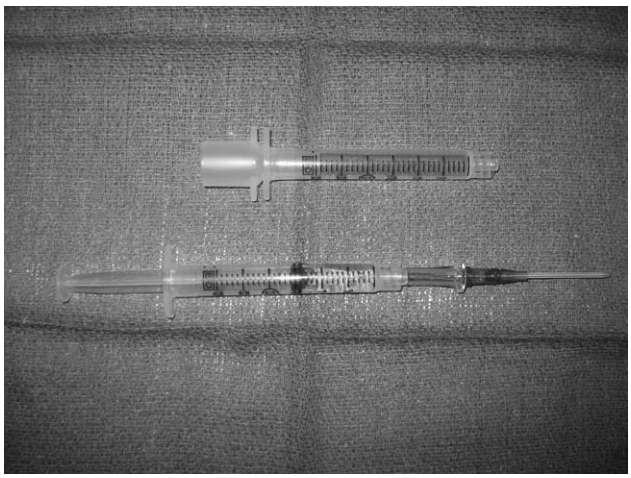

Fig. 2. Equipment after assembly. (Top) Anesthesia circuit adapter. (Bottom) Seeker syringe.

help decrease the risk of bleeding. Knowledge of the anatomy and relying on the bubble chamber should ensure correct placement in the midline.

CONCLUSION

In the operating room, respiratory distress in the pediatric patient requires quick corrective action to prevent a catastrophic outcome. Our technique of percutaneous needle insufflation using common materials found in the operating room can be a helpful adjunct in a time of need. Quickly constructed and at a minimal cost, the device can be just one of the many useful tools found in the otolaryngologist's airway armamentarium.

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