

NEONATAL TRACHEOSTOMY OVER A RIGID BRONCHOSCOPE

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The placement of a tracheostomy tube in the neonatal patient poses special technical challenges to the surgeon. A direct laryngoscopy and bronchoscopy are often part of the airway evaluation and frequently precede a tracheostomy. Leaving a rigid bronchoscope in place in the tracheal lumen for the tracheostomy is a variation on the standard technique in which reintubating the patient generally follows endoscopy. This report discusses the technique of performing a tracheostomy over a rigid bronchoscope, as well as the advantages conferred by this technique.

Maintenance of an adequate airway is the typical reason for placement of a tracheostomy in the neonatal population. An adequate airway may be needed for a child who is deemed to have an inadequate airway because of a difficult exposure caused by anatomic challenges (eg, in cases of Pierre-Robin sequence and micrognathia), pathologic obstruction of the upper airway (eg, subglottic stenosis, tracheomalacia), or an inability to ventilate spontaneously with extended intubation times and ventilatory dependence.¹ In either case, the decision to place a tracheostomy may need to be considered. The neonatal patient will often require a direct laryngoscopy and bronchoscopy before placement of the tracheostomy to fully evaluate the airway and definitively rule out any other impedance to adequate ventilation.

SURGICAL TECHNIQUE

Because a neonatal tracheostomy will often be preceded by a direct laryngoscopy and bronchoscopy,² the bronchoscope can be used in the placement of the tracheostomy for several technical advantages. A direct laryngoscopy and bronchoscopy with a rigid bronchoscope can first be performed to assess the patient's airway and diagnose existing pathology. This technique is well described and will not be discussed here, except to say that the endoscopist performs endoscopy from the head of the bed, with the patient supine and often extended to gain adequate exposure of the airway. The anesthesia team administers anesthesia from the side of the bed, and video monitors lie on the opposite side of the bed. The reader is referred to

several texts for detailed descriptions of these endoscopic techniques.^{3,4}

Once laryngoscopy and bronchoscopy have been performed, the surgeon can elect to keep the bronchoscope in place for the placement of the tracheostomy. The bronchoscope is positioned such that the distal tip is just above (1 to 2 mm) the carina (Figs 1 and 2). Airway endoscopy cases require effective communication between the anesthesia team and the endoscopist, and electing to perform the tracheostomy over the bronchoscope adds to the need for clear communication between the 2 teams.

With the appropriately sized bronchoscope in place in the airway, a member of the anesthesia or surgical team will need to hold it in place while the tracheostomy is performed. This requires a person to be seated at the head of the bed in the endoscopist's chair, with a hand supporting the bronchoscope in the airway (see Figs 1 and 2). The beam splitter camera, usually used by the authors for endoscopy, can be used to visually monitor the position of the bronchoscope in the airway by viewing the video monitor carrying the image from the camera. The bronchoscope needs to be supported off of the gums and/or teeth of the patient by this member of the team. The member of the team holding the bronchoscope therefore needs to have a comfortable position, as he/she will need to remain at the head of the bed supporting the bronchoscope for the duration of the procedure. Alternatively, the position is confirmed by the endoscopist and the bronchoscope is taped in place at the gum line. A window can then be placed on the bronchoscope to allow for more efficient ventilation.

With the airway maintained by the rigid bronchoscope, attention can be turned to the tracheostomy. It will often be necessary to pull excess skin and fat back away from the neck by placing tape around the chin and securing it to the operating table. The landmarks of the neck are then palpated along the midline. Frequently, the cartilage of the airway is soft and pliable in these patients and may make identification of the usual anatomic landmarks difficult with standard endotracheal intubation. Palpation over a steel bronchoscope, however, can lend rigidity to the airway, making the landmarks more easily identified and,

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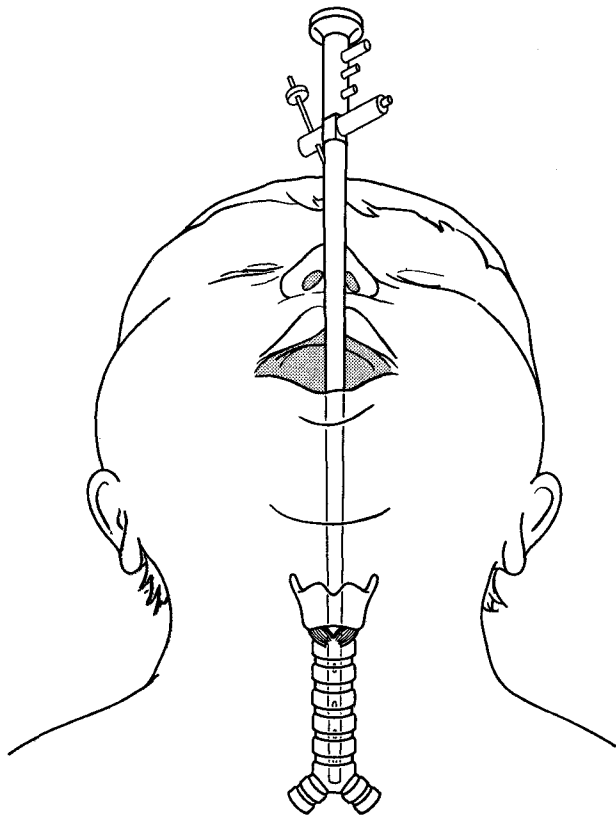


FIGURE 1. Anterior view of the bronchoscope positioned in the airway 1 to 2 mm above the carina.

most importantly, letting the operator positively identify the midline even if landmarks are not easily palpable.

The patient is then prepped and draped with towels over the chest and the 2 sides of the neck, but the chin and face are left uncovered to provide access to the airway. The person supporting the bronchoscope remains seated at the head. The tracheostomy may then be performed. A vertical incision is used, and fat is removed from the subcutaneous tissues with Bovie cautery. Strap muscles are separated in the vertical midline. The thyroid isthmus is either transected with Bovie cautery or mobilized inferiorly with a Kittner or sponge to isolate the trachea from surrounding soft tissue. Occasionally, thyroid or anterior jugular veins may need to be cross-clamped, divided, and tied.⁵ Palpation of the midline over the bronchoscope will aid the operator in finding the trachea. The cricoid and superior rings of the trachea are definitely identified.

Stay sutures of 4-0 prolene are placed through the third and fourth tracheal cartilages in a vertical orientation on each side just lateral to the midline. They are labeled right and left with steri-strips. These sutures can be used to open the tracheostoma in the event of an emergency by pulling the edges of the stoma laterally (Fig 3). A beaver blade is used to make a vertical incision on the midline of the trachea through 2 cartilaginous rings (usually rings 3 and 4). The skin edges are then matured to the tracheostoma with 4.0 chromic sutures at 4 corners (Fig 4). This creates a more secure and stable stoma in the event of accidental decannulation in the immediate postoperative period.

The bronchoscope will need to be partially withdrawn as the tracheostomy tube is inserted. The tracheostomy tube can then be seen through the bronchoscope as it is placed inside the lumen of the trachea. Once the tracheostomy tube is fully inserted, ventilation can be switched

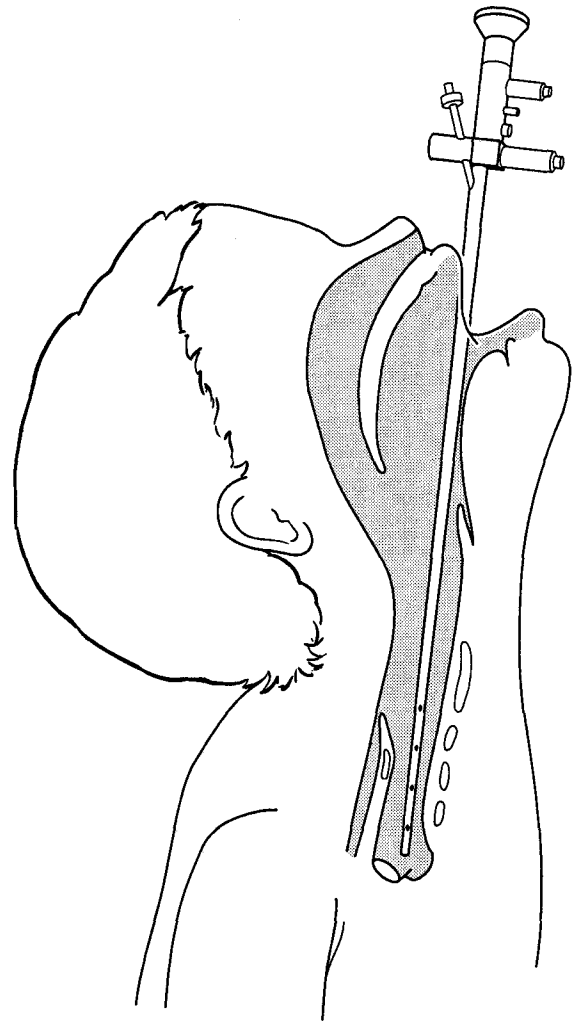


FIGURE 2. Sagittal view of the bronchoscope 1 to 2 mm above the carina.

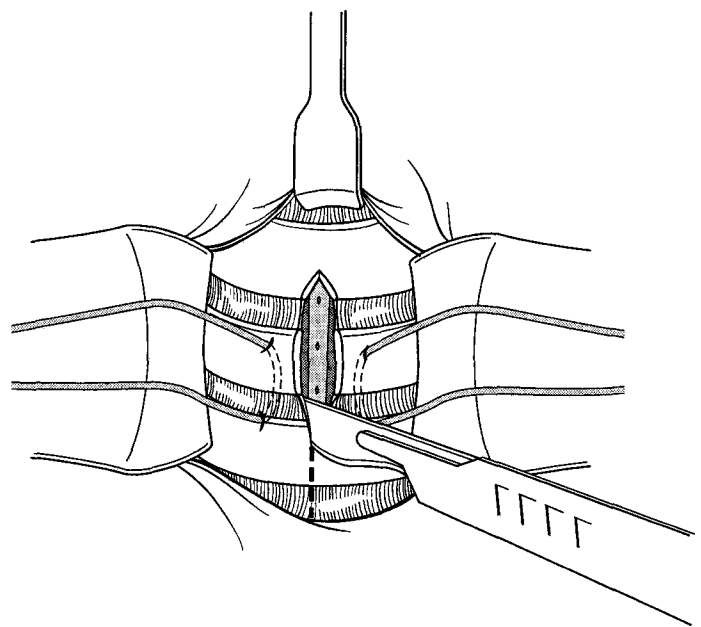


FIGURE 3. Anterior view of the surgical wound and the tracheostomy with the stay sutures in position. The bronchoscope is seen within the tracheal lumen.

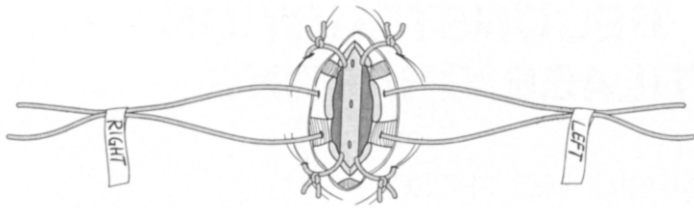


FIGURE 4. Anterior view of the surgical wound, showing the skin-to-trachea sutures in place at the 4 corners.

from the bronchoscope to the tracheostomy tube. The available sizes of the tracheostomy tube in the neonate will include a 3.0-, 3.5-, and 4.0-mm inner diameter tube based on the size of the child's trachea and any need for high-pressure postoperative ventilation. Visualization with a flexible pediatric laryngoscope through the tracheostomy tube is always performed after placement to ensure proper positioning and measurement of distance above the carina. Flexible endoscopy should be performed after the shoulder roll has been removed for more accurate assessment of the resting position of the tracheostomy tube. The tracheostomy tube is secured with a tracheostomy tie. The child is admitted to an age-appropriate intensive care unit. The tracheostomy ties are changed on postoperative day 3. The tracheostomy tube is changed between postoperative day 5 and 7.

DISCUSSION

Several advantages are offered to improve the technical facility of the neonatal tracheostomy if a rigid bronchoscope is used during the procedure. Among them is the need for less airway manipulation. Because a rigid bronchoscopy will often precede a tracheostomy, supporting the bronchoscope in the airway while ventilations are maintained through the bronchoscope means that the larynx will not need to be reintubated after the bronchoscope is removed. This may be especially useful in the child who has a difficult airway exposure, and may lend added security to the procedure by not allowing the airway to be lost once it has been obtained with a bronchoscope.

Secondly, the rigidity of the bronchoscope will often aid in the palpation of anatomic landmarks and the identification of the midline. The cartilage of both the thyroid and the trachea is much softer and more difficult to palpate in the neonate, because it is composed of more cellular cartilage and less hyaline cartilage.⁶ Tracheostomy over a bronchoscope can be especially helpful in the neonatal patient with excess fat in the cervical region or the patient who has had a previous tracheotomy or other neck surgery and has scarred and obscured tissue planes.

Lastly, the bronchoscope can be used to visualize the tracheostomy tube as it enters the airway, leaving no doubt as to the possibility of a false passage created in the connective tissues anterior or lateral to the trachea, thus

helping to avoid the possible complications of pneumomediastinum and pneumothorax,⁷⁻⁹ which may be more common in the preterm infant.¹⁰

Incorporation of the bronchoscope for airway maintenance and visualization during tracheostomy requires excellent communication between the surgical and the anesthesia teams. A member of the anesthesia team often supports the bronchoscope during the procedure. The role this person plays in the operation is discussed before the skin incision; doing so improves their effectiveness and, ultimately, the ease and safety of the operation.

In certain situations, use of the bronchoscope is not recommended. A neonate with extremely difficult airway exposure that is already being adequately ventilated via an endotracheal tube should stay intubated. With a precarious airway, it is best to perform the procedure over the existing endotracheal tube. The decision to use a bronchoscope should be determined by the surgeon's confidence in his or her endoscopic skills and experience.

CONCLUSION

The use of the bronchoscope for maintaining the airway during neonatal tracheostomies offers several advantages over a tracheostomy performed while the child is intubated with a standard endotracheal tube. This technique should be considered for use in appropriate situations. One challenge to the operating surgeon is that this technique will require enhanced communication with the anesthesia team. This technique may prove especially useful in those cases where a bronchoscopy is to be performed before a tracheostomy for evaluation of the airway.

REFERENCES

1. Miller RH, Gianoli GJ, Guarisco JL: Tracheostomy in the first year of life. *Ann Otol Rhinol Laryngol* 99:896-901, 1990
2. Seid AB, Gluckman JL: Tracheostomy, in Paparella MM, Shumrick DA, Gluckman JL, et al (eds): *Otolaryngology*, vol 3., Philadelphia, PA, WB Saunders, 1991, pp 2429-2437
3. Hulka GF, Wilmott RW, Cotton RT: Evaluation of the Airway, in Myers CM, Cotton RT, Shott SR (eds): *The Pediatric Airway*, Philadelphia, PA, JB Lippincott, 1995, pp 25-44
4. Green CG, Holinger LD, Gartlan MG: Technique, in Holinger LD, Lusk RP, Green CG (eds): *Pediatric Laryngology and Bronchoesophagology*, Philadelphia, PA, Lippincott-Raven, 1997, pp 97-116
5. Kirchner JA: Avoiding problems in tracheotomy. *Laryngoscope* 96: 55-57, 1986
6. Holinger PH, Brown WT, Maurizi DG: Tracheostomy in the newborn. *Am J Surg* 109:771, 1965
7. Gibson R, Byrne JET: Tracheotomy in neonates. *Laryngoscope* 82:643-650, 1972
8. Rabuzzi DD, Reed GF: Intrathoracic complications following tracheotomy in children. *Laryngoscope* 81:939-946, 1971
9. Gaudet PT, Peerless A, Sasaki CT, et al: Pediatric tracheostomy and associated complications. *Laryngoscope* 88:1633-1641, 1978
10. Kenna MA, Reilly JS, Stool SE: Tracheotomy in the pre-term infant. *Ann Otol Rhinol Laryngol* 96:68-71, 1987