CHEST

Performance, Long-term Management, and Coding for Percutaneous Dilational Tracheostomy

Jaspal Singh, MD, MHS, MHA, FCCP; and Ronald F. Sing, DO, FCCP

Percutaneous dilatational tracheotomy (PDT) has become increasingly popular and has gained widespread acceptance. The modern PDT procedure has also evolved to whereby it can be safely performed by surgeons and nonsurgeons in the ICU. Moreover, bedside PDT has proven clinical outcomes and can save hospital resources. As such, PDT done in the ICU is now a widely performed procedure, often being the tracheostomy procedure of choice. Today, many pulmonologists and intensivists who can use bedside PDT do not perform this procedure; it is conceivable this practice may expand, especially among pulmonologists and intensivists. Although numerous indications exist for tracheostomy, the focus of this article is limited to bedside PDT for prolonged mechanical ventilation, which is the most common indication for this procedure. We describe the logistics and operations needed for programs to incorporate PDT into routine ICU care.

CHEST 2019; 155(3):639-644

KEY WORDS: interventional pulmonary; respiratory failure; tracheostomy; tracheotomy

Since Ciaglia et al[1] introduced the percutaneous dilatational tracheotomy (PDT) in 1985, bedside PDT is often performed by many surgeons and nonsurgeons in the ICU.[2] The procedure has evolved past earlier controversies to the point of proven efficacy, safety, and clinical outcomes.[3,4] In addition, the procedure can save ICU transport costs and logistics, minimize operating room scheduling issues and delays, and save hospital resources.[5,6] For these reasons, PDT performed in the ICU is now a widely recognized option. In many ICUs such as ours, it has become the tracheostomy procedure of choice.

Given recent trends showing increased numbers of patients undergoing tracheostomy,[7,8] a demand in expertise for tracheostomy procedures exists. Should pulmonologists and intensivists include PDT in their practice, it may become a source of professional satisfaction as well as added practice productivity.

Evidence of Utility and Safety

Several studies have been published comparing various techniques of percutaneous tracheostomy with the open surgical tracheotomy, with most suggesting either lower complication rates with

ABBREVIATIONS: CPT = Current Procedural Terminology; HCPCS = Healthcare Common Procedure Coding System; PDT = percutaneous dilatational tracheostomy; PEEP = positive end-expiratory pressure

AFFILIATIONS: From Pulmonary, Critical Care and Sleep Medicine (Dr Singh), and Trauma, Critical Care and Surgery (Dr Sing), Carolinas Medical Center, Charlotte, NC.

CORRESPONDENCE TO: Jaspal Singh, MD, MHS, MHA, FCCP, Pulmonary and Critical Care Consultants, Carolinas Medical Center, Atrium Health, 1000 Blythe Blvd, Ste 503, Charlotte, NC 28203; e-mail: jaspal.singh@atriumhealth.org

DOI: https://doi.org/10.1016/j.chest.2018.10.049

percutaneous methods, or no statistical significances between them.[9-11] A systematic review by Delaney et al[12] examined 17 randomized controlled trials involving 1,212 patients and concluded that PDT was associated with lower bleeding and mortality. Furthermore, a meta-analysis by Higgins and Punthakee[13] reported no significant difference when comparing overall complications, with a trend toward favoring the percutaneous method. PDT still has limitations and risks, including possibly a higher incidence of decannulation and obstruction. Furthermore, some investigators have proposed a learning curve for PDT, noting possible increased complications in patients operated on by inexperienced operators or in institutions where the procedure is performed infrequently.[14] Therefore, early experience with PDT is recommended under controlled settings. Notably, the American College of Surgeons still recommends bedside PDT as the procedure of choice, even in high-risk patients.[11]

Contraindications

Absolute and relative contraindications, as with other procedures, are often a matter of debate (Table 1). Most published articles consider cervical injury, pediatric age, coagulopathy, and emergency airway necessity as absolute contraindications. For inexperienced operators, especially nonsurgeons, we recommend avoiding such cases. We do note that with increasing experience, PDT can be performed safely in select patients who are morbidly obese,[15] have short, fat necks,[16] with coagulopathy,[17] have neck or cervical trauma,[18] and even those with high oxygen requirements.[19] These latter conditions require increased operator and team experience in PDT prior to performance; in some centers, these may be best accomplished via an open surgical approach. Therefore, in deciding between percutaneous and open surgical approaches, relevant factors may also include skills of the operating team, local resources, and anatomic and physiologic considerations highlighted earlier. Newer operators are cautioned to gain substantial experience with PDT prior to performing it in more complex circumstances.

Procedural Logistics of a PDT Program

The PDT Team

Key personnel who are familiar with the procedure will assist the primary surgeon or pulmonologist and enhance procedure facilitation and patient safety. In our institution, the team would include the operating physician, an airway assistant (typically another physician or advanced care practitioner), a bedside nurse, and a respiratory therapist at a minimum. We also have a second assistant across the bed from the operator, usually a resident or fellow in training, but in other centers this person may include an operating room technician or physician assistant. In some institutions, an anesthesiologist may serve to assist the sedation and airway strategies, especially if skilled respiratory therapy support is not available. It is critical that the airway assistant and the respiratory therapist are familiar with each step of the procedure as to not prematurely remove the endotracheal tube prior to confirmation of the tracheostomy. During the procedure, the airway will intermittently become partially compromised with the dilator and insertion of the tracheostomy tube. This action will result in frequent ventilator alarm triggering that requires diligent monitoring by a respiratory therapist to ensure the airway is not truly lost; this is especially concerning in patients with higher oxygenation and/or positive end-expiratory pressure (PEEP) requirements (eg, $F_{IO_2} > 0.6$ and/or PEEP > 12 cm H_2O). The bedside nurse monitors the patient and vital signs and, in cases in which the procedure is performed under moderate sedation, the nurse might be asked to administer sedation and analgesia. In some institutions, the sedation and analgesia may be

TABLE 1] Absolute and Relative Contraindications for Percutaneous Tracheostomy

Absolute contraindications to consider:	Relative contraindications to consider:
• Patient age younger than 8 years • Necessity of emergency airway access because of acute airway compromise • Gross distortion of the neck anatomy due to the following: Hematoma Tumor Thyromegaly High innominate artery	• Patient obesity with short neck that obscures neck landmarks • Medically uncorrectable bleeding diatheses • Prothrombin time or activated partial thromboplastin time > 1.5 times the reference range • Platelet count < 50,000/μL • Bleeding time > 10 min • Need for positive end-expiratory pressure > 20 cm H_2O • Evidence of infection in the soft tissues of the neck at the prospective surgical site

administered by an anesthesia team. For nonsurgeons, we also recommend that a surgeon skilled in the procedure be readily available for backup until the operator is comfortable with the procedure and associated outcomes.

Early Patient Selection

We recommend that early cases be performed in patients with clear anatomic landmarks, who exhibit hemodynamic stability, and have only modest ventilator requirements (eg, $F_{IO_2} \leq 0.4$, PEEP ≤ 8 cm H_2O). We also recommend reviewing the procedural steps with the entire PDT team in a careful, deliberate manner with early cases. Additional precautions are recommended to avoid other ICU distractions from any of the PDT team members.

Case Preparation

Similar to other operative procedures, we recommend the use of a checklist[20,21] for PDT to enhance patient safety.[22] Mirroring traditional operating room practices, such as at least a 6-h fast or holding of enteral feedings, is important especially when tracking clinical outcomes (discussed later). The PDT team is assembled at the bedside with a commercially available PDT tray. Some kits are all-inclusive packages with chlorhexidine-based preparation, full-body drapes, syringes, dilator, lidocaine with 1/100,000 epinephrine, suture, needle driver/hemostat, and 8.0-mm cuffed regular tracheostomy tube. Emergent airway supplies such as a laryngoscope, endotracheal tubes of varying sizes, and a hemodynamic resuscitation cart should be immediately available at the bedside in the event of unplanned emergencies. A flexible bronchoscope with video monitor is positioned in sight of the operator close to the bed. Although tracheostomy can be performed with local analgesia and moderate (conscious) sedation, many institutions such as ours prefer deeper sedation and liberal analgesia strategies. We also use neuromuscular blockade for the procedure.

Patient Positioning

The patient is positioned at the head of the bed with a shoulder roll to provide neck extension if appropriate. Patients at risk or those with acute spinal cord injury can be kept in a neutral position. The airway assistant is positioned at the head of the bed along with the respiratory therapist.

Procedural Steps

The procedure itself is performed with proper procedural hygiene, sterile preparation with drapes, and identification of landmarks.[9] Local anesthesia is applied, and the airway identified in two discrete steps: (1) percutaneously with confirmation from a rush of air upon needle penetration; and (2) endoluminally with bronchoscopy. The guidewire is placed with care to move caudally toward the carina, and subsequent dilational procedure occurs. The dilator is a hydrophilic-coated instrument that facilitates smoother dilation. The dilator is removed, and the tracheostomy tube is placed through the tract. Clinical confirmation is performed, and the tube is then secured as per usual methods. Bronchoscopic confirmation, as well as qualitative or quantitative end-tidal carbon dioxide confirmation of tracheal placement, is recommended. Many institutions might perform postprocedural chest radiographs to also exclude pneumothorax, although this step may not be necessary.[23,24] Additional details of this procedure are available in select references[9,25] as well as commercial websites from the manufacturers of respective PDT kits.

Bronchoscopy for Intraprocedural Aide and Postprocedural Confirmation

We recommend bronchoscopy be performed by the airway assistant to: (1) aid in the visualization of each of the steps; (2) confirm final placement via direct visualization of the carina; and (3) lessen complications.[26,27] Although others have noted that routine bronchoscopy may not be necessary,[3] we find this extremely helpful to facilitate team-based care, communication, and education. Real-time ultrasonography has been shown to be a safe and effective alternative to fiber-optic bronchoscopy,[28] although the authors have limited experience in this technique.

Practice Logistics of a PDT Program

Training

Training requirements for PDT have not been well defined. As with many other invasive surgical procedures, we believe a combination of didactics and simulation-based training and testing should be used prior to embarking on the procedure. We acknowledge that training does not translate directly into competency, credentialing, or mastery.

For reference, the American College of Chest Physicians Interventional Pulmonary Procedures Guidelines recommends at least 20 procedures[29] in a supervised setting to establish basic competency for the physician performing the procedure, and an annual experience of 10 cases to maintain credentialing. The American

College of Chest Physicians Guidelines are based on expert consensus and have been helpful to establish basic competency and credentialing procedures. We agree with these recommendations but suggest that additional structured didactics, simulation-based training, and co-training of the entire PDT "team" may be needed. This approach may be important especially when performing the procedure in lower volume centers, with less readily available surgical backup, or when attempting more complex cases.

Notably, specific training requirements for PDT are not included in training requirements for the pulmonary and critical care fellowships as documented by the American Board of Internal Medicine.[30] We recognize that interventional pulmonary training programs will often incorporate PDT[31]; however, we postulate that lack of emphasis on procedures such as PDT in general programs may affect adoption of this procedure.

The number of cases required to be credentialed may vary by institution; those planning on pursuing credentialing should verify the process with hospital bylaws and medical executive committee recommendations. Similarly, institutions may vary regarding if PDT should be singled out as a special privilege vs a core privilege under surgery or critical care. In our practice, it is a special privilege for pulmonologists but a core privilege for surgeons.

Clinical Service

Pulmonologists and surgeons will need to make themselves available for bedside PDT for the duration of the procedure with minimal interruptions and distractions. For expediency, some practices have designated proceduralists to allow clinical emergencies and interruptions to be handled by others. Some practices also have a backup individual(s) who can perform the procedure or manage complications when others are not available.

Although complications are infrequent, nonsurgeons and less experienced operators should consider consulting with others who might assist in the event of a complication. We recommend being mindful of periprocedural hypotension related to sedation, clinical monitoring for signs and symptoms of hemorrhage, tube dislodgement, site infection, and subcutaneous emphysema. Other complications may include tracheal stenosis, pneumonia, tracheitis, sternoclavicular osteomyelitis, or tracheoesophageal fistula.[32]

Postprocedurally, we recommend daily examination of the tracheostomy tube, sutures, and cleaning of the inner cannula for the first 7 days. Around the seventh day, we aim for suture removal along with planning for the first tracheostomy tube change by a member of the operating team. For patients on full ventilator support, we generally remove sutures alone and maintain the tracheostomy tube until weaning has occurred. Following the first tracheostomy tube change, subsequent tracheostomy tube changes are performed by respiratory and nursing personnel.[33] Following weaning from mechanical ventilation, the decannulation process begins with feedback from our nursing, respiratory therapy, and speech-language pathology colleagues in a team-based fashion as others have shown.[34] For patients unable to be decannulated or who have residual tracheal concerns, we offer clinic appointments for follow-up to discuss issues and reexamine the need for tracheostomy. Exchanging and cleaning of tracheostomy tubes varies depending on disease states, secretions, cleaning patterns, and physical location per protocol.[35] Often, local respiratory resources, pulmonologists, or surgeons may be equipped to manage patients' tracheostomy needs.

Documentation

Documentation requirements for PDT are similar to other procedural requirements and include: date and time of procedure; informed consent in chart; anesthesia plan and documentation of medications administered; appropriate diagnosis and indication(s); operator(s) and assistant(s) names; description of procedure; estimated blood loss; complications (if any); and follow-up recommendations for further tracheostomy care. We encourage the use of templates for this documentation to ensure proper clinical communication, to meet the requirements of hospital accrediting bodies, and to meet the requirements for proper coding and billing practices.

Coding and Billing

Coding and documentation requirements can vary according to payer as well as by region. Local insurance carriers and coding experts should be consulted. We routinely bill by using Current Procedural Terminology (CPT) code 31600 for "Tracheostomy, Planned Procedure." This code is for both PDT and for open tracheostomy and is inclusive of all bedside preparation time specific to the procedure itself. We do not bill for the tracheostomy supplies because the hospital bills all surgical supplies. Some surgeons do not bill follow-up evaluation and management visits related to the

tracheostomy because they assume there is a global period and, therefore, the visits are nonpayable. According to the Centers for Medicare & Medicaid Services fee schedule, tracheostomy procedures include zero global days, which means any visit or service performed one or more days following surgery in a Medicare patient is payable separately.[36] Some commercial payers, however, do impose a 10-day global period on CPT 31600.[37] Because our teams are usually caring for the patient's respiratory needs, we often incorporate documentation relevant to tracheostomy care as per subsequent evaluation and management encounters. Other codes of note:

- Tracheostomy tube change prior to establishment of fistula tract CPT 31502, used for premature tracheostomy tube changes (eg, balloon rupture, or tube dislodgement) prior to epithelialization of the tract (usually by the seventh postoperative day).
- Routine bronchoscopy (CPT 31622), although often helpful with PDT, cannot be billed without clear documentation showing that it was medically necessary to perform a separate procedure. Separate procedures can include a diagnostic BAL (CPT 31624) or bronchoscopy with therapeutic clearance of secretions or blood (CPT 31645 for initial procedure, or 31646 for subsequent procedure); again, documentation needs to indicate that these procedures are medically necessary.
- In the clinic, if a tracheostomy tube is changed, durable medical equipment may then be billed for supplies, including tracheostomy tubes using Healthcare Common Procedure Coding System (HCPCS) codes A7520 (tracheostomy tube, uncuffed), A7521 (tracheostomy tube, cuffed), or A7522 (tracheostomy tube, stainless), tracheostomy masks (A7525), tracheostomy collars/holders (A7526), and tracheostomy caps (A7527).

Performance Improvement and Quality Review

As with other operative procedures, a performance improvement and patient safety program is critical to identify and characterize adverse events as well as monitor clinical outcomes; PDT is no exception. We encourage all considering a PDT program to consult with their institution's performance improvement and patient safety or similar program so as best to understand the local processes and resources, to be involved in the definitions and tracking of outcomes, and to enhance a culture of patient safety. Because programs are often benchmarked to traditional operating room outcomes measures, this fact is another reason to mirror the operating room process if feasible. For example, if a tracheostomy in the operating room requires IV antibiotics, we recommend the same procedure being applied to the bedside procedure.

Conclusions

We believe that bedside PDT has become the procedure of choice for tracheostomy in ICU patients with respiratory failure and in need of prolonged mechanical ventilation. Moreover, we believe it can be accomplished safely and expediently by surgeons and nonsurgeons and add clinical value if performed by pulmonologists and intensivists.

Acknowledgments

Author contributions: Both authors made substantial contributions to this article and are equally accountable.

Financial/nonfinancial disclosures: The authors have reported to *CHEST* the following: J. S. is a consultant for Medtronic and Somnoware Sleep Solutions. R. F. S. is a paid speaker and has received educational grant support from Cook Medical.

Other contributions: The authors thank Jill Jurgensen, BS, for reviewing the manuscript.

References

1. Ciaglia P, Firsching R, Syniec C. Elective percutaneous dilatational tracheostomy: a new simple bedside procedure; preliminary report. *Chest*. 1985;87(6):715-719.
2. Hsia DW, Ghori UK, Musani AI. Percutaneous dilational tracheostomy. *Clinics Chest Med*. 2013;34(3):515-526.
3. Dennis BM, Eckert MJ, Gunter OL, Morris JA, May AK. Safety of bedside percutaneous tracheostomy in the critically ill: evaluation of more than 3,000 procedures. *J Am Coll Surg*. 2013;216(4):858-865.
4. Putensen C, Theuerkauf N, Guenther U, Vargas M, Pelosi P. Percutaneous and surgical tracheostomy in critically ill adult patients: a meta-analysis. *Crit Care*. 2014;18(6):544.
5. Bacchetta MD, Girardi LN, Southard EJ, et al. Comparison of open versus bedside percutaneous dilatational tracheostomy in the cardiothoracic surgical patient: outcomes and financial analysis. *Ann Thorac Surg*. 2005;79(6):1879-1885.
6. Mirski MA, Pandian V, Bhatti N, et al. Safety, efficiency, and cost-effectiveness of a multidisciplinary percutaneous tracheostomy program. *Crit Care Med*. 2012;40(6):1827-1834.
7. Mehta AB, Syeda SN, Bajpayee L, Cooke CR, Walkey AJ, Wiener RS. Trends in tracheostomy for mechanically ventilated patients in the United States, 1993–2012. *Am J Respir Crit Care Med*. 2015;192(4):446-454.
8. Cox CE, Carson SS, Holmes GM, Howard A, Carey TS. Increase in tracheostomy for prolonged mechanical ventilation in North Carolina, 1993-2002. *Crit Care Med*. 2004;32(11):2219-2226.
9. Lamb C. Percutaneous dilational tracheostomy. In: Beamis JF, Mathur P, Mehta AC, eds. *Interventional Pulmonary Medicine*. Vol. 230, 2nd ed. New York, NY: Informa Healthcare; 2010:209-220.
10. Brotfain E, Koyfman L, Frenkel A, et al. Bedside percutaneous tracheostomy versus open surgical tracheostomy in non-ICU patients. *Crit Care Res Pract*. 2014;2014:156814.
11. Kornblith LZ, Burlew CC, Moore EE, et al. One thousand bedside percutaneous tracheostomies in the surgical intensive care unit: time to change the gold standard. *J Am Coll Surg*. 2011;212(2):163-170.

12. Delaney A, Bagshaw SM, Nalos M. Percutaneous dilatational tracheostomy versus surgical tracheostomy in critically ill patients: a systematic review and meta-analysis. *Crit Care*. 2006;10(2):R55.
13. Higgins KM, Punthakee X. Meta-analysis comparison of open versus percutaneous tracheostomy. *Laryngoscope*. 2007;117(3):447-454.
14. Beiderlinden M, Karl Walz M, Sander A, Groeben H, Peters J. Complications of bronchoscopically guided percutaneous dilational tracheostomy: beyond the learning curve. *Intensive Care Med*. 2002;28(1):59-62.
15. Romero CM, Cornejo RA, Ruiz MH, et al. Fiberoptic bronchoscopy-assisted percutaneous tracheostomy is safe in obese critically ill patients: a prospective and comparative study. *J Crit Care*. 2009;24(4):494-500.
16. Tabaee A, Geng E, Lin J, et al. Impact of neck length on the safety of percutaneous and surgical tracheotomy: a prospective, randomized study. *Laryngoscope*. 2005;115(9):1685-1690.
17. Auzinger G, O'Callaghan GP, Bernal W, Sizer E, Wendon JA. Percutaneous tracheostomy in patients with severe liver disease and a high incidence of refractory coagulopathy: a prospective trial. *Crit Care*. 2007;11(5):R110.
18. Ben Nun A, Orlovsky M, Anson Best L. Percutaneous tracheostomy in patients with cervical spine fractures—feasible and safe. *Interactive Cardiovasc Thorac Surg*. 2006;5(4):427-429.
19. Beiderlinden M, Groeben H, Peters J. Safety of percutaneous dilational tracheostomy in patients ventilated with high positive end-expiratory pressure (PEEP). *Intensive Care Med*. 2003;29(6):944-948.
20. Pronovost P, Berenholtz S, Dorman T, Lipsett PA, Simmonds T, Haraden C. Improving communication in the ICU using daily goals. *J Crit Care*. 2003;18.
21. Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med*. 2009;360(5):491-499.
22. Rajendran G, Hutchinson S. Checklist for percutaneous tracheostomy in critical care. *Crit Care*. 2014;18(2):425.
23. Francesca H, Maria O, Ray C. Routine chest X-ray after percutaneous tracheostomy is unnecessary. *Am Surgeon*. 2005;71(1):51-53.
24. Yeo WX, Phua CQ, Lo S. Is routine chest X-ray after surgical and percutaneous tracheostomy necessary in adults: a systemic review of the current literature. *Clin Otolaryngol*. 2014;39(2):79-88.
25. Lerner AD, Yarmus L. Percutaneous dilational tracheostomy. *Clinics Chest Med*. 2018;39(1):211-222.
26. Fernandez L, Norwood S, Roettger R, Gass D, Wilkins H III. Bedside percutaneous tracheostomy with bronchoscopic guidance in critically ill patients. *Arch Surg*. 1996;131(2):129-132.
27. Barba CA, Angood PB, Kauder DR, et al. Bronchoscopic guidance makes percutaneous tracheostomy a safe, cost-effective, and easy-to-teach procedure. *Surgery*. 1995;118(5):879-883.
28. Gobatto AL, Besen BA, Tierno PF, et al. Comparison between ultrasound- and bronchoscopy-guided percutaneous dilational tracheostomy in critically ill patients: a retrospective cohort study. *J Crit Care*. 2015;30(1):220.e213-220.e217.
29. Ernst A, Silvestri GA, Johnstone D. Interventional pulmonary procedures. *Chest*. 2003;123(5):1693-1694.
30. American Board of Internal Medicine. Critical care medicine policies. *Internal Medicine and Subspecialty Policies*. http://www.abim.org/certification/policies/internal-medicine-subspecialty-policies/critical-care-medicine.aspx. Accessed March 5, 2018.
31. Lamb CR, Feller-Kopman D, Ernst A, et al. An approach to interventional pulmonary fellowship training. *Chest*. 2010;137(1):195-199.
32. Cipriano A, Mao ML, Hon HH, et al. An overview of complications associated with open and percutaneous tracheostomy procedures. *Int J Crit Illn Inj Sci*. 2015;5(3):179-188.
33. Engels PT, Bagshaw SM, Meier M, Brindley PG. Tracheostomy: from insertion to decannulation. *Can J Surgery*. 2009;52(5):427-433.
34. Welton C, Morrison M, Catalig M, Chris J, Pataki J. Can an interprofessional tracheostomy team improve weaning to decannulation times? A quality improvement evaluation. *Can J Respir Therapy*. 2016;52(1):7-11.
35. JD D, Niven A, Hess D. Airway management. In: Hess D, Macintyre N, Galvin W, Mishoe S, eds. *Respiratory Care: Principles and Practice*. Burlington, MA: Jones & Bartlett Learning; 2016:408-428.
36. CMS. Physician fee schedule. https://www.cms.gov/apps/physician-fee-schedule/search/search-criteria.aspx. Accessed March 5, 2018.
37. CMS. Global surgery booklet. https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/downloads/GloballSurgery-ICN907166.pdf. Accessed October 7, 2018.