

Percutaneous Dilational Tracheostomy

David W. Hsia, MD^{a,*}, Uzair K. Ghori, MD^b,
Ali I. Musani, MD^c

KEYWORDS

- Percutaneous dilational tracheostomy • Chronic respiratory failure • Flexible bronchoscopy
- Critical illness

KEY POINTS

- There are numerous indications for PDT placement in the management of chronic respiratory failure.
- PDT has been safely performed by surgical and medical physicians, including critical care intensivists and interventional pulmonologists.
- There are multiple methods of performing the procedure and the single dilator variant of the Ciaglia method is currently the most widely used.
- PDT compares favorably with surgical tracheostomy in regards to procedure time, complications, and cost.
- Flexible bronchoscopy is commonly used as a procedural adjunct and has been shown to decrease complications.
- Because of its advantages, PDT has become one of the most common procedures performed in the modern ICU.

INTRODUCTION

Tracheostomy is one of the oldest surgical procedures and has been performed for several thousand years. There are many indications for tracheostomy placement, such as the need for prolonged mechanical ventilator support, improved clearance of secretions, protection from aspiration, and maintenance of the airway because of sequelae from upper airway obstructions or trauma. In addition, tracheostomy has additional potential benefits over endotracheal tube (ETT) intubation because it decreases the work of breathing,¹ reduces ventilator-associated pneumonia,² provides a more secure airway, and permits patient phonation and swallowing. Tracheostomy plays a prominent role in the treatment of prolonged respiratory failure

and more than 50% of all tracheostomies are placed in critically ill patients.³

The modern operative procedure remains largely unchanged from the methodology described by Chevalier Jackson in the early 1900s.⁴ Jackson's approach involved a long incision, good exposure of the anatomic structures, and division of the thyroid isthmus. His guidelines on the procedure were instrumental in improving procedural safety and outcomes. Subsequent refinements to the procedure and improvements in equipment have resulted in decreased procedure-related morbidity and mortality.⁵ In 1957, Sheldon and Pudenz⁶ described a Seldinger method of percutaneous tracheostomy placement. The procedure became more widely used after the introduction of the percutaneous dilational method by Ciaglia in

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^a Department of Medicine, Harbor-UCLA Medical Center, 1000 West Carson Street, Box #405, Torrance, CA 90509, USA; ^b Department of Medicine, Military Hospital Rawalpindi, Main Peshawar Road, 46000 Rawalpindi, Pakistan; ^c National Jewish Health, 1400 Jackson Street, J225, Molly Blank Building, Denver, CO 80206, USA

* Corresponding author.

E-mail address: dhsia@labiomed.org

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1985.⁷ Percutaneous tracheostomy is now recognized as a cost-effective procedure that can be performed easily and safely at the bedside by interventional pulmonologists, critical care physicians, and surgeons in the intensive care unit (ICU).

PERCUTANEOUS DILATIONAL TRACHEOSTOMY TECHNIQUES

Percutaneous dilational tracheostomy (PDT) uses the insertion of a tracheal cannula by a modified Seldinger approach. A guidewire is inserted through the anterior tracheal wall; dilation is then performed until the tracheal stoma is large enough to permit insertion of the tracheal cannula. Cannula insertion is generally performed between the second and third tracheal rings, with a suggestion of decreased risk of bleeding when placed above the fourth tracheal ring.⁸ Several variations of the procedure have been developed and are in use today.

The Ciaglia method⁷ is currently the most commonly used PDT technique; it was originally described using serial dilation with progressively larger hydrophilic coated dilators and is now adapted in commercially available kits to use a single conical dilator (Ciaglia Blue Rhino Tracheostomy Introducer Kit, Cook Critical Care, Bloomington, IN; Per-Fit Kit, SIMS Portex, Keene, NH) (Fig. 1). Before the procedure, the distal tip of the ETT is repositioned within the subglottic space proximal to the intended tracheostomy dilation site. A midline incision is made over the anterior trachea and the pretracheal soft tissue is bluntly dissected with mosquito clamps. The underlying trachea is then identified using a needle and introducer sheath. Flexible bronchoscopic visualization is commonly used to provide endoscopic guidance from within the trachea (Fig. 2). Removal of the needle allows an introduction of a J-shaped guidewire through the introducer sheath into the trachea and directed caudally into the distal airways. The introducer sheath is then removed and dilation of the trachea and soft tissue is performed initially with a short dilator followed by a curved, conical dilator. Special precautions must be taken to ensure proper midline puncture of the anterior trachea wall and introduction of the guidewire and subsequent dilation through the anterior wall while avoiding puncture of the posterior membranous portion of the trachea. A tracheostomy tube is loaded onto an introducer dilator and inserted into the trachea over the guidewire through the dilated stoma and secured in place. The use of the single dilator method is theorized to decrease the risk of injury to the posterior tracheal wall and prevent the risk of oxygen desaturation or

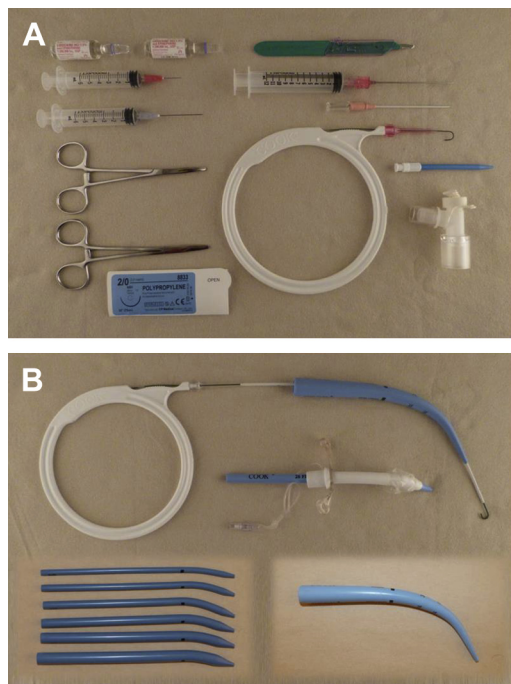


Fig. 1. Single and multiple dilator methods based on the Ciaglia technique. (A) Example of equipment found in commercially available PDT kits. (B) Multiple and single dilator systems. The guidewire and guide catheter are shown inserted through a single conical-shaped Blue Rhino dilator. A tracheostomy cannula is loaded onto a specialized introducer. Inset shows a set of multiple dilators with sizes ranging from 18F to 36F catheter compared with a single dilator.

inadequate ventilation by minimizing the period of time needed to dilate the tracheostomy stoma and insert the tracheostomy cannula. Another modification of the Ciaglia method (Ciaglia Blue Dolphin Tracheostomy Introducer Kit; Cook Critical Care) using a balloon dilator has also been developed (Fig. 3).⁹ PDT using single dilation has been shown to decrease procedure time compared with the multiple and balloon dilation methods.¹⁰⁻¹²

Numerous kits using other PDT dilation methods are also commercially available. The Griggs' dilational forceps technique (Portex PDT Kit; Portex, Hyathe, Kent, UK) uses curved Howard-Kelly forceps with a special groove that permits passage of the guidewire through the forceps.¹³ The guidewire directs the path of the forceps, which are used to dilate the soft tissue and trachea. The translaryngeal tracheostomy method (Translaryngeal Tracheostomy Kit; Mallinckrodt, Courta-boeuf, France) directs the guidewire caudally either within or external to the ETT. The ETT is removed and the patient is reintubated with a

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