# Evaluation of a Modified Percutaneous Tracheostomy Technique Without Bronchoscopic Guidance*

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***Background:*** **Most complications of percutaneous tracheostomy are caused by failure to cannulate the trachea and injury to surrounding structures. Traditionally, the procedure has been performed under bronchoscopic assistance, which may interfere with the patient's ventilation and is cumbersome. A modification was described in which the subcutaneous tissue is bluntly dissected with a hemostat down to the pretracheal fascia. The procedure is then performed with the guidance of the operator's finger, making the routine use of a bronchoscope no longer necessary.**

***Methods:*** **The modified technique was adopted and prospectively evaluated in an observational clinical study over a 30-month period, in patients requiring elective tracheostomy. Two commercially available kits were used. Patients' records were kept in files, and they were evaluated with regard to operative technique, complications, failure rate, and loss of airway.**

***Results:*** **During the study period, 61 procedures were attempted. All were performed at the patients' bedside. In three patients (4.9%), the percutaneous procedure was deferred due to anatomic problems: cervical venous engorgement in one patient, and difficulty in dissection in another patient. In the third patient, the trachea could be felt, but the tube provided with the kit was not long enough. One patient had persistent wound bleeding, requiring revision in the operating room. No other procedure-related complications were reported. In three patients, early tube dislodgement occurred, but whether this was related to the percutaneous procedure is debatable. Bronchoscopy was not used.**

***Conclusions:*** **The modified percutaneous technique, with limited surgical dissection, without routine bronchoscopy, is simple and safe when performed by physicians with surgical training. It is relatively easy to learn, saves costs and operating room burden, and carries low morbidity rates.**

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**Key words:** bronchoscopy; mechanical ventilation; percutaneous tracheostomy

**Abbreviation:** MPT = modified percutaneous tracheostomy

Tracheostomy is an old surgical procedure, probably dating back to ancient Egypt.[1] During the nineteenth century, the procedure was considered dangerous and was seldom performed, due to the high rate of complications. In 1909, Jackson[2] described and defined the surgical principles for performing this operation while avoiding most of the short- and long-term complications. He emphasized the use of good exposure by performing a long incision, dividing the thyroid isthmus, and especially avoiding incision of the trachea too high.[3] In 1969, Toye and Weinstein[4] described a technique of percutaneous tracheostomy using a cutting dilator. The technique failed to gain popularity mainly due to bleeding complications. In 1985, Ciaglia et al[5] first described a method of percutaneous dilatational technique, using multiple dilators, over Seldinger wire, which was safe and simple. A commercial kit using this technique became available, and the procedure carried low short-term, as well as long-term complication rates.[6] Another technique of percutaneous tracheostomy using a guidewire dilating forceps was later described by Griggs et al,[7] which has also been applied in another commercial kit. Routine use of bronchoscopic guidance has been suggested

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by the kit manufacturers, and some authors.[8–10] However, the use of bronchoscopy is cumbersome and may result in difficulty in maintaining proper ventilation and even result in loss of airway.[11,12]

A modification of the technique, performed by surgeons and using a limited blunt dissection of the subcutaneous and pretracheal tissues, has been described and has been shown to be safe without routine bronchoscopic guidance.[13] This procedure can be performed at the patient's bedside, without the need of the operating room. We prospectively assessed this technique in a university hospital setting, to further evaluate the safety and effectiveness of the technique of combining a limited blunt dissection and the "Seldinger over the wire percutaneous tracheostomy," using both commercially available kits.

## Materials and Methods

Between July 2000 and December 2002, all patients who required an elective tracheostomy due to prolonged mechanical ventilation underwent modified percutaneous tracheostomy (MPT) without patient selection. Both commercially available kits were used: The kit using Griggs technique (Portex Limited; Hythe Kent, UK) that uses an "over the guidewire" dilating forceps, and the kit using Ciaglias technique (Blue Rhino; Cook Critical Care; Bloomington, IN) that uses a single curved cone shaped dilator over the Seldinger wire. It is important to stress that the Cook "Blue Rhino" kit does not include the tracheostomy tube, so tubes of different lengths can be used, while in the Portex kit, one tube of conventional length is included that must be used due to the kit design. In patients who need longer tubes due to body habitus or edema, it may be impossible to use the conventional Portex kit (Portex kits of different lengths are not currently available to us).

The procedure was performed at bedside, either in the ICU or in the various hospital departments, without transporting the patient to any other facility. The procedure was performed by one attending surgeon or by a surgical resident under the guidance of the attending surgeon. When the procedure was performed in the ICU, an anesthetist was present and manipulated the endotracheal tube. When the procedure was performed in other departments, another surgical resident managed the tube. Sedation was achieved by incremental doses of propofol, until desired sedation was obtained. All patients had continuous monitoring of BP, heart rate, respiratory rate, and oxygen saturation. Diathermy was not used. Mechanical ventilation was maintained throughout the procedure with mandatory mechanical ventilation and a fraction of inspired oxygen of 1.0. The patients were followed up prospectively with regard to complications: bleeding, failure to cannulate or to intubate the trachea, loss of airway, inadequate ventilation, and injury to the surrounding structures.

### *Operative Technique*

With the patient in the supine position, and the neck mildly hyperextended, the anterior neck is prepared with chlorhexidine solution and alcohol. A midline, vertical, 2-cm incision is made just above the suprasternal notch to allow insertion of the operator's index finger through the incision (Fig 1). Using a hemostat, the subcutaneous tissues are dissected bluntly down to the pretracheal fascia. The trachea is then manually palpated. The endotracheal tube cuff is deflated and retracted under guidance of the finger palpating the trachea. The retraction of the tube is easily felt by the operator's finger, and then the cuff is re-inflated (Fig 2). The angiocath included in the kit is introduced into the trachea, between the second and third tracheal rings under the guidance of the operator's finger palpating the trachea, and airflow in the syringe confirms the right position of the angiocath tip (Fig 3). The needle is withdrawn, leaving only the cannula tip inside the trachea. The Seldinger wire is introduced through the cannula and the dilator is advanced over the wire, while the wire is firmly anchored to avoid sliding of the dilator over the wire and injury to the surrounding structures. Depending on which kit was used, either the guidewire dilator forceps or the long cone-shaped dilator is advanced, dilating the

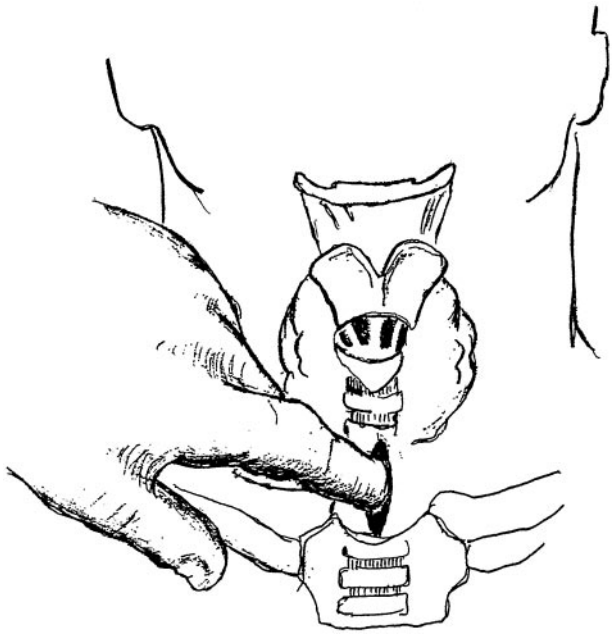

Figure 1. A midline, vertical, 2-cm incision is made just above the suprasternal notch to allow insertion of the operator's index finger through the incision.

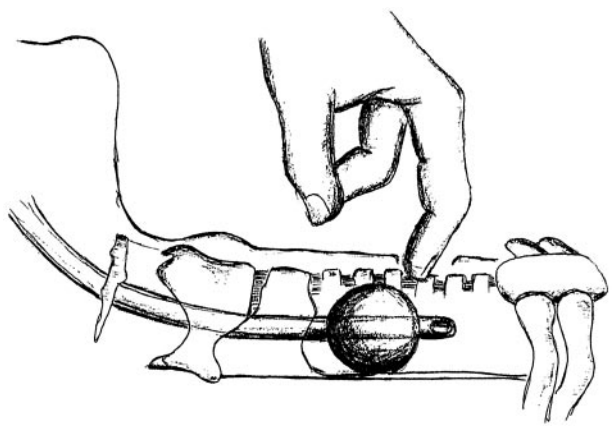

Figure 2. The retraction of the tube is easily felt by the operator's finger, and then the cuff is re-inflated.

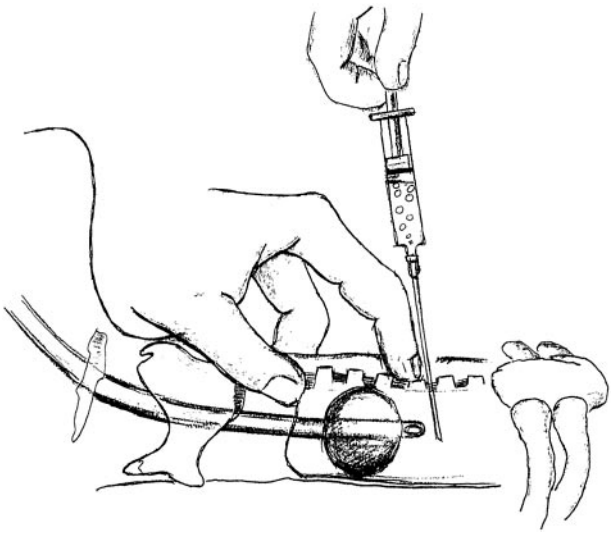

FIGURE 3. The angiocath is introduced into the trachea, between the second and third tracheal rings under the guidance of the operator's finger palpating the trachea, and air flow in the syringe confirms the right position of the angiocath tip.

opening on the anterior trachea, and then the tracheostomy tube is inserted. The correct positioning of the tube is confirmed either by end-tidal volume carbon dioxide monitoring, when available, or simply by the end-expiratory volume in the respirator. The tube is then secured in place by silk sutures to the skin. A chest radiograph is routinely performed after the procedure.

## RESULTS

Between July 2000 and December 2002, 61 tracheostomies were performed by our surgical service using the MPT technique. In 9 tracheostomies, the Ciaglias technique kit was used; in the remaining 52 tracheostomies, the Griggs technique kit was used. Seventeen patients underwent the procedure bedside at the different hospital departments, and 44 patients underwent the procedure in two ICUs. No patients were transferred or moved from their original department for the procedure.

In three patients, MPT was deferred: in one patient due to cervical venous engorgement in the area of the skin incision, and in the other patient because of morbid obesity and subcutaneous edema, which did not allow effective blunt dissection for the trachea to be felt. Both patients were transferred to the operating room, and operated on in the conventional way. In a third patient, a longer tube was required due to body habitus. The tube included in the Portex kit was not long enough; since the Cook kit was not available at that time, the operation was converted to the open procedure so a longer tube could be inserted. In one patient, persistent bleeding from the subcutaneous tissues required revision in the operating room, where a small subcutaneous artery was ligated. No other operative complications related to the procedure were observed, and loss of airway did not occur in any of the patients. No pneumothorax occurred. In three patients, early dislodgement of the tube occurred, within 48 h, after the operation using the Portex kit. They were immediately intubated and placed on ventilation; later, a new tube was inserted, one percutaneously while the other two required an open exploration in the operating theater. Twenty-three patients died in the hospital during the same admission due to their original diseases.

In 34 patients, the cannulas were removed after a mean of 16 days. Two patients required mechanical ventilation again after the cannula was removed. Both patients were intubated, and new cannulas could be inserted by the same technique. Five patients eventually required a permanent tracheostomy. In one patient, MPT was performed 3 years after a previous tracheostomy was performed. In spite of the scarring, the procedure was completed without complications. No patient selection concerning body habitus, general condition, or obesity was done, but for one patient cited before who had massive subcutaneous edema.

After the initial 10 procedures, performed by one attending surgeon (H.P.), all the following MPTs were performed by surgical residents, under the attending surgeon's guidance. Usually, after 6 to 10 procedures performed under guidance, the resident could perform MPT alone. It is important to stress that all residents had performed open-neck operations before they started performing MPT.

## DISCUSSION

Percutaneous tracheostomy has several advantages over the conventional surgical operation. It is simpler, less expensive, and can be performed bedside without moving the patient.[14] This is especially important in cases in which the patient's condition is critical, and moving him or her to and from the operating theater is cumbersome and even dangerous. Several reports, however, have described the percutaneous technique to be dangerous when performed by inexperienced personnel.[11] Injury to the adjacent structures including the great vessels of the neck and the esophagus have been reported, as well as paratracheal insertions and "high tracheostomies," with the potential of long-term complications.[15–18] These complications led several authors to advocate the routine use of a bronchoscope to confirm the right positioning of the guidewire and the tube.[8,19] Others, however, have shown that bronchoscopy

during the procedure can result in hypercarbia, respiratory acidosis, and even increased intracranial pressure.[12,20] Lately, the routine use of bronchoscopy has been challenged.[21,22] Indeed, when the procedure adopted is strictly percutaneous, by blind puncture (*ie*, without the dissection up to the pretracheal fascia), guidance by the bronchoscope is probably warranted since the trachea can be easily missed, especially in obese patients. Bronchoscopy in this setting facilitates endotracheal tube positioning, and confirms the right placement of the guidewire and the tube. The blind percutaneous method is used especially by personnel without surgical skills and experience, making bronchoscopic guidance important. A modification of the blind percutaneous puncture has been described, in which limited blunt dissection of the subcutaneous tissues is performed before the puncture is done.[13] The tracheal rings can then be easily palpated, so the needle can be inserted safely in the right place.

In the present study, we prospectively evaluated this method, performed over a 30-month period, by our surgical service. During this time period, 61 procedures were attempted. In three patients (4.9%), the percutaneous procedure was deferred due to anatomic problems: cervical venous engorgement in one patient, and difficulty in the dissection in another patient. In the third patient, the trachea could be felt, but the tube from the kit was not long enough. This problem does not occur with the Blue Rhino kit since tubes of different length can be used. One patient had persistent bleeding, requiring revision of the incision in the operating room. No other procedure-related complications were reported. In three patients, early tube dislodgement occurred; whether this was related to the percutaneous procedure is debatable. Bronchoscopic guidance was not used. No long-term complications were reported, but the follow-up is relatively short.

In conclusion, the above-described modification of the percutaneous technique is simple and safe when performed by personnel with surgical training and knowledge of the surgical anatomy of the neck. It is relatively easy to learn and has low morbidity rates. The method is presently our method of choice for patients who need elective tracheostomy for prolonged mechanical ventilation.

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