Preliminary Report

Percutaneous Dilatational Tracheostomy with Bronchoscopic Guidance: Ramathibodi Experience

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Background: *Tracheostomy is considered as the airway management of choice for patients in the ICU who require prolonged mechanical ventilation or airway protection. Percutaneous dilational tracheostomy (PDT) was first described in 1985 and now is a well-established procedure that can be performed at the bedside by a pulmonologist with less surgical equipment required.*
Design: *A retrospective analysis.*
Material and Method: *Twelve patients underwent PDT because of prolonged endotracheal intubation between March and December 2006. The procedures were done by using bedside percutaneous dilatation tracheostomy with guidewire dilator forceps (GWDF) technique with bronchoscopic guidance under general anesthesia in either the intensive care unit or the intermediate care unit of Department of Medicine, Ramathibodi Hospital.*
Results: *There were seven men and five women with a mean age of 55.0 $\pm$ 11.8 years. Operative mortality was 0%. Procedure related complication was not found. Operation time in each case was less than ten minutes. Bronchoscopic examination performed in one of the cases after one month of tracheostomy tube removed showed no scar at the tracheostomy site.*
Conclusion: *PDT with bronchoscopic guidance is a safe and easy procedure that can be done by pulmonologist at the bedside setting.*

Keywords: *Tracheostomy, Percutaneous dilatational tracheostomy, Guidewire dilating forceps, Complication*

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Tracheostomy is considered as the airway management of choice for patients who need prolonged mechanical ventilation or airway protection. Currently, several approaches to tracheotomy are available, included conventional surgical tracheostomy (CST), percutaneous dilatational tracheostomy (PDT), and translaryngeal tracheostomy. In 1955, Shelden et al reported the first attempt to perform PDT with cutting trocar[1]. Unfortunately, their method caused multiple complications, and fatalities were reported secondary to the trocar's laceration of vital structures adjacent to the airway. Until 1985, Ciaglia et al[2] described the new PDT method, based on needle guide wire airway access followed by serial dilations with sequentially larger dilators. When compared to CST, this new technique was easier to perform, needed shorter operative time and resulted in less postoperative and perioperative complications such as bleeding and stomal infections. Recently, many types of dilators have been developed to ease operators in performing tracheostomy. Examples were serial dilators[2], forceps dilator[3,4], single tapered dilator[5] and screw-like dilator[6]. Guide wire dilating forceps (GWDF) was first described by Griggs et al in 1990[4]. It is now a well-established procedure that can be performed at the bedside with less surgical equipment when compared to CST[7]. Under bronchoscopic guidance, it provides the operator with direct visual

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information and assures that the tracheostoma is placed correctly and that possible complications are recognized early[8].

The aim of the present study was to determine the outcome of the guide wire dilator forceps PDT, under bronchoscopic guidance, with special reference to technical difficulty, duration of operation, complication, and post extubation follow-up.

Materials and Methods

Patients and equipment

This retrospective analysis included 12 consecutive patients who underwent PDT for prolonged mechanical ventilation from March through December 2006 in the medical ICU or Intermediate Care Unit of Ramathibodi Hospital. Abnormal neck anatomy, uncorrectable coagulopathy, hemodynamic instability, or excessive ventilatory requirements were considered contraindications to PDT. All patients or their family gave informed consent for this procedure. All tracheostomies were performed with a kit (Portex; Hythe, Kent, UK) with curved dilating forceps code 100/540/070-090 (Fig. 1).

Patient monitoring during tracheostomy

All PDTs were performed at the bedside in the ICU and under general intravenous anesthesia. The anesthetic induction consisted of 5 mg of midazolam and atracurium 50 mg intravenously. This was followed by continuous intravenous propofol (300 mg/hr) and atracurium (30 mg/hr) for maintenance phase. All patients were pre-oxygenated with 100% oxygen for 5-10 minutes and vital signs, pulse oxymetries, and electrocardiograms were continuously monitored throughout the procedure. Two physicians were involved in the procedure, one took care of the airway and operated the bronchoscopic guidance while the other performed PDT.

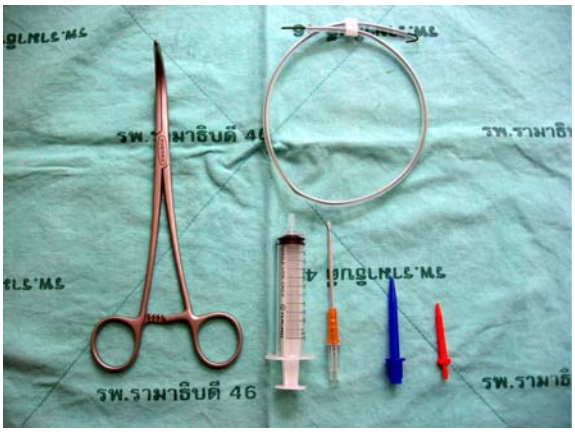

Fig. 1 Percutaneous tracheostomy kit (Portex; Hythe, Kent, UK) with curved dilating forceps code 100/540/070-090

Procedure and follow-up

The patient's neck was placed in a slightly extended position. Tracheostomy site was marked and a horizontal skin incision was made (1.5-2.0 cm) between first and second or second and third tracheal rings. After suctioning of the oropharynx, the endotracheal tube was pulled back until tip of endotracheal tube was well above the tracheostomy site-which could be identified easily with the help of the bronchoscopic light. The trachea was then punctured using an 18-gauge sheathed needle (needle catheter). Correct position of the needle was in the middle of the anterior tracheal wall, which could be confirmed bronchoscopically. The metallic needle was removed and flexible guide wire was inserted through the catheter lumen into the trachea. This was followed by catheter removal, leaving the guide wire as a bridge from skin incision and trachea punctured site into the tracheal lumen. By using the Seldinger technique under guide wire direction, the tracheal punctured lumen was pre-dilated using the provided dilator. This was followed by serial curved-forceps dilatations (in horizontal directions) until the desired tracheal punctured size was achieved, thus facilitated the final insertion of tracheal cannula or tracheostomy tube. To avoid possible injury to the posterior tracheal wall, continuous bronchoschopic monitoring was performed throughout the entire procedure. Bronchoscopic examination through tracheostomy tube was the final step to ensure correct position of tracheostomy tube in the tracheal lumen.

Data collection and analysis

Data collected included demographic information, duration of the procedure and vital signs before and after the procedure. The success rate, efficacy, safety, and outcome, as well as short-term and long-term complications, including site infection and bleeding, were also carefully monitored and recorded.

Statistical analysis

Continuous variables were calculated to obtain their mean values and standard variations, while categorical variables were reported as proportions. All data were analyzed with a statistical software package (SPSS, version 11.5 for Windows; SPSS Inc; Chicago, IL).

Table 1. Characteristics of 12 patients

No.	Age (yrs), sex	Cause of respiratory failure	Duration of orotracheal intubation prior to tracheostomy (days)	Operative result	Complication	Decannulation	Days decanulated (days)	Hospital outcome
1	47, M	Pneumonia	26	success	none	yes	19	survived
2	61, M	CVA	23	success	none	no		survived
3	69, M	Pneumonia	28	success	none	no		survived
4	50, M	Sepsis	25	success	none	no		died
5	44, F	Pneumonia	9	success	none	no		died
6	46, F	Myasthenia gravis	32	success	none	no		survived
7	63, M	Lung cancer	33	success	none	no		died
8	63, M	Subglottic stenosis	8	success	none	no		survived
9	44, M	Pneumonia	25	success	none	no		survived
10	36, F	Botulinum intoxication	14	success	none	yes	16	survived
11	66, F	COPD	30	success	none	no		survived
12	72, F	Post cardiac arrest	7	success	none	no		died
Mean $\pm$ SD		55 $\pm$ 11.8	21.6 $\pm$ 9.5					

M: Male, F: Female, CVA: cerebrovascular accident, COPD: chronic obstructive pulmonary disease
SD = Standard deviation

Results

The 12 patients who underwent PDT included seven men and five women, with the mean age of ($\pm$ SD) 55.0 $\pm$ 11.8 years (Table 1). The mean duration of orotracheal intubation prior to tracheostomy was 21.6 $\pm$ 9.5 days. The indication for tracheostomy was prolonged mechanical ventilation from a variety of medical conditions (Table 1).

All PDTs were performed without technical difficulties. There were no procedure failures. The operative time, as defined by the time spent from first puncture of the trachea to the successful insertion of the tracheostomy tube and connection to the respirator, was less than 10 minutes. The correct position of the tracheal cannula was achieved in all patients.

There was no significant desaturation, nor violations of vital signs throughout the procedure. Complications such as major bleeding, posterior tracheal wall injury, pneumothorax, or death because of the procedure were not observed.

The patients were followed until death or decannulation. Four patients died prior to decannulation, mainly from their basic diseases. Fiberoptic bronchoscopy performed one month after decannulation, in one of the two decannulated cases, showed no scar at the tracheostomy site (Fig. 2). There was no stomal infection in the present study.

Discussion

Tracheostomy is one of the most commonly performed surgical procedures in critically ill patients who require long-term mechanical ventilation. This procedure has been traditionally performed in the operating room using CST. In 1985, Ciaglia et al described an alternative method in which tracheostomy could be performed percutaneously, using a Seldinger

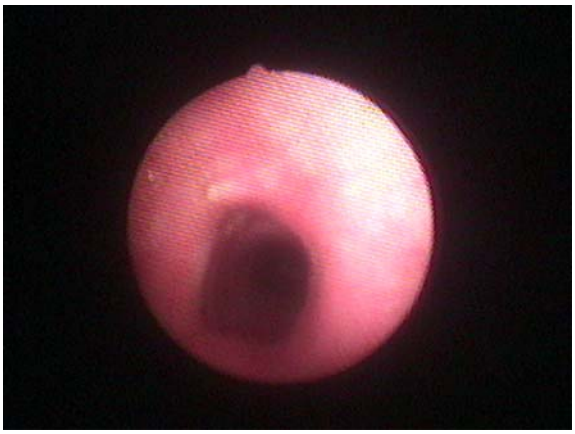

Fig. 2 Fiberoptic bronchoscopy performed in one of two cases who were successfully decannulated showing no scar at the tracheostomy site

approach[2]. Compared to CST, PDT has a number of potential advantages. The procedure is relatively simple to learn and perform[9]. In addition, PDT may be performed at the patient's bedside with a limited number of personnel. This eliminates the potential risks associated with transporting a critically ill patient, as well as the inconvenience and expense of scheduling and utilizing operating room facilities. Because of these advantages, PDT is gaining an increasing popularity nowadays[10].

The mean operative time of less than 10 minutes in this study was similar to experiences from previous reports[7,11,12]. On average, time used in performing PDT was approximately 10 minutes less than the CST[13]. This resulted in a shorter duration and a lesser chance of hypoxic exposure during tracheostomy procedure - a major risk in critically ill patient.

The previously reported early PDT-related complications included major bleeding, paratracheal insertion, posterior tracheal wall injury, subcutaneous emphysema, and pneumothorax[12-16]. These complications, however, was not found in our study. This might result from the bronchoscopic guidance, which provided the operator with direct visual information assuring the correct placement of tracheostoma and avoiding possible complications. In the present day, many authors recommended the use of fiberoptic bronchoscopic guidance as a part of PDT[8,12,17].

Tracheostomy procedure was one among many factors leading to the occurrence of late complication of tracheal stenosis[18]. Polderman et al found the incidence of clinically significant tracheal stenosis was 5% in patients performed CST, compared to 0% in the PDT group[19]. In general, PDT appeared to be a less traumatic procedure. The skin incision required in PDT is smaller than in CST. Furthermore, PDT acquired tracheal opening (tracheostoma) by dilating the soft tissue space between tracheal rings, instead of direct cutting through cartilagenous rings as in CTS. Lesser incidence of tracheal stenosis at stomal site would therefore be expected. This was confirmed bronchoscopically in one of the presented cases who were able to decannulate and showed no scar formation at the stomal site.

Until this day, various dilators were developed in order to ease the operators in performing PDTs. Kaiser et al compared two methods of PDT: the Ciaglia progressive dilatational tracheostomy and the Griggs forceps dilatational tracheostomy[20]. They concluded that progressive dilatational tracheostomy took a longer operative time, caused more hypercapnia and more minor and major difficulties than forceps dilatational tracheostomy. Fikkers et al, in two series, studied the effects of Griggs' GWDF technique and the single tapered dilatation technique (Ciaglia Blue RhinoTM) in a large number of patients. They found both methods to be equally safe and effective[21]. Complications of PDT, however, were likely to occur during the process of learning each individual technique - the 'learning curve' rather than the type of technique itself [22].

In summary, PDT with bronchoscopic guidance is a safe and easy way to perform procedures, that can be done by pulmonologist in a bedside setting.

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การเจาะคอด้วยวิธี percutaneous dilatational tracheostomy โดยใช้กล้องส่องหลอดลมนำตำแหน่ง: ประสบการณ์ที่โรงพยาบาลรามาธิบดี

วิบูลย์ บุญสร้างสุข, สุมาลี เกียรติบุญศรี, สไบทิพย์ จูฑะกาญจน์

ภูมิหลัง: การเจาะคอเป็นหัตถการที่จำเป็นในผู้ป่วยที่ได้รับการใส่เครื่องช่วยหายใจเป็นเวลานาน หรือเพื่อป้องกันการสำลัก การเจาะคอโดยวิธี percutaneous dilatational tracheostomy เริ่มมีรายงานครั้งแรกตั้งแต่ปี พ.ศ. 2528 และปัจจุบันได้รับการยอมรับอย่างแพร่หลายว่าสามารถทำได้ง่าย ใช้เครื่องมือน้อย และทำได้ที่ข้างเตียง

รูปแบบการศึกษา: เป็นการศึกษาย้อนหลัง

วัสดุและวิธีการ: ตั้งแต่เดือนมีนาคมถึงธันวาคม ปี พ.ศ. 2549 มีผู้ป่วย 12 รายได้รับการเจาะคอโดยวิธีนี้ การเจาะคอกระทำที่ข้างเตียงโดยเทคนิค percutaneous dilatation tracheostomy guidewire dilator forceps โดยใช้กล้องส่องหลอดลมนำตำแหน่ง ผู้ป่วยทุกรายได้รับการให้ยาสลบโดย general anesthesia และทำในหอผู้ป่วย ICU และ intermediate care unit ของภาควิชาอายุรศาสตร์

ผลการศึกษา: ผู้ป่วยที่ได้รับการเจาะคอโดยวิธีนี้ เป็นผู้ป่วยชาย 7 คน และหญิง 5 คน อายุเฉลี่ย 55.0 $\pm$ 11.8 ปี ไม่พบผู้ป่วยเสียชีวิตหรือผลแทรกซ้อนจากการทำหัตถการ ระยะเวลาในการทำในแต่ละราย ใช้เวลาน้อยกว่า 10 นาที ได้มีการทำการส่องกล้องหลอดลมในผู้ป่วย 1 รายซึ่งสามารถถอดท่อช่วยหายใจออกได้ภายหลัง ไม่พบว่ามีรอยแผลในหลอดลม ณ จุดที่ทำการเจาะคอนั้น

สรุป: การเจาะคอโดยวิธี percutaneous dilatational tracheostomy โดยใช้กล้องส่องหลอดลมช่วยนำตำแหน่งเป็นหัตถการที่ปลอดภัย สามารถทำได้ง่ายที่ข้างเตียงผู้ป่วย