Experience of Percutaneous Dilatational Tracheostomy by using Grigg's Technique in Siriraj Hospital

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Background: *Percutaneous dilatational tracheostomy (PDT) was increasingly performed after the commercial kit was available in 1985. Several studies showed that PDT was equivalent to surgical tracheostomy considering perioperative and long-term complications and PDT was more cost-effective and provide greater feasibility in terms of bedside capacity and nonsurgical operation.*

Material and Method: *The data of patients who were performed PDT at Division of Respiratory Disease and Tuberculosis, Department of Medicine, Faculty of Medicine Siriraj Hospital were retrospectively reviewed since March 2007 to December 2011. All procedures were done at bedside in intensive care unit or general ward of internal medicine under intravenous anesthesia. PDT was performed by using Griggs' technique. This technique is based on Seldinger guidewire technique and uses the guidewire dilator forceps (GWDFs) to enlarge the hole in the trachea under flexible bronchoscopic visualization.*

Results: *Ninety-one patients were enrolled with a mean age of 68 years old (range 17-100). Majority of patients had American Society of Anesthesiologist (ASA) classification 3. The most common indication for tracheostomy was failure to wean from the mechanical ventilator (68 patients; 74.7%). Fifty-two procedures (57.1%) were done at intensive care unit and 39 procedures (42.9%) were done at general ward of internal medicine. Mean duration of procedure was 18 minutes (range 5-90). The rate of perioperative complication was 11.0%. Five patients (5.5%) had desaturation and all of them were improved by short disruption of the procedure for ventilatory support. Three patients (3.3%) had moderate bleeding and one (1.1%) had excessive bleeding that were stopped by electrocauterization and pressure compression. There was 1 serious perioperative complication that was accidental extubation. No perioperative or postoperative mortality that related to procedure was found.*

Conclusion: *PDT is a safe procedure and can be performed easily and rapidly at the bedside either in intensive care unit or general ward with closed monitoring. Proper patient selection and attention to technical detail are necessary in maintaining low complication rates.*

Keywords: *Percutaneous dilatational tracheostomy, PDT, Tracheostomy, Griggs' technique, Seldinger, Guidewire dilator forceps*

J Med Assoc Thai 2013; 96 (Suppl. 2): S22-S28
Full text. e-Journal: *http://jmat.mat.or.th*

Tracheostomy is a procedure that is commonly done in patients who require prolonged mechanical ventilation. There are 2 approaches to tracheostomy: surgical tracheostomy, the traditional method, and percutaneous dilational tracheostomy (PDT). In 1957, PDT was first described[1] and increasingly performed after the commercial kit was available in 1985[2]. Several studies[3-6] showed that PDT was equivalent to surgical tracheostomy considering perioperative and long-term complications. The popular techniques are Ciaglia's and Griggs' technique that were developed in 1985 and 1990, respectively. Both techniques were safe procedure and more cost-effective; they provide greater feasibility in terms of bedside capacity and nonsurgical operation.

The present study was undertaken in order to evaluate safety and complication of percutaneous dilatational tracheostomy by using Grigg's technique.

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Material and Method

Patients

The data of patients who were performed PDT at Division of Respiratory Disease and Tuberculosis, Department of Medicine, Faculty of Medicine Siriraj Hospital were collected since March 2007 to December 2011. The data collected included demographic information of all patients, duration of procedure,

complications (perioperative, early and late postoperative complications). The definition of complications was refer as in Durbin's study[7].

Equipment

All procedures were performed with a kit and guidewire dilator forceps (Portex® Griggs™ Percutaneous Dilation Tracheostomy Kits; Smiths Medical UK). The procedure was performed under bronchoscopic visualization by using fiberoptic flexible bronchoscope (Pentax FB-15RBS, outer diameter 4.9 millimetre). The equipment was shown in Fig. 1.

Procedure

Informed consent was obtained in all patients prior to the procedure. All procedures were done at bedside in intensive care unit or general ward of internal medicine under intravenous anesthesia. The patients were preoxygenated by ventilation with 100% oxygen for at least 15 minutes before starting procedure. Blood pressure, heart rate, pulse oximetry and electrocardiograms were continuosly monitored. PDT was performed by using Griggs' technique. Patients were in supine position with the neck extended. Landmark of incision site was between 2nd and 3rd tracheal rings or 2 fingerbreadth above suprasternal notch. After skin preparation under sterile technique and local anesthesia with 1% lidocaine, a 1.5-2 cm of horizontal skin incision was done. The subcutaneous tissue was explored by blunt dissection and bleeding was stopped by electrocauterization.

The cuff of endotracheal tube (ETT) is deflated and ETT was withdrawn under brochoscopic visualization until the cuff was just below the vocal cord. The 16G needle and cannula was carefully introduced into the trachea. The position of needle was confirmed by bronchoscopy (Fig. 2). The needle was removed and the cannula was left in place. A J-tipped flexible guidewire is threaded through the cannula into the trachea based on Seldinger guidewire technique (Fig. 3). The stoma was progressively dilated by using 2 short dilators (Fig. 4A and 4B). The guidewire dilator forceps (GWDFs) were advanced over the guidewire (Fig. 5). The handle of forceps was lifted to vertical position and was opened to enlarge the tracheal stoma. The tracheostomy tube was passed over the

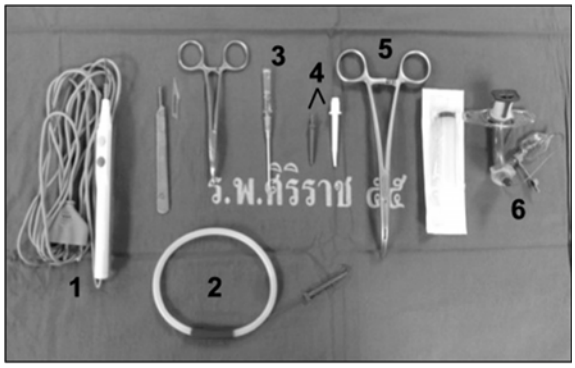

Fig. 1 Tracheostomy kit with guidewire dilator forceps (GWDFs); (1) electrocautery pencil; (2) J-tipped flexible guidewire; (3) 16G needle and cannula; (4) 2 short dilators; (5) GWDFs; (6) tracheostomy tube

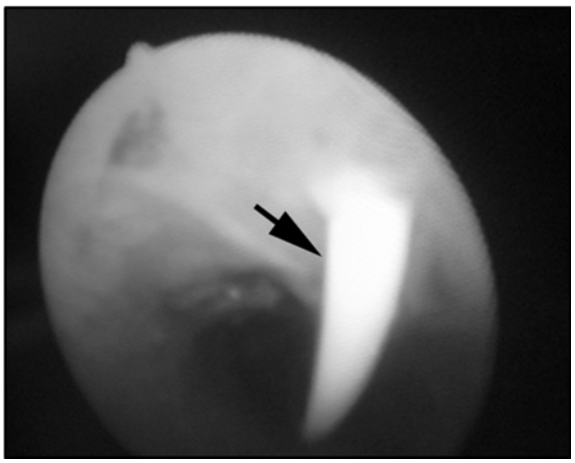

Fig. 2 The procedure was performed under bronchoscopic visualization. This figure shows the cannula (arrow) at anterior wall of trachea

Fig. 3 A J-tipped flexible guidewire (arrow) is threaded through the cannula into the trachea based on Seldinger guidewire technique

guidewire into trachea. The guidewire was removed and the position of tracheostomy tube was checked by bronchoscopy and then inflated the tracheostomy tube cuff. The tracheostomy tube and trachea were suctioned and the ventilator circuit was connected.

Statistical analysis

The present study was approved by the ethics committee of our institution. The continuous variables were presented as the mean $\pm$ SD (range). The categorical data were presented as proportions. All statistical analyses were performed using statistical software (SPSS for windows, version 13.0; SPSS; Chicago, IL).

Results

Ninety-one patients were enrolled with a mean age of 68 years old (range 17-100). There were 58 males (63.7%) and 33 females (36.3%). The majority of patients had ASA (American Society of Anesthesiologist) classification 3 (70 patients; 76.9%). Pneumonia with or without acute respiratory distress syndrome (ARDS) was the most common underlying condition (Table 1). The most common indication for tracheostomy was failure to wean from the mechanical ventilator (74.7%) and mean duration of endotracheal intubation was 18 days (range 3-59 days). Fifty-two procedures (57.1%) were done at intensive care unit and 39 procedures (42.9%) were done at general ward of internal medicine. The trachea cannot be palpated in 13 patients (14.3%). Mean time from consultation to date of procedure was 1.8 days (range 1-10 days) and mean duration of procedure was 18 minutes (range 5-90 minutes) (Table 2).

The rate of perioperative complications was 11.0% (Table 3). Five patients (5.5%) had desaturation and all of them were improved by short disruption of the procedure for ventilatory support. There were 2 serious perioperative complications; one was inadvertent extubation (1 patient) during the endotracheal tube (ETT) was withdrawn and the other was excessive bleeding. In a case of inadvertent extubation, the new ETT was then reinserted and the procedure was continued. One patient had excessive bleeding that was stopped by electrocauterization and pressure compression. There was 1 case that had minimal continued bleeding in the first day of postoperation. Bleeding was stopped by topical application of gauze with adrenaline. There was 1 serious postoperative complication which was inadvertent decannulation of tracheostomy tube in the second day of postoperation. ETT was then inserted with ventilatory support and PDT was re-performed in the next day. No perioperative or postoperative mortality that related to procedure was found.

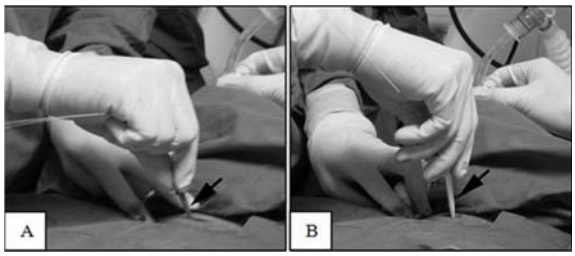

Fig. 4 (A & B) The stoma was progressively dilated by using 2 short dilators (arrows)

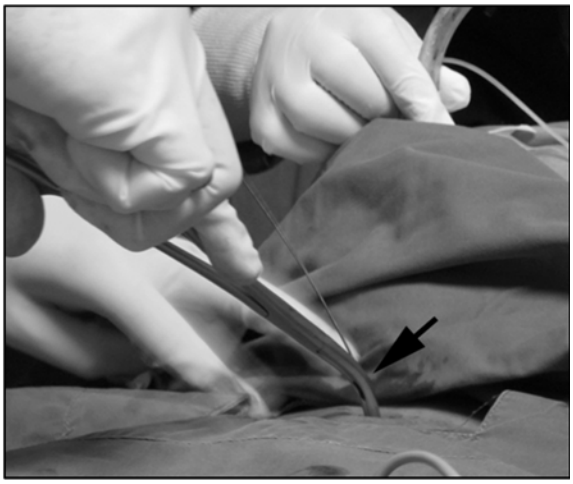

Fig. 5 The guidewire dilator forceps (arrow) were advanced over the guidewire

Discussion

Percutaneous dilatational tracheostomy (PDT), first described in 1957[1], is a minimally invasive procedure alternative to surgical tracheostomy. The advantages of this technique over surgical tracheostomy include less tissue damage, lower risk of bleeding and wound infection and ability to be performed at the bedside[8] that reduces the risk of patient's transportation. PDT has been shown to reduce the cost of tracheostomy compared with surgical tracheostomy[9]. There were several techniques of PDT described. The popular techniques are the Ciaglia's and the Griggs' techniques that were developed in 1985 and 1990, respectively. Anon and Gomes[10] compared Ciaglia and Griggs method in 63 critically ill patients,

Table 1. Patient's characteristic

Baseline characteristic	n (%)
Number of patients	91 (100)
Age (years)	68 ± 19.5 (17-100)*
Sex	
Male	58 (63.7)
Female	33 (36.3)
ASA** classification	
2	10 (11.0)
3	70 (76.9)
4	11 (12.1)
Underlying conditions	
Pneumonia with or without ARDS[#]	70 (76.9)
ARDS (not caused from respiratory tract infections)	2 (2.2)
COPD[##] with acute exacerbations	5 (5.5)
Neuromuscular diseases	5 (5.5)
Post cardiac arrest	4 (4.4)
Neurologic disease and unable to protect airway	5 (5.5)

* Mean ± SD (range)
** ASA = American Society of Anesthesiologist
[#] ARDS = acute respiratory distress syndrome
[##] COPD = chronic obstructive pulmonary disease

Table 2. Procedure

Variables	n (%)
Duration of endotracheal intubation (days)	18 ± 9.1 (3-59)*
Site of patient's care	
General ward	39 (42.9)
Intensive care unit	52 (57.1)
Indication of tracheostomy	
Failure to wean	68 (74.7)
Inability to protect airway	18 (19.8)
Airway support in patient with neuromuscular disease	5 (5.5)
Time from consultation to date of procedure (days)	1.8 ± 1.6 (1-10)*
Tracheal position	
Direct visible and easily palpated	7 (7.7)
Easily palpated (< 1 centrimeter depth)	43 (47.3)
Hardly palpated (1-3 centrimeter depth)	28 (30.8)
Cannot be palpated (> 3 cm depth)	13 (14.3)
Duration (minutes)	18.0 ± 11.9 (5-90)*

* Mean ± SD (range)

and found no significant difference in the rate of complications between the two groups.

The present study shows that PDT had a short duration from consultation to date of procedure. This may shorten duration of weaning from mechanical ventilation and hospital stay. All procedures were performed at the bedside in either intensive care unit or general ward. But the monitoring facility at the site of procedure should be considered. The procedure can be performed even a trachea cannot be easily palpated with a carefully located landmark and explored subcutaneous tissue. The mean procedure time was 18

Table 3. Complications of PDT

Variables	n (%)
Perioperative complications	10 (11.0)
Bleeding	
Moderate bleeding (any bleeding considered abnormal)	3 (3.3)
Excessive bleeding (more than 20 ml estimated blood loss)	1 (1.1)
Inadvertent extubation	1 (1.1)
Desaturation (pulse oximetry < 90% for more than 30 seconds)	5 (5.5)
Early postoperative complications	6 (6.6)
Bleeding	
Minimal change of dressing	4 (4.4)
Minor continued bleeding	1 (1.1)
Inadvertent decannulation	1 (1.1)
Late postoperative complications	2 (2.2)
Local inflammation	1 (1.1)
Local cellulitis or pus	1 (1.1)

minutes. One patient had a long procedure time (90 minutes) due to difficulty in identifying the trachea and there were many attempts to insert the tracheostomy tube. This patient had a hardly palpated trachea and had a short duration of desaturation that was improved by short disruption of the procedure.

In the previous studies[11-14], the perioperative complication rate varied between 4%-25% because it depended on the definition of complications used in each studies. Kearney et al[15] performed PDT in 824 patients by using Ciaglia's technique. They reported the mortality rate was 0.6%. The overall complication rate was 15% and the majority of these were minor complications. The perioperative and early postoperative complication rates were 6% and 5%, respectively. Siranovic et al[16] reported the complications of Griggs' technique in 200 patients. They found the overall early complication rate, which included perioperative and early postoperative complications, was 22.5% and no death occurred due to procedure. Major bleeding, defined as hematocrit decrease of $\geq$ 3% or required transfusion, was 0.5% and major continued bleeding, defined as requiring re-exploration to control bleeding, was 1%; this was not found in the present study. The present study shows that the overall complication rate was 19.8% and there were 3 serious complications (3.3%) that included excessive bleeding (1 patient), inadvertent extubation (1 patient) and inadvertent decannulation (1 patient). Several studies[17-19] used ultrasound of the neck to reduce the bleeding complication. There were no posterior wall injuries or tracheal lacerations or tracheoesophageal (TE) fistulae in the present study. There was a report of tracheal lacerations and TE fistula in some studies[15] and these complications can be avoided by using bronchoscopic confirmation of the needle tip or forceps position. No mortality that related to the procedure was found in the present study.

According to the results of present and previous studies, PDT is a safe procedure alternative to open surgical tracheostomy that can be performed at the bedside. However, surgical tracheostomy may be safer than PDT in some conditions, which include patients with difficulty in palpation of the anatomical landmarks (very obese, short or bull neck, enlarged thyroid gland, nonpalpable cricoids cartilage or gross deviation of the trachea) and infection or malignancy at the site of tracheostomy[8].

Conclusion

Percutaneous dilatational tracheostomy is a safe procedure and can be performed easily and rapidly at the bedside either in intensive care unit or general ward with close monitoring. Proper patient selection and attention to technical detail are necessary in maintaining low complication rates.

Potential conflicts of interest

None.

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ประสบการณ์การเจาะหลอดลมคอ (percutaneous dilatational tracheostomy) โดยใช้ Griggs' technique ในโรงพยาบาลศิริราช

ศุภฤกษ์ ดิษยบุตร, แจ่มศักดิ์ ไชยคุนา, วิรัช ตั้งสุจริตวิจิตร, อรรถ นานา

ภูมิหลัง: ปัจจุบันมีการทำการเจาะหลอดลมคอโดยวิธี percutaneous dilatational tracheostomy (PDT) มากขึ้น ซึ่งหลายการศึกษาพบว่า PDT เป็นวิธีที่ปลอดภัยและมีภาวะแทรกซ้อนน้อยไม่ต่างจากวิธี surgical tracheostomy นอกจากนี้ PDT ยังสามารถทำได้ข้างเตียงผู้ป่วยทำให้อาจลดค่าใช้จ่ายของหัตถการและลดภาวะแทรกซ้อนที่อาจเกิดขณะเคลื่อนย้ายผู้ป่วยไปยังห้องผ่าตัดได้

วัสดุและวิธีการ: เก็บรวบรวมข้อมูลย้อนหลังของผู้ป่วยที่ได้รับการเจาะหลอดลมคอด้วยวิธี PDT โดยสาขาวิชาโรคระบบการหายใจและวัณโรค ภาควิชาอายุรศาสตร์ โรงพยาบาลศิริราช ตั้งแต่เดือนมีนาคม พ.ศ. 2550 ถึงเดือนธันวาคม พ.ศ. 2554 โดยหัตถการทำแบบข้างเตียงที่หอผู้ป่วยวิกฤตและหอผู้ป่วยสามัญของภาควิชาอายุรศาสตร์ ซึ่งมีการติดตามสัญญาณชีพตลอดการทำหัตถการและให้ยาระงับความรู้สึกผ่านทางหลอดเลือดดำ และทำ PDT โดยใช้ Griggs' technique ซึ่งใช้หลักการของ Seldinger guidewire technique และใช้ guidewire dilator forceps ในการถ่างขยายผนังของหลอดลมซึ่งใช้การส่องกล้องหลอดลมเพื่อช่วยยืนยันตำแหน่งของเข็ม, guidewire และ forceps

ผลการศึกษา: รวบรวมผู้ป่วยจำนวน 91 ราย มีอายุเฉลี่ย 68 ปี (ช่วงอายุ 17-100 ปี) ผู้ป่วยส่วนใหญ่มี American society of anesthesiologist (ASA) classification เท่ากับ 3 ข้อบ่งชี้ส่วนใหญ่ของการเจาะหลอดลมคอคือการหย่าเครื่องช่วยหายใจไม่สำเร็จในผู้ป่วย 68 ราย (74.7%) และหัตถการจำนวน 52 หัตถการ (57.1%) ทำในหอผู้ป่วยวิกฤต และ 39 หัตถการ (47.9%) ทำในหอผู้ป่วยสามัญของภาควิชาอายุรศาสตร์ ระยะเวลาเฉลี่ยของการทำหัตถการเท่ากับ 18 นาที (ช่วงเวลา 5-90 นาที) พบภาวะแทรกซ้อนขณะทำหัตถการเท่ากับ 11% ซือ มีผู้ป่วย 5 ราย (5.5%) มีภาวะออกซิเจนในเลือดต่ำขณะทำหัตถการและดีขึ้นหลังจากหยุดการทำหัตถการในช่วงเวลาสั้นๆ ผู้ป่วย 3 ราย (3.3%) มีภาวะเลือดออกปานกลางและ 1 รายมีเลือดออกมากกว่า 20 มิลลิลิตรแต่สามารถหยุดเลือดได้โดยการจี้ไฟฟ้าและกดห้ามเลือด พบภาวะแทรกซ้อนรุนแรงขณะทำหัตถการ คือ ท่อช่วยหายใจเลื่อนหลุดขณะทำหัตถการจำนวน 1 ราย ไม่พบการเสียชีวิตที่สัมพันธ์กับการทำหัตถการ

สรุป: การเจาะหลอดลมคอด้วยวิธี PDT เป็นวิธีที่ไม่ยากและปลอดภัย สามารถทำหัตถการได้ข้างเตียงโดยไม่ต้องเคลื่อนย้ายผู้ป่วยไปห้องผ่าตัดและสามารถทำได้ทั้งในหอผู้ป่วยวิกฤต และสามัญภายใต้การตรวจติดตามสัญญาณชีพอย่างใกล้ชิด