ORIGINAL ARTICLE

Percutaneous Dilational Tracheostomy - A 3 Year Experience in a General Hospital in Malaysia

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Summary

All percutaneous tracheostomies performed in the general intensive care unit (ICU), Hospital Sultanah Aminah, Johor Bahru, Malaysia, from July 1999 to June 2002 were studied. The tracheostomies were performed as an elective bedside technique in the ICU.

A total of 352 percutaneous tracheostomies were performed. Eighty-eight percent of the tracheostomies were completed within 15 minutes. The most common complication was bleeding which occurred in 52 patients (14.7%). The rest of the complications encountered were:- transient hypoxia twelve (3.4%), inability/ difficulty to insert tracheostomy tube eight (2.3%), false passage four (1.1%), transient hypotension two (0.6%), pneumothorax two (0.6%), peristomal infection two (0.6%), subcutaneous emphysema one (0.3%), cuff rupture one (0.3%), oesophageal cannulation one (0.3%), and granuloma formation one (0.3%). Conversion to conventional tracheostomies were performed on 7 patients (2%). There was one unfortunate death related to percutaneous tracheostomy.

In conclusion, percutaneous dilational tracheostomy can be used safely to manage the airway of critically ill patients.

Key Words: Percutaneous tracheostomy, ICU, Airway management

Introduction

Ciaglia P et al performed the first percutaneous dilational tracheostomy (PDT) in 1985. Since then, the percutaneous approach to tracheostomy, which allows the safe bedside insertion of a cuffed tracheostomy tube between the tracheal rings under 15 minutes with technical ease and minimal tissue trauma, has gained widespread acceptance as an alternative to surgical tracheostomy since it can be performed quickly, safely and without the need to transfer critically ill patients to the operating theatre.

However, this technique is still relatively new in Malaysia, being carried out in only a few centers presently.

In Hospital Sultanah Aminah, we have been performing percutaneous dilational tracheostomy (PDT) since 1999. A prospective 3 year experience in PDT from July 1999 to June 2002 is being highlighted here.

Materials and Methods

This is a prospective observational study. Data on all percutaneous dilational tracheostomies (using dilating forcep technique) carried out at the intensive care unit from July 1999 to June 2002 were collected and analysed. There were a total of 351 patients with 352 tracheotomies. The procedure was performed by an anaesthetist posted to ICU.

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All tracheostomies were performed as an elective bedside technique in the ICU. The patients were intubated and mechanically ventilated prior to performing PDT. Routine ICU monitoring (ECG, SpO2 and invasive arterial pressures) was continued during the procedure. After adequate sedation (midazolam 0.2mg/kg), analgesia (fentanyl 1-2mg/kg) and muscle relaxation (atracurium 25 – 50mg), the patient was placed in a supine position with the neck extended, the vertebral axis maintained straight and the shoulders symmetrically elevated. The endotracheal tube was then withdrawn with the aid of a laryngoscope until the cuff was above the vocal cord. All patients were pre-oxygenated with 100% oxygen and ventilated using either pressure-controlled or volume-controlled ventilation at a rate of 12 – 15/min.

Procedure

The procedure was carried out under strict aseptic technique with mask, gloves and gown. The skin was cleaned with povidone and then alcohol before draping. The area of skin where incision was going to be made was infiltrated with bupivacaine 0.5% with adrenaline 1 in 200,000. A small horizontal incision was made at the midline between the cricoid cartilage and the suprasternal notch. Blunt dissection of the superficial tissues up to the investing fascia was performed using artery forceps. The operator then stabilized the larynx by holding it between the thumb and forefinger and introduced a 14G brannula, attached to a syringe filled with saline, into the trachea until free withdrawal of air into the syringe. The outer plastic cannula was advanced into the tracheal lumen and the inner needle and the syringe were removed. The syringe was then attached to the outer plastic cannula and there should be free filling of air into the syringe on suction. The guidewire was fed into the cannula and the plastic cannula withdrawn, leaving the guidewire in place. The dilator was passed over the guidewire and pushed to penetrate the anterior tracheal wall dilating it. The dilator was removed once free movement of the guidewire in the trachea and dilator was confirmed. A special pair of curved forceps incorporating a groove in the opposing surfaces of its jaws, was slid over the wire with the jaws closed. The forceps was then opened to dilate soft tissues and the tracheal wall and later withdrawn in the opened position. Finally the tracheostomy tube was passed over the guidewire into the trachea. The ventilator tubings were attached to the tracheostomy tube, the endotracheal tube removed, the cuff of the tracheostomy tube inflated and the chest auscultated. The position of the tracheostomy tube was subsequently verified by chest X-ray. Coagulation profile and blood urea level of all patients on the day of procedure were recorded.

The duration of the procedure from the time of skin incision to anchorage of tracheostomy tube was recorded. All patients were followed up until their discharge from hospital.

The following patients were excluded:-

1. Children < 12 years old
2. Patients with signs of bleeding
3. Patients with localized infection over the anterior neck
4. Patients with cervical injuries
5. Patients with difficult anatomy :- morbidly obese, enlarged thyroid gland or previous surgery at tracheotomy site.

Results

In the 3 year period, 352 tracheostomies were performed in 351 patients (229 male, 122 female). On average, 23.3% of mechanically ventilated patients in our ICU had tracheostomies performed. The ages of the patients ranged from 12 to 86 years (mean of 40.2). Out of the 351 patients, 169 were Malays, 84 Chinese, 71 Indians and 27 other races e.g. Indonesians.

All patients required prolonged mechanical ventilation due to a variety of underlying diseases (Table I). The majority of these patients (62.6%) had their tracheostomies performed early i.e. < 7 days (Table II).

PDT were done within 15 minutes in 309 patients (88%) (Table III). Only 7 tracheostomies (2%) took more than 30 minutes to perform as these PDT were converted to surgical tracheostomies, due to various reasons, namely inability to insert tracheostomy tubes and false passages.

Of the 351 tracheostomies, 170 patients (48.4%) died before decannulation and 164 patients (46.7%) were successfully decannulated while another 17 patients (4.8%) were transferred to another hospital with the tracheostomies.

We classified the complications of PDT according to the time of occurrence relative to the procedure as perioperative (including the operative period and first

24 hours after the operation) and post-operative till discharge from hospital (Table IV).

Bleeding was the most frequent complication. 52 patients (14.9%) had bleeding which could easily be ceased with adrenaline pack compression. However, 2 patients needed red blood cells and blood products transfusions for the bleeding to be arrested and 1 patient had a cardiac arrest due to blood blocking the endotracheal tube.

Twelve patients (3.4%) suffered transient hypoxia which did not cause any untoward effect.

Two patients (0.6%) had transient hypotension which responded to fluids.

Two pneumothorax cases were treated by closed chest drainage with percutaneous chest tube placement. Cuff rupture was solved by changing the tube over a guiding catheter placed over a guide wire.

Out of the 8 cases of inability to insert tracheostomy tube, 4 were due to false passages and all of them were converted to surgical tracheostomies. The remaining 4 cases were of unknown cause, 3 were converted to surgical tracheostomies and 1 was successfully inserted by the intensivist.

We had one patient with esophageal cannulation. She was a 58 year-old small-sized Chinese lady of 35kg weight. She had bronchiectasis with bronchopneumonia. The trachea was deviated to the right and the oesophagus overlying the vertebral column was identified as the trachea. The procedure was otherwise easily performed. The patient desaturated after the ventilator was connected to the tracheostomy tube. Fibreoptic bronchoscopy confirmed oesophageal cannulation. The patient was immediately reintubated orally and brought to OT for surgical tracheostomy and repair of perforated esophagus. She was successfully decannulated a month later.

One patient had granuloma formation. He was a 70 year-old Malay man who suffered bilateral flail chest from a motor vehicle accident. PDT was done on day 3 of ventilation which was uneventful. There was difficulty in pulling out the fenestrated tracheostomy tube on day 19 of PDT. Fibreoptic bronchoscopy revealed a thin membrane of suprastomal granulation tissue partially occluding the fenestration. Excision was done 3 days later. He was finally decannulated on day 33 of PDT.

Peristomal cellulities greater than 2 cm in diameter developed in two patients and was treated successfully by local wound care.

In all patients (164 patients) who were decannulated, the stoma closed completely within five days and often within 24 hours.

N.B. One tracheostomy was abandoned as patient arrested due to ETT blockage by blood as the trachea was dilated with a dilator.

Table I: The primary diagnosis of 351 patients

Primary diagnosis	No of patients	%
Polytrauma /trauma	100	48.1
CNS disease	45	12.8
Tetanus	4	1.1
Sepsis	63	17.9
Cardiovascular diseases	33	9.4
Asthma	13	3.7
COPD	19	5.4
Poisoning	7	2.0
GI Disease	29	8.2
Renal Failure	29	8.2
Illness related to pregnancy	9	2.6
Total	**351**	**100%**

Table II: Duration of intubation before PDT

Duration of Intubation	No of tracheostomies	%
< 7 days	220	62.6
> 7 days	132	37.5

Table III: Duration of procedure

Duration of procedure	No of PDT
< 5 min	1 (0.3%)
5 – 10 min	206 (58.7%)
> 10 min	102 (29.1%)
> 15 min	23 (6.6%)
> 20 min	12 (3.4%)
> 30 min	7 (2.0%)

Table IV: Various complications encountered in 352 tracheotomies

Complications	No of patients
Perioperative	
Bleeding	52 (14.7%)
Transient hypoxia	12 (3.4%)
Transient hypotension	2 (0.6%)
Inability / difficulty to insert tracheostomy tube	8 (2.3%)
Subcutaneous emphysema	1 (0.3%)
Pneumothorax	2 (0.6%)
Cuff rupture	1 (0.3%)
False passage	4 (1.1%)
Oesophageal cannulation	1 (0.3%)
Converted to surgical tracheostomies	7 (2.0%)
Postoperative till discharge	
Granuloma formation	1 (0.3%)
Peristomal infection	2 (0.6%)

Table V: Early and late complications of PDT

Reference	17	18	19	20	21	22	23	24	25	26	27	28	29	Total
Number of patients	55	165	22	21	71	61	36	100	53	356	411	76	141	1568
Bleeding	2	3	1	2	2	1		5	3	16	3	2	8	48
Subcutaneous emphysema	2	2						2			9			15
False passage								1		6	3	2	3	15
Premature extubation				1						6			5	12
Cuff rupture						2				1	2		1	6
Pneumothorax	1		1					2		2	3		1	10
Scar							3							3
Voice change		1								1				2
Stomal infection		1	1			1		3		2	6		2	16
Stomal granulation		1			3					2	3			9
Tracheo- oesophageal fistula		1								1	1			3
Tracheal stenosis or tracheomalacia			2				2	4		8	6			22
Death						1		1		1		2	1	6

Table VI: Bleeding and Platelet Count

Platelet count	No of patients	No of patients with bleeding	%
19,000 – 50,000	27	9	33.3%
50,000 – 100,000	66	8	12.1%
> 100,000	259	35	13.5%
Total	352	52	14.7%

Chi-square : 11.30 p = 0.003

Table VII: Bleeding and Prothrombin Time

PT Ratio	No of patients	No of patients with bleeding	No of patients without bleeding	% with bleeding	P value
Normal	50	8	42	16	
>1.00 – 1.25	150	14	136	9.3	0.3
>1.25 – 1.50	87	13	74	14.9	0.94
>1.50 – 1.75	32	5	27	15.6	0.79
>1.75 – 2.00	5	0	5	0	0.44
>2.00	28	12	16	42.9	0.02
Total	**352**	**52**	**300**		

Table VIII: Bleeding With Partial Thromblastin Time

PTT Ratio	No of patients	No of patients with bleeding	No of patients without bleeding	% with bleeding	P value
Normal	97	12	85	12.4	
>1.00 – 1.25	121	19	102	15.7	0.61
>1.25 – 1.50	68	7	61	10.3	0.87
>1.50 – 1.75	25	4	21	16.0	0.42
>1.75 – 2.00	17	7	10	41.1	0.01
>2.00	24	3	21	12.5	0.61
Total	**352**	**52**	**300**		

Discussion

Since its introduction by Ciglia et al in 1985, PDT has gained much popularity in the ICU due to its advantages: a bedside procedure, faster, more cosmetic, time saving and therefore cost saving and safer in patients with severe coagulopathies.

The experience of other investigators (Table V) and our data suggest that PDT is a safe alternative to surgical tracheostomy for the management of patients who require prolonged intubation.

The incidence of hemorrhage for PDT was 0 – 7.8% (6,8,21,22) but our results showed an incidence of 14.9% which was still lower than that for surgical tracheostomies (0.9 – 37.3%) in different series (30).

As bleeding was our main complication, we analysed the coagulation profile of those patients with bleeding and found a significant correlation between bleeding and severe coagulopathies (Table VI).

Table VI – VIII showed that there is no difference in the incidence of bleeding if the coagulopathy is not

severe. The incidence of bleeding becomes significant when PT ratio is more than 2.00, PTT ratio is more than 1.75 and platelet count is less than 50,000 x 10^3.

There was one death (0.3%) due to PDT in this series. Death due to PDT ranges between 0 and 1% in the literature. The only one death occurred in a 37 year-old Chinese male who had mitral valve prolapse with right heart failure and hepatic failure in addition to bilateral bronchopneumonia with pleural effusion. He developed bleeding during dilatation with the blue dilator. The blood tracked up the endotracheal tube and patient arrested because of hypoxia. The PDT was abandoned and he died 2 days later.

It may be possible to lower the complication rate of PDT and improve its safety. The routine use of fibreoptic bronchoscope would ensure correct puncture and dilatation of the trachea. Attention should be paid to the proper positioning of the neck and the Seldinger technique. Patients with severe coagulapathies especially patients with renal failure and hepatic failure may need the coagulopathy corrected as near normal as possible before procedure.

Conclusion

PDT is a safe alternative to surgical tracheostomy. Tracheostomy can now be performed by the bedside by the anesthetist or intensivist. However, PDT is not a procedure to be taken lightly. Training and supervision are needed and increasing experience will lower complications further.

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