Anaesth Intensive Care 2008; **36:** 69-73

Safety of percutaneous tracheostomy in obese critically ill patients: a prospective cohort study

A. S. ALDAWOOD*, Y. M. ARABI†, S. HADDAD‡

Intensive Care Unit, King Fahad Hospital, King Abdulaziz Medical City, Riyadh, Saudi Arabia

SUMMARY

Obesity has been described as a relative contraindication for percutaneous tracheostomy. The objective of our study was to examine the safety and complications of percutaneous tracheostomy in obese patients. We conducted a prospective cohort study of all consecutive patients who underwent percutaneous tracheostomy at a tertiary medical-surgical intensive care unit between May 2004 and October 2005. We compared percutaneous tracheostomy in obese patients (body mass index ≥30 kg/m^2) to non-obese patients. We documented the occurrence of the following complications: aborting the procedure, accidental extubation, conversion to surgical tracheostomy, paratracheal placement, the development of pneumothorax, major bleeding (requiring blood product transfusion or surgical intervention) or death. We also documented hypoxia, minor bleeding (requiring pressure dressing or suturing), subcutaneous emphysema and transient hypotension. During the study period, 227 percutaneous tracheostomies were performed. There were 50 percutaneous tracheostomies in the obese group and 177 in the non-obese group. In 45 obese patients, percutaneous tracheostomy was performed without bronchoscopic guidance. Major complications were significantly higher in obese patients (12% vs. 2%, P=0.04), while the rate of minor complications was not significantly different between the two groups. There were no instances of death or pneumothorax, subcutaneous emphysema or need for surgical intervention during or in the postoperative period in either group. Our study suggests that percutaneous tracheostomy can be performed safely in the majority of obese patients.

Key Words: percutaneous tracheostomy, obesity, body mass index, complication

Percutaneous tracheostomy (PT) has gained increasing popularity since the description of the Ciaglia technique in 1985[1]. It is one of the most commonly performed procedures in critically ill patients requiring long-term mechanical ventilation and it continues to replace conventional surgical tracheostomy as the procedure of choice in intubated patients[2,3]. Despite its clinical simplicity and safety, obese patients with large, thick necks are considered poor candidates for PT and are commonly referred for surgical tracheostomy placement, and are even considered as a relative contraindication because of unidentifiable neck anatomy[2,4,5].

With the increasing prevalence of obesity in the general population, it would be expected that an increasing portion of patients admitted to intensive care units (ICU) would be obese[6-8]. Few studies[4,10-12] have evaluated the safety of PT in obese patients, most of which used bronchoscopic guidance. Only one case series has reported the safety of PT without bronchoscopic guidance[13].

The routine use of bronchoscopy has been advocated as an adjunct to PT[10,14]. However, bronchoscopy has risks as well, including decreased oxygenation and ventilation, particularly in patients with severe respiratory failure; loss of the airway has also been described[15,16]. There is growing evidence supporting the fact that PT can be safely performed without bronchoscopic guidance[17].

The objective of our study was to examine the safety and complications of PT without bronchoscopic guidance in obese patients. It is hoped that this study will provide additional insight on this important issue.

*M.D., F.R.C.P.C., F.C.C.P., Assistant Professor, King Saud Bin Abdulaziz University and Program Director of Critical Care Fellowship Program, Consultant Intensive Care and Pulmonary.
†M.D., F.C.C.P. , Assistant Professor, Chairman of Critical Care Department, Consultant Intensive Care and Pulmonary.
‡M.D., C.E.S., Consultant Critical Care, Intensive Care Department.

Address for reprints: Dr A. Aldawood, PO Box 1132, Riyadh 1149, Saudi Arabia.

Accepted for publication on September 24, 2007.

METHODS

Setting

This prospective study was conducted in a 21-bed, medical-surgical ICU in an 800-bed tertiary care teaching hospital in Riyadh, Saudi Arabia. This ICU is a closed unit, run by in-house full-time board-certified intensivists, with more than 1000 admissions per year.

Patients

All consecutive patients who underwent PT between May 2004 and October 2005 were included.

Procedure

The first 29 PTs included in the study were performed using Griggs' technique (guide-wire dilating forceps) according to the methodology described elsewhere[19]. Later, the Ciaglia 'single-step' dilation technique was introduced to our unit and the remaining PTs were performed using this technique. The PT procedures were routinely performed without bronchoscopic guidance. In selected cases, bronchoscopy was used upon the discretion of the treating intensivist. Contraindication to bedside PT included visible blood vessels in the operative field, unstable cervical spine, active cutaneous infection and age less than 16 years.

Each tracheostomy was attended by two physicians, one of whom at least was a critical care consultant. Before starting the procedure, sedation and muscle relaxation were achieved through the use of intravenous agents (midazolam, fentanyl, propofol and cisatracurium) at the discretion of the treating intensivist.

Measurements

Patients were prospectively identified as being obese (body mass index [BMI] $\geq$30 kg/m^2) or not obese (BMI $<$30 kg/m^2) and the latter formed the control group. The following data were collected: age, gender, Acute Physiology and Chronic Health Evaluation (APACHE) II score[19], BMI calculated as weight (in kilograms)/height (in metres squared), the duration of mechanical ventilation prior to the tracheostomy and the coagulation profile on the day of the procedure including platelet count and International Normalised Ratio (INR).

The use of bronchoscopic guidance was documented. Complications of PT in both groups were monitored as per the definitions listed below. All patients were followed until ICU discharge or death.

Definition of complications

Complications were divided into major and minor. Major complications included aborting the procedure, accidental extubation, conversion to surgical tracheostomy, paratracheal placement, pneumothorax, major bleeding (requiring blood product transfusion or surgical intervention) or death. Minor complications included transient hypoxia (an increase in FiO_2 of $>$10% to achieve the pre-procedure oxygen saturation), minor bleeding (requiring pressure dressing or suturing), subcutaneous emphysema and transient hypotension.

Statistical analysis

Continuous data were expressed as median and interquartile range and compared using the Kruskal-Wallis test. Categorical data were expressed as a percentage and compared using the Chi square test or Fisher's exact test. Statistical significance was defined as alpha less than 0.05. Statistical analysis was performed using Minitab for Windows (release 13.1, Minitab inc, College, State, PA, U.S.A.). The study was approved by the Institutional Review Board.

RESULTS

During the 18-month study period, 227 patients underwent PT, of whom 50 were obese (BMI $>$30). Table 1 shows the characteristics of the obese and non-obese patients who had PT. There were no statistically significant differences between the

TABLE 1

Characteristics and demographics of obese and non-obese patients who underwent percutaneous tracheostomy

Variable	Obese patients	Non-obese patients	*P* value
Number of patients	50	177	
Male gender (%)	32 (68%)	142 (80%)	0.02
*Age (years)	62 (44-72)	59 (28-73)	0.14
*BMI	33.53 (31.2-36)	23.38 (20.47-26.45)	
*APACHE II	83 (65-101)	74 (60-97)	0.22
Patients with INR $>$1.5(%)	2 (4%)	12 (7%)	0.64
Patients with platelets count $<$100,000 /mm^3 (%)	5 (10%)	14 (8%)	0.65
Duration of MV prior to PD (days)	9 (8-17)	9.5 (4-12)	0.11
Extubation trial given (%)	20 (40%)	61 (34%)	0.47

* Values are expressed as a median (interquartile range). BMI=body mass index, APACHE II=Acute Physiology and Chronic Health Evaluation II, INR=International Normalised Ratio, MV=mechanical ventilation.

groups regarding age, APACHE II score, INR, extubation trial prior to PT or the duration of mechanical ventilation prior to PT. There were also no significant differences between the two groups in thrombocytopenia or prolonged INR coagulopathy in either group. The use of bronchoscopic guidance in the obese group was significantly higher than in the non-obese group (5 [10%] vs. 5 [2.8%], $P=0.04$).

TABLE 2
Perioperative complications for percutaneous tracheostomy in obese and non-obese patients

Variable	Obese patients (50 patients)	Non-obese patients (177 patients)	*P* value
Major complications			
Procedure aborted	3 (6%)	2 (1%)	0.038
Paratracheal insertion	1 (2%)	0	0.22
Surgical intervention	0	0	–
Accidental extubation	2 (4%)	2 (1%)	0.21
Major bleeding	0	0	–
Pneumothorax	0	0	–
Death	0	0	–
Total of major complications	6 (12%)	4 (2%)	0.04
Minor complications			
Minor bleeding	0	8 (5 %)	0.13
Oxygen desaturation	2 (4%)	0	0.047
Subcutaneous emphysema	0	0	–
Hypotension	0	3 (2%)	0.47
Total of minor complications	2 (4%)	11 (6%)	0.5

All values are expressed as numbers (percentages).

Complications

Table 2 shows the complications in both groups. Major complications occurred more frequently in obese patients (6/50 vs. 4/177, $P=0.04$). These complications included three incidents of aborting the procedure, two accidental extubations and one paratracheal insertion. However, none of these complications resulted in death. There were no instances of pneumothorax or subcutaneous emphysema in either group. There were no significant differences in minor complications between the obese and non-obese patients.

DISCUSSION

Our study demonstrates that PT in obese patients can be performed safely in the majority of patients. However, there is a slight but significant increased risk of major complications when compared to non-obese patients. These major complications did not result in irreversible sequelae or mortality. Minor complications did not differ between the groups. The overall complication rate in the whole cohort (obese and non-obese) was 10%, which was similar to the reported complications rate of 3 to 17%[13,20]. In our study, 50 of 227 (22%) patients undergoing PT were obese. This is consistent with a study on the percentage of obesity

TABLE 3
Studies describing complications of PT in obese patients

Authors and year	Study design	Number of patients	Definition of obesity	Use of broncho-scopic guidance	Result
Mansharamani et al[13] 2000	Case series	13	BMI 27 ≥kg/m^2	No	No significant complications in the obese patients, only one patient had paratracheal placement
Byhahn et al[4] 2005	Prospective	73	BMI ≥27.5 kg/m^2	Yes	The complications rate was significant higher in the obese group (44% vs. 18%, $P<0.001$)
Blankenship et al[10] 2005	Prospective	7	BMI >35 kg/m^2	Yes	There were no complications in the obese patients
Urwin et al[12] 2000	Case report	1	BMI=58 kg/m^2	No	No complications
Scott et al[11] 2000	Case report	3	Mean BMI 46 kg/m^2	Yes	No complications
Aldawood et al 2007	Prospective	50	BMI ≥30 kg/m^2	No	The major complications were significantly higher in obese patients; the overall complication rate as well as the rate of minor complications was not statistically significantly different between the two groups.

BMI=body mass index.

in critically ill patients[21]. Therefore, we believe that this group should not be excluded from PT because of the resource utilisation savings associated with this procedure when compared to surgical tracheostomy.

Literature about PT in obese patients is scant. Many PT studies excluded obese patients[5,13]; some considered obesity as a relative contra-indication to the performance of the procedure[2,4,5]. Existing studies that examined the safety of PT in obese patients are summarised in Table 3. Of note, these studies included small numbers of patients, had different study designs and different definitions of obesity and complications. Also, the use of bronchoscopic guidance was variable. These studies reported variable rates of complications ranging from 0 to 44%. No mortality was reported related to PT in obese patients. We believe that the variability in the complication rates is related to the above-mentioned factors. This includes the different definitions of complications. Additionally, retrospective studies may under-estimate complication rates compared to prospective studies.

Whether bronchoscopy provides a significant advantage to treatment requires further study. Most recommendations are based on observational studies and expert opinions. To date, there is no multicentre randomised controlled trial comparing the safety of bronchoscopic and non-bronchoscopic-guided PT in high-risk patients such as those with obesity. Several studies[16,17,21-23] have demonstrated the safety of PT without bronchoscopic guidance.

Our study has several strengths. It included a large cohort of patients with prospective data collection, with clear definition of complications. This ICU is run under a closed system and is staffed mainly by Critical Care Board certified intensivists, which increases the homogeneity of clinical management. This ICU has a long-standing history of performing PT. However, it should be noted that as a potential limitation, the study was conducted at a single centre.

CONCLUSION

Our study suggests that PT can be performed safely in the majority of obese patients. Depending on this, it might be possible to suggest that bronchoscopy is a safety issue either in a positive or negative sense. As it stands, data to make conclusive comments about this is not available at this time.

REFERENCES

1. Ciaglia P, Firsching R, Syniex C. Elective percutaneous dilatational tracheostomy. A new simple bedside procedure: preliminary report. Chest 1985; 87:715-719.
2. Freeman B, Isbella K, Lin N, Buchman T. Meta analysis of prospective trials comparing percutaneous and surgical tracheostomy in critically ill patients. Chest 2000; 118:1412-1418.
3. Honan D, Malkan D, Tierney E. Confirming tracheal cannulation during percutaneous tracheostomy without endoscopic guaidance. Anaesthesia 2003; 58:1027-1028.
4. Byhahn C, Lischke M, Meininger D, Halbig S, Westphal K. Perioperative complication during percutaneous tracheostomy in obese patients. Anaesthesia 2005; 60:12-15.
5. Bardell T, Drover J. Recent developments in percutaneous tracheostomy: improving techniques and expanding roles. Curr Opin Crit Care 2005; 11:326-332.
6. Pi-Sunyer FX. Health implications of obesity. Am J Clin Nutr 1991; 53 (6 Suppl):1595s-1603s.
7. Flegal KM, Graubard BI, Williamson DF, Gail MH. Excess death associated with underweight, overweight, and obesity. JAMA 2005; 293:1861-1867.
8. Tremblay A, Bandi V. Impact of body mass index on outcomes following critical care. Chest 2003; 123:1202-1207.
9. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among USA children, adolescents, and adult, 1999-2002. JAMA 2004; 291:2847-2850.
10. Blankenship R, Kulbersh B, Gourin C, Blanchard A. High- risk tracheostomy: exploring the limits of the Percutaneous tracheostomy. Laryngoscope 2005; 115:987-989.
11. Scott MJ, Leigh J. Percutaneous tracheostomy in three morbidly obese patients using the 'Blue Rhino' technique. Anaesthesia 2000; 55:917-919.
12. Unwin S, Short S, Hunt P. Percutaneous dilational trachestomy in the morbidly obese. Anaesthesia 2000; 55:393-394.
13. Mansharamani NG, Koziel H, Garland R, LoCicero J, Critchlow J, Ernst A. Safety of bedside percutaneous dilatational tracheostomy in obese patients in the ICU. Chest 2000; 117:1426-1429.
14. Barba CA, Angood PB, Kauder DR, Latenser B, Martin K, McGonigal MD et al. Bronchoscopic guidance makes percutaneous tracheostomy a safe, cost effective, and easy-to-teach procedure. Surgery 1995; 118:879-883.
15. Beiderlinden M, Walz M, Sander A, Groeben H, Peters J. Complications of bronchocopically guided percutaneous dilatational tracheostomy: beyond the learning curve. Intensive Care Med 2002; 28:59-62.
16. Reilly P, Sing R, Gibson F, Anderson H, Rotondo M, Tinkoff G et al. Hypercarbia during tracheostomy: a comparison of percutaneous endoscopic, percutaneous Doppler, and standard surgical tracheostomy. Intensive Care Med 1997; 23:859-864.
17. Parn H, Butnaru G, Hass I, Afanasyv A, Gutman M. Evaluation a modified percutaneous tracheostomy technique without bronchoscopic guidance. Chest 2004; 126:868-872.
18. Griggs WM, Worthley LI, Gilligan JE, Thomas PD, Myburg JA. A simple percutaneous tracheostomy technique. Surg Gynecol Obstet 1990; 170:543-545.
19. Knaus WA, Wagner DP, Draper EA, Zimmerman JE, Bergner M, Bastos PG et al. The APACHE III prognostic system: risk Prediction of hospital mortality for critically ill hospitalized adults. Chest 1991; 100:1619-1636.
20. Dongelmans D, Lely A, Tepaske R, Schultz M. Complication of percutaneous dilating tracheostomy. Critical Care 2004; 8:397-398.

21. Aldawood A, Arabi Y, Haddad S. Association of obesity with increased mortality in the critically ill patient. Anaesth Intensive Care 2006; 34:629-633.
22. Mallick A, Venkatanath D, Elliot SC, Hollins T, Nada Kumar C. A prospective randomized trail of capnography vs. bronchoscope for Blue Rhino percutaneous tracheostomy. Anaesthesia 2003; 58:864-868.
23. Maddali M, Paratap M, Fahr J, Zarroug AW. Percutaneous tracheostomy by guidewire dilating forceps technique: is bronchoscopic guidance mandatory? Middle East J Anesthesiol 2002; 16:509-519.