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Tracheostomy in the critically ill: clinical impact of new procedures

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Introduction

Tracheostomy has been used for decades in intensive care patients to establish long-term or emergency access to the airways. In fact it represents one of the most frequently performed surgical procedures in critically ill patients. Tracheostomy offers a number of practical advantages compared to conventional endotracheal intubation, like decrease of airway resistance and dead space, easy airway suctioning, improvement of the patients' comfort, avoidance of laryngeal and vocal cord injury and security of the airway. Up to now decisions on the timing of tracheostomy have been more or less based on the recommendations of a consensus conference from 1989 in which translaryngeal intubation is recommended as the method of choice for an artificial airway up to 10 days and tracheostomy is preferred when the need for an artificial airway exceeds 21 days. In contrast to these recommendations, more recently there has been some evidence in the literature that, in addition to the advantages described above, early tracheostomy might be beneficial for intensive care patients by reducing days on the ventilator, ICU stay and total hospital stay.

However, conventional surgical tracheostomy (ST) is an invasive procedure associated with a remarkable number of complications. A literature review revealed an overall incidence of complications for ST (including early and late complications) varying from 6% to 66% with a mortality rate of nearly 2%. The introduction of percutaneous tracheostomy (PT) was certainly motivated by the idea of developing a technique that can be safely and easily performed at the bedside at a substantially lower risk of post-procedure complications compared to conventional ST. Three different types of percutaneous tracheostomy technique based on commercially available kits are commonly used. The Ciaglia PDT set (Cook) using increasing sizes of dilators, the Portex PDT set (Portex) using a specially designed forceps for dilatation and the Fantoni translaryngeal tracheostomy TLT set (Mallincrodt) using a specially designed cannula consisting of a flexible plastic cone with a pointed metal tip at its end to enter and dilate the trachea from its inner lumen outwards to the skin. The growing use of these percutaneous tracheostomy techniques raises the question whether their early bedside use offers real advantages at a substantially lower risk of complications. Three crucial key points should be considered in terms of the impact of these techniques on the critically ill patient:

1. Does early tracheostomy really provide a benefit with regard to days on the ventilator, ICU stay and total hospital stay?
2. Are percutaneous tracheostomy techniques really superior to conventional ST with regard to the rate of early and late complications?
3. Is there a difference between the percutaneous techniques available with regard to early and late complications?

The following is a brief selection of studies dealing with these questions and highlighting the potential impact of these techniques on both patient care and costs.

Hill BB, Zweng TN K, Maley RH, Charash WE, Toursarkissian B, Kearney PA (1996) Percutaneous dilational tracheostomy: report of 356 patients. J Trauma 40: 238–243

This study evaluates procedure time, complications and costs of percutaneous dilatational tracheostomies (PDT) according to the Ciaglia method without fiberoptic guidance. The technique was applied in 356 cases. Operative data were prospectively collected whereas early and late complications were identified retrospectively. Two hundred thirty male and 123 female patients underwent PDT after an average history of 14 ± 8 days (range 0–60 days) with an artificial airway via a conventional endotracheal tube. The procedure-related mortality was 1 out of 356 (0.3 %) and the overall complication rate 19 % (69/356). In 9 % of the patients intraoperative complications could be observed. Premature extubation of the conventional endotracheal tube and paratracheal dilatation (each in 2 % of the cases) could be identified as the most common complications during the procedure. The follow-up in 258 of these patients revealed an incidence of symptomatic tracheal stenosis of 3.7 % after an average cannulation time of 66 ± 97 days. This study additionally offers a literature-based comparison of complications of conventional tracheostomy (ST) versus PDT including six studies on ST and on PDT. In summary, this comparison from the literature demonstrates a markedly reduced procedure-related mortality rate (3.2 % ST vs 0.3 % PDT), stenosis rate (6.6 % ST vs 3.3 % PDT) and overall complication rate (42 % ST vs 15 % PDT).

Walz MK, Peitgen K, Thürauf N, Trost HA, Wolfhard U, Sander A, Ahmadi C, Eigler FW (1998) Percutaneous dilatational tracheostomy – early results and long-term outcome of 326 critically ill patients. Intensive Care Med 24: 685–690

This prospective clinical study evaluates the perioperative and postoperative complications and long-term sequelae of 326 patients undergoing PDT according to the Ciaglia method under fiberoptic guidance. The percutaneous tracheostomy was performed in 202 male and 124 female patients after a median period of 5 days (range 0–31 days) on mechanical ventilation via a conventional endotracheal tube. In total, two procedure-related deaths (0.6 %) were observed. In 18 patients early complications (defined as < 24 h after performance) occurred, of which five were assessed as life-threatening, late complications (defined as > 24 h after performance) were observed in 14 patients, of which two were assessed as life-threatening. In total, the rate of early and late complications related to the procedure was 9.5 %. The long-term results (defined as > 6 months after decannulation) of this study are based on the analysis of 106 patients who could be recruited for the follow-up examination after an average time period of 9.9 ± 5.6 months. In 46 of 106 patients (43.4 %) a tracheal stenosis of more than 10 % was identified using a two-plane X-ray approach, but only one patient suffered clinically from the symptoms of tracheal stenosis.

Holdgaard HO, Pedersen J, Jensen RH, Outzen KE, Midtgaard T, Johansen LV, Møller J, Paaske PB (1998) Percutaneous dilatational tracheostomy versus conventional surgical tracheostomy. Acta Anaesthesiol Scand 42: 545–550

In a prospective randomized trial the study evaluates the safety and efficacy of conventional surgical tracheostomy (ST) compared to percutaneous dilatational tracheostomy (PDT) according to the Ciaglia method without fiberoptic guidance. Sixty patients selected for the study were randomized to either ST or PDT. Demographic data of the two groups showed no significant differences. In both groups the procedure was performed after an average time of conventional translaryngeal intubation of approximately 7 days (ST 168 h vs PDT 156 h). In the ST group the mean duration of the procedure was 15.5 (5–47) min compared to 11.5 (7–24) min in the PDT group. Intraoperative complications like minor bleeding were observed in 24 cases in the ST group, compared to six cases in the PDT group. Major bleeding occurred twice in the ST group and was observed in none of the PDT patients. Postoperatively minor bleeding occurred in nine of the ST patients compared to two patients of the PDT group. There was no difference in major bleeding complications (one in each group) between the two collectives. With eight versus none of the patients in the PDT group, the ST group demonstrated a markedly greater risk of developing major postoperative infections.

Ambesh SP, Kaushik S (1998) Percutaneous dilational tracheostomy: the Ciaglia method versus the Rapitrach method. Anesth Analg 87: 556–561

This prospective study compared two percutaneous dilational tracheostomy (PDT) techniques with regard to technical difficulties and complications in 80 consecutive patients. Forty patients underwent tracheostomy according to the Ciaglia method (CM), in 40 patients the Rapitrach method (RM) was used. There was no significant difference between the two groups with regard to age, gender and duration of previous translaryngeal intubation. The time observed for the tracheostomy procedure was 14 ± 5.5 min in the CM group and 6.5 ± 3.5 min in the RM group. No serious complication was observed in eihter group. A blood loss of more then 10 ml occurred in two of the CM and three of the RM patients, surgical emphysema in one patient of each group, stoma infection in one patient of the CM and two patients of the RM group. In the CM group stoma dilation was difficult to achieve in three patients whereas difficulties in cannulating the trachea occurred

in three cases in the RM group. In summary, this study did not show any significant differences between the two methods evaluated, with a markedly lower complication rate when compared to that involved in conventional surgical tracheostomy reported in the literature.

Discussion

Percutaneous tracheostomy is a technique used more and more in the intensive care setting. The simplicity of the procedure, the possibility of bedside use, a suggested lower complication rate and better cosmetic results have been considered to be the major advantages of PDT when compared to conventional ST. These considerations coincide with some evidence from the literature that early tracheostomy might be beneficial for the patient by shortening the number of days on the ventilator, on the ICU and in hospital (Rodriguez JL et al. [1990] Surgery 108:655–659 and D'Amelio LF et al. [1994] Am Surg 60:180–185). However, despite these hints from the literature and a growing trend to use PDT, the optimal timing of tracheostomy remains controversial. The studies of Hill et al. and Walz et al. report the largest series of patients to undergo PDT currently available in the literature. These studies showed the safety and efficacy of PDT in the intensive care setting, demonstrating a lower complication rate when compared to conventional tracheostomy. Both studies used the Ciaglia method for PDT, while only Walz and co-workers used fiberoptic guidance. In their prospective randomized trial comparing PDT and ST Holdgaard et al. found a significantly lower complication rate for the PDT group, thus further supporting the findings of the studies mentioned above.

The cost-effectivness data in the literature are misleading because the costs of bedside-performed PDT are mostly compared to ST in the operating theater. However, it should be standard for intensive care to perform any invasive or surgical procedure (like tracheostomy) at the bedside without transportation whenever possible (Van Natta TL et al. [1998] Ann Surg 227:618–624). Ambesh et al. could not demonstrate a difference with regard to technical difficulties and complication rate in a comparison of two different percutaneous techniques. Theoretically, damage to the posterior tracheal wall seems to be more likely with forceps dilatation when compared to the stepwise dilational procedure with specially designed dilators. In our opinion, the risk of posterior tracheal wall injury can be minimized by the standardized use of fiberoptic guidance, which should be the procedure of choice independent of the method chosen. Theoretically the method of translaryngeal percutaneous tracheostomy should cause the smallest risk of tracheal wall injury, however there is currently only one study available which evaluates this technique (Fantoni A. et al. [1997] Intensive Care Med 23: 386–392).

The reduced complication rate, which seems to be very probable, has to be further evaluated in direct comparison to conventional open tracheostomy at the bedside. Although it appears that percutaneous tracheostomy is becoming the first line method in intensive care patients, one should be aware that a lower risk does not imply a less serious consideration of indications.