# PERCUTANEOUS DILATATIONAL TRACHEOSTOMY

GM KOKSAL*, NC SAYILGAN* AND H OZ**

## Abstract

***Background:*** The aim of this study was to investigate the rate, timing, the incidence of complications of percutaneous dilatational tracheostomy (PDT) and its effects by on nosocomial pneumonia.

***Methods:*** The study is a retrospective analysis of 104 patients (56 males, 48 females) ≥18 years (54 ± 19) who had undergone a PDT for respiratory failure during the five years 1998-2003.

***Results:*** Among 238 patients requiring mechanical ventilation ≥48 hours, 104 (43.7%) required PDT. PDT was performed after 4.3 ± 2.3 days of ventilation and the disconnection from mechanical ventilation was 13.6 ± 8.5 days. Lower airway tract infection was detected in 88 patients: 55 patients (62.5%) before PDT and in 33 patients (37.5%) after PDT. The nosocomial pneumonia was observed after 5.9 ± 1.67 days of ventilation.

***Conclusions:*** Our results suggest that PDT was performed relatively early, with an acceptable complication rate and that our post-PDT nosocomial pneumonia incidence is low.

**Keywords:** Percutaneous dilatational tracheostomy; weaning; nosocomial pneumonia.

## Introduction

Percutaneous dilatational tracheostomy (PDT) is frequently

From Dept of Anaesth. & Reanimation, Istanbul Univ., Cerrahpasa Medical Faculty, Istanbul, Turkey.

* MD, Senior Resident

** MD, Prof. Dr.

Corresponder: Dr. Guniz Meyanci Koksal, E-mail: gunizkoksal@hotmail.com. PK 26 34301, Cerrahpasa Istanbul/Turkey, GSM: +90 542 413 85 05.

performed to facilitate weaning from mechanical ventilation, and to prevent damage to the oropharynx and larynx caused by prolonged translaryngeal intubation[1,2]. This group of critically ill patients includes those with chronic respiratory disorders being ventilated during an acute episode, patients in coma or with a prolonged inability to protect their airway, those with major neurological or chest trauma, upper airway abnormalities, or others unable to tolerate disconnection from the ventilator[3]. PDT has been recognized as a reliable alternative to surgical tracheostomy in patients with persistent respiratory failure[4].

The aim of this study was to investigate the rate, timing and complications of PDT and to identify the causes of nosocomial pneumonia, before and after PDT, over a 5 year period (1998-2003).

## Material and Methods

The study was a retrospective analysis conducted in a 4 bed multi-disciplinary Intensive Care Unit (ICU) in Istanbul University, Cerrahpasa Medical Faculty, of 104 patients who had undergone a PDT during the period January 1998-January 2003.

Patients consisted of 56 males, 48 females with a mean age of 54 ± 19 (range 18-92 years) and a mean APACHE II SCORE OF 18.4 ± 3.3 (range 12-26). All patients were >18 years old, in acute respiratory failure requiring endotracheal intubation and mechanical ventilation. They required PDT for persistent respiratory failure and prolonged weaning from mechanical ventilation. Indications. intraoperative and postoperative complications and the occurrence of nosocomial pneumonia were documented.

The following parameters were recorded by one of the investigators: age, gender, and diagnosis at ICU admission. The Acute Physiology and Chronic Health Evaluation II (APACHE II) scores were calculated using clinical data available from the first 24 hours of intensive care. The head of the bed was elevated to >30° during all assessments.

The diagnostic criteria for ventilator-associated pneumonia were modified from criteria established by the American College of Chest

Physicians[5].

1- A new radiographic infiltrate was prospectively defined as occurring >48 hours after the start of mechanical ventilation or ≥48 hours before PDT. Persistence was defined as the infiltrate being radiographically visible for at least 72 hours.

2- Fever was defined as an increase in the core temperature of ≥1°C and core temperature of >38.3°C.

3- Leukocytosis was defined as a 25% increase in circulatory leukocytes from baseline and a leukocyte count >$10x10^3/mm^3$.

4- Tracheal aspirates were considered purulent if a gram stain showed >25 neutrophils per high-power field.

PDT was the procedure of choice at our unit. All PDT procedures were performed by an anesthetist at the bedside in the ICU, with continuous monitoring of blood pressure, heart rate, respiratory rate and oxygen saturation. Mechanical ventilation (mandatory ventilation mode) was maintained throughout the procedure; the fraction of inspired oxygen was increased to 1.0. All patients received intravenous midazolam and rocuronium. Employing the "Seldinger technique", a guidewire was then placed below the first tracheal ring, and a stoma created with forceps (Griggs technique)[6,7]. Flexible fiberoptic broncoscopy was not routinely performed.

## Results

During the five years (1998-2003), 1131 patients were admitted to our ICU. Of these, 238 required mechanical ventilation for over 48 hours (21%) of which 104 required PDT (43.7%). The main indication for PDT was an anticipated prolonged ventilatory support. The indications for mechanical ventilation were: head injury 42 (40.4%), chronic obstructive pulmonary disease (including asthma and emphysema) 13 (12.5%), acute neurological dysfunction 29 (27.9%) and surgical procedures 20 (19.2%). PDT was performed on average at 4.3 ± 2.3 days (range, 2 to 10 days). The complications encountered during PDT are shown in Table 1.

*Table 1*

*PDT complications*

| | **Number** | **%** |
|---|---|---|
| No complications | 87 | 83.7 |
| Premature extubation | 3 | 2.88 |
| Bleeding/no transfusion | 2 | 1.9 |
| Guidewire dislodgement | 2 | 1.9 |
| Puncture of endotracheal tube cuff | 10 | 9.6 |

The mean duration of disconnection of mechanical ventilation was 13.6 ± 8.5 days (range, 5 to 120 days) in ICU.

In the pre-PDT period 55 patients (62.5%) had lower airway infections compared to 33 (37.5%) after PDT. The nosocomial pneumonia was clinically manifest at a mean 5.9 ± 67 days (range, 3 to 10 days). The frequencies of identified microorganisms in cultures of endotracheal aspirate are shown in Table 2. Complications after discharge are shown Table 3.

*Table 2*

*Frequency of identified microorganisms in cultures of endotracheal aspirate during mechanical ventilation in pre-PDT and post-PDT patients.*

| Type of microorganism | Pre-PDT | | Post-PDT | |
|---|---|---|---|---|
| | No. | % | No. | % |
| MRSA | 6 | 10.9 | 2 | 6 |
| MRSA, P. aeroginosa | 12 | 21.8 | 5 | 15 |
| MRSA, A. baumannii, P. aeroginosa | 8 | 14.5 | 0 | |
| E. bacter. spp | 1 | 1.8 | 14 | 42.4 |
| A. baumannii, MRSA | 6 | 10.9 | 0 | |
| E. bacter. spp, MRSA | 3 | 5.5 | 0 | |
| Candida Albicans | 1 | 3 | 0 | |
| E. bacter. spp, MRSA, P. aeroginosa | 2 | 3.6 | 0 | |
| Citrobacter, A. baumannii, MRSA | 3 | 5.5 | 0 | |
| E. bacter. spp, P. aeroginosa | 2 | 3.6 | 0 | |
| Klebsiella | 2 | 3.6 | 0 | |
| P. aeroginosa | 6 | 10.9 | 8 | 24.2 |
| A. baumannii | 4 | 7.2 | 2 | 6.1 |
| Haemaphilus Influenzae | 0 | | 1 | 3 |
| Total | 55 | 62.5 | 33 | 37.5 |

MRSA; Methicillin resistant staphylococcus aureus

E. bacter. spp; Enterobacteriaceae spp

P. aeroginosa; Pseudomonas aeroginosa

A. baumannii; Acinetobacter baumannii

*Table 3*
*PDT complications after discharge*

| | **Number** | **%** |
|---|---|---|
| No complications | 98 | 94.2 |
| Tracheal stenosis | 2 | 1.9 |
| Airway obstruction at decannulation | 3 | 2.9 |
| Stomal infection | 1 | 0.96 |

## Discussion

PDT is an important procedure for securing a functional and safe airway[8]. The clinical indications, the timing of the PDT procedure and the relationship between PDT and nosocomial pneumonia that identify patients at increased risk of prolonged mechanical ventilation, are not well defined.

Fischler et al[9] reported a 10% PDT rate in patients requiring mechanical ventilation for at least 24 hours, with a complication rate of 13%. Kollef et al[10] found that PDT was performed in 9.8% of all mechanically ventilated patients after a mean of 9.7 ± 6.4 days. Mansharamani et al[11] found that PDT was performed after 18.7 ± 7.46 days of mechanical ventilation with a complication rate of 4 to 17% in experienced hands. The most common complications include bleeding, subcutaneous emphysema, aspiration and stomal infection.

Some studies have suggested that PDT is associated with an increased risk of nosocomial pneumonia[12,13], although others suggest that early PDT reduces its frequency[14]. Rodriguez et al[15] showed that PDT performed within 2 days could reduce the duration of ventilation and ICU and hospital stay, and also the incidence of pneumonia rate. Lesnik et al[14] found that the mean duration of ventilatory support and the incidence of pneumonia were lower with early PDT (within the first 4 days) than late (>4 days). Blot et al[16], reported no significant differences between early (within 48 hours) and late (>7 days) PDT groups in the incidence of nosocomial pneumonia in neutropenic ICU patients, but hospital stay and ventilatory support were significantly longer in the early PDT group.

Georges et al[13], found that PDT was performed in 10.6% of all mechanical ventilated patients (1270 patients) after a mean of 17.8 ± 13.4 days. Nosocomial pneumonia occurred 8.7 ± 17.3 days after the PDT, and they showed that PDT may have contributed to the development ventilator-associated pneumonia in colonized patients. Morar et al[12] assessed the impact of PDT on colonization and infection of the lower airways.

In the current study, PDT was performed at 4.3 ± 2.3 days; its incidence among patients ventilated for over 48 hours was 43.7%. The incidence of nosocomial pneumonia was 84.6% among patients ventilated for 48 hours and more. Nosocomial pneumonia was diagnosed at 5.5 ± 1.67 days; 62.5% of cases were diagnosed before and 37.5% after PDT. These results are not consistent with the above studies[11,12,13,16].

We performed PDT early in patients requiring mechanical ventilation for more than 3 days. The gap of 1.6 days between nosocomial pneumonia diagnosis time and PDT performance time appears to contradict the low incidence of post-PDT nosocomial pneumonia. However, nosocomial pneumonia detected more than 48 hours after PDT was considered as post-PDT pneumonia, hence our low incidence. Our overall PDT rate was higher than the previous studies because our patients were mostly multi-trauma, and required prolonged ventilatory support. Our PDT complication rate of 6.3% is within the range of reported studies[9,10,11].

Georges et al[13] isolated S. aureus from the endotracheal aspirate of patients with early nosocomial pneumonia, and isolated P. aeruginosa from those with late pneumonia. Morar et al[12] isolated Haemophilus influenzea, S. aureus, A. baumonnii and P. aeruginosa from endotracheal aspirate of pre and post-PDT patients. We isolated Enterobacteriaceace spp (42.4%) from pre-PDT patients, and polymicrobial agents (21.8%) (MRSA and P. aeruginosa) from post-PDT patients. These pathogenic agents differ from those of previous studies[12,13], because of the heterogenous nature of our patients. However, in Morar's study from a pediatric intensive care unit, the patients were more homogenous[12]. The

adult and pediatric populations thus differ in their lower airway-infecting agents.

Our results suggest that our early performance of PDT in our ICU leads to acceptable intra and postoperative complication rate when compared with previous studies. Additionally, our incidence of post-PDT nosocomial pneumonia is lower than the pre-PDT.

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