Original article

Colonization and infection in tracheostomized patients at tertiary care hospital in Eastern Nepal

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Abstract

Introduction: Tracheostomy is a life saving emergency procedure and provides many benefits for long term ventilator dependent patients. However, colonization and infection of airways after tracheostomy is one of the serious complications increasing patient morbidity and mortality. **Objective:** To find out the colonizing agent in the trachea of tracheostomized patients and the type and frequency of post tracheostomy infection. **Methods:** Study was conducted in 30 consecutive, adult patients requiring either elective or emergency tracheostomy at BPKIHS, Nepal. First and second tracheal swab was obtained immediately after tracheostomy and on the seventh day. Micro-organisms isolated from the culture of tracheal swab were noted. Patients were observed for infectious complications after tracheostomy. **Results:** Eighteen (60%) tracheostomies were performed electively and 12(40%) as an emergency. Sixty-eight isolates were grown from the culture of tracheal swabs. Out of 60 tracheal swabs, nine showed sterile culture. Single micro-organism was isolated from 35(58.33%) tracheal swabs and polybacterial isolation was seen in 16(26.66%) swabs. *Pseudomonas aeroginosa* was the commonest micro-organism isolated. After *Pseudomonas, Staphylococcus aureus* in the first culture and *Acinetobacter anitratus* in the second culture was the commonest organisms isolated. Five (16.6%) patients developed stomal infection and three (10.0%) developed pneumonia as a complication of tracheostomy. **Conclusion:** Trachea of the tracheostomized patients is heavily colonized by *Pseudomonas aeruginosa, Acinetobacter anitratus* and *Staphyloccus aureus* . Stomal infection and pneumonia are the infectious complication occurring within seven days of tracheostomy.

Keywords: colonization, pneumonia, pseudomonas, stomal infection, tracheostomy

Introduction

Tracheostomy is a life saving emergency procedure and provides many benefits for long term ventilator dependent patients.[1, 2] However, colonization and infection of airways after tracheostomy is one of the serious complications increasing patient morbidity and mortality.[3, 4]

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The usual mechanism of tracheo-bronchial colonization occurs after aspiration of organisms from the colonized oropharynx.[5] Unlike this, presence of tracheostomy bypasses the nasopharyngeal defences and allows bacteria to have direct access from the stoma to the respiratory tract.[6,7] Enteric Gram negative bacteria are the organisms frequently found to be colonizing and infecting the airways of tracheostomized patients.[6,8]

Stomal infection, tracheobronchitis and pneumonia are the common infections occurring after tracheostomy.[4,6] Most of the time, infections occur only after preceding colonization by an etiological agent.[8] The knowledge of the type of colonizing agent at the tracheostomy site, therefore is very important to standardize empirical antibiotic strategies or for starting antibiotic after patient develops infections.

Studies on the microorganisms colonizing and infecting the airways of tracheostomized patients are limited in our patient population. The present study was therefore designed and conducted to find out the type of colonizing agent in the trachea of tracheostomized patients and to find out the type and frequency of post tracheostomy infection.

Methods

This study was conducted in 30 consecutive patients, age 15 years and above undergoing tracheostomy for various indications in B.P. Koirala Institute of Health Sciences, Dharan, Nepal. Patients who could not be followed for 7 days after tracheostomy either due to death or LAMA (left against medical advice) were excluded. Each patient's age, sex, associated underlying condition and type of tracheostomy were noted. Elective tracheostomy was defined as one performed under general anaesthesia in intubated patients. Emergency tracheostomy was performed in patients with respiratory distress under local anaesthesia. First tracheal swab was obtained immediately after tracheostomy by rubbing a sterile swab stick to the tracheal mucosa. Second swab was obtained on the seventh day of tracheostomy. The specimens were labeled and sent to laboratory immediately for culture and sensitivity.

Reports on micro-organism were received after 72 hours of culture. Micro-organisms isolated from the culture of tracheal swab on first and seventh day were noted. Patients were observed for seven days after tracheostomy for any infectious complications including stomal infection, tracheo-bronchitis and pneumonia.

Stomal infection was defined as an area of induration and redness with pus formation in and around tracheostomy site. Tracheobronchitis was defined as at least one of temperature >38.5°C, leucocyte count >12000/mm^3 or leucopenia <4000/mm^3 plus new onset of purulent endotracheal aspirate plus a positive bacterial count > 10^6 cfu/ml in tracheal aspirate culture. Bronchopneumonia was diagnosed by means of the same criteria for tracheobronchitis combined with the presence of a new or progressive pulmonary infiltrate on chest radiograph for more than 48 hours.

Statistical analysis was done using SPSS. The values are presented as number or percentage. A value of $p < 0.05$ was considered statistically significant.

Results

The mean age of our patient was 52±12 years. Nineteen (63.3%) patients were males and 11(36.6%) were females. Prolonged intubation was the commonest indication for tracheostomy in 12(40.0%) patients (Table-1).

Table 1: Indications for tracheostomy

Indications	No. of patients (%)
Prolonged intubation	12 (40.0%)
Upper airway obstruction	6 (20.0%)
Trauma (hanging, bullet injury)	3 (10.0%)
Infection (tetanus, meningitis, encephalitis, GB Syndrome)	7 (23.3%)
Head and Neck surgery	2 (6.6%)

Eighteen (60%) tracheostomies were performed electively and 12(40%) as an emergency. Sixty-eight isolates were grown from the culture of tracheal swabs. Single micro-organism was isolated from 35(58.33%) tracheal swabs and polybacterial isolation was seen in 16(26.66%) swabs. Out of 60 tracheo-stomal swabs, nine (six in first and three in second sample) showed sterile culture (Table-2). *Pseudomonas aeroginosa* was the commonest micro-organism isolated from the culture of both the tracheal swabs. After *Pseudomonas, Staphylococcus aureus* in the first culture and *Acinetobacter anitratus* in the second culture was the commonest organisms isolated (Table-2).

Table 2: Organisms isolated from the culture of tracheal swab

Organisms isolated	No. of organisms isolated in 1st sample	No. of organisms isolated in 2nd sample	Total percentage of organism isolated
Pseudomonas aeruginosa	10	17	39.70%
Staphylococcus aureus	8	5	19.11%
Acinetobacter anitratus	7	12	27.94%
Klebsiella pneumoniae	3	2	7.35%
Enterococcus species	1	3	5.88%

Five (16.6%) patients developed stomal infection and three (10.0%) developed pneumonia as a complication of tracheostomy. Out of three, two patients with pneumonia were found to have stomal infection.

Discussion

We found that, trachea of the tracheostomized patient is heavily colonized by *Pseudomonas aeruginosa, Acinetobacter anitratus* and *Staphylococcus aureus.* Stomal infection and pneumonia are the infectious complication occurring within seven days of tracheostomy.

Tracheostomy bypasses the nasopharyngeal defenses and impairs mucociliary function, allowing bacteria to have prolonged contact with the epithelial surface.[6] Leakage of secretion around the tube and opening of the binding site for bacteria after tracheostomy causes high rate of colonization in the airway.[9] Heavy colonization of trachea by micro-organisms in tracheostomized patients was also found by Niederman MS and Koirala P et al.[8,10] Bacterial colonization was found in 92% of patients from whom tracheal secretions were cultured in a study done by Arola MK.[11] In our study, microorganisms were isolated from 85% of the tracheal swab culture.

We found many organisms colonizing the trachea, even immediately after tracheostomy. As many of our patients were admitted in hospital for some days before undergoing tracheostomy, predominance of these organisms even in the first culture indicates their acquisition during their hospital stay. A nosocomial infection remains a significant consequence of hospitalization and imposes a heavy burden on health care resources.

Also, many of our patients were chronically and critically ill and were admitted in the intensive care unit. Out of 30, three patients had chronic obstructive pulmonary disease, four were diabetic and six had malignancy. Chronically and critically ill are known to be more vulnerable for colonization and subsequent infection of the airways.[8] Bacteria binds more avidly in the mucosal surface of patients with serious illness resulting in the increase rate of colonization.[6] Critical illness can also alter the composition of cell surface carbohydrates and glycoproteins, thereby creating new and increased numbers of binding sites for Gram negative bacteria.[12]

Pseudomonas aeruginosa was the commonest organism isolated from the culture of tracheal swab in our study. This organism is known to have tropism for the tracheo-bronchial tree.[13] Mechanical injury to the tracheal surface either due to endotracheal intubation or suctioning is known to expose binding site for *Pseudomonas*.[14] This binding is further enhanced by the production of carbohydrate by tracheobronchial cell when repairing the injury after tracheostomy.[15] There is a clear evidence that the tracheostomized patients particularly post ICU have predisposition to become colonized by *P. aeruginosa*.[6,9] It was also the most common organism isolated in patients with COPD, diabetes and malignancy in our study.

After *Pseudomonas*, *Staphylococcus aureus* and *Acinetobacter anitratus* were the commonest organism isolated from the first and second tracheal swab culture respectively. These are the common organisms isolated from the hospitalized patients and are associated with most of the nosocomial infections. *Staphylococcus*

aureus is the commonest pathogen responsible for the nosocomial infections, [16,17,18,19] especially nosocomial pneumonia, surgical wound infection, and bloodstream infection.[20] Infection with *Staphylococcus* contributes significantly to patient's morbidity and mortality.[21] Respiratory infections with *S. aureus* are common in patients with compromised airway defenses and hospitalized patients.[22] Previous studies also found *P. aeruginosa* and *S. aureus* to be the most frequent organism isolated from the culture of the tracheal swab.[7,10,23] In a study by Inweregbu K et al, *S. aureus* and *P. aeruginosa* were the most common pathogens associated with nosocomial pneumonia in intensive care unit.[19]

Infection with *Acinetobacter* species is a recognized problem in hospitals, causing pneumonia, bloodstream infection, meningitis and urinary tract infections.[24] The frequency of hospital acquired infection with *Acinetobacter* species is increasing mainly in intensive care units and in immune compromised patients. The occurrence of nosocomial infections with multidrug-resistant *Acinetobacter* and *Pseudomonas* is a growing problem.[25] *Acinetobacter* was the most common organism isolated from the tracheal tube of hospitalized patient followed by *P. aeruginosa* and *S. aureus* in a study done by Abdollahi A et al.[26]

We observed stomal infection in five of our patients. The reported incidence of stomal infection varies from 4% to 63% for surgical and 0% to 10% for percutaneous tracheostomy.[27] Our patients were tracheostomized by both surgical and percutaneous methods, which could have resulted in the 16% incidence of stoma infection.

Three (10%) patient developed pneumonia in the post tracheostomy period. Tracheostomy has been identified as an independent risk for ventilator associated pneumonia.[28] The reported incidence of pneumonia in mechanically ventilated patients is high with rates of 18% after percutaneous and 26% after surgical tracheostomy.[29,30] The incidence and the risk of pneumonia is found to be low when the tracheostomy is performed early. All of our patients being not mechanically ventilated and percutaneous method of tracheostomy in some of our patients could be the possible reasons for lower incidence of pneumonia in our study. Also, we might have missed few complications that occurred after first week as we observed our patients only for seven days following tracheostomy.

Out of three patients with pneumonia, two had stomal infection. Development of pneumonia in the same patients with stomal infection is an important finding in our study. Proper care of the stoma and management of stomal infection in tracheostomized patients might be an important step in preventing the complication like pneumonia. Most common organism isolated from patients developing infections was *Pseudomonas aeruginosa*.

Our sample size was small. Also, we included tracheostomized patients admitted both in intensive care unit requiring mechanical ventilation and those admitted in ward without mechanical ventilation. The pattern of organism colonizing the trachea and the incidence of infections could vary between these subjects.

Conclusion

Trachea of the tracheostomized patients is heavily colonized by *Pseudomonas aeruginosa, Acinetobacter anitratus* and *Staphylococcus aureus*. Stomal infection and pneumonia are the infectious complication occurring within seven days of tracheostomy. Proper care of stoma and management of stomal infection is an important step in preventing pneumonia in tracheostomized patients.

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