Main Article

Colonization and Antimicrobial Resistance Patterns of Potentially Pathogenic Micro-organisms in Tracheostomized Patients

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ABSTRACT

Introduction

Tracheostomy is one of the most common and ancient surgical procedure performed in the world but it is like a double-edged sword which not only facilitates respiration, but also impairs the natural resistant barrier, thereby augmenting the colonization of other secondary pathogenic micro-organisms. Hence, it is important to know the pattern of microbiological colonizers in tracheostomized patients, so that adequate empiric antimicrobial coverage can prevent development of hospital acquired pneumonia. This study aims to identify various micro-organisms colonizing lower airway in tracheostomized patients.

Materials and Methods

An observational cross-sectional study was conducted in a tertiary based teaching hospital in North Bengal, India during July 2021 to July 2022. A total of 56 patients were included in the study.

Results

Positive Cultures on day 0 were found in 20.8% & 65.6% of patients in wards and ICUs respectively. Out of the positive cultures isolated on day 0, Staphylococcus aureus was the most common organism (80%) obtained from ward patients whereas, Acinetobacter baumannii was most common organism (47.61%) in ICU admitted patients. On day 7, positive cultures were found in 66.6% & 84.4% of admitted patients in wards and ICUs respectively. Staphylococcus aureus was again the most common organism obtained (56.25%) in wards whereas, Pseudomonas aeruginosa was the most common organism (44.44%) obtained in ICU admitted patients followed by Acinetobacter baumannii (33.33%).

Conclusion

Culture positivity rates were higher in patients who were previously intubated in Intensive care unit, which establishes the fact that any procedure which warrants airway manipulations, increases the chance of hospital acquired infections. Antibiotic resistance is very common in ICU admitted patients and has a tendency to increase over time. Hence, upscaling of antibiotics is recommended only after proper sensitivity check of the tracheal aspirates.

Keywords

Tracheostomy; Culture; Antibiotic sensitivity; Hospital acquired pneumonia

Tracheostomy is one of the most common and ancient surgical procedure performed in the world. Current literature suggests, due to advancement in medical diagnostics, treatment procedures and increased awareness in the common people, it has been observed that supraglottic obstruction due to oro-pharyngo-laryngeal carcinoma is no longer the first and foremost indication of tracheostomy in emergency setup. Acute traumas to the laryngo-tracheal architecture or maxillofacial injury have now emerged as the primary causes which necessitate emergency tracheostomy. With advancement in medical procedures, various techniques have been applied to perform tracheostomy which can be either a conventional open surgical (OS) technique or can be achieved through graded percutaneous dilatational

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technique (PDT), with or without fiber optic bronchoscopy & real time visualization of tracheobronchial anatomy. Each procedure has its own merits and demerits and usually performed according to the surgeon's preference and patient profile.

Nosocomial infection is among the leading causes of mortality[1,2] and Hospital Acquired Pneumonia (HAP) and Ventilator-associated pneumonia (VAP) are second leading cause of all nosocomial infection.[3] In India, incidence of VAP is as high as 58% in Intensive Care Units (ICUs).[4] In healthy non-smoking adults, the distal airways are usually sterile[5,6] but with altered defenses of airway, like chronic bronchitis, chronic obstructive pulmonary disease (COPD), bronchiectasis, or tracheostomized patients, distal airways may become colonized by potential pathogenic microorganisms (PPMs) and non-potential pathogenic microorganisms (non-PPMs).[7,8,9] Previous studies showed that predominant PPMs in tracheostomized patients are *Moraxella catarrhalis*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*.[10,11,12] This information is required for providing adequate antimicrobial coverage when tracheostomized patients start exhibiting infectious signs and symptoms.[13,14]

Tracheostomy is like a double-edged sword which when in-situ, not only facilitates respiration, but also impairs the natural resistant barrier, thereby augmenting the colonization of other secondary PPM or non-PPM, which, in turn, aggravates lower respiratory tract infections. Tracheostomy tubes themselves being a 'foreign element', provokes body's innate immunity system, leading to secondary infections and granulomatous reactions, which further provides a constant nidus of infections for lower respiratory tract pathogens, thus continuing a vicious cycle of hospital and ventilator acquired infections.

Hence, it is important to know the pattern of microbiological colonizers in tracheostomized patients, so that adequate empiric antimicrobial coverage can prevent development of HAP and VAP and ultimately lead to reduced mortality among patients. This cross-sectional study aims to identify various microorganisms colonizing lower airway in tracheostomized patients.

Materials and Methods

This is an observational cross-sectional study conducted in a tertiary based teaching hospital in North Bengal, India during July 2021 to July 2022. All patients aged above 12 years admitted in intensive care units (ICUs), Male & Female General Surgical and ENT wards who underwent tracheostomy performed by the ENT department of the institute were included in this study. Pre tracheostomized patients or patients with previous /known history of systemic infections were excluded from the study.

Demographic variables of subjects, Indications of performing tracheostomy along with site of performing the procedure (ICU/major or emergency OT) were recorded. For subjects from ICU, duration of intubation prior to tracheostomy & any type of antibacterial received by the subjects prior to tracheostomy was recorded along with its duration. Tracheal aspirate of subjects was sent for culture and the detailed culture reports were recorded and pattern of microbiological flora was noted. Antibiotic sensitivity testing was performed on all positive cultures and patterns of antibiotic sensitivity were recorded accordingly.

Open surgical tracheostomy was performed in the major and emergency OT under strict aseptic precautions following which tracheal suctioning was done to clear the secretions. The tip of the suction catheter was cut and placed in a sterile container. The container was sealed, and transported to the microbiology lab for bacteriological analysis. This was labelled as Day 0 culture. Standard post tracheostomy care was ensued. Tracheostomy tube change was done every 2-4 days after tracheostomy under strict aseptic conditions. On the seventh post-operative day, tracheal suctioning was done with a sterile suction catheter, its tip cut, put in a sterile container and send for bacteriological analysis. This was labelled Day 7 culture. Bacterial Cultures were done on McConkey's agar, and Sheep Blood agar and the isolates were identified using grams staining and standard biochemical reactions. After identification, susceptibility pattern was tested by culturing in Muller Hilton agar using standard disk diffusion method according to the standard CLSI guidelines.

The study was approved by the Institutional Ethical Committee. Informed consent in writing was obtained from each patient prior to his/her inclusion in the study. Investigations and interventions were strictly according to the principles stated in the declaration of Helsinki 1964 and its subsequent amendments.

Results

A total of 56 patients were included in this study as per the inclusion criteria. Out of 56, 24 (42.8%) patients were admitted in general surgical and ENT wards whereas, 32(57.2%) patients were admitted in Intensive Care Units (ICUs).

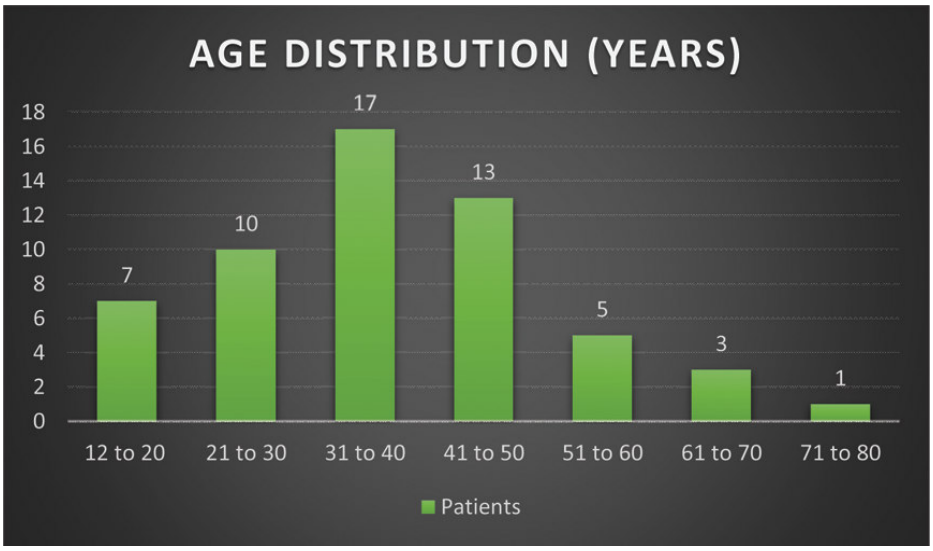

Fig. 1. Age Distribution

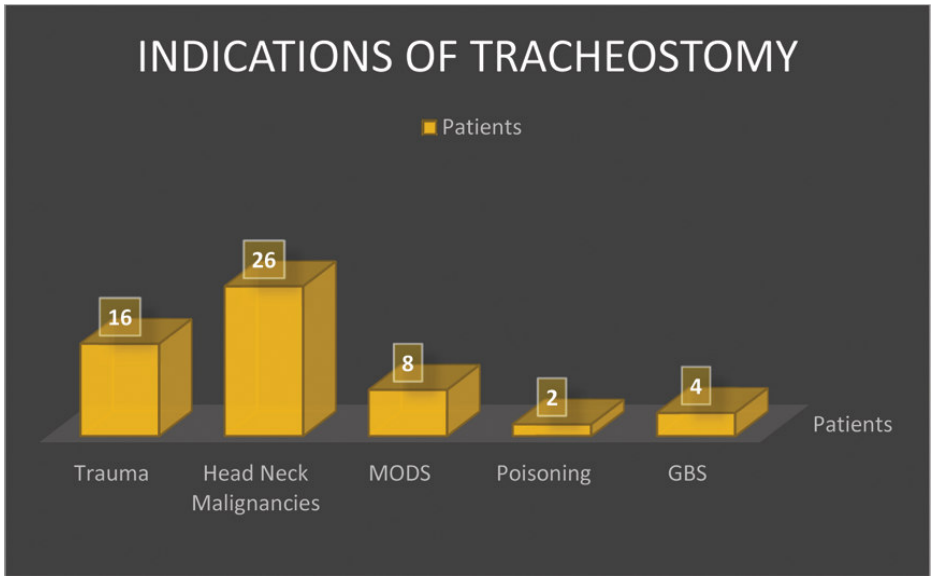

Fig. 2. Indications of Tracheostomies

30.35% of the patients were in the age group of 31-40 years (most). 1.78% of patients belonged to age group of 71-80 years (least) (Fig. 1). The Male: Female Ratio in our study was 3:1.

Head Neck malignancy was the most common indication (46.4%) of performing tracheostomy followed by trauma (28.57%). Detailed indications of tracheostomies performed are mentioned in (Fig. 2). Head and neck malignancy was more common in the patients aged above 40 years whereas Guillain- Barre syndrome and trauma were more common indication for tracheostomy in younger age groups. The Culture positivity rate was higher in patients admitted in critical care unit in both day 0 & day 7 (Fig. 3 & 4).

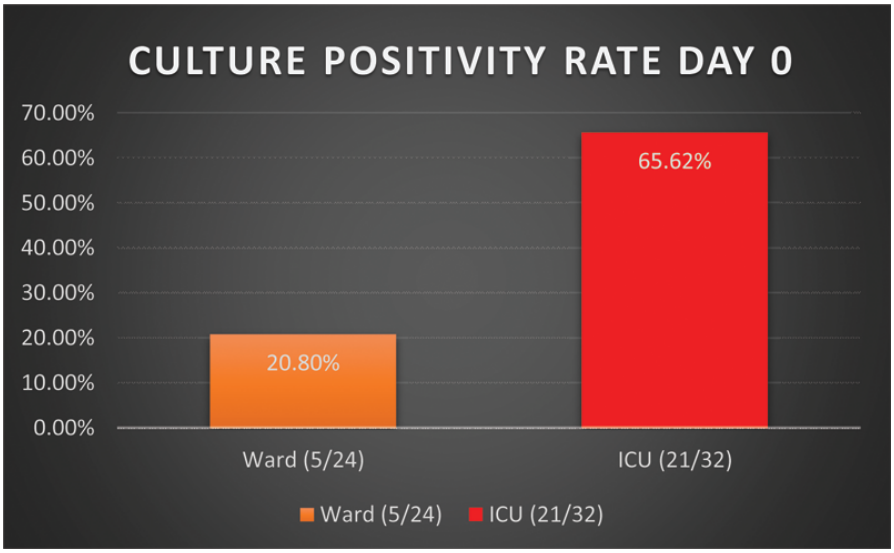

Fig. 3. Culture Positivity Rates at day 0

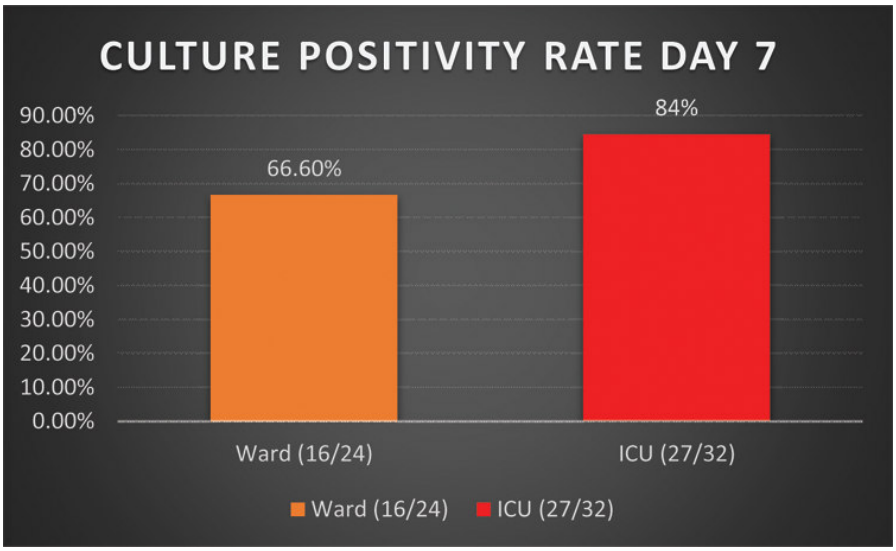

Fig. 4. Culture Positivity Rates at day 7

Positive Cultures on day 0 were found in 20.8% & 65.6% of patients in wards and ICUs respectively. Out of the positive cultures isolated on day 0, *Staphylococcus aureus* was the most common organism (80%) obtained from ward patients whereas, *Acinetobacter baumannii* was most common organism (47.61%) in ICU admitted patients. On day 7, positive cultures were found in 66.6% & 84.4% of admitted patients in wards and ICUs respectively. Here, *Staphylococcus aureus* was again the most common organism obtained (56.25%) in wards whereas, *Pseudomonas aeruginosa* was the most common organism (44.44%) obtained in ICU admitted patients followed by *Acinetobacter baumannii* (33.33%) (Fig. 5 & 6).

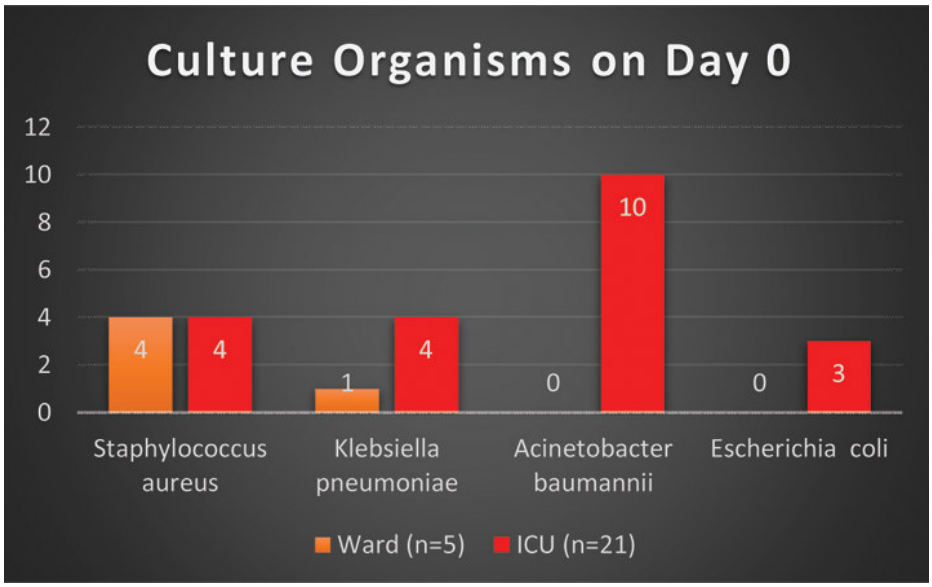

Fig. 5. Culture organisms on day 0

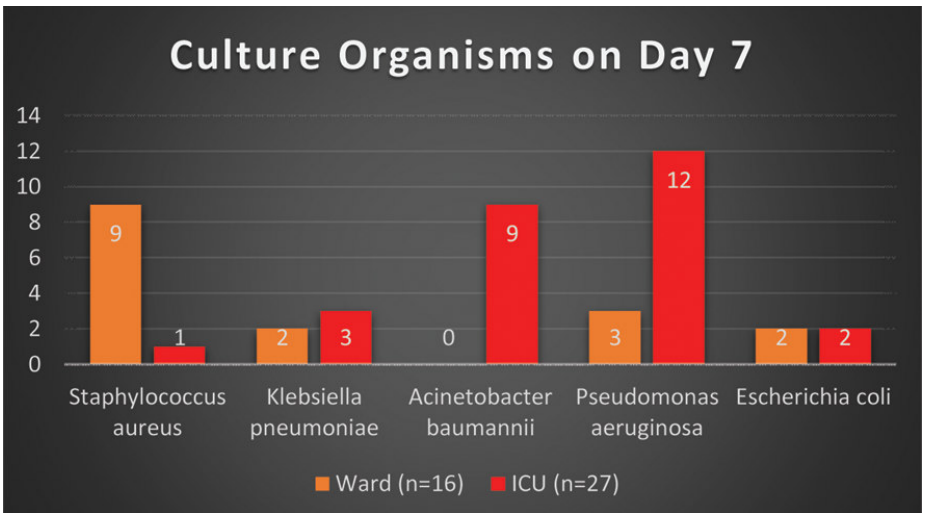

Fig. 6. Culture organisms on day 7

Antibiotic sensitivity pattern was observed on day 0 cultures and of 20.8% culture positive patients admitted in general wards, most were sensitive to antibiotics with least to ciprofloxacin (Fig. 7). In 65.62% of culture positive critical care units patients on day 0, resistance to linezolid (9.52% were sensitive) was mostly observed followed by ciprofloxacin. Similarly on day 7, of 66.6% of culture positive ward patients, sensitivity to colistin was observed the most (93.75%) with least sensitivity to ciprofloxacin (43.75%) (Fig. 8). In critical care unit patients, out of 84.4% culture positive patients, highest sensitivity was observed in colistin (77.77%) and least in Linezolid (11.11%).

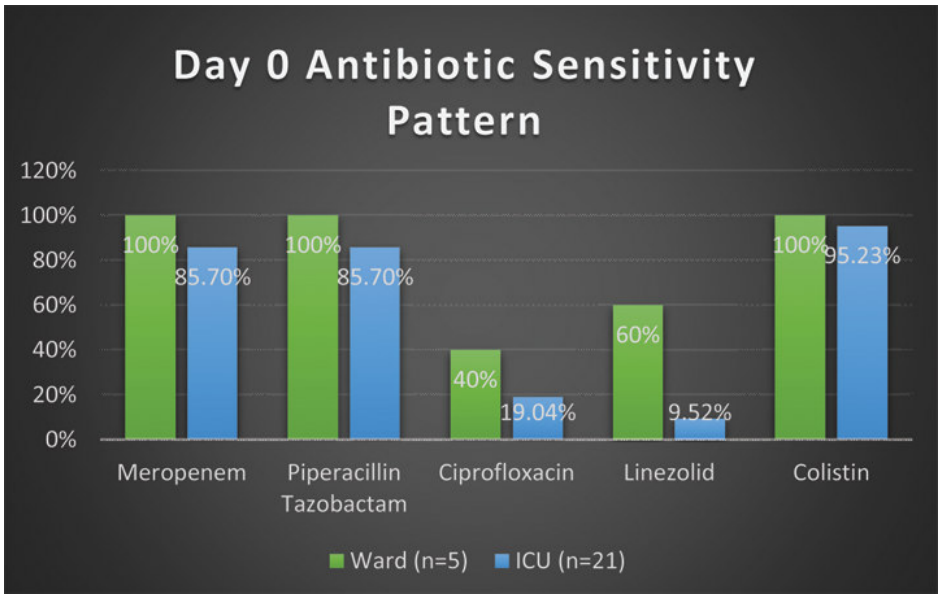

Fig. 7. Antibiotic Sensitivity pattern Day 0

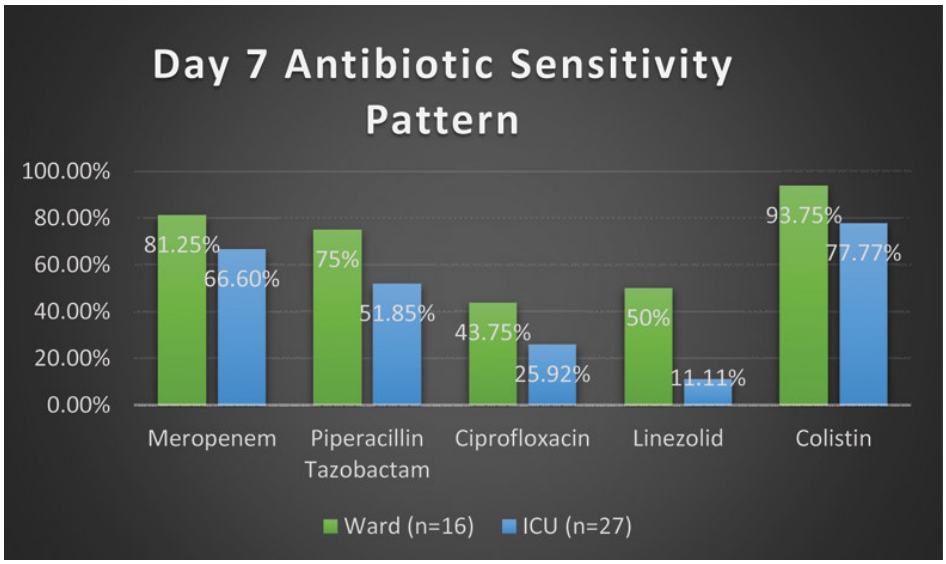

Fig. 8. Antibiotic Sensitivity Pattern Day 7

Discussion

Our study included patients of age group ranging between 14 to 72 years. Patients who underwent tracheostomy and admitted in general ward were predominantly of older age group and head and neck malignancy was the commonest indication in them, whereas trauma, Multi Organ Dysfunction Syndrome (MODS), Guillain Barre syndrome were more common indications in the patients admitted in critical care unit, and comprising of a younger mean age group.

As found in the Day 0 culture, lower respiratory tract was mostly sterile in patients who were not previously intubated, yielding negative results in 79.2% cases admitted in wards, remaining 20.8% whose culture turned out to be positive, showed growth of *staphylococcus aureus;* whereas 65.62% positivity rate was observed in patients who were admitted in critical care unit, and therefore, were previously intubated. 47.61% of the positive cultures were found to be of *Acinetobacter baumannii* followed by 19.04% of *Klebsiella pneumoniae*. Similarly, on day 7, *Staphylococcus aureus* remained as the primary pathogen in ward patients whereas, *Pseudomonas aeruginosa* (44.44%) and *Acinetobacter baumannii* (33.33%) appeared to the most common isolates from previously intubated patients who were being treated in the critical care unit. These results are in accordance with the study of Aswin Mukundan et al.[15]

Endotracheal intubation can be a preliminary factor for iatrogenic infections since it has a role in reducing muco-ciliary function and mucus accumulation which can act as a niche for bacteria. Even performing procedure under aseptic conditions, bacterial growth was inevitable and our studies show similarities with that of Jung et al[16] and Shanthi M et al.[17]

Cader et al[18] in a 10 year retrospective study of tracheostomy colonisation and microbiological examination in Intensive care unit patients showed that the most common organisms isolated were *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. This finding is also similar to our obtained results. In a recent study done by Havens et al[19] on paediatric population of chronic ventilator dependent children and tracheostomy patients, found that Methicillin resistant *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the most common organisms isolated. These results are similar to our findings. Another study done by Raveendra et al[20] on bacterial biofilms on tracheostomy tubes present in critically ill patients showed *Acetobacter baumannii* and *Pseudomonas aeruginosa* the most common organisms.

Most of these bacteria grown in our culture did not progress towards a full-blown infection. All patients were on antibiotics prior to and after the procedure. Amoxycillin clavulanate was the most common antibiotic prescribed in ward. In case of patients in the ICU, antibiotics were chosen by the primary physician.

Most antibiotics were sensitive to patients admitted in wards with comparative lesser sensitivity to ciprofloxacin and linezolid. Tran et al[21] in a study done in Vietnam on microbial resistance in 220 ICU patients, showed 77% resistance to ciprofloxacin along with other drugs. Our study showed 80.96% resistance to ciprofloxacin on day 0 in ICU patients which was second to Linezolid with 90.48% resistance. Cader et al[18] in their study of ICU patients also showed that 89% of Acinetobacter strains were resistant to ciprofloxacin however, no data with linezolid was mentioned.

Conclusion

Tracheostomy itself predisposes the lower respiratory tract for colonization by exogenous microorganisms. Culture positivity rates were higher in patients who were previously intubated in Intensive care unit, which establishes the fact that any procedure which warrants airway manipulations, increases the chance of hospital acquired infections. Antibiotic resistance is very common in ICU admitted patients and has a tendency to increase over time. Hence, upscaling of antibiotics is recommended only after proper sensitivity check of the tracheal aspirates.

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