Tracheostomy colonisation and microbiological isolates of patients in intensive care units-a retrospective study

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Received 10 March 2019; received in revised form 15 April 2019; accepted 15 April 2019
Available online 29 March 2020

KEYWORDS
Tracheostomy; Intubation; Antibiogram; Antibiotics

Abstract
Objective: To find out the type of bacteria colonising the tracheostomy tube and to determine the antibiotic sensitivity pattern and resistance in patients who have had tracheostomy in intensive care unit (ICU) set up and to initiate proper empirical treatment in such patients.

Methods: The study was a retrospective review of patients who underwent tracheostomy at Ministry of Health, Sur Hospital, Oman January 2005 and December 2015. The Hospital has 4 bedded pediatric intensive care unit (PICU) and 10 bedded adult ICU which is headed by consultant anaesthetists, consultant physicians, ICU trained nurses and respiratory therapists. All patients who required mechanical ventilation and were therefore subject to an orotracheal intubation and those who underwent a conventional tracheostomy were considered for inclusion. Patients who had been intubated in other hospitals or ICUs, other airways infection issues were excluded from this study. Data's were collected from computer based hospital management system, operation theatre and registers in Medical records department and entered in a preformed questionnaire before thorough analysis. The specimens for swab was obtained from the cut tracheostomy tube tips and the samples were sent to microbiology laboratory for isolation of the organism and obtain an antibiogram to know the susceptibility and resistance to antibiotics. Data were analyzed by Statistical Package for Social Sciences (SPSS, version 16, Chicago, Inc) and the values are reported as number (%). The commonest isolated organism was Pseudomonas followed by Acinetobacter.

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Peer review under responsibility of Chinese Medical Association.

https://doi.org/10.1016/j.wjorl.2019.04.002
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Results: During the ten year retrospective study, there were 108 patients included in our study with 56 males and 51 females. Fourteen different microorganisms were isolated during our study which included *Pseudomonas aeruginosa* (n = 39), *Acinetobacter baumanii* (n = 28), *Klebsiella* (n = 10) and coagulase negative staphylococcus (n = 6). The most commonest organisms in both genders was *Pseudomonas aeruginosa* closely followed by *Acinetobacter baumanii*. In children under age of 12, it was *Pseudomonas aeruginosa* and in adults the impending organism was *Acinetobacter baumanii*. In terms of antibiograms, 89% of *Acinetobacter*, 38% of *Staphylococcus aureus*, 37% of *Klebsiella* and 54% of *Proteus mirabilis* were resistant to ciprofloxacin. These organisms were resistant to ceftazidime in 97%, 83%, 89% and 57% of the cases, respectively and resistant to imipenem in 7.4%, 18.2%, 1.8% and 8.1%.

Conclusions: In summary, this study presents the most common microorganisms colonized from tracheostomy of hospitalized patients and their pattern of antibiotic resistance. As our study showed, *Pseudomonas* is the most common microorganism isolated from tracheostomy tube. Ciprofloxacin was also the most prevalent antibiotic revealing resistant pattern. Moreover, most of the microorganisms were sensitive to imipenem and pipracillin-tazobactam.

### Materials and methods

The study was a retrospective review of patients who underwent tracheostomy at Ministry of Health, Sur Hospital, Oman between January 2005 and December 2015. The Hospital has 4 bedded pediatric intensive care unit (PICU) and 10 bedded adult ICU which is headed by consultant anesthetists, consultant physicians, ICU trained nurses and respiratory therapists. All patients who required mechanical ventilation and were therefore subject to an orotracheal intubation and those who underwent a conventional tracheostomy were considered for inclusion. Patients who had been intubated in other hospitals or ICUs, those that had an intubation method other than orotracheal (i.e. nasopharyngeal, larynx mask) and patients that already had a tracheostomy were considered for exclusion. Patients with previous pneumonia, other airways infection issues and in adults the impending organism was *Pseudomonas aeruginosa* and in adults the impending organism was *Acinetobacter baumanii*. In children under age of 12, it was *Pseudomonas aeruginosa* and in adults the impending organism was *Acinetobacter baumanii*. In terms of antibiograms, 89% of *Acinetobacter*, 38% of *Staphylococcus aureus*, 37% of *Klebsiella* and 54% of *Proteus mirabilis* were resistant to ciprofloxacin. These organisms were resistant to ceftazidime in 97%, 83%, 89% and 57% of the cases, respectively and resistant to imipenem in 7.4%, 18.2%, 1.8% and 8.1%.

Conclusions: In summary, this study presents the most common microorganisms colonized from tracheostomy of hospitalized patients and their pattern of antibiotic resistance. As our study showed, *Pseudomonas* is the most common microorganism isolated from tracheostomy tube. Ciprofloxacin was also the most prevalent antibiotic revealing resistant pattern. Moreover, most of the microorganisms were sensitive to imipenem and pipracillin-tazobactam.

### Table 1 Incidence of organisms isolated.

| Organism                        | Frequency | Percentage |
|---------------------------------|-----------|------------|
| *Pseudomonas aeruginosa*        | 39        | 37.0       |
| Proteus                         | 3         | 39.8       |
| *Stenotrophomonas maltophilia*  | 1         | 40.7       |
| *Providencia*                   | 1         | 41.7       |
| *Extended spectrum Beta lactamase producing E coli* | 1 | 42.6 |
| *Carbapenam resistant Klebsiella* | 1 | 43.5 |
| *Streptococcus*                 | 2         | 45.4       |
| *Klebsiella*                    | 10        | 54.6       |
| *Enterobacter*                  | 2         | 56.5       |
| *coli*                          | 1         | 57.4       |
| *Acinetobacter*                 | 28        | 83.3       |
| *Escherichia coli*              | 2         | 85.2       |
| *Staphylococcus aureus*         | 3         | 88.0       |
| *coagulase Negative staphylococcus* | 6 | 93.5 |
| *Negative swab*                 | 7         | 100.0      |
| **Total**                       | **108**   | **100**    |
analysis. The specimens for swab was obtained from the cut tracheostomy tube tips (obtained by cutting the tip with sterile knife) while patient had tube change and the samples were sent to microbiology laboratory for isolation of the organism and obtain an antibiogram to know the susceptibility and resistance to antibiotics. Antibiotic susceptibility was evaluated by disc diffusion method on Mueller Hinton agar according to clinical and laboratory standards institute (CLSI) guidelines. The samples were obtained from patients admitted to the intensive care unit of our hospital and patient relatives filled an informed consent to enrol them for the study, approved by the ethical committee involved in research. Data were analyzed by Statistical Package for Social Sciences (SPSS, version 16, Chicago, Inc) and the values are reported as number (%).

Results

During the ten year retrospective study, there were 108 patients included in our study with 56 males and 51 females. Fourteen different microorganisms were isolated during our study which included Pseudomonas aeruginosa (n = 39), Acinetobacter baumannii (n = 28), Klebsiella (n = 10) and coagulase negative staphylococcus (n = 6) and many other organisms as included in the Table 1. The most commonest organisms in both genders was Pseudomonas aeruginosa closely followed by Acinetobacter baumannii. In children under age of 12, it was Pseudomonas aeruginosa and in adults the impending organism was Acinetobacter baumannii (Table 1).

In terms of antibiograms, 89% of Acinetobacter, 38% of Staphylococcus aureus, 37% of Klebsiella and 54% of Proteus mirabilis were resistant to ciprofloxacin. These organisms were resistant to ceftazidime in 97%, 83%, 89% and 57% of the cases, respectively and resistant to imipenem in 7.4%, 18.2%, 89% and 57% of the cases, respectively. In addition, 100% of Acinetobacter, 79% of Escherichia coli, 65% of Klebsiella and 89% of Proteus mirabilis were resistant to cefepime. On the other hand, 93% of Staphylococcus aureus, 100% of Acinetobacter and 85% of Staphylococcus epidermidis were resistant to penicillin (Table 2).

Discussion

Of all hospitalized patients requiring mechanical ventilation, approximately 10% will receive a tracheostomy. Infections are among the most important and the leading cause of mortality and morbidity in ICU. The findings of this study would be helpful in selection of appropriate antibiotics. In this study, all the positive colonies obtained from the tracheostomy cases were considered. In our study, Gram negative bacteria were the most common isolated organisms including Acinetobacter and Pseudomonas aeruginosa (Table 3).

In summary, this study presents the most common microorganisms colonized from tracheostomy of hospitalized patients and their pattern of antibiotic resistance. As our study showed, Pseudomonas is the most common microorganism isolated from tracheostomy tube. Ciprofloxacin was also the most prevalent antibiotic revealing resistant pattern. Moreover, most of the microorganisms were sensitive to imipenem and pipracillin-tazobactam.

Declaration of Competing Interest

The authors declare no conflict of interest in publishing the article.
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Edited by Jie Gao