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Original Research Article

Bacteriological profile in intubated and mechanically ventilated babies in NICU in Krishna Institue of Medical Sciences, Karad, Maharashtra, India

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ABSTRACT

Background: Infections are the most important and leading cause of mortality and morbidity among the patients admitted in ICU. Nosocomial infection is a critical issue among intubated patients which is responsible for significant morbidity and mortality of these patients. The objectives of this study were to characterize bacterial species from the respiratory tract of patients undergoing endotracheal intubation and to determine the sensitivity of organism to various antibiotics. To propose a suitable antibiotic therapy in intubated and mechanically ventilated babies according to cultures and antibiotic sensitivity obtained from ET tube of previously intubated and ventilated babies in NICU.
Methods: It was a cross sectional descriptive study conducted in the NICU settings of KIMS, Karad, from January 2016 to June 2016. 78 neonates were intubated for more than 48 hours were included in the study during this duration, among which 44 were considered as cases.
Results: Out of 44 samples,16 were sterile and 28 were positive for organisms.25 cases were started prophylactic antibiotics before intubation with inj. ampicillin and inj. gentamicin (27.3%), inj. piperacillin and inj. amikacin (15.9%), inj. vancomycin (9.1%), inj. meropenem (2.3%), of which 6 cases were sterile and 19 were positive for organisms. Antibiotic sensitivity to inj. colisitn (38.7%) followed by inj. tigecycline (13.6%), inj. levofloxacin (4.6%) and inj. tetracycline (2,3%) and inj. clindamycin (2.3%). In majority cases antibiotic sensitivity was obtained positive to 3 antibiotics.
Conclusions: From the present study we have come to a conclusion that analyzing ET culture was important as the sensitivity to the antibiotics obtained was different from those given prophylactically as a protocol. Hence this study will help us in implementing different antibiotics prophylactically with regard to the commonly obtained sensitivity pattern.

Keywords: Antibiotic sensitivity, Intubation, Hospital acquired infections, Neonatal intensive care unit, Neonatal care, Respiratory infections

INTRODUCTION

Infections are the most important and leading cause of mortality and morbidity among the patients admitted in ICU. Nosocomial infection is a critical issue among intubated patients which is responsible for significant morbidity and mortality of these patients. One of the most important types of this infection is pneumonia which commonly occurs in relation to the endotracheal tube and mechanical ventilation named ventilator associated pneumonia. Patients with mechanical ventilation have an increased risk for respiratory tract infection because the

tube which has been inserted in trachea reduces the clearance of bacteria and increases the leakage of secretion around the cuff of tube and disable the ciliary tract by damaging it. Nosocomial infection is a frustrating and budget consuming issue and due to increased time of hospitalization it imposes a heavy burden on health care resource. Irrational and overuse of newer generation antibiotic often results in multidrug resistance of microorganisms in hospital setup.

Ventilator-associated pneumonia (VAP) is pneumonia in mechanically ventilated patients that develops later than or at 48 h after the patient has been placed on mechanical ventilation. VAP is the second most common hospital-acquired infection among paediatric and neonatal intensive care unit (ICU) (NICU) patients. Overall, VAP occurs in 3 to 10% of ventilated paediatric ICU (PICU) patients.[1-4] Surveillance studies of nosocomial infections in NICU patients indicate that pneumonia comprises 6.8 to 32.3% of nosocomial infections in this setting.[5-7] The purpose of this study was to determine the prevalence of bacterial species and its antimicrobial sensitivity pin endotracheal tubes in mechanically ventilated neonates admitted to NICU of Krishna Institute of Medical Sciences.

Various studies have proposed different causative microorganism as the most common etiology for intubation related respiratory infections including *Pseudomonas aeruginosa*, *A. baumannii*, and methicillin resistant *Staphylococcuus aureus* (MRSA) or *S. aureus* in children.[8,2-7] The concerns related to the nosocomial infections are exacerbated by the presence of antibiotic resistant bacteria which increases morbidity rate and the associated costs.[9]

METHODS

This study was conducted in the NICU settings of Krishna Instittute of Medical Sciences, Karad, Maharashtra, India. This study period extended from January 2016 to June 2016.

This study includes 78 babies intubated for more than 48 hours were selected in the present study. Among them 44 were cases which included neonates who were intubated for >48 hours. All the babies more than 1 month of age and Those who were extubated, died or were discharged within 48 hours were exxcluded from the study.

Upon enrollment, details of the babies were recorded, like name, age on admission, gender, cause of admission, underlying respiratory disease, day of intubation, Indication of intubation, if antibiotic given before intubation, day of life during sample collection, total number of days of intubation, organism obtained on ett culture, antibiotic sensitivity seen etc.

On extubation, the lower 5 cm of endotracheal tube was cut with sterile scissors using sterile technique and was sent to the microbiological laboratory for analysis to obtain microbial colonisation and culture as well the antibiotic sensitivity in them. The microbial culture was grown on blood agar (Tryptic Soy Agar with 5% sheep blood) medium and incubated at 35oC for 48 hrs. If the sample was obtained positive for organism, confirmation was done on VITEC machine, which also detected antibiotic sensitivity for following antibiotics - Pipracillin/Tazobactam, Ceftazidime, Cefoperazone/Sulbactum, Cefepime, Aztreonam, Doripenem, Imipenem, Meropenem, Amikacin, Gentamycin, Ciprofloxacin, Levofloxacin, Minocycline, Tigecycline, Colistin, Trimethoprin/Sulfamethoxazole. Minimum inhibitory concentration for that specific organism was obtained. The data was interpreted using Microsoft excel and SSPE.

RESULTS

In this study done at Krishna Institute of Medical Sciences from January 2016 to June 2016, 78 neonates were intubated out of which 44 cases were obtained.

Majority of the neonates needing intubation were preterms (77.7%) followed by birth asphyxiated babies (40.9%), meconium aspirated babies (29.55%), early onset sepsis (15.9%), respiratory depression following convulsion (6.82%), aspiration pneumonia (4.55%) and severe dehydration (2.27%) (Table 1).

Table 1: Indications of intubation.

Indications of admission needing intubation	No. of cases	Percentage (n = 78)
Preterm Care	34	43.58
Meconium aspiration syndrome	13	16.6
Early onset sepsis	7	8.9
Birth asphyxia	18	23
Severe dehydration	1	1.2
Aspiration pneumonia	2	2.5
Respiratory depression due to convulsions	3	3.8

Table 2: Cases intubated for more than 2 days.

Cases requiring intubation for more than 2 days	No.	Percentage (n = 44)
Preterm care	21	47.7
Meconium aspiration syndrome	7	15.91
Early onset sepsis	3	6.82
Birth asphyxia	7	15.91
Severe dehydration	1	2.27
Respiratory depression due to convulsions	2	4.55
Aspiration pneumonia	2	4.55

Neonates who were intubated for more than 48 hours were considered as cases, included preterm (47.7%),

meconium aspiration syndrome (15.9%) and birth asphyxia (15.9%), early onset sepsis (6.82%), respiratory depression due to convulsions (4.55%), aspiration pneumonia (4.55%), severe dehydration (2.27%) (Table 2).

Table 3: Gender based prevalence of organisms.

Gender	Organisms cultured					
	Acinetobacter	***Klebsiella***	***Staphylococcus***	***Pseudomonas***	***E. coli***	**Total (n = 28)**
Males	6 (40%)	3 (20%)	3 (20%)	2 (13.3%)	1 (6.67%)	15
females	4 (30.77%)	5 (38.46%)	3 (23.07%)	1 (7.69%)	0	13
Total	10 (35.72%)	8 (28.57%)	6 (21.42%)	3 (10.72%)	1 (3.57%)	28

Table 4: Organisms obtained on ETT culture.

Cultures obtained	No. of cases	Percentage (n=28)
Acienetobacter	10	35.7
Klebsiella	9	28.5
Coagulase positive *staphylococcus*	6	21.4
Pseudomonas	3	10.7
E. coli	1	3.5

Majority of the cases were intubated from 2-3 days and age on admission ranging from 1 day to 12 days of life. Majority of the samples were obtained on day 3 and day 4 of life using sterile technique.

Out of 44 samples,16 samples were sterile, and 28 samples were positive for organisms. 25 cases were started prophylactic antibiotics before intubation with inj ampicillin and inj gentamicin (27.3%), inj piperacillin and inj amikacin (15.9%), inj vancomycin (9.1%), inj meropenem (2.3%), of which 6 cases were sterile and 19 were positive for organisms.

The most common organism in both genders was Acinetobacter which was similar to our study (Table 3).

Table 5: Organisms obtained in different cases.

Cases	Organism commonly obtained					Total
	Acinetobacter	***Klebsiella***	***Coa staphylococcus***	***Pseudomonas***	***E. coli***	
Preterm care	5 (35.7%)	4 (28.6%)	4 (28.6%)	1 (7.1%)	0 (0%)	14 (100%)
Meconium aspiration syndrome	1 (25.0%)	3 (75.0%)	0 (0%)	0 (0%)	0 (0%)	4 (100%)
Birth asphyxia	2 (50%)	0 (0%)	0 (0%)	1 (25%)	1 (25%)	4 (100%)
Early onset sepsis	1 (50%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	2 (100%)
Severe dehydration	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)
Aspiration pneumonia	1 (50%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	2 (100%)
Respiratory depression due to convulsion	0 (0%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	1 (100%)

Table 6: Commonly obtained sensitive antibiotics to the cultured organisms.

Antibiotic sensitivity most commonly obtained (mic)	No. of cases	Percentage (n=44)
Inj colisitn	17	38.7
Inj teigecycline	6	13.6
Inj levofloxacin	2	4.6
Inj tetracycline	1	2.3
Inj clindamycin	1	2.3

In the present study we observed that most commonly obtained organism was *Acienetobacter* (22.7%), *Klebsiella* (20.5%), coagulase positive *Staphylococcus* (13.6%), *Psedomonas* (6.8%) and *E. coli* (2.3%) (Table 4).

In the present study we obtained antibiotic sensitivity to inj. colisitn (38.7%) followed by inj. tigecycline (13.6%), inj. levofloxacin (4.6%) and inj. tetracycline (2,3%) and inj. clindamycin (2.3%) (Table 6).

DISCUSSION

Infections are the most important and leading cause of mortality and morbidity among the patients admitted in ICU. Nosocomial infections is a critical issue among intubated patients which is responsible for significant morbidity and mortality of these patients.

The rate of NICU admission has drastically increased in last few years due emergence of newer life saving techniques. Intubation is an integral part of resuscitation which is commonly done in case of severe birth asphyxia, meconium stained liquor, preterm delivery. New emerging bacterial strains has made it difficult to prophylactically treat and prevent infections.

From our study we have come to a conclusion that analysing ET culture was important as the sensitivity to the antibiotics obtained was different from those given prophylactically as a protocol. Hence this study will help us in implementing different antibiotics prophylactically with regard to the commonly obtained sensitivity pattern. In this study done at Krishna Institute of Medical Sciences from January 2016 to June 2016, 78 neonates were intubated out of which 44 cases were obtained.

Majority of the neonates needing intubation were preterms (77.7%) followed by birth asphyxiated babies (40.9%), meconium aspirated babies (29.55%), early onset sepsis (15.9%), respiratory depression following convulsion (6.82%), aspiration pneumonia (4.55%) and severe dehydration (2.27%). Neonates who were intubated for more than 48 hours were considered as cases, included preterm (47.7%), meconium aspiration syndrome (15.9%) and birth asphyxia (15.9%), early onset sepsis (6.82%), respiratory depression due to convulsions (4.55%), aspiration pneumonia (4.55%), severe dehydration (2.27%). Majority of the cases were intubated from 2-3 days and age on admission ranging from 1 day to 12 days of life. Majority of the samples were obtained on day 3 and day 4 of life using sterile technique. Out of 44 samples, 16 samples were sterile, and 28 samples were positive for organisms. 25 cases were started prophylactic antibiotics before intubation with inj. ampicillin and inj. gentamicin (27.3%), inj. piperacillin and inj. amikacin (15.9%), inj. vancomycin (9.1%), inj. meropenem (2.3%), of which 6 cases were sterile and 19 were positive for organisms.

The study by Simoni et al showed that 100% of samples from airway prosthesis are positive in culture; however, other studies have reported a positive culture rate between 0% and 33% in obtained samples from airway tubes.[10,11] Cardinosa et al have reported a positive culture result in 89% of their samples. The variation could be explained by the technique of intubation, clinical and individual characteristics of study population, colonization during intubation or lack of sufficient precautions for intubation due to the high work load in an emergency setting. In study by Wadhwani JL et al Gram-negative bacteria were the most common isolated organisms including *Pseudomonas aeruginosa* and *Klebsiella* which is in the same line with the study by Nardi et al.[12,13] Amini et al also conducted a descriptive study on distribution of isolated microorganisms from tracheal tube of ICU patients declaring that *S. aureus* (23.6%), *Klebsiella* species (23.3%), *Acintobacter species*. (20.7%), *P. aeroginosa* (18.2%), *E. coli* (7.7%), and Enterobacter species, were the most common isolates.[14] This study as well as the other ones in similar settings confirm that *P. aeruginosa*, *klebsiella* and *S. aureus* are among the most 3 prevalent isolated organisms from endotracheal tube aspirate.

A total of 880 patients were enrolled in study by Abdollahi A et al including 531 male (60.3%) and 349 female (39.7%).[15] Nineteen different microorganisms were isolated during the study including *Acinetobacter* (213, 24.2%), *Pseudomonas aeruginosa* (147, 16.7%), *Staphylococcus aureus* (106, 12%), *Proteus mirabilis* (90, 10.2%), and the remainder organisms which are summarized.[15] The most common organism in both genders was *Acinetobacter* which was similar to our study. In the present study we observed that most commonly obtained organism was *Acinetobacter* (22.7%), *Klebsiella* (20.5%), coagulase positive *Staphylococcus* (13.6%), *Pseudomonas* (6.8%) and *E. coli* (2.3%).

Low birth weight has been shown to be a risk factor for the development of nosocomial pneumonia. A 41-month surveillance study demonstrated a significant association between a birth weight of 1,500 g and a higher rate of nosocomial pneumonia.[16] However, low birth weight may be a marker for an increased duration of mechanical ventilation. That study was limited by the lack of a specific control for the duration of mechanical ventilation. Apisarnthanarak et al focused on estimated gestational age (EGA) rather than birth weight in their 10-month-long case control study of 211 intubated NICU patients.[17] VAP rates were much higher in babies with an EGA of <28 weeks (19 VAP cases) than in babies with an EGA of <28 weeks (5 VAP cases) (P <0.001) (56). Similar result was obtained in our study, with majority of the organisms isolated in preterms (14 cases) followed by meconium aspiration syndrome (4 cases), birth asphyxia (4 cases), early onset sepsis (2 cases), aspiration pneumonia (2 cases), and 1 case each due to severe dehydration and respiratory depression due to convulsion. In contrast to study done by Tandia K et al most of the positive blood cultures were obtained within 4 days of intubation (69.7%) and most common organism being *Acinetobacter* (39.1%).[7]

In contrast to the study done by Tandia K et al and were the antibiotic sensitivity most commonly was obtained to inj. piperacillin-tazobactum followed by meropenem and ceftriaxone.[7] In a study by Nazal-Matunog et al, most of the Gram negative bacteria were sensitive to ciprofloxacin compared with 3% resistant cases; there

was amikacin resistance in 9.7% of the cases with the highest resistance to cefamandole (57%), cefotaxime (50%), and tobramycin (50%)

In the present study we obtained antibiotic sensitivity to inj colistin (38.7%) followed by inj tigecycline (13.6%), inj levofloxacin (4.6%) and inj tetracycline (2,3%) and inj clindamycin (2.3%) (Table 6). In majority cases antibiotic sensitivity was obtained positive to 3 antibiotics. The antibiotic sensitivity obtained were different from the antibiotic which were prophylactically started in few cases.

Cases with sterile cultures had better outcome as compared to babies with culture positive for organism. Among 17 patients with sterile culture or sensitivity to single antibiotic 2 expired (11.7%) and among 27 patients with sensitivity to >1 antibiotic 6 expired (11.7%).[18]

Recommendations for Current Practice and Future Research, the lack of a gold standard plagues all literature regarding VAP in both adults and children. Several recommendations have been given to decrease VAP. The CDC and Health care Infection Control Practices Advisory Committee suggest using orotracheal tubes (instead of nasotracheal tubes) when patients require mechanical ventilation, changing breathing circuits of ventilators only if the malfunction or if they are visibly contaminated, and using endotracheal tubes with dorsal lumens to allow respiratory secretions to drain.[19.] There are no recommendations for the preferential use of sucralfate, histamine 2 receptor antagonists, or antacids for stress bleeding prophylaxis.[19]

Head-of-bed elevation

Supine position has been associated with VAP in adult patients, which is thought to be related to an increase in gastroesophageal reflux and aspiration. Semirecumbent positioning has been demonstrated to decrease surrogate outcomes such as aspiration and gastroesophageal reflux in adults and one clinical trial demonstrated a dramatic decrease in the incidence of confirmed VAP in patients with head-of-bed elevation (5% versus 23%; OR, 6.8; 95% CI, 1.7 to 26.7).[21] The efficacy of semirecumbent positioning in preventing VAP in children has not been established.

Hand hygiene

Efforts at reducing person-to-person transmission of bacteria are crucial for preventing nosocomial infections. Significant bacterial contamination of hospital employees' hands during routine patient care has been demonstrated.[22] The concept that routine hand washing by health care workers reduces nosocomial infections is not new, but the first study investigating the impact of hand hygiene on the rate of hospital-acquired infections in NICU patients was recently performed.[23]

In-line suctioning

Endotracheal suctioning is used for eliminating bronchopulmonary secretions from the airway. Traditional open endotracheal suction requires disconnection from the ventilator. Closed endotracheal suction systems present the potential for bacterially contaminated secretions to pool in the lumen of the tube, with reinoculation of the respiratory tract with each repeated suctioning. On the other hand, a closed system could potentially decrease environmental contamination of the respiratory device.[24]

H_2 blockers/Sucralfate

The acidification of gastric contents is thought to decrease colonization with potentially pathogenic bacteria. Stress ulcer prophylactic medications that increase gastric pH, like H2 antagonists and antacids, may increase colonization with pathogenic organisms and increase the risk of VAP.[25]

Selective decontamination

The impact of using topical antibiotics on tracheostomy sites on exogenous colonization or infection of the lower airways has been studied.[2]

Oral hygiene

The CDC suggests that health care facilities develop and implement a comprehensive oral hygiene program for patients in acute-care settings or residents in long-term care facilities who are at high risk for health care-associated pneumonia.[26]

CONCLUSION

In the given study, we found that *Acinetobacter*, *Klebsiella* and *Staphylococcus* were the commonest organisms found in ET culture. From the present study we have come to a conclusion that analysing ET culture was important as the sensitivity to the antibiotics obtained was different from those given prophylactically as a protocol. Hence this study will help us in implementing different antibiotics prophylactically with regard to the commonly obtained sensitivity pattern.

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