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Original Article

Study of Healthcare-associated Infection in Intensive Care Units of a Rural Medical College

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Abstract

Introduction: Healthcare-associated infection (HCAI) is a leading infection in the management of intensive care unit (ICU) patients, which causes a high economic burden for the patient's relatives and prolongs the stay of the patients in ICU. In this rural medical college, with the limited resources, we could control the infection in many cases with first-line antibiotics instead of second-line antibiotics used by the other authors worldwide.

Aim: The aim of the study was to study the healthcare-associated infection in ICU.

Materials and Methods: Samples collected were analyzed routinely and real-time polymerase chain reaction assay was also done outside the lab for early detection of organism. We took samples from the white coat pockets of staff nurses and the site of peripheral intravenous catheter insertion. Along with we insisted the HCW to follow the protocol and procedures strictly as per the infection surveillance team.

Conclusion: To conclude, adherence and to follow the stipulations laid by the Infection Control Committee and careful monitoring yielded good response and brought down the HCAI and health care cost.

Key words: Healthcare-associated infection, Intensive care unit, *P.aeruginosa*, infection, hand hygiene

INTRODUCTION

Healthcare-associated infection (HCAI) is defined as the infection which has developed in patients after 48 h or within 30 days of admission.[1]

HCAI some label it as a nosocomial infection is a challenging task in treating patients in intensive care unit (ICU). Among the vulnerable infection which we come across during this study were *Pseudomonas aeruginosa*, *Acinetobacter baumannii* (AB), *Staphylococcus*, resistant type of *Escherichia coli*, *Klebsiella*, etc., some important infections to mention.[2]

Prof. Dr. Semmelweiss, a Hungarian obstetrician in 1847, was the first to describe an HCAI and provide an intervention to avert its spread through "hand hygiene," which still holds good as proclaimed by WHO in Geneva in 2005–2006 as "Clear care is safe care."[3]

P. aeruginosa sometimes may be an opportunistic infection, a leading cause of death as it is present in 5–20% of hospitalized patients, so it can be endogenous or exogenous.[4] The risk of acquired HCAI is a recognized problem in hospital worldwide. However, knowledge of HCAI and adherence to the stipulated protocol may bring down the incidences.

This study involves a few observations made in this hospital ICUs, including late-onset sepsis (LOS) in low birth weight infants in NICU and other ways and means of transmission of infection.

Multiple study and references made by Haque *et al.*, in 2018[2] (70 related articles) indicate that the type of adverse events affecting hospitalized patients is adverse drug reaction, HCAI, and surgical complications. This small study was confining to HCAI that too in a limited area of Health Care in our MICU and NICU.

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Aim

The aim of the study was to study the healthcare-associated infection in ICU.

MATERIALS AND METHODS

The study was done in this Mount Zion Medical College Hospital with 550 inpatients beds, 8 MICU beds, 6 PICU beds, and 8 SICU beds. The study was approved by the local ethics committee.

After unsuccessful infection control by conventional antibiotics and recurrence of the same infection isolates, we decided to carry out (with limited resources) some possible methods of analysis and investigations and following the international guidelines, which yielded some reliable results and are compared with the already published articles. It was up to our satisfaction and encouragement in this rural medical college setup.

In the period from January 2018 to November 2019, all consecutive patients hospitalized in the ICU, samples from many sites such as blood samples, urinary catheters, ventilators, pharyngeal, perianal areas swabs, peripheral intravenous catheter sites, and environmental sites such as tape water, washbasins, and samples from the white coat pockets of staff nurses of MICU and NICU were collected and sent for analysis.

Hand hygiene techniques and surface contacts of healthcare workers also done.

For patients with prolonged stay in the ICUs, multiple samples (one every week until ICU discharge) were collected for isolate recovery.

Samples from coat pockets of nurses in MICU and NICU with the sterile pieces of cloths attached – one polyester and other polyester cotton blend on their dominant hand pockets were collected with aseptic precautions.

We also surveyed a single bed step-down observation room near MICU from where a recurrent infection of *P. aeruginosa* was isolated after the transfer of patients from MICU, who were not infected with *P. aeruginosa* previously.

Real-time polymerase chains reactions (PCR) assay was done in a few selected patients (done outside labs) for rapid detection of organism, especially for *Acinetobacter baumannii* colonization.

RESULTS

With available resources and under financial constraints, our study was limited to 200 patients and 300 samples since few patients needed another assay during review. This was good for tabulation and financial implications.

Of these, 300 isolates – *P. aeruginosa* was recovered from 126 isolates [Figure 1]. Fourteen patients from the single bedded step-down room near MICU have also grown isolates of *P. aeruginosa*. Eleven samples grow with AB in the conventional methods, but it was for 20 samples in the PCR assay, reinforcing the real-time PCR assay is reliable and fast in getting the reports.

We observed hand wash technique also few days at the beginning of the study. Hand wash with soap and water (60%) as well as alcohol gel (43%) was done. Before wearing gloves, nobody has done a hand wash, whereas it was 60% hand wash after removing the gloves. Gloves play an essential role in reducing the risk of infection transmission. Auxiliary nurses performed had hygiene on 51% occasions compared with 27% by the regular nurses.

In spite of adherence to the protocols stipulated, there was a report of isolation of PA in the single bedded step-down room. Hence, tape water was sent for isolation of organism which revealed the growth of *P. aeruginosa*. Remedial works were done; still, there were isolates of PA intermittently, after which we installed PAIL end filter as done by Garvey *et al.*, which yielded good results of negative for *P. aeruginosa*.

High touch surfaces such as patient bed care, equipment, charts, and tables in the workstation all handled by the staff nurses. They observed the protocol we stipulated, but the housekeeping staffs though we educated them, minimally followed the hand hygiene and surface contact techniques. May be due to low education qualification and understanding, we hope so. 50% of the time, they are the ones spreading infections from one bed to another, sometimes from outside also.

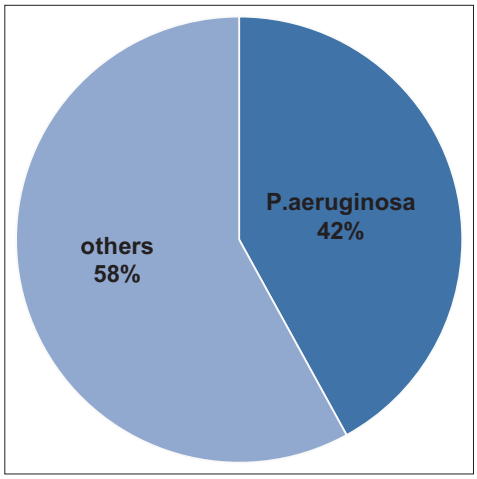

Figure 1: Distribution of *Pseudomonas aeruginosa*

Since it was a financially affecting task, without putting further efforts in this category of people, we advised the supervisors of housekeeping and staff nurses in MICU to watch strictly the housekeeping staff and to insist for adhere to aseptic techniques – after which there was a reduction of cases of *P. aeruginosa* infection.

Fifty samples from pharyngeal and perianal regions and urinary catheters were sent for microbiological investigations, which yielded *A. baumannii*. Because of multiple sites of infections, we sent it for conventional culture and sensitivity and real-time PCR outside our lab. Urinary samples also grow with multidrug-resistant organisms such as PA/AB/Kleb/*E. coli*.

Some 24 patients developed phlebitis of the PIVC. Samples taken from the catheter inserted sites and the area around the catheter were sent for culture. After strict instructions regarding the PIVC insertion and at the end of the baseline period, there was a significant reduction in the PIVC associated SAB infection rate.

Results of 10 each batch of samples from the coat pockets of staff nurses, which showed the bacterial load was higher in 8 batches (80%) in the polyester cotton blend fabric than on the polyester fabric 4 (20%). The organism was *Staphylococcus* spp., *P. aeruginosa*, *Klebsiella* spp., *E. coli,* and vancomycin-resistant *E. coli*.

Reports from NICU (9 samples) which show infant born <32–34 weeks of gestation who presented with sepsis. 71% with *S. aureus* and 3% coagulase-negative (CoNS) organisms was identified.

DISCUSSION

P. aeruginosa is a ubiquitous and important opportunistic pathogen in the health care setting, particularly those with the impaired host or mucosal immunity. It is found in a wide range of moist, nutrient-limited environments, may colonize hospital and domestic water taps, sinks, drains, toilets, and showers. *P. aeruginosa* forms biofilms that allow the persistence of microorganism in the water system for long periods. Once infected, it may remain in the same room for months together and cause continuous transmission. This helps to explain why high colonization rates of the hospital water system have been seen.[5]

Nosocomial *P. aeruginosa* outbreaks have been reported as associated with the water sources. Other potential routes of transmission include cross-infection, for example, patient to patient, carriage on the hands of HCW, and through contaminated medical equipment.

Transmission of *P. aeruginosa* through water and hand wash basin taps matters in NICU-supported by disinfection and replacement of high-risk plumbing parts which grew positive for *P. aeruginosa*. Between February 2019 and June 2019, we recovered isolates mainly from sink taps, floor taps, and damaged corners of a plastic rubber mattress in front of the bathroom door. During this period aromatic cleaning solution was used which was inappropriate for inert surface cleaning. Corrective infection control measures were implemented, including (i) revision of the disinfection protocol, (ii) drying of water surfaces on mattress after disinfection, and (iii) replacement of all sink taps in MICU and NICU.

There was no infection in other areas. Hence, a new cleaning method adopted using a cloth impregnated with antiseptic solution cleaned first from the sink tap down the outlet of the sink once only in a modification to the suggestion of Garvey *et al.*, using three separate cloth which was costlier in our economic situation.[6]

HCAI caused by multidrug-resistant AB also reported, which was continue to be an important problem. Multiple study including Blanco-Lobo *et al.* study described a low sensitivity of the conventional method for detecting *A. baumannii* colonization, so we preferred RT-PCR assay of rapid detection. Real-time PCR proved positive results within 3 h as claimed by Blanco *et al.* when compared with the conventional culture and sensitivity which took nearly 48–72 h.[7]

An observation study in accordance with the King *et al.*, a study involving healthcare workers assigned in 3 shifts with three nurses, three ANMS, and three cleaning staffs each in the shift in rotation for a specified period of study (1 month) which was a good model for this study and supportive for even to detect small mistake which was corrected very easily.[8] As usual, they touched all the surfaces during routine work in the MICU such as BP recording, equipment cleaning, distribution of meals, distribution of medications, and injection, among other works in the MICU.

Hand hygiene was observed, noting type of aseptic used (soap and water and alcohol-based solution) use of antiseptic before and after removal of gloves and swabs from high touch surfaces such as table surfaces, case record and the results are recorded. All subconsciously developed the hand hygiene practice, possibly after the education of the technique.

Regarding peripheral intravenous cannulae, infections with *S. aureus* resulted in morbidity and mortality and increased the cost of health care. Hence, we formulated

a program including healthcare worker education, removal of unnecessary catheters, removal of PIVC at or before 72 h, standard chart for phlebitis assessment, recording of the name of the staff nurse who inserted the cannula, date and time of insertion, hand hygiene practice, with an alert for out of hospital PIVC insertion, and those inserted in suboptimal conditions. Uniformity was maintained in this, including the phlebitis scoring system. Daily observation of the phlebitis scoring being followed till now.

With this multidisciplinary involvement which ensured to improve infection control in PIVC. The fact that improved process technique rather than a reduction in device use was associated with improved outcome. The compliance of the above program consistently brought down the infection rate to a significant level more than 85%. Some claimed impregnated sponge dressing for vascular catheters in addition to above-programmed care.

Wearing a white coat signifies a means of identification, professionalism, and cleanliness of the staff and protects the individuals against body fluids and other contaminants. However, it poses a problem by the transmission of contaminants to the peers, patients, and environmental surfaces in the health care facility.

Sepsis occurs one in every five of low birth weight infants worldwide. LOS due to *Staphylococcus capitis* occurred in low birth weight infants almost alternate days in our NICU recently with 10–15% mortality. Hence, we received a request from our NICU to combine with the evaluation of causes and containment of LOS along with our ongoing surveillance in our NICU. LOS was primarily with CoNS Staphylococci. Methicillin resistance and vancomycin resistance are reported worldwide and mortality was more with *S. aureus* than CoNS.[9]

In our NICU, SA capitis was the dominant organism involved and the response also surprisingly above to our expectation because of the strict compliance and knowledge of sepsis in LBW infants by our staff. After adherence to our surveillance and corrective measures as in MICU, LOS mortality became nil till the end of the study.

Follow-up Screening

After the implementation of infection control standards in the MICU on every 3 months intervals, the patients treated for NCI were reviewed with culture report of samples and nobody reported a positive PA infection or any other organism.

In the MICU step-down room same 3 months interval culture from already positive sites were analyzed; the incidence of PA isolates from MICU step-down room sample decreased from 14 isolates to zero only at the end of the study. PIVC-associated SAB events also decreased from 24 samples to 1 at the end of the study.

CONCLUSION

Double locus sequence typing method of *P. aeruginosa* was convenient and a straightforward tool for identifying *P. aeruginosa* species types. Importance of water sampling, clinical surveillance, molecular identification of species, identifying the source such as water taps, the rubber matte in front of the toilet facilities and education of healthcare workers in following in handwashing technique, insertion of PIVC technique, analysis of the type of fabric and colonization are an eye-opener to us. There was a remarkable outcome in controlling the NCI in MICU and other investigated areas. LOS infection in very LBW infant and SC-related LOS was found to be associated with severe morbidity and mortality.

Recommendation

The revised recommendation in PIVC dressing impregnated with povidone-iodine which is freely available in our setup instead of chlorhexidine for the vascular catheter in ICU yielded a good response.

A large portion of nosocomial infection is preventable with the increased infection control methods and compliance of regulatory guidelines and will bring down the infections to a large extent.

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REFERENCES

1. Horan TC, Gaynes RP. Surveillance of nosocomial infections. In: Mayhall CG, editor. Hospital Epidemiology and Infection Control. Philadelphia, PA: Lippincott Williams and Wilkins; 2004. p. 1659-702.
2. Haque M, Sartelli M, McKimm J, Abu Bakar M. Health care-associated infections an overview. Infect Drug Resist 2018;11:2321-33.
3. Semmelweis I. Die Aetiologie, der Begriff und die Prophylaxis des Kindbettfiebers. [The Etiology, Concept and Prophylaxis of Childbed Fever]. Pest, Wien und Leipzig, CA: Hartleben's Verlag-Expedition; 1861.
4. Blanc DS, Francioli P, Zanetti G. Molecular epidemiology of *Pseudomonas aeruginosa* in the intensive care units a review. Open

Microbiol J 2007;1:8-11.
5. Bédard E, Prévost M, Déziel E. *Pseudomonas aeruginosa* in premise plumbing of large buildings. Microbiologyopen 2016;5:937-56.
6. Garvey MI, Bradley CW, Tracey J, Oppenheim B. Continue transmission of *Pseudomonas aeruginosa* from a wash hand basin critical care unit. J Hosp Infect 2016;94:8-12.
7. Blanco-Lobo P, González-Galán V, García-Quintanilla M, Valencia R, Cazalla A, Martín C, *et al*. Clinical validation of a real-time polymerase chain reaction assay for rapid detection of *Acinetobacter baumannii* colonization. J Hosp Infect 2016;94:68-71.
8. King MF, Hoskes CJ, Sleigh P. Modeling environment contamination in hospital single and four-bed rooms. Indoor Air 2015;25:694-707.
9. Loomba PS, Taneja J, Mishra B. Methicillin and vancomycin resistant *S. aureus* in hospitalized patients. J Glob Infect Dis 2010;2:275-83.

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