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ICU INFECTIONS IN A SUPER SPECIALITY CANCER INSTITUTE

Medical Science

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ABSTRACT

Background: Intensive care unit (ICU) acquired infections account for substantial morbidity and mortality. The study aimed to evaluate the quality indicators and microbial flora and also healthcare professionals for applying the safe practices in the ICU of the cancer institute.
Patients and Methods: This prospective, observational study was conducted in a tertiary care cancer hospital from September 2017 to February 2018.
Results: Catheter-related blood-stream infections (CRBSI) -5.72% was the most frequently observed ICU-acquired infection, while the rates of catheter-associated urinary tract infections (CAUTI) - 2.76% and surgical site infections (SSI) - 1.55% were lower than CRBSI. The percentage of VAP was (1.14%), while bedsore was low (0.16%). There were only 6 cases of needle stick injury (NSI) with 0.02%. Out of all the microbial flora, Gram-negative organisms were common with E. Coli constituting 27.33% followed by Klebsiella 12.17%. The result of the evaluation of the healthcare professionals (nursing staff) for applying the safe practices in ICU through a structured questionnaire was 99%.
Conclusions: Among the quality indicators, CRBSI was the most frequently observed ICU-acquired infection followed by CAUTI. E. Coli followed by Klebsiella was the most prevalent microbial flora. The application of safe practices by the healthcare professionals (nursing staff) in the ICU of our cancer institute was 99%. Our recommendations would help HCP in other ICU facilities in improving quality indicators and reducing ICU infections.

KEYWORDS

cancer institute, CRBSI, ICU, infections, safe practices, super specialty.

INTRODUCTION

Intensive care unit (ICU) acquired infections account for substantial morbidity and mortality. It is also associated with increased financial expenses. Improving infection prevention and control in critical care can reduce the above-mentioned burden. Health care professionals have the responsibility to reduce the infection rate by understanding the risk factors associated with ICU infections.[1,2]

Infections in critically ill patients are central line-associated infections, ventilator-associated infections, urinary tract infections, and other bloodstream infections. Risk factors associated with ICU infection are the presence of underlying disease, underlying comorbidities, presence of indwelling catheters, long hospital stay, and frequent contact with the healthcare workers.[1,3]

The contributory factors in the above infections and antimicrobial resistance have to be understood. The factors which can reduce the stay in the ICU and subsequent infections are the basic training of the health care professionals (HCP), including doctors and paramedics, safe practices in ICU, and proper counseling sessions for them to understand the need for safe practices in ICU to improve the early recovery of the patient, lesser stay in ICU and fasten recovery. Prevention of the multi-drug resistant (MDR) strains in ICU by using the antibiotics policy decreases the emergence of the resistant strains. The function of the hospital infection control program plays an important role in reducing the ICU infection rates and may prove to be very beneficial for the hospital and leads to a lesser stay in the hospital.[4,5]

AIM AND OBJECTIVES

The primary objective of the study was to evaluate the Quality Indicators and Microbial Flora in the ICU of the cancer institute.

The secondary objectives of the study were (a) to evaluate the healthcare professionals (nursing staff) for applying the safe practices in the intensive care units (b) to make recommendations for the infection control measures in ICU.

Patients and Methods:

This prospective, observational study was conducted in a tertiary care cancer hospital and research center. The study was conducted by the first author (RP) from September 2017 to February 2018. The data were collected over six months from the department of microbiology regarding the Quality Indicators and Microbial Flora in ICU of BMCHRC, Jaipur. Data regarding infection control rates in critical care units. Preventive measures were also studied.

Data were collected from 50 nursing staff by administrating a structured Questionnaire and through interviews. There were 8 questions and each yes carried 1 mark. The total score was 400 marks.

Structured Questionnaire (nursing staff was questioned):

1. Are you aware of hand hygiene, and techniques of handwashing?
2. Are you aware of practices for bedsore prevention?
3. Are you aware of biomedical waste management and color-coding?
4. Are you aware of what to do after a needle stick injury?
5. Awareness regarding the preparedness to wean the patient?
6. Head elevation of the patient and suctioning of the endotracheal tube procedures were asked.
7. Sterile techniques for catheterization were asked from the nursing and their importance?
8. Immunization against Hepatitis was asked.

Ethics:

The study protocol was approved by the concerned Ethics committee before conducting the study. Patient confidentiality was preserved throughout all research procedures.

Statistical analysis:

All the records were carefully recorded in the excel sheets, charts were prepared and the information obtained was analyzed according to the objectives of the study. All statistical data analysis was obtained with a statistical package for social sciences (SPSS) version 10.0 for Windows.

Definitions:

An infection manifested on admission into the hospital is defined as community-acquired (CAI).

A nosocomial or hospital-acquired infection (HAI) is defined as an infection that is not present or incubating at the time when the patient is admitted.

Hospital-acquired infections also include the infections acquired during an earlier hospital period.

An ICU acquired infection is defined as an infection that develops at least 48 hours after admission into ICU. The presence of infection was recorded according to the definition of the Centers for Disease Control and Prevention (CDC).[1,2]

Pneumonia was diagnosed when a new or progressive infiltration,

consolidation, or pleura effusion was found with the presence of any two of the following: fever > 38° or hypothermia < 36°, leucocytosis > 10 × 103 /mm3 or leukopenia <4.0 × 103/mm3 and new purulent tracheal aspirate.[3] Pneumonia without preceding ventilator treatment was also diagnosed as LRTI.

Catheter-related bloodstream infection (CRBSI): The same strains of bacteria isolated in blood cultures and a semi-quantitative catheter tip culture, when no other site of infection was present. A CRI infection was also diagnosed if a patient had a positive semi-quantitative catheter tip culture while blood cultures showed no growth or were not done, there were clinical signs of infection, no other site of infection was present, and a favorable response to antimicrobial therapy was obtained.

Sepsis was defined based on any of the following three symptoms in the presence of infection: temperature ≥ 38 °C or ≤ 36 °C, heart rate ≥ 90 beats /minute (if the patient had medication to prevent tachycardia, only the two remaining criteria were required), respiratory rate ≥ 20 breaths /minute or need for mechanical ventilation unrelated to neuromuscular disease or a need for general anesthesia, white blood cells ≥ 12 000 /mm3 or ≤ 4 000 /mm3 or > 10% premature bands.

Severe sepsis was defined as sepsis with one or more organ dysfunction. Renal: urine output < 0.5 ml/kg/hour for more than 1 hour; respiratory: evidence of acute pulmonary dysfunction defined as a PaO2/FiO2 ratio of < 33 kPa (< 250 mmHg); haematological: platelet count < 80 × 109 or a more than 50% decrease from the highest value; metabolic: unexplained metabolic acidosis (pH ≤ 7.30 or base excess < -5.0 Meq/l or plasma lactate level > 1.5 times the upper limit of normal).

Septic shock was defined as sepsis-induced hypotension despite adequate fluid resuscitation and a need for vasopressors to maintain systolic blood pressure ≥ 90 mmHg or mean arterial pressure ≥ 70 mmHg.

Ventilator-associated pneumonia (VAP) as defined by CDC is pneumonia that occurs in a patient who was intubated & mechanically ventilated at the time of onset of pneumonia or within 48 hours before the onset of pneumonia. The criteria include New or progressive infiltrates, Consolidation, cavitation pr pleural effusion on chest X-ray, and At Least one of the following – the new onset of purulent sputum or change of character of sputum, fever, increased or decreased WBC counts, organism cultured from blood Isolation of an etiological agent from biopsy or bronchial brushing specimen.

RESULTS:

The results of the study are shown in Table 1, Table 2, and Table 3. Among the quality indicators, CRBSI (5.72%) was the most frequently observed ICU-acquired infection in our ICU, while the rates of catheter-associated urinary tract infections (CAUTI) - 2.76%, and surgical site infections (SSI) - 1.55% were lower than CRBSI. The percentage of VAP was (1.14%), while bedsore was low (0.16%). There were only 6 cases of needle stick injury (NSI) with 0.02% [Table 1].

Table 1: Monthly and average monthly quality indicators in our study

Quality Indicators	Month 1 Percentage	Month 2 Percentage	Month 3 Percentage	Month 4 Percentage	Month 5 Percentage	Month 6 Percentage	Average Monthly Percentage
CRBSI	6.32%	7.30%	6.26%	5.22%	5.22%	4.02%	5.72%
CAUTI	2.50%	4.06%	2.00%	2.06%	4.36%	1.56%	2.76%
SSI	1.60%	2.20%	2.10%	1.28%	1.20%	0.92%	1.55%
VAP	3.40%	0%	0%	0%	3.44%	0.00%	1.14%
BED SORE	0.04%	0.04%	0.02%	0.02%	0.02%	0.02%	0.16%
NSI	0.02%	0.00%	0.04%	0.02%	0.02%	0.02%	0.02%

Out of all the microbial flora, Gram-negative organisms were common with E. Coli constituting 27.33% followed by Klebsiella 12.17%. Coagulase-negative staphylococcus was identified in 11.83%. Pseudomonas and Actinobacteria were identified in 9.83% and 8.50% respectively. Fungal isolates were present in 6.33% of cases [Table 2].

Table 2: Average and monthly average microbial flora isolated from patients in ICU in our study.

Microbial Flora	Month 1 Percentage	Month 2 Percentage	Month 3 Percentage	Month 4 Percentage	Month 5 Percentage	Month 6 Percentage	Average Monthly Percentage
Escherichia Coli	30%	24%	30%	30%	23%	27%	27.33%
Klebsiella	16%	16%	12%	10%	10%	9%	12.17%
CoNS	9%	8%	10%	10%	16%	18%	11.83%
Pseudomonas	8%	16%	6%	11%	10%	8%	9.83%
Actinobacteria	2%	5%	7%	20%	5%	12%	8.50%
Fungi	9%	7%	9%	6%	4%	3%	6.33%
Others	6%	6%	6%	2%	5%	10%	5.83%
MSSA	4%	8%	9%	4%	6%	2%	5.50%
Enterobacter	8%	4%	7%	3%	8%	2%	5.33%
MRSA	4%	2%	2%	3%	9%	2%	3.67%
Enterococcus	4%	4%	2%	1%	4%	7%	3.67%

The result of the evaluation of the healthcare professionals (nursing staff) for applying the safe practices in ICU through a structured questionnaire was 99% [Table 3].

Table 3: Data from the structured questionnaire asked from 50 nursing staff of ICU

Structural Questionnaire administered to the nursing staff	Frequency (Maximum)	Percentage
Are you aware of hand hygiene, and techniques of handwashing?	50 (50)	100%
Are you aware of practices for bedsore prevention?	50 (50)	100%
Are you aware of biomedical waste management and color-coding?	50 (50)	100%
Are you aware of what to do after a needle stick injury?	46 (50)	92%
Awareness regarding the preparedness to wean the patient?	50 (50)	100%
Head elevation of the patient and suctioning of the endotracheal tube procedures were asked.	50 (50)	100%
Sterile techniques for catheterization were asked from the nursing and their importance?	50 (50)	100%
Immunization against Hepatitis was asked.	50 (50)	100%
Total	396 (400)	99%

DISCUSSION:

The high rates of infection are not surprising because the patients treated in the ICU are the sickest in the hospital. Advanced medicine with its new treatment modalities and organ replacement therapies has allowed successful treatment of patients with more severe illnesses, especially cancers in ICU. However, these patients are often susceptible to infection because of the impairing effects of their underlying diseases and therapies on the immune system e.g. cancer chemotherapy as well as the consequences of surgery.[1]

The main risk factors can be divided into three key groups: those related to patient characteristics and underlying diseases, those related to the acute disease process, and those related to the use of invasive diagnostic or therapeutic procedures.[2] Underlying diseases can impair host defense mechanisms, predisposing to the development of ICU infection. Patients on immunosuppressive medication), e.g., cancer chemotherapy,[3] older patients,[4] and patients with malnutrition are at an increased risk.[5] These endogenous risk factors are hard to influence by preventive methods.[3-5]

Standard Precautions are "the minimum infection prevention practices that apply to all patient care, regardless of suspected or confirmed infection status of the patient, in any setting where healthcare is delivered". These practices are designed to both protect HCPs and prevent them from spreading infections among patients, especially those involving blood-borne pathogens.[6] Standard precautions include: (i) hand hygiene, ii) use of personal protective equipment (e.g., gloves, gowns, masks), iii) safe injection practices, iv) safe handling of potentially contaminated equipment or surfaces in the patient environment, v) respiratory hygiene/cough etiquette.[5,6]

Infection control can be very cost-effective. Approximately one-third of nosocomial infections are preventable. Continuous surveillance of nosocomial infections is an important preventive measure and has per se been associated with the reduction of nosocomial infections.[6,7] Without a systematic evaluation, the real incidence of infections, which is an important indicator of the quality of treatment, in ICU remains obscure.[7,8]

Hand washing, as basic as it is, is an extremely important part of preventing the spread of infection.[9] The health care providers need to

keep their hands clean any time they touch the patient, e.g. when they put in the intravenous cannula, when they maintain it, and when they take it back out.[9] Health care providers must be sure to clean every part of their hands, even under their nails. While on the job, it is important for health care providers to have short, unpolished nails and to keep jewelry to a minimum. Long nails and acrylic nails are frowned upon by health care professionals because they give pathogens more places to hide. Nail polish makes it difficult for the HCP to see under their nails, meaning anything could be under there, and could infect another patient. Wearing excessive amounts of jewelry lessens the effectiveness of handwashing by giving pathogens another place to hide.[10]

Hand hygiene compliance by HCP at the ICU was monitored by the infection control practitioner (ICP) through a randomly selected one-hour observational period, completed 3 times a week, during all working shifts and including all health care workers, according to a specific sequence set forth by the INICC protocol.[11,12]

Other nosocomial infections are harder to prevent because they spread through the use of ICU devices. Device-associated nosocomial infections are the biggest risk to ICU patients as it is a place for those who are in critical condition.[13] Patients are often hooked up to machines that help them perform basic functions, such as breathing and excreting waste. As a result, device-associated nosocomial infections, such as ventilator-associated pneumonia (VAP), catheter-related bloodstream infections, and urinary catheter-related infections, account for over 80% of all nosocomial infections.[14]

Bacterial colonization is associated with the hospital stay, and critically ill patients are especially susceptible due to treatments such as immunosuppressive medications or long-term or repeated courses of antimicrobials, or the use of invasive devices. Antimicrobials can cause selective pressure on the patients´ bacterial flora, modifying it to select potential pathogenic colonizers to the bacterial flora of the skin or the oropharyngeal or gastrointestinal tract, from which many ICU-acquired infections are assumed to arise. Exogenous colonization arises from cross-contamination either via direct contact from the hands of the medical staff or by the transmission of 21 exogenous microbes via contaminated equipment.[15-18] Several microbial agents are responsible for ICU-acquired infections, (especially UTIs) such as Escherichia coli, Pseudomonas spp, Proteus mirabilis, Klebsiella spp, Enterobacter spp, Staphylococcus spp, Enterococcus faecalis, Candida spp, and Enterococcus spp.

Antimicrobial resistance is a growing problem in hospitals, where resistant organisms are often first detected in ICUs. Previous studies have demonstrated that the rates of antimicrobial resistance are greater in bacteria isolated from ICUs compared with other hospital wards and outpatient clinics. Hospitalization in ICUs may be an independent risk factor for getting an infection by multidrug-resistant strains.[19]

In general, Gram-negative bacteria (GNB) accounted for 71 percent of all isolates and were more common in all ICUs.[20] This finding was also observed in our study with majority being GNB. As per various studies, Pseudomonas aeruginosa (21%) was the most common isolate, but in our case E.Coli (27.33%). In our ICU, Pseudomonas aeruginosa was 4th most common (9.83%). It was observed that the bacterial etiology of nosocomial bacteremia differed between the various ICUs.

A high (8.50%) prevalence of Acinetobacter baumannii bacteremia was a notable finding of our study. A. baumannii is an important nosocomial pathogen that mainly affects ICU patients with impaired host defences. In the West, its most common source is the lower respiratory tract (LRT) as also found in our study. However, outbreaks of A. baumannii bacteremia in ICUs due to IV catheters or environmental sources have been reported from India.[21]

The incidence of drug-resistant Gram-negative has become a global problem for several reasons, particularly in ICUs, and will pose more and more of a challenge in the future. The most common source of ICU-acquired Gram-negative bacteremia was pneumonia observed in several other studies.[22] VAP is the most common infection acquired in ICU. The prevention strategy of VAP includes pharmacological & non-pharmacological interventions. In my study, average monthly percentage of VAP was 1.14%. When asked (observed) about all the preventive measured about the VAP, they were followed in the ICU which was marked by the decrease in the VAP cases.

CRBSI rates can be substantially reduced by the application of stringent procedures and technological inventions. Hand hygiene promotion and implementation of a bundle of targeted interventions for catheter-related infections are effective to prevent CRBSI. Guidelines include sterile insertion and handling of central vascular catheters (CVC). These guidelines recommend less infection-prone insertion sites, effective skin antisepsis, the use of specific catheter types, scheduled changes of device material and dressings, and formal training of involved healthcare workers with the use of checklists.[23,24] CRBSI was the highest (5.72%) in my research. It has been estimated as per studies that at least 56% of CRBSI could be prevented.[25]

One of the risk factors for CAUTI is prolonged catheterization. The most common organism isolated from the urine specimens of our patients were E.Coli and K. pneumonia, followed by CoNS, and P. aeruginosa. Our finding was similar to other studies.[26] Urinary tract infections (UTIs) are the most common type of nosocomial infections, accounting for 40% of all infections in hospitals per year. Almost 80% of these infections are due to instrumentation or catheterization. Organisms attacking any portion of the urinary system cause urinary tract infections. [27,28] Organisms may reach the bladder in two ways: a) through the inside of a catheter (i.e. the backward flow of urine) b) by traveling up the space between the outer surface of the catheter and the urethral mucosa. Therefore, once the catheter is inserted, any back-and-forth movement of the catheter (e.g. raising the collection bag above the level of the bladder), allowing urine to be collected in an open drainage system (bag or container) should be avoided because each of these activities potentially enables the organism to enter the bladder. The first way (backward flow of urine in the catheter) is the more common infection in men. The second (Organisms migrating into the bladder along the outside of the catheter) is more common in women in part because of their shorter urethra. [27,28] In various studies, when asked regarding the technique and precautions about the safe handling of catheters many nursing staff were unaware, so although the prevalence of CAUTI was less it further has to be reduced by appropriate measures as already described. [27,28] In our study, the nursing staff were well aware about the technique and precautions in the safe handling of catheters.

As stated in my results that there were the lowest incidences of Needlestick injuries in the six-month study duration there were only five documented cases of NSI which is a very good quality indicator. Out of the six cases reported only one case has blood fluid exposure with the HIV-positive patient The risk of a health care worker acquiring HIV after a needle stick or other “sharps” injury is less than 0.3%. Policies that are in keeping with the local and national guidelines must include a screening of patients, disposal of sharps and wastes, protective clothing, managing inoculation accidents, sterilization, and disinfection. Hospital policy must include measures to obtain serological testing of the source. The one case which had NSI with the biohazard was provided with a PEP regimen within 3 hours of the injury (in our study).

Staff infected with blood-borne pathogens may transmit these infections to patients and require careful evaluation concerning their duties. This status should not be used as a cause for discrimination. When the nursing staff were asked regarding the use of personal protective measures and about the needle stick injuries, 99% of them were aware and all of them were using the PPE in their work standard” precautions involves work practices that are essential to provide a high level of protection to patients, health care workers, and visitors. [29-31]

Surgical site infection (SSI) is defined as an incisional or organ/space infection occurring within 30 days after an operation or within 1 year in absence of an implant.

Incisional SSIs are further divided into a)Superficial incisional (only involves the skin and subcutaneous tissue) b) deep incisional (involves deeper soft tissue, including fascia and muscle layers.) In most SSIs, the source of the pathogen(s) comes from the patient skin mucous membranes or bowel and rarely from another infected site in the body (endogenous sources) while exogenous sources of SSI pathogens are occasionally responsible e.g. Contaminated surface or instrument, or from a member of the surgical team. Antibiotics prophylaxis should be given to the patient undergoing surgery. The dose of the antibiotics must be administered within 60 minutes before incision, to achieve adequate concentration at the surgical site. Surgical site infection (SSI) accounts for 15% of all nosocomial infections and, among surgical

patients, represents the most common nosocomial infection. The postsurgical infection leads to increased length of postoperative hospital stay, drastically escalated expense, higher rates of hospital readmission, and jeopardized health outcomes. In the majority of SSI cases, the pathogen source is the native flora of the patient's skin, mucous membranes, or hollow viscera. [32-34]

Although rapidly bactericidal, alcohol, once evaporated, has no persistent antimicrobial effect. For this reason, alcohol is often combined with either iodine or chlorhexidine in surgical preparations that take advantage of alcohol's potential for rapid bacterial killing over aqueous preparations. Alcohol may also prolong the effects of other disinfectants. The prevention of surgical site infections encompasses meticulous operative technique, timely administration of appropriate preoperative antibiotics, and a variety of preventive measures aimed at neutralizing the threat of bacterial, viral, and fungal contamination posed by operative staff, the operating room environment, and the patient's endogenous skin flora. It is the latter aspect of contamination, and specifically mechanical methods of prevention, on which this review focuses.[34]

A pressure ulcer is a local injury to the skin or underlying tissue, typically over a bony prominence, as a result of constant pressure. Prevention includes identifying vulnerable persons and implementing specific prevention measures, i.e. following a patient repositioning schedule, using pressure-reducing surfaces, and assessing nutrition and providing supplementation. Management involves treatment of local and distant infections, removal of necrotic tissue, maintenance of a moist environment for wound healing, and possibly surgery. There were only five reported cases of bedsores, which is also a good quality indicator of the care we are giving to our patients. In our research, when asked about the care for the bedsores 100% of the nursing staff were aware of the care pattern.

Recommendations

1. Standard Precautions should be part of the work culture of all health care settings and the daily practice of each HCP during the care of all clients/patients/residents at all times.
2. A risk assessment should be made by the HCP before each interaction with a client/patient/resident or their environment to determine which precautions are required to prevent transmission during the planned interaction.
3. A comprehensive hand hygiene program should be implemented in all healthcare facilities.
4. Education in the proper use of PPE should be provided to all HCPs and other staff who have the potential to be exposed to blood and body fluids.
5. Gloves are to be worn when it is anticipated that the hands will be in contact with mucous membranes, non-intact skin, tissue, blood, body fluids, secretions, excretions, or equipment and environmental surfaces contaminated with the above.
6. Gloves are not mandatory for routine health care activities in which contact is limited to the intact skin of the patient.
7. Hand hygiene should be done before putting on gloves for aseptic procedures.
8. Gowns are to be removed immediately after the task for which it has been used in a manner that prevents contamination of clothing or skin and prevents the agitation of the gown.
9. A mask and eye protection must be worn to protect the mucous membranes of the eyes, nose, and mouth when it is expected that a procedure or care activity is likely to generate splashes or sprays of blood, body fluids or secretions or excretions.
10. Clients/patients/residents who visibly soil the environment or for whom appropriate hygiene cannot be maintained are to be placed in single rooms with dedicated toileting facilities.
11. A sharps injury prevention program is to be implemented in all health care settings.

CONCLUSIONS:

Among the quality indicators, CRBSI was the most frequently observed ICU-acquired infection followed by CAUTI. E. Coli followed by Klebsiella was the most prevalent microbial flora. The application of safe practices by the healthcare professionals (nursing staff) in the ICU of our cancer institute was 99%.

ICU-acquired infection. Our recommendations would help HCP in other ICU facilities in improving quality indicators and reducing ICU infections.

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