Nosocomial Infections in the Intensive Care Units – Device Associated Infections
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Introduction

In a hospital setting, the Intensive Care Units (ICUs) have the highest prevalence of health care associated infections. The frequency of these infections as well as the risk of acquiring them, both vary by the type of ICU, and the frequency of specific pathogens also varies by the infection site. Nosocomial infections in the ICUs are commonly caused by multi drug resistant organisms (MDRO) such as MRSA, VRE, ESBL and MBL producing gram negative bacilli and managing such infections can be a daunting challenge to the intensivist. Furthermore, these infections result in increased mortality, morbidity and length of hospital stay and thus, also adds to the cost of treatment. The goal of this article is to discuss the risk factors, specific Device Associated Infections (DAI) in the ICU and infection prevention measures.

The Global and Indian Scenario

World over, leading healthcare organisations have been concerned with nosocomial infections in the ICUs and have carried out studies to estimate the prevalence of these infections and measure their impact on the healthcare delivery processes. The European Prevalence of Infection in Intensive Care (EPIC) study involving over 4500 patients demonstrated that the nosocomial infection prevalence rate in ICUs was 20.6% [1]. Similarly, the estimates provided by the USA's National Nosocomial Infections Surveillance (NNIS), now known as the National Health Care Safety Network (NHSN), indicate that approximately 1.7 million nosocomial infections occurred in the US hospitals in 2002, with 24% of these infections occurring in the ICUs, i.e., a rate of 13 per 1000 patient days [2].

In India, a three year prospective study involving 12 ICUs from 7 hospitals located in 7 cities reported an overall infection rate of 4.4% and an excess mortality of 19.0% [3]. Recently a tertiary care hospital in South India reported infection prevalence rate of 25% in ICU patients with overall mortality of 31% [4].

The Risk factors

The patients admitted to an ICU can have numerous health conditions which compromise normal host defence mechanisms to infections. Besides, other factors such as those related to health care environment, personnel and treatment can also contribute to the development of various infections. Predisposing factors for ICU infections and their relation to other potential causes can be categorized as below –

1. **Host health status** - Advanced age, malnutrition, alcoholism, smoking, chronic lung disease and hyperglycemia.
2. **Presence of acute / existing disease**, trauma and/or burns.
3. **Invasive procedures** – Surgery (ies) / surgical drains, Endotracheal intubation, central venous catheterization extracorporeal renal support, nasogastric tube and urinary catheterization.
4. **Treatment modalities** - Antimicrobial therapy, immunosuppressive treatment, parenteral nutrition, transfusion of blood and blood products and length of stay.
5. **Patient safety and care** - Adequacy of nursing and support staff, hand hygiene compliance, etc.

Device Associated Infections in ICU

Patients admitted to ICUs undergo a variety of invasive procedures involving devices, which predispose them to acquiring DAI. As introduced previously in the first issue of this article series, DAIs namely Ventilator Associated Pneumonia (VAP), Central Line Associated Blood Stream Infection (CLABSI) and Catheter Associated Urinary Tract Infection (CAUTI), account for a of the nosocomial infections acquired in the ICUs and active surveillance plays a key role in controlling these DAIs. The rate of incidence of DAI is calculated as number of infections per 1000 device days. Though the rate of device use in the developing countries is equal or even lower to that in the developed countries, the DAIs are found to be exceedingly higher in the developing countries than in the developed countries such as the USA [5].

The three most commonly occurring DAIs in ICUs are summarised below

1. **Ventilator associated pneumonia (VAP):** Mechanical ventilation is an inherent underlying cause to the development of VAP. This pneumonia develops due to micro aspiration of oropharyngeal colonizing flora. Overall VAP incidence in India is about 10 per 1000 ventilator days [3]. A study on VAP performed in hospitals in 10 developing countries showed that VAP prolonged the length of hospital stay and increased the risk of death by 14% [6]. Supine patient position, increase in gastric pH, continuous sedation, age > 60 yrs, head injury, post surgical patients, reintubation are some of the known risk factors for development of VAP.

2. **Central line associated blood stream infection (CLABSI)**: In most patients admitted to ICUs, Central Venous Catheter (CVC) is required to administer drugs and fluids, parenteral nutrition and monitoring of central venous pressure. An estimated rate of CLABSI in the United States is between 1 and 5.6 per 1000 catheter days [7]. A three year prospective multicentric study in India documented CLABSI rate of 7.92 / 1000 catheter days [3]. The risk factors for CLABSI include longer duration of catheter use, using catheter with multiple lumens, suboptimal skin disinfection, inadequate hand hygiene, use of three way stopcocks, use of vented IV containers and oozing at the site of insertion.

3. **Catheter associated urinary tract infection (CAUTI)**: CAUTI is a common infection, accounting for approximately 23% of nosocomial infections in the ICU. CAUTI is generally less severe than VAP and CLABSI and is not associated with excess patient mortality. Risks factors for CAUTI include female gender, diabetes and long duration of catheterization.

The table below summarises preventive strategies for DAIs in ICUs

	VAP	CLABSI	CAUTI
1.	Adherence to hand hygiene	Adherence to hand hygiene	Adherence to hand hygiene
2.	Limit the use of mechanical ventilation	Aseptic technique during insertion with use of 2% chlorhexidine for skin disinfection	Aseptic technique during catheter insertion and maintenance
3.	Semi recumbent patient position	Use of needle less connectors	Maintaining closed drainage system
4.	Avoiding re-intubation	Use of sterile transparent dressing to cover the site	Prompt removal of the catheter when not needed
5.	Maintaining endotracheal cuff pressure	Use of collapsible IV fluid containers	
6.	Continuous sub glottic-suctioning	Disinfection of ports with 70% alcohol before accessing the CVC	
7.	Oral decontamination		

Prevention of infections in ICUs

In order to achieve effective prevention of nosocomial infections acquired in ICUs, a multi directional approach is necessary. Proper hand washing and alcohol hand disinfection before and after touching every patient remains the most effective and simple infection control measure. Disinfection and sterilization of equipment and environment using standard methods and appropriate disinfectants in the right concentration helps to minimise transmission of microorganisms to patients. The bundle protocols recommended by Centers for Disease Control and Prevention, USA, for prevention of DAIs have to be adopted as practice guidelines to minimise incidence of DAIs.

Furthermore, close monitoring of compliance with bundle protocols, hand hygiene compliance and incidence of DAI is equally important and forms an integral part of the surveillance of ICU based HAIs. Antibiotic stewardship involving judicious antibiotic usage in terms of appropriate selection, right dosage and duration, and timely de-escalation of empiric antibiotics is also an absolutely essential aspect of the control of ICU HAIs.

Thus, in conclusion, application of good practice guidelines, minimising risk factors and continuing staff education are essential to control the incidence of ICU-HAIs.

References

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