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The impact of interventions to improve adherence to preventive measures on the incidence of nosocomial infections in ICUs

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ABSTRACT

Half of all life-threating nosocomial infections occur in intensive care units (ICUs) and, despite the advances in intensive care, the incidence of nosocomial infections is still high. About one third of nosocomial infections are considered preventable. Awareness of risk factors, adherence to preventive measures and collaboration of all members participating in preventive programmes can lead to reduction of the incidence of nosocomial infections and thus can produce a positive impact on reducing morbidity, mortality and healthcare costs. A retrospective surveillance study was performed in a 14-bed medical ICU to identify device-related infections before and after the preventive interventions. Ventilator-associated pneumonia (VAP), central line-associated bloodstream infections (CLABSI) and catheter-associated urinary tract infections (CAUTI) were obtained and compared before and after the interventions. In the year before the interventions, device-related nosocomial infections were diagnosed in 7.9% out of 737 hospitalised patients in the ICU, and in the year after the interventions they were diagnosed in 5.1% out of 684 hospitalised patients. Before the interventions, the infection rates were distributed as follows: 7.5 CLABSI/1000 catheter days, 28.4 VAP/1000 ventilator days, 6.5 CAUTI/1000 catheterisation days. After the interventions, the rates were distributed as follows: 2.5 CLABSI/1000 catheter days, 26.5 VAP/1000 ventilator days and 4.1 CAUTI/1000 catheterisation days. The implementation of effective preventive measures and maintaining strict surveillance is the basis of limiting the risk of nosocomial infections. Since hospital nosocomial infection rate is considered an indicator of quality and safety of care, all infection control activities are focused to decrease rate of nosocomial infections.

Key words: nosocomial infections, intensive care unit, prevention and control, invasive procedures

Introduction

Nosocomial infections are a worldwide health care problem and are associated with increased morbidity and mortality, prolonged duration of hospital stay and increased economic costs. Nosocomial infections affect about 5-10% of hospitalised patients. Patients in intensive care units (ICUs) have a 5-10 times higher risk of acquiring nosocomial infections than patients in other wards. (1-4) The European Prevalence of Infection in Intensive Care Study (EPIC), involving over 4,500 patients, demonstrated that the nosocomial infections prevalence rate in ICU was 20.6%. (5) So the majority of all nosocomial infections are acquired in ICUs, although ICUs account for about 10% of all hospital beds. The reason for this high incidence is multifactorial and includes the use of invasive procedures, the high prevalence of multidrug-resistant pathogens and specific patient characteristics like severe acute physiologic derangements, immunocompromised status and chronic comorbid illness. (6) The most common nosocomial infections in ICUs are bloodstream infections, pneumonia, urinary tract infections and surgical site infections. Nosocomial infections are associated with a mortality rate varying from 5% to 35%. (2,5,7) Epidemiological data regarding nosocomial infections in ICUs in Croatia are lacking.

Nowadays nosocomial infections are considered an undesirable outcome of treatment. A significant number of these infections is preventable. Prevention of nosocomial infections includes two major strategies: infection control measures and control of antibiotic use. Infection control programmes are the responsibility of all services and

individuals providing health care. The responsible health authority has to provide a national prevention programme, and both hospital administration and staff are obligated to work together on reduction of nosocomial infections. (8) The important factor in an infection control strategy is surveillance, a process of identifying the local hospital problem and priorities in prevention activities. Nosocomial infections surveillance includes collecting data and counting rates, and analysing and interpreting results. That is why good documentation is crucial in the process of surveillance. The aim of surveillance is finding an optimal intervention as a preventive action and evaluating the impact of these interventions. (9-11) Approximately one third of nosocomial infections are considered preventable and that is why they are considered an indicator of the quality of patient care and a patient safety issue.

Here we present our attempt to improve ICU medical staff awareness on adherence to preventive measures in order to improve our infection control strategy and reduce the incidence of nosocomial infections.

Materials and methods

In an attempt to reduce the rate of nosocomial infections, a strict infection control strategy was implemented in a 14-bed medical ICU from January 2012. The first step included educational interventions. ICU staff was informed through a lecture about nosocomial infections, the most common pathogens in the hospital and antimicrobial resistance and ways of transmission. This improved staff awareness of nosocomial infections and of the need for preventive interventions. The measures to reduce person-to-person transmission were implemented. All ICU staff underwent a hand hygiene education and afterwards good hand hygiene compliance was secured by continuing observation and surveillance from the Hospital Infection Control Commission. In accordance with the hospital management, materials needed for preventive precautions were obtained: enough gloves, gowns, sterile material, antiseptics, dressings for central vein catheters, closed aspiration systems etc. Architectural changes in the department were also made so that infected patients could be properly isolated. A new environmental cleaning strategy was implemented which also included periodic cleaning with hydrogen peroxide. At the same time, a device-specific strategy was conducted in order to minimise these infections. As the most common nosocomial infections in ICUs are related to invasive procedures, all medical staff was informed of the current guidelines related to the placement and management of intravascular catheters and urinary bladder catheters, as well as the management of patients on mechanical ventilation. All invasive procedures were documented in electronic form in a patient medical history database from the moment that the device was placed to the moment that it was removed, including all data conducted at regular daily surveillance. From the microbiological point of view, a screening swab for MRSA and Klebsiella pneumoniae KPC were obtained from all patients admitted to the ICU, together with other microbiological specimens when the infection was present or suspected. Audits from a microbiologist and clinical pharmacologist were made in order to be up to date with the hospital's microbiological situation and to improve antimicrobial utilisation. In collaboration with the Hospital Infection Control Commission, bundles to prevent device-related infections were implemented. First, the central line infection prevention bundle was implemented, then a urinary tract infection prevention bundle, and the last was a bundle for the prevention of ventilator-associated pneumonia. Adequate data collection was necessary in order to monitor trends, identify needs for new interventions and identify areas for improvement in patient care. All data regarding patients hospitalised in the ICU (presence of devices and procedures with a known risk of infection, antimicrobial therapy, microbiological laboratory results and medical and nursing chart review) which were previously documented in multiple sources were put together in a specially-designed computerised programme with the possibility to search and analyse data. The collected data were the basis for an evaluation of the impact of implemented interventions and of the need for changing the strategy.

Here, we present a retrospective study of nosocomial infection surveillance in a 14-bed medical ICU. Nosocomial infections were defined according to criteria of the Centre for Disease Control and Prevention (CDC) criteria, and invasive

Table 1. Comparison of device related nosocomial infections rates before and after the intervention

	Before interventions	After interventions	p*	Significance
Rate of CLABSI/1000 catheter days	7.5	2.5	0.017	S
Rate of VAP/1000 ventilator days	28.4	26.5	0.055	NS
Rate of CAUTI/1000 catheter days	6.5	4.1	0.067	NS

CAUTI, catheter-associated urinary tract infections; CLABSI, central line-associated bloodstream infections; VAP, ventilator-associated pneumonia
*result is significant at $p<0,05$

device-related infections were defined according to the National Nosocomial Infection Surveillance System (NNIS) criteria. (2,4) An intervention to improve adherence to preventive measures started at January 2012. The rates of the 3 most common nosocomial infections – ventilator-associated pneumonia (VAP), central line-associated bloodstream infections (CLABSI) and catheter-associated urinary tract infections (CAUTI) were compared before and after the interventions. Data for the study were obtained from all admissions between January 2011 and January 2013.

Results

In the year before the interventions the device-related nosocomial infections were diagnosed in 7.9% out of 737 hospitalised patients in the ICU. The most common infection was VAP (55%), followed by CLABSI (26%) and CAUTI (19%). Rates of device-related nosocomial infections were distributed as follows: 7.5 CLABSI/1000 catheter days, 28.4 VAP/1000 ventilator days and 6.5 CAUTI/1000 catheterisation days. (table 1)

In the year after interventions, device-related nosocomial infections were diagnosed in 5.1% out of 684 hospitalised patients in ICU. As before intervention, VAP was the most common infection (52%), followed by CAUTI (36%) and CLABSI (12%). The rates of device-related nosocomials infections were distributed as follows: 2.5 CLABSI/1000 catheter days, 26.5 VAP/1000 ventilator days and 4.1 CAUTI/1000 catheterisation days. (table 1)

The results show a reduction of all device-related nosocomial infections rates after the intervention. The reduction of the CLABSI rate after the intervention was statistically significant, while the reduction of VAP and CAUTI was not statistically significant. (table 1)

When multidrug-resistant pathogens were analysed both in the year before and after the interventions, the three most frequent pathogens were Acinetobacter baumanii anitratus, Pseudomonas aeruginosa and Klebsiella pneumoniae ESBL.

Discussion

Data from CDC shows that the most common nosocomial infections are CAUTI (40%), VAP (25%) and CLABSI (10%). (2) The EPIC study showed that 20.6% patients had an ICU-acquired infection and the distribution was as follows: pneumonia 46.9%, lower respiratory tract infection 17.8%, urinary tract infection 17.6%, bloodstream infection 12%. (5) The Rosenthal multicenter prospective cohort surveillance study showed that rates of device-related infections in ICUs are much higher in ICUs from the developing world compared to those in the United States (US). The rate for CLABSI in developed countries was 7.6 per 1000 catheter days versus 2.0 per 1000 catheter days for a comparable ICU in the US. The overall rate of VAP was also much higher in developing countries than in the US, at 13.6 versus 3.3 per 1000 ventilator days. The same trend exists for CAUTI: 6.3 versus 3.3 per 1000 catheter days, respectively. (12) Based on the surveillance studies between 2008 and 2012, CDC reported that significant progress had been made in the prevention of nosocomial infections and a 44% reduction in CLABSI was reported. The same trend exists for surgical site infections, while a 3% increase was reported for CAUTI. (2) Epidemiological data about nosocomial infections in ICU in Croatia are lacking. Majority of data are estimations, and one of rare studies about this topic is a Baršić et al. incidence study on nosomial infections in critically ill infectious disease patients over a 7-year period. (13)

The prevention of nosocomial infections is fundamental and can be achieved through strict infection control measures, educational interventions, good antimicrobial use and close collaboration of all members who provide health care. Approximately one third of nosocomial infections are considered preventable. Umsheid et al. described how 65-70% of CLABSI and CAUTI and 55% of VAP are preventable. (3)

In order to reduce the incidence of nosocomial infections in our 14-bed medical ICU, we conducted a series of interventions in order to improve the awareness of ICU staff about adherence to preventive measurements. The most important part of our strategy was the implementation of a new way of documenting all procedures and actions related to devices. Documentation is in electronic form and all the actions taken with the device, together with the name of the staff member who performed it, is clearly visible. By documenting all procedures, the staff is obliged to work according to the guidelines and to good medical practice. Analysis of our data showed the highest incidence of VAP, while the incidence of CAUTI was the lowest. When compared with the Rosenthal study, the post- intervention rates for CLABSI and CAUTI were similar to the rates in the US, while the VAP rate was much higher. After the interventions, the reduction of device-related nosocomial infections rates was registered. The reduction of the CLABSI rate after the intervention was statistically significant, while the reduction of the CAUTI and VAP rates was not statistically significant. This is because, at the beginning of the interventions, emphasis was put on the reduction of the CLABSI rate, so the results were best for this device-related nosocomial infection. When desirable results for CLABSI were achieved, we placed our attention on the reduction of the VAP rate, so a VAP prevention bundle was implemented with a new protocol of care for patients on mechanical ventilation. As a result of these interventions, we are expecting positive results in reducing the VAP rate in the future.

Conclusion

The implementation of effective preventive measures and maintaining strict surveillance is the basis for limiting the risk of nosocomial infections and can thus produce a positive impact on reducing morbidity, mortality and healthcare costs. Since the hospital nosocomial infection rate is considered as an indicator of quality and safety of care, all infection control activities are focused to decrease the rate of nosocomial infections.

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