การเฝ้าระวังการติดเชื้อในโรงพยาบาลชนิดการติดเชื้อในกระแสเลือด

รจนา บำรุงศักดิ์ ส.ม.*, ปราณี วตะกูลสิน วท.ม.**, อัชราภร เกษมสายสุวรรณ วท.ม.***, เพียงพิมพ์ ตันติลีปิกร วท.ม.*, ยุทธนา สมานมิตร วท.บ.*, นฤมล สวรรค์ปัญญาเลิศ พ.บ., ส.ม.*

* สำนักวิชาการแพทย์ กรมการแพทย์ กระทรวงสาธารณสุข อำเภอเมือง จังหวัดนนทบุรี 11000

** โรงพยาบาลเลิดสิน 190 ถนนสีลม แขวงศรีเวียง เขตบางรัก กรุงเทพมหานคร 10500

*** สถาบันโรคทรวงอก 74 ถนนติวานนท์ อำเภอเมือง จังหวัดนนทบุรี 11000

Abstract: Surveillance for Healthcare-Associated Bloodstream Infections (HA-BSIs)

Bumrungsak R*, Watagulsin P**, Kasemsaisuwan A***, Tantilipikara P*, Samanmit Y*, Sawanpanyalert N*

* Bureau of Medical Technical and Academic Affairs, Department of Medical Services, Ministry of Public Health, Muang Nonthaburi, Nonthaburi, 11000

** Lerdsin hospital, 190 Silom Rd., Sriwiang, Bangrak, Bangkok, 10500

*** Central Chest Institute of Thailand, 74 Tiwanond Road, Muang Nonthaburi, Nonthaburi, 11000

(E-mail: rojana_b@yahoo.com)

Healthcare-associated bloodstream infections (HA-BSIs) related to substantial mortality and morbidity. These infections primarily caused by bacteria and classified as primary or secondary infection when associated with microbiological-confirmed of infection at other body sites. HA-BSIs were also associated with the increasing of multidrug resistant microorganisms (MDROs) which could severely limit treatment options, complicate medical management and prolong hospital stays. To address these issues, an HAI surveillance, including central-line associated bloodstream infection (CLABSI) was proposed to provide the necessary data for HAI prevention and control. This HA-BSI surveillance was intended to be a platform for developing sustainable surveillance for HAIs in the future, including other HAI types. This surveillance was conducted in intensive care units (ICUs), Lerdsin hospital and Central Chest Institute of Thailand, during January - December 2016, using the modified BSI definition adopted from the United States Centers for Disease Control and Prevention's (US CDC) National Healthcare Safety Network (NHSN). There were in total of 65 episodes met this HA-BSI definition and surveillance protocol. Male and female were 69.2% and 30.8%, respectively. The mean age was 65.5 ± 17.4 years and ages ranged 20 - 91 years. At the end of event timeframe (14 days after date of event), 52.3% died, 41.5% was still in surveillance unit, and 6.2% was transferred to other unit within the hospitals. The BSI was 83.1% and present on admission (POA) was 16.9%. The BSI associated with central-line was 49.2%. When stratified by types of central line, non-tunneled short-term catheter (50.0%) was the most common device, followed by hemodialysis catheter (18.8%), peripherally inserted central catheter (15.6%) and tunneled catheter (6.3%). Insertion sites were jugular (46.9%), subclavian (18.8%), femoral (18.8%), and brachial (6.3%). Laboratory-confirmed BSI identified 96.9% of recognized pathogen. In these total 65 episodes, 71 pathogens were identified. The most frequent pathogens causing HA-BSI were gram-negative bacteria (77.5%) that comprised of *Klebsiella pneumoniae* (41.8%), *Acinetobacter baumannii* (16.4%), and *Escherichia coli* (12.7%) and Gram-positive bacteria caused 19.7% of HA-BSI, mostly were *Staphylococcus aureus* (64.3%). Multidrug resistant *Klebsiella pneumoniae* (73.9%), *Acinetobacter baumannii* (88.9%), *Pseudomonas aeruginosa* (60.0%) and *Escherichia coli* (28.6%) were found. The secondary infections localized at other body sites were 50.8%. The total BSI rate was 2.70 per 1,000 patient days, the primary BSI rate was 1.60 per 1,000 patient days and CLABSI rate was 2.4 per 1,000 central line days. Gram-negative bacteria remained predominant among etiologic pathogens causing HA-BSIs.

Keywords: Healthcare-associated infection (HAI), Bloodstream infection (BSI), Central line-associated BSI (CLABSI), HAI Surveillance

บทคัดย่อ

การติดเชื้อในโรงพยาบาลชนิดการติดเชื้อในกระแสเลือดมีความสัมพันธ์กับอัตราป่วยและอัตราตายที่เพิ่มขึ้นการติดเชื้อส่วนใหญ่มีสาเหตุจากเชื้อแบคทีเรีย ซึ่งจำแนกได้เป็นการติดเชื้อแบบปฐมภูมิ และทุติยภูมิ เมื่อพบการติดเชื้อในร่างกายส่วนอื่นๆ นอกจากนี้ยังเกี่ยวข้องกับการเพิ่มขึ้นของเชื้อจุลชีพดื้อยาหลายขนาน ซึ่งเป็นการจำกัดทางเลือกในการรักษาผู้ป่วย เพิ่มความซับซ้อนในการจัดการทางการแพทย์ และเพิ่มระยะเวลานอน

ในโรงพยาบาลของผู้ป่วยเพื่อจัดการปัญหาการติดเชื้อในกระแสเลือดจึงได้ดำเนินการเฝ้าระวังการติดเชื้อในกระแสเลือดครอบคลุมถึงการติดเชื้อในกระแสเลือดที่เกี่ยวข้องกับการใส่สายสวนหลอดเลือดดำส่วนกลางเพื่อให้ได้ข้อมูลที่จำเป็นในการป้องกันและควบคุมการติดเชื้อ และเป็นต้นแบบในการพัฒนาการเฝ้าระวังการติดเชื้อชนิดอื่นๆ ที่ยั่งยืนในอนาคต การเฝ้าระวังนี้ดำเนินการในหออภิบาลผู้ป่วยหนักโรงพยาบาลเลิดสิน และสถาบันโรคทรวงอก ระหว่างเดือนมกราคม ถึงธันวาคม 2559 โดยใช้นิยามการเฝ้าระวังที่ปรับจากนิยามการติดเชื้อในกระแสเลือดของศูนย์ป้องกันและควบคุมโรคแห่งชาติ สหรัฐอเมริกา (US CDC) โดยพิจารณาผลการเพาะเชื้อจากตัวอย่างเลือดทุกรายที่เข้าได้กับนิยามการเฝ้าระวัง และบันทึกลงในแบบเก็บข้อมูล ผลการเฝ้าระวังพบการติดเชื้อ 65 ครั้งเป็นชายร้อยละ 69.2 หญิงร้อยละ 30.8 อายุเฉลี่ย 65.5 ± 17.4 ปี ช่วงอายุที่พบการติดเชื้อ 20 - 91 ปี ในช่วงเวลาที่เฝ้าระวังแต่ละเหตุการณ์ (14 วัน) ผู้ป่วยเสียชีวิตร้อยละ 52.3 ยังคงพักรักษาในหอผู้ป่วยเดิมร้อยละ 41.5 และย้ายไปหอผู้ป่วยอื่นร้อยละ 6.2 พบเป็นการติดเชื้อที่เกิดจากการรักษาพยาบาลร้อยละ 83.1 และเป็นการติดเชื้อที่พบในวันที่เข้ารับรักษาแบบผู้ป่วยในร้อยละ 16.9 เป็นการติดเชื้อในกระแสเลือดที่เกี่ยวข้องกับการใส่สายสวนหลอดเลือดดำส่วนกลางร้อยละ 49.2 เมื่อจำแนกประเภทของสายสวนหลอดเลือดดำพบมากที่สุดคือ สายสวนชนิด non-tunneled ร้อยละ 50 รองลงมาคือสายสวนสำหรับฟอกเลือด ร้อยละ 18.8 สายสวนหลอดเลือดดำผ่านทางหลอดเลือดดำส่วนปลาย ร้อยละ 15.6 และสายสวนชนิด tunneled ร้อยละ 6.3 ตำแหน่งที่พบเป็นหลอดเลือดดำ jugular ร้อยละ 46.9 รองลงมาคือหลอดเลือดดำ subclavian ร้อยละ 18.8 หลอดเลือดดำ femoral ร้อยละ 18.8 และหลอดเลือดดำ brachial ร้อยละ 6.3 ผลการเพาะเชื้อทางห้องปฏิบัติการพบเป็นเชื้อจุลชีพที่ทำให้เกิดโรค ร้อยละ 96.9 โดยในจำนวนการติดเชื้อทั้งหมด 65 ครั้ง จำแนกได้เชื้อจุลชีพ 71 เชื้อ เชื้อจุลชีพที่พบเป็นสาเหตุของการติดเชื้อร้อยละ 77.5 เป็นแบคทีเรียแกรมลบ ประกอบด้วย *Klebsiella pneumoniae* ร้อยละ 41.8 *Acinetobacter baumannii* ร้อยละ 16.4 และ *Escherichia coli* ร้อยละ 12.7 และเป็นแบคทีเรียแกรมบวกร้อยละ 19.7 ซึ่งพบเป็น *Staphylococcus aureus* ร้อยละ 64.3 โดยเชื้อจุลชีพที่จำแนกได้ พบว่า *A.baumannii*ร้อยละ 88.9, *K. pneumoniae* ร้อยละ 73.9,*P. aeruginosa* ร้อยละ 60.0และ*E. coli* ร้อยละ 28.6 ดื้อต่อยาต้านจุลชีพการติดเชื้อในกระแสเลือดที่พบร้อยละ 50.8 เป็นการติดเชื้อแบบทุติยภูมิ อัตราการติดเชื้อในกระแสเลือดรวม 2.7 ครั้ง ต่อ 1,000 วันนอน เป็นอัตราการติดเชื้อในกระแสเลือดชนิดปฐมภูมิ 1.6 ครั้ง ต่อ 1,000 วันนอน และอัตราการติดเชื้อในกระแสเลือดที่เกี่ยวข้องกับการใส่สายสวนหลอดเลือดดำส่วนกลาง 2.4 ครั้ง ต่อ 1000 วันใส่สายสวนสวนหลอดเลือดส่วนกลางแบคทีเรียชนิดแกรมลบเป็นเชื้อจุลชีพก่อโรคที่พบมากที่สุด

คำสำคัญ : การติดเชื้อในโรงพยาบาล การติดเชื้อในกระแสเลือด การติดเชื้อในกระแสเลือดที่เกี่ยวข้องกับการใส่สายสวนหลอดเลือดดำส่วนกลาง การเฝ้าระวังการติดเชื้อในโรงพยาบาล

Introduction

Healthcare-associated bloodstream infections (HA-BSIs) relate to substantial mortality and morbidity, particularly in critically ill patients or patients admitted to intensive care units (ICUs).[1] HA-BSIs are also associated with the increasing of multidrug resistant microorganisms (MDROs) which can severely limit treatment options, complicate medical management and prolong hospital stays.[1-2] The extent of HAIs is believed to be underestimated in terms of disease burden, severity of outcomes, and economic impact.[3] These infections can be caused by bacterial, viral and fungal pathogens.[4] BSIs are often classified as primary infection (originating in the bloodstream) or secondary infection when associated with microbiological-confirmed of infection at other body sites.

A central line, also known as a central venous line, is a catheter that is placed into a large vein, usually in the neck (internal jugular vein), chest (subclavian vein), groin (femoral vein) or arms (known as peripherally inserted central catheters or PICC line). It is often used for infusion, withdrawal of blood, measure central venous pressure, or give fluids and medications to critically ill patients.[5] Central line usually remain in place for a longer period than other venous access devices. Insertion with sterile technique is very important, as a line may serve as an entry point or be infected with any pathogen organisms. Therefore primary BSI can be further classified by device association, either as central line-associated BSI (CLABSI) or non-central line associatedprimary BSI.Secondary BSI cannot be classified as central-line associated, as an infection at another body site argues against a primary BSI due to catheter presence.

An HA-BSI surveillance, CLABSI, was proposed to provide the necessary data and intended to be a platform for developing sustainable surveillance for HAIs for the future, including other HAI types and detection of antimicrobial resistance.

Materials and Methods

This surveillance was conducted in intensive care units (ICUs), Lerdsin hospital and Central Chest Institute, during January-December 2016, using the modified BSI definition adopted from the United States Centers for Disease Control and Prevention's (US CDC) National Healthcare Safety Network (NHSN).[6] Each positive blood culture was screened for possible cases and recorded on the case report form for case that met this surveillance protocol. HAI program based on MS access was developed and used for data entry, cleaning and validation. Double data entry were performed. The central line-days and patient-days were monthly collected and used for calculating the denominators for determining BSI and CLABSI incidence rates.

Related terms

Date of Event: the date when the first criteria used to meet the case definition occurs for the first time within the window period.

Event Timeframe: a 14 calendar day timeframe (date of event = day 1 of the 14 day timeframe).

Healthcare-associated Infection: a case where the date of event occurs > 2 calendar days after hospital admission, with date of admission as Day 1.

Present on Admission: a case where the date of event occurs ≤ 2 calendar days after hospital admission, with date of admission as Day 1.

Results

There were in total of 65 episodes met this HA-BSI definition and surveillance protocol. Male and female were 69.2% and 30.8%, respectively. The mean age was 65.5±17.4 years and 20-91 years in range. Figure 1 showed the distribution of BSI events during this surveillance. The most episodes were found in August, 2016.

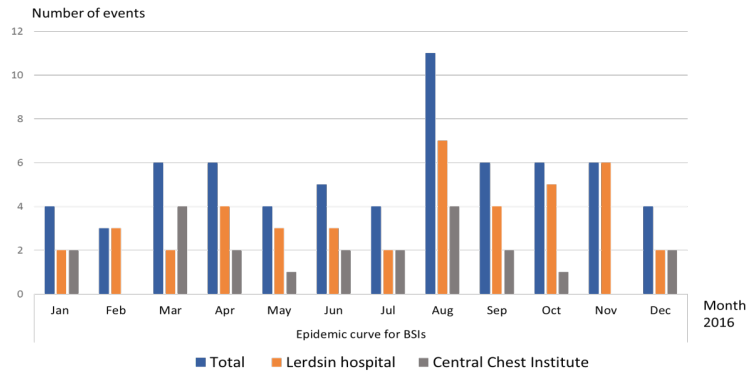

Figure 1 Epidemic curve for BSI events by month, 2016

At the end of event time frame (14 days after date of event), 52.3% died, and 41.5% was still in surveillance unit, and 6.2% was transferred to other unit within hospital. The HA-BSI was 83.1% and infection presented on admission (POA) was 16.9%. The BSI that associated with central line was 49.2%. When stratified by types of central-line, non-tunneled short-term catheter was the most common device, followed by hemodialysis catheter, peripherally inserted central catheter (PICC), tunneled catheter and other (50.0, 18.8, 15.6, 6.3 and 18.8%, respectively) (Figure 2).

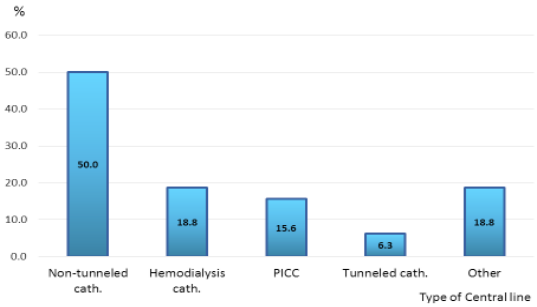

Figure 2 Type(s) of central line(s)

Insertion sites were jugular, subclavian, femoral, brachial, unknown location and other (46.9, 18.8, 18.8, 6.3, 9.4 and 9.4%, respectively) (Figure 3). The other included thoracic or basilic vein.

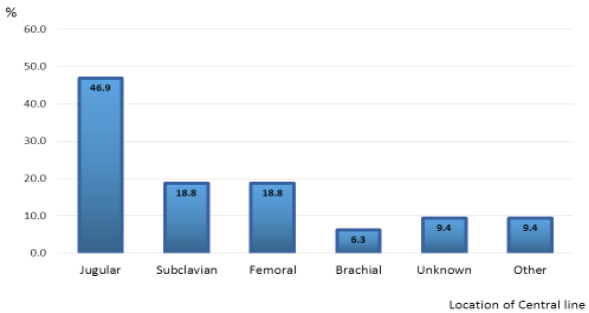

Figure 3 Insertion site(s) of central line(s)

Laboratory-confirmed BSI found recognized pathogens 96.9% and common commensals 3.1%. In these total 65 episodes, 71 pathogens were identified (Figure 4). The most frequent pathogens causing HA-BSI were gram-negative bacteria (77.5%) comprised of *Klebsiella pneumoniae* (41.8%), *Acinetobacter baumannii* (16.4%), and *Escherichia goli* (12.7%) and gram-positive bacteria (19.7%), mostly identified *Staphylococcus aureus* (64.3%).

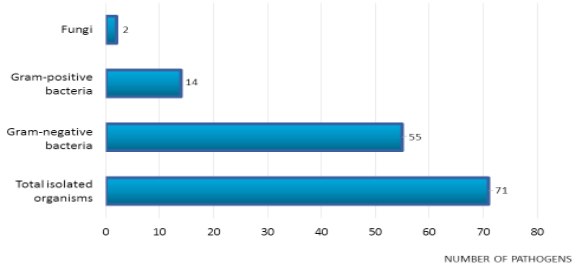

Figure 4 Pathogens identified of laboratory-confirmed BSI

The secondary infections localized at other body sites were 50.8%. The common sites were respiratory tract (75.8%) and urinary tract (18.2%). When defined MDROs as an isolate with non-susceptibility to at least one agent in three or more antimicrobial categories, multidrug resistant *K. pneumoniae* (73.9%), *A.baumannii* (88.9%), *P. aeruginosa* (60.0%) and *E. coli* (28.6%) were found (Figure 5). Whereas 55.6% *S. aureus* isolates were methicillin-resistant (MRSA).

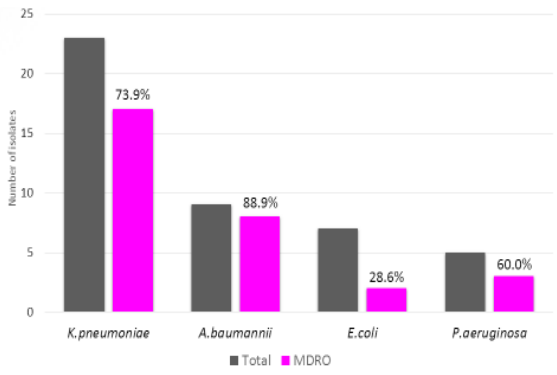

Figure 5 Multidrug resistant Gram-negative bacteria isolated

The total BSI rate was 2.7 per 1,000 patient days, the primary BSI rate was 1.6 per 1,000 patient days and CLABSI rate was 2.4 per 1,000 central line days. The device utilization rate (DUR) was 0.35 per patient days.

Discussions

Healthcare-associated infections (HAIs) or infections acquired in healthcare settings are the most frequent adverse event in healthcare delivery and a major threat to the patient safety in any healthcare facilities. These infections were defined as condition that results from an adverse reaction to the presence of any infectious agent(s) that was not present at the time of hospital admission. Bloodstream infections (BSIs), as a complication of critical illness, are a major cause of morbidity and mortality worldwide. Severe sepsis, septic shock, and multisystem organ dysfunction related to BSI frequently require admission in ICU for appropriate management.[1, 7] The case fatality rate associated with BSI reaches 35 - 50% when associated with admission to ICU.[8] In an international study of the prevalence and outcomes of infections in ICUs, BSIs were observed in 15% of infected patients and represented the third-most commonly met infection.[9] BSIs have been raditionally classified as either community acquired (CA) or hospital acquired (HA). These classification is reconsidered due to the evolving of healthcare system organization. A growing proportion of patients, with older age and several comorbidities, are treated as outpatients, with a shift of healthcare services from hospitals to the community with different out-of-hospital facilities.[10-11] In this sense, HA-BSIs have been defined as infection in patients who had recent contact with some aspect of healthcare, such asrecent hospitalization, living in a nursing home or long-term care facilities, receiving healthcare at home, under hemodialysis, intravenous chemotherapy, wound care, or enteral nutrition.[10, 12]

This surveillance found HA-BSI was 83.1% and infection present on admission (POA) was 16.9%. POA was defined as an infection occurred less than 2 days after admission. POA was reported either if that patient was transferred directly from another hospital where he or she was admitted for more than 2 calendar days, or re-admitted to same hospital with previous hospital admission more than 2 calendar days and discharge date within 14 days before date of infection. This finding was similar to the report of Valle and colleague, approximately one in five BSIs diagnosed at ICU admission might be classified as healthcare associated BSIs. The pathogens responsible for healthcare-associated BSIs were similar to those isolated from hospital-acquired BSIs.[13] According to this surveillance, BSI that associated with central-line was 49.2%. When stratified by types, half of the infection was associated with non-tunneled short-term catheter insertion and much higher than tunneled insertion. This finding complied with the Joint Commission of CLABSI toolkit that non-tunneled central venous catheters (CVCs) account for the majority of CLABSI.[14] For entry site, jugular was the most common insertion site found in this surveillance. Based on the study of Timsit, the internal jugular access is associated with a low rate of severe mechanical complications in ICU as compared with subclavian accessand it is preferable for short-term access and haemodialysis.[15]

Laboratory-confirmed BSI identified 96.9% of recognized pathogen. The most frequent pathogens causing HA-BSI were gram-negative bacteria and *K.pneumoniae* was the most common isolates. Patients with central vein catheter have additional risk factors for catheter-related BSIs, including improper adoption of sterile technique, inexperience of the operator, site of insertion, colonization of insertion site, contamination and duration of catheter placement.[16-17] This surveillance also found that half of infections were localized at other body sites. The most common site was respiratory tract. Similar to study of Choudhuri and colleague observed that the most common infection of ICU-acquired infection in a tertiary care of Northern India was pneumonia and common organism isolated was *K.pneumoniae*[18] When defined MDROs as an isolate with non-susceptibility to at least one agent in three or more antimicrobial categories, the multidrug resistant *K. pneumoniae* (73.9%), *A. baumannii* (88.9%), *P. aeruginosa* (60.0%) and *E. coli* (28.6%) were found. Whereas 55.6% *S. aureus* isolates were methicillin-resistant (MRSA). Antimicrobial therapy is the major treatment of BSIs, along with clinical management of severe sepsis and septic shock that may eventually develop. Emergence of resistant bacteria in the ICU implies an even higher challenge for the clinician, dealing with seriously ill patients, who need prompt institution of effective antimicrobial therapy in a setting of higher prevalence of resistant isolates, broad-spectrum antibiotic, use and ease of cross-transmission of resistant microorganisms.[9] In general, prior antibiotic exposure and hospitalization, residency in nursing home and in long-term care facilities, and other described risk factors for healthcare related BSIs are associated with an increased risk of developing a BSI caused by resistant microorganisms.

Conclusions

The total BSI rate was 2.7 per 1,000 patient days, the primary BSI rate was 1.6 per 1,000 patient days and CLABSI rate was 2.4 per 1,000 central line days. The device utilization rate (DUR) was 0.35 cases per patient days. BSIs were associated with the use of central line catheters. Gram-negative bacteria remained predominant among etiologic pathogens causing HA-BSIs.

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