ISSN: 2279 - 0594

ournal of Biomedical and Pharmaceutical Research 2 (1) 2013, 100-104

RESEARCH ARTICLE

ICU-BASED RESEARCH ON BACTERIAL PATHOGENS LINKED TO BLOODSTREAM INFECTIONS AND DRUG RESISTANCE

Dr. Aarti Gupta[1], Dr. Jayant Balani[2]

[1]Associate Professor Dept. of Microbiology Gian Sagar Medical College & Hospital Ram Nagar (Banur), Distt. Patiala, Punjab

[2]Assistant Professor Dept. of Microbiology Gian Sagar Medical College & Hospital Ram Nagar (Banur), Distt. Patiala, Punjab

ABSTRACT:

Background: Multidrug resistant microbes are commonly found in intensive care units. For timely care, micro-biological diagnosis of bacteraemia is crucial; however, the findings of culture and antibiotic susceptibility testing take three to four days. It is crucial to furnish intensivists with up-to-date information regarding antibiotic susceptibility patterns in order to commence empirical therapy.

Methodology: The goal of this research was to determine the micro-biological profile of bloodstream infections (BSI) in subjects from the intensive care unit (ICU). The micro-biological characteristics, pattern of antibiotic susceptibility, and particular mechanism of antibiotic resistance of the isolates were investigated.

Results: Out of 300 subjects that were suspected, 22% had BSI. The most common isolates were A. Baumannii and P. aeruginosa, which exhibited MBL and ESBL synthesis as the main mechanisms of resistance.

Conclusion: Implementing a strong antibiotic strategy and adhering to hospital infection control measures is warranted due to the high prevalence of anti-microbial resistance in isolates causing bloodstream infections in intensive care units.

Key Words: Antibiotic resistance, blood stream infection, pathogens

INTRODUCTION:

Subjects in intensive care units experience bloodstream infections two to seven times more commonly than subjects in wards[1]. All critically sick subjects have a high rate of morbidity and mortality due to bloodstream infections (BSI), which necessitates common diagnostic testing, higher antibiotic prescription rates, and longer hospital stays. Even when blood cultures are taken in an attempt to identify the infection, the results are commonly difficult to interpret or negative[2,3]. Separating real bacteraemia from a false positive culture result is crucial, but it can be challenging in an intensive care unit (ICU) due to several factors such common invasive procedures, the use of ventilators and nebulizers, among others. False positive culture reports are expensive because they commonly result in more diagnostic testing, prescriptions for antibiotics, and longer hospital stays[4,5]. Furthermore, bacteriological cultures and antibiotic susceptibility tests require three to four days to yield results. Nonetheless, in suspected cases of BSI, micro-biological identification of bacteraemia is crucial for timely subject management and antibiotic treatment. Multidrug resistant bacteria are commonly found in intensive care units (ICUs) since most subjects are on higher doses of antibiotics[6]. Thus, it becomes more crucial to give intensivists up-to-date information regarding antibiotic susceptibility patterns before initiating empirical therapy. The goal of the current research is to identify the micro-biological cause of bloodstream infections (BSIs) in critically sick subjects from the medical and surgical ICUs. The micro-biological characteristics, pattern of antibiotic susceptibility, and particular mechanism of antibiotic resistance of the isolates were thoroughly investigated[7]. The results of this research will be very beneficial in developing antibiotic policies for subjects in intensive care units.

MATERIAL AND METHODS

This urban tertiary care teaching hospital's intensive care unit served as the site of this observational prospective research.

Subject selection: The research comprised subjects who were admitted to intensive care units, both medical and surgical, throughout a one-year period.

*Corresponding author: Dr. Jayant Balani

The research included all subjects admitted to intensive care units who had a clinical suspicion of BSI. Each subject's complete medical history and test results were gathered and entered onto a specifically created performa.

Sample Collection: Three separate blood draws were performed on the subjects. The first blood sample was drawn as soon as the subject was admitted to the intensive care unit, ideally within a few hours of the subject's admission and before the start or modification of antibiotics. A second sample of blood was taken after 72 hours, and a third sample was taken after 7 days. When clinical suspicion persisted and no organism was found in prior blood cultures, a second sample was taken. For the purpose of collecting blood, the subject's or their relative's written consent was sought (in the event that the subject is asleep). For the main inoculation, brain heart infusion (BHI) broth with anticoagulant SPS was utilized.

Blood Collection procedure: Instead of using an indwelling central line catheter, a set of blood samples was obtained via venipuncture of peripheral veins such as the antecubital vein. The venipuncture site was cleansed with a cotton swab soaked in 70% alcohol and let to dry. The site was not palpable after being washed with povidone-iodine and allowed to dry. 10 milliliters of blood were drawn using a syringe and sterilized needle. At the subject's bedside, blood was infused with blood culture broth. A cotton swab dipped in 70% alcohol was used to sanitize the rubber cap of the blood culture broth bottle prior to the removal of the aluminum cap used for blood collection. Without changing needles, the drawn blood was immediately infused into the blood culture broth. In order to avoid clotting and ensure that the blood and blood culture broth were well mixed, the blood culture broth was stirred right away.

Laboratory Processing: For a maximum of seven days, blood culture broths were cultured at 370C in a CO2 incubator. Every 24 hours, the broth was shaken and thoroughly inspected to look for visible signs of growth such turbidity, color changes, or the production of pellicle formation. Subcultures were carried out on the second, fourth, and seventh days of incubation, either in response to the visualization of growth markers or not, onto 5% sheep blood agar, chocolate agar, MacConkey agar, and two Sabouraud's Dextrose Agar slants, one of which was incubated at room temperature and the other at 370C. Slants were checked every day for growth for a period of four weeks. At the beginning of every subculture, gram-stained smears were made and used to look for bacteria as well as early yeast cell identification.

All growth on MacConkey, chocolate, and blood agar was observed in accordance with the established protocol. According to CLSI recommendations, an antibiotic sensitivity test was performed using a modified Kirby Bauer disk diffusion method. By using the cefoxitin (30 µg) disk method, all staphylococcal isolates were tested for methicillin resistance, and all gram-negative isolates were screened for ESBL generation. The combined disk test using betalactamase and betalactamase inhibitor verified the generation of ESBL. The ESBL producers were identified using a novel scheme, and the Amp C producers were screened and confirmed using a modified three-dimensional assay. Metallobetalactamase production was assessed in enterobacteriaceae, P. aeruginosa, and A. baumannii strains resistant to meropenem. The combined disc test method of imipenem and meropenem was employed.

RESULTS

In the course of the research, there were 1454 admissions to both intensive care units. Of these, 300 subjects (216 from the medical ICU and 84 from the surgical ICU) with a clinical suspicion of bloodstream infection (BSI) were thoroughly examined in terms of the bacterial profile of BSI, the pattern of antibiotic susceptibility, and the mechanism of resistance. Out of the 300 suspected cases, 66, or 22%, experienced BSI. Compared to surgical ICUs, where the incidence of BSI was 31%, the medical ICU showed a 19% incidence of BSI. P. aeruginosa and A. baumannii were the most commonly occurring isolates out of all 66 samples (Table 1). Out of the 66 BSI cases, 10 were identified as primary BSI in the first blood culture, accounting for 15% of the cases; 16 isolates (24%) were found in the second blood culture sample; and 40 isolates (61%) were found in the third blood culture sample. The first blood culture sample contained S. aureus and P. aeruginosa as isolated organisms. 52 (79%) of the 66 isolates were bacteria, and 14 (21%) were fungus. Fungemia rate is

correspondingly 5% (14/150). Gram negative bacteria accounted for 81% of BSI in 52 bacterial isolates, whereas gram positive cocci were responsible for 19% of BSI. Seventy-five percent of S. epidermidis strains were found to be methicillin resistant. However, none showed resistance to teicoplanin, linezolid, or vancomycin. The synthesis of Amp C and ESBL was mostly observed in all K. pneumoniae and E. coli isolates. The main mechanism of resistance in P. aeruginosa and A. Baumannii was the development of ESBL and MBL.

Table 1: Distribution of pathogens in BSI cases

Organism	Total no.(n=66)	Percent (%)
P. aeruginosa	12	18
A. baumannii	12	18
K. pneumoniae	10	15
E. coli	6	9
C. koseri	2	3
S. aureus	2	3
S. epidermidis	8	12
C. albicans	6	9
C. tropicalis	2	3
A. fumigatus	2	3
A. niger	2	3
S. cerevisiae	2	3

Table 2: Antibiotic resistance pattern of GNB

Antibiotic	P. aeruginosa (n=12)	A. baumannii (n=12)	K. pneumonia (n=10)	E.coli (n=6)	C.koseri (n=2)
Ampicillin	-	-	10	6	2
Amp/Clavulanic acid	-	-	10	6	2
Piperacillin	6	12	-	-	2
Pip/Tazobactam	6	8	6	6	2
Gentamicin	10	6	4	6	2
Amikacin	12	6	4	4	2
Tobramycin	12	12	-	-	-
Cefotaxime	12	12	10	6	2
Ceftazidime	8	12	10	6	2
Cefoperazone	12	10	10	6	2
Cefepime	8	10	8	6	2
Meropenem	12	12	2	4	0
Ciprofloxacin	12	10	10	6	2
Levofloxacin	10	10	6	6	2
Tmp / Sulfamethxazole	10	10	10	4	2
Tetracycline	12	12	10	6	2
Chloramphenicol	12	-	-	-	-
Polymyxin B	2	-	-	-	-
Colistin	4	-	-	-	-

DISCUSSION

The rate of bloodstream infections in intensive care units is rising. It has been shown to differ greatly between regions, and this is partly due to regional differences in risk factor distribution and blood culture rates[8-10]. There have been reports of BSI in ICUs ranging from 0.47 percent to 20.9%. This is probably because research populations differ, studies last longer, and hospitals have different intensive care management setups. A total of 300 subjects with a clinical suspicion of BSI were included in this investigation. Clinical characteristics, risk factors, the micro-biological profile of bloodstream infections (BSI), antibiotic susceptibility and resistance mechanisms, the source of BSI, and the prognosis were all thoroughly examined in the individuals[11-14]. Compared to the medical ICU, the surgical ICU had a greater overall reported incidence of BSI.

This is a result of both a higher number of interventions and a larger research population that included admissions from a variety of surgical specialties, including cardiology, general surgery, neurosurgery, orthopaedics, and obstetrics and gynecological surgery. In the surgical ICU, the majority of research conducted globally and in India have found a greater incidence of nosocomial bloodstream infections. In our research, the incidence of bloodstream infections (BSI) was 5% overall, 0.6% for primary BSI, and 4% for nosocomial BSI. In the medical ICU, the incidence of BSI was found to be 19%, whereas in the surgical ICU, it was 31%. Gram negative bacilli cause roughly 20% of CLABSI infections, with CoNS, S. aureus, Enterococci, and Candida spp. being the most commonly reported causal pathogens worldwide[15-18]. On the other hand, the micro-biological profile of subjects from India paints a contrasting picture. Over the past ten years, gram negative organisms have exhibited a preponderance over gram positive organisms, despite the fact that CoNS and Staphylococcus species are common gram-positive pathogens involved with bloodstream infections[19,20].

CONCLUSION

It is determined that the most common cause of blood stream infections in intensive care unit (ICU) subjects is Gram negative bacteria, with P. aeruginosa and A. baumannii being the most common. A high percentage of meropenem resistance (71%) was observed in gram-negative bacteria. The high rate of anti-microbial resistance in the isolates that cause bloodstream infections (BSI) in intensive care units (ICUs) necessitates the introduction of stringent antibiotic policies and rigorous adherence to hospital infection control protocols in order to prevent the isolates' continuous growth.

REFERENCES

1. Didier Pittet, Debra Tarara and Richard P. Wenezel. Nosocomial bloodstream infection in critically ill subjects, Excess length of Stay, Extra Costs, and Attributable Mortality. JAMA 1994; 271:1598- 1601.
2. Leigh G Donowitz, Richard P Wenzel and John W Hoyt. High risk of Hospital-Acquired Infection in ICU subject. Crit Care Med 1982; 10:355-357.
3. Shirin Shafazand and Ann B. Weinacker. Blood Cultures in the Critical Care Unit: Improving Utilization and Yield. Chest 2002; 122:1727-1736.
4. Robert S. Munford. Severe sepsis and septic shock, Chapter 254, In: Harrison's principles of internal medicine, 16th ed. Dannis Kasper, Anthony S. Fauci, Dan L. Longo, Eugene Braunwald, Stephen L. Hauser, J. Larry Jameson. MacGraw-Hill Medical Publishing division, USA. 1996. Vol 2:1607-1612.
5. Blood stream infection definition, Australian commission on safety and quality in health care. Available at www.health.qld.gov.au/chrisp/icare/aica_bsi_def_v1
6. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, and Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of surgical wound infections. Am J infect control 1992; 20:271-274. Available at www.cdc.gov/ncid/dhgp/nnis_pubs.html
7. Bloodstream Infection Surveillance Definitions Available at http://www.austa.gov
8. Michael L. Wilson. General principles of specimen collection and transport. Clin Infect Dis 1996; 22:766- 777.
9. Larry G. Reimer, Michael L. Wilson and Melvin P. Weinstein. Update on Identification of Bacteremia and Fungemia. Clin Microbiol Rev 1997; 10:444-465.
10. Little JR, Murray PR, and Traynor PS. A randomized trial of povidone-iodine compared with iodine tincture for venipuncture site disinfection: effects

on rates of blood culture contamination. Am J Med 1999; 107:119-125.

11. Melvin P. Weinstein. Minireview Blood culture contamination: Persisting problems and Partial Progress. J Clin Microbiol 2003;41:2275-2278.
12. Konneman's Color Atlas and Textbook of Diagnostic Microbiology 6th edition, Lippincott Williams and Wilkins.2006
13. Clinical Laboratory Standards Institute (CLSI). Performance standards for anti-microbial susceptibility testing, 18th informational supplement. CLSI document M100-18, Wayne, Pennsylvania: 2008
14. C. Rodrigues, P. Joshi, SH Jani M. Alphonse, R. Radhakrishnan and A. Mehta. Identification of betalactamases in nosocomial gram negative clinical isolates. Indian J of Med Microbiol 2004; 22:247-250.
15. S. Singhal, T. Mathur, S. Khan, DJ Upadhyay, S Chugh, R Gaind et al. Evaluation of methods for identification of AmpC betalactamase from gram negative clinical isolates from tertiary care hospitals. Indian J of Med Microbiol 2005;23:120-124
16. B. Behera, P. Mathur and A. Das and V. Sharma. An evaluation of four different phenotypic techniques for identification of metallobetalactamases producing Pseudomonas aeruginosa. Indian J of Med Microbiol 2008; 26:233-237.
17. K. B. Laupland Incidence of bloodstream infection: a review of population-based studies Clin Microbiol Infect 2013; 19: 492–500.
18. Mohd Suhail Lone, Junaid Ahmad, Dalip K. Kakru, Lubna Samad, Shagufta Roohi,Abiroo Naqash, Akeela Fatima Blood Stream Infections in Intensive Care Units. A Research fromNorth India Journal of Microbiology and Related Research / Volume 2 Number 1 / January – June 2016
19. J. Rello, M. Ricart, B. Mirelis, E. Quiontana, M. Gurgui, A. Net and G. Prats. Nosocomial bacteremia in a medical-surgical intensive care unit: epidemiologic characteristics and factors influencing mortality in 111 episodes. Intensive Care Med 1994; 20:94-98.
20. Christian Brun-Buisson, Francoise Doyon, Jean Carlet, Pirre Dellamonica,Francois Gouin, Agnes Lepoutre et al. Incidence, Risk Factors and Outcome of Severe Sepsis and Septic Shock in Adults A Multicenter Prospective Research in Intensive Care Units. JAMA 995; 274:968-974.