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Study of Clinical and Bacteriological Profile of Adult Septicemia in Tertiary Care Hospital

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Abstract

Septicemia is, when a micro-organism enters the bloodstream from elsewhere in the body, such as the: skin, lungs, kidneys, bladder. It is a life-threatening condition which must be treated otherwise it will lead to sepsis and other complications. It is difficult to differentiate sepsis from other non-infectious conditions in critically ill patients admitted with systemic inflammatory response syndrome. The prevalence of causative organism causing sepsis differs from region to region depending on the systemic involvement. The treatment of sepsis is very challenging due to emerging multidrug resistant (MDR) microorganisms. With the rising problem of drug resistance, the present study was undertaken to evaluate the clinical profile and the bacteriological profile causing bloodstream infections in adult patients with their antimicrobial sensitivity pattern. This study was aimed at isolating and identifying bacterial agents from blood culture and antimicrobial sensitivity as well as the clinical profile of the patients diagnosed clinically as having sepsis. A Cross-Sectional observational study was conducted on 60 patients, who showed signs and symptoms of septicemia. All adult patients above 18 years, admitted to ICU with features of severe sepsis and septic shock as per SCCM/ACCP guidelines were included. Under aseptic conditions blood was drawn for culture and antibiotic susceptibility testing was performed for bacterial isolates on Muller-Hinton agar. The antibiotic susceptibility testing of the isolates was done using Kirby-Bauer disc diffusion method. Out of 60 patients, 32 were males and 28 were females, with mean age was 54.06 years with slight male preponderance. The most commonaffectedage group was above60 years. Most common source of infection was from the respiratory tract (40%) followed by intra-abdominal (30%) infections and urinary tract infections. Out of 60 samples 58 (96.66%) samples showed bacterial growth. Out of the 60 isolates, 67.24% (39/58) were Gram negative bacilli, 32.75% (19/58) were Gram positive bacteria and 3.33% (2/60) were shown no growth. Among those Klebsiella spp.-25.86% (15/58) was the most frequent isolate from blood culture followed by CoNS-18.96% (11/58), Pseudomonas spp. 17.24% (10/58), E. coli 15.51% (9/58). In our study, Klebsiella showed sensitivity to Amikacin (60%) and Meropenem (53.33%), but resistance to Ceftriaxone (60%) and Ciprofloxacin (53.33%), whereas CoNS was highly sensitive to Pipericillin+Tazobactum (81.8%), but resistant to Azithromycin (72.72%), Ciprofloxacin (63.63%) and Clindamycin (63.63%).Pseudomonas and rest other microbes shown variable multidrug resistant. As treatment of sepsis is challenging because of raising multidrug resistance among both Gram-positive and -negative organisms, the knowledge of their resistance patterns is critical in a local geographic area for adequate management of sepsis.

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Key Words

Sepsis, septicemia, gram-positive and-negative organisms, klebsiella spp, cephalosporins

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INTRODUCTION

The continuous or transient presence of microorganisms within the blood stream is bacteremia, while its dissemination throughout the body with evidence of systemic responses toward microorganisms with variable severity is septicemia[1]. Day by day the incidence of sepsis and the number of sepsis-related deaths are increasing and among hospitalized patients it is 8.7% per year[2].Almost all the critically ill patient presents with similar clinical pictures in infection, SIRS, various severities of sepsis and organ dysfunction. This issue is most important because the therapies and outcomes greatly differ between patients with and without sepsis.

Septicemia is the leading cause of mortality among ICU patients. Sepsis due to infections are frequent and life-threatening. It can lead to increase in morbidity, mortality and health care cost of patients admitted in intensive care unit (ICU). In addition to this, the treatment becomes challenging due to emerging multidrug resistant (MDR) microorganisms. The early diagnosis of sepsis and its appropriate therapy is very challenging in intensive care units (ICU). The distribution of causative organisms of septicemia varies from place to place, so the knowledge of common pathogens causing respective systemic involvement and its resistance patterns is a must before starting the empirical therapy.

Hence, the present study was undertaken to know the clinical profile and to evaluate the most prevalent bacterial pathogen causing sepsis in adult patients admitted to an Intensive Care Unit (ICU) with their antimicrobial sensitivity pattern.

MATERIALS AND METHODS

A Cross-Sectional observational study was conducted in the Department of General Medicine in KBN Teaching and General hospital in Kalyana Karnataka, from July 2022-December 2022, for a duration of 6 months. A total of 60 patients, above 18 years, who showed signs and symptoms of septicemia and septic shock as per SOFA/Sepsis-3 guidelines were included[3].Under aseptic precautions, around 5-10 ml of blood was collected from patients before administration of the antibiotics. The blood was immediately inoculated into the BACTEC blood culture bottles. Once the culture became positive, subculturing was done on 5% sheep blood agar and McConkey agar. It was incubated aerobically at 37°C overnight for bacterial isolation. The standard bacteriological techniques were used for identification of culture isolates. The antibiotic susceptibility testing was done by using Kirby-Bauer disc diffusion method.

RESULTS AND DISCUSSIONS

A total of 60 patients diagnosed clinically as having sepsis, blood culture was performed. Out of 60 patients, 32 were males and 28 were females. The mean age of the patients was 54.06 years. The most common affected age group was above 60 years with slight male preponderance (Table 1). The most common co-morbidities associated were diabetes mellitus (80%), followed by hypertension (60%) and chronic kidney disease (40%) (Table 2).The most common clinical presentation was fever with chills (60%), followed by breathlessness (33.33%) and pain abdomen (30%) (Table 3).Most common source of infection was from the respiratory tract (40%) followed by intra-abdominal (30%) infections and urinary tract infections (16.66%)(Table 4). The mean vital parameters of 60 septicemic patients were Respiratory Rate 26 cpm, GCS Score 8.5, Systolic BP 97 mm hg, Heart Rate 102.9 bpmand Temperature 39.5°C. They had following mean laboratory parameters PaO2/FiO2 ratio 308, Hematocrit 31.6 %, Total Leucocyte Count 15,480 cells/µl, Sr Creatinine 2.6 mg/dl, Sr Bilirubin 2.35 mg/dl, Sr Lactate 3.2 mg/dl, Hemoglobin 10.5 g/dl and Platelet 201.5 cells x 103/µL (Table 5). Overall mortality among the patients with septicemia was 43.33%, deaths due to intra-abdominal cause (38.46%) was more than respiratory (34.61%) and urinary cause (15.38%) (Table 4).

Out of 60 samples, 58 (96.66%) samples showed bacterial growth. Out of the 58 isolates, 67.24% (39/58) were gram negative bacilli and 32.75% (19/58) were gram positive bacteria(Table 6). The most common bacteria isolated was Klebsiella spp. (25.86%) followed by CoNS-(18.96%), Pseudomonas spp. (17.24%) and E. coli (15.51%). The multidrug susceptibility test showed, Klebsiella sensitivity to Amikacin (60%) and Meropenem (53.33%), but resistance to Ceftriaxone (60%) and Ciprofloxacin (53.33%), whereas CoNS was highly sensitive to Pipericillin+Tazobactum (81.8%), but resistant to Azithromycin (72.72%), Ciprofloxacin (63.63%) and Clindamycin (63.63%). Pseudomonas and rest other microbes shown variable multidrug resistant (Table 7A and 7B).

Sepsis is a syndrome shaped by host factors (eg-sex, race and other genetic determinants, age, comorbidities, environment) and pathogen factors, with characteristics that changes over time. An aberrant or dysregulated host response and the presence of organ dysfunction differentiates sepsis from infection[3].

Septicemia is an important cause of illness and death among hospitalized patients in developing countries. The most common cause of sepsis around the world is micro-bacterial infections and blood culture helps to isolate these organisms. The drug resistance has become a serious health problem all over the world as many bacterial pathogens have developed resistance to most of the antibiotics. The causative microorganism which has been reported to

Table 1: Age and Sex wise Group Distribution among the Study.

AGE (in years)	No. of Female Patients	No. of Male Patients	Total No. of Patient	Total Percentage (%)
21-30	04	02	06	10
31-40	04	03	07	11.66
41-50	02	08	10	16.66
51-60	04	06	10	16.66
61-70	08	14	22	36.66
>70	02	03	05	8.33
Total	24	36	60	100.00

Table 2: Associated co-morbidities

Co-existing illness	No. of patients	Percentage (%)
Diabetes mellitus	48	80
Hypertension	36	60
Chronic kidney disease	24	40
Chronic obstructive pulmonary disease	22	36.66
Chronic liver disease	18	30
Coronary artery disease	3	5

Table 3: Clinical manifestations of septicemia patients.

Symptoms	No. of patients	Percentage (%)
Fever with Chills	36	60
Breathlessness	20	33.33
Burning micturition	10	16.66
Altered Sensorium	6	10
Pain abdomen	18	30
Cellulitis	6	10

Table 4: Sepsis cases according to infection sites and progression to shock and/or death.

Infection site	Total Number (N=60)	Improved (n=34/ 56.66%)	Death (n=26/ 43.33%)
Pulmonary	24/ 40%	15/ 44.11%	9/ 34.61%
Abdominal	18/ 30.00%	8/ 23.52%	10/ 38.46%
Urinary	10 /16.66%	6/ 17.64%	4/ 15.38%
Catheter	2/ 3.33%	1/ 2.94%	1/ 3.84%
Other	6/ 10.00%	4/ 11.76%	2/ 7.69%

Table 5: Vital and Laboratory Parameters of septicemia patients

Vital Parameters (mean)	
Respiratory Rate (cpm)	26
GCS Score (3-15)	8.5
Systolic BP (mm Hg)	97
Heart Rate (bpm)	102.9
Temperature >38 °C or <36 °C	39.5°C
Laboratory Parameters (mean)	
PaO_2/FiO_2 ratio	308
Hematocrit (%)	31.6
Total Leucocyte Count (cells/µl)	15480
Sr Creatinine (mg/dl)	2.6
Sr Bilirubin (mg/dl)	2.35
Sr Lactate (mg/dl)	3.2
Hemoglobin (g/dL)	10.5
Platelet (cells x 10^3/µL)	201.5

Table 6: Bacteriological Profiles among the Culture positive patients (n=60).

Bacterial isolates	Number/ Percentage of the isolates
No. bacteria isolated	
Gram-positive cocci	[19]/ [32.75%]
CoNS	11
Staphylococcus aureus	5+1
Enterococcus spp.	2
Gram-negative bacilli	[39]/ [67.24%]
Escherichia coli	9
Klebsiella pneumoniae	15
Enterobacter spp.	2
Salmonella Typhi	2
Acinetobacter baumanii	1
Pseudomonas spp.	10
Proteus mirabilis	0
No Growth	[2]/ [3.33%]

Table 7A: Antibiotic Susceptibility pattern of the Gram-positive cocci (n=19).

Antibiotics	CoNS [11]		Staphylococcus aureus [6]		Enterococcus spp. [2]	
	Sn	R	Sn	R	Sn	R
Amikacin	7/ 63.63	1/ 9.09		1/ 16.66		
Gentamycin	6/ 54.54		3/ 50	1/ 16.66		2 [100%]
Penicillin				1/ 16.66		1 [50%]
Ampicillin	1/ 9.09	4/ 36.36		2/ 33.33		2 [100%]
Ceftriaxone			1/ 16.66	2/ 33.33		
Ciprofloxacin	1/ 9.09	7/ 63.63	1/ 16.66	3/ 50		
Clindamycin		7/ 63.63	2/ 33.33			
Cotrimoxazole	2/ 18.18	5/ 45.45				
Erythromycin		1/ 9.09	1/ 16.66	1/ 16.66		1 [50%]
Linezolid	5/ 45.45	3/ 27.27	3/ 50	1/ 16.66	1 [50%]	
Imipenem			1/ 16.66	1/ 16.66		
Meropenem	4/ 36.36		1/ 16.66	2/ 33.33		
Nitrofurantoin	1/ 9.09					
Norflox	1/ 9.09	2/ 18.18				

Teicoplanin	1/ 9.09				2 [100%]
Tigecycline				1/ 16.66	
Tetracycline	2/ 18.18		1/ 16.66		
Vancomycin	4/ 36.36	1/ 9.09	6/ 100		1 [50%]
Tazomac	9/ 81.81	1/ 9.09	3/ 50		
Amoxyclav	2/ 18.18	4/ 36.36		3/ 50	
Colistin	1/ 9.09	1/ 9.09			
Minocycline					
Levofloxacin				1/ 16.66	
Zostum			1/16.66		
Azithromycin				3/ 50	
Doxy	4/ 36.36	2/ 18.18	2/33.33%	3/ 50	
Clarithromycin				3/ 50	
Zostum	5/ 45.45	2/ 18.18			
Azithromycin	1/ 9.09	8/ 72.72			

Table 7B: Antibiotic Susceptibility pattern of the Gram-negative bacilli (n=39).

Antibiotics	E. Coli [9]		KlebsiellaM Spp. [15]		Pseudomonas spp. [10]		S. Typhi [2]		Enterobacter spp. [2]		Acinetobacter baumanii [1]	
	Sn	R	Sn	R	Sn	R	Sn	R	Sn	R	Sn	R
Amikacin	3/33.33	4/44.44	9/ 60	4/26.66	3/30	4/40	1/50	1/ 50	2/ 100			
Gentamycin			5/33.33	4/26.66	3/30	5/50		2/100	2/ 100		1/100	
Penicillin												
Ampicillin		3/33.33										
Ceftriaxone	1/11.11	6/66.66	2/13.33	9/60	2/20	5/50		2/100			1/ 50	1/100
Ciprofloxacin		7/77.77	4/26.66	8/53.33	2/20	6/60	1/50					
Clindamycin				5/26.66	1/10	1/10		1/ 50				
Cotrimoxazole		1/11.11	2/13.33		2/20	2/20			1/ 50			
Erythromycin												
Linezolid				3/20	1/10	2/20		1/ 50	1/ 50			
Imipenem	3/33.33		5/33.33	3/20	2/20		1/50		1/ 50			1/100
Meropenem	2/22.22	6/66.66	8/53.33	3/20	6/60	2/20	1/50		1/ 50			1/100
Nitrofurantoin	4/44.44	3/33.33	3/20	4/26.66	1/10	1/10						
Norflox	1/11.11	6/66.66	1/6.66	4/26.66	2/20	2/20						
Teicoplanin					1/10							
Tigecycline	1/11.11	1/11.11	3/20	1/6.66	2/20							
Tetracycline					1/10	1/10						
Vancomycin						3/30					2/100	
Piperacillin +Tazobactam		4/44.44	3/33.33	5/33.33	5/33.33	4/40	6/60	1/50	1/ 50		2/ 100	
Amoxiclav	2/22.22		4/26.66	1/6.66	3/30	2/20	1/50					
Colistin	5/55.55		1/6.66	2/13.33	1/10	4/40						
Levofloxacin		2/22.22	1/6.66	3/20	1/10	4/40	1/50		1/ 50			
Azithromycin			1/6.66			2/20			1/ 50			
Doxy				1/6.66	1/10	1/10			1/ 50			
Zostum	4/44.44	5/55.55	3/20	5/33.33	2/20	2/20	1/50					
Tobra	2/22.22	1/11.11	1/6.66		3/30	1/10						

cause septicemia vary in distribution from place to place. The rapid identification and antimicrobial susceptibility testing of the causative agents of bloodstream infections by the microbiological laboratory methods provides essential information to clinicians for selecting appropriate antimicrobial therapy for patients with bloodstream infections. Monitoring of blood culture isolates and determination of susceptibility to antibiotics are necessary for proper and adequate treatment of patients.

The incidence of sepsis is influenced by age, sex and race/ethnicity. It is highest at the extremes of age and more common in males then in females. There are many risk factors related to both predisposition to development of an infection and acute organ dysfunction. The common risk factors include pulmonary disorders, HIV infection, cancers and immunosuppression[4].In our study, out of 60 patients, 60% (36/60) were male and 40% (24/60) were female patients, with male preponderance. The mean age of the patients was 54.06 years. The most common affected age group was above 60 years. The most common co-existing illness was diabetes followed by hypertension, chronic kidney disease, COPD, chronic liver disease and CAD. In the study of paary tt *et al.,* 64.2% were males and 34.8% were females with mean age of 54±17 years with male preponderance. Most common co-existing illnesses were hypertension (42%), type II diabetes mellitus (42%), followed by chronic kidney disease, CAD, liver disease, COPD and malignancy[5].Our study results are similar with paary tt *et al*., except the most common risk factor was diabetes.

As sepsis is a medical emergency, can present with various signs and symptoms at different times, which include fever or low temperature and shivering, altered mental status, difficulty breathing/rapid breathing, increased heart rate, weak pulse/low blood pressure, low urine output, cyanotic or mottled skin, cold extremities and extreme body pain or discomfort[6-8].In our study the most common clinical presentation was fever with chills (60%), followed by breathlessness (33.33%) and pain abdomen (30%).

The Sepsis can arise from both community-acquired and hospital-acquired infections. Of these infections, pneumonia is the most common source, accounting for about half of cases., next most common are intra abdominal and genitourinary infections[4]. in our study, most common source of infection was from the respiratory tract (40%) followed by intra-abdominal (30%) infections and urinary tract infections (16.66%). In the study of Paary tt *et al.*, most common source of infection was from respiratory tract (37.2%) followed by urinary tract (10.3%) and intra-abdominal (9.5%) site[5]. In the study of Morello LG *et al.*, nearly half of the sepsis cases were secondary

to pulmonary infections (49%), followed by abdominal infections (20%) and cases of infections with unidentified sources (9%)[9]. In our study the most common source of infection was from the respiratory tract (40%) followed by intra-abdominal (30%) infections and urinary tract infections (16.66%).

The sepsis/ septicemia can be caused by bacterial, viral or fungal infections and these can enter the body through various routes. Only one-third of cases of septicemia yields positive blood cultures, while many cases are culture negative at all sites. The most common gram-positive isolates are Staphylococcus aureus and Streptococcus pneumoniae, while the commonest gram-negative isolates are Escherichia coli, Klebsiella species and Pseudomonas. In recent years, gram-positive infections have been reported more often than gram-negative infections, yet a 75-country point-prevalence study of 14,000 patients on intensive care units (ICUs) found that 62% of positive isolates were gram-negative bacteria, 47% were gram-positive bacteria and 19% were fungi[4]. In our study out of 58 positive samples, 39 (67.24%) were Gram Negative Bacilli and 19 (32.75%) were Gram Positive Cocci. Septicemia due to Gram negative bacteria predominated over Gram positive and these findings were comparable to those with other studies from India as well as other countries (Divatia *et al.,* 2016., Sahoo *et al.,* 2016., Gupta *et al.,* 2016., Sonawane [10-13]. Our findings were not correlated with a study Kumalo[14] where they reported gram positive sepsis was higher than that of gram-negative sepsis. Among those positive blood culture samples, Klebsiella spp. - 25.86% (15/58) was the most frequent isolate from blood culture followed by CoNS-18.96% (11/58), Pseudomonas spp. 17.24% (10/58), E. coli 15.51% (9/58), which correlates with Oza[15]. Kumalo *et al.,* 2016 also reports that CoNS being the second most common isolates from blood culture.

When infections are treated with resistant antibiotics, the people are at risk of developing sepsis, so antimicrobial susceptibility testing is the mainstay of treatment of sepsis. In our study, among the gram-negative isolates, Klebsiella spp (15/ 39) shown highly resistance to Ceftriaxone (60%) and to Ciprofloxacin (53.33%) and shown sensitivity to Amikacin (60%) and Meropenem (53.33%), Pseudomonas was 60% sensitive to Meropenem, E. Coli shown equal resistant to Ceftriaxone, Meropenem and Norfloxacin i.e., 66.66% and low sensitivity to Nitrofurantoin and Pipericillin+Tazobactum i.e., 44.44%, whereas S. Typhi was 100% resistant to Gentamicin along with Ceftriaxone and 60% resistant to Pipericillin+Tazobactum, Enterobacter spp were highly sensitive to Amikacin, Gentamicin and Pipericillin+Tazobactum (100%), but 100% resistant to Vancomycin and Acinetobacter spp resistant to Ceftriaxone, Imipenem and Meropenem. Among the gram-positive isolates, CoNS shown maximum sensitivity to Pipericillin+Tazobactum (81.81%) followed by Amikacin (63.63%), whereas CoNS is highly sensitive to Pipericillin+Tazobactum (81.8%), but resistant to Azithromycin (72.72%), Ciprofloxacin (63.63%) and Clindamycin (63.63%).Vancomycin was the only antibiotic for which Staphylococcus aureus was 100% sensitive. Enterococcus Species was 100% sensitive to Teicoplanin but 100% resistant to Gentamicin and Ampicillin. The study of Parihar, R.S *et al.,* concluded that most of thegram-negative organisms showed a very high resistance to beta-lactam antibiotics except imipenem which is sensitive to all strains, whereas gram positive organisms are completely sensitive to vancomycin and resistant to penicillin followed by erythromycin, clindamycin and levofloxacin[16]. In the study of Shivani Raina et al.,drug sensitivity of gram-negative bacteria showed Imipenem was the most effective drug with sensitivity ranging from 80-100%. Piperacillin/tazobactam showed good sensitivity against Proteus spp (80%) and E. coli (77.4%). Amikacin had good sensitivity profile against E. coli (79.6%) and Proteus spp. (70%). Nitrofurantoin was also an effective antibiotic against E. coli with 81.2% sensitivity. Polymyxin B was quite effective against Pseudomonas spp. and Acinetobacter spp with 95% and 87.5% sensitivity respectively. Gram negative bacterial isolates were highly resistant to cotrimoxazole, fluoroquinolones and cephalosporins like cefepime, cefotaxime, ceftazidime, cefuroxime. Gram positive isolates showed 100% sensitivity to Linezolid and Vancomycin. Nitrofurantoin also turned out to be effective with Staphylococcus aureus showing 100% sensitivity and CoNS 83.3%. Fifty or less than fifty percent gram positive isolates were resistant to Norfloxacin. Majority of the gram-positive bacteria were resistant to Penicillin and Co-trimaxazole[17].

CONCLUSION

As sepsis is the leading cause of death from infection, it needs utmost and careful attention. The treatment of sepsis is challenging because of raising multidrug resistance among both Gram-positive and -negative organisms. As the causative organisms and its drug resistance varies from region to region, the knowledge of organisms causing sepsis would help the clinicians to treat the sepsis patients adequately and appropriately. The evolution of sepsis can be prevented by recognizing early signs and symptoms of sepsis and the appropriate antibiotic treatment of infection. The infection in the community can be prevented by effective hygiene practices and educating patient regarding infections and availability of vaccines and prompt seeking of medical care.

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