Punjab Univ. J. Zool., Vol. 31 (1), pp. 087-093, 2016

ISSN 1016-1597(Print)
ISSN2313-8556 (online)

Original Article

Deranged biochemical and hematological profile of septicemia patients in Mayo hospital, Lahore

Riffat Mehboob[1*], Sami Ullah Mumtaz[2], Zoya Manzoor[3], Sajid Abaidullah[2], Fridoon Jawad Ahmad[1]

[1]Department of Biomedical sciences, King Edward Medical University, Lahore, Pakistan
[2]North Medical Ward, King Edward Medical University, / Mayo Hospital, Lahore, Pakistan
[3]Center for research in Molecular Medicine, University of Lahore, Pakistan.

(**Article history:** Received: May 20, 2016; Revised: June 15, 2016)

Abstract
Septicemia is a devastating medical condition encountered in many hospitals of developing countries. Hepatorenal dysfunction is traditionally viewed as late feature of septicemia due to its obvious effects on hepatorenal organs. This study was undertaken to establish the possible role of serum biomarkers of liver, kidney and blood in the diagnosis of septicemia. 101 confirmed patients of septicemia from a tertiary care hospital in Lahore were included. Liver and renal function tests were performed for all patients. Patients were divided into 3 age groups on the basis of age: 30-50, 51-70 and 71-90 years. In Liver function Tests, ALT (37.62%), AST (50.49%) and ALP (99%) were elevated, Bilirubin was normal in majority of patients while total protein was in normal range in 97.02% patients and the trend of albumin was towards low (44.55%).In Renal function tests, urea was elevated in 71.29% and creatinine in 51.48% patients and in electrolytes Na+ was low in 41.58% patients K+ were normal in majority of patients. Hematological parameters such as WBCs were high in 84.16%, hemoglobin was low in 78.12% and platelets were normal. The most common causes were urinary tract infection (31.68%), bed sores (17.82%), chest infection (12.87%) and wound infection (7.92%). According to this study, diabetes (45.56%) was the main comorbidity of septicemia. Most of the patients were between 51-70 years while septicemia occurred equally in both genders. Major predictors for diagnosis were WBCs, hemoglobin, AST, ALT, ALP, urea and creatinine. Other biomarkers gave no information regarding septicemia diagnosis. This demands the use of improved diagnostic biomarkers in developing countries.

Keywords: Septicemia, comorbidity, inflammatory responses, Lahore**.**

To cite this article: MEHBOOB, R., MUMTAZ, S.U., MANZOOR, Z., ABAIDULLAH, S. AND AHMAD, F.J., 2016. Deranged biochemical and hematological profile of septicemia patients in Mayo hospital, Lahore. *Punjab Univ. J. Zool.,* **31**(1): 87-93.

INTRODUCTION

Septicemia is a systemic inflammatory response caused by the circulation of pathogenic organisms or their toxins in the blood or tissues (Sridharan and Chamberlain 2013). Septicemia is often caused by bacterial infection such as *Staphylococcus aureus*, sometimes preceded by or occurring in combination with viral infections and, to a lesser extent, fungal infections (Grant, 2009). During the past few decades, it has become an increasingly common condition among hospitalized patients (Dellinger, 2016). It causes over 34,000 deaths each year in the United States (Melvan *et al.,* 2011). In Pakistan, septicemia is one of the leading causes of hospital mortality (Tariq *et al.,* 2009). Symptoms vary among different patients. Most commonly reported symptoms of septicemia are fever, dyspnea, diarrhea and vomiting (Alam *et al.,* 2012).

Most common sites of origin of septicemia are the urinary tract (Rossignol *et al.,* 2016) and lungs. Novel and most effective approaches are urgently required for treating such infections. Bacteria can invade and contaminate intravenous lines at the site of puncture or wound and lead to septicemia. The situation can be controlled by the use of new skin disinfectants and by avoiding infusion pauses with interruption of intravenous lines and to replace the caps for the stopcocks with new ones each time the caps are removed. These measures are helpful in reducing the incidence

75-PUJZ-61020250/16/0087-0093
*Corresponding author: mehboob.riffat@gmail.com

of septicemia due to the *Bacillus spp*. (Matsumoto *et al.,* 2000).

The present study was done to evaluate alterations in LFTs, RFTs and blood cells, major causes, etiological factors and gender wise distribution of septicemia in a tertiary care hospital in Lahore, Pakistan.

MATERIAL AND METHODS

In this cross-sectional, observational and Descriptive Study, 101 diagnosed patients of septicemia with age more than 30 years were included from the medical wards and Accident and Emergency Department of Mayo Hospital Lahore, while children, pregnant or lactating women were excluded from the study.

In order to determine the etiology of the disease at the time of presentation, these patients have been carefully examined. Consent was taken from the patients. All other ethical issues were considered during the process of data collection.

Table I: Normal ranges of biochemical and hematological profiles

Sr. No.	Parameters	Normal Ranges
1.	Bilirubin	0.1-1.0mg/dl
2.	AST	8-48 IU/L
3.	ALT	7-55IU/L
4.	Alkaline phosphatase	45-115U/L
5.	Albumin	3.5-5.3mg/dl
6.	Total Protein	6.0-8.5g/dl
7.	Glucose	70-110mg/dl
8.	Urea	15-45mg/dl
9.	Creatinine	0.8-1.4mg/dl
10.	Na+	135-145meq/l
11.	K+	3.5-5.5meq/l
12.	White blood cells	4-10.510³/ul
13.	Platelets	150-45010³/ul
14.	Hemoglobin Male	13.5-17g/dl
15.	Hemoglobin Female	12-15g/dl

Data was recorded on a Performa specially designed for this purpose. Patients were divided into three age groups; 30-50 years, 51-70 years and 71-90 years, respectively. Majority of the patients were between 51-70 years (39/101; 39.39%), whereas 37 patients (37.37%) were between 30-50 years and 25 patients (25.25%) were in age range of 71- 90 years. There were 51 males and 50 females with mean age of males 60.37±18.65 and for females mean age was 55.02±17.206 (Table I). For each patient liver function tests, renal function tests and complete blood count was carried out. Renal function tests performed in this study were urea and creatinine (Table I) and Liver function tests were bilirubin, alanine aminotransferase (ALT), aspartate aminotransferse (AST), alkaline phosphatase (ALP), albumin and serum total protein (Table I) while the electrolytes studied were Na^+ and K^+ (Table I). Blood glucose levels were also measured (Table I). Hematological tests (CBC) were white blood cells count, platelets and hemoglobin (Table I).

RESULTS

51 patients were diabetic, 23 were smokers and 27 had history of hypertension (Figure 1). Bilirubin and K+ were normal whereas urea and creatinine were high in majority of patients in all three age groups. Glucose was normal in 17.82% in 1st age group (30-50) but was high in 24.78% in 2nd age group (51-70) and 17.82% patients of 3rd age group (71-90). Na+ was normal in 1stand 3rd age group patients but was low in patients in 2nd age group. The ALT was normal in most of the patients in all three groups. Variation was not observed according to age groups in these patients (Table II).

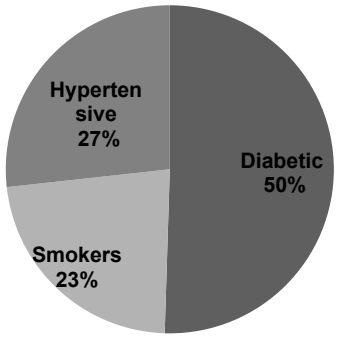

Figure 1: Risk Factors of Septicemia observed in this study

The ALP, total protein and albumin were almost same for both genders. ALT was raised in 48.51%, AST in 50.50% and ALP in 99% of

patients. Variations in WBCs, platelets and hemoglobin were same in both genders (Table III).

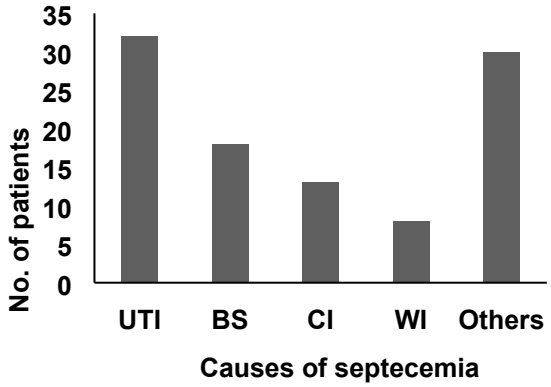

Figure 2: All causes of septicemia observed in this study

Bilirubin, total protein and electrolytes were normal whereas glucose was high in 55.45%. More males had raised blood glucose levels (64.70%) compared to females (46%). Urea was high in 71.29% and creatinine was high in 52.48% of patients. WBC's were high in 84.16% whereas platelets were low in 36.63% and hemoglobin was low in 78.21% patients (Table III-IV).

Causes of Septicemia

Around thirty different causes of septicemia were observed during this study and in few patients multiple causes of septicemia were also seen. Most common causes were UTI (32/101), bed sores (18/101), chest infection (13/101), wound infection (8/101), aspiration pneumonia (6/101), brain injury (5/101),diabetic foot (4/101) (Fig. 2).

Table II: Age wise variations in Biochemical and hematological profiles

Parameters	Patients (%)								
	30-50 years			51-70 years			71-90 years		
	L	N	H	L	N	H	L	N	H
Biliribin	0	30.69	5.940	0	32.67	5.94	0	18.811	5.940
AST	0	17.82	18.81	0	19.80	18.81	0	11.88	12.87
ALT	0	22.77	13.86	0	22.77	15.84	0	16.83	7.92
ALP	0	0.99	35.64	0	0	38.61	0	0	24.75
T. Protein	0.990	35.64	0	1.980	36.63	0	0	24.75	0
Albumin	12.87	23.76	0	17.82	20.79	0	13.86	10.89	0
Glucose	2.970	17.82	15.841	2.970	13.861	21.782	0.990	5.940	17.821
Urea	0	16.831	19.801	0	7.920	30.693	0	3.960	20.79
Creatinine	12.871	9.900	13.861	2.970	9.900	25.742	2.970	9.900	11.88
Na	12.871	21.782	1.980	18.811	16.831	2.970	9.900	14.851	0
K	3.960	31.683	0.990	5.94	32.67	0	1.980	21.78	0.990
WBC	0	7.920	28.71	0	5.940	32.67	0	1.980	22.77
Platelets	13.86	19.80	2.970	10.89	26.732	0.990	11.88	11.88	0.990
Hemoglobin (M)	12.87	2.970	0	14.85	2.970	0	14.85	1.980	0
Hemoglobin (F)	15.84	4.950	0	14.85	3.960	1.980	4.950	1.980	0.990

L (low), N (Normal), H (High), M (Males), F (Females)

1) Septicemia due to UTI

The 16 patients out of 32 were males and others females. Bilirubin, ALT, total protein and electrolytes was normal in majority of patients. Glucose was high in 56.87%. Urea was high in 68.75% whereas creatinine was also elevated in 59.37%. AST was high in 56.25% and ALP in all the patients. Albumin was low in 56.25% patients. WBCs were high in 84.37% whereas platelets were low in 50% and hemoglobin was low in 78.12% (Table IV).

2) Septicemia due to Bed Sores

The 9 patients were males and 9 were females. Bilirubin, electrolytes, ALT, AST and total protein was normal. Blood glucose was high in 56.87% whereas urea was high in 68.75%. Creatinine was high in 44.44%. ALP was high in all bed sores patients and albumin was low in 55.55% patients. WBCs were high in 83.33% and platelets were low in 44.44% whereas hemoglobin was low in 83.33% patients (Table IV).

Table III: Gender wise variations in all biochemical parameters

Parameter	Males (%)			Females (%)		
	L	N	H	L	N	H
Biliribin	0	86.27	13.72	0	78	22
AST	0	49.01	50.18	0	50	50
ALT	0	64.70	38.29	0	38	62
ALP	0	1.96	98.03	0	0	100
T. Protein	5.88	94.11	0	0	100	0
Albumin	41.17	58.82	0	48	52	0
Glucose	5.88	29.41	64.70	8	46	46
Urea	0	27.45	72.54	0	30	70
Creatinine	19.60	29.41	50.98	18	28	54
Na	45.09	49.01	5.88	38	58	4
K	9.80	88.23	1.96	14	84	2
WBC	0	17.64	82.32	0	14	86
Platelets	39.21	54.90	5.88	34	62	4
Hemoglobin	84.31	15.68	0	72	22	6

L (Low), N (Normal), H (High)

3) Septicemia due to Chest Infection

Chest infection as a cause of septicemia was seen in 13 patients, 8 males and 5 females. Bilirubin, ALT, total protein & electrolytes were normal, while glucose was high in 69.23%, urea was high in 61.53% and creatinine was high in 46.15%.

Albumin was low in 61.53 % and AST was raised in 46.15% whereas ALP was high in all. WBCs were high in 76.92% and platelets were low in 30.76% whereas hemoglobin was low in 76.92% (Table IV).

4) Septicemia due to Wound Infection

5 patients were males and 3 were females. Bilirubin, total protein and K+ were normal in most of the patients with wound infections, while 62.5% patients had low Na+, 50% had low albumin and glucose was high in 62.5% (Table IV).

Table IV: Variations in all biochemical and hematological parameters

Patients (%)			
Bilirubin			
UTI	**UTI**	**UTI**	**UTI**
87.5	87.5	87.5	87.5
Alanine aminotransferase (ALT)			
UTI	**BS**	**CI**	**WI**
87.5	72.2	61.53	62.5
Aspartate aminotransferase (AST)			
UTI	**BS**	**CI**	**WI**
56.2	55.5	53.8	75
Alkaline phosphatase (ALP)			
UTI	**BS**	**CI**	**WI**
100	100	100	100
Albumin (ALB)			
UTI	**BS**	**CI**	**WI**
56.25	55.55	61.53	50
Total Protein			
UTI	**BS**	**CI**	**WI**
100	100	100	100
Glucose			
UTI	**BS**	**CI**	**WI**
56.8	56.8	69.2	62.5
Urea			
UTI	**BS**	**CI**	**WI**
68.7	68.7	61.5	87.5
Creatinine			
UTI	**BS**	**CI**	**WI**
59.3	44.4	46.15	87.5
Electrolytes (Na/K)			
UTI	**BS**	**CI**	**WI**
62.5	66.6	69.2	62.5
White blood cells (WBC's)			
UTI	**BS**	**CI**	**WI**
84.37	83.33	76.92	87.5
Platelets			
UTI	**BS**	**CI**	**WI**
50	44.44	30.76	37.5
Hemoglobin			
UTI	**BS**	**CI**	**WI**
78.12	83.33	76.92	75

UTI (Urinary tract infection), BS (Bed sores), CI (Chest infection), WI (Wound infection)

DISCUSSION

Septicemia has become a leading cause of death in hospital settings (Dellinger 2016). Among different diagnostic tests such as procalcitonin (Sridharan and Chamberlain, 2013), interleukin 6, C-reactive protein (Fink-Neuboeck *et al.,* 2016) hematological tests, liver function tests, renal function tests etc., hematological, liver and renal function tests are widely used for diagnosing septicemia. These tests are performed to assess deranged blood picture and the function of liver and kidney during diseased state. Liver dysfunction is usually viewed as late feature of septicemia (Recknagel *et al.,* 2012). Hyper-bilirubinemia is commonly seen during critical illness and often results in adverse outcome (Vanwijngaerden *et al.,* 2011). According to a study, hyper-

bilirubinemia and increased ALP are the indicatives of septicemia (Brooks *et al.,* 1991). Extremely high levels of ALP and a normal bilirubin was also seen (Maldonado *et al.,* 1998). In our study, ALP was high in all, whereas bilirubin was normal in most of the patients (82.18%).

Elevated peripheral white blood cell count, elevated serum levels of ALP, bilirubin, creatinine, potassium, urea and reduced serum albumin levels were also observed in another study (Young *et al.,* 1990). Abnormality in hematologic system takes place in almost every patient of septicemia. Anemia, leukocytosis and thrombocytopenia are the most common abnormalities (Aird, 2003). In a study conducted in Bangladesh, white blood cells count or TLC did not show any positive result in diagnosing septicemia but thrombocytopenia was present in 50% of cases (Mannan *et al.,* 2010). In our study, WBCs were elevated in 84.16% and platelets were normal in 58.41% patients. Increased WBCs count and decreased hemoglobin (Hb) predicts infection (Gille-Johnson *et al.,* 2012). Hemoglobin was low in our study, which is an indicative of anemia and 78.12% patients with UTI were anemic (Table IV).

Urinary tract is found to be the most likely sites of the origin of the septicemia followed by lungs (Saint, Greene et al. 2016) . In our study, different causes of septicemia were seen but UTI came out to be the major cause of septicemia followed by bed sores, chest infection and wound infection (Fig. 2).

Risk factors that significantly and independently increase the death rate in septicemia are age, male sex, history of diabetes, smoking (Godwin *et al.,* 2016) and disability in activities of daily living. Diabetes increases the susceptibility to infection and septicemia (Koh *et al.,* 2012). Moreover, diabetes is one of the most common co-morbidity present in patients with sepsis (Esper *et al.,* 2009). Diabetes was seen in 50.49% cases in our study and was the most common risk factor. Smoking adversely affects the immune system, respiratory tract, skin and soft tissues and it is a risk factor for septicemia (Huttunen *et al.,* 2011). In addition, in our study, males and females were equally affected by septicemia (50.50% males, 49.0% females). Except for ALT which was normal in majority of males (64.70%) but elevated in females (62%), all tests done in this study had almost same results for both males and females (Table III).

Immunocompromised patients are at greater risk for developing bloodstream infections, such as septicemia (Papagheorghe 2012). Better early life conditions aids in better development of adaptive immunity, which may enhance immunity against bacterial infections (Wong *et al.,* 2012). A research done in USA confirms that vitamin D and solar UVB plays an important role in reducing the risk of septicemia (Grant, 2009). In addition, improving nutritional status is also helpful in reducing the risk of septicemia (Jaar *et al.,* 2000). Moreover, patient should take care of personal hygiene. There should be proper management of a surgical wounds, cuts and pricks. Proper medical treatment is also needed along with prophylactic antibiotics and a regular medical checkup.

CONCLUSION

Septicemia is mainly a personal hygiene related disease, so it can be greatly reduced by taking proper hygienic measures. In this study Mostly, there was no difference in biochemical & hematological parameters gender wise but where derangement was observed, it was in male patients. Major risk factors of septicemia were old age, low socioeconomic status, hypertension and diabetes. It is highly recommended to enhance awareness regarding septicemia, its proper treatment with proper antibiotics & good hydration as well as importance of personal hygiene. In Pakistan, there is a need to use improved diagnostic biomarkers (*e.g.* PCT, genetic markers, C-reactive protein etc) as being used in many developed countries to achieve promising accuracy.

REFERENCES

AIRD, W.C., 2003. The hematologic system as a marker of organ dysfunction in sepsis.*Mayo Clin Proc.,* **78**(7): 869-881.

ALAM, M.S., PILLAI, P.K., *ET AL.* 2012. Antimicrobial therapy and outcome of septicemia patients admitted to a University Hospital in Delhi. *Arzneimittelforschung*. **62**(3): 117-122.

BROOKS, G.S., ZIMBLER, A.G. *ET AL.* 1991. Patterns of liver test abnormalities in patients with surgical sepsis. *Am Surg*. **57**(10): 656-662.

DELLINGER, E.P., 2016. *Prevention of Hospital-Acquired Infections. Surg Infect (Larchmt)*. (in press)

ESPER, A. M., MOSS, M., ET AL., 2009. The effect of diabetes mellitus on organ dysfunction with sepsis: an epidemiological study. *Crit Care*, **13**(1): R18.

FINK-NEUBOECK, N., LINDENMANN, J., ET AL. 2016. Clinical impact of interleukin 6 as a predictive biomarker in the early diagnosis of postoperative systemic inflammatory response syndrome after major thoracic surgery: A prospective clinical trial.*Surgery*. (in press)

GILLE-JOHNSON, P., HANSSON, K.E., ET AL. 2012. Clinical and laboratory variables identifying bacterial infection and bacteraemia in the emergency department.*Scand J Infect Dis*., **44**(10): 745-752.

GODWIN, C.A., LINDER, B.J., *ET AL.,* 2016. Effects of Smoking Status on Device Survival Among Individuals Undergoing Artificial Urinary Sphincter Placement. *Am. J Mens. Health*.,(in press)

GRANT, W.B., 2009. Solar ultraviolet-B irradiance and vitamin D may reduce the risk of septicemia. *Dermatoendocrinol*., **1**(1): 37-42.

HUTTUNEN, R., HEIKKINEN, T., *ET AL.,* 2011. Smoking and the outcome of infection.*J Intern. Med.,* **269**(3): 258-269.

JAAR, B.G., HERMANN, J.A., *ET AL.,* 2000. Septicemia in diabetic hemodialysis patients: comparison of incidence, risk factors, and mortality with nondiabetic hemodialysis patients. *Am J Kidney Dis.,* **35**(2): 282-292.

KOH, G.C., PEACOCK, S.J., *ET AL.,* 2012. The impact of diabetes on the pathogenesis of sepsis. *Eur. J. Clin. Microbiol. Infect. Dis*., **31**(4): 379-388.

MALDONADO, O., DEMASI, R., *ET AL.* 1998. Extremely high levels of alkaline phosphatase in hospitalized patients.*J Clin. Gastroenterol,* **27**(4): 342-345.

MANNAN, M.A., SHAHIDULLAH, M., *ET AL.,* 2010. Utility of C-reactive protein and hematological parameters in the detection of neonatal sepsis. *Mymensingh Med J*., **19**(2): 259-263.

MATSUMOTO, S., SUENAGA, H. *ET AL.,* 2000. Management of suspected nosocomial infection: an audit of 19 hospitalized patients with septicemia caused by Bacillus species. J*pn J Infect Dis.***53**(5): 196-202.

MELVAN, J.N., SIGGINS, R.W., *ET AL.,* 2011. Suppression of the stem cell antigen-1 response and granulocyte lineage expansion by alcohol during septicemia.*Crit Care Med*., **39**(9): 2121-2130.

PAPAGHEORGHE, R. 2012. Bloodstream infections in immunocompromised hosts. *Roum. Arch. Microbiol. Immunol.,* **71**(2): 87-94.

RECKNAGEL, P., GONNERT, F.A., *ET AL.,* 2012. Liver dysfunction and phosphatidylinositol-3-kinase signalling in early sepsis: experimental studies in rodent models of peritonitis. *PLoS Med*., **9**(11): e1001338.

ROSSIGNOL, L., VAUX, S., *ET AL.,* 2016. Incidence of urinary tract infections and antibiotic resistance in the outpatient setting: a cross-sectional study. *Infection* (in press).

SAINT, S., GREENE, M.T. *ET AL.,* 2016. A Program to Prevent Catheter-Associated Urinary Tract Infection in Acute Care. *N. Engl. J. Med.,* **374**(22): 2111-2119.

SRIDHARAN, P. AND CHAMBERLAIN, R., 2013. The efficacy of procalcitonin as a biomarker in the management of sepsis: slaying dragons or tilting at windmills? *Surg Infect (Larchmt.,* **14**(6): 489-511.

TARIQ, M., JAFRI, W., *ET AL.,* 2009. Medical mortality in Pakistan: experience at a tertiary care hospital. *Postgrad. Med. J.,*.**85**(1007): 470-474.

VANWIJNGAERDEN, Y.M., WAUTERS, J., *ET AL.,* 2011. Critical illness evokes elevated circulating bile acids related to altered hepatic transporter and nuclear receptor expression. *Hepatology,* **54**(5): 1741-1752.

WONG, I.O., COWLING, B.J., *ET AL.,* 2012. Trends in mortality from septicaemia and pneumonia with economic development: an age-period-cohort analysis.*PLoS One,* **7**(6): e38988.

YOUNG, G.B., BOLTON, C.F., *ET AL.* 1990. The encephalopathy associated with septic illness. *Clin. Invest. Med*., **13**(6): 297-304.