Adult bacteremia
Comparative study between diabetic and non-diabetic patients

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ABSTRACT

Objectives: To compare type of infection, microbiology, source, complications and outcome of bactermia in diabetic and non-diabetic patients in our teaching hospital. To study the risk factors associated with diabetic bacteremia's mortality and to compare our findings with those reported in the literatures.

Methods: Retrospective study of all adult cases of bactermia admitted to King Abdulaziz University Hospital, Jeddah, Kingdom of Saudi Arabia, from January 1998 to January 1999.

Results: Rate of bacteremia per 1000 admission was 23. We compared 71 episodes in 48 diabetics with 100 episodes in 77 non-diabetics. Diabetic patients were older than non-diabetics (mean age 61.08 versus 49.89 years, p <0.001). No statistically significant difference was found between the 2 groups in the type and source of infection. Klebsiella of urinary source was isolated from 37% episodes in diabetics versus 11% non-diabetics (p 0.03). Acute renal failure and septic shock were the 2 complications significantly developed in non-diabetics compared to diabetics (19% versus 7% and 13% versus 4%, p=0.02 and 0.05). Mortality due to bacteremia was 24% in diabetics and 44% in non-diabetics (p 0.007). Hospital acquired infections, presence of underlying malignancy, use of ventilators, development of septic shock and acute renal failure, were factors associated with high mortality in diabetic bacteremia.

Conclusions: Our results are comparable with those reported in the literatures. The better outcome observed in our diabetic bactermia could be due to adequate glycemic control during bacteremic episode and appropriate choice of empiric antibiotics.

Keywords: Bacteremia, diabetics, sources, risk factors, outcome.

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Diabetes mellitus (DM) is one of the common endocrine disorders. There is a higher rate of bacteremia in diabetics compared to non-diabetics,[1] which could be due to impaired defence mechanisms observed in diabetics with poor metabolic control.[2,3] Mortality due to bacteremia has been reported to be between 20 and 30%.[4-7] In diabetics, mortality due to bacteremia is variable. Some reports have found it to be higher than non-diabetics,[1] while others had reported similar mortality in both.[8,9]

To our knowledge, not many studies has been carried out comparing between bacteremia in diabetic and non-diabetic patients.

The aim of our study is to compare between bacteremia in diabetics and non-diabetics, in our teaching hospital in Saudi Arabia. We are going to study the type of infection, microbiology, source, complications, outcome, and risk factors associated with high mortality in diabetic bacteremia, also, we are going to compare our findings with those reported in the literature.

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Methods. It is a retrospective study in which all episodes of bacteremia that occurred in adult patients (>14 years of age) at King Abdulaziz University Hospital (KAUH) between January 1998 to January 1999 were analyzed. Blood for culture was obtained under aseptic precautions. Blood cultures were performed using the Bact/Alert Microbial Detection System (Organon Teknika, USA). To 2 bottles containing 40 ml of broth culture media one for aerobic and the other for anaerobic growth, 4 ml of the patients blood were added. Culture bottles were loaded into the instrument and remained there for 5 to 7 days or until designated positive. All bottles designated positive were smeared and sub cultured. Identification of bacteria using the standard diagnostic microbiological methods were used.[10]

Organisms that are commonly recovered from the environment or skin were considered contaminant, unless the clinical findings, results of cultures from other body sites, or the number of positive blood cultures (>2 sets) indicate a high probability for true bloodstream infection.

The medical notes of the patients were reviewed. Patients were divided into 2 groups according to the presence or absence of DM. Patients were defined as diabetics if they had been previously diagnosed or if fasting blood sugar when they are afebrile > 7.8mmol/l.

Detailed information of each patient was obtained regarding the age, sex, the ward in which bacteremia occurred, duration of DM and its treatment, the underlying disorder, use of immunosuppressive agents (steroid and chemotherapy), type of infection (hospital or community acquired), source of the bacteremia and the microorganism isolated. An episode of bacteremia is defined as hospital acquired if it occurred more than 48 hours post-admission.[11]

The presence of urinary catheter and endotracheal tube, central or peripheral intravenous lines were recorded as well as the patients temperature, systolic and diastolic blood pressure, white blood cell count and blood chemistry during the bacteremic episode.

Complications that occurred during bacteremia like septic shock, acute renal failure (ARF), adult respiratory distress syndrome (ARDS), disseminated intravascular coagulation (DIC), coma, duration of hospital stay and fatal outcome due to bacteremia were recorded.

Comparison between the 2 groups was made according to different variables. Significant association between the different underlying disorders and DM was recorded, as well as the influence of different factors (including DM) on mortality.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS7.5). A two-tailed student's t-test and Chi-square test were used as appropriate. Results were considered significant if P value was less than 0.05.

Results. From a total of 7379 patients greater than 14 years of age admitted to the hospital, 171 episodes of bacteremia was recovered. Bacteremia rate in our hospital was 23.2/1000 admission. Seventy-one episodes occurred in 48 diabetic patients (1.48 episode/diabetic) and 100 episodes in 77 non-diabetic patients (1.30 episode/non-diabetic).

The mean age of diabetics was 61.08+/-15.39 years while non-diabetics 49.89+/-21.82 years ($p<0.001$) with male: female ratio 2.2:1 versus 1.2: 1 (p 0.11).

Of the total diabetic patients 13 of 48 (27%) were on insulin treatment and 31 of 48 (65%) on oral hypoglycemic agents.

Of the bacteremic episodes in diabetics 29 of 71 (41%) were community acquired versus 42 of 71 (59%) hospital acquired while in non-diabetics it was 33 of 100 (33%) and 67 of 100 (67%) (p 0.30).

Of the total bacteremic episodes 126 of 171 (74%) occurred in the medical ward, 40 of 171 (23%) in the surgical ward and 5 of 171 (3%) in the obstetric and gynecology ward.

Underlying disorders. Ischemic heart diseases, heart failure and hypertension were the 3 disorders significantly associated with DM. (Table 1).

Source of bacteremia. There was no significant difference in the source of bacteremia between diabetics and non-diabetics. (Table 2).

Type of microorganism. There was no significant difference in the percentage of microorganisms isolated from blood culture between the 2 groups, except for Klebsiella which was the most common cause of bacteremia of urinary source in diabetic patients, 7 of 19 (37%) versus 3 of 19 (11%) in non-diabetics (p 0.03). (Table 3).

In patients with a urinary catheter and urinary source of bacteremia, Klebsiella was the most common cause in diabetics, 5 of 6 (83%) versus 1 of 6 (17%) in non-diabetics (p 0.04), while in patients

Table 1 - Underlying disorders in diabetics and non-diabetics.

Underlying disorder	Diabetics N=48 No.(%)	Non-Diabetics N=77 No.(%)	P value
Ischemic heart disease	17 (35)	11 (14)	0.006
Heart failure	13 (27)	8 (10)	0.02
Hypertension	30 (62.5)	13 (17)	<0.001
Cerebrovascular accident	8 (17)	8 (10)	0.31
Chronic renal failure	4 (8)	3 (4)	0.29
Chronic obstructive airway disease	5 (10)	2 (3)	0.06
Obstructive jaundice	6 (12.5)	3 (4)	0.07
Coma	3 (6)	5 (6.5)	0.96

No. = number %=percentage

without a urinary catheter, it was similar in both groups.

Complications. ARF and DIC were the 2-complication significantly developed in non-diabetics bacteremia, 19 of 100 (19%) versus 5 of 71 (7%) in diabetics (p 0.02) and 13 of 100 (13%) versus 3 of 71 (4%) in diabetics (p 0.05). Septic shock developed in 19 of 71 (27%) episodes in diabetics versus 27 of 100 (27%) episodes in non-diabetics (p 0.97) and ARDS occurred in 2 episodes in non-diabetics.

Outcome. Seventeen of 71 (24%) of bacteremic episodes in diabetics were fatal compared to 44 of 100 (44%) of episodes in non-diabetics (p 0.007).

In bacteremia in diabetic patients, we found that hospital acquired episodes were associated with higher mortality compared to community acquired, 15 of 42 (36%) of hospital acquired episodes were fatal versus 2 of 29 (7%) community acquired episodes (p 0.005), underlying disorders like malignancy was also associated with high mortality 4 of 6 (67%) of episodes in patients with malignancy were fatal compared to 2 of 6 (33%) who were alive (p 0.01).

The presence of endotracheal tube was associated with poor outcome in diabetic bacteremia, 11 of 17 (65%) died versus 6 of 17 (35%) were alive (p <0.001).

Complications like septic shock and acute renal failure were associated with high mortality rate in diabetics, 11 of 19 (58%) of those who developed septic shock died versus 8 of 19 (42%) were alive (p<0.001). All bacteremic episodes in diabetic patients, which were complicated by ARF (5 of 5), had fatal outcome.

No significant association was found between mortality in diabetic bacteremia and hypothermia or neutropenia.

Diabetes mellitus itself was not associated with higher mortality, where 11 of 48 (23%) diabetics died compared to 37 of 48 (77%) were alive (p 0.08).

Hospital stay. The mean duration of hospital stay was 30.48+/-19.71 days in diabetics versus 25.23+/-17.59 days in non-diabetics (p 0.14).

Table 2 - Source of bacteremia in diabetic and non-diabetic patients.

Source	Episodes in diabetic N=71 No.(%)	Episodes in diabetic N=100 No.(%)
Urinary tract	19 (27)	28 (28)
Respiratory tract	3 (4)	7 (7)
Extremities	1 (1)	0
Intra-abdominal	9 (13)	9 (9)
Unknown	27 (38)	46 (46)
Others	12 (17)	10 (10)

No=Number (%)=percentage

Discussion.

It had been reported that bacteremic episodes in diabetics are more than in non-diabetics[1] and this has been found in our study.

Leibovici et al[9] had reported that diabetic patients were older than non-diabetics, a finding similar to

Table 3 - Percentage of microorganism isolated from blood culture of diabetics and non-diabetics according to source of infection.

	U.T.		R.T.		Extremities		I.A.		Unknown		Others	
	DP	NDP	DP	NDP	DP	NDP	DP	NDP	DP	NDP	DP	NDP
Isolates (n)	19	28	3	7	1	0	9	9	27	46	12	10
Microorganism (%)												
Staph.aureus	0	3.6	66.7	71.4	100	0	11.1	11.1	48.1	65.2	33.3	40
Streptococci	0	3.6	0	0	0	0	0	0	18.5	13	0	20
Klebsiella	36.8	10.7	33.3	0	0	0	11.1	22.2	22.2	8.7	16.7	0
E.coli	36.8	35.7	0	0	0	0	44.4	22.2	3.7	2.2	8.3	10
Psudomonas	21.1	14.3	33.3	14.3	0	0	22.2	0	3.7	8.7	16.7	10
Enterobacter	5.3	25	0	0	0	0	11.1	33.3	3.7	4.3	16.7	10
Acinetobacter	0	7.1	0	14.3	0	0	11.1	0	0	0	0	10
Bacteroides	0	0	0	0	0	0	0	0	0	0	8.3	0
Others	0	21.4	0	14.3	0	0	0	0	6.9	20.5	0	33.3

DP=diabetic patients, NDP=non-diabetic patients, UT=urinary tract, RT=respiratory tract, IA=intraabdominal, Staph.aureus=staphylococcus aureus, E.coli=Escherichia coli

what we found, but the mean age of both groups in our study was lower than what had been reported.[8,9]

Hospital acquired infection is noted in diabetics as 9-32%[8,12] and in non-diabetics as 14-60%.[8,12] Our diabetics have a higher rate of hospital acquired infection which was 59.2%, and there was no significant difference in the type of infection between the 2 groups, a finding also reported by others.[9] Medical ward was the one with the highest number of bacteremic episodes, the chronic disorders and the prolonged hospital stay of patients admitted to the medical ward could explain this. So, it is important to discharge patients early from the hospital to decrease the risk of hospital acquired infections and bacteremia.

Ischemic heart diseases, heart failure and hypertension are the 3 disorders significantly associated with diabetes mellitus and this has been reported by Leibovici et al.[9]

Although many studies have found urinary source of bacteremia in diabetics to be more frequent than in non-diabetics,[1,7-9,12] in our study no significant difference in the urinary source of bacteremia has been found between the 2 groups.

Unknown source of bacteremia varies. Some reports have found it to be between 10-27%[7-9] in diabetics and from 9 to 31%[9] in non-diabetics. We found a higher frequency of unknown source of bacteremia being 38 and 46% in diabetics and non-diabetics. Mellors et al[13] and Leibovici et al[14] found a higher bacteremia of unknown source in diabetics while MacFarlane et al[7] and Leibovici et al[9] found no statistically significant difference between the 2 groups, a finding similar to our finding.

There was no significant difference in the percentage of microorganism causing bacteremia in diabetics and non-diabetics except for Klebsiella which was the most common organism that causes bacteremia of urinary source in diabetics compared to non-diabetics. Similar findings was reported by Leibovici et al[9] while others have reported E.coli to be the most common cause.[1,7,8] Studies carried out by Hansen et al[15] and Lin et al[16] on Klebsiella bacteremia have shown a strong association between it and diabetes mellitus. Eltahawi[17] have studied the antibiotics most active *in vitro* against Gram-negative bacilli recovered from patients in ICU at KAUH and found that imipenem, ciprofloxacin and amikacin were the most active. The results showed that multi drug resistance among Klebsiella species to unrelated classes of anti microbial (eg aminoglycosides and beta-lactams) was common. Klebsiella antibiotics susceptibility had also been studies at National Taiwan Hospital[16] and it showed susceptibility to imipenem, quinolones and ampicillin/sulbactam. Therefore the choice of empiric antibiotics treatment in diabetic patients with bacteremia of urinary source should include anti-Klebsiella coverage eg quinolones or imipenem.

Diabetic patients are more susceptible to Staphylococcus aureus bacteremia with poorer prognosis than in the general population,[18] in our study Staphylococci were isolated in similar rate in both groups as has been found in other series.[1,7,9]

Leibovici et al[9] and Carton et al[8] have found that ARF and septic shock are more common in diabetics, in our study, ARF was more common in non-diabetics as does DIC, while no significant difference was found between both groups in the development of septic shock.

The outcome of bacteremia in diabetics is variable; some reports found a higher mortality[1] while others found it to be similar to that of non-diabetics.[7-9] In our study we found a better outcome of bacteremia in diabetic patients compared to non-diabetics, which could be due to adequate glycemic control during infection, early diagnosis of the infection foci and appropriate choice of empiric antibiotics.

The type of bacteremia being hospital acquired, the presence of severe underlying disease, like malignancy, the use of ventilators and the development of septic shock and ARF were factors associated with poor outcome in diabetic patients with bacteremia, results similar to those known for the general population.[19]

Intraabdominal infection as a source of bacteremia in diabetics has been reported to be associated with high mortality,[20-22] but we didn't find significant association between any source of infection and mortality in diabetic bacteremia.

In conclusion, diabetic patients with bacteremia are older than non-diabetics, with no difference in the type or source of bacteremia between the 2 groups. Klebsiella is the most common cause of their bacteremia of urinary source. Therefore, the choice of empiric antibiotic should include anti Klebsiella coverage eg quinolones or imipenem. Diabetic patients have a better outcome with lower frequency of ARF and septic shock.

The difference between our results and those reported in the literatures is the better outcome in our diabetic bacteremia, which could be due to adequate glycemic control during bacteremic episode and appropriate choice of empiric antibiotics.

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