Asymptomatic Bacteriuria (ASB) in diabetic patients: Treat or not to treat: A prospective, observational study conducted at a tertiary care hospital

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ABSTRACT

Background: The term asymptomatic bacteriuria (ASB) refers to the isolation of bacteria in a urine specimen of individuals who denied symptoms of urinary tract infection. Diabetes mellitus (DM) is a disease involving multiple organ systems, hallmarked for its chronicity and thus-forth endless complications including asymptomatic bacteriuria. **Objectives:** This study aimed to determine the characteristics of asymptomatic bacteriuria and antibiotic susceptibility pattern amongst patients with diabetes. **Settings and Design:** A prospective observational study was conducted at a tertiary care hospital in Karachi, Pakistan. **Methods and Material:** The study included all those patients with a diagnosis of diabetes with no signs and symptoms of urinary tract infection but showing the growth of an organism in urine culture. Pregnant females and subjects who used antibiotics in last two weeks were excluded. A total of 222 urine cultures were observed prospectively who met the inclusion criteria through non-probability consecutive sampling. **Results:** Out of 222 urine cultures observed, mean age of subjects were 62.89 ± 13.77 out of which 76% were females, and 61% had a family history of diabetes. The most frequent organisms isolated were Escherichia. Coli (E. Coli), Enterococcus, Klebsiella, Pseudomonas, and Enterobacter species. A total of 20 subjects got dual bacterial growth in their cultures among which 17 subjects had a growth of Enterococcus with any other pathogen causing UTI. Gender, family history of diabetes, levels of HBA1c, and older age groups all were found significantly associated with ASB. **Conclusions:** Our study is the first to analyze and study the associated risk factors amongst ASB in DM patients, and to identify the pathogens involved along with assessing their antibiotic resistance profiles. Also, due to the increase resistance to antibiotics we would recommend to use antibiotics in ASB patients only if they have any two or more comorbidities.

Keywords: Asymptomatic, bacteria, culture, diabetes, urine

Introduction

Diabetes mellitus, hallmarked for its chronicity and endless complications, occurs due to a defect in the production or utilization of insulin.[1-3] According to the International Diabetes Federation, approximately 425 million adults worldwide had diabetes out of which, 79% belonged to countries with low socioeconomic status.[4] According to the survey conducted in 2017, the prevalence of type 2 diabetes is reported to be 16.98%.[5] With this disease on the rise, diabetes mellitus has become a hot topic of discussion ultimately leading to further elaboration of disease processes that can ensue due to the initial ailment of it. Diabetes mellitus is notorious for causing cardiovascular, neurological, and renal insult.[6,7] Diabetes has

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a negative impact on humoral immunity and neutrophilic function, it also damages the antioxidant system, evidently making patients prone to infections of any organ system of the body including infection of the urinary tract.[1,8,9] Even after treatment, re-infection is common amongst diabetics.[1,9,10] Considering this information, asymptomatic bacteriuria amongst diabetics poses an imminent threat of progressing from urethritis to life-threatening pyelonephritis in a matter of no time.

Asymptomatic bacteriuria (ASB) is the existence of bacteria in the urine with no clinical signs and symptoms of a UTI.[11,12] It is detected via urine culture of a properly collected urine specimen as per certified medical guidelines.[11,12] ASB is diagnosed either upon the presence of 100,000 colony forming units per ml in a midstream clean catch urine sample or upon the presence of 100 CFU per ml in the urine sample obtained from a catheterized patient.[11,12] While E- Coli is the most common organism, atypical pathogens with increased antimicrobial resistance are found more in the urine cultures of the former.[13-16] With an increased risk of upper urinary tract involvement and the likelihood of ASB progressing to a symptomatic UTI in this patient population, having urine samples cultured both pre and post-treatment are suggested.[15,17,18]

Diabetic patients with ASB often tend to experience pyelonephritis and albuminuria.[13,19] Past studies have shown that women with diabetes are three times more likely to have ASB.[20-22] Diabetics mostly get admitted for a complication of ASB including acute pyelonephritis. which affects 3.4-17% of diabetic males.[23] and 6-24 times of women.[23] Diabetic patients are prone to get ASB complications.[24,25] The most serious of which, being renal abscess, emphysematous pyelonephritis, renal papillary necrosis and urosepsis.[1,23,26] Furthermore, it has been proposed in previous studies that diabetic patients with ASB may recede with greater frequency toward renal failure several years forth.[13,23] Patients with urinary tract infection in diabetic patients are usually sensitive to ciprofloxacin or gentamicin.[20,27]

Once diagnosed with diabetes mellitus, patients require lifelong insulin therapy or adjunctive therapy with this hormone to control glycemic levels.[3,6,7] Adequate metabolic control not only limits complications of the disease but also lowers the risk of acquiring infection in an already susceptible diabetic patient.[28] In addition to adequate management, WHO recommends monitoring for adverse effects that can come about due to this disease.[13] Among the interventions suggested is screening for pathologies that can later proceed to manifest as kidney disease.[7] In view of this guideline and the projected estimate of diabetes mellitus on the rise especially in countries with low socioeconomic status, considering the paucity of data regarding findings of asymptomatic bacteriuria amongst the diabetic population in Pakistan, urged to conduct this study. The primary objective of this study is to determine the characteristics of asymptomatic bacteriuria in diabetes mellitus patients.

Materials and Methodology

A prospective observational study conducted in the internal medicine department of tertiary care hospital for the duration of 6 months. A sample size of 220 was calculated by using a Rao-soft sample size calculator (http://www.raosoft.com/samplesize.html). Permission was taken from the Institution of Review Board (approval no. IRB/DUHS/2019/108/085) and informed consent were taken from all the participants of the study Consent was taken from all patients and ethical committee approval was taken back in 03/15/2020.

Clean voided, mid-stream urine samples were collected from all the subjects and processed following standard guidelines. Urine gram stain examination was done to look for the pus cells and bacteria. In patients with significant bacteriuria, antibiotic susceptibility was done according to clinical laboratory standards institute (CLSI) guidelines.[29] For diagnosing ASB in females, two consecutive specimens with isolation of the same species in quantitative counts of at least 100,000 colony forming units (CFUs)/mL of urine were considered, whereas in males, a single specimen with one bacterial species isolated in a quantitative count of at least 100,000 CFUs/mL was considered. Patient with urine analysis confirming bacterial infection but without any signs and symptoms of UTI were included in our study.

After the data collected through the non-probability consecutive sampling method, it was analyzed on IBM-SPSS version 25.0 and results were obtained. The statistical difference was calculated via independent sample t-test, Chi-square, and fisher's exact test, and considered significant if <0.05.

Results

Out of the 222 subjects, three times more women with a younger mean age of 61.54 ± 13.86 as compared to men were recruited. Around 58% of males had a family history of Diabetes Mellitus (DM), in contrast to 62% of females. 28.37% of females had a known history of Chronic Kidney Disease (CKD) in contrast to 9% among males. 36% of females had hypertension while this number was 14.28% among males. Ischemic heart disease was found to be in 4.95% of females and 4.50% of males respectively. Almost 40% of the subjects had there HBA1c in the range of 6.5-9.0%, 22% in the range of 5.7-6.5%, remaining were equally distributed in the range of <5.7%, 9-11.5%, 11.6-14.0% and greater than 14.0% respectively.

Escherichia Coli, Enterococcus species, and Klebsiella pneumonia were the most prevailing organisms being isolated from the urine samples of all the subjects, with the frequency of 54%, 13%, 11% among females and 49%, 11% and 9% among males. Dual growth was observed in 20 of the total subjects, out of which 16 were females. 43.75% of the dual growth among females isolated *E. Coli* and Enterococcus species while 18.75% isolated Enterococcus with Klebsiella species. In contrary 75% of the dual growth among males showed the growth of Enterococcus and *E. Coli* while 25% showed Enterococcus and Proteus Mirabilis.

Out of the 20 subjects who got a dual growth in their cultures, 13 had a positive family history for DM.

Amongst the cultures that came positive, E. coli (n = 129) was found most sensitive to Amikacin (84.49%) followed by Fosfomycin (80.62%) and Gentamicin (66.67%). The resistance was mostly documented to Ampicillin (86.04%) followed by cefixime (82.94%) and cefuroxime (82.17%). Amongst the 27 positive cultures of Klebsiella pneumonia, the most sensitive antibiotic was Fosfomycin (70.37%) followed by:

Amikacin (55.56%) and Piperacillin/Tazobactam (44.44%), while the most resistance were Ceftriaxone (77.78%), Cefixime (77.78%), and Cefuroxime (74.07%) respectively. Pseudomonas was positive in 10 cultures, being most sensitive to Ciprofloxacin (70%) followed by Ceftazidime (60%) and Amikacin (60%) and being also most resistant to Ceftazidime (40%), [Table 1].

Amongst the patients with chronic kidney disease (n = 83), Enterococcus was the most likely organism to be positive in urine culture with 57.8% infecting (n = 26), while rest 42.2% (n = 19) infecting non-CKD patients (p = 0.002). While *E. coli* was positive in only 35 CKD patients (27.1%), the rest 94 cultures (62.9%) were infected in non-CKD patients (p = 0.0002). Enterobacter was exclusively present in the cultures of patients with CKD, with all the 9 growths (100%) opposed to no growths in non-CKD patients (p = 0.0001), which showed that patient with underlying CKD are at very high risk of ASB and its complications including pyelonephritis or perinephric abscess.

With respect to patients presenting with no other co-morbidities except for diabetes (n = 70), *E. coli* was mostly likely associated organism (n = 52) with a *P* value of 0.001. Enterococcus was opposed to more likely occurring in patients with multiple co-morbidities (p = 0.010). With respect to patients with Benign prostatic hyperplasia (n = 22), *E. coli* was infecting 50% of their cultures (n = 11), among others (p = 0.561). Considering BPH as a prevalent co-morbid in the old age males, yet the frequency of asymptomatic bacteriuria in BPH is quite low as compared to other co-morbidities in our study population (9.90%). It can be postulated that even though BPH is considered as a significant risk factor of asymptomatic bacteriuria, it is more likely to cause symptomatic urinary infections rather than asymptomatic ones. Urinary tract infection prevalence is increasing as the time passes. Factors like diabetes, hypertension and female gender put you at high risk to get a urinary tract infection, so in such scenario the prevalence of urinary tract infection without any symptoms is also very high. This study is of great benefit for the primary care physicians as after analysis of the results, we recommend the initiation of antibiotics in patient having asymptomatic bacteriuria but with two or more risk factors, as by doing this we can prevent the symptoms to develop and to prevent the complications which can be caused if bacteriuria stayed untreated.

Discussion

Many studies investigated the risk factors associated with ASB in DM patients. This study aimed to outline the associated risk factors of ASB in DM, the pathogens involved, and their antibiotic sensitivity profiles.

Various studies conducted have shown demographic factors (particularly age and female gender) to be associated with ASB in DM patients. Such is the case in our study with results showed that the mean age of our patients was (62.89 ± 13.77), similar to Geerlings *et al.*, (63.0 ± 10) Turan *et al.*, (60.8 ± 9.5) and Odetoyin *et al.*, (65.52 ± 9.4).[23,29,30] The mean age in our study however differed from the findings of Hamdan *et al.*, Boroumand *et al.*, and Zhanel *et al.*, which reported lower mean ages.[31-33] The greatest percentage of patients with ASB in our study were found in the 50-75 years age range, with 66.7% of the total study population falling in this group. This age range was comparable to Meiland *et al.*, where 61.8% of the diabetic patients positive for ASB were in the 56-75 years age range.[34]

Various studies have confirmed the role of the female sex as a risk factor for ASB in diabetics, like study by Turan *et al.*, where 77.2% of females were positive for ASB.[23] Results from the studies by Jha *et al.*, (70%) and Alebiosu *et al.*, (72.7) reported similar results as well, while Banerjee *et al.*, reported a lower frequency (59%).[19,35,36] Bissong *et al.*, and Matteucci *et al.*, however recorded higher percentages of women in their studies at 86.4% and 86% respectively, and thus concluding that the female gender was a positive risk factor for ASB.[10,37] The high prevalence of women in our study population can be since most of the women have undergone postmenopausal changes (the mean age of women in this study was 61.54 ± 13.86).[38]

The role of glycemic control (HbA1c) as a risk factor for diabetic patients to develop ASB has been controversial. Studies in the literature are both for and against its role as a risk factor. Turan *et al.*, confirmed in their study as poor glycemic control to be a risk factor for ASB.[23] The mean HbA1c reported was (8.7 ± 2.0), which is like our study.[29] A study in India on diabetic patients showed 71.43% of their patients had poorly controlled DM.[39] Matteucci *et al.* reported mean HbA1c of 7.9 ± 1.1, slightly lower compared to our results.[37] Bonadio *et al.*, reported mean HbA1c of 9.6 ± 2.0, higher than our findings.[7] The mean HbA1c reported by Zhanel *et al.*, was higher than our results at 13.3 ± 4.1, but they too concluded that HbA1c and ASB are not related.[33] Similar conclusions have been reached by Nicolle *et al.*, and He *et al.*,[20,40] The inconsistent variability among the relation between glycemic control and ASB reflects the variety of study populations and the selection criteria used in these studies.

Zhanel *et al.*, reported that 5.9% of their patients had kidney disease, much lower than our study.[33] The high prevalence of CKD in our study could be due to diabetic nephropathy, or the effect of ASB and DM collectively on the kidneys. An interesting result in our study was related to the pathogens cultured in

Table 1: Frequency of susceptibily to antibiotics of microorganisms isolated in the cultures

Antibiotics		1. Staph Aureus	2. MRSA	3. Enterococcus	4. Streptococcus	5. P.Aeruginosa	6. E. Coli	7. K. Pneumonia	8. Proteus Mirabilis	9. Acinetobacter	10. K. Oxytoca	11. Burkholderia Cepacia	12. Enterobacter	13. Citrobacter
Aztreonam	Sensitive	0	0	0	0	0	0	0	0	0	0	0	0	0
	Resistant	0	0	0	0	1	1	2	0	0	0	0	0	0
Amikacin	Sensitive	4*	2^	2	0	6^	109*	15^	1^	0	2*	0	3^	1*
	Resistant	0	1^	1	0	3^	8	10	0	1^	2^	0	5^	0
Amoxicillin/Clavulanic acid	Sensitive	1	0	21^	5*	0	57	8	2*	0	2*	0	0	0
	Resistant	0	3*	1	0	0	58	16	0	0	2*	0	0	0
Ampicillin	Sensitive	0	0	20	5*	0	4	1	2*	0	0	0	0	0
	Resistant	0	0	20^	0	0	111*	2	0	0	1	0	2	0
Ciprofloxacin	Sensitive	3^	0	1	0	7*	33	4	1^	0	1^	0	2	0
	Resistant	1*	1^	5	0	3^	87	19	0	2*	3*	0	7*	0
Ceftriaxone	Sensitive	0	0	1	0	0	20	5	1^	1^	1^	0	2	0
	Resistant	0	0	3	3	0	99	21*	0	1^	2^	0	7*	1*
Cefixime	Sensitive	0	0	2	0	0	22	5	1^	0	1^	0	2	0
	Resistant	0	0	1	0	0	107^	21*	0	0	3*	0	7*	1*
Cefuroxime	Sensitive	0	0	1	0	0	22	6	1^	0	1^	0	2	0
	Resistant	0	0	2	0	0	106	20^	1^	0	3*	0	7*	1*
Co-trimoxazole	Sensitive	0	0	2	1	0	36	3	1^	0	1^	1*	2	0
	Resistant	1*	0	1	1	0	57	14	0	2*	2^	0	1	1*
Gentamicin	Sensitive	4*	1	3	0	4	86	11	0	0	1^	0	4^	0
	Resistant	0	1^	1	0	3^	33	14	0	1^	3*	0	5^	1*
Meropenem	Sensitive	0	0	1	0	4	85	11	0	2*	0	1*	3	1*
	Resistant	0	0	0	0	2	7	7	0	0	2^	0	4	0
Piperacillin/Tazobactam	Sensitive	0	0	3	0	7*	81	12	1^	2*	1	0	2	1*
	Resistant	0	0	0	0	3^	34	13	0	0	2^	0	5^	0
Vancomycin	Sensitive	3^	3*	18	1	0	0	0	0	0	0	0	0	0
	Resistant	0	0	12	0	0	0	1	0	0	0	0	0	0
Fosfomycin	Sensitive	0	0	32*	4^	1	104^	19*	2*	1^	1^	0	4^	1*
	Resistant	0	0	7	1	0	16	5	0	0	1	0	4	0
Nitrofurantoin	Sensitive	3^	1	13	1	0	51	8	0	0	1^	0	0	0
	Resistant	0	0	5	0	0	2	1	0	0	1	0	1	1*
Levofloxacin	Sensitive	0	0	7	3	1	4	1	1^	0	0	1*	0	0
	Resistant	0	0	26*	2*	2	8	5	0	0	1	0	3	1*
Colomycin/Polymyxin B	Sensitive	0	0	0	0	2	6	8	0	0	2*	0	5*	0
	Resistant	0	0	0	0	0	0	0	0	0	0	0	0	0
Tobramycin	Sensitive	0	0	0	0	1	6	0	0	0	0	0	0	0
	Resistant	0	0	0	0	1	6	7	0	0	2^	0	4	0
Sulbactam/Cefoperazone	Sensitive	0	0	0	0	0	0	0	0	0	0	0	4	0
	Resistant	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceftazidime	Sensitive	0	0	0	0	6^	6	8	0	0	2^	1*	4	0
	Resistant	0	0	0	0	4*	0	0	0	0	0	0	0	0
Linezolid	Sensitive	0	0	15	0	0	0	0	0	0	0	0	0	0
	Resistant	0	0	0	0	0	0	0	0	0	0	0	0	0
Cloxacillin	Sensitive	4*	0	0	0	0	0	0	0	0	0	0	0	0
	Resistant	3*	3*	0	0	0	0	0	0	0	0	0	0	0

*Most Sensitive/Resistance antibiotic amongst the particular Organism. ^2nd most Sensitive/Resistance antibiotic amongst the particular Organism

Table 1: Contd...	
Abbreviations=Organisms	**MIC=Minimal inhibitory concentration:**
1. Methicillin sensitive Staphylococcal Aureus (*n*=4).	Ampicillin: Susceptibility ≥29 mm, Resistant ≤28 mm
2. Methicillin resistant Staphylococcal Aureus (*n*=2)	Amoxicillin+clavulanic acid: Susceptibility ≥22 mm, Resistant ≤21 mm
	Cefuroxime: Susceptibility ≥24 mm, Resistant ≤20 mm
	Ciprofloxacin: Susceptibility ≥21 mm, Resistant ≤15 mm
	Co-trimoxazole: Susceptibility ≥16 mm, Resistant ≤10 mm
	Gentamicin: Susceptibility ≥15 mm, Resistant ≤12 mm
3. Enterococcus species (*n*=24).	Ampicillin: Susceptibility ≥17 mm, Resistant ≤16 mm
	Amoxicillin+clavulanic acid: Susceptibility ≥17 mm, Resistant ≤16 mm
	Ciprofloxacin: Susceptibility ≥21 mm, Resistant ≤15 mm
4. Streptococcus species (*n*=4).	Ampicillin: Susceptibility ≥24 mm, Resistant ≤19 mm
	Ciprofloxacin: Susceptibility ≥17 mm, Resistant ≤13 mm
5. Pseudomonas Aeruginosa (*n*=8).	Amikacin: Susceptibility ≥17 mm, Resistant ≤14 mm
	Aztreonam: Susceptibility ≥22 mm, Resistant ≤15 mm
	Ciprofloxacin: Susceptibility ≥21 mm, Resistant ≤15 mm
	Meropenem: Susceptibility ≥19 mm, Resistant ≤15 mm
	Gentamicin: Susceptibility ≥15 mm, Resistant ≤12 mm
	Piperacillin/Tazobactam: Susceptibility ≥21 mm, Resistant ≤14 mm
6. Escherichia Coli (*n*=82).	Amikacin: Susceptibility ≥17 mm, Resistant ≤14 mm
	Aztreonam: Susceptibility ≥21 mm, Resistant ≤17 mm
	Ciprofloxacin: Susceptibility ≥21 mm, Resistant ≤15 mm
	Meropenem: Susceptibility ≥23 mm, Resistant ≤19 mm
	Gentamicin: Susceptibility ≥15 mm, Resistant ≤12 mm
	Piperacillin-Tazobactam: Susceptibility ≥21 mm, Resistant ≤17 mm
7. Klebsiella Pneumonia (*n*=20).	Amikacin: Susceptibility ≥17 mm, Resistant ≤14 mm
	Aztreonam: Susceptibility ≥21 mm, Resistant ≤17 mm
	Ciprofloxacin: Susceptibility ≥21 mm, Resistant ≤15 mm
	Meropenem: Susceptibility ≥23 mm, Resistant ≤19 mm
	Gentamicin: Susceptibility ≥15 mm, Resistant ≤12 mm
	Piperacillin-Tazobactam: Susceptibility ≥21 mm, Resistant ≤17 mm
8. Proteus Mirabilis (*n*=1).	Amikacin: Susceptibility ≥17 mm, Resistant ≤14 mm
	Aztreonam: Susceptibility ≥21 mm, Resistant ≤17 mm
	Cefuroxime: Susceptibility ≥18 mm, Resistant ≤14 mm
	Ciprofloxacin: Susceptibility ≥21 mm, Resistant ≤15 mm
	Meropenem: Susceptibility ≥23 mm, Resistant ≤19 mm
	Gentamicin: Susceptibility ≥15 mm, Resistant ≤12 mm
9. Acinetobacter species (*n*=1).	Amikacin: Susceptibility ≥17 mm, Resistant ≤14 mm
	Aztreonam: Susceptibility ≥21 mm, Resistant ≤17 mm
	Ciprofloxacin: Susceptibility ≥21 mm, Resistant ≤15 mm
	Meropenem: Susceptibility ≥18 mm, Resistant ≤14 mm
	Gentamicin: Susceptibility ≥15 mm, Resistant ≤12 mm
	Piperacillin-Tazobactam: Susceptibility ≥21 mm, Resistant ≤17 mm

patients with CKD as comorbidity. Our results showed that Enterococcus was present in 57.8% of these patients. A study on renal transplant patients found Enterococcus to be present in 35% of the cultures. Another finding of note was the exclusive presence of Enterobacter in CKD patients with 9 growths as opposed to no growth in non-CKD patients. Hypertension was reported to be 12% as reported by Meiland *et al.*,[34] Tencer *et al.*, reported 37.5% of their patients to be hypertensive, while even greater frequencies were found by Papazafiropoulou *et al.*, (79.5%) and Kasyan *et al.*, 87.3%.[2,38,41]

A study conducted in Sudan showed the growth of *E. coli* (56.4%), K. Pneumoniae (23.0%), and E. faecalis (12.8%) in the urine culture.[31] Klebsiella pneumonia (42.4%), *E. coli* (21.2%), and E. faecalis (12.1%) were isolated from the study in Nigeria,[19] while *E. coli* (67%), Enterococcus (9%), Klebsiella (14%) were found in the study conducted in Southern India.[42] Odetoyin

et al., performed a study where the isolated organisms were Staphylococcal aureus (80.9%), Klebsiella (9.5%), Enterococcus faecalis (4.8%), and *E. coli* (4.8%).[30]

One of the aims of our study was to assess the antibiotic sensitivity and resistance present in each organism cultured. We found that *E. coli* was mainly susceptible to aminoglycosides and Fosfomycin, with resistance mainly to ampicillin and 3rd generation cephalosporins. Nigussie *et al.*, found that *E. coli* was sensitive to nitrofurantoin (100%), norfloxacin (90.9%), ciprofloxacin (81.8%), but resistant to Ampicillin (100%), trimethoprim-sulfamethoxazole (81.8%), gentamicin (72.7%).[43] This study also showed that *E. coli* was resistant to Gentamicin (72.7%),[42] but our study showed it was susceptible to Gentamicin (66.7%). The resistance of *E. coli* in this study to Ampicillin was 100%,[43] compared to our results which shows a resistance of 86.04%. Our study showed a 67.4%

resistance to Ciprofloxacin as compared to the 81.8% sensitivity in the study by Nigussie *et al.*,.[43] Bissong *et al.*, in their analysis found *E. coli* was resistant to Nalidixic acid 33.3%, Gentamicin 26.7%, and Cefuroxime 13.3%.[10] These results differed from ours as Gentamicin was sensitive in 66.7% of the organisms, and the resistance of Cefuroxime was much higher in our study (82.17% v 13.3%). A study conducted in India found *E. Coli* to be 100% sensitive to Imipenem, but 90% resistant to 3rd generation cephalosporins, thus resembling the resistance pattern of *E. Coli* seen in our study.[39]

K. pneumonia was susceptible to Fosfomycin (70.37%) followed by Amikacin (55.56%) and Piperacillin/Tazobactam (44.44%) while showing resistance mostly to the cephalosporins. A study in China showed that K. pneumonia was resistant to Amoxicillin (100%), Cephalothin (50%), Cefuroxime (41.7%).[40] These results are in agreement with our findings that show high resistance to cephalosporins. Our study showed a lower resistance of K. pneumonia to Amoxicillin as compared to the results shown in this study (59.2% v 100%). Alebiosu *et al.*, found that K. pneumonia was susceptible to gentamicin and ciprofloxacin in 85.7% of the organisms, nitrofurantoin in 78.5%, and 71.4% in ofloxacin.[19] Our antibiotic profile for K. pneumonia shows its susceptibility to Gentamicin in 40.7% cases, 14.8% to ciprofloxacin, and 29.6% to nitrofurantoin, thus showing the susceptibility of the organism to all antibiotics were much lower.

The most sensitive antibiotics for enterococcus were fosfomycin (71.1%), amoxicillin (46.67%), and vancomycin (40%). Enterococcus showed resistance mainly to levofloxacin (57.78%) and ampicillin (44.44%). He *et al.*, showed that enterococcus in their studies was resistant to levofloxacin as well (33.3%), but the resistance to the antibiotic seen in our study was greater.[40] Hamdan *et al.*, documented ampicillin to be sensitive to 80% of the organism, while we found the sensitivity to ampicillin in our study was much lower.[31] A study in Southern India placed the sensitivity of the pathogen to vancomycin at 89%, which was much greater as to sensitivity seen to the same antibiotic in our study.[43]

We also found that Candida was present in 12.16% of the organisms cultured. These results closely mimic the findings of Jha *et al.*, who found a prevalence of 16.67% of the organism.[35] A much higher percentage was however seen in diabetic patients with ASB in India, where 7 cases of candida were isolated from a total of 21 species (33.33%).[39]

A few limitations can be noted in this study. The study took place at a single tertiary care hospital in an urban city. The sexual hygiene, socioeconomic status, urinary catheterization, and the duration of diabetes was not taken into account for our subjects.

Conclusions

Despite many studies present in the literature (about ASB in DM patients) with their diverse protocols and study populations, data regarding the risk factors of ASB in DM patients in Pakistan

was scarce. In this regard, our study is the first to analyze and study the associated risk factors amongst ASB in DM patients, and to identify the pathogens involved along with assessing their antibiotic resistance profiles. Based on our results we recommend similar studies should be conducted in the region, to improve and develop the guidelines and protocols on managing patients with ASB and DM. But from the limited data which we got from our study. We would recommend that doctors or nephrologist should plan to start antibiotics prophylactically with a caution because of high prevalence of resistance to antibiotics, so our recommendation would be to use antibiotics prophylactically only if patient had two or more comorbidities in order to prevent the complications that can be caused by ASB like pyelonephritis, perinephric abscess etc.

Key points

- This study showed the statistical data of bacterial culture growth in diabetic patient and antibiotic sensitivity against those specific micro-organisms
- Study proved that in diabetic patients if patient had two or more co-morbidities, he or she should be treated prophylactically which is a take home message to our study.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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