ORIGINAL RESEARCH ARTICLE: BACTERIOLOGICAL STUDY OF URINE DURING PREGNANCY IN RELATION TO PRESENCE OR ABSENCE OF SYMPTOMS

Dr. Sonal Lakum[1*], Dr.Noopur Nagar[2]

Abstract

Background: Urinary tract infection (UTI) is a common health hazard among pregnant women .UTI may manifests either as a symptomatic bacteriuria or asymptomatic bacteriuria. As per the authors, the prevalence of asymptomatic UTI is 2% to 10% in pregnant women while symptomatic UTI accounts for 1-18% during pregnancy.

Objective: The Objective of Study is to detect significant bacteriuria in pregnant women during antenatal period & to find out Antibiotic susceptibility and resistance pattern of various bacterial isolates from urine sample of antenatal patients and establishing its relationship with presence or absence of symptoms.

Methodology: This hospital based prospective study was carried out on urine samples of 100 pregnant women to determine the profile of bacteria and their susceptibility pattern isolated from pregnant women with and without symptoms of Urinary tract infection (UTI). Mid-stream urine samples were collected using sterile, wide mouthed container with screw cap top. Predesigned and structured questionnaire was used for the collection of data. Urine samples were processed in the laboratory within 2 hours of collection. Urine sample was examined for Gross Examination, Wet mount examination, Gram staining, Culture and Colony counting and Antibiotic Sensitivity Test**.**

Result: A total of 26 six patients showed significant bacteriuria with colony count of $>10^5$ CFU/ml. Out of total 26 patients, 20 (76.92%) patients had symptomatic bacteriuria and 6 (23.08%) patients had asymptomatic bacteriuria. Escherichia coli (34.61%) was the most common organism isolated followed by Staphylococcus aureus (26.92%). Gram positive bacteria showed the maximum sensitivity to Vancomycin and Levofloxacin whereas Gram negative bacteria showed maximum sensitivity to Imipenem. The maximum number of patients with asymptomatic as well as symptomatic bacteriuria were in their first trimester of pregnancy and belonged to the age group of 20-25 years.

Conclusion: We would like to come to the conclusion that screening and treatment of bacteriuria should be considered as a standard of obstetric care because it is frequent in pregnant women and can cause complications if left untreated.

Keywords: Urinary Tract Infection, Pregnancy, Asymptomatic bacteriuria (ASB), Symptomatic bacteriuria

[1*]Assistant Professor, Department of Microbiology, Parul Institute Of Medical Sciences & Research, Parul University ,Vadodara, Gujarat, India

[2]Associate Professor , Department of Obstetrics and Gynaecology, Parul Institute of Medical Sciences & Research, Parul University, Vadodara, Gujarat, India
E mail: nups.nagar@gmail.com

[*]**Corresponding Author:** Dr. Sonal Lakum
*Assistant Professor, Department of Microbiology, Parul Institute Of Medical Sciences & Research, Parul University, Vadodara, Gujarat, India, E mail:drskumar80@gmail.com

DOI: 10.48047/ecb/2023.12.si10.00331

INTRODUCTION:

Asymptomatic bacteriuria (ASB) signifies a significant quantitative count of bacteria in the urine without symptoms of a lower (acute cystitis) or upper urinary tract/kidney (acute pyelonephritis) infection (UTI) [1].In pregnancy, the apparent reduction in immunity of pregnant women tends to encourage the growth of pathogens .Symptomatic urinary tract infections are divided in to lower tract (cystitis) or upper tract (acute pyelonephritis) infections. Cystitis is defined as significant bacteriuria with associated bladder mucosal invasion and Pyelonephritis is defined as significant bacteriuria with associated inflammation of the renal parenchyma, calices and pelvis [4]. As many as 20-40% of pregnant women with ASB, if proper treatment is not given, they will develop pyelonephritis later in their pregnancy compared with <1% of pregnant women without ASB[5].

Escherichia coli is the major etiological agent for UTI, Proteus mirabilis, Klebsiella species, Pseudomonas aeruginosa and Enterobacter species are less frequent agents. Urine culture is the gold standard of diagnosis. As asymptomatic bacteriuria is clinically significant in pregnancy, it should be treated at all stages. Screening is an essential component of prenatal care. The American College of obstetrics and Gynecology (ACOG) recommends routine screening for bacteriuria with a urine culture at the first prenatal visit and during the third trimester. Screening and treatment of asymptomatic bacteriuria is recommended in pregnant women. [6] Treatment of UTI in pregnancy is very important for mother and child. As there is a close relationship between ASB and obvious UTI, Screening and treatment of ASB also help to reduce poor pregnancy outcome like preterm birth and low birth weight.

Dhiraj Hospital is a rural based tertiary care centre; this study will help antenatal women for the detection of asymptomatic bacteriuria and symptomatic bacteriuria and early starting the therapy hence, prevent maternal morbidity. Studies have also shown that treatment of bacteriuria reduces the incidence of complications and lowers the long term risk of sequelae following asymptomatic bacteriuria.

MATERIAL & METHOD:

This hospital based prospective study was carried out on urine samples of 100 pregnant women who attended Obstetric OPD of Dhiraj General Hospital for antenatal check up, in a period from August 2014 to July 2015 to determine the profile of bacteria and their susceptibility pattern isolated from pregnant women with and without symptoms of Urinary tract infection (UTI).

Predesigned and structured questionnaire was used for the collection of data.

Inclusion criteria: Pregnant women without current antibiotic therapy and who were willing to participate in the study.

Exclusion criteria: Pregnant women with current antibiotic therapy and who were not willing to participate in the study.

Collection of sample

Mid stream urine samples were collected using sterile, wide mouthed container with screw cap top. On the urine sample container, patients' name, age, and time of collection were mentioned.

Study participants were informed to clean their hands and genital area with water before collection of the clean catch mid stream urine samples. Urine samples were processed in the laboratory within 2 hours of collection and specimen those were not processed within 2 hours were kept refrigerated at 4 degree Celsius until they were processed.

Processing of urine sample

Gross examination:-was done to observe colour, turbidity and results were noted.

Wet mount examination:-was done to observe pus cells, RBCs, parasites and any other finding. All the observations were recorded.

Gram stain: - was performed on all centrifuged samples and examined.

Culture: - Was done on MacConkey agar, Blood agar, and Cystine lactose electrolyte deficient media. All media were prepared in clinical microbiology laboratory except Blood agar which was from Hi media. The plate was incubated aerobically at 37 degree Celsius for 24 hours.

Isolation of uropathogens were performed by a surface streak procedure using calibrated standard loop method for semi quantitative culture. A calibrated sterile platinum wire loop that has the 4.0 mm diameter is designed to deliver 0.01 ml was used for the semi quantitative method and plating. A loop full of the well mixed urine sample was inoculated on MacConkey, Blood agar and CLED (Cystine lactose electrolyte deficient medium). All the plates were then incubated at 37 degree Celsius aerobically for 24 hours. The plates were examined macroscopically for bacterial growth. A significant bacterial count was taken for specimen that

produced $>10^5$ colonies but specimen containing $<10^5$ colonies considered insignificant or due to contamination.

Colony counting
The Petri dish containing bacterial colonies was kept on the Digital colony counting machine, the instrument is provided with magnifying lens and colonies were counted.

Biochemical Tests: - Tests were performed according to standard guidelines. [7]
Indole, Citrate, Oxidase, Urease, Triple sugar iron, H2S production, Gas production, Catalase, Coagulase and Mannitol salt agar.

Antibiotic Sensitivity Test
Antibiotic sensitivity test was performed according to CLSI guidelines by modified Kirby Bauer disc diffusion method.

The following antibiotics were tested by disc diffusion method.
Amoxicillin-clavulanic acid (30 mcg), ciprofloxacin (5mcg), Gentamicin (10 mcg), Amikacin (30 mcg), Cefuroxime (30 mcg), cefipime (30 mcg), cefotaxime (30 mcg), Imipenem (10 mcg), co-trimoxazole (25 mcg) for gram negative bacilli. Ceftazidime (30 mcg), Piperacillin (100 mcg), Piperacilin-Tazobactum (100/10 mcg), Aztreonam (30mcg) for pseudomonas species, penicillin (10units), Linezolid (15 mcg), cefoxitin (1 mcg), Vancomycin (30 mcg), levofloxacin (5 mcg), doxycycline (30 mcg) for Gram positive cocci. A standard inoculums adjusted to 0.5 McFarland was swabbed on to Mueller-Hinton agar plate and antibiotic disc were placed after drying the plate for 15 min and incubated at 37 degree Celsius for 24 hrs.

The reference strains used as control were Escherichia coli (ATCC 25922), Staphylococcus aureus (ATCC 25923) AND Pseudomonas aeruginosa (ATCC 27853)

Reading of plates and interpretation of results:-
For AST, after incubation plates were carefully examined for the inhibition zones. The plates were held a few inched above a non-reflecting background and read under reflected light. Inhibition zones were measured by naked eye with the help of antibiotic zone scale and the zone diameters including the diameter of the discs were noted. All the results were recorded and interpreted using CLSI guidelines.

RESULTS:
In this study total of 100 antenatal patients' urine samples were studied for assessment of symptomatic and asymptomatic bacteriuria. Twenty (76.92%) were symptomatic and 06 (23.08%) were asymptomatic (Refer table 1). Twenty six samples with growth were tested for Antibiotic sensitivity.

Table 1: Prevalence of UTI in pregnant women with or without symptoms

Selection for Inclusion	Total	Percentage (%)
Asymptomatic bacteriuria	06	23.08
Symptomatic bacteriuria	20	76.92
Total	26	100

Table 2: Asymptomatic bacteriuria and trimester of pregnancy

Trimester of pregnancy	Total	Percentage
First	05	83.34
Second	01	16.66
Third	00	00
Total	06	100

In this study total of 100 pregnant patients were studied, out of 6 asymptomatic patients with significant bacteriuria, 5 (83.34%) belonged to first trimester, 01(16.66%) belonged to second trimester and 00(00%) belonged to third trimester. (Refer Table 2)

Table 3 Symptomatic bacteriuria and trimester of pregnancy

Trimester of pregnancy	Total	Percentage
First	05	25
Second	10	50
Third	05	25
Total	20	100

Out of 20 symptomatic patients with significant bacteriuria, 5 (25%) belonged to first timester 10 (50%) belonged to second trimester and 5 (25%) belonged to third trimester. (Refer table 3)

Table 4: Etiological agents causing bacteriuria

Agents	Number (n=26) (%)	Asymptomatic Bacteriuria (06)	Symptomatic Bacteriuria (20)	P value
Escherichia coli	09 (34.61%)	03 (33.33%)	06 (66.67%)	0.6789
Staphylococcus aureus	07 (26.92%)	01 (14.29%)	06 (85.71%)	0.90
Coagulase negative staphylococci	07 (26.92%)	00 (0%)	07 (100%)	0.24
Klebsiella species	01 (3.85%)	00 (0%)	01 (100%)	0.51
Candida species	01 (3.85%)	01 (100%)	00 (0%)	0.51
Enterococcus species	01 (3.85%)	01 (100%)	00 (0%)	0.51

A total of 26 microbial isolates were recovered from 100 patients under study. In 09 (34.61%) patients, Escherichia coli were recovered, which was the most common pathogen followed by Staphylococcus aureus 07 (26.92%), Coagulase negative staphylococci 07 (26.92%), Klebsiella species 01 (3.85%), Candida species 01(3.85%) and Enterococcus species 01 (3.85%). (Refer table 4 and Graph 1)

Graph 1: Graphical presentation of Etiological agents causing bacteriuria

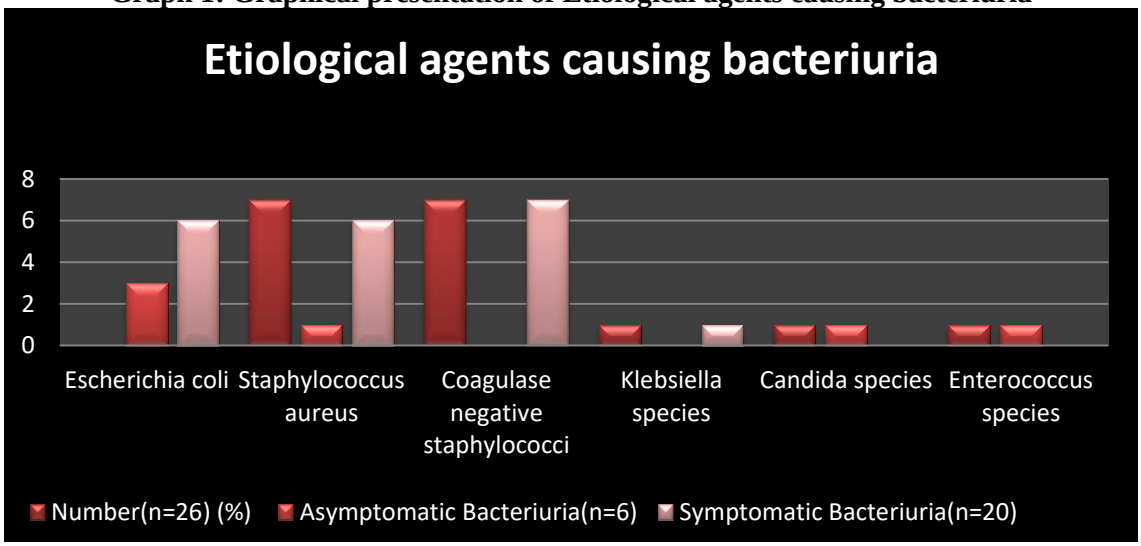

Table 5: Comparison of symptomatic and asymptomatic bacteriuria in different age Group

Age group(years)	Asymptomatic Bacteriuria (06) (%)	Symptomatic Bacteriuria (20) (%)	P value
15-20	01 (16.67%)	00 (0%)	0.51
20-25	04 (66.66%)	13 (65%)	0.67
25-30	01 (16.67%)	07 (35%)	0.72
30-35	00 (0%)	00 (0%)	-
35-40	00 (0%)	00 (0%)	-

A total of 100 patients were studied and patients with asymptomatic bacteriuria and with symptomatic bacteriuria were compared in relation to the age group in years. The age group 20-25 years constitutes the largest group with asymptomatic bacteriuria (66.66%) followed by the age group 15-20 (16.67%), 25-30 (16.67%) and age

group 30-35 (00%) and 35-40 (00%). Refer table 5).

Table 6: Sensitivity pattern of Escherichia coli (n=9)

Name of Antibiotics	Sensitive	Intermediate	Resistant
Amikacin	07 (70.78%)	00 (0%)	02 (22.22%)
Amoxicillin- clavulanic acid	05 (55.56%)	00 (0%)	04 (44.44%)
Cefipime	05 (55.56%)	00 (0%)	04 (44.44%)
Cefuroxime	04 (44.44%)	00 (0%)	05 (55.56%)
Cefotaxime	03 (33.33%)	01 (11.11%)	05 (55.56%)
Imipenem	09 (100%)	00 (0%)	00 (0%)
Gentamicin	07 (70.78%)	00 (0%)	02 (22.22%)
Co-trimoxazole	02 (22.22%)	00 (0%)	07 (70.78%)
Ciprofloxacin	05 (55.56%)	01 (11.11%)	03 (33.33%)

The in *vitro* antibiotic sensitivity pattern of *Escherichia* coli is as follows, all the 09 isolates were sensitive to Imipenem (100%) followed by Amikacin 07 (70.78%), Gentamicin 07 (70.78%), Amoxicillin + clavulanic acid 05 (55.56%), Cefipime 05 (55.56%), Ciprofloxacin 05 (55.56%), Cefuroxime 04 (44.44%), Cefotaxime 03 (33.33%) and Co-trimoxazole 02 (22.22%). (Refer table 6 and Graph 2)

Graph 2: Showing Sensitivity pattern of Escherichia coli (n=9)

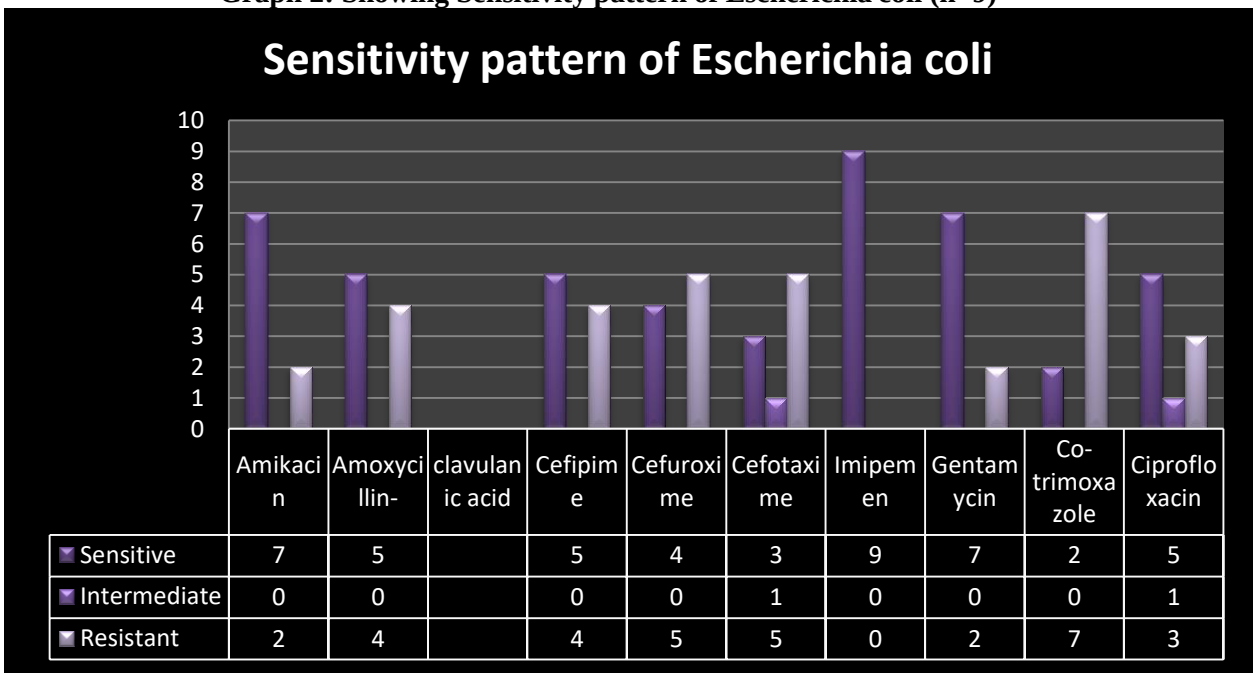

Table-7 Sensitivity pattern of Staphylococcus aureus (n=6)

Name of Antibiotics	Sensitive	Intermediate	Resistant
Erythromycin	02 (33.33%)	01 (16.67%)	03 (50%)
Penicillin	01 (16.67%)	00 (0%)	05 (83.33%)
Co-trimoxazole	01 (16.67%)	00 (0%)	05 (83.33%)
Linezolid	05 (83.33%)	00 (0%)	01 (16.67%)
Cefoxitin	02 (33.33%)	00 (0%)	04 (66.67%)
Vancomycin	06 (100%)	00 (0%)	00 (0%)
Levofloxacin	04 (66.67%)	00 (0%)	02 (33.33%)
Gentamicin	06 (100%)	00 (0%)	00 (0%)
Doxycycline	05 (83.33%)	00 (0%)	01 (16.67%)

The *vitro* antibiotic sensitivity pattern of *Staphylococcus aureus* is as follows, it showed maximum sensitivity to Vancomycin (100%) and Gentamicin (100%) followed by Doxycycline 05

(83.33%), Linezolid 05 (83.33%), Levofloxacin 04 (66.67%), Erythromycin 02 (33.33%), Cefoxitin 02 (33.33%), Penicillin 01 (16.67%) and Co-trimoxazole 01 (16.67%). (Refer table 7)

Table 8 sensitivity pattern of Coagulase negative Staphylococcus aureus (n=7)

Name of Antibiotics	Sensitive	Intermediate	Resistant
Erythromycin	02 (28.57%)	00 (0%)	05 (71.43%)
Penicillin	00 (0%)	00 (0%)	07 (100%)
Co-trimoxazole	01 (14.29%)	00 (0%)	06 (85.71%)
Linezolid	06 (85.71%)	00 (0%)	01 (14.29%)
Cefoxitin	02 (28.57%)	00 (0%)	05 (71.43%)
Vancomycin	07 (100%)	00 (0%)	00 (0%)
Levofloxacin	07 (100%)	00 (0%)	00 (0%)
Gentamicin	07 (100%)	00 (0%)	00 (0%)
Doxycycline	06 (85.71%)	00 (0%)	01 (14.29%)

The in *vitro* antibiotic sensitivity pattern of Coagulase negative Staphylococcus aureus is as follows, it showed maximum sensitivity to Vancomycin (100%), Gentamicin (100%), Levofloxacin (100%) followed by Linezolid 06 (85.71%),Doxycycline 06 (85.71%), Cefoxitin 02 (28.57%), Erythromycin 02 (28.57%), Co-trimoxazole 01(14.29%) and Penicillin 00 (0%). (Refer table 8)

Table 9 sensitivity pattern of Enterococcus species

Name of Antibiotics	Sensitive	Intermediate	Resistant
Erythromycin	00 (0%)	01 (100%)	00 (0%)
Penicillin	01 (100%)	00 (0%)	00 (0%)
Co-trimoxazole	00 (00%)	00 (0%)	01 (100%)
Linezolid	01 (100%)	00 (0%)	00 (00%)
Cefoxitin	00 (00%)	00 (0%)	01 (100%)
Vancomycin	01 (100%)	00 (0%)	00 (0%)
Levofloxacin	01 (100%)	00 (0%)	00 (0%)
Gentamicin	00 (0%)	01 (100%)	00 (0%)
Doxycycline	00 (0%)	00 (0%)	01 (100%)

The in vitro antibiotic sensitivity pattern of Enterococcus species is as follows. It showed maximum sensitivity to Penicillin 01 (100%), Linezolid 01 (100%), Vancomycin 01 (100%), Levofloxacin 01 (100%) followed by Erythromycin 00 (00%), Co-trimoxazole 00 (00%), Cefoxitin 00(00%), Gentamicin 00 (00%) and Doxycycline (00%). (Refer table 9)

Table No 10: sensitivity pattern of Klebsiella species

Name of Antibiotics	Sensitive	Intermediate	Resistant
Amikacin	00 (0%)	00 (0%)	01 (100%)
Amoxicillin-clavulanic acid	00 (0%)	00 (0%)	01 (100%)
Cefipime	00 (00%)	00 (0%)	01 (100%)
Cefuroxime	00 (0%)	00 (0%)	01 (100%)
Cefotaxime	00 (00%)	00 (0%)	01 (100%)
Imipemen	01 (100%)	00 (0%)	00 (0%)
Gentamycin	00 (0%)	00 (0%)	01 (100%)
Co-trimoxazole	00 (0%)	00 (0%)	01 (100%)
Ciprofloxacin	00 (0%)	00 (0%)	01 (100%)

The in vitro antibiotic sensitivity pattern of Klebsiella species is as follows. It showed maximum sensitivity to imipenem 01 (100%) followed by Amikacin 00 (00%), Amoxicillin-clavulanic acid 00 (00%), Cefipime 00 (00%), Cefuroxime 00 (00%), Cefotaxime 00 (00%), Gentamicin 00 (00%), Co-trimoxazole 00 (00%) and Ciprofloxacin 00 (00%). (Refer table 10)

DISCUSSION:

The first evidence that ASB may be associated with adverse pregnancy outcomes came in 1960, when Kass hypothesized that ASB, which persisted in 6%

of pregnant women, was associated with the development of acute pyelonephritis.[8] Kass made the first recommendation to screen and treat pregnant women for ASB, estimating that his strategy would prevent 10% of preterm births.

During the next 50 years, the potential association between ASB and adverse pregnancy outcome such as preterm birth (PTB) was the subject of many studies, yet remained controversial. The advent of meta analysis that combine the results of clinical trials offered a new opportunity to synthesize data from multiple studies. The authors concluded that a strong association exists between untreated ASB and LBW/PTB and that antibiotic treatment of ASB during pregnancy is effective at reducing LBW.

A 2001 Cochrane Review including fourteen studies concluded that antibiotic treatment was effective against ASB, and reduced incidence of pyelonephritis, LBW and PTB. An update in 2007 confirmed the antibiotic effectiveness for pyelonephritis and LBW prevention, but failed to show a significant reduction in PTB with antibiotic treatment. [9]

Despite minor disagreements over the strength of the ASB-PTB relationship, treatment of bacteriuria in pregnancy has wide spread support. In fact, Screening and treatment of bacteriuria in pregnancy is currently common practice in several countries. Bacteriuria screening was strongly recommended by Global Alliance to prevent prematurity and stillbirth (GAPPPS) review group for intervention of LBW and maternal morbidity including pyelonephritis. ASB screening included in the WHO recommended antenatal care package.

One striking example of the high rates of ASB observed in some developing countries was a study of 500 consecutive pregnant women in Berlin, Nigeria using standard methods in clinical Microbiology. Authors of the study described a striking 86.6% of these women as having ASB with 90% of the cultures resulting in growth of a single organism. Urine microscopy further revealed that 72.4% of ASB positive women also had pyuria (white blood cells in urine). Staphylococcus aureus was the most frequent organisms isolated (29.9%), followed by Escherichia coli 29.1%.[10]In the study by Amadi ES et al in Abakaliki, Nigeria, they found the prevalence to be78.7% and 45.3%. In the study by Imade PE et al.[11]Some studies like Turpin CA et al[12] found the prevalence of ASB to be 7.3% which was less than the study by Achala Thakur et al[13], Gayathree L et al [14] found the prevalence of ASB to be 6.2% which was less than Achala's study.

Various other studies show an incidence varying from 4% to 23.9% (Kriplani J of Obstretics & Gynaecology of India)[15]

Table-11 Comparison of bacterial isolates in National studies

Study andAuthors	Sample Size	Bacterial isolates	Percentage
Khattak AM et al [16]	290	18	6.20
Lavanya SV et al2000[17]	500	42	8.4
Sanyogita Jain etal 2013[18]	100	11	11
Present study,2014	100	26	26

In the present study out of total 100 antenatal patients, six patients (23.08%) had asymptomatic bacteriuria and 20 (76.92%) patients had symptomatic bacteriuria.

Table-12 Comparison of bacterial isolates in various International studies

Study andAuthors	Country	SampleSize	Result/conclusion
Dr.Kawser Parveen et al. 2011[19]	Dhaka	250	Out of 250 samples collected and analyzed during the study period, sixty five (65) samples showed significant growth which amounted to the prevalence of 26.0%.
M.Rahimkhani at el.2008[20]	Iran	86	The main finding in the present study was that 29.1% of the pregnant women who were in first trimester had asymptomatic bacteriuria which is much higher than figures reported from other countries.
J.Schnarr andF.Small ,2008[21]	Canada	9734	In a prospective examination of 9734 pregnant women, 7.4% of them were diagnosed as having urinary tract infection, 5.1% with asymptomatic bacteriuria, 1.3% with acute cystitis and 1% with acute pyelonephritis.

Present study 2014 shows highest prevalence of asymptomatic bacteriuria (83.43%) in first trimester. This is consistent with Mr.Rahimkhani et al [20]. Whereas the highest prevalence of Symptomatic bacteriuria was found in the second trimester (50%). The Microbiological profile observed in present study showed highest isolation of *Escherichia* coli followed by *Staphylococcus aureus, Coagulase negative staphylococci, and Candida species. Klebsiella species and Enterococcus species.*

Most of the studies conducted in Africa and Arab countries showed less than 50% isolation of Escherichia from UTI patients but reported higher percentage of (29%) of *staphylococcus aureus* as second most frequently isolated bacteria from UTI cases.

Reports from other developing or developed countries were the isolation of Gram positive bacteria as uropathogens is very low [22,23,24] In the present study, our special importance is our observation of 26.93% isolation rate of Coagulase negative staphylococci in patients with symptomatic bacteriuria and Staphylococcus aureus 14.29% in patients with asymptomatic bacteriuria and 85.71% isolate from patients with symptomatic bacteriuria. In the present study due to certain limitations species s identification of coagulase negative staphylococcus was not done.

Our study recommends early screening for asymptomatic bacteriuria as well as symptomatic bacteriuria in pregnancy mainly in the first trimester. Quantitative culture remains the gold standard of diagnosis. As there is increase in antibiotic resistance which affects empirical regimens, resistance patterns of various antibiotics sshould be taken in to consideration.

CONCLUSION

We would like to come to the conclusion that screening and treatment of bacteriuria should be considered as a standard of obstetric care because it is frequent in pregnant women and can cause complications if left untreated.

DECLARATIONS

Funding: NIL
Conflict of interest: None

REFERENCES:

1. Wingert A, Pillay J, Sebastianski M, et alAsymptomatic bacteriuria in pregnancy: systematic reviews of screening and treatment effectiveness and patient preferencesBMJ Open 2019;9:e021347. doi: 10.1136/bmjopen-2017-021347
2. Task Force on UTI. Philippine Practice Guidelines Group in infectious Disease.Urinary Tract Infection in pregnancy. 1998;1:16-9
3. Zhanel GG, Harding GK, Guay DR. Asymptomatic bacteriuria. Which patients should be treated ? Arch Intern Me.1990;150(7):1389-96
4. Connolly A, Thorp JM Jr. Urinary tract infections in pregnancy. Urol Clin NorthAm 1999;26:779-87
5. Le J, Briggs GG, McKeown A, Bustillo G. Urinary tract infections duringpregnancy. Ann Pharmacother 2004; 38(10):1692-701.
6. Nicolle LE: Asymptomatic Bacteriuria: review and discussion of the IDS guidelines. Int J Antimicrob Agents 2006; 28:42-48
7. Jean F Mac Faddin, Biochemical Tests for Identification of Medical Bacteria,Third Edition, Lippincott Williams and Wilkins, Philadelphia
8. Kass EH, Bacteriuria and Pyelonephritis of pregnancy. Archives of internal medicine. 1960;105:190-98
9. Gilbert N, O'Brien VP, Hultgren S., Macones G, Lewis WG, Lewis AL. Urinary tract infection as a preventable cause of pregnancy complications: opportunities,challenges, and a global call to action. Global Adv Helath Med.2013:2(5):59-69
10. Amadi ES, Asymptomatic Bacteriuria among Pregnant women in Abakaliki, Ebonyi State Nigeria, J. Med Sci.2007;7(4):698-700
11. Imade PE, Izekor PE, Eghafona No, Enabulele OI, Ophori E. Asymptomatic bacteriuria among pregnant women. N Am J Med Sci. 2010;2(6):263-266.
12. Turpin CA, Minkah B, Danso KA, Frimpong EH. Asymptomatic bacteriuria in pregnant women attending antenatal clinic at komfo anokye teaching hospital, Kumasi, Ghana Medical Journal. 2007;41(1):26-9
13. Thakur A, Baral R, Basnet P, Rai R, Agrawal A, Regmi MC, Uprety DK. Asymptomatic Bacteriuria in Pregnant Women. J Nepal Med Assoc 2013;52(192):567-70
14. Gayathree L. Shetty S, Deshpande SR, Venkatesh DT. Screening for Asymptomatic bacteriuria in pregnancy: An evaluation of various screening tests in Hassan district hospital, India. JCDR 2010; 4(4):2702-2706

15. Kriplani A, Bukshee K, Ratan A. Asymptomatic bacteriuria in pregnant Indian patients at All India Institute of Medical Sciences, New Delhi, And Treatment with single dose antimicrobial therapy. J of Obst Gyn of India 1993;43:489-491
16. Khattak AM, Khattak S, Khan H. Ashiq B, Mohammad D. Rafiq M. Prevalence of asymptomatic bacteriuria in pregnant women. Pak J Med Sci.2006;22:162-6
17. Lavanya S V, Jogalakshmi D. Asymptomatic bacteriuria in antenatal women. Indian J Med Microbiol 2002;20:105-6
18. Sanyogita Jain, H Khavari-Daneshvar, R Sharifian, Asymptomatic bacteriuria and pyuria in pregnancy. Acta Medica Iranica 2008;46(5):409-412
19. Dr.PK, Dr.MA, Dr.BAA., Dr.BM. Prevalence of Urinary Tract Infection duringpregnancy. J.Dhaka National Med.col.Hos.2011;17(02);8-12
20. M Rahimkhani, H Khavari-Daneshvar, R Sharifian, Asymptomatic bacteriuria and pyuria in pregnancy. Acta Medica Iranica 2008;46(5):409-412
21. Schnarr J, Smail F. Asymptomatic bacteriuria and symptomatic urinary tract infections in pregnancy. Eur J Clin Invest 2008; 38(suppl2) : 50-57
22. M.Akram, M. Shahid and A.U. Khan, "Etiology and antibiotic resistance patterns of community acquired urinary tract infections in JNMC hospital Aligarh, India', Annals of Clinical Microbiology and Antimicrobials 2007;6:4-10
23. E. Mahesh, D. Ramesh, V.A. Indumathi "Complicated Urinary Tract Infection in a tertiary care centre in South India", Al Ameen Journal of Medical Science,2010; 3(2) 120-127
24. Yengkokpam, D. Ingudam, "Antibiotic Susceptibility Pattern of Urinary Isolates in Imphal (Manipur), India", Nepal Medical College Journal, 2007;9(3):170-172