10.21761/jms.v8i02.04

ORIGINAL RESEARCH ARTICLE

A Prospective Study to Identify Asymptomatic Bacteriuria: The Causative Organisms, Antibiotic Sensitivity and its Safety in Pregnant Females

Saba Sharif[1], Namita Agarwal[2*], Shashi Bala Arya[2], Rahul Kumar Goyal[2$], Shubhangi Gupta[3]

ABSTRACT

Introduction: The common procedure of urinary catheterization during childbirth may introduce bacteria that can cause urinary tract infections. Immune function is relatively compromised during pregnancy. The current study was aimed to identify antenatal patients with bacteriuria, the causative organism and its antibiotic sensitivity in patients with bacteriuria.

Materials and Methods: The current prospective cross-sectional study involved antenatal patients who were being admitted to the delivery room. A clean catch midstream urine sample was collected in a sterile container of which 5 to 10 mL of the sample was obtained in a separate sterile vial (container 1) for screening tests for leucocyte esterase and nitrite, and the remaining sample (container 2) was taken for routine microscopy, culture, and sensitivity. The reports were collected and tabulated, and bacteriuria was confirmed and statistically analyzed.

Results: A total of 200 patients were evaluated, and 40 of them had asymptomatic bacteriuria. In this study positive leukocyte esterase test and nitrite test results were considerably higher in the cases than the controls ($p < 0.05$) at 10.0 and 47.5%, respectively. *Escherichia coli* was found to be the most prevalent bacteria in this study, followed by, *Pseudomonas, Enterococcus faecalis, Candida albicans,* and coagulase-negative *Streptococcus* and *Klebsiella*. Most of the *E. coli* isolates (100.0%) were sensitive to amikacin, a category D drug. The majority of *Pseudomonas* isolates (100.0%) were sensitive to colistin, a category C drug. Amongst category A drugs, *Pseudomonas* was sensitive to – cefoperazone-sulbactam, meropenem and piperacillin-tazobactam.

Conclusion: It is a standard practice to send urine routine and microscopy test in antenatal patients. As most patients are asymptomatic, investigations are required for early diagnosis of significant bacteria like leucocyte esterase, nitrite and culture and sensitivity. This will help us to institute appropriate treatment and improve maternal and fetal outcomes.

Keywords: Asymptomatic bacteriuria, *Escherichia coli,* Urinary tract infection.

Submission: 31-08-2023; **Acceptance:** 01-11-2023; **Published:** 31-12-2023

[1]Senior Resident, [2]Professor, [3]Assistant Professor

Department of Obstetrics and Gynaecology, [$]Department of Microbiology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India.

Corresponding Author: Namita Agarwal, Professor, Department of Obstetrics and Gynaecology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India., e-mail: dr.ektabrijesh@gmail.com

How to cite this article: Sharif S, Agarwal N, Arya SB, Goyal RK, Gupta S. A Prospective Study to Identify Asymptomatic Bacteriuria: The Causative Organisms, Antibiotic Sensitivity and its Safety in Pregnant Females. SRMS J Med Sci. 2023;8(2):67-71.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

The changes in the urinary tract during pregnancy make women more susceptible to infection. The same uropathogens that affect non-pregnant women also cause urinary tract infections in pregnant women. The common procedure of urinary catheterization during childbirth may introduce bacteria that can cause urinary tract infections. Immune function is relatively compromised during pregnancy. The increased frequency of urinary tract infections found in pregnancy may also be due to this immunosuppression.[1] A urinary tract infection during pregnancy may or may not present with symptoms. Worldwide, 2 to 10% of all pregnant women have symptomatic bacteriuria.[1] During pregnancy, the urogenital tract undergoes both hormonal and mechanical changes that enhance the likelihood of harmful bacteria colonizing the area. The gold standard for diagnosing bacteriuria is quantitative culture. While a negative result effectively rules out the presence of bacteriuria, a pregnant woman with a positive dipstick test is very likely to have a clear diagnosis of asymptomatic bacteriuria.[2] Less than 1% of pregnant women without symptomatic bacteriuria would be labeled as positive when tested with dipsticks, and only 2% of pregnant women with asymptomatic bacteriuria would not receive antibiotic therapy when necessary.[3] At least 100,000 colony-forming units (CFU)/mL of the same species of bacteria in midstream clean-catch urine specimens in a single specimen for males or in two consecutive specimens for women serve as quantitative criteria for identifying severe bacteriuria in an asymptomatic person. Leukocyte esterase and nitrite tests are frequently used in primary care settings to assess urine symptoms; however, because pyuria detection is not specific for urinary tract infection, these tests are not helpful in identifying silent bacteriuria. A

good diagnostic test for identifying bacteriuria is still urine microscopic analysis for microorganisms.[4]

Thus, the current study was aimed to identify antenatal patients with bacteriuria, causative organisms and antibiotic sensitivity in patients with bacteriuria.

MATERIALS AND METHODS

The current prospective cross-sectional investigation involved antenatal patients who were being admitted to the delivery room.

- In accordance with established procedures, a sterile, wide-mouthed container was used to collect a clean catch midstream urine sample.
- With the aid of a K-90 catheter and following all aseptic precautions, urine was collected from antenatal patients who had premature rupture of membranes.
- Following the collection of the urine in a sterile vial, 5 to 10 mL of the urine were placed in a separate sterile vial (container 1) for a screening nitrite test and a leucocyte esterase test, and the remaining urine sample (container 2) was taken for routine microscopy, culture, and sensitivity.
- The reports were collected and tabulated, and bacteriuria was confirmed and statistically analyzed.
- The existence of bacteriuria was determined by the colony count of 10.[5]

RESULTS

A total of 200 patients were studied out of which 40 patients had asymptomatic bacteriuria (Table 1, and Figure 1).

Patients without asymptomatic bacteriuria were considered as controls and patients with asymptomatic bacteriuria were taken as cases studied.

- The mean age in the patients with asymptomatic bacteriuria was 23.68 ± 3.91 years and in patients with asymptomatic bacteriuria, is 28.12 ± 5.82 years. About 42.5% of patients with asymptomatic bacteriuria belonged to 19 to 24 years of age, and only 15% were above 35 years of age. The maximum number of patients without asymptomatic bacteriuria were between 19 and 24 years (67.5%), and only 3.1% were above 35 years. Parity status was not statistically significant.
- The obstetric history in antenatal patients were studied and was found that abortions and live births in patients with asymptomatic bacteriuria is 37.5 and 65%, respectively, while, in patients without asymptomatic bacteriuria is 26.3 and 51.3%, respectively.
- Only 2 (5.0%) patients had urinary tract infections in previous pregnancy in patients with pregnancy in patients without asymptomatic bacteriuria.
- It was found that most of the cases were affected by *Escherichia coli* (70.0%) followed by *Pseudomonas* (12.5%), *Enterococcus faecalis* (7.5%), *Candida albicans* (5.0 distribution of the colony count in studied sample majority of the cases were 105 (77.5%) followed by 105 to 107 were (22.5%) and coagulase-negative *Streptococcus* (2.5%) and *Klebsiella* (2.5%) (Table 2) (Figure 2).

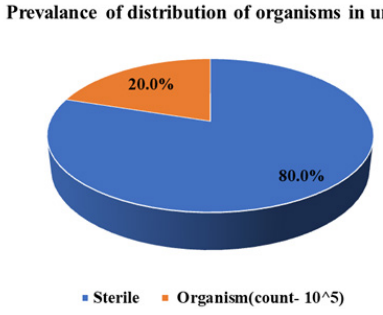

Figure 1: The prevalence of asymptomatic bacteriuria in the studied patients

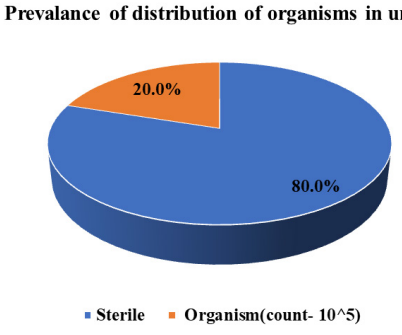

Figure 2: Pie chart showing the distribution of organisms causing asymptomatic bacteriuria in antenatal patients

Table 1: The prevalence of asymptomatic bacteriuria in the studied patients

Organism distribution	*Frequency (n = 200)*	*Percentage (%)*
Sterile	160	80.0
Organism	40	20.0

Table 2: The organism causing asymptomatic bacteriuria in antenatal patients

Organism distribution		*Frequency (n = 200)*	*Percentage (%)*
Sterile		160	80.0
Organism (n = 40)	*Escherichia coli*	28	70.0
	Pseudomonas	5	12.5
	Enterococcus faecalis	3	7.5
	Candida albicans	2	5.0
	Coagulase Negative streptococcus	1	2.5
	Klebsiella	1	2.5

Table 3: Antibiotic sensitivity pattern in different microorganism

Antibiotic sensitivity	*Microorganism*					
	Escherichia coli (n = 28)	*Pseudomonas (n = 5)*	*Enterococcus faecalis (n = 3)*	*Candida albicans (n = 2)*	*Coagulase Negative streptococcus (n = 1)*	*Klebsiella (n = 1)*
Ampicillin (A)	2 (7.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Amoxy-clavulinic acid (A)	5 (17.9%)	1 (20.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Piperacillin-tazobactam (A)	13 (46.4%)	2 (40.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cefuroxime(A)	3 (10.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cefuroxime Axetil (A)	3 (10.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Ceftriaxone (A)	3 (10.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cefoperazone / Sulbactam (A)	11 (39.3%)	3 (60.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Imipenem (A)	22 (78.6%)	2 (40.0%)	0 (0.0%)	1 (50.0%)	1 (100.0%)	1 (100.0%)
Meropenem (A)	24 (85.7%)	3 (60.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1 (100.0%)
Amikacin (D)	28 (100.0%)	3 (60.0%)	2 (66.7%)	2 (100.0%)	1 (100.0%)	1 (100.0%)
Gentamicin (D)	18 (57.1%)	3 (60.0%)	3 (100.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
Nalidixic acid (D)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Ciprofloxacin (D)	3 (10.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Tigecycline (D)	25 (89.3%)	4 (80.0%)	3 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Nitrofurantoin (B)	19 (67.9%)	1 (20.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Colistin (C)	26 (92.9%)	5 (100.0%)	3 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Trimethoprim / Sulfamethoxazole (D)	2 (7.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Ertapenem (B)	8 (28.6%)	2 (40.0%)	1 (33.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

- The *E. coli* isolates were sensitive most commonly to amikacin (100.0%) followed by tigecycline (89.3%), meropenem (85.7%), piperacillin-tazobactam (46.4%) and cefoperazone-sulbactam (39.3%) (Table 3). Amongst category A and B drugs, *E. coli* was sensitive to – meropenem, piperacillin-tazobactam and cefoperazone-sulbactam. Amongst category D drugs *E. coli* is sensitive to amikacin and tigecycline (Table 3).
- The *Pseudomonas* isolates were sensitive most commonly to colistin (100%) followed by tigecycline (80%), cefoperazone-sulbactum (60%), meropenem (60%) and amikacin (60%). Amongst category C and D drugs, *Pseudomonas* was sensitive to – colistin and tigecycline. Amongst category A drugs *Pseudomonas* was sensitive to – cefoperazone-sulbactam, meropenem and pipercillin-tazobactam (Table 3).

DISCUSSION

All age groups are susceptible to urinary tract infections, but women, and pregnant women in particular, are more vulnerable than non-pregnant women because of a narrow urethra, easy fecal flora contamination, and physiological changes that take place in the urogenital tract during pregnancy. Asymptomatic bacteriuria is a microbiological diagnosis made when a specific quantitative count of bacteria is found in a correctly collected urine sample from a person who has no symptoms or visible evidence of a urinary tract infection. Pregnancy-related asymptomatic bacteriuria is defined as having 1,000,000 organisms per milliliter.[5] Preterm or low birth weight births are more frequent in pregnant women who have silent bacteriuria, and patients are at high risk of developing preeclampsia, anemia, and pyelonephritis (20–40%). According to Sonkar N *et al.*,[6] 16.7% of pregnant women had asymptomatic bacteriuria. According to Neelima N. *et al.*,[7] 24.7% of pregnant women have asymptomatic bacteriuria. In a comparison study by Rajaa MN *et al.*[8] it was discovered that 13.7% of pregnant women with a positive urine culture at the time of testing did not show symptoms of a urinary tract infection (UTI). As age advances, the prevalence of asymptomatic bacteriuria increases. In this study, 25% of patients with asymptomatic bacteriuria were between the ages of 30 and 34, and 42.5% were between the ages of 19 and 24. According to Neelima N *et al.*,[7] asymptomatic bacteriuria was common in people between the ages of 18 and 25. Among those, 42.9% were multigravida, and

Table 4: Nitrite and leucocyte esterase test in urine of the studied patients

		Control (n-160)	*Case (n = 4 0)*	x^2	*p-value*
Nitrite test	Positive	0(0.0%)	4(10.0%)	16.327	<0.001
	Negative	160(100.0%)	36(90.0%)		
Leucocyte esterase	Positive	0(0.0%)	19(47.5%)	83.978	<0.001
	Negative	160(100.0%)	21(52.5%)		
Pus cells present	0–4	160(100.0%)	0(0.0%)	0.998	<0.001
	5–10	0(0.0%)	40(100.0%)		
Sugar	Present	1(0.6%)	3(7.5%)	0.717	0.005
	Absent	159(99.4%)	37(92.5%)		
Albumin	Present	0(0.0%)	2(5.0%)	0.881	0.004
	Absent	160(100.0%)	38(95.0%)		

85.7% were in the third trimester. A maximum (26%) of the culture's positive women, according to Rajaa MN *et al.*,[8] were in the 25 to 33 age group. In this study (Table 4), the leukocyte esterase test and nitrite test results were considerably higher in the cases than the controls at 10.0 and 47.5%, respectively. The nitrite test had a lower sensitivity (74.4%). According to Jayalakshmi J & Jayaram VS,[9] the nitrite test had a lower sensitivity (74.4%), since 12 positive cases—including all infections brought on by gram-positive cocci, were missed as false negatives. Even though Nuns D *et al.*[10] claimed that the leukocyte esterase (LE) dipstick sensitivity was 100%, other researchers have found substantially lower levels. Due to 42 false positives, which included 26 patients with sterile pyuria, the Jayalakshmi J & Jayaram VS[9] research had a lower sensitivity (61.7%) and negative predictive value (NPV) (96.7%) than the other tests. Its specificity was also lower (92.7%). Nitrite test results showed high specificity (99.56%) and positive predictive value (PPV) (93.75%), but lower sensitivity (71.42%) and negative predictive value (97.43%), according to Kheya Mukherjee *et al.*[11] leukocyte esterase test results were equivalent to nitrite test in terms of sensitivity (71.42%) and negative predictive value (97.9%). Though the sensitivity of the nitrite test and leukocyte esterase test separately was found to be less sensitive (71.42%), Rohini N. S. *et al.*,[12] found that when these two colorimetric tests were combined and used as a dipstick with either test positive, the sensitivity and negative predictive value were, respectively, 90.47 and 99.09%. When bacteriuria was eliminated with antibiotic therapy, it was noted that the incidence of preterm deliveries decreased (Robertson JG *et al.*).[13] *E. coli* (70%) and *Pseudomonas* (12.5%), *Enterococcus faecalis* (7.5%), *Candida albicans* (5.0%), coagulase-negative *Streptococcus* (2.5%), and *Klebsiella* (2.5%), respectively, accounted for the bulk of the cases. According to Sonkar N *et al.*,[6] the most common and prevalent isolates were *E. coli* (n = 22, 61.1%), Cons (n = 6, 16.7%), and *S. aureus* (3, 8.3%).
According to Rajaa MN *et al.*,[8] *E. coli* and *S. aureus* were the two most prevalent bacterial isolates.

Several bacterial isolates are a cause of asymptomatic bacteriuria in pregnant women, according to Anjali Agarwal *et al.*[14] *E. coli* was found in the majority of research and it is the bacteria that causes asymptomatic bacteriuria most frequently (39.2%).

According to Bhaskaran K *et al.*,[15] the *E. coli* isolates were most frequently resistant to cefuroxime (98%) followed by ampicillin (96%) and ciprofloxacin (54%) and most sensitive to nitrofurantoin (83.3%). Most gram-negative bacilli were responsive to amikacin, imipenem, and nalidixic acid while being least sensitive to cotrimoxazole, according to Yadav K.,[16] vancomycin, tetracycline, and amoxyclav were the drugs that more gram-positive cocci were sensitive to, while erythromycin was the drug that they were least sensitive to. According to Valentina and Srirangaraj,[17] nitrofurantoin, amikacin, and imipenem showed greater gram-negative bacilli sensitivity, while vancomycin, amoxyclav, and tetracycline showed greater gram-positive bacilli sensitivity. These results are consistent with those of Yadav K.[16] Gram-negative isolates were extremely responsive to nitrofurantoin, meropenem, and imipenem, according to Anjali Agarwal *et al.*,[14] which is consistent with other investigations.

Antimicrobial susceptibility pattern of gram-negative bacteria, as reported by Ethiopia, *et al.*,[18] showed that the majority of isolates showed susceptibility to nitrofurantoin (95.2%), norfloxacin (85.7%), ciprofloxacin and ceftriaxone (for each, 80.95%), amikacin (76.2%), ceftazidime (71.4%).

CONCLUSION

As most patients are asymptomatic, investigations are required for early diagnosis of significant bacteriuria in urine like leucocyte esterase, nitrite and culture and sensitivity. This will help us to institute appropriate treatment and improve maternal and fetal outcomes. This study emphasizes the importance of including urine culture tests in routine antenatal investigations for pregnant women in order to diagnose and treat asymptomatic bacteriuria early. Asymptomatic bacteriuria

has many adverse effects to pregnancy like preterm labor, premature rupture of membranes, intrauterine growth retardation, low birth weight and NICU admissions. Knowledge of the common organism causing asymptomatic bacteriuria and its antibiotic sensitivity and resistance can be used to determine a treatment plan for pregnant women who have asymptomatic bacteriuria before receiving a culture sensitivity assessment. This study found that most common organisms were sensitive to category C and D drugs, which are contraindicated during pregnancy, limiting our choice of antibiotics during pregnancy. Administration of appropriate antibiotics (category A and category B)in pregnancy may, therefore, require long-term antibiotic therapy and follow-up with repeated urine examinations. Health education addressing personal and environmental cleanliness is required during pregnancy in order to lower the risk of infection and comorbidities.

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