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Original Research Article

Prevalence of Asymptomatic Bacteriuria Among Pregnant Women: A Cross-Sectional Study

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Abstract:

Introduction: Asymptomatic bacteriuria (ASB) in pregnancy is associated with adverse maternal and fetal outcomes, including pyelonephritis, preterm labor, and low birth weight. Physiological changes during pregnancy, such as ureteral dilation, urinary stasis, and hormonal alterations, increase the risk of ASB. Escherichia coli is the predominant uropathogen, followed by Klebsiella pneumoniae and Staphylococcus aureus. This study aimed to determine the prevalence of ASB among pregnant women in a tertiary care hospital in Gujarat, India.

Materials and Methods: A cross-sectional study was conducted over six months, enrolling 220 asymptomatic antenatal women. Midstream urine samples were collected, cultured, and analyzed for bacterial growth. Antimicrobial susceptibility testing was performed using the Kirby-Bauer disc diffusion method per CLSI guidelines. Data were analyzed using SPSS version 21, with categorical variables compared using chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results: Among 220 antenatal women, 17.3% had ASB. ASB prevalence was significantly higher in antenatal women with lower socioeconomic status, prior UTI, diabetes, and hypertension. Escherichia coli was the most common isolate (57.9%), followed by Staphylococcus aureus and Enterococcus faecalis (10.5% each). E. coli showed high sensitivity to amikacin (90%), gentamicin (100%), and piperacillin-tazobactam (90%) but moderate resistance to ampicillin (40%).

Conclusion: ASB prevalence in antenatal women was 17.3%, underscoring the need for routine screening, especially in high-risk women with a history of UTIs, diabetes, or hypertension. Empirical treatment should follow local antimicrobial susceptibility patterns to prevent resistance. Targeted health education and counselling for women from lower socioeconomic backgrounds should emphasize ASB risks, personal hygiene, and the benefits of early screening.

Keywords: Antibiotic Susceptibility, Antenatal Women, Asymptomatic Bacteriuria, Escherichia Coli, Risk Factors.

Introduction

Asymptomatic bacteriuria (ASB) is characterized by the presence of significant bacteriuria—typically defined as $\geq 10^5$ colony-forming units per milliliter (CFU/mL) of a single bacterial species—in a urine sample from an individual without symptoms of a urinary tract infection (UTI) [1]. Physiological changes during pregnancy, including ureteral dilation, urinary stasis, and hormonal alterations, predispose pregnant women to bacteriuria, increasing the risk of complications if left untreated [2]. The prevalence of asymptomatic bacteriuria (ASB) among pregnant women in India varies across studies, ranging from 7.3% to 25.3% [3–5]. This variation may be attributed to differences in study populations, geographic regions, and screening methodologies.

Untreated ASB during pregnancy is associated with adverse maternal and fetal outcomes, including an increased risk of pyelonephritis, preterm labor, low birth weight, and higher perinatal mortality rates[6]. Given these potential complications, routine screening and appropriate management of ASB in pregnant women are essential to improve pregnancy outcomes[7].

Escherichia coli is consistently identified as the predominant uropathogen in ASB cases among pregnant women in India, followed by organisms such as Klebsiella pneumoniae and Staphylococcus aureus [8]. Antibiotic susceptibility patterns indicate that these pathogens often exhibit resistance to commonly used antibiotics, underscoring the importance of culture and sensitivity testing to guide effective treatment[9]. Despite the recognized importance of screening, there is a lack of uniformity in implementing routine urine culture tests for pregnant women in many healthcare settings across India. This study aims to determine the prevalence of ASB among pregnant women attending a tertiary care hospital in Western India, identify the causative microorganisms, and assess their antimicrobial susceptibility patterns.

Materials and Methods

Study Design and Setting: This cross-sectional study was conducted at a tertiary care hospital in Gujarat, India for period of 6 months.

Study Population: Antenatal women at any gestational age presenting to a tertiary care hospital in Gujarat who consented to participate were enrolled. Pregnant women without symptom of UTI were included. Women with symptomatic UTIs, those on antibiotic therapy within the past two weeks, pyrexia of unknown origin and those with known renal diseases were excluded.

Sample Size: The minimal sample size was estimated to be 180 (with 5% absolute error at 95% confidence interval and adding 10% attrition rate) considering the prevalence rate of ASB about 12.12% from the study of Sarawat S et al.[10] but we have included 220 participants in our study through convenient sampling method.

Data Collection: Written informed consent was obtained from all participants. A structured questionnaire was used to collect demographic details, obstetric history, medical history, and socioeconomic status. Clinical variables, including gestational age, parity, history of previous UTIs, and comorbidities were recorded.

Sample Collection and Processing: Participants were provided sterile containers and instructed on midstream clean-catch urine collection after thorough perineal cleaning. Samples were promptly transported for processing; delayed specimens were refrigerated at 4°C. Samples were immediately transported to the microbiology laboratory for direct microscopy and culture.

Direct Microscopy: A drop of uncentrifuged urine was placed on a clean glass slide, air-dried, heat-fixed, and Gram-stained. A wet smear of uncentrifuged urine was examined to quantify pus cells and microorganisms.

Culture: Urine samples were cultured on MacConkey, Blood, and CLED agar using a calibrated loop delivering 0.01 mL of urine. Plates were incubated at 37°C for 18–24 hours and examined for colony growth. Morphological and biochemical tests were used for presumptive identification. Significant bacteriuria was defined as $\geq 10^5$ CFU/mL of a single pathogen, while counts between 10^2 and 10^4 CFU/mL were classified as insignificant bacteriuria. Sterile cultures were recorded as negative.[11]

Antibiotic Susceptibility Testing: Antimicrobial susceptibility testing was conducted using the Kirby-Bauer disc diffusion method per CLSI guidelines. Susceptibility patterns of common uropathogens, including Escherichia coli, Staphylococcus aureus, Enterococcus faecalis, Klebsiella pneumoniae, Pseudomonas aeruginosa, and coagulase-negative Staphylococcus (CoNS), were evaluated against antibiotics such as amikacin, gentamicin, cefoperazone-sulbactam, piperacillin-tazobactam, ceftriaxone, ciprofloxacin, nitrofurantoin, linezolid, and vancomycin.

Statistical Analysis: Data were analyzed using SPSS version 21. Continuous variables were presented as mean ± standard deviation, while categorical variables were summarized as frequency and percentage. Comparisons of categorical variables were made using the chi-square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant.

Results

Out of 220 antenatal women, 38 (17.3%) had asymptomatic bacteriuria, 15 (6.8%) had insignificant bacteriuria, and 167 (75.9%) had sterile urine cultures. These findings emphasize the need for routine screening to prevent complications (Table 1).

Table 1: Distribution of bacteriuria among antenatal women

Bacteriuria	Frequency (n)	Percentage (%)
Total antenatal women	220	100
Asymptomatic bacteriuria	38	17.3
Insignificant bacteriuria	15	6.8
Sterile	167	75.9

Although ASB prevalence was slightly higher among younger women (<20 years, 26.7%) and those aged >30 years (20%), the association was not statistically significant (p=0.249). Rural residence (18.6%) showed a slightly higher ASB prevalence than urban areas (15%), but this was not significant (p=0.625). Religion was not a significant factor (p=0.396). Education level showed an inverse relationship with ASB, with the highest prevalence among illiterate women (28.6%) and the lowest among those with secondary education (10.7%), but this was not statistically significant (p=0.136). However, socioeconomic status showed a significant association with ASB, with a higher prevalence in the lower middle and lower class (22.1%) compared to the middle class (8%) (p=0.009) [Table 2].

ASB was more common in later gestational ages (≥35 weeks, 20%), though the association was not significant (p=0.620). Primigravida women had a slightly higher prevalence of ASB (18.3%) than multigravida women (16%), but parity was not a significant factor (p=0.782) [Table 2].

Table 2: Association of risk factors with asymptomatic bacteriuria

Risk Factors	Total Patients (n=220)	ASB Present (n=38)	ASB Absent (n=182)	χ^2 & p value
Age group (years)				
< 20	30 (13.6%)	8 (26.7%)	22 (73.3%)	χ^2= 2.77, p value = 0.249
20 to 30	150 (68.2%)	22 (14.7%)	128 (85.3%)	
> 30	40 (18.2%)	8 (20%)	32 (80%)	
Residence				
Rural	140 (63.6%)	26 (18.6%)	114 (81.4%)	χ^2= 0.24, p value = 0.625
Urban	80 (36.4%)	12 (15%)	68 (85%)	
Religion				
Hindu	180 (81.8%)	30 (16.7%)	150 (83.3%)	χ^2= 1.85, p value = 0.396
Muslim	35 (15.9%)	6 (17.1%)	29 (82.9%)	
Other	5 (2.3%)	2 (40%)	3 (60%)	
Education				
Illiterate	35 (15.9%)	10 (28.6%)	25 (71.4%)	χ^2= 1.68, p value = 0.136
Primary	54 (24.5%)	12 (22.2%)	42 (77.8%)	
Secondary	75 (34.1%)	8 (10.7%)	67 (89.3%)	
Higher secondary	40 (18.2%)	5 (12.5%)	35 (87.5%)	
Graduate and above	16 (7.3%)	3 (18.8%)	13 (81.3%)	
Socioeconomic class				
≥Middle class	75 (34.1%)	6 (8%)	69 (92%)	χ^2= 6.85, p value = 0.009
Lower middle and lower	145 (65.9%)	32 (22.1%)	113 (77.9%)	
Gestational age				
<30 weeks	40 (18.2%)	6 (15%)	34 (85%)	χ^2= 0.95, p value = 0.620
30-34 weeks	80 (36.4%)	12 (15%)	68 (85%)	
≥35 weeks	100 (45.5%)	20 (20%)	80 (80%)	
Parity				
Primigravida	120 (54.5%)	22 (18.3%)	98 (81.7%)	χ^2= 0.08, p value = 0.782
Multigravida	100 (45.5%)	16 (16%)	84 (84%)	
Previous UTI history				
Yes	40 (18.2%)	14 (35%)	26 (65%)	χ^2= 9.29, p value = 0.02
No	180 (81.8%)	24 (13.3%)	156 (86.7%)	
Diabetes mellitus				
Yes	24 (10.9%)	8 (33.3%)	16 (66.7%)	χ^2= 4.83, p value = 0.02
No	196 (89.1%)	30 (15.3%)	166 (84.7%)	
Hypertension				
Yes	32 (14.5%)	10 (31.3%)	22 (68.8%)	χ^2= 4.04, p value = 0.04
No	188 (85.5%)	28 (14.9%)	160 (85.1%)	
Anaemia				
Yes	65 (29.5%)	12 (18.5%)	53 (81.5%)	χ^2= 0.01, p value = 0.915
No	155 (70.5%)	26 (16.8%)	129 (83.2%)	

A significant association was found with previous UTI history (p=0.02), as women with prior UTIs had a much higher ASB prevalence (35%) than those without (13.3%). Diabetes mellitus (p=0.02) and hypertension (p=0.04) were also significantly associated with ASB, with higher prevalence rates in affected individuals (33.3% and 31.3%, respectively). However, anaemia did not show a significant association (p=0.915) [Table 2].

Among the 38 antenatal women with ASB, E. coli was the most common isolate (57.9%), followed by

S. aureus and E. faecalis (10.5% each). Coagulase-negative Staphylococcus and K. pneumoniae accounted for 7.9% each, while P. aeruginosa was the least frequent (5.3%) [Figure 1].

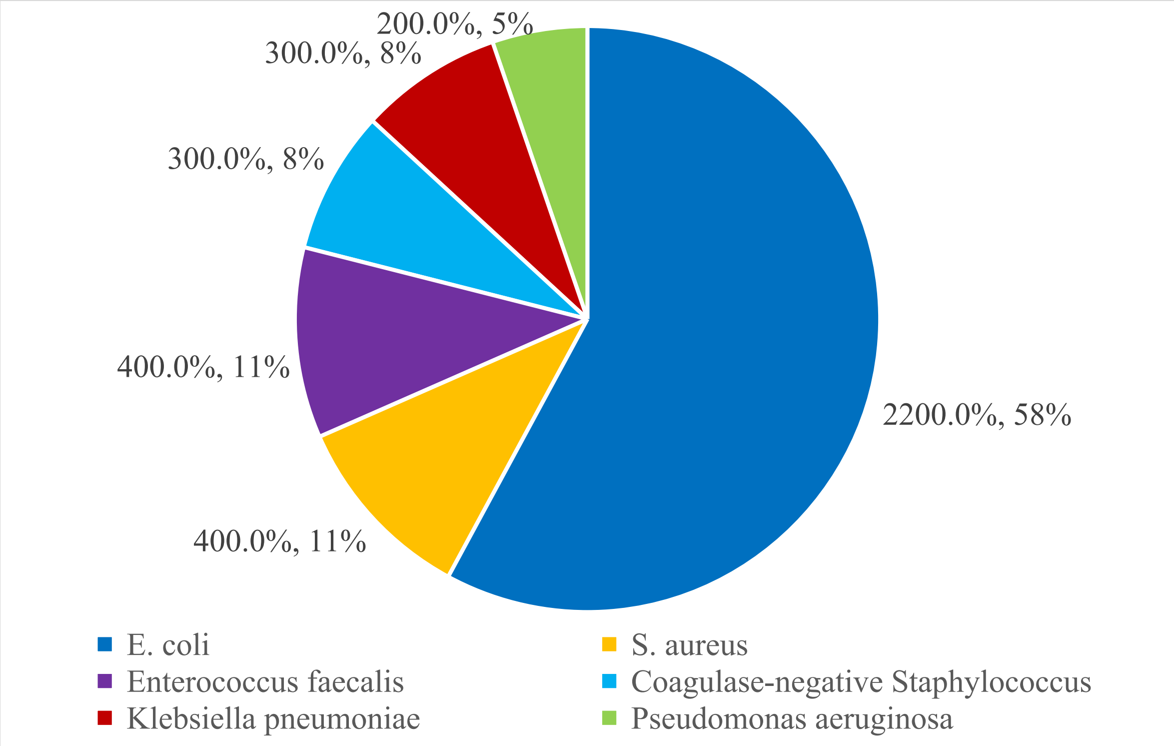

Figure 1: Distribution of bacterial isolates among antenatal women with asymptomatic bacteriuria

Table 3: Antibiotic sensitivity profile of bacterial isolates (in percentage)

Antibiotic	E. coli	S. aureus	E. faecalis	CoNS	K. pneumoniae	P. aeruginosa
Amikacin	90	85	80	75	90	90
Ampicillin	40	50	55	45		
Amoxicillin	80	40	80	38	30	
Amoxicillin-clavulanic acid	100	70	100	55	90	
Aztreonam		-	-	-		90
Cefotaxime		60	-	50	50	
Ceftaclav	100	65	-	55	90	
Ceftoparazone-sulbactam	100	80	-	78	85	70
Ceftazidime	85	-	-	-	50	
Ceftriaxone	80	75	-	68	65	90
Cefoxitin	100	85	-	78	100	-
Cephalexin		50	-	45		-
Ciprofloxacin	80	60	55	50	90	95
Co-trimoxazole		50	50	45		
Gentamicin	100	85	78	75	90	90
Imipenem	95	-	95	-	90	85
Linezolid		100	95	98	90	
Nalidixic acid		-	90	-	95	90
Nitrofurantoin		70	100	75	90	
Norfloxacin	80	55	90	45	90	95
Piperacillin-tazobactam	90	-	-	-	85	90
Vancomycin	-	100	100	98	90	
Trimethoprim-sulfamethoxazole	80	60	65	50	45	

The antibiotic sensitivity profile of bacterial isolates from antenatal women with asymptomatic bacteriuria revealed varying susceptibility patterns. E. coli, the most common isolate, showed high sensitivity to amikacin (90%), gentamicin (100%), ceftoparazone-sulbactam (100%), ceftaclav (100%), and piperacillin-tazobactam (90%). It exhibited moderate sensitivity to ciprofloxacin (80%) and ceftriaxone (80%), while its resistance was notable for ampicillin (40%). S. aureus demonstrated the highest sensitivity to linezolid (100%), vancomycin (100%), and amikacin (85%), with moderate sensitivity to ceftriaxone (75%) and ciprofloxacin (60%). Enterococcus faecalis showed excellent susceptibility to nitrofurantoin (100%), linezolid (95%), and vancomycin (100%), whereas its sensitivity to ciprofloxacin (55%) and co-trimoxazole (50%) was lower. Coagulase-negative Staphylococcus (CoNS) exhibited high sensitivity to linezolid (98%), vancomycin (98%), and cefoxitin (78%) but lower sensitivity to amoxicillin (38%) and ciprofloxacin (50%). Klebsiella pneumoniae was highly sensitive to amikacin (90%), cefoxitin (100%), and piperacillin-tazobactam (85%), though its sensitivity to ceftriaxone (65%) and ciprofloxacin (90%) remained moderate. Pseudomonas aeruginosa showed strong sensitivity to ciprofloxacin (95%), piperacillin-tazobactam (90%), and aztreonam (90%), while its susceptibility to ceftoparazone-sulbactam (70%) and imipenem (85%) was slightly lower. These findings highlight the need for targeted antibiotic therapy based on local susceptibility patterns to effectively manage asymptomatic bacteriuria in pregnant women (Table 3).

Discussion

Prevalence of Asymptomatic Bacteriuria in Pregnancy: The prevalence of asymptomatic bacteriuria (ASB) in this study was 17.3%, similar to study conducted in Assam [11] (17.69%), Nellore[12] (17%), and Lucknow[13] (16.7%). Lower rates were reported in Kanpur[14] (7.3%) and West Bengal[15](8.4%). Other studies found prevalence rates of 13.5% in Mangaluru[16], 12.12% in Rajasthan[10], and 11.97% in Vadodara[17]. Variations may be due to differences in study populations, diagnostic criteria, and socio-demographic factors.

Association of risk factors with asymptomatic bacteriuria: In the present study, ASB prevalence was higher in younger women (<20 years: 26.7%) and older women (>30 years: 20%), though not statistically significant (p=0.249). This aligns with Talukdar B et al.[18], who reported the highest prevalence (10.40%) in the 20–30 years group and the lowest (7.69%) in women >30 years, with no significant difference. Senapati J et al.[11] and studies from West Bengal similarly found peak prevalence in the 26–30 years group, ranging from 45% to 61.90%[15]. Sarawat S et al.[10] and Imade PE et al.[19] also reported the highest prevalence in the 21–30 years group. However, studies from Ghana found a higher prevalence in women >35 years[20] . The increased ASB prevalence in younger women (21–30 years) may be due to higher sexual activity and increased urinary tract colonization, while in older women, multiparity is a likely contributing factor[21].

In the present study, ASB prevalence was slightly higher in rural (18.6%) than urban areas (15%), though not statistically significant (p=0.625). An inverse relationship was observed with education, with the highest prevalence among illiterate women (28.6%) and the lowest in those with secondary education (10.7%), though not significant (p=0.136). Socioeconomic status showed a significant association, with higher prevalence in the lower middle and lower class (22.1%) compared to the middle class (8%) (p=0.009). Studies by Talukdar B et al.[18] also reported higher ASB in rural areas, linked to poor sanitation. While education was not significantly associated with ASB in Talukdar B et al.[18] and Labi et al.[22], southeastern Nigeria reported higher prevalence among the least educated. These findings suggest that poor sanitation and limited healthcare access in rural and lower socioeconomic groups may contribute to increased ASB prevalence.

In the present study, ASB prevalence was higher in later gestational ages (≥35 weeks, 20%), though not statistically significant (p=0.620). In contrast, multiple studies, including Talukdar B et al.[18], Senapati J et al.[11] and Sarawat S et al.[10] reported higher prevalence in the second trimester. likely due to urinary stasis, vesicoureteral reflux, or hormonal fluctuations.

In the present study, ASB was slightly more common in primigravida women (18.3%) than in multigravida women (16%), though not significant (p=0.782). Talukdar B et al.[18] also reported higher ASB prevalence in nulliparous women (11.81%) than those with one or two parities (7.69%), with no significant association. Similar trends were observed by Senapati J et al.[11] (70%) and Sarawat S et al.[10] (59.1%).

A significant association was found between ASB and a history of UTIs (p=0.02), with a higher prevalence in women with prior UTIs (35%) compared to those without (13.3%). ASB was also significantly associated with diabetes mellitus (33.3%, p=0.02) and hypertension (31.3%, p=0.04), while anaemia showed no significant relationship (p=0.915). Similar findings were reported by Senapati J et al.[11]

Bacterial Isolates in ASB: E. coli was the most common isolate (57.9%), followed by S. aureus and E. faecalis (10.5% each). Coagulase-negative Staphylococcus and K. pneumoniae accounted for 7.9% each, while P. aeruginosa was the least frequent (5.3%). Similar findings were reported by Talukdar B et al.[18] (E. coli 52.17%, K. pneumoniae 21.73%, S. aureus 17.39%, E. faecalis 8.69%) and Senapati J et al.[11] (E. coli 55%, S. aureus 25%). However, Sarawat S et al.[10] found E. faecalis (56.8%) to be the most prevalent, followed by E. coli (31.8%). Studies in Telangana also reported E. faecalis (42.1%) and E. coli (42.1%) as dominant isolates, differing from findings where E. coli was the primary pathogen[4]. The predominance of E. coli aligns with its strong adherence to the uroepithelium via fimbriae, facilitating colonization and persistence in the urinary tract. The presence of S. aureus and E. faecalis may be linked to poor perineal hygiene or hospital-acquired infections, while K. pneumoniae and P. aeruginosa, though less common, could be associated with antibiotic resistance and prior healthcare exposure.

Antibiotic susceptibility patterns and their implications: In the present study, E. coli, the most common isolate, exhibited high sensitivity to aminoglycosides (amikacin 90%, gentamicin 100%) and β-lactam/β-lactamase inhibitor combinations (ceftoparazone-sulbactam 100%, ceftaclav 100%, piperacillin-tazobactam 90%). However, moderate sensitivity was observed for ciprofloxacin (80%) and ceftriaxone (80%), while resistance to ampicillin (40%) was noted. The resistance to ampicillin may be attributed to its widespread use in both community and hospital settings, leading to the selection of resistant strains. S. aureus showed the highest sensitivity to linezolid (100%) and vancomycin (100%), indicating that these agents remain effective for Gram-positive infections. E. faecalis was highly susceptible to nitrofurantoin (100%) and vancomycin (100%), supporting the use of these drugs as first-line treatment options for Enterococcus-related UTIs. Coagulase-negative Staphylococcus demonstrated high sensitivity to linezolid (98%) and vancomycin (98%) but had reduced susceptibility to amoxicillin (38%) and ciprofloxacin (50%), reflecting the growing resistance among CoNS isolates. K. pneumoniae exhibited good sensitivity to amikacin (90%) and cefoxitin (100%), though resistance to ceftriaxone (35%) suggests potential β-lactamase production. P. aeruginosa remained susceptible to ciprofloxacin (95%) and piperacillin-tazobactam (90%), confirming their role in empirical treatment.

These findings align with studies by Talukdar B et al.[18], who reported high sensitivity of E. coli to imipenem and S. aureus to vancomycin and ciprofloxacin, underscoring the role of carbapenems in resistant cases. Senapati J et al.[11] also found E. coli to be highly susceptible to ciprofloxacin and ceftriaxone, reinforcing their use in ASB management. Sarawat S et al.[10] reported excellent sensitivity of Enterococcus species to vancomycin and nitrofurantoin, consistent with the present study. Previous literature highlights a trend of increasing resistance to ampicillin and cephalosporins, likely due to antibiotic overuse, self-medication, and inadequate treatment courses. The predominance of nitrofurantoin sensitivity across studies further supports its role as a preferred treatment in ASB during pregnancy[2,4,15].

Conclusion

The prevalence of asymptomatic bacteriuria (ASB) among antenatal women was 17.3%, underscoring the need for routine screening to prevent maternal and fetal complications. Lower socioeconomic status, history of urinary tract infections, diabetes mellitus, and hypertension were significantly associated with ASB. Escherichia coli was the most common isolate, followed by Staphylococcus aureus and Enterococcus faecalis. Antibiotic susceptibility patterns revealed high sensitivity of E. coli to amikacin, gentamicin, and piperacillin-tazobactam, while resistance was observed for ampicillin. Empirical antibiotic treatment should be guided by local antimicrobial susceptibility patterns to minimize the risk of resistance and enhance treatment efficacy. Targeted health education and counselling should be provided to women from lower socioeconomic backgrounds and those with limited education, emphasizing the risks of ASB, the importance of personal hygiene, and the benefits of early screening to prevent complications.

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