Prevalence of urinary tract infection among pregnant women at Bugando Medical Centre, Mwanza, Tanzania

A. MASINDE[1*], B. GUMODOKA[1], A. KILONZO[1], and S.E. MSHANA[2]
[1]*Department of Obstetric and Gynaecology, Bugando Medical Centre, P.O. Box 1370, Mwanza, Tanzania*
[2]*Weill Bugando University College of Health Sciences, P.O. Box 1464 Mwanza, Tanzania*

Abstract: Urinary tract infections (UTI) are the most common bacterial infections during pregnancy and these infections. Untreated UTI can be associated with serious obstetric complications. This cross-sectional study was carried out to determine the prevalence of UTI among symptomatic and asymptomatic pregnant women attending Bugando Medical centre (BMC) in Mwanza, Tanzania. A total of 247 pregnant women were enrolled, of these 78 (31.5%) were symptomatic and 169 (68.4%) asymptomatic. UTI was diagnosed using mid stream urine (MSU) culture on standard culture media and urinalysis was done using rapid dip stick. The prevalence of bacteriuria among symptomatic and asymptomatic pregnant women were 17.9% and 13.0% respectively, with no significant difference between the two groups (p= 0.307). Using univariate analysis there was no association of parity (p=0.825), gestational age (p=0.173), education (p=0.615), age (p=0.211) and marital status (p=0.949) with bacteriuria. The sensitivity and specificity of urine dipstick was 38.9% and 86.7% respectively. *Escherichia coli* (47.2%) and *Enterococcus* spp (22.2%) were the most commonly recovered pathogens. The rate of resistance of *Escherichia coli* to ampicillin, tetracycline, sulfamethaxazole / trimethoprim, gentamicin, ciprofloxacin, nitrofurantoin, ceftriaxone, and imipenem were 53%, 58.8%, 64.7%, 5.9%, 11.8%, 5.9%, 29.4% and 0%, respectively. In conclusion, asymptomatic bacteriuria among pregnant women is prevalent in our setting and majority of *Escherichia coli* are resistant to ampicillin, tetracycline, SXT and ceftriaxone. Due to low sensitivity of rapid dip stick, routine urine culture and susceptibility testing is recommended to all pregnant women at booking.

Key words: Urinary tract infection, pregnancy, bacteriuria, *Escherichia coli*, Tanzania

Introduction

Urinary tract infections are the most common bacterial infections during pregnancy accounting for approximately 10% of hospital visits by women (Millar *et al* 1997). These infections can be asymptomatic or symptomatic bacteriuria occurring in 5–10% and 1–3% among pregnant women, respectively (Gilstrap *et al.*, 2001). In a study in Hanang in northern Tanzania a prevalence of UTI of 16.4 % among pregnant women has been reported by Olsen *et al*. (2000). Urinary tract infection can be associated with increased risk to the foetus and the mother (Macejko *et al* 2007). The physiological changes that occur in urinary tact during pregnancy can cause otherwise healthy women to be more susceptible to serious complications due to UTI. Approximately 90% of pregnant women develop ureteral dilatation (hydronephrosis of pregnancy), which persists until delivery (Santos *et al*., 2002). Some 30% of patients with untreated asymptomatic bacteriuria develop symptomatic cystitis and up to 30–40% develop pyelonephritis (Barnick *et al*., 1991). Pyelonephritis in pregnancy has been associated with increased morbidity and mortality for mother and child (Blomberg *et al*., 2005a). Only a few (1%) women without bacteriuria develop symptomatic cystitis (Patterson & Audriole, 1987). Urinary tract infections have been attributed to cause preterm deliveries (Haram *et al*., 2003).

Escherichia coli has been found to be the commonest (80-90%) cause of UTI among pregnant women. Klebsiella, Enterobacter, Proteus species and gram positive bacteria account for the remaining cases (Millar *et al.*, 1997; Gilstrap *et al*., 2001; Delzell *et al*., 2000). Among gram-positive isolates, *Staphylococcus saprophyticus* and *Enterococcus* are the commonest species. The susceptibility to antibiotics of these organisms can vary geographically and antibiotic therapy should be prescribed based upon established patterns of antimicrobial sensitivities in the specific institution (Jamie *et al*., 2002).

Routine screening of pregnant women for UTI has been associated with a decrease in associated complications (Millar *et al.*, 1997). Urine culture is the gold standard by which other screening tests are evaluated, but it is the most

* Correspondence: Dr. Antony Masinde; E-mail: amassinde@yahoo.com

expensive and requires 24–48 hours for final interpretation (Eigbefoh *et al* 2008; Shelton *et al* 2001). Various alternatives have been proposed but each has its limitations. Microscopic evaluation of urine for pyuria, the presence of white blood cells, has a poor sensitivity of 22–29% (Shelton *et al.,* 2001). Urine dipstick testing for nitrite or leukocyte esterase has variable sensitivities (50–92%) and specificities (83–97%) (McNair, 2002).

The magnitude of UTI among pregnant women in Lake Victoria Zone of Tanzania is not known. The study was therefore, carried out to determine the prevalence of UTI among pregnant women attended at Bugando Medical Centre in Mwanza and the susceptibility patterns of the common isolates.

Material and methods

Study area

This study was carried out in the Department of Obstetric and Gynaecology of the Bugando Medical Centre (BMC) in Mwanza, north-western Tanzania. BMC is a referral hospital in the Lake zone and serves 6 regions (Mwanza, Kagera, Shinyanga, Mara, Tabora and Kigoma). It has a bed capacity of 850 with 5,435 deliveries a year, 16 beds in antenatal ward, and an average number of 10 patients admitted in the ward daily. Antenatal clinic serves about 150 pregnant mothers in a month (htt://www.bugandomedicalcentre.go.tz)

Study population and sampling

The study population included pregnant women attending Bugando Medical Centre. There was no gestational age limits. This was an analytical cross-sectional study conducted from July to October 2008. A formula of Kish & Lisle (1965) was used to calculate the sample size. $n = z^2 p (1-p) / d^2$. Where: z = Z score for 95% confidence interval = 1.96, p = prevalence, d = tolerable error =5% .A proportion of 20% was used as p (Akinloye *et al.,* 2006)

A serial sampling method was used; at least 5 pregnant women were recruited daily until the sample size was reached. A standardized questionnaire was filled for each patient to obtain socio-demographic information.

Urine collection and analysis

Mid stream urine were collected on the same day of enrolment using sterile container (HIMedia laboratories Pvt. Limited, Mumbai, India). Specimens were sent to the laboratory for analysis on the same day. Most of the specimens were analyzed within an hour of collection. Urinalysis using urine dipstick (Mannheim GmbH, Germany) was done following manufacturer's instructions.

A 1μ and 10 μl were used to inoculate urine samples on CLED, MacConkey and Blood agar plates (OXOID-England). Plates were incubated for 24hr at 37^{o}C. A diagnosis of UTI was made when there were at least 10^5 colony forming unit (CFU)/ml of urine. High colony counts with more than one species of bacteria were considered as contaminations. For contaminated specimens, repeat culture was ordered. Identification was done using in-house biochemical testing (Murray *et al.,* 1995). Disc diffusion method was used to determine susceptibility of the isolates. Individual colonies were suspended in normal saline to 0.5 McFarland and using sterile swabs the suspensions were inoculated on Muller Hinton agar for 18-24hr. All procedures were done as recommended by Clinical Laboratory Standard Institute (CLSI). For quality control, *E. coli* ATCC 25922 was used as control strains (CLSI, 2000).

For gram-negative bacteria the following discs were tested: Ampicillin (10μl), sulfamethazole-trimethoprim (SXT) (1.25/23.75μg), tetracycline (30μg), Nitrofurantoin (300mcg), Ceftriaxone (30μg), Gentamycin (10μg), Ciprofloxacin (5μl) and Imipenem (30μg). Penicillin (10 IU), Erythromycin (15μl), and Clindamycin (2μl) were used for gram-positive bacteria only. Symptomatic patients were given treatment empirically before culture results. All patients were asked to come back for results after 2 days.

Data analysis

Data were entered in the computer, using Epi-data and analyzed using SPSS 10.0. The Chi-square- test and Fisher exact tests were used to perform and establish any statistical difference. Univariate analysis was used to determine the association. Probability values of < 0.05 were considered as statistically significant.

Ethical considerations

This study was approved by BMC/Well Bugando University College of Health Sciences Ethics Review Board. An informed consent was obtained before collection of urine specimens and results were used in the management of patients.

Results

Study population and prevalence of bacteriuria

A total of 247 pregnant women were recruited in this study. Of these 89.4% were 15-34 years old. The mean gestation age was 34.05±7.44 and 85% of the women were in the third trimester. Among 247 pregnant women, 36 (14.6%) were found to have significant bacteriuria (Table 1). Prevalence of symptomatic and asymptomatic bacteriuria was 17.9% and 13%, respectively. High rate of bacteriuria was observed in the third trimester with 85.8% and 90.9% of symptomatic and asymptomatic bacteriuria, respectively. There was no association between maternal age, parity, gestational age, occupation, marital status and education with bacteriuria (Table 1). A total of 78 subjects reported urological symptoms including increased frequency of micturition (67.9%) and dysuria (64.1%); (Table 2).

Bacterial isolates and their susceptibility

Thirty six urine samples had significant bacteriuria of single isolate. *E. coli* (42.7%) was the most predominant organism recovered. The rate of resistance to ampicillin, co-trimoxazole, ceftriaxone, gentamicin and nitrofurantoin among *E. coli* were 52.9%, 64%, 29.4% 5.9% and 5.9%, respectively (Table 3). All *E. coli* isolates were sensitive to imipenem. *Klebsiella pneumoniae* accounted for 5.5% of isolates. Other Gram negative bacteria (*Acinetobacter spp, Pseudomonas spp, Morganella spp, and Enterobacter spp*) contributed 16.7% of the isolates, and they were resistant to different antibiotics (Table 3).

Table 1: Prevalence of bacteriuria and demographic characteristic of study population (N=247)

Variables	Response	No. subjects	No. (%) Bacteriuria	95% CI[1]	P-value[2]
Maternal age	<15	2	0 (0)	--	
	15-24	112	24 (21.4)	13.83;29.03	
	25-34	109	11 (10.1)	4.44;15.74	**0.211**
	35-44	23	1 (4.3)	-3.99;12.69	
	>45	1	0 (0)	--	
Parity	0-1	88	15 (17.0)	9.19;24.91	
	2-3	101	16 (15.8)	8.72;22.96	**0.825**
	>4	58	5 (8.6)	1.4;15.84	
Gestation age	1st Trimester	8	1 (12.5)	-10.42; 35.42	
	2nd Trimester	29	3 (10.3)	-0.74;21.42	**0.173**
	3rd Trimester	210	32(15.2)	10.38;20.1	
Occupation	None	9	2(22.2)	-4.94;49.38	
	Housewife	128	19(14.8)	8.68;21.0	
	Employed	24	4(16.7)	1.76;31.58	--
	Business	56	9(16.1)	6.45;25.69	
	Peasant	30	2(6.7)	-2.26;15.6	
Marital status	Single	16	3(18.8)	-0.38;37.88	
	Married	223	32(14.3)	9.75;18.95	**0.949**
	Separated	4	1(25.0)	-17.44; 67.44	
	Divorced / widowed	4	0(0)	--	
Education	Illiterate	15	1(6.7)	-5.96;19.3	
	Primary	158	22(13.9)	8.52;19.3	**0.615**
	Secondary	68	13(19.1)	9.77;28.47	
	Higher learning	6	0(0)	--	
Total		**247**	**36(14.6)**	**10.17; 18.97**	

[1]Confidence interval for proportion in percentages; [2] Univariate analysis

Table 2: Common symptoms of urinary tract infections N=78

Symptoms	Number of subjects	% of subjects
Vomiting	19	24.4
Dysuria	50	64.1
Suprapubic pain	45	57.7
Fever	34	43.6
Flank pain	27	34.6
Chills	11	14.1
Frequency of micturition	53	67.9
Nausea	26	33.3

Enterococcus spp (22.2%) was the second common isolate. It was found to be resistant to co-trimoxazole in 75%, penicillin in 50 % and ampicillin in 12.5%. *Staphylococcus aureus* and Group B *Streptococci* were isolated in 5.6% and 2.8%, respectively. They were all resistant to erythromycin.

Discussion

The overall prevalence of bacteriuria among pregnant women in this study was 14.6 %. This is similar to the prevalence of UTI (16.4%) among pregnant women in northern Tanzania (Olsen *et al,* 2000). The prevalence of symptomatic and asymptomatic bacteriuria was observed to be 17.9% and 13%, respectively. A study in Enugu, Nigeria reported similar findings (Ezeome *et a*l 2006). However, the prevalence of asymptomatic bacteriuria observed in our study is significantly high compared to those reported in developed countries and this is likely to be attributed to low socio-economic status (Gilstrap *et al.,* 2001, Santos *et al.*, 2002; Sheikh *et al.*, 2000).

Different factors have been documented to contribute to UTI among pregnant women. These include age, parity, gestation age, level of education (Gilstrap *et al.,* 2001; Smaill *et al.*, 2007; Santos *et al.*, 2002; Dimetry *et al.*, 2007). In this study there was no significant association between these factors and bacteriuria. Similar findings have been reported elsewhere (Sheikh *et al.,* 2000).

E. coli strains were the most common isolates. Similar findings have been reported in northern Tanzania (Blomberg *et al.,* 2005a) and elsewhere (Millar *et al.,* 1997; Gilstrap *et al.,*

Table 3: Rate of resistance to antibiotic among Gram negative bacteria

Bacteria	SXT	TE	CIP	AMP	CRO	NF	G	IMP
E. coli (N=17)	64.7	58.8	11.8	52.9	29.4	5.9	5.9	0
K. pneumoniae (N=2)	50.0	50.0	0	100.0	100.0	0	50.0	0
Other GNB (N=6)	66.7	83.3	50.0	66.7	50.0	50.0	16.6	16.6

Key: SXT=Co-trimoxazole; **TE=**Tetracycline**, CIP=**ciprofloxacin**, AMP=**Ampicillin**, CRO=**Ceftriaxone; **NF=**Nitrofurantoin; **G=G**entamicin**, IMP=**Imipenem

Table 4: Rate of resistance to antibiotics among Gram positive bacteria

Bacteria	AMP	TE	CIP	ER	DA	NF	PEN	SXT
Enterococcus (N=8)	12.5	75.0	0	-	-	0	50.0	75.0
Other GPB (n=3)	33.3	33.3	33.3	100.0	33.3	33.3	33.3	100.0

Key: AMP=Ampicillin; **TE=**Tetracycline; **CIP=**ciprofloxacin; **E=**Erythromycin; **DA=**Clindamycin; **NF=**Nitrofurantoin; **PEN=**Penicillin**,**

Sensitivity and specificity of Urine dip stick

The prevalence of UTI among pregnant women by dipstick and culture was 17% and 14.5%, respectively. The sensitivity and specificity of urine dipstick was 38.9 % and 86.7%, respectively. Positive predictive value and negative predictive value were 33.3% and 89.3%, respectively (Table 4).

Table 5: Sensitivity and specificity of rapid screening test using culture as gold standard

		Culture		
		Positive (%)	Negative (%)	Total
Rapid screening test	Positive	14(33.3)	28(66.7)	42(100)
	Negative	22(10.7)	183(89.3)	205(100)
	Total	36(14.5)	211(85.5)	247(100)

Sensitivity = 38.9 %; Specificity = 86.7 %; Positive predictive value = 33.3 %; Negative predictive value = 89.3%; False positive = 66.7 %; False negative = 10.7 %

2001; Dalzell *et al.,* 2000; Eigbefoh *et al.,* 2008). Most of the isolates were found to be sensitive to nitrofurantoin, ciprofloxacin and gentamicin. Similar observations have been reported by other workers (Blomberg *et al.,* 2005a; Ezesh *et al.,* 2003). Since ciprofloxacin is associated with foetal arthopathy it is not recommended in pregnancy (Briggs *et al* 2001). On the other hand, gentamicin is reserved for acute pyelonephritis (Macejko *et al* 2007). Nitrofurantoin, therefore, remains drug of choice as it is safe to use in pregnancy. The drug is recommended for both asymptomatic and symptomatic bacteriuria (Briggs *et al.,* 2001; Jamie *et al.,* 2002).

In the present study among *E. coli,* 94% of isolates were sensitive to nitrofurantoin. In similar study in northern Tanzania, 96% of *E. coli* isolates were found to be sensitive to nitorfurantoin (Blomberg *et al.,* 2005a). This drug can therefore, be used in our setting for the treatment of suspected UTI in pregnant women. In this study most of Gram negative bacteria (GNB) were resistant to ampicillin with more that half of *E. coli* being resistant to this drug. *E. coli* resistance to ampicillin in a study in northern Tanzania was lower (17%) than in our study (Blomberg *et al.,* 2005a). The use of this drug in the treatment of suspected GNB infection in our setting should not be recommended. Slightly over one-third of *E. coli* isolates were resistance to ceftriaxone, similar to what was observed at Muhimbili National Hospital in Dar es Salaam (Blomberg *et al* 2005b).

A significant difference between the two tests in determining bacteriuria among pregnant women was observed in this study. The sensitivity dipstick in our study was similar to findings by Tincello *et al.* (1995) but slightly lower than what was observed in a study in Nigeria (Eigbefoh *et al* 2008). The positive predictive value in this study was 33.3%; other studies have found it to vary from 16% to 62% (Shelton *et al.,* 2001). Leucocyte esterase has a detection limit of 5–15 cells / ml of urine with the darkest colour block equivalent to 500 cells / ml. The presence of leucocyte esterase is indicative of pyuria. It may therefore, be unreliable in patients with low pyuria (Eigbefoh *et al.,* 2008; Tincello *et al.,* 1995). The dipstick test was found to have very high false positive which indicates that treatment based on the presence of leukocyte esterase would expose approximately 67% of the mothers and their foetuses to unnecessary antibiotics (Shelton *et al.,* 2001; Olsen *et al.* 2000).

In conclusion, asymptomatic bacteriuria among pregnant women is prevalent in our setting and majority of *E. coli* are resistant to ampicillin, co-trimoxazole and ceftriaxone. The dipstick test has limited use in screening for asymptomatic bacteriuria because of its low sensitivity, compared with the urine culture. The study recommends the use of nitrofurantoin in managing asymptomatic bacteriuria and acute cystitis. Routine culture in the diagnosis of UTI among pregnant women at booking is important to prevent adverse outcome for the mother and child.

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