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Prevalence of Asymptomatic Urinary Tract Infections among Pregnant Women Residing in a Rural and an Urban Area in Tanzania

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A hospital-based cross-sectional study was conducted. Urine samples were collected using mid-stream "clean catch" method from 192 pregnant women attending antenatal clinics at Muhimbili National Referral Hospital in Dar es Salaam City, and Mkuranga District Hospital in Coast Region. The study aimed to assess the prevalence of asymptomatic urinary tract infections (bacteriuria) among pregnant women residing in rural and urban areas and determine the antibiotic sensitivity profiles of causative pathogens using the Kirby-Bauer disk diffusion method. Fourteen bacteria were isolated and their prevalence determined as *Escherichia coli* (64.2 %), *Klebsiella pneumoniae* (14.3 %), *Staphylococcus saprophyticus* (7.1 %) and *Pseudomonas aeruginosa* (14.3 %) with the resistance rates of the antibiotics ranging from 30-100 %. Nitrofurantoin showed the lowest resistance (0-33%). The prevalence rates of asymptomatic bacteriuria among pregnant women residing in urban and rural areas were 2.1 and 12.5 %, respectively. All isolated bacteria were resistant to Co-amoxiclav and erythromycin. Nitrofurantoin can thus be used as the first-line drug for treatment of asymptomatic bacteriuria because of the observed lower resistance rate.

Key words: asymptomatic bacteriuria, antibiotic resistance, pregnant women

INTRODUCTION

The urinary tract, as with all other organ systems, undergoes numerous physiological changes in response to pregnancy [1]. These normal adaptations may be associated with some complications, such as acute infections and urinary retention, which in turn increase the risk of poor outcomes for the pregnancy. An apparent decrease in immunity during pregnancy appears to encourage microbial proliferation for both commensal and non-commensal microorganisms. Similarly, glucosuria which may develop during pregnancy supports microbial growth in urine that subsequently encourages occurrence of urinary tract infections (UTI) and the associated complications [1-2]. Complications resulting from UTI during pregnancy include pregnancy hypertension, anemia, chronic renal failure, premature delivery, low birth weight and fetal mortality [3]. The incidence of these complications can be decreased by treating immediately both asymptomatic or symptomatic bacteriuria and UTI presenting during pregnancy [4]. Throughout this document, the words bacteriuria and asymptomatic UTI will be used interchangeably.

Many health facilities in resources-limited countries do not perform routine urine culture tests for antenatal patients because of being more expensive, instead many clinicians opt for the rapid dipstick urinalysis for diagnosis of UTI in pregnant women [5]. The true picture of such urine specimen may not be fully assessed as the dipstick/strip cannot quantify the extent of infection in such patients impeding provision of appropriate antimicrobial therapy, which is usually observed through antimicrobial sensitivity testing. As consequence, antibiotics are usually given empirically without urine specimen culturing resulting in probable irrational use of antibiotics. This creates another health challenge during antenatal period, which later on compromises antimicrobial oral

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treatment options in infants with microbial infections [6-7].

Evidence shows that the prevalence rates of UTI may vary according to geographical areas and socio-economic status of a given community [8]. Hence, this study aimed to determine the prevalence rates of bacteriuria/asymptomatic UTI among pregnant women residing in urban and rural areas and assess the resistance patterns of the causative microorganisms. In many parts of Tanzania, antibiotics have been widely used to empirically treat the clinically examined individuals with UTI. Therefore, understanding the extent of antibiotic resistance is of vital importance as the changing rate of antibiotic resistance has a great impact on the management of UTI [9].

METHODOLOGY

Study design and sampling procedures

This was a cross-sectional study involving collection of mid-stream urine samples from pregnant women attending antenatal clinics (ANC) at Mkuranga District Hospital in Coast Region representing rural areas, and Muhimbili National Referral Hospital (MNH) in Dar es Salaam representing urban areas. The non-probability convenience sampling technique was employed to recruit a total of 192 pregnant women attending the ANC at the two hospitals using the formula: $n = z^2 p (1-p) / d^2$. Where: z = Z score for 95% confidence interval = 1.96, p = prevalence, d = tolerable error =5%. A proportion of 14.6% was used as p in accordance with previous findings [8]. The following individuals were excluded in the study: pregnant women with apparent febrile symptoms, with complaints of dysuria, urinary hesitancy, incontinence, incomplete voiding and individuals on antibiotic therapy during the study period.

Sample collection and isolation of bacteria

From each consenting participant, clean catch mid-stream urine sample was collected using a sterile wide open container and was transported to Pharmaceutical Microbiology Laboratory at Muhimbili University of Health and Allied Sciences (MUHAS) in an ice-packed container for analysis. An aliquot of 1ml of each sample was inoculated into a cysteine lactose electrolyte deficient (CLED) agar and incubated for 24 hours at 37°C. Urine samples yielding non-significant or/and mixed growth did not have the test repeated. The presence of asymptomatic UTI/bacteriuria was considered positive when a sample exhibited bacterial counts $\geq 10^5$ colony forming unit per millilitre (cfu/ml). This was followed by further identification of the isolated bacteria based on colony morphology and biochemical tests [10]. All participants were vividly explained how to collect a clean catch mid-stream urine, though it is not guaranteed that each participant followed the instructions effectively, which could be one of the drawbacks of this study.

Antibacterial susceptibility testing

The Kirby-Bauer disk diffusion method was used for antibacterial susceptibility testing of the isolated bacteria grown on Muller-Hinton agar plates (LAB-M, Lancashire, UK) and incubated at 37°C for 24 hours. Three commonly used antibiotics for treatment of UTI during pregnancy namely nitrofurantoin, erythromycin and Co-amoxiclav, in accordance with the standard treatment guidelines (STG) of Tanzania, were employed for this purpose [11]. Each test was done in triplicate for statistical purpose and consistency of results. The obtained results were then interpreted as resistant (R), intermediate (I) or susceptible (S) as per Clinical Laboratory Standards Institute [12].

Ethical considerations

Following approval of this study by the MUHAS Ethical Committees and permission from the hospital authorities to conduct the study, all participants were clearly informed on the objectives of the study and provided with written informed consent. They were also explained that all information gathered and laboratory results obtained were solely to be used for purposes of the study. In order to maintain confidentiality names of participants and other personal particulars were not

disclosed. Data were entered into a computer for analysis and interpretation by using code numbers. For treatment purposes, laboratory findings were made available to health care personnel for interventions whenever deemed necessary.

RESULTS

Demographic characteristics and prevalence of bacteriuria

A total of 192 pregnant women were recruited in this study with an equal number from both study areas. The subjects' ages ranged from 18 to 45 with the median age of 32 years. A significant difference of ages among the subjects was evident ($p < 0.01$). About one third (31.2%) of the pregnant women had age between 34 and 41years (Table 1). Of 192 pregnant women, 14(7.3%) of them had significant bacteriuria (Tables 1 and 2). Half of pregnant women diagnosed with bacteriuria (significant bacteria growth) had age between 18 and 25, while only one patient in the age group of over 41 years had bacteriuria (Table 1).

Association between pregnant women's ages and incidence of UTI was significantly evident (Chi-square=295.5; df =27; $p <0.01$). Regression analysis showed that, controlling for age, more pregnant women from the rural area (Mkuranga District) were 6.1 times more likely to contract bacteriuria (95% CI; 3.8-11.5; $p < 0.01$). Likewise, younger pregnant women (age group of 18-28) were 0.916 folds more likely to have bacteriuria than the older age groups (95% CI; 0.84-0.99; p= 0.028).

Table 1: Age distribution and prevalence of asymptomatic bacteriuria among the study population

Age group	Bacteriuria	Mkuranga (n=96)	MNH (n=96)
		Number of patients (%)	Number of patients (%)
18-25	Yes	6 (3.1)	1 (0.5)
	No	20 (10.4)	23 (12.0)
26-33	Yes	1 (0.5)	0 (0.0)
	No	23 (12.0)	29 (15.1)
34-41	Yes	3 (1.6)	1 (0.5)
	No	23 (12.0)	33 (17.2)
Over 41	Yes	1 (0.5)	0 (0.0)
	No	19 (9.9)	9 (4.7)

Isolation of bacteria and antibiotic susceptibility test

Significant bacteria were detected among pregnant women attending ANC or/and residing in rural area Mkuranga District 12.5% (n=12) than in urban, Dar es Salaam City (2.1%; n=2) as shown in Table 1. A total of 4 species of bacteria were isolated from 14 pregnant women.

Of these 14 isolates, 12 (85.7%) were recovered from pregnant women attending ANC in rural area (Table 2). The four isolated bacteria species were comprised of 13 Gram negative bacterial isolates, of which majority (66.7%; n=9) was *E. coli* followed by equal numbers (15.4%; n=2) of *K. pneumoniae* and *P. aeruginosa* (Table 2). Of 14 isolated bacteria, only two bacterial isolates of *E. coli* and *K. pneumoniae* were recovered from two subjects attending ANC in urban area, which were resistant to erythromycin and co-amoxiclav as shown in Tables 2 and 3. A total of 11 (78.6%) isolates were resistant to the tested antibiotics, of those 9(64.3%) were recovered from pregnant women attending ANC in rural area (Table 3). The resistance rates to co-amoxiclav and erythromycin ranged from 50.0%-100.0%. About 67% (n=6) *E. coli*, 50% (n=1) isolates of *K. pneumoniae* and *P. aeruginosa* each, exhibited resistance to at least two of the tested antibiotics as shown in Table 3.

Table 2: Bacteria isolated from pregnant women attending ANC in the study areas

Isolated bacteria	Frequency of isolation (%)		
	Mkuranga	MNH	Total (n=14)
E. coli	8(57.1)	1(7.1)	9(64.2)
K. pneumoniae	1(7.1)	1(7.1)	2(14.3)
S. saprophyticus	1(7.1)	NBG	1(7.1)
P. aeruginosa	2(14.3)	NBG	2(14.3)
Total	12(85.7)	2(14.3)	14(100.0)

Key: NBG - no bacteria growth

Table 3: Antibiotic susceptibility profiles of bacteriuria-associated pathogens isolated from pregnant women

Bacteria	Antibiotics	Hospital	
		Mkuranga (%)	MNH (%)
E. coli (n=9)	Nitrofurantoin	R(33.3); I(22.3); S(33.3)	R(0.0); S(11.1)
	Erythromycin	R(88.9)	R(11.1)
	Co-amoxiclav	R(88.9)	R(11.1)
K. pneumoniae (n=2)	Nitrofurantoin	S(50.0)	I(50.0)
	Erythromycin	R(50.0)	R(50.0)
	Co-amoxiclav	R(50.0)	R(50.0)
S. saprophyticus (n=1)	Nitrofurantoin	I(100.0)	NBG
	Erythromycin	R(100.0)	NBG
	Co-amoxiclav	R(100.0)	NBG
P. aeruginosa (n=2)	Nitrofurantoin	R(50.0); S(50.0)	NBG
	Erythromycin	R(100.0)	NBG
	Co-amoxiclav	R(100.0)	NBG

Key: R-resistant; I-intermediate; S- susceptible; NBG- no bacteria growth

DISCUSSION

Asymptomatic urinary tract infections are among the commonest problems facing pregnant women due to physiological and anatomical changes they undergo during pregnancy [1]; thus assessment of its prevalence and potential complications becomes necessary for better antimicrobial therapeutic treatment. The UTI may be manifested as asymptomatic bacteriuria or symptomatic bacteriuria [13]. Female are at higher risk due to their anatomical structures of which is a short urethra, vagina and anus proximity and inability of women to empty their bladder completely [1]. Moreover, pregnant women are at higher risk due to physiological and immunological changes that occur during pregnancy [14]. At around week 6 of pregnancy, the urethra begins to dilate, a condition known as “hydroneprosis of pregnancy” which peaks at 22-26 weeks of pregnancy and persist until delivery, which is associated with constant UTI with painful urination [15].

Our study revealed an overall prevalence of UTI of 7.3 % that is slightly lower than what was reported previously in Arusha, Tanzania (14 %) and 15% Ethiopia [16-17], 38.8 % in Kenya [18]; 47.5% observed in Ethiopia [17, 19]; 64.4 % in Libya [20] and 57.1 % in Italy [21]. However, our findings from the rural area (Mkuranga District) showed that pregnant women in rural area were more prone to UTI, which was reflected in the observed higher prevalence of the infection. The prevalence of UTI among pregnant women in urban and rural areas was 2.1 and 12.5 % respectively. The findings from rural area (Mkuranga) is comparable with the previous studies conducted in Ethiopia (10.2 %) [19], in Khartoum, Sudan

(12.1%) [22], and in Makah, Saudi Arabia (12.0%) [23], which is relatively lower than that of previous studies conducted in Addis Ababa (20 %) [24], and in Tanzania (17.9 %) as earlier reported by Masinde *et al*. [8]. The current prevalence rate of UTI in Dar es Salaam (urban area) was very low (2 %). The difference might be due to the small number of symptomatic pregnant women included in the later studies [22-23]. Presumably this is due to low socio-economic status and low education since these had been attributed to high prevalence of UTI in communities [16-17]. Likewise, the observed variation could be because of differences in the environment, social habits of the communities, the standard of personal hygiene and education levels [25].

Similar to other previous studies, Gram-negative bacteria were the most commonly isolated bacteria from the pregnant women [19-20, 26]. *Escherichia coli* was found to be the most frequent (4.7 %) bacterial isolate in this study, which is in line with other reports from different areas [22-24]. The bacterium was also the leading cause of UTI in about 64.2 % (n=14) of the pregnant women, which is comparatively higher than what were previously reported elsewhere, which was 21.5 % in Kenya [18] and 47.5% in Gondar, Ethiopia [19]. Only one Gram positive bacterium, *S. saprophyticus* was isolated from a pregnant woman at Mkuranga. Its isolation is not unusual, as it one of the causes of UTI in most patients [19, 26].

Pregnant women in the study age group of 18-25 were highly infected (53.8%) followed by those between 34 and 41years (30.8%), which is in concordance with previous studies findings [16]. However, other previous studies reported that the later age group (34-41years) was the most affected [17, 26]. Most probably, it is because women in this age group are more sexually active which might predispose them to UTI. Low-income status was another factor that has been associated with high prevalence of UTI among pregnant women [17, 25].

In this study, all isolated bacteria were resistant to co-amoxiclav as compared to other studies, in Kenya ranging from 50% against *Proteus* species to 80% against Citrobacter species [18] while the rate of 14.5% was reported in Sudan against *E. coli* [22]. This difference could be attributed to increasing use of the antibiotics and adaptability of the pathogens to the antibiotic as result of the irrational use of the drug. The high rate of antibiotic resistance to erythromycin revealed in our study is contrary to what was previously observed in Ethiopia 14.3% [16]. Our study showed that most of the detected bacteria were sensitive to nitrofurantoin that showed the lowest rate of resistance (30-50%) against the tested bacteria. This result is also in concordant with previous findings that exhibited a low rate of antibiotic resistance against the drug ranging from as low as 14-50% [16]. This observation may be explained by the fact that the antibiotic is less commonly used and available in pharmacies as over the counter medicine compared to erythromycin and co-amoxiclav [27]. A linear relationship exists between trends of antibiotic usage and resistance rates [28].

CONCLUSION

Significant differences in prevalence rates were noted between rural and urban areas. *Escherichia coli* were the leading cause of UTI/bacteriuria among the pregnant women in the rural area. A high rate of antibiotic resistance was observed against erythromycin and co-amoxiclav, which are habitually indicated for UTI during pregnancy. Nitrofurantoin should preferably be used for the treatment of UTI in pregnancy because of lower antibiotic resistance observed in the present study. Further studies with larger sample size should be conducted on antimicrobial resistance profiling to come up with more conclusive recommendations.

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REFERENCES

[1] Jeyabalan, and K.Y. Lain. Urol. Clin. North. Am. 34, 2007, 1-6.

[2] G. Haider, N. Zehra, A. Afroze Munir, and A. Haider. J. Pak. Med. Assoc. 60, 2010, 213-216.

[3] N.M. Gilbert, V. P. O'brien, S. Hultgren, G. Macones, W. G. Lewis and A. L. Lewis. Glob. Adv. Health Med. 2(5), 2013, 59-69.

[4] S. Cox and F. Reid. Obstet. Gynaecol. Reprod. Med. 25(5), 2015, 123-127.

[5] Foxman. Am. J. Med. 113(1), 2002, 5-13.

[6] Z. Segal, M. J. Cohen, D. Engelhard, A. Tenenbaum, A. M. Simckes, S. Benenson and D. Averbuch. Acta Paediatr. 105(4), 2016, 156-60.

[7] J. L. Robinson, J. C. Finlay, M. E. Lang and R. Bortolussi. J. Paediatr. Child. Health. 19(6), 2014, 315-319.

A. Masinde, B. Gumodoka, A. Kilonzo and S.E. Mshana. Tanzan. J. Health Res. 11(3), 2009, 154-161.

[8] N. Taneja, P. Rao, J. Arora and A. Dogra. Ind. J. Med. Res. 127(1), 2008, 85-88.

[9] M. Cheesbrough. District Laboratory Practice in Tropical Countries. Part 2, Second Edition. Cambridge University Press. The Edinburgh Building, Cambridge, CB2 8RU, UK, 2006.

[10] Standard Treatment Guidelines (STG) and the National Essential Medicine List for Tanzania (NEMLIT) 2013.

[11] Clinical and Laboratory Standards Institute (CLSI) Guidelines. Performance Standards for Antimicrobial Susceptibility Testing; 21st Informational Supplement. Update M100-S21. Wayne, PA: CLSI. 2011.

[12] J. Matuszkiewicz-Rowińska, J. Małyszko and M. Wieliczko. Arch. Med. Sci. 11(1), 2015, 67-77.

[13] P. Soma-Pillay, C. Nelson-Piercy, H. Tolppanen and A. Mebazaa. Cardiovasc. J. Afr. 27(2), 2016, 89-94.

[14] E.H. Kass and F. Maxwell. J. Urol. 168(2), 2002, 420-424.

[15] Derese, H. Kedir, Z. Teklemariam, F. Weldegebreal and S. Balakrishnan. Ther. Clin. Risk Manag. 12, 2016, 251.

[16] Tadesse, M. Teshome, Y. Merid, B. Kibret and T. Shimelis. BMC Res. Notes. 7(1), 2014, 155.

[17] A.O. Ayoyi, G. Kikuvi, C. Bii and S. Kariuki. Pan. Afr. Med. J. 26(1), 2017, 1-12.

[18] A. Alemu, F. Moges, Y. Shiferaw, K. Tafess, A. Kassu, B. Anagaw and A. Agegn. BMC Res. Notes. 5, 2012, 197.

[19] M. Tamalli, S. Bioprabhu and M.A. Alghazal. Int. J. Med. Sci. 3(5), 2013, 455-459.

[20] M.A. de Francesco, G. Ravizzola, L. Peroni, R. Negrini and N. Manca. Med. Sci. Monit. 13(6), 2007, 136-144.

[21] Z.H. Hamdan, H.M.Z. Abdel, K.A. Salah and A. Ishag. Ann. Clin. Microbiol. Antimicrob. 10, 2011, 2.

[22] S.F. Hani, M.A. Ahmed, A.A.E. Ghada, K.A. Ahmad and M.M. Amr. Biomed. Pharma. J. 6(1), 2013, 1-7.

[23] A. Assefa, D. Asrat, Y. Woldeamanuel, Y. Hiwot, A. Abdella and T Melese. Ethiop. Med. J. 46(3), 2008, 227-235.

[24] S.C. Onuoha and K. Fatoku. Am. J. Life Sci. 2(2), 2014, 46-52.

[25] B. Sekharan, D. D. Kumar, K. R. Kumari and C. A. Joachim. UK J. Pharm. Biosci. 5(2), 2016, 50-55.

[26] S. Levy. The Antibiotic Paradox: How Misuse of Antibiotics Destroys their Curative Powers. Perseus Cambridge, 2002.

[27] B.G. Bell, F. Schellevis, E. Stobberingh, H. Goossens and M. Pringle. BMC Infect. Dis. 14, 2014, 13.