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Original Article

Urinary tract infection in female in Kirkuk city, Iraq: Association between risk factors and bacterial type

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ABSTRACT

Background: Urinary tract infection is the most common community and hospital bacterial infection and characterized by high rate of treatment failure and recurrences. **Aim:** to determine the association between risk factors and bacterial type. **Materials and Methods:** A prospective cross-sectional study conducted during the period from 1st of June 2015 to the end of January 2016. The population included in the study are 563 women, of them 425 (75.5%) were outpatients, and 138 (24.5%) were inpatients. Their age range between 18 and 80 years, with a mean age of 33.59±15.29 years. Urine samples were immediately cultured on blood agar and MacConkey's agar by spread plate technique. Bacterial colonies with different morphology were selected, purified and identified according to their biochemical characteristics using conventional standard methods. **Results:** Mean age was significantly (F=5.14, P=0.002) different in relation to bacterial type. Women infected with *E. coli* were with higher mean age (37.84 year), followed by those infected with *Staphylococcus aureus* (31.97 year), then *Klebsiella pneumonia* (28.76 year) and *Proteus mirabilis* (28.50 year). BMI mean value was significantly (F=6.33, P=0.000) different in women infected with different bacteria and higher value was in those infected with *E. coli* (26.15), while it was about the same in those infected with *Staphylococcus aureus* (24.6), then *Klebsiella pneumonia* (24.9 year) and *Proteus mirabilis* (24.1). Pus cell scale mean value was significantly (F=6.67, p=0.000) higher in cases infected with *E. coli* (2.04), while 1.77 in *Staphylococcus aureus*, infected cases, 1.15 in women infected with *Klebsiella pneumonia* and 1.33 in those infected with *Proteus mirabilis*. **Conclusion:** Age, BMI, pus cells scale, and education levels were significantly associated with bacterial type.

Key words: Urinary tract infection; Kirkuk; *E. coli*; *Staphylococcus aureus*; *Klebsiella pneumonia*; *Proteus mirabilis*

INTRODUCTION

Urinary tract infection is the most common community and hospital bacterial infection encountered in human population for all age groups [1]. The prevalence of UTI was higher with in female as compared to male and increased in both gender with age [2]. *Enterobacteriaceae* form the common etiologic agents of primary and recurrent urinary tract infection [3]. However, *E. coli* still form the common etiological agent of urinary tract infections in both genders [2]. The problems in the management of urinary tract infections are attributed to factors related to host and those related to the causative agents of urinary tract infections (4). The most important factor related to causative agents of urinary tract infection that lead to treatment failure and recurrent infection was the emergence of resistance to antibiotics [3-8]. Thus this study was conducted to determine the association between risk factors and bacterial type.

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MATERIALS AND METHODS

Study Design

A prospective cross-sectional study conducted during the period from 1st of June 2015 to the end of January 2016. The population included in the study is 563 women, of them 425 (75.5%) were outpatients and 138 (24.5%) were inpatients. Their age range between 18 and 80 years, with a mean age of 33.59±15.29 years. The study proposal was approved by the Ethical Committee of College of Science, Tikrit University and verbal informed consent taken from each woman before enrolment in the study.

Bacterial Isolation

Urine samples were centrifuged and sediments immediately cultured on blood agar and MacConkey's agar by spread plate technique. Bacterial colonies with different morphology were selected, purified and identified according to their biochemical characteristics using conventional standard methods [9].

Statistical Analysis

Analysis performed using SPSS (version20). The data presented as percentages, mean value and standard deviation. Chi square used to calculate significance for frequency, while t test used to determine significance in mean difference. P value of < 0.05 regarded significant.

RESULTS

Mean age was significantly (F=5.14, P=0.002) different in relation to bacterial type. Women infected with *E. coli* were with higher mean age (37.84 year), followed by those infected with *Staphylococcus aureus* (31.97 year), then *Klebsiella pneumonia* (28.76 year) and *Proteus mirabilis* (28.50 year) (Table 1). BMI mean value was significantly (F=6.33, P=0.000) different in women infected with different bacteria and higher value was in those infected with *E. coli* (26.15), while it was about the same in those infected with *Staphylococcus aureus* (24.6), then *Klebsiella pneumonia* (24.9 year) and *Proteus mirabilis* (24.1) (Table 1).

Pus cell scale mean value was significantly (F=6.67, p=0.000) higher in cases infected with *E. coli* (2.04), while 1.77 in *Staphylococcus aureus*, infected cases, 1.15 in women infected with *Klebsiella pneumonia* and 1.33 in those infected with *Proteus mirabilis* (Table 1).

Table 1: Bacterial type in regard to age, BMI and pus cell mean values

Variable	Bacterial type	N	Mean	Std. Deviation
Age	*E. coli*	135	37.84	17.47
	Staph aureus	41	31.98	14.01
	Klebsiella pneumonia	34	28.76	11.18
	Proteus mirabilis	24	28.50	11.68
	Total	234	34.54	16.02
BMI	*E. coli*	135	26.15	2.95
	Staph aureus	41	24.61	3.06
	Klebsiella pneumonia	34	24.94	1.97
	Proteus mirabilis	24	24.11	2.16
	Total	234	25.49	2.87
Pus Cell	*E. coli*	135	2.04	1.07
	Staph aureus	41	1.76	1.30
	Klebsiella pneumonia	34	1.15	1.23
	Proteus mirabilis	24	1.33	1.27
	Total	233	1.79	1.20

Age F=5.136, P=0.002; BMI F=6.328, P=0.000; Pus cell F=6.672, P=0.000

E. coli predominantly isolated from married women (85.2%, 115/135), while in single women it was isolated from 14.8% (20/135). Also, 75.6% (31/41) of *Staphylococcus aureus* was isolated from married women and 24.4% (10/41) was isolated from single women. In addition, 70.6% (24/34) of *Klebsiella pneumonia* was isolated from married women, while 29.4% (10/34) was isolated from single women. Furthermore, 79.2% (19/24) of *Proteus mirabilis* was isolated from married women and 11.1 (5/24) % was isolated from single women, Table 2. The overall frequency distribution of the 4 bacteria between married and single women was not with significant (Chi=4.71, P>0.05) differences (Table 2).

The frequency rate of UTI aetiology for the four isolated bacteria is no significantly different (Chi=27.29, P>0.05) in relation to child number. The overall isolation rate not demonstrates a specific pattern in regards to child number. *E. coli* higher isolation rate was from nulliparous (24.4%), while the lower isolation was from women with 7 children (1.5%). *Staphylococcus aureus* isolation rate was 31.7% from nulliparous and lowest isolation was from women with 6 children (2.4%). *Klebsiella pneumonia and Proteus mirabilis* lower isolation rate was from women with 7 child, while higher isolation rate was from nulliparous (Table 3).

There was no significant (Chi=8.43, P>0.05) differences in the isolation of the 4 bacteria in relation to delivery method. However, *E. coli* was predominantly isolated from women with vaginal delivery (57%), followed by non-pregnant women (25.2%) and lower rate was in those delivered by caesarean section (17.8%). *Staphylococcus aureus*, *K. pneumonia and*

Table 2: Bacterial type in regard to marital status

Marital status	Bacteria				Total
	E. coli	Staph aureus	K. pneumonia	Proteus mirabilis	
Married					
Count	115	31	24	19	189
% within mar status	60.8	16.4	12.7	10.1	100.0
% within bacteria	85.2	75.6	70.6	79.2	80.8
% of total	49.1	13.2	10.3	8.1	80.8
Single					
Count	20	10	10	5	45
% within mar status	44.4	22.2	22.2	11.1	100.0
% within bacteria	14.8	24.4	29.4	20.8	19.2
% of total	8.5	4.3	4.3	2.1	19.2
Total					
Count	135	41	34	24	234
% within mar status	57.7	17.5	14.5	10.3	100.0
% within bacteria	100.0	100.0	100.0	100.0	100.0
% of total	57.7	17.5	14.5	10.3	100.0

Chi=4.71, P>0.05

Proteus mirabilis show the pattern of isolation rate of *E. coli*. In addition, the overall isolation rate was 56% in women with vaginal delivery, 29.9% in non-pregnant and 14.1% in women with caesarean section delivery method (Table 4).

The isolation rate was lower in women with history of operation for *E. coli(12.6%)*, Staphylococcus *aureus (9.8%)*, *K. pneumonia(3%) and Proteus mirabilis(12.5%)*. However, this low rate of isolation may be due to small size number of women with history of operation in our study cohort. The frequency distribution pattern for the four bacteria was not significantly (Chi =2.65, P>0.05) different in relation to operation history (Table 5).

There was a significant (Chi=18.25, P=0.032) differences between the four isolated bacteria in relation to education level. The predominant rate of isolation for the 4 bacteria was from women higher education level, however, the lowest isolation rate was from women with secondary education level for *E. coli (11.1%)*, primary education level for *Staphylococcus aureus(7.3%) and K. pneumonia(5.9%)*, and illiterate (4.2%) for *Proteus mirabilis* (Table 6).

E. coli, Staphylococcus *aureus*, *K. pneumonia and Proteus mirabilis* were not significantly (Chi =13.72, P>0.05) different in their isolation rates in relation to economic status. All the four bacteria were predominantly (≥1/2 of the isolates) isolated from women with average economic level, followed by those with good economic level. This may be due to samples driven effect as 501from 563 of the study population were from average and good economic level (Table 7).

The four type isolated bacteria were not significantly (Chi=0.43, P>0.05) different in relation to hospital setting and all bacteria types were predominantly (70.7% - 76.5%) isolated from outpatient women (Table 8).

DISCUSSION

The type of UTI causative bacteria was significantly correlated to mean age of women with positive culture. Women infected with *E. coli* were with higher mean age (37.84 year), followed by those infected with *Staphylococcus aureus* (31.97 year), then *Klebsiella pneumonia* (28.76 year) and *Proteus mirabilis* (28.50 year). Amiri et al [10], Iran, found that *E. coli* account as a cause of UTI for more than ½ of the cases and 86.9% of their study population were in the age of > 25 years and this indicated that older age women are more prone to get UTI due to *E. coli*. In addition, Salman et al (11), Diyala, Iraq, reported that *E. coli* caused UTI in women and 78% of them are with age of <30 years. However, the above data was contracted with the finding of Njunda et al [12] as they found high rate of UTI in diabetic women with age of > 40 years.

Colonization of urinary tract with *E. coli* was enhanced in postmenopausal women estrogen reduction which attributed to vaginal muscle weakness, increased vaginal pH and decrease in vaginal flora [13]. BMI mean value was significantly different in women infected with different bacteria and higher value was in those infected with *E. coli*, while it was about the same in those infected with *Staphylococcus aureus*, *Klebsiella pneumonia* and *Proteus mirabilis*.

Table 3: Bacterial type in regard to child number

Child number	Bacteria				Total
	E. coli	Staph aureus	K. pneumonia	Proteus mirabilis	
0.00					
Count	33	13	14	9	69
% within child number	47.8	18.8	20.3	13.0	100.0
% within bacteria	24.4	31.7	41.2	37.5	29.5
% of total	14.1	5.6	6.0	3.8	29.5
1.00					
Count	10	7	6	6	29
% within child number	34.5	24.1	20.7	20.7	100.0
% within bacteria	7.4	17.1	17.6	25.0	12.4
% of total	4.3	3.0	2.6	2.6	12.4
2.00					
Count	21	3	4	3	31
% within child number	67.7	9.7	12.9	9.7	100.0
% within bacteria	15.6	7.3	11.8	12.5	13.2
% of total	9.0	1.3	1.7	1.3	13.2
3.00					
Count	25	6	2	1	34
% within child number	73.5	17.6	5.9	2.9	100.0
% within bacteria	18.5	14.6	5.9	4.2	14.5
% of total	10.7	2.6	0.9	0.4	14.5
4.00					
Count	19	4	5	2	30
% within child number	63.3	13.3	16.7	6.7	100.0
% within bacteria	14.1	9.8	14.7	8.3	12.8
% of total	8.1	1.7	2.1	0.9	12.8
5.00					
Count	18	4	2	2	26
% within child number	69.2	15.4	7.7	7.7	100.0
% within bacteria	13.3	9.8	5.9	8.3	11.1
% of total	7.7	1.7	0.9	0.9	11.1
6.00					
Count	7	1	1	1	10
% within child number	70.0	10.0	10.0	10.0	100.0
% within bacteria	5.2	2.4	2.9	4.2	4.3
% of total	3.0	0.4	0.4	0.4	4.3
7.00					
Count	2	3	0	0	5
% within child number	40.0	60.0	0.0	0.0	100.0
% within bacteria	1.5	7.3	0.0	0.0	2.1
% of total	0.9	1.3	0.0	0.0	2.1
Total					
Count	135	41	34	24	234
% within child number	57.7	17.5	14.5	10.3	100.0
% within bacteria	100.0	100.0	100.0	100.0	100.0
% of total	57.7	17.5	14.5	10.3	100.0

Chi=27.29, P>0.05

The mean value of pus cell scale was significantly higher in cases infected with *E. coli*, followed by in those infected with *Staphylococcus aureus*, *Proteus mirabilis*, and *Klebsiella pneumonia*. This variation in pus cell scale between cases infected with different bacterial types could be due IBC and QIR formation and the difference in their virulence factors.

E. coli, *Staphylococcus aureus*, *Klebsiella pneumonia* and *Proteus mirabilis* were predominantly isolated from married women than from single women, but there were no significant differences in frequency distribution when analysis performed on bacterial type strata. In addition, the infection was lower in single than in married women due to that intercourse in married women was a risk factor for UTI [14-18].

Child number was not significantly influence bacterial type in women urinary tract infection. The overall isolation rate not demonstrates a specific pattern in

Table 4: Delivery method influence on bacterial type

Delivery method	Bacteria				Total
	E. coli	Staph aureus	K. pneumonia	Proteus mirabilis	
No pregnancy					
Count	34	13	14	9	70
% within del method	48.6	18.6	20.0	12.9	100.0
% within bacteria	25.2	31.7	41.2	37.5	29.9
% of total	14.5	5.6	6.0	3.8	29.9
Vaginal					
Count	77	24	19	11	131
% within del method	58.8	18.3	14.5	8.4	100.0
% within bacteria	57.0	58.5	55.9	45.8	56.0
% of total	32.9	10.3	8.1	4.7	56.0
Caesarean					
Count	24	4	1	4	33
% within del method	72.7	12.1	3.0	12.1	100.0
% within bacteria	17.8	9.8	2.9	16.7	14.1
% of total	10.3	1.7	0.4	1.7	14.1
Total					
Count	135	41	34	24	234
% within del method	57.7	17.5	14.5	10.3	100.0
% within bacteria	100.0	100.0	100.0	100.0	100.0
% of total	57.7	17.5	14.5	10.3	100.0

Chi=8.43, P>0.05

Table 5: Operation history influence on bacterial type

Operation history	Bacteria				Total
	E. coli	Staph aureus	K. pneumonia	Proteus mirabilis	
No					
Count	118	37	32	21	208
% within operation	56.7	17.8	15.4	10.1	100.0
% within bacteria	87.4	90.2	97.0	87.5	89.3
% of total	50.6	15.9	13.7	9.0	89.3
Yes					
Count	17	4	1	3	25
% within operation	68.0	16.0	4.0	12.0	100.0
% within bacteria	12.6	9.8	3.0	12.5	10.7
% of total	7.3	1.7	0.4	1.3	10.7
Total					
Count	135	41	33	24	233
% within operation	57.9	17.6	14.2	10.3	100.0
% within bacteria	100.0	100.0	100.0	100.0	100.0
% of total	57.9	17.6	14.2	10.3	100.0

Chi=2.65, P>0.05

regards to child number for the all 4 isolated bacterial genus. *E. coli* higher isolation rate was from nulliparous and was 16 times than the lower isolation rate from women with 7 children. *Staphylococcus aureus* isolation rate was 13 times from nulliparous than the lowest isolation from women with 6 children. *Klebsiella pneumonia and Proteus mirabilis* higher isolation rate was from nulliparous and not isolated from women with 7 child.

There were no significant differences in the isolation of the 4 bacteria in relation to delivery method. However, *E. coli* was predominantly isolated from women with vaginal delivery (76.2%) and 25.8%, however, this not consistent to that reported by Amiri et al for Iran, they reported that *E. coli* was isolated from 51.7% of women with vaginal delivery and from 48.3% from those with caesarean section. *Staphylococcus aureus* isolation rate was 85.7% in women delivered vaginally, while a rate of 80% was reported for Iran. *K. pneumonia* isolation rate was 95% from women delivered vaginally and this is much higher to that for Iran (28%). *Proteus mirabilis* show isolation rate of 73.3% and was about similar to that of Iran [10].

Previous history of operation not influence the type of bacterial isolation, however, the isolation rate was

Table 6: Education level influence on bacterial type

Education level	Bacteria				Total
	E. coli	Staph aureus	K. pneumonia	Proteus mirabilis	
Illiterate	37	10	5	1	53
Count	69.8	18.9	9.4	1.9	100.0
% within education	27.4	24.4	14.7	4.2	22.6
% within bacteria	15.8	4.3	2.1	0.4	22.6
% of total					
Primary	23	3	2	3	31
Count	74.2	9.7	6.5	9.7	100.0
% within education	17.0	7.3	5.9	12.5	13.2
% within bacteria	9.8	1.3	0.9	1.3	13.2%
% of total					
Secondary	15	4	7	7	33
Count	45.5	12.1	21.2	21.2	100.0
% within education	11.1	9.8	20.6	29.2	14.1
% within bacteria	6.4	1.7	3.0	3.0	14.1
% of total					
Diploma/ B Sc	60	24	20	13	117
Count	51.3	20.5	17.1	11.1	100.0
% within education	44.4	58.5	58.8	54.2	50.0
% within bacteria	25.6	10.3	8.5	5.6	50.0
% of total					
Total	135	41	34	24	234
Count	57.7	17.5	14.5	10.3	100.0
% within education	100.0	100.0	100.0	100.0	100.0
% within bacteria	57.7	17.5	14.5	10.3	100.0
% of total					

Chi=18.25, P=0.032

Table 7: Economic status influence on bacterial type

Economic status	Bacteria				Total
	E. coli	Staph aureus	K. pneumonia	Proteus mirabilis	
Poor					
Count	19	0	2	0	21
% within econ status	90.5	0.0	9.5	0.0	100.0
% within bacteria	14.1	0.0	5.9	0.0	9.0
% of total	8.1	0.0	0.9	0.0	9.0
Average					
Count	69	21	18	12	120
% within econ status	57.5	17.5	15.0	10.0	100.0
% within bacteria	51.1	51.2	52.9	50.0	51.3
% of total	29.5	9.0	7.7	5.1	51.3
Good					
Count	44	19	12	11	86
% within econ status	51.2	22.1%	14.0	12.8	100.0
% within bacteria	32.6	46.3	35.3	45.8	36.8
% of total	18.8	8.1	5.1	4.7	36.8
Very good					
Count	3	1	2	1	7
% within econ status	42.9	14.3	28.6	14.3	100.0
% within bacteria	2.2	2.4	5.9	4.2	3.0
% of total	1.3	0.4	0.9	0.4	3.0
Total					
Count	135	41	34	24	234
% within econ status	57.7	17.5	14.5	10.3	100.0
% within bacteria	100.0	100.0	100.0	100.0	100.0
% of total	57.7	17.5	14.5	10.3	100.0

Chi=13.72, P>0.05

Table 8: Hospital setting influence on bacterial type

Hospital setting	Bacteria				Total
	E. coli	Staph aureus	K. pneumonia	Proteus mirabilis	
Outpatient					
Count	100	29	26	17	172
% within setting	58.1	16.9	15.1	9.9	100.0
% within bacteria	74.1	70.7	76.5	70.8	73.5
% of total	42.7	12.4	11.1	7.3	73.5
Inpatient					
Count	35	12	8	7	62
% within setting	56.5	19.4	12.9	11.3	100.0
% within bacteria	25.9	29.3	23.5	29.2	26.5
% of total	15.0	5.1	3.4	3.0	26.5
Total					
Count	135	41	34	24	234
% within setting	57.7	17.5	14.5	10.3	100.0
% within bacteria	100.0	100.0	100.0	100.0	100.0
% of total	57.7	17.5	14.5	10.3	100.0

Chi=0.43, P>0.05

lower in women with history of operation for *E. coli*, *Staphylococcus aureus*, *K. pneumonia and Proteus mirabilis*. This low rate of isolation may be due to small size number of women with history of operation in our study cohort. Presumably, operation may be associated with increased incidence of UTI if the operation was on renal system or due to catheterization during the operation. History of catheterization was significantly associated with increased incidence of UTI [2, 19, 20], however, Emiru et al not found a significant association between UTI and history of catheterization [21].

There was a significant differences between the four isolated bacteria in relation to education level and this not consistent with that reported by others [19,21-24]. The predominant rate of isolation for the 4 bacteria was from women with higher education level, however, the lowest isolation rate was from women with secondary education level for *E. coli*, primary education level for *Staphylococcus aureus and K. pneumonia*, and illiterate (4.2%) for *Proteus mirabilis*.

E. coli, *Staphylococcus aureus*, *K. pneumonia and Proteus mirabilis* were not significantly different in their isolation rates in relation to economic status, and hospital setting. This may be due to samples driven effect as 501from 563 of the study population were from average and good economic level and most of the women included in this study were recruited from outpatient setting.

In conclusion, age, BMI, pus cells scale, and education levels were significantly associated with bacterial type.

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