Symptomatic Urinary Tract Infection in Diabetic Pregnant Women, Effect of the Type of Diabetes and Glycemic Control

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ABSTRACT

Objectives: To compare the prevalence of symptomatic urinary tract infection (S-UTI) in women with gestational diabetes mellitus (GDM), pregestational diabetes mellitus (PGDM), and the effect of glycemic control methods.

Materials and Methods: This is a retrospective review of women with GDM and PGDM, who had S-UTI treated at Sultan Qaboos University Hospital between January 1, 2009, and December 31, 2010.

Results: From a total of 639 women with diabetes mellitus (DM), 91% (n = 581) had GDM and 9% (n = 58) had PGDM. The prevalence of S-UTI was 6.7% (n = 43). The prevalence of S-UTI was 6.5% (n = 38) in women with GDM and 8.6% (n = 5) in women with PGDM. In women with GDM, S-UTI occurred in 4.6% (n = 5) of insulin users compared to 6.9% (n = 33) in noninsulin users. Differences were not statistically significant.

Conclusion: The prevalence of S-UTI is similar in women with GDM and PGDM regardless of the method used for glycemic control.

Key words: Diabetes mellitus, gestational, infection, pregestational, urinary tract

INTRODUCTION

Urinary tract infection (UTI) is seen frequently in pregnant women whether they are suffering from diabetes mellitus (DM) or not. When compared with nonpregnant women and pregnant women have a two-fold increase in risk of being affected with S-UTI. This is due to the urinary stasis during pregnancy caused by anatomical and physiological changes in the urinary tract, such as pressure effect by the gravid uterus on the ureters and the relaxant effect of progesterone on the urinary tract muscles.[1]
The prevalence of S-UTI during pregnancy in nondiabetic women varies from 3% to 10.1% while in diabetic pregnant women it can be as high as 27.6%.\(^{[2-4]}\) The UTI could be either lower UTI, which could be either asymptomatic bacteriuria or acute cystitis, or the less common but more serious acute pyelonephritis. During pregnancy, there are physiological and anatomical changes that occur in the urinary tract which increases the incidence of asymptomatic bacteriuria and its progression to either acute cystitis and/or acute pyelonephritis.

In pregnant women with DM, UTI is the most commonly observed maternal infection, because in addition to the anatomical and physiological changes seen in the renal tract during pregnancy, DM usually suppresses the immune system and enhances the progression of acute cystitis to acute pyelonephritis and renal abscess. There is limited research on the incidence of S-UTI in pregnant diabetic women. However, this article is the first in the Middle East and among very few worldwide to compare the prevalence of S-UTI in GDM and pregestational diabetes mellitus (PGDM).

In this study, our aim is to determine the prevalence of S-UTI (acute cystitis or acute pyelonephritis) in pregnant women with GDM, (transient DM diagnosed during pregnancy) and PGDM (DM diagnosed prior to pregnancy) and also to determine whether the method of glycemic control has an impact on the prevalence rates.

**MATERIALS AND METHODS**

This is a retrospective review of pregnant diabetic women (GDM and PGDM) who were being monitored and delivered at Sultan Qaboos University Hospital, Muscat, Oman, between January 1, 2009, and December 31, 2010 who had S-UTI. Relevant data were retrieved from the delivery suite register and computer database. Data retrieved that were maternal age, gravidity and parity, body mass index at the initial appointment, antenatal complications and treatment options gestational age at delivery and birth weight. All apparent nondiabetic pregnant women had random blood sugar performed at the initial visit. If the blood sugar level was >7mmol/L, a 2 h 75 oral grams glucose tolerance test (OGTT) was performed. However, this test (OGTT) was performed at the initial antenatal visit for women who are known to be nondiabetic but have at relatively higher risk of developing DM due to a history of recurrent miscarriages, macrocosmic baby, fetal malformations, unexplained intrauterine fetal death, family history of DM, previous gestational diabetes, and glycosuria on two occasions.

Diagnosis of GDM was made based on hospital criteria using 75 g of glucose load and 2 h OGTT. If either fasting or 2 h blood glucose level (venous plasma glucose) exceeded 5.5 and 9 mmol/l, respectively, the woman was considered to be diabetic. Pregnant women who were not at an increased risk of developing DM, 50 g oral glucose challenge test (OGCT) was performed between 24 and 28 weeks gestation, and if blood sugar was ≥7.8 mmol/l, 75 g oral OGTT was performed. This is the criteria for screening and diagnosis of DM is adopted by SQUH.

All pregnant women had mid-stream specimen of urine sent for culture at their first antenatal visit and proper antibiotic treatment was given to those with significant bacteriuria (≥10\(^5\) colony forming units per milliliter of the same organism) whether they were symptomatic or not. All cases reviewed had symptomatic lower UTI. During the study period, there were no cases of acute pyelonephritis.

The management of DM was by diet and/or metformin or subcutaneous insulin. Glycemic control was considered satisfactory when preprandial glucose level was <5.5 mmol/L and 2 h postprandial <8 mmol/L. Long-term glycemic control was assessed by estimating glycosylated hemoglobin, and when it was <6%, glycemic control was considered satisfactory. Ultimately, all women with PGDM enrolled in this study received insulin therapy.

**Statistical analysis**

Statistical analysis was performed using Chi-square test, Mann–Whitney test and Fisher’s exact test as appropriate, the difference between values was considered significant when \( P \leq 0.05 \).

**RESULTS**

During the study period, there were 5811 deliveries, of whom, 639 women had DM (10.9%). There were 43 cases of S-UTI, and all of these cases were diagnosed as acute cystitis with significant bacteriuria; there were no cases of pyelonephritis. The overall prevalence of S-UTI among diabetic pregnant women was 6.7%.

The majority of pregnant diabetic women had GDM 91% (\( n = 581 \)) and only 9% (\( n = 58 \)) had PGDM. This is due to the fact that pregnancy is diabetogenic due to the rising levels of various hormones during pregnancy, mainly human placental lactogen. Of the 43 cases of S-UTI reported during the study period, 6.5% (\( n = 38 \)) was identified in women with GDM and 8.6% (\( n = 5 \)) in women with PGDM. The difference between the two groups was not statistically significant.
The demographic characteristics of diabetic pregnant women who developed UTI are shown in Table 1. There were no significant differences in maternal age, gravidity, parity and body mass indices between women with GDM and PGDM. Women with PGDM delivered at a significantly lower gestational age compared with women with GDM ($P = 0.04$) and subsequently their babies had a significantly lower birth weight ($P = 0.02$).

Table 2 shows that there were no significant differences with respect to antenatal complications such as hypertension and preeclampsia, polyhydramnios, malpresentation, abnormal lie, and prelabor rupture of membrane between women with GDM and PGDM.

In women with GDM, glycemic control was achieved with diet and or metformin in 81.4% ($n = 473$); in this group there were 33 cases of S-UTI (6.9%). Insulin administration was necessary to achieve glycemic control in 18.6% ($n = 108$); in this group, there were five cases of S-UTI (4.6%). The differences between the two groups were not statistically significant. Since this is a retrospective study, statistical data on glycemic control in the two groups were not available.

Out of 58 women with PGDM, 86.2% ($n = 50$) had Type 2 DM while only 13.8% ($n = 8$) had Type 1 DM. There were four cases of S-UTI in women with Type 2 DM (8%) while there was only one case of UTI in a woman with Type 1 DM. The difference between the two groups was not statistically significant.

**DISCUSSION**

DM is the most common chronic disease in the Omani population. It has been estimated that the DM affects about 12% of the population and equally affects males and females.[5] In Oman, nearly 3% of pregnant women have developed GDM by the time of delivery.[6] In the United Arab Emirates, GDM complicates approximately 5% of pregnancies.[7]

In this study, GDM complicated 10.9% of pregnancies, which may be due to the strict diagnostic criteria (either fasting > 5.5, and or 2 h post 75 g of glucose > 9 mmol/l). Those relatively low cut off fasting glucose levels may be responsible for including many pregnant women in the category of GDM, this also may explain that majority of women in this category, their glycemic control was achieved by either diet alone and or metformin 81.4% ($n = 473$), while only 18.6% ($n = 108$) required insulin therapy. Pregnant diabetic women, whether they had either GDM or PGDM are at an increased risk of antenatal complications including symptomatic and asymptomatic UTI.[8] In this study, the predominant type of DM was GDM, while a minority of the women had PGDM (91% and 9%, respectively). DM adversely affects pregnancy outcomes such as preeclampsia, preterm labor, and cesarean delivery, as well as low mean birth weight (PGDM with microvascular involvement), and macrocosmic babies.[9,10] Diabetic women are predisposed to an increased risk of developing UTI; this predisposition results from many factors such as glycosuria, adherence of bacteria to the uroepithelium and dysfunction of the immune system.[12]

The overall prevalence of UTI in diabetic pregnant women was 6.7%, which is in line with the prevalence rates reported in diabetic and nondiabetic pregnant women by Rizk in 2002.[6] In his study, S-UTI was seen in 6.6% of women with GDM and 5.3% of pregnant nondiabetic women. The difference was not statistically significant.

### Table 1: Demographic data of pregnant women with S-UTI, GDM versus PGDM

| Demographic feature | S-UTI and GDM ($n=30$) | S-UTI and PGDM ($n=5$) | $P$ | 95% CI |
|---------------------|------------------------|------------------------|-----|--------|
| Age (years)         | 30.1±5.6*              | 34.0±8.4               | 0.17 | −1.79-9.59 |
| Gravidity           | 4.1±3.2                | 6.8±5.7                | 0.11 | −0.68-6.08 |
| Parity              | 2.3±2.8                | 5.2±5.1                | 0.056 | −0.07-5.85 |
| BMI (kg/m²)         | 33.2±6.56              | 33.0±5.30              | 0.94 | −0.39-5.99 |
| Gestational age at birth | 37.9±2.8              | 34.8±5.2               | <0.0001 | 143.45-21.94 |
| Birth weight (g)    | 3044±735               | 2175±1038              | 0.12 | −1593.8-198.20 |

*Values are mean±SD; SD—Standard deviation; S-UTI—Symptomatic urinary tract infection; GDM—Gestational diabetes mellitus; PGDM—Pregestational diabetes mellitus; CI—Confidence interval; BMI—Body mass index

### Table 2: Antenatal complications of women with S-UTI, GDM versus PGDM

| Complication                      | S-UTI and GDM ($n=38$) | S-UTI and PGDM ($n=5$) | $P$ | OR (95% CI) |
|-----------------------------------|------------------------|------------------------|-----|-------------|
| Hypertension and preeclampsia, $n$ (%) | 4 (10.50)              | 2 (40)                 | 0.355 | 5.6 (0.71-44.81) |
| Polyhydramnios, $n$ (%)           | 2 (5.25)               | 1 (20)                 | 0.316 | 4.5 (0.329-61.43) |
| Malpresentation and abnormal lie, $n$ (%) | 2 (5.25)               | 2 (40)                 | 0.06 | 12.0 (1.29-118.17) |
| PROM, $n$ (%)                     | 0 (0)                  | 1 (20)                 | 0.116 | 25.6 (0.903-729.43) |

S-UTI—Symptomatic urinary tract infection; GDM—Gestational diabetes mellitus; PGDM—Pregestational diabetes mellitus; OR—Odds ratio; CI—Confidence interval; PROM—Prelabour rupture of membrane
In this study, the prevalence of S-UTI in GDM women was lower than in PGDM women (6.5% and 8.6%, respectively). Although this difference was not statistically significant, the majority of women had GDM and their glycemic control was achieved by diet and or metformin. This indicates that they were mildly diabetic, which resulted in relatively fewer S-UTI cases in this group.

In women with GDM, the prevalence of S-UTI in women treated with diet and or metformin was more than in women treated with insulin (6.9% and 4.6%, respectively). Although the difference was not statistically significant, it may show that insulin therapy may have achieved better glycemic control than diet and or metformin.

CONCLUSION

In this study, no cases of acute pyelonephritis were diagnosed because all pregnant women had mid-stream specimen of urine sent for culture at their first antenatal visit and proper antibiotic treatment was given to those with significant bacteriuria whether they are symptomatic or not. Acute pyelonephritis was reported in 21% and 35% in pregnant women with untreated asymptomatic bacteriuria.[13,14]

Limitations

The main limitation of this study is the relatively small number of cases, but we may be able to conclude that in well controlled DM in pregnant diabetic women, the prevalence of S-UTI is similar in women with GDM and PGDM regardless of the method used for glycemic control.

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Conflicts of interest

There are no conflicts of interest.

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