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Original Article

Teenage pregnancy in type 1 diabetes mellitus

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Younger maternal age at delivery has been linked to adverse reproductive outcomes. Pregnancy complicated by type 1 diabetes mellitus (T1DM) is also associated with adverse pregnancy outcomes. Optimising diabetic glycaemic control prior to pregnancy is known to reduce the rate of congenital abnormalities and improve pregnancy outcomes. Teenage pregnancies are not usually planned and little data exist on teenage pregnancy complicated by T1DM. We sought to identify the glycemic control achieved in teenage pregnancy with T1DM and to clarify if there is an associated increase in adverse pregnancy outcomes compared to those seen in older women with T1DM.
We compared outcomes in 18 teenagers (TG) with 582 older women with T1DM (CON) from 1995–2007. TG booked to the combined diabetes-obstetrical service at a median gestational age of 11 weeks (range 6–22) compared to 7 weeks in CON (range 4–40, $p < 0.02$). Glycaemic was worse in TG compared to CON at 13, 26 and 35 weeks gestation, despite higher insulin doses. First trimester miscarriage rate did not differ between groups. Major congenital anomaly rate was 6.2% (1/16) compared to 3.2% in CON. This preliminary study has demonstrated that pregnant teenage women with T1DM book later to specialised care and have worse glycaemic control in pregnancy compared to older women with T1DM. This group also appear to be more insulin resistant than older women in early pregnancy. Our data would suggest that teenagers with type 1 diabetes mellitus may constitute a high-risk group for adverse pregnancy outcomes.

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Introduction

Younger maternal age at delivery has been linked to adverse reproductive outcomes (1). In particular, children of young mothers (aged 13–19) have a lower birth weight and are more likely to be born prematurely when compared to offspring of older women (aged 20–24). This association between young maternal age and adverse outcomes was independent of socio-demographic factors (1). Ireland has a relatively low teenage pregnancy rate (26 per 1000 of 15–19 yr olds in 2002) in comparison to Scotland (47 per 1000), England and Wales (53 per 1000) and the USA (64 per 1000) (2).

Pregnancy complicated by type 1 diabetes mellitus (T1DM) is also associated with adverse pregnancy outcomes (2). Despite attempts to optimise glycaemic control throughout pregnancy, adverse events, including congenital malformations and perinatal mortality, remain higher than seen in the general population in most studies of women with type 1 and 2 diabetes (3–6).

Optimising diabetic glycaemic control prior to pregnancy is known to reduce the rate of congenital abnormalities and improve pregnancy outcomes (7).

Specialised prepregnancy clinics are available in many centres to ensure adequate glycaemic control of T1DM at conception in those women with T1DM who plan their pregnancies. Even in unplanned pregnancies, booking as early as possible in pregnancy to a combined sub-specialist diabetes/obstetrical clinic is essential in order to optimise diabetes control as quickly as possible during the critical period of organogenesis.

Teenage pregnancies are not usually planned and little data exist on teenage pregnancy complicated by T1DM. We sought to identify the degree of glycaemic control achieved in pregnancy by teenagers with T1DM and to clarify if there is an associated increase in adverse pregnancy outcomes compared to those seen in older women with T1DM in pregnancy.

Study design and methods

A computerised clinical database is maintained on all women with T1DM in pregnancy attending at three University maternity teaching hospitals in Dublin (approximately 23 000 total deliveries/year) since 1995. Care is delivered to all pregnant women with T1DM in these hospitals by a single team of endocrinologists (RF, BTK, MMB), and a specific obstetrical team at each clinic site. Care is delivered in a combined diabetes/obstetrical outpatient clinic.

All women with T1DM are treated with similar treatment protocols of multiple daily insulin regimes using a combination of rapid acting insulins, insulin analogues and intermediate insulin Neutal Protamine Hagedorn (NPH) premeals and at bedtime or using continuous subcutaneous insulin infusion (CSII) therapy. Insulin regimes consist of short acting insulin or insulin analogues premeals and NPH insulin up to four times a day (premeals and bedtime). Those patients already on CSII are continued on pump therapy. All women perform home blood glucose monitoring (HBGM) seven times daily (before and 1-h postmeals and at bedtime). Glucose goals are fasting, premeal and bedtime readings of < 5.0 mmol/L, and 1-h postmeal readings of < 7.0 mmol/L. HBGM readings are reviewed once or twice weekly and insulin doses adjusted by the endocrine team. Glycohemoglobin (HBAlc) is checked monthly throughout pregnancy. HBA1c within the normal range is the goal of treatment (i.e., non-diabetic range 4.5–5.9%) (8). Serum fructosamine corrected for albumin is checked at each clinic visit. Again the goal range for our assay is a fructosamine value corrected for albumin of below 250 μmol/L (normal range is 205–285 μmol/L in our laboratories) (9). All women have access to dietetic service and diabetes nurse educator as part of their standard care.

Pregnancy outcomes recorded included miscarriage rate, pre-eclampsia rate, caesarean section rate, birth weight, gestation at delivery, congenital abnormality rate and perinatal mortality rate. Data on maternal age at booking, gestation at booking, duration of diabetes mellitus, insulin dose (at baseline and delivery), HbA1c (at baseline, week 13, week 26 and week 36) and age were recorded. Results are expressed as means ± standard deviation unless otherwise indicated.

Data were entered into an Excel spreadsheet and the statistical methods used for comparison between groups included Student t-test, Wilcoxon/Mann–Whitney U test, chi-squared test or Fisher's Exact test as appropriate. Statistical significance was considered at $p < 0.05$.

Results

Demographics

Data were available on 590 singleton pregnancies in women with pre-existing T1DM from 1995 to 2007. Eighteen of these women were aged 19 yr or less at booking to the combined obstetric and diabetes antenatal clinics giving a prevalence of teenagers amongst pregnant women with type 1 diabetes of 18/590 (3.1%). The teenage group (TG) had a mean age of 17.9 ± 1.1 yr while the older mothers [control group (CON)] had a mean age of 31.0 ± 4.9 yr. Thirty-one women in CON were treated with CSII. No women in TG was using CSII. The median duration of diabetes since diagnosis was 9 yr in TG (range 4–15) compared to 13 yr in CON (range 0.5–37, $p < 0.001$) respectively. TG presented to the combined diabetes/obstetrical service at a median gestational age at booking of 11 weeks (range 6–22) compared to 7 weeks in CON (range 4–40, $p < 0.02$) (Table 1).

Table 1. Teenage pregnancy complicated by T1DM; Demographics, glycaemic control, pregnancy outcomes and obstetric complications

	Teenage group (TG) N = 18	Control group (CON) (CON)N = 572	p- value
Age (years)	17.9 ± 1.1	31.0 ± 4.9	< 0.0001
Duration of diabetes (years)	9 (4–15)	13 (0.5–37)	< 0.001
Booking gestation (weeks)	11 (6–22)	7 (4–40)	< 0.02
Fructosamine			
Baseline	349 ± 57	339 ± 69	t NS
13 weeks gestation	331 ± 32	286 ± 43	< 0.001
26 weeks gestation	299 ± 37	264 ± 38	< 0.005
36 weeks gestation	256 ± 32	238 ± 30	< 0.05
Miscarriage	2	83	NS
Gestational age at birth (weeks)	38.1 ± 1.6	38.2 ± 2.3	NS
Term infant weight	3.94 ± 0.66	3.76 ± 0.57	NS
PET	4/18 (22%)	62/572 (11%)	NS
C section	6/16 (38%)	240/489 (49%)	NS
Major congenital abnormality	1/16 (6.25%)	15/489 (3.1%)	NS
Perinatal death	0	17/489 (3.4%)	NS

NS, Not significant; PET, pre-eclamptic toxaemia; T1DM, type 1 diabetes mellitus.

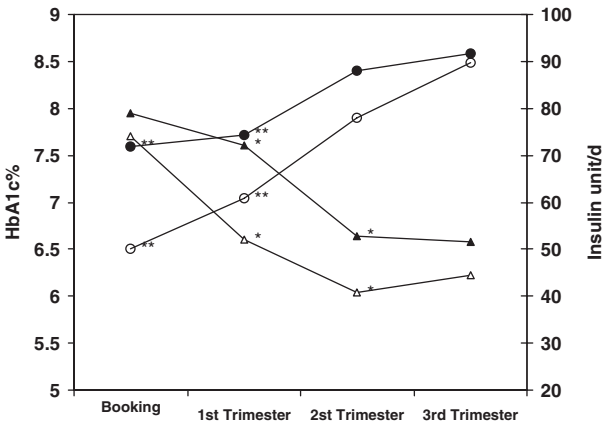

Fig. 1. HBA1c levels in the teenage pregnancy group (▲) vs. HBA1c levels in the older pregnancy group (Δ) $*p < 0.05$ between groups. Daily insulin dose in teenage pregnancy group (●) compared to daily insulin dose in older pregnancy group (○). ** $p < 0.05$ between groups.

Glycaemic control and insulin dose

Glycaemic control at booking was similar between groups with HbA1c of 8.0 ± 1.4% in TG vs.7.7 ± 1.5% [p = not significant (NS)] in CON. However, HbA1c was higher in TG compared to CON for the remainder of pregnancy. At week 13, HbA1c was 7.6 ± 1.1% vs. 6.6 ± 1.0% ($p < 0.02$). At week 26, TG had a HbA1c of 6.6 ± 0.7% vs. 6.0 ± 0.9% ($p < 0.01$). In late pregnancy (36 weeks), the TG had a HbA1c 6.6 ± 0.8% vs. 6.2 ± 0.9 (p = 0.12) (Fig. 1). Corrected fructosamine values are shown in Table 1.

Total insulin doses were higher in TG compared to CON at booking (71.9 ± 21.2 units/d vs. 50.2 ± 19.0 units/d, $p < 0.001$) and at 13 weeks gestation (74 ± 17 units/d vs. 61 ± 25 units/d, $p < 0.05$. Total insulin doses did not differ between groups at 26 weeks and 36 weeks gestation (Fig. 1).

Pregnancy and perinatal outcomes

There were 2/18 (11%) first trimester spontaneous abortions (miscarriage) in TG compared to 83/590 (14%) in CON group. The rate of caesarian section was high in both groups [TG = 6/16(38%), CON = 240/489 (49%)]. Gestational age at delivery did not differ between groups (38.1 ± 1.6 in TG vs. 38.2 ± 2.3 weeks in CON). There was a trend to a higher rate of pre-eclamptic toxaemia (PET) in TG vs. CON (22% vs. 11%). Mean birth weight was greater in TG vs. CON (3.94 ± 0.66 vs. 3.76 ± 0.57 kg) but this did not reach statistical significance.

There was one major congenital anomaly in TG. A 16-yr old primigravida presented to the combined clinic at 12 weeks gestation and a baseline HBA1c of 9.6%. Her control was suboptimal throughout pregnancy with a HBA1c nadir of 7.4% and a delivery HBA1c of 7.7%. She delivered a male infant weighing 3.71 kg at 38 weeks with spinal stenosis and sacral agenesis. Major congenital anomaly rate in TG was 1/16 (6.2%) compared to 15/489 (3.1%) in CON. Perinatal mortality rate was 0/16 in TG compared to 17/489 (3.5%) in CON (Table 1). The average yearly congenital malformation rate for all women delivering in Dublin was 1.8% from 1997 to 2006 (10).

Discussion

Teenage pregnancy and T1DM in pregnancy are associated with adverse pregnancy outcomes (1, 3, 4, 11). Little data exist on teenage pregnancy in women with T1DM. To identify if teenage pregnancy in women with T1DM constituted a high-risk group for adverse outcomes, we compared glycaemic control and pregnancy outcomes in pregnant teenagers with T1DM with older mothers with T1DM in pregnancy. All women attended a sub-specialist diabetic/obstetrical service offering intensive management of T1DM in pregnancy, and care was delivered by a single team of endocrinologists.

Our data on a relatively small number of teenage pregnancies with T1DM show that when compared to older women with T1DM in pregnancy the TG booked later for care, had worse glycaemic control throughout pregnancy (although not at initial booking), and had higher doses of insulin until the end of the first trimester. There was a trend to a higher birth weight in the TG with one major congenital abnormality.

Late booking to specialist care in the TG is due to the fact that pregnancy in teenagers with diabetes is likely to be unplanned. Late booking among young women has been demonstrated previously (12). This may be due to young women failing to take pregnancy tests at an early gestational age compared to older women (13).

However, the consequences of the delay in booking seen in the TG with T1DM (median 12 weeks) in contrast to teenage pregnancies of women without diabetes is that many of this group do not access specialist care until after the period of organogenesis in the first 8 weeks of pregnancy. Thus the limited time to optimise glycaemic control in these subjects is missed. This may be reflected in a high rate of congenital abnormalities in this group as seen by one case of major congenital anomaly among 16 teenage pregnancies in our study. Many teenagers with T1DM may be unaware of the importance of strict glycaemic control early in pregnancy. This has been demonstrated in women with T1DM who have unplanned pregnancies (14).

Many studies exist showing poor glycaemic control among non-pregnant teenagers with T1DM. A recent study showed poor clinic attendance among young patients with T1DM (15). In this study, Saunders et al.

found that 23.8% of patients in their young patient clinic failed to attend for over 2 yr. Average HbA1c was 9.2% with only 3.8% of patient in their cohort achieving a HbA1c < 7%. Morris et al. for the DARTS/MEMO group reported poor glycaemic control and failure to adhere to prescribed insulin doses (16). In teenagers this would appear to be an even more pronounced phenomenon.

Glycaemic control throughout pregnancy was worse in our TG despite higher insulin doses until week 36 of gestation (Fig. 1). HBA1c levels differed by up to 1% at 13 weeks gestation. With intensive management of both groups this gap is narrowed to a 0.4% difference in HbA1c.

Insulin doses were higher in our TG at booking and until the end of the first trimester despite worse glycaemic control, as seen in the significantly higher HBA1c levels in the TG at 13 weeks gestation. There is evidence of increased insulin resistance in young adults with T1DM (17). As the mean mean age of TG was 17.9 ± 1.1 yr, increased insulin resistance associated with puberty is not likely to be in anyway responsible for the higher doses of insulin. The difference in insulin dose persists when corrected for HbA1c, booking gestation and when women treated with CSII are excluded.

Insulin omission or poor compliance with dietary regimens may explain these data. Previous studies of young non-pregnant subjects with T1DM have shown that insulin omission is common (18). Insulin omission may be especially common in young women (19). Insulin omission and poor dietary adherence cannot be ruled out in our group, but given the high degree of motivation among pregnant women with T1DM to optimise pregnancy outcomes, insulin omission is less likely compared to a non-pregnant group. The combination of poor glycaemic control despite higher insulin doses may explain the trend to a higher birth weight seen in our TG. Infants born to teenage mothers have been shown to have a lower than average birth weight (1). This lower birth weight was not seen in the infants of teenage mothers with T1DM.

There was a trend to a higher rate of PET in the teenage pregnant group. Nulliparous young women are at increased risk of this condition (20) as are women with T1DM in pregnancy (20).

This preliminary study has demonstrated that pregnant teenage women with T1DM book later to specialised care and have worse glycaemic control in pregnancy compared to older women with T1DM. This group also appears to be more insulin resistant than older women in early pregnancy and this may result in a delay in optimising insulin doses at this critical stage. Pregnant teenagers with T1DM may have increased rates of macrosomia and higher rates of PET than the older women with T1DM in pregnancy.

In a recent study, Charron-Prochownic et al. concluded that having diabetes mellitus did not significantly decrease risk-taking behaviour of teenagers regarding unplanned pregnancy (21). Therefore teenage girls and young women with T1DM should be educated about the risks of unplanned pregnancy and the importance of pregnancy avoidance. There is evidence that formal education in this area may be effective in reducing teenage pregnancy in this group (22). Teenage girls with T1DM should also be aware of the critical importance of early booking to specialised care in the event of an unplanned pregnancy. All women of reproductive age with T1DM should be made aware of the importance of glycaemic control in early pregnancy and have the option of attending a prepregnancy service.

While some recent studies have suggested that outcomes for teenage pregnancy in the non-diabetic population are as good as for older mothers (23), our data would suggest that young women with T1DM may constitute a high-risk group for adverse pregnancy outcomes.

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