Gestational diabetes: what's up?

Kerstin E. Berntorp^{1,2}

Received: 3 November 2015 / Accepted: 30 March 2016 / Published online: 12 May 2016
© Springer-Verlag Berlin Heidelberg 2016

Keywords Fetal over-nutrition · Gestational diabetes · Macrosomia · Maternal obesity · Metabolic syndrome · Prevention · Treatment · Type 2 diabetes

Abbreviation

GDM Gestational diabetes mellitus

Gestational diabetes mellitus (GDM), until recently defined as any degree of hyperglycaemia first detected in pregnancy [1], is a growing public health concern [2]. The prevalence of GDM shows an increasing trend in most racial/ethnic groups and parallels the global epidemic of obesity and type 2 diabetes [3]. GDM and type 2 diabetes have many risk factors in common and they share the same genetic susceptibility [4, 5]. Both are characterised by insulin resistance and an inability of the beta cells to compensate with a sufficient increase in insulin secretion [4]. Although glucose tolerance usually reverts to normal after delivery, affected women remain at high risk of developing type 2 diabetes during their lifetime, with an estimated lifetime risk of about 50–70% [6]. In addition to hypertensive pregnancy disorders [4], GDM is associated with dyslipidaemia and other components of the metabolic syndrome [7], and if present, an increased risk of cardiovascular disease [8].

GDM and maternal obesity are independently associated with adverse pregnancy outcomes, and children born to mothers with GDM and overweight/obesity are more likely to be macrosomic and large for their gestational age [9–11]. In addition to short-term complications, they also have an increased risk of long-term complications similar to those in their mothers [12, 13]. Studies indicate that offspring exposed to maternal diabetes or GDM in utero are at a higher risk of developing childhood obesity and glucose intolerance in early adulthood than offspring not exposed to maternal diabetes [12, 14]. Moreover, if the offspring is female, she is more likely to develop GDM herself and thereby create a vicious circle. Prevention of GDM and fetal over-nutrition in pregnancy could therefore be important strategies to interrupt this trans-generational cycle of obesity and diabetes (Fig. 1).

To date, several studies have demonstrated the effectiveness of lifestyle interventions in the prevention of type 2 diabetes [15]. A beneficial effect on the risk of diabetes was also found in the Diabetes Prevention Program in women with a history of GDM, which was sustained during a 10-year follow-up period [16]. Since obesity is one of the most powerful modifiable risk factors for GDM in pregnant women [12, 17], many intervention studies have focused on reducing weight or on reducing gestational weight gain in pregnancy, most often by changes in diet and physical activity. The effects of combined diet and exercise interventions during pregnancy were recently reviewed by Cochrane [18]. No clear evidence for the prevention of GDM was found. In contrast, a newly published meta-analysis concluded that moderate exercise programmes initiated early during pregnancy reduce the risk of GDM and excessive gestational weight gain [19]. Ideally, interventions aimed at improving metabolic conditions and placental function in obese women should take place before pregnancy, prior to conception [20]. Interestingly, Zhang et al recently reported that adherence to a healthy lifestyle in the

---

✉ Kerstin E. Berntorp
kerstin.berntorp@med.lu.se

¹ Department of Clinical Sciences Malmö, Lund University, Malmö, Sweden

² Department of Endocrinology, Skåne University Hospital, SE-205 02 Malmö, Sweden

Fig. 1 Interrupting the trans-generational vicious circle of diabetes and obesity by prevention and treatment

period before pregnancy was associated with a lower risk of GDM, independently of its benefit on body weight [21]. However, it remains to be demonstrated whether prevention of GDM reduces fetal overgrowth and the risk of diabetes and obesity in the offspring.

Treatment of GDM has been shown to be successful in preventing major perinatal and maternal complications and in reducing fetal growth [22]. It has been hypothesised that treatment of mild GDM reduces the risk of obesity in the child. However, follow-up of two randomised controlled studies of intensive treatment of mild GDM during pregnancy did not show any effect on BMI in offspring at 4–5 and 5–10 years of age [23, 24]. A longer follow-up time is possibly required to fully test the impact of antepartum maternal glycaemic control on the long-term risk of obesity in the offspring.

In the following articles, the consequences of GDM for the mother and her offspring and the effects of prevention and treatment of GDM are discussed in greater detail. Marja Väärasmäki provides an update on whether GDM is worth treating [25], Cuilin Zhang et al, discuss whether prevention of GDM is possible [26], and Peter Damm et al review the long-term consequences of GDM [27].

Duality of interest The author declares that there is no duality of interest associated with this manuscript

Contribution statement The author was the sole contributor to this paper.

References

- World Health Organization (2013) Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy. WHO, Geneva
- Guariguata L, Linnenkamp U, Beagley J, Whiting DR, Cho NH (2014) Global estimates of the prevalence of hyperglycaemia in pregnancy. *Diabetes Res Clin Pract* 103:176–185
- Hunt KJ, Schuller KL (2007) The increasing prevalence of diabetes in pregnancy. *Obstet Gynecol Clin N Am* 34(173–199):vii
- Ben-Haroush A, Yegorov Y, Hod M (2004) Epidemiology of gestational diabetes mellitus and its association with type 2 diabetes. *Diabet Med* 21:103–113
- Mao H, Li Q, Gao S (2012) Meta-analysis of the relationship between common type 2 diabetes risk gene variants with gestational diabetes mellitus. *PLoS One* 7:e45882
- Kim C, Newton KM, Knopp RH (2002) Gestational diabetes and the incidence of type 2 diabetes: a systematic review. *Diabetes Care* 25:1862–1868
- Brewster S, Zinman B, Retnakaran R, Floras JS (2013) Cardiometabolic consequences of gestational dysglycemia. *J Am Coll Cardiol* 62:677–684
- Harreiter J, Dovjak G, Kautzky-Willer A (2014) Gestational diabetes mellitus and cardiovascular risk after pregnancy. *Women's Health* 10:91–108
- HAPO Study Cooperative Research Group (2010) Hyperglycaemia and Adverse Pregnancy Outcome (HAPO) Study: associations with maternal body mass index. *BJOG* 117:575–584
- Catalano PM, McIntyre HD, Cruickshank JK et al (2012) The hyperglycemia and adverse pregnancy outcome study: associations of GDM and obesity with pregnancy outcomes. *Diabetes Care* 35:780–786
- Wahabi HA, Fayed AA, Alzeidan RA, Mandil AA (2014) The independent effects of maternal obesity and gestational diabetes on the pregnancy outcomes. *BMC Endocr Disord* 14:47
- Moore TR (2010) Fetal exposure to gestational diabetes contributes to subsequent adult metabolic syndrome. *Am J Obstet Gynecol* 202:643–649
- Dabelea D, Crume T (2011) Maternal environment and the transgenerational cycle of obesity and diabetes. *Diabetes* 60:1849–1855
- Crume TL, Ogden L, West NA et al (2011) Association of exposure to diabetes in utero with adiposity and fat distribution in a multiethnic population of youth: the Exploring Perinatal Outcomes among Children (EPOCH) Study. *Diabetologia* 54:87–92
- Dunkley AJ, Bodicoat DH, Greaves CJ et al (2014) Diabetes prevention in the real world: effectiveness of pragmatic lifestyle interventions for the prevention of type 2 diabetes and of the impact of adherence to guideline recommendations: a systematic review and meta-analysis. *Diabetes Care* 37:922–933
- Aroda VR, Christophi CA, Edelstein SL et al (2015) The effect of lifestyle intervention and metformin on preventing or delaying diabetes among women with and without gestational diabetes: the Diabetes Prevention Program outcomes study 10-year follow-up. *J Clin Endocrinol Metab* 100:1646–1653
- Torloni MR, Betran AP, Horta BL et al (2009) Prepregnancy BMI and the risk of gestational diabetes: a systematic review of the literature with meta-analysis. *Obes Rev* 10:194–203

18. Bain E, Crane M, Tieu J, Han S, Crowther CA, Middleton P (2015) Diet and exercise interventions for preventing gestational diabetes mellitus. *Cochrane Database Syst Rev*, Issue 4, Art. No.: CD010443. doi:[10.1002/14651858.CD010443.pub2](https://doi.org/10.1002/14651858.CD010443.pub2)
19. Sanabria-Martinez G, Garcia-Hermoso A, Poyatos-Leon R, Alvarez-Bueno C, Sanchez-Lopez M, Martinez-Vizcaino V (2015) Effectiveness of physical activity interventions on preventing gestational diabetes mellitus and excessive maternal weight gain: a meta-analysis. *BJOG* 122:1167–1174
20. Catalano P, deMouzon SH (2015) Maternal obesity and metabolic risk to the offspring: why lifestyle interventions may have not achieved the desired outcomes. *Int J Obes* 39:642–649
21. Zhang C, Tobias DK, Chavarro JE et al (2014) Adherence to healthy lifestyle and risk of gestational diabetes mellitus: prospective cohort study. *BMJ* 349:g5450
22. Falavigna M, Schmidt MI, Trujillo J et al (2012) Effectiveness of gestational diabetes treatment: a systematic review with quality of evidence assessment. *Diabetes Res Clin Pract* 98:396–405
23. Gillman MW, Oakey H, Baghurst PA, Volkmer RE, Robinson JS, Crowther CA (2010) Effect of treatment of gestational diabetes mellitus on obesity in the next generation. *Diabetes Care* 33: 964–968
24. Landon MB, Rice MM, Varner MW et al (2015) Mild gestational diabetes mellitus and long-term child health. *Diabetes Care* 38: 445–452
25. Väärasmäki M (2016) Is it worth treating gestational diabetes: if so, when and how? *Diabetologia*. doi:[10.1007/s00125-016-3976-6](https://doi.org/10.1007/s00125-016-3976-6)
26. Zhang C, Rawal S, Chong YS (2016) Risk factors for gestational diabetes: is prevention possible? *Diabetologia*. doi:[10.1007/s00125-016-3979-3](https://doi.org/10.1007/s00125-016-3979-3)
27. Damm P, Houshmand-Oeregaard A, Kelstrup L, Lauenborg J, Reinhardt Mathiesen E, Dalsgaard Clausen T (2016) Gestational diabetes mellitus and long-term consequences for mother and offspring: a view from Denmark. *Diabetologia*. doi:[10.1007/s00125-016-3985-5](https://doi.org/10.1007/s00125-016-3985-5)