HKCOG Guidelines

Number 7
Part 1

July 2008

Guidelines for the Management of Gestational Diabetes Mellitus
Part 1 – Screening and Diagnosis

published by The Hong Kong College of Obstetricians and Gynaecologists
A Foundation College of Hong Kong Academy of Medicine

1 RATIONALE FOR THE SCREENING OF GESTATIONAL DIABETES MELLITUS (GDM) IN HONG KONG

1.1 It has been shown by a study in a multiethnic population that there is increasing prevalence of GDM across all ethnic groups when the same Oral Glucose Tolerance Test (OGTT) and diagnostic approach was applied [1].

1.2 Studies conducted in multiethnic societies in North America, England, and Australia have all indicated that irrespective of the type of OGTT, Asians and Chinese have the highest prevalence of GDM [1-6].

1.3 Recent international recommendations on the screening of GDM have emphasized the need for screening in Asians irrespective of other additional risk factors [7-9].

1.4 There is now clear evidence in the literature for an association between GDM and increased obstetrical and perinatal complications. While the incidences of different complications may vary among different studies, increased risk of certain complications has been consistently reported in the literature. These complications include pre-eclampsia / pregnancy-induced hypertension, preterm birth, urinary tract infection, antepartum haemorrhage, caesarean delivery, neonatal polycythaemia and hyperbilirubinaemia, perinatal infection, birth asphyxia, birth trauma and increased fetal size [1,10-15]. Furthermore, treatment can improve perinatal outcome and reduce mortality rates [1,5,13]. The effect of treatment on the reduction of serious perinatal morbidity has been confirmed in the most recent study by Crowther et al [16].

1.5 There has been limited data from Hong Kong to allow an adequate assessment of the effect of GDM on pregnancy. In the annual statistics of the Department of Obstetrics and Gynaecology, The University of Hong Kong, there has been a progressive increase in the prevalence of GDM. Using the original World Health Organization (WHO) criteria [17], the prevalence of GDM increased progressively from 5.9% in 1988 to 10.8% in 2002. A study performed in the Prince of Wales Hospital, also using the WHO criteria, had found that the prevalence of GDM was 14.2% [18]. Thus there can be little dispute that GDM has become one of the most common, if not the commonest, medical complication during pregnancy in Hong Kong.

1.6 A number of local studies that focused on diet-treated GDM have recently been published. The findings indicated that the impact of mild GDM in Chinese women is similar to that reported in the literature, and included increased incidence of preterm birth,

pre-eclampsia, urinary tract infection, large-for-gestational age infants, neonatal jaundice requiring treatment, and admission into the neonatal unit [19-21]. Moreover, GDM remains to be one of the leading causes of stillbirth [22]. These effects were found despite the instigation of treatment. These findings implied that if treatment was to be withheld, or that the diagnosis were not made, the pregnancy outcome would have been much worse. Such a concept is consistent with the finding that treatment reduces serious perinatal morbidity [16] and stricter control of GDM has improved perinatal outcome [13]. Thus the diagnosis and treatment of GDM is one of the effective means of maintaining a high standard of obstetric care in Hong Kong.

2 SCREENING OF GDM

2.1 Rationale for screening

The majority of the women with GDM remains asymptomatic, and only a small percentage display complications or features suggestive of GDM. Furthermore, these features tend to be late signs of the effect of GDM, and subsequent treatment may not be effective in time to prevent or reduce the occurrence of complications. In view of the high prevalence of GDM, screening is the only effective way of identifying those who are affected in time for treatment.

2.2 Screening by risk factors

It is already an established practice that women at high-risk of GDM are tested for glucose intolerance during pregnancy. Hence the identification of risk factors constitutes a form of screening. Among the risk factors identified in the literature, ethnicity appears to be the most significant, and various recommendations all stated that Asians constituted such a high risk category that they should undergo screening irrespective of the other risk factors such as maternal age [7-9]. This would imply that the almost the entire obstetric population in Hong Kong should be tested, following the primary screening by ethnicity, with the OGTT. Indeed, in the Department of Obstetrics & Gynaecology, The University of Hong Kong, universal screening for GDM with the oral glucose tolerance test (OGTT) has become the protocol since 2003. However, a very high risk group can be further targeted using a combination of classical risk factors such as advanced age and obesity, together with other newly reported risk factors, to enable an early diagnosis of GDM to be made. Since women with these risk factors can be considered as having positive screening, they should proceed directly to the diagnostic OGTT. The risk factors for GDM [3, 5, 9, 14, 19-21, 23-29] are listed in Appendix 1.

2.3 Screening by maternal blood glucose measurement

For the majority of the local obstetric population, there may not be any risk factor other than ethnicity. In this case, some form of biochemical test is necessary. The testing of glycosuria is not acceptable as a screening test. An acceptable screening test must involve the estimation of blood glucose in one of the following forms: (Appendix 2).

2.3.1 Random glucose screening

This is used in several obstetric units in Hong Kong (Appendix 2). The postprandial glucose level is not influenced by gestation at testing [30,31]. In the

recent recommendation of the WHO consultation [8] a random capillary plasma glucose (RCPG) of ≥ 12.2 mmol/L is classified as "diabetes likely", and RCPG of < 5.5 mmol/L is "diabetes unlikely". In a study on a non-pregnant Asian population, 4.7% of subjects with RCPG <6.1 mmol/L and 19.7% of subjects with RCPG between 6.1 and <13.3 mmol/L had diabetes [32]. Nevertheless, while women with GDM had significantly higher random glucose level than the women with positive screening but normal OGTT, who in turn had higher random glucose level than the women with negative screening [21], the validity of a random glucose measurement for screening has not been thoroughly tested in prospectively studies. Using the RCC curve, a local study has shown that the random glucose is inferior to both the glucose challenge test and the fasting glucose with the optimal cutoff value set at 4.7 mmol/L as guided by the Youden index [33]. The advantage of the random glucose test is that it is convenient for both the patients and doctors, and a high enough random glucose value alone can be diagnostic of GDM [8].

2.3.2 The 50g Glucose Challenge Test (GCT)

The GCT has been a popular test and is used in many centres especially in the U.S.A, and it is administered without regard to the time of day or the time elapsed from the last meal. In Singapore, a study on 146 patients with no risk factors suggested that using a threshold plasma glucose level of 7.1 mmol/L, 36% of them needed to undergo the 75g OGTT and the diagnostic yield was 22.6% (12/53) [34]. Using 7.8 mmol/L as the threshold value, 20% needed the OGTT and the diagnostic yield was 28.6%. The study concluded that the GCT is useful for Singaporean women and the threshold of 7.8 mmol/L is appropriate. However, when the actual data was scrutinised, the threshold of 7.8 mmol/L allowed the identification of only 67% (8 out of 12) of the women with GDM, and the merit of this approach is debatable. It has been known for some time that the glucose response is lower if the GCT is performed 1 hour after a test meal [35]. This observation was subsequently confirmed in another study that demonstrated a significantly higher glucose response when the 50g glucose load was administered in the fasting state [36]. The study concluded that the prandial state (i.e. fasting or postprandial) exerts an effect sufficient enough to alter the sensitivity and specificity of the GCT. Recently, it has been shown that the percentage of women with a positive screening test result was significantly higher when the GCT was done in the afternoon (31.1%) compared to the morning (17.0%) [37]. On the other hand, women with a positive screening test result in the afternoon was less likely to be diagnosed with GDM by the 75g OGTT (31.5% versus 40.0%), but a greater percentage of the total number screened in the afternoon had GDM (9.8%

versus 6.8%). It has been pointed out that since the screened positive women need to undergo an OGTT for confirmation, the diagnosis will be delayed, that the GCT is non-specific, and that some of the GCT-positive women who do have GDM will not return for the definitive GTT [38]. Women who found the glucose load for the OGTT intolerable will have difficulty with the GCT as well. The logistical problem, the possible delay in making a diagnosis, and the effects of factors like meals and timing of the test all render the test less preferable than the OGTT for the high-risk population. In Hong Kong, it has been shown that the optimal cutoff value is 7.0 mmol/L for the local population, but that there was no significant difference with either the fasting or the 2-hour postbreakfast glucose, and this non-physiological test was recommended against [33]. The recommended cutoff value for the GCT is shown in Appendix 2.

2.3.3 Fasting plasma glucose (FPG)

Fasting plasma glucose (FPG) has recently been recommended to be a more cost effective means of screening for GDM, and studies conducted in various centres with different ethnic group suggested that the OGTT can be eliminated in a significant proportion of the subjects with much cost saving [39-42]. However, there is no consensus on the cutoff value, which varied from 5.17 – 5.39 mmol/L [38], 4.5-4.9 mmol/L [39], to 4.8 mmol/L [40], and which is related to the specific value in and the type of the OGTT. One of the studies also used a FPG value of <4.4 mmol/L to run out GDM and ≥ 5.3 mmol/L to rule in GDM. In the Hong Kong Chinese, the optimal value was suggested to be 4.1 mmol/L [33]. However, another study in the same centre suggested that the FPG corresponding to a 2-hour plasma glucose value of 11.1 mmol/L was 5.6-5.8 mmol/L, and that 71.4% of women with the WHO category of diabetes mellitus will be missed if the 2-hour glucose level was not used for diagnosis [18]. While the FPG has also been recommended to replace the GCT for the screening of GDM in Hong Kong [33], the optimal cutoff value may need to be further determined. Indeed, the sensitivity of using the FPG for screening has been challenged [43]. Certainly, in an area with a high prevalence of GDM, there may not be any advantage to use the FPG for the screening of GDM.

2.3.4 2-hour postbreakfast glucose

This has been examined in the Prince of Wales Hospital and the result is comparable to that of the GCT as well as the FPG, with an optimal cutoff value set at 5.0 mmol/L[33]. However, the major problem is the accurate timing of blood sampling for outpatients, and the exercise involved in commuting to the clinic for blood sampling after breakfast could have affect the glucose level and hence its sensitivity. There is not yet

enough evidence for its application as a standard screening test.

2.4 Time of screening

2.4.1 Screening by risk factors can be done at the very first antenatal visit. The later appearance of risk factors before any biochemical screening has taken place can also be considered as positive screening, an example of which is the appearance of polyhydramnios or excessive fetal growth. Under such circumstances, we should proceed directly to the OGTT.

2.4.2 For the low-risk population, the recommended gestation for universal screening is around 24-28 weeks [7,8]. This is because the majority of women with GDM develop this condition in the last trimester. In the public hospitals of Hong Kong, the current arrangement of shared-care with the Maternal and Child Health Centres for low-risk women meant that they only return to the obstetric clinics at or after 28 weeks. Performing the screening at 28-30 weeks, together with a repeat blood count to screen for the development of anaemia, will be a more efficient approach. As well, this will reduce the chance of missing the development of GDM in the last trimester.

3 DIAGNOSIS OF GDM

3.1 By convention, the diagnosis of GDM is based on the results of the OGTT (Appendix 3).

3.2 The diagnosis can also be made on the basis of a random glucose as recommended by the World Health Organization (WHO) (Appendix 3). This may happen in the situation where GDM is strongly suspected on clinical grounds, or where an incidental finding of a high glucose level was made during investigation and monitoring for other conditions, or when the women cannot tolerate the glucose drink for the OGTT.

3.3 A number of different OGTTs are used internationally, with the oral glucose load varying from 50g to 100g. A woman should be considered to have GDM if her OGTT result has satisfied the standard diagnostic criteria published in the literature for that form of OGTT. This scenario may occur especially if the woman has the OGTT arranged by doctors other than her obstetrician. In such cases, the documentation in the medical records should include the reference cutoff values.

3.4 For women tested for the first time in pregnancy, the standard test performed should be the WHO 75g OGTT. The 75g OGTT is being increasing adopted worldwide, and the data generated in Hong Kong can be compared with those from other centres as well as with the WHO figures. In the WHO criteria [8,17], there are two categories i.e. impaired glucose tolerance (IGT) and diabetes mellitus (DM). In the WHO recommendation, both IGT and DM are included in the diagnostic spectrum of GDM. Studies outside Hong Kong have shown that the WHO 75g OGTT can identify more abnormal outcomes and missed fewer perinatal complications compared

with the 100g OGTT using the National Diabetes Data Group criterion [24, 44]. Local studies have confirmed that GDM, as diagnosed with the 75g OGTT, was similarly associated with increased maternal and perinatal morbidity [19-21] as well as preterm birth [45], despite the fact that the majority of the women belonged to the milder category of IGT. The impact of IGT on the fetus was also confirmed by another local study in which a significant biochemical effect can be found in the newborn of IGT pregnancies, with raised cord C-peptide and insulin concentrations [46]. Thus the WHO 75g OGTT is the preferred diagnostic test for GDM in Hong Kong.

3.5 In apparently "normal" women with or without a prior OGTT, the OGTT should be repeated or performed when unexpected outcomes or complications are encountered, such as unexplained fetal macrosomia (in the absence of risk factors such as postterm pregnancy, maternal obesity etc) or intrauterine death. There have been occasions when the diagnosis has been missed, or that GDM has developed very recently. The confirmation of otherwise of GDM will help the counseling of the woman and provide information for the subsequent management of the index or future pregnancy.

3.6 The use of glycosylated haemoglobin (HbA1c) in the diagnosis of GDM is not helpful because the glucose intolerance is of recent onset and cannot be reflected in the level of HbA1c, which serves as an indicator of the degree of glycaemia around 4-6 weeks before blood sampling. The measurement of HbA1c is useful when there is a need to distinguish genuine GDM from undiagnosed pre-existing diabetes, when glycaemic control is unsatisfactory; and when previously undiagnosed diabetes is thought to be the cause of stillbirth, infant macrosomia, and congenital anomalies, in the index pregnancy.

4 RECOMMENDATION

4.1 All low-risk pregnant women of Asian origin attending the antenatal clinics of Hong Kong should ideally be screened for gestational diabetes mellitus at between 24-30 weeks gestation, i.e. universal screening should be considered in Hong Kong.

4.2 For Asian/Chinese women without the aforementioned risk factors, the method of screening should be standardized and in the form of either a 50g GCT or a FPG. In an urgent situation, such as the late presentation of obstetric complications that could be related to GDM, a random glucose screening may also be helpful. An abnormal screening result should be followed by the 75g OGTT in order to establish or rule out the diagnosis of GDM.

4.3 Women with risk factor(s) should proceed directly to the 75g OGTT after booking for antenatal care. This will avoid missing women with asymptomatic pregestational diabetes which is associated with increased risk of fetal anomalies and loss. If the initial result was normal, a repeat test should be done at 28-30 weeks gestation to exclude GDM developing in the third trimester.

4.4 75 g OGTT can be adopted as a diagnostic test.

4.5 All pregnant women diagnosed to have IGT or DM by the WHO criteria should be managed as GDM. The treatment and monitoring of GDM is given in Part 2 of the guidelines.

Appendix 1 Risk Factors for the GDM in Asian /Chinese Women

- Maternal age ≥ 35
- Body Mass Index ≥ 25kg/m^2 before pregnancy or at booking in the first trimester
- Family history of diabetes mellitus, especially in parents
- Carrier of the α-thalassaemia trait
- Carrier of HBsAg
- Past Obstetric History
  - GDM
  - Macrosomic infant
  - Unexplained stillbirth
  - Congenital malformations that could be compatible with diabetic embryopathy
  - Pre-eclampsia/eclampsia
- Current Pregnancy
  - Conceived after ART/IVF, especially for conditions such as PCOS
  - Multiple pregnancy
  - Haemoglobin >13 g/dl in the first trimester
  - Polyhydramnios
  - Fetal size > date (AC > HC before 34 weeks, AC > 95^{th} centile or EFW > 95^{th} centile)
  - Recurrent and significant glycosuria (≥ 2 plus)
  - Currently on medications such as steroid or other immunosuppressants
  - Unexplained fetal demise
  - Unexplained macrosomic infant

Appendix 2 Screening for GDM

A. Random glucose (local population):

1. Plasma : venous ≥ 5.8 mmol/L if ≤ 2h postprandial[21]

   Plasma : venous ≥ 5.0 mmol/L if > 2h postprandial[21]

   or

2. Plasma : venous > 4.7 mmol/L[32]

B. 50g Glucose Challenge Test:

1. International[34]
   - Plasma : venous : > 7.8mmol/l
2. Local population[33]
   - 7.0 mmol/L

C. Fasting glucose:

1. International[38-40]
   - Plasma : 4.5 – 5.39 mmol/L
2. Local population[33]
   - 4.1 mmol/L

Appendix 3 Diagnosis of GDM [8]

- By 75g OGTT –

  Diabetes mellitus :

  Fasting - Whole Blood : venous ≥ 6.1 mmol/l

  capillary ≥ 6.1 mmol/l

  Plasma : venous ≥ 7.0 mmol/l

  &/or 2 h postglucose load - Whole blood : venous ≥ 10.0 mmol/l

  capillary ≥ 11.1mmol/l

  Plasma : venous ≥ 11.1 mmol/l

  Impaired glucose tolerance :

  Fasting - Whole Blood : venous < 6.1 mmol/l

  capillary < 6.1 mmol/l

  & 2h postglucose load - Whole blood : venous ≥ 6.7 and < 10.0 mmol/l

  capillary ≥ 7.8 and <11.1 mmol/l

  Plasma : venous ≥ 7.8 and <11.1 mmol/l

- By random glucose –

  Whole Blood : venous ≥ 10.0 mmol/l

  capillary ≥ 11.1 mmol/l

  Plasma : venous ≥ 11.1 mmol/l

  capillary ≥ 12.2 mmol/l

Note: GDM includes both the categories of DM and IGT.

REFERENCE LIST

1. Beischer NA, Wein P, Sheedy MT, Steffen B. Identification and treatment of women with hyperglycaemia diagnosed during pregnancy can significantly reduce perinatal mortality rates. *Aust N Z J Obstet Gynaecol* 36:239-247, 1996.

2. Beischer NA, Oates JN, Henry OA, Sheedy MT, Walstab JE. Incidence and severity of gestational diabetes mellitus according to country of birth in women living in Australia. *Diabetes* 40 Suppl 2:35-38, 1991.

3. Dornhorst A, Paterson CM, Nicholls JS, Wadsworth J, Chiu DC, Elkeles RS, Johnston DG, Beard RW. High prevalence of gestational diabetes in women from ethnic minority groups. *Diabete Med* 9:820-825, 1992.

4. Hughes PF, Agarwal M, Newman P, Morrison J. Screening for gestational diabetes in a multi-ethnic population. *Diabetes Res Clin Pract* 28:73-78, 1995.

5. Koukkou E, Taub N, Jackson P, Metcalfe G, Cameron M, Lowy C. Difference in prevalence of gestational diabetes and perinatal outcome in an innercity multiethnic London population. *Eur J Obstet Gynaecol Reprod Biol* 59:153-157, 1995.

6. Yue DK, Molyneaux LM, Ross GP, Constantino MI, Child AG, Turtle JR. Why dose ethnicity affect prevalence of gestational diabetes? The underwater volcano theory. *Diabet Med* 13: 748-752, 1996.

7. American Diabetic Association. Gestational diabetes mellitus. *Diabetes Care* 21 suppl 1:S60-S61, 1998.

8. Alberti KGMM, Zimmet PZ. Definition, diagnosis and classification of Diabetes Mellitus and its complications; Part 1: Diagnosis and classification of Diabetes mellitus. Provisional report of a WHO consultation. *Diabet Med* 15:539-553, 1998.

9. Naylor CD, Sermer M, Chen E, Farine D. Selective screening for gestational diabetes mellitus. N Engl J Med 337; 1591-1596, 1997.

10. Diamond MP, Salyer SL, Vaughn WK, Cotton RB, Entman SS, Boehm FH. Continuing neonatal morbidity in infants of women with Class A diabetes. *South Med J* 77:1386-1388, 1984.

11. Hawthorne G, Snodgrass A, Tunbridge M. Outcome of diabetic pregnancy and glucose intolerance in pregnancy: an audit of fetal loss in Newcastle General Hospital 1977-1990. *Diabetes Res Clin Pract* 25:183-190, 1994.

12. Rey E, Monier D, Lemonnier MC. Carbohydrate intolerance in pregnancy: incidence and neonatal outcomes. *Clin Invest Med* 19:406-415, 1996.

13. Hod M, Rabinerson D, Kaplan B, et al. Perinatal complications following gestational diabetes mellitus how 'sweet' is ill? *Acta Obstet Gynecol Scand* 75; 809-815, 1996.

14. MacMahon MJ, Ananth CV, Liston RM. Gestational diabetes mellitus. Risk factors, obstetric complications and infant outcome. *J Reprod Med* 43; 372-378, 1998.

15. Jensen DM, Sorensen B, Feilberg-Jorgensen N, Westergaard JG, Beck-Nielsen H. Maternal and perinatal outcomes in 143 Danish women with gestational diabetes mellitus and 143 controls with a similar risk profile. *Diabet Med* 17; 281-286, 2000.

16. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS, for the Australian Carbohydrate Intolerance Study in Pregnant Women (ACHOIS) Trial Group. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. *N Engl J Med* 352; 2477-2486, 2005.

17. World Health Organization Expert Committee on Diabetes Mellitus. *Technical Report Series*, World Health

Organization, Geneva, 1980; 646: 8-12.

18. Ko GTC, Tam WH, Chan JCN, Rogers M. Prevalence of gestational diabetes mellitus in Hong Kong based on the 1998 WHO criteria. *Diabet Med* 19; 80, 2002.

19. Lao TT, Lee CP. Gestational "impaired glucose tolerance": should the cut-off be raised to 9mmoll^{-1}? *Diabet Med* 15:25-298, 1998.

20. Lao TT, Ho LF. Impaired glucose tolerance and pregnancy outcome in Chinese women with high body mass index. *Hum Reprod* 15: 1826-1829, 2000.

21. Lao TT, Tam KF. Gestational diabetes diagnosed in third trimester pregnancy and pregnancy outcome. *Acta Obstet Gynecol Scand* 80: 1003-1008, 2001.

22. Lau TK, Li CY. A perinatal audit of stillbirths in a teaching hospital in Hong Kong. *Aust N Z J Obstet Gynaecol* 34: 416-421, 1994.

23. Jang HC, Cho NH, Jung KB, On KS, Dooley SL, Metzger BE. Screening for gestational diabetes mellitus in Korea. *Int J Gynecol Obstet* 51:115-122, 1995.

24. Deerchanawong C, Putiyanum C, Wongsuryrat M, Serirat S, Jinayon P. Comparison of National Diabetes Data Group and World Health Organization Criteria for detecting gestational diabetes mellitus. *Diabetologia* 39: 1070-1073, 1996.

25. Solomon CG, Willett WC, Carey VJ, et al. A prospective study of pre-gravid determinants of gestational diabetes mellitus. *JAMA* 278: 1078-1083, 1997.

26. Radon PA, McMahon MJ, Meyer WR. Impaired glucose tolerance in pregnant women with polycystic ovary syndrome. *Obstet Gynecol* 94:194-197, 1999.

27. Lao TT, Ho LF. ∝-Thalassaemia trait and gestational diabetes mellitus in Hong Kong. *Diabetologia* 44: 966-971, 2001.

28. Lao TT, Chan LY, Tam KF, Ho LF. Maternal hemoglobin and risk of gestational diabetes mellitus in Chinese women. *Obstet Gynecol* 99: 807-812, 2002.

29. Lao TT, Tse KY, Chan LY, Tam KF, Ho LF. HBsAg carrier status and the association between gestational diabetes with increased serum ferritin concentration in Chinese women. *Diabetes Care* 26; 3011-3017, 2003.

30. Gillmer MDG, Beard RW, Brooke FM. Carbohydrate metabolism in pregnancy. I. Diurnal plasma glucose profile in normal and diabetic women. *Br Med J* iii: 399-404, 1975.

31. Campbell DM, Sutherland HW, Pearson DWM. Maternal glucose response to a standardized test meal throughout pregnancy and postnatally. *Am J Obstet Gynecol* 171: 143-146, 1994.

32. Puavilai G, Kheesukapan P, Chanprasertyotin S, Chantraraprasert S, Suwanvilaikorn S, Nitiyanant W, et al. Random capillary plasma glucose measurement in the screening of diabetes mellitus in high-risk subjects in Thailand. *Diabetes Res Clin Pract* 51: 125-131, 2001.

33. Tam WH, Rogers MS, Yip SK, Lau TK, Leung TY. Which screening test is the best for gestational impaired glucose tolerance and gestational diabetes mellitus? *Diabetes Care* 23: 1432, 2000.

34. Wong L, Tan ASA. The glucose challenge test for screening gestational diabetes in pregnant women with no risk factors. *Singapore Med J* 42:517-521, 2001.

35. Coustan DR, Widness JA, Carpenter MW, Rotondo L, Pratt DC, Oh W. Should the fifty-gram, one-hour plasma

36. glucose screening test for gestational diabetes be administered in the fasting or fed state? *Am J Obstet Gynecol* 154: 1031-1035, 1986.

37. Lewis GF, Polonsky KS, McNally C, Barron WM, Blackman JD. Prior feeding alters the response to the 50-g glucose challenge test in pregnancy. *Diabetes Care* 16: 1551-1556, 1993.

38. McElduff A, Hitchman R. Screening for gestational diabetes: the time of day is important. *Med J Aust* 176: 136, 2002.

39. Moses R. Gestational diabetes: what is the relevance of the glucose challenge test? *Med J Aust* 176: 354, 2002.

40. de Aguiar LGK, de Matos HJ, Gomes M de B. Could fasting plasma glucose be used for screening high-risk outpatients for gestational diabetes mellitus? *Diabetes Care* 24: 954-955, 2001.

41. Reichelt AJ, Spichler ER, Branchtein L, Nucci LB, Franeo LJ, Schmidt MI, for the Brazilian Study of Gestational Diabetes (EBDG) Working Group. Fasting plasma glucose is a useful test for the detection of gestational diabetes. *Diabetes Care* 21:1246-1249, 1998.

42. Perucchini D, Fischer U, Spinas GA, Huch R, Huch A, Lehmann R. Using fasting plasma glucose concentrations to screen for gestational diabetes mellitus: prospective population-based study. *Br Med J* 319: 812-815, 1999.

43. Agarwal MM, Hughes PF, Punnose J, Ezimokhai M. Fasting plasma glucose as a screening test for gestational diabetes in a multi-ethnic, high-risk population. *Diabet Med* 17: 720-726, 2000.

44. Juutinen J, Hartikainen A-L, Bloigu R, Tapanainen JS. A retrospective study on 435 women with gestational diabetes. Fasting plasma glucose is not sensitive enough for screening but predicts a need for insulin treatment. *Diabetes Care*; 23:1858-1859, 2000.

45. Pettitt DJ, Narayan KMV, Bennett PH, Knowler WC, Hanson RL. Comparison of World Health Organization and National Diabetes Data Group procedures to detect abnormalities of glucose tolerance during pregnancy. *Diabetes Care* 17: 1264-1268, 1994.

46. Lao TT, Ho LF. Does maternal glucose intolerance affect the length of gestation in singleton pregnancies? *J Soc Gynecol Invest* 10: 366-371, 2003.

47. Roach VJ, Fung H, Cockram CS, Lau TK, Rogers MS. Evaluation of glucose intolerance in pregnancy using biochemical markers of fetal hyperinsulinaemia. *Gynecol Obstet Invest* 45: 174-176, 1998.

ACKNOWLEDGEMENT:

This document was prepared by Professor Terence Lao, Dr. Mary Tang, Professor TK Lau, Dr. CY Li, Dr HY Tse, Dr. Helena Lam, Dr. WK To, Dr. Shell Wong, Dr. CM Tai, Dr. KT Tse, Dr. SY Sin, Dr. ST Liang and Dr. Belinda Leung and was endorsed by the Council of the Hong Kong College of Obstetricians and Gynaecologists.