Postpartum level of HbA1c and risk factors of delivering a large baby

Maysam Hatem Khaleel 1, Hanan Hazim Mohammed Noori 2*, Marwa Jaafar Sadac 3

1Department of Obstetrics and Gynecology, Al-Zafaraniyah General Hospital, Baghdad, Iraq.
2Head of Department of Gynecology and Obstetrics, Al-Qaim Hospital, Al-Anbar Province, Iraq.
3Department of Obstetrics and Gynecology, Al_Yarmouk Teaching Hospital, Baghdad, Iraq
*Corresponding author: Hanan Hazim Mohammed Noori (M.B.Ch.B, C.A.B.O.G.DGO)
Email: dr.ammar2013@gmail.com.

Abstract

Background: A mother who had abnormal glucose tolerance during pregnancy may lead to delivery of a large baby. Glycosylated hemoglobin concentration might be expected to identify women who had high blood glucose concentration before delivery. The aim of current study was to identify retrospectively gestational diabetes in mothers of large babies.

Methods: A prospective case-control study that was conducted in the Department of Obstetrics and Gynecology at Al-Imamine Al-Kadhimein Medical City, Baghdad, Iraq for a period of one year and included 100 women who recently delivered newborns and divided into two groups; Macrosomia group included 50 women who delivered babies weighed 4000gm or more and control group included 50 women who delivered babies weighed less than 4000gm. Women who were known cases of diabetes, blood disorders, delivered a preterm baby, delivered a baby with any congenital malformations, or still birth delivery were excluded from this study. Blood was obtained from all women within 72 hours after delivery to investigate for HbA1c level. A questionnaire was applied to all women to collect the needed information.

Results: The prevalence of macrosomia was significantly increased with increasing age, and parity of mothers, gestational age ≥40 weeks, increasing body mass index level, positive history of macrosomia, and positive family history of diabetes. Mean HbA1c was significantly higher in women who delivered macrosomic babies than those who delivered babies with birth weights<4000gm. The cut-off point of HbA1c level was 5.8%, so HbA1c level >5.8% was predictive for macrosomia.

Conclusion: HbA1c is a good indicator of unscreened or unobserved glucose intolerance in mothers who delivered a macrosomic baby. Other possible risk factors for macrosomia included aging, increased parity, obesity, previous history of macrosomia, and family history of diabetes.

Keywords: Macrosomia, HbA1c, gestational diabetes, parity, BMI.

How to cite this article: Mohammed Noori HH, Khaleel MH, Sadac MJ (2020): Postpartum level of HbA1c and risk factors of delivering a large baby, Ann Trop & Public Health; 23 (7): 894-900-. DOI: http://doi.org/10.36295/ASRO.2020.23710

Introduction

Gestational diabetes mellitus (GDM), which is defined as diabetes diagnosed in the second and third trimesters of pregnancy (1), has emerged as a global public health concern (2). The global prevalence of GDM varies widely from 1 to 28% depending on population characteristics, screening methods, and diagnostic criteria (3). A review revealed that the prevalence varied from 5.4% in Europe (4) to 11.5% in Asia (5). It causes a diverse range of adverse maternal and neonatal outcomes (6) and it is a threat to maternal and child health (7). In babies, GDM has been found to be associated with macrosomia or larger than normal
gestational-aged infants, neonatal hypoglycemia, and type 2 DM later in life\(^8\). Macrosomia is a term used to describe a newborn whose birth weight is greater than 4–4.5 kg \(^9\). The prevalence of fetal macrosomia varied from region to region \(^10\), due to variation of contributory factors investigated in different studies \(^11\). This condition affects 3–15% of all pregnancies worldwide \(^12\). Fetal macrosomia complicates delivery process for both mothers and neonates \(^12\). Macrosomic babies are at a higher risk of developing both short and long term health outcomes; including birth asphyxia, still birth, obesity and metabolic disorders \(^13\). In addition, shoulder dystocia, skeletal injuries, meconium aspiration, hypoglycemia, and fetal death are reported to be associated with fetal macrosomia \(^14\). Similarly, long-term health effects precipitated by macrosomia include type 2 DM, hypertension, and obesity in adulthood \(^15\). On the other hand, it is known that in the course of GDM, and after childbirth, there is usually a return to normal blood glucose levels. On the other hand, glycated hemoglobin (HbA1c) remains pathological even after delivery and is therefore a retrospective marker of glycemic equilibrium \(^16\). The normal value according to the data obtained during the Diabetes Control and Complications Trial is 4 to 6%. In pregnant women, data from the UK Prospective Diabetes Study Group study allows this value to be set at a threshold of 6.5% \(^16\). As such, it is important to understand the burden of GDM in various parts of the world to provide country-specific information to help inform on policy and planning. Compared with developed countries, researches on macrosomia in developing world such as Iraq, particularly in the study settings are insufficient. The aim of this study was to identify retrospectively GDM in mothers of large babies.

**Patients and Methods**

A prospective case-control study that was conducted in the Department of Obstetrics and Gynecology at Al-Imamine Al-Kadhimein Medical City, Baghdad, Iraq for a period of one year (from Feb. 2015 to the end of Jan. 2016) and included 100 women recently delivered a newborn. They were divided into two groups:

- **Macrosomia group**: included 50 women who delivered babies ghedwei 4000gm or more.
- **Control group**: included 50 women who delivered babies weighed less than 4000gm.

A 3-ml blood sample was obtained from each woman included in this study within 72 hours after delivery and sentin container or tube contained ethylenediamine tetra acetic acid (EDTA) to the local laboratory to investigate for HbA1c level. Then they were compared between the two study groups. Women who were known cases of DM, blood disorders, delivered a preterm baby, delivered a baby with any congenital malformation, or still birth delivery were excluded from this study. Prior maternal consent was obtained from all participated mothers.

**Data collection tools**: A questionnaire was applied to all women to collect the needed information and the questionnaire was filled by the researcher through face-to-face interview with study participants. It included questions to gather information such as age, menstrual history including last menstrual period, gestational age, parity, history of abortion, history of still birth or congenital anomaly, family history of diabetes and history of previous macrosomic baby. General examination included blood pressure, pulse rate, temperature, body built, weight, height, to calculate the body mass index (BMI) using following formula: \(\text{BMI} = \frac{\text{Weight (Kg)}}{\text{Height (m)}}^2\). Participants were classified according to BMI as: Normal weight (≤24.99 kg/m\(^2\)), overweight (25 - 29.99 kg/m\(^2\)) and obese (≥30 kg/m\(^2\)) \(^17\).

**Statistical analysis**

The data were analyzed using Statistical Package for Social Sciences (SPSS) version 25 and presented as mean, standard deviation and range. Categorical data presented by frequencies and percentages. Chi-squared test was used to assess association between macrosomia and certain information. Independent \(t\)-test (two tailed) was used to compare the HbA1c.
level between study groups. Receiver operating characteristic (ROC) curve analysis was used for prediction of HbA1c level as predictor of macrosomia. \( P \)–value less than 0.05 was considered significant.

**Results**

In this study, 100 women were enrolled. Their age ranged from 17 to 40 years. The prevalence of macrosomia was significantly increased with increasing age of mothers (\( P = 0.001 \)), increasing parity of mothers (\( P = 0.016 \)), gestational age \( \geq 40 \) weeks (\( P = 0.001 \)), increasing BMI (\( P = 0.001 \)), positive history of macrosomia (\( P = 0.001 \)), and positive family history of DM (\( P = 0.001 \)) as shown in Table (1).

**Table (1) Association between macrosomia and certain characteristics of participants**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study group</th>
<th>Total No. (%)</th>
<th>( P ) -value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro No. (%)</td>
<td>Control No. (%)</td>
<td>(n= 100)</td>
</tr>
<tr>
<td>Age (Year)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 20</td>
<td>1 (11.1)</td>
<td>8 (88.9)</td>
<td>9 (9.0)</td>
</tr>
<tr>
<td>20 – 29</td>
<td>15 (38.5)</td>
<td>24 (61.5)</td>
<td>39 (39.0)</td>
</tr>
<tr>
<td>( \geq 30 )</td>
<td>34 (65.4)</td>
<td>18 (34.6)</td>
<td>52 (52.0)</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nulliparous</td>
<td>8 (42.1)</td>
<td>11 (57.9)</td>
<td>19 (19.0)</td>
</tr>
<tr>
<td>1 – 3</td>
<td>14 (35.9)</td>
<td>25 (64.1)</td>
<td>39 (39.0)</td>
</tr>
<tr>
<td>( &gt; 3 )</td>
<td>28 (66.7)</td>
<td>14 (33.3)</td>
<td>42 (42.0)</td>
</tr>
<tr>
<td>Gestational age (Week)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 40</td>
<td>18 (34.6)</td>
<td>34 (65.4)</td>
<td>52 (52.0)</td>
</tr>
<tr>
<td>( \geq 40 )</td>
<td>32 (66.7)</td>
<td>16 (33.3)</td>
<td>48 (48.0)</td>
</tr>
<tr>
<td>BMI Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>3 (14.3)</td>
<td>18 (85.7)</td>
<td>21 (21.0)</td>
</tr>
<tr>
<td>Overweight</td>
<td>30 (53.6)</td>
<td>26 (46.4)</td>
<td>56 (56.0)</td>
</tr>
<tr>
<td>Obese</td>
<td>17 (73.9)</td>
<td>6 (26.1)</td>
<td>23 (23.0)</td>
</tr>
<tr>
<td>Mode of delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVD</td>
<td>18 (40.0)</td>
<td>27 (60.0)</td>
<td>45 (45.0)</td>
</tr>
<tr>
<td>C/S</td>
<td>32 (58.2)</td>
<td>23 (41.8)</td>
<td>55 (55.0)</td>
</tr>
<tr>
<td>History of macrosomia</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Regarding HbA1c level, the mean was significantly higher in women who delivered macrosomic babies than those who delivered babies with birth weights <4000gm (6.13 versus 5.67%, respectively, $P=0.002$).

**Table (2) Comparison between study groups by HbA1c level**

<table>
<thead>
<tr>
<th>HbA1c level (%)</th>
<th>Study group</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macrosomia (Mean±SD)</td>
<td>Control (Mean±SD)</td>
</tr>
<tr>
<td></td>
<td>6.13±0.84</td>
<td>5.67±0.61</td>
</tr>
</tbody>
</table>

Receiver operating characteristic (ROC) curve analysis was constructed for HbA1c level as predictor of macrosomia. As shown in Table (3) and Figure (1), the cut-off point of HbA1c level was 5.8%, so HbA1c level >5.8% is predictive for macrosomia as a large significant area under the curve (AUC= 80.4%) indicating significant association between higher level of HbA1c level and prediction of macrosomia. Also, HbA1c level of 77.3% was sensitive, 72.7% was specific and 75% was accurate as a marker for prediction of macrosomia.

**Table (3) Diagnostic accuracy of HbA1c level for prediction of macrosomia**

<table>
<thead>
<tr>
<th>HbA1c level (%)</th>
<th>Cut-off value</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.8</td>
<td>77.3%</td>
<td>72.7%</td>
<td>73.9%</td>
<td>76.2%</td>
<td>75%</td>
</tr>
</tbody>
</table>
Discussion
Macrocosmia is challenging in modern obstetric because of fetal and maternal complications associated with it. Gestational diabetes is one of the main risk factor for fetal macrocosmia. HbA1c is a good indicator for glucose intolerance undetected or unnoticed among mothers how delivered macrocosmic newborns (18). In this study, there was a significant relationship between HbA1c and birth weight and this result agreed with a result reported by (16). This result might indicate carbohydrate intolerance in mothers who gave birth to a new macrocosmic babies. A threshold value of 5.8% for HbA1c that we demonstrated could be interesting insofar as it allows an estimate of the risk of macrocosmia and therefore of carbohydrate imbalance in the mother. This study showed a significant association of other factors with macrocosmia such as aging, increased parity, obesity, previous history of macrocosmia, and family history of DM. Agreement was noticed with a number of studies as (19,20) when they showed that the mean age of mothers who delivered macrocosmic babies was significantly higher than that in mothers who delivered normal babies. The higher growth velocity may be because of age-related changes in maternal metabolism. Similar results found in studies conducted by (21, 22) who agreed that multiparity is another important risk factor for macrocosmia. This might be due to the fact that in the same woman, birth weight increases with parity. Moreover, (23,23) agreed with this study when they reported that maternal obesity is associated with fetal overgrowth. Fetal growth is a complex biologic process that is regulated by both maternal and fetal factors including genes and environment. Maternal obesity likely contributes to macrocosmia via mechanisms including increased insulin resistance (even in women who do not have diabetes) resulting in higher fetal glucose and insulin levels. Placental lipases metabolize triglycerides in maternal blood, allowing free fatty acids to be transferred in excess to the growing fetus (25). This study was in an accordance with (21,26) who found that a woman with previous macrocosmic baby had increased risk for delivering a macrocosmic baby than a control. In fact, women with macrocosmic babies have a 5 – 10 times greater probability of having macrocosmia in subsequent pregnancies than women without previous history of macrocosmia (24). Diabetes is common in Iraq like endemic diseases as brucella and hydatid cyst (27-28).

Conclusion
HbA1c is a good indicator of unscreened or unobserved glucose intolerance in mothers who delivered a macrocosmic baby. Other possible risk factors for macrocosmia included aging, increased parity, obesity, previous history of macrocosmia and family history of DM.

Figure (1) ROC curve for HbA1c level as a predictor of macrocosmia.
ETHICAL CLEARANCE

The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

FUNDING: Self-funding

References


