Delivery (timing, route, peripartum glycemic control) in women with gestational diabetes mellitus

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Abstract

Objectives: To provide management guidelines for labour and delivery in women with gestational diabetes.

Materials and methods: A literature search was performed using the PubMed and Cochrane databases. Foreign societies guidelines were also consulted.

Results: There is no additional information from recent studies that supports changing current French guidelines about timing of delivery in gestational diabetes. The incidence of shoulder dystocia is increased in women with gestational diabetes, especially when infants weigh more than 4500g. Elective caesarean-section when the foetal weight is greater than or equal to 4250 to 4500 grams may reduce the risk of shoulder dystocia. Meticulous attention to avoiding maternal hyperglycaemia during labour can prevent neonatal hypoglycaemia. There is no significant role for x-ray pelvimetry in the management of gestational diabetes.

Conclusion: Management of labour and delivery in women with gestational diabetes will mainly depend on estimated foetal weight, especially when macrosomia is present.

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Keyword: gestational diabetes, macrosomia, guidelines, caesarean section, review

Résumé

Accouchement (terme, voie, équilibre glycémique perpartum) adapté au diabète gestationnel

But : Proposer des recommandations pour la prise en charge du travail et de l’accouchement des patientes présentant un diabète gestationnel.

Matériel et méthodes : Recherche bibliographique à partir de la base de données Medline et de la Cochrane Database Library. Consultation des recommandations des sociétés savantes de diabétologie et de gynécologie-obstétrique étrangères.

Résultats : Aucune nouvelle information à partir des études récemment publiées ne permet d’apporter de modifications aux recommandations publiées concernant le terme de l’accouchement en cas de diabète gestationnel. L’incidence de la dystocie des épaules est augmentée en cas de diabète gestationnel particulièrement chez les nouveau-nés pesant plus de 4500 g. La réalisation d’une césarienne avant travail en cas de poids au-delà de 4 250 à 4500 g pourrait réduire le risque de dystocie des épaules. Une attention particulière afin d’éviter les hyperglycémies maternelles durant le travail pourra limiter le risque d’hypoglycémie néonatale. La radiopelvimétrie n’a pas d’intérêt dans la prise en charge du diabète gestationnel.

Conclusion : La prise en charge du travail et de l’accouchement chez les patientes présentant un diabète gestationnel tient principalement compte de l’estimation du poids fœtal, en particulier si une macrosomie est suspectée.

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Mots clés : diabète gestationnel, macrosomie, recommandations, césarienne ; revue

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1. Introduction

In gestational diabetes mellitus, and particularly in the presence of macrosomia, the increased risk of intrauterine death, fetal hypoxia, shoulder dystocia (especially with birth weight greater than 4500 grams), brachial plexus injury, hypoglycaemia, hyperbilirubinaemia and transfer to the intensive care unit impact on the events at the end of pregnancy and delivery.

The aim of this work was to study the data in the literature in order to decide upon the best management approach with regard to the modalities of labour and the delivery route in gestational diabetes mellitus, taking into consideration glycaemic control and the effect on the foetus, especially in cases involving macrosomia.

2. Analysis of the literature

A literature search was performed using the PubMed and Cochrane databases with the keywords “gestational diabetes” [MeSH], “time of delivery” (not part of MeSH), “delivery, obstetrics” [MeSH], “labour, induced” [MeSH], “anaesthesia” [MeSH], “anaesthesia, obstetrical” [MeSH] and “glycemic control during labour” (not part of MeSH).

For each term, the number of articles found is shown below:

- “gestational diabetes” + “delivery, obstetrics” n = 547
- “anaesthesia” n = 53
- “anaesthesia, obstetrical” n = 5
- “glycaemic control during labour” (not part of MeSH)

This investigation was completed with a manual search of the references of the selected articles and through consultation of the guidelines from foreign learned societies (National Institute for Health and Clinical Excellence, American Diabetes Association, Canadian Diabetes Association).

3. Timing of delivery

There are already existing guidelines with regard to the timing and indications for labour induction in cases of gestational diabetes mellitus (artificial induction of labour from 37 weeks LMP – April 2008).

The document published on the website of the French High Health Authority (HAS) recommends the following approach:

- **The actions to be taken for insulin-dependent diabetes are based on a case-by-case multidisciplinary decision. If the diabetes is poorly controlled or affects the foetus, it is not recommended that the pregnancy exceed 38 weeks LMP + 6 days.**
- **In cases of well-controlled gestational diabetes mellitus without foetal effects, there is no justification for actions different from those of a normal pregnancy.**

The definition of poorly controlled diabetes is not given in the recommendation but refers to diabetes requiring insulin therapy and in which the glycaemic objectives have not been attained (expert opinion).

Recent studies (ACHOIS and HAPO) [1, 2] have not provided new information requiring substantial modifications to this recommendation.

4. Benefits of performing L/S ratio by amniocentesis

Gestational diabetes mellitus is associated with an increased risk of hyaline membrane disease. The lecithin/sphingomyelin ratio or the presence of phosphatidylglycerol found via amniocentesis have been suggested for assessing lung maturation. The first studies showed that a low L/S ratio [3] or the absence of phosphatidylglycerol [4] were associated with a higher risk of lung immaturity and could be discriminating factors (indicative) in cases of gestational diabetes mellitus. These initial studies however were contradicted by several other studies, which showed that these markers, though indeed well correlated with gestational age, are not modified by diabetes or even glycaemic control [5-9]. Furthermore, amniocentesis is an invasive procedure, which carries well-documented risks in the third trimester [10-12].

**In summary, measurement of the L/S ratio or phosphatidylglycerol for the assessment of lung maturity is no longer beneficial in cases of gestational diabetes mellitus (EL3).**

5. Delivery route

5.1. When should caesarean delivery be recommended with gestational diabetes mellitus?

In gestational diabetes mellitus, the choice of delivery route is based on macrosomia screening, the objective of which is to prevent shoulder dystocia and its complications as well as brachial plexus palsy. The question remains as to the preferable evaluated weight threshold for recommending a caesarean delivery and the study of its impact on the prevention of shoulder dystocia and brachial plexus palsy. The decision can obviously not be made without considering the non-specific obstetrical parameters of the diabetes, i.e., uterine scarring, placenta location and the foetal presentation.

5.1.1. Prevention of shoulder dystocia

It has been clearly demonstrated in the literature that diabetes is an independent risk factor of shoulder dystocia [13-15]. In 1991, Langer et al. performed a retrospective study on 75,979 vaginal deliveries occurring from 1970 to 1985, including 1,589 diabetic women (2.1%), the majority of whom were Hispanic. They observed that the non-diabetic women had an
overall rate of shoulder dystocia of 0.3%, while the diabetic women had a 3.2% rate [14]. In addition, a macrosomic child born to a diabetic mother had a three-fold higher risk of shoulder dystocia than a macrosomic child of a non-diabetic mother, with this risk increasing proportionately to the weight (Table 1).

Casey et al. specifically compared the obstetrical outcomes of patients monitored for gestational diabetes in relation to that of the general population [16]. Apart from complications during pregnancy, there was a significantly greater rate of shoulder dystocia (3% versus 1%) and a higher birth weight (mean weight of 3581 ± 616 g for women with gestational diabetes versus 3290 ± 546 g for the general population).

At 4500 grams and over, there is a three times greater risk of shoulder dystocia for a newborn of a diabetic mother compared to a newborn of a non-diabetic mother.

5.1.2. Occurrence of brachial plexus palsy

The occurrence of brachial plexus palsy is a complication involving around 1 to 2 per 1000 births [17]. Many of these cases recover spontaneously or with the assistance of physical therapy. For those that persist, recovery of shoulder and elbow function is possible in 75% of cases in the first year if surgery is done; the hand has the same percentage of recovery in the first 3 or 4 years [18, 19]. The risk of shoulder dystocia increases with foetal weight, as does the occurrence of brachial plexus palsy. Ecker et al. studied the risk factors for the occurrence of 80 cases of brachial plexus palsy that occurred out of 77,616 births [20]. A total of 3526 female patients (4.5%) presented with gestational diabetes mellitus. Their results show that maternal diabetes, foetal weight, and vaginal birth are independent risk factors for the occurrence of brachial plexus palsy (3.19 times greater for diabetes, 17.94 times greater for a birth weight > 4 500 g and 20 times greater for vaginal birth) (Table 2).

Bryant et al. likewise studied the occurrence of brachial plexus palsy in 943 diabetics and found that the rate increased proportionately with weight: 0.8% among 3500 – 3999 gram foetuses, 3.3 % among 4000 – 4499 gram, 8% among 4500 – 4999 gram and 20% for an estimated foetal weight greater than or equal to 5000 grams [21]. This study had a small sample size (8 cases of brachial plexus palsy) but confirms the data of Ecker et al. by also showing a higher rate in diabetics.

The need for instrumental extraction at birth is an independent factor in the occurrence of brachial plexus palsy [22, 23]. The risk of trauma occurring during birth is 6.7 times greater in a child with macrosomia according to Kolderup et al. In addition, this risk is linked to the method of delivery: forceps multiply this risk by 3.8 (CI = 2.5-5.9), and the vacuum extractor increases it by 2.9 times (IC = 1.1-8.0) compared to a spontaneous vaginal delivery [23].

5.1.3. Prophylactic caesarean delivery

The aim of caesarean delivery is to prevent shoulder dystocia and its corollary, brachial plexus palsy. As part of a before and after study, Conway et al. evaluated the implementation of a protocol in which caesarean delivery was performed prophylactically for any suspicion of estimated foetal weight greater than 4250 g in a diabetic mother (91% of patients had gestational diabetes). This was the threshold selected to correct the echographic margin of error [24]. They noted a two-fold reduction in the occurrence of shoulder dystocia (1.1% versus 2.4 %), with a simultaneous increase in the caesarean rate (25.1% versus 21.7%, p < 0.04). This data strongly suggests that caesarean-sections reduce the occurrence of shoulder dystocia and thus the occurrence of brachial plexus injury; this did not become a zero risk however, as 1 to 4% of brachial plexus palsy cases occurred after the caesarean-section [25]. This improvement can nevertheless be balanced with both the maternal risks (Table 3), as well as the foetal risks related to this surgical procedure.

It is important but difficult to define a weight threshold value above which a caesarean delivery can be recommended for reducing the risk of shoulder dystocia, as there is currently no consensus among the experts (Table 4).

Several studies have attempted to assess the effects of the performance of a caesarean delivery on public health and the number of them that should be performed in order to prevent a permanent case of brachial plexus palsy (Table 5).

**In summary, due to the increased risk of shoulder dystocia and brachial plexus palsy, it seems reasonable to recommend a caesarean delivery to a patient being monitored for gestational diabetes when the estimated foetal weight is greater than a threshold value between 4250 and 4500 grams (EL3). There are insufficient data in the literature for enabling a choice to be made between these two values. The decision will be made on an individual basis according to information from the patient on the benefit risk balance of the caesarean in this situation (expert opinion).**

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**Table 1**

<table>
<thead>
<tr>
<th>Birth weight</th>
<th>Diabetic mother (%)</th>
<th>Non-diabetic mother (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 – 4249 g</td>
<td>3.1</td>
<td>2.7</td>
</tr>
<tr>
<td>4250 – 4499 g</td>
<td>7.4</td>
<td>5.2</td>
</tr>
<tr>
<td>4500 – 4749 g</td>
<td>27.9</td>
<td>8.1</td>
</tr>
<tr>
<td>4750 – 4999 g</td>
<td>55.6</td>
<td>14.8</td>
</tr>
<tr>
<td>≥ 5000 g</td>
<td>62.5</td>
<td>9.8</td>
</tr>
</tbody>
</table>

**Table 2**

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Odds Ratio</th>
<th>Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>3.19</td>
<td>1.62 – 6.27</td>
</tr>
<tr>
<td>Caesarean</td>
<td>0.05</td>
<td>0.01 – 0.20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Birth weight</th>
<th>Odds Ratio</th>
<th>Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 4000 g versus &lt; 4000 g</td>
<td>9.56</td>
<td>6.15 – 14.86</td>
</tr>
<tr>
<td>≥ 4500 g versus &lt; 4500 g</td>
<td>17.94</td>
<td>10.29 – 31.28</td>
</tr>
<tr>
<td>≥ 5000 g versus &lt; 5000 g</td>
<td>45.15</td>
<td>15.81 – 128.75</td>
</tr>
</tbody>
</table>

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5.2. Benefits and modalities of glycaemic control in the delivery room

From a maternal viewpoint, labour may be considered a stress test, which originates from a reduction in the need for insulin [34], with a risk of hypoglycaemia, particularly with the use of intensive insulin therapy. From a foetal viewpoint, the aim is to conserve foetal well-being and to prevent neonatal hypoglycaemia.

It has been shown that the risk of neonatal hypoglycaemia in type 1 or 2 pre-gestational diabetic patients was increased in cases of intrapartum maternal glucose levels > 8.0 mmol/L (1.44 g/L) [6, 33, 35, 36]. There are few studies based specifically on the management of patients being monitored for gestational diabetes. According to a recent study by Flores-Le Roux et al. [37], glycaemic control during delivery does not in most cases require the use of insulin (86 %), and the peripartum imbalance is related both to the quality of the glycaemic control during the pregnancy and to the HbA1c value in the third trimester. Neonatal hypoglycaemia is more common in patients treated with insulin than in patients on diet therapy (60.5% versus 29.5%; p = 0.02) and would not, according to the author, be linked to the hyperglycaemic state of the mother during labour, a hypothesis that has already been suggested by Barret [38].

In summary, there is no reason to use an aggressive protocol (insulin therapy) in the delivery room for controlling maternal glucose, as this leads to maternal hypoglycaemia, which is poorly tolerated in the foetus. Close monitoring could however be carried out in the delivery room (capillary glucose level every hour ± urine dipsticks for ketone presence.) Insulin therapy started with an intravenous glucose solution in case of glucose levels above 8 mmol/L or 1.44 g/L could be instituted (expert opinion).

5.3. Recommendation for monitoring modalities and management during labour

Foetal monitoring during labour was the focus of recommendations by the French National College of Obstetricians and Gynaecologists (CNGOF) in 2007 (Modalities of foetal monitoring during labour – December 2007).

There is little data concerning the monitoring of gestational diabetes mellitus during labour. The main risk remains that of shoulder dystocia during the expulsion phase [39, 40]. A long second phase of labour [41, 42], and conversely, a too rapid descent in the interspinal plane [13, 43, 44] could be risk factors.

Table 3
Risk of elective caesarean-section compared to vaginal birth.

<table>
<thead>
<tr>
<th>Complications</th>
<th>Allen et al. [26]</th>
<th>Villar et al. [27]</th>
<th>Liu et al. [28]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac arrest</td>
<td>5.1 [4.1-6.3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haematoma</td>
<td>1.0 [0.1-7.6]</td>
<td>5.1 [4.6-5.5]</td>
<td></td>
</tr>
<tr>
<td>Scar infection</td>
<td>1.7 [0.9-3.2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfusion</td>
<td>0.7 [0.2-2.7]</td>
<td>1.75 [1.33-2.30]</td>
<td>0.4 [0.2-0.8]</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>4.57 [2.84-7.37]</td>
<td>3.2 [2.2-4.8]</td>
<td></td>
</tr>
<tr>
<td>Anaesthesia</td>
<td>2.3 [2.0-2.6]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thromboembolism</td>
<td>2.2 [1.5-3.2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stay</td>
<td>RR = 2.54 [2.01-3.20]</td>
<td>1.47 additional days</td>
<td></td>
</tr>
</tbody>
</table>

Table 4
Estimated foetal weight threshold for performing a caesarean-section.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Estimated foetal weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acker et al. [13]</td>
<td>1985</td>
<td>4000 g</td>
</tr>
<tr>
<td>Langer et al. [14]</td>
<td>1991</td>
<td>4250 g</td>
</tr>
<tr>
<td>Conway et al. [24]</td>
<td>1998</td>
<td>4250 g</td>
</tr>
<tr>
<td>Gonen et al. [29]</td>
<td>2000</td>
<td>4500 g</td>
</tr>
<tr>
<td>American College of Obstetricians and Gynaecologists [30]</td>
<td>2002</td>
<td>4500 g</td>
</tr>
<tr>
<td>Royal College of Obstetricians and Gynaecologists [31]</td>
<td>2005</td>
<td>4500 g</td>
</tr>
</tbody>
</table>

Table 5
Number of caesarean sections needed according to estimated foetal weight per ultrasound to prevent one permanent brachial plexus palsy.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Population studied</th>
<th>Number of caesarean sections to avoid one permanent brachial plexus palsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rouse et al. 1996 [32]</td>
<td>Diabetics</td>
<td>489 caesareans for an estimated birth weight ≥ 4000 g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>443 caesareans for an estimated birth weight ≥ 4500 g</td>
</tr>
<tr>
<td>Ecker et al. 1997 [20]</td>
<td>Diabetics</td>
<td>219 to 962 caesareans for an estimated birth weight ≥ 4000 g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>91 to 400 caesareans for an estimated birth weight ≥ 4500 g</td>
</tr>
<tr>
<td>Kolderup et al. 1997 [23]</td>
<td>Macrosomias (3.5% GDM)</td>
<td>148 to 258 caesareans for an estimated birth weight ≥ 4000 g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58 to 97 for 4500</td>
</tr>
<tr>
<td>Bryant et al. 1998 [21]</td>
<td>Diabetics (1.5%) and non-diabetics</td>
<td>155 to 588 caesareans for an estimated birth weight of 4500 g</td>
</tr>
<tr>
<td>Gonen et al. 2000 [29]</td>
<td>Macrosomias*</td>
<td>74 caesareans for an estimated birth weight ≥ 4500 g</td>
</tr>
<tr>
<td>Hawkins et al. 2006 [33]</td>
<td>General population, no weight or diabetic sub-group</td>
<td>1 per 5000 to 10000</td>
</tr>
</tbody>
</table>

GDM = Gestational diabetes mellitus
*Unknown prevalence of gestational diabetes
of shoulder dystocia. Nevertheless, contradictory data have been found in the literature and it is quite difficult to define abnormalities that are predictive of events leading to shoulder dystocia. In addition, the use of instrumental extraction independently increases the risk of shoulder dystocia [22, 23].

**In summary, in cases where vaginal delivery is acceptable, it seems logical to recommend a dynamic trial of labour, especially if the foetal weight has been estimated at over 4000 grams (expert opinion).**

**In a well-controlled diabetic patient, labour monitoring does not require specific measures (expert opinion).**

**Lastly, given the risk of neonatal hypoglycaemia in cases of macrosomia in diabetic mothers and in the event of difficult extraction, the paediatrician must be notified of the birth of the child (expert opinion).**

5.4. Uterine scarring and gestational diabetes mellitus

Due to the rise in the number of caesarean deliveries in the last decade, going from 10.9% in 1981 in France to 20.1% in 2008, there has been an increase in the number of pregnant women with uterine scarring, being 5 to 14% of women in the birthing room. Depending on the local conditions, it is now generally agreed that they can benefit from a trial of labour, or even an induction of labour [45].

There is little data in the literature concerning the association of uterine scarring and gestational diabetes mellitus, and the success rate of vaginal birth varies according to the different studies.

In 2000, Blackwell et al. noted a success rate of 43.7% [46]. According to Coleman et al., this success rate was 67% in a retrospective study in which repeat caesarean section was performed for an estimated foetal weight of 4000 grams; this success rate was lower than that of the general population (77%). They noted an increase in the risk of forceps use [OR = 2.71; CI 95% (1.15-6.45)] and vacuum extraction [OR = 2.59; CI 95% (0.89-7.73)] [47]. Lastly, both of these studies found no differences in maternal and foetal morbidity [46, 47].

Marchiano et al. more recently obtained a relative risk of success of 0.94 [CI 95% (0.87-1.00)] for vaginal delivery in women with gestational diabetes compared to a control group, with an odds ratio for success after adjustment of 0.87 [CI 95% (0.68-1.10)] [48].

**In summary, the performance of x-ray pelvimetry has no benefit when there is clinical suspicion of foetopelvic disproportion due to its high rate of false positive results and its poor predictive value of the foetopelvic index (NP3). In addition, it leads to an increase in the number of caesarean deliveries without a reduction in neonatal morbidity.**

5.5. Benefits of x-ray pelvimetry

In cases of cephalic presentation, x-ray pelvimetry is used in cases of suspected macrosomia to screen for foetopelvic disproportion through the comparison of the dimensions of the mobile foetus (biparietal diameter) and those of the pelvis in order to assess whether the vaginal route might cause dystocia. This is done particularly with the assistance of tools such as the Magnin diagram [49].

The use of x-ray pelvimetry is debatable however on many levels. First of all, according to Fine et al., this examination has a high false positive rate, going from 22.5% in case of absolute disproportion to 28.6% for moderate disproportion [50]. Other authors have confirmed this poor predictive value of the foetopelvic index, which is a cause of increase in the number of caesarean deliveries [51-54]. Marpeau et al. studied the mechanisms of arrest of dilation during the active phase of labour, a condition which is highly feared in case of macrosomia [55]. They showed that most cases of arrest are not in relation to the standard measurements of cephalopelvic comparison but are rather due to other events during labour (uterine dynamics, posterior presentation). Finally, Parsons et al. showed in a randomised study the lack of significant differences between maternal and foetal issues. The study included 200 primiparous women divided into two groups: clinical pelvimetry versus clinical pelvimetry plus x-ray pelvimetry [56]. The concordance between the two methods was 76.5%. The sub-group of patients diagnosed clinically with borderline pelvis per the clinical exam had a significantly higher incidence of caesarean-section if they had received x-ray pelvimetry. No significant differences were noted in terms of maternal and foetal issues.

6. Conflicts of interest

The authors do not have any conflicts of interest to declare

References


