A CASE CONTROL STUDY

Head circumference, as predictor of cephalopelvic disproportion: A prospective analysis of cases of spontaneous vaginal delivery and caesarean section in Ekiti State, Nigeria

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Abstract

Cephalopelvic disproportion (CPD) is a previously undiagnosed anatomical misfit between maternal pelvis and the fetal head. It is one of the major indications for Cesarean section (CS), especially in sub-Saharan Africa. Early diagnosis, could avert events that can increase maternal and perinatal morbidity and mortality associated with this condition. This study was designed to determine the mean head circumference of the fetus in relation to CPD as an indicator for Cesarean section. A total of 350 parturients who had spontaneous vaginal deliveries (group A) were compared with another 350 parturients who had cephalopelvic disproportion leading to CS (group B). The socio-demographic characteristics, delivery parameters, head circumference, fetal weight and length were recorded in a proforma and analyzed using SPSS version 21. P value was set at 0.05. The mean head circumference for the all the babies delivered in this study was 34.6 ± 1.7cm. The mean head circumference of babies delivered to women with CPD via Cesarean section compared to those who had vaginal delivery was significantly greater (35.1 ± 1.5 vs 34.1 ± 1.8, mean difference 1.9±0.1, X2, 0.308 p<0.001). The cut-off for diagnosis of cephalopelvic disproportion was head circumference 34.8cm which has a specificity of about 74% and sensitivity of 88% with area under the curve being 66%. The study demonstrated that when the head circumference of a baby is 34.8cm and above, the risk of having cephalopelvic disproportion leading to a CS is high with sensitivity of 88% and specificity of about 74%. (Afr J Reprod Health 2023; 27[6]: 154-159).

Keywords: Cephalopelvic disproportion, head circumference, caesarean section, spontaneous vaginal delivery

Résumé

La disproportion céphalo-pelvienne (CPD) est une inadéquation anatomique non diagnostiquée entre le bassin maternel et la tête fœtale. C'est l'une des indications majeures de la césarienne (CS), notamment en Afrique subsaharienne. Un diagnostic précoce pourrait éviter des événements susceptibles d'augmenter la morbidité et la mortalité maternelles et périnatales associées à cette affection. Cette étude a été conçue pour déterminer le périmètre crânien moyen du fœtus par rapport à la CPD comme indicateur de césarienne. Un total de 350 parturientes ayant eu des accouchements vaginaux spontanés (groupe A) ont été comparés à 350 autres parturientes qui présentaient une disproportion céphalo-pelvienne entraînant une CS (groupe B). Les caractéristiques sociodémographiques, les paramètres d'accouchement, le périmètre crânien, le poids et la longueur du fœtus ont été enregistrés dans un formulaire et analysés à l'aide de SPSS version 21. La valeur P a été fixée à 0.05. Le périmètre crânien moyen pour tous les bébés nés dans cette étude était de 34,6 ± 1,7 cm. Le périmètre crânien moyen des bébés nés de femmes atteintes de DPC par césarienne par rapport à ceux ayant accouché par voie basse était significativement plus élevé (35,1±1,5 vs 34,1±1,8, différence moyenne 1,9±0,1, X2, 0,308 p<0,001). Le seuil pour le diagnostic de disproportion céphalo-pelvienne était le tour de tête de 34,8 cm, ce qui a une spécificité d'environ 74 % et une sensibilité de 88 %, l'aire sous la courbe étant de 66 %. L'étude a démontré que lorsque le tour de tête d'un bébé est de 34,8 cm et ci-dessus, le risque d'avoir une disproportion céphalo-pelvienne conduisant à un CS est élevé avec une sensibilité de 88 % et une spécificité d'environ 74 %. (Afr J Reprod Health 2023; 27[6]: 154-159).

Mots-clés: Disproportion céphalo-pelvienne, circonférence crânienne, césarienne, accouchement vaginal spontané

Introduction

Cephalopelvic disproportion (CPD) is a previously undiagnosed anatomical misfit between maternal pelvis and the fetal head. It is one of the major indications for Caesarean section in the world and especially in sub-Saharan Africa1,2. The incidence of CPD in Maiduguri northern Nigeria is about 65.3%5
while it is about 36.0% and 19.3% in a study done in the south –south and Lagos Nigeria respectively.10,11 It is important to diagnose CPD early as it is the major cause of obstructed labour which continues to plague thousands of women each year with its associated morbidity and mortality, and this occurs mostly in sub-Saharan Africa.1 CPD is the term used to describe a situation where there is a total halt to the progress of labour due to mechanical reasons, despite good uterine contractions, in which surgical assistance is needed to prevent feto-maternal jeopardy.1 It is the leading cause of obstructed labour with its attendant sequelae. Ubom et al in a study done in Ile Ife showed that about 94% of women who had obstructed labour was as a result of previously undiagnosed CPD. Nulliparity and low socio-economic status, have been implicated as risk factors for CPD and obstructed labour.12,13

If the diagnosis of disproportion is made early, these adverse events can be averted resulting in better maternal and perinatal outcomes. Severe birth asphyxia is one of the most feared complication of cephalopelvic disproportion, cerebral palsy, puerperal sepsis, uterine rupture and fistulae.13 Several factors have been described to contribute to cephalopelvic disproportion, the most important of which is the fetal head being bigger than the maternal bony pelvis. A normal pelvis should be gynecoid in shape with anterioposterior diameter of inlet, middle cavity and outlet being 11cm,12cm and 13cm respectively. Transverse diameter on pelvic inlet, middle cavity, and outlet being 13cm, 12cm and 13cm respectively. A pelvis is said to be borderline when any of its diameter is 0.5cm short of the normal dimension, contracted when it is 1cm less in two perpendicular planes.1,5,6 Women who had rickets, poliomyelitis or previous injury to the pelvic bone may be at increased risk of developing cephalopelvic disproportion because the bones and muscles affected would have led to abnormality of the pelvis, and malpositioning have all been implicated in CPD.

To date, there is paucity of data on head-circumference as a risk factor for cephalopelvic disproportion. Damitew et al1 concluded in their study in Ethiopia that studies on fetal head size and maternal age need to be researched in-depth to assess their accuracy in predicting CPD. The problems of late detection is particularly grave in the developing world where the mother may go into labor in facilities that lack minimum standards to perform cesarean section. Hence, another reason to identify people at risk in order to avert this untoward complication.

The objective of this study is to determine the mean head circumference at the time of delivery in Ekiti state and its relationship to cephalopelvic disproportion. The results would be useful for recommendations on the prevention of CPD and its sequelae in Nigeria.

**Methods**

**Study location**

The study was carried out at the Labour ward unit of Ekiti State University Teaching Hospital (EKSUTH). EKSUTH is one of the two teaching hospitals in Ekiti State. It serves as a referral hospital to private and public primary health institutions in surrounding towns in Ekiti State, parts of Ondo, Osun and Kogi States. Ado Ekiti, the state capital has about 446,749 people from 2006 population census and it is situated at an elevation of 439 metres above sea level.

**Study design**

The study was a case control study.

**Study duration**

The study was carried out over a 5 year period.

**Inclusion criteria**

This comprised consecutive consenting pregnant women who had caesarean section secondary to CPD and those who had SVD at term in EKSUTH. All preterm deliveries were excluded. This prospective analysis was carried out on 700 women, three hundred and fifty women (350) who had successful vaginal delivery and 350 women who had emergency lower segment caesarean section on
account of cephalopelvic disproportion. The socio-demographic data include maternal age, educational background, religion, parity and gestational age of delivery whether below, at or above the expected date of delivery were retrieved from their case files. Using a convenience sampling technique, 350 consecutive women who had caesarean section on account of cephalopelvic disproportion as diagnosed by either the consultant or senior registrar and 350 consecutive women who had spontaneous vaginal deliveries were recruited into the study and immediately the babies were delivered and cleaned up, the head circumferences were measured using non-elastic tape measures held around the occiput, above the eyebrows and ears with the inches side facing up. This was done by trained nurses using the above landmarks. The length of the baby was also measured from the head to the heel of the foot. Also the fetal weight and sex were also noted.

**Data collection and analysis**

Baseline data included maternal age, occupation, religion, educational status, parity and booking status. Other parameters include baby head circumference, baby length, and weight.

1. Primary outcome measure includes:
   a. Mean head circumference of babies at which CPD will occur.
   2. Secondary outcomes include the following:
   b. Mean head circumference of babies in Ekiti state.

Data collected was entered into and analysed using Statistical Software for Social Sciences version 21 (SPSS 21). Continuous variables were analysed using mean and standard deviation while categorical variables were presented in frequency and percentages. Test of significance was done with Student t-test or ANOVA for continuous variable, while chi-square test and Fischer’s exact test were used for categorical variables. Level of significance is set at a P value of less than 0.05(P<0.05). Sensitivity, specificity and with their 95% confidence intervals (CI) were calculated using these thresholds.

**Ethical considerations**

The study was explained to the women and only those who accepted to participate in the study and gave informed consent were included in the study, the study was approved by the Ethics and Research Committee of the Ekiti State University Teaching Hospital, Ado-Ekiti EKSUTH/A86/2018/03/009.

**Results**

Seven hundred women, three hundred and fifty women (350) who had successful vaginal delivery and 350 women who had emergency lower segment caesarean section on account of cephalopelvic disproportion were recruited into the study.

Table 1 shows that the mean head circumference of babies in both groups (Spontaneous vagina delivery and Caesarean section) was (34.6 ±1.7cm). The mean head circumference of babies of women who had Caesarean section was 35.1 ±1.5cm, while those who had SVD was (34.1± 1.8cm). The difference of 1.93 ± 0.1cm, was statistically significant X² =0.4, P<0.001.

**Table 1:** The mean head circumference of babies in both groups

<table>
<thead>
<tr>
<th></th>
<th>Vaginal delivery</th>
<th>Caesarean section</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age</td>
<td>Maternal age</td>
<td>Maternal age</td>
<td>Maternal age</td>
</tr>
<tr>
<td>Weight</td>
<td>Weight</td>
<td>Weight</td>
<td>Weight</td>
</tr>
</tbody>
</table>

While about 399 (57.2%) of participants were multipara, only 298 (42.8%) were primipara. About 294 women both in the SVD and CS group (42.2%) delivered below their expected date of delivery 37-39 weeks 6 days, 16.5% of both groups at the expected date of delivery (40weeks), only 41.3% of both groups delivered after the due date (>40weeks). Concerning the sex ratio, 369 (52.9%) of the babies were male while 328(47.1%) were females. Figure 1 shows that the cut off for diagnosis of cephalopelvic disproportions was head.
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Head circumference, as predictor of cephalopelvic disproportion and 1.4 for SVD and C/S respectively. In the same vein the weight of the babies were comparable as both groups have average birth weight of 3.0kg. In addition, CPD was common among primigravida (P<0.001). The study showed that babies with mean weight 3.4±0.5kg are likely to have CPD, p=0.001.

Table 3: Comparative analysis between the EDD, parturients age and mode of delivery

<table>
<thead>
<tr>
<th>Expected Date of delivery</th>
<th>SVD (%)</th>
<th>C/S (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below EDD</td>
<td>176 (59.90)</td>
<td>118 (40.10)</td>
<td>0.00</td>
</tr>
<tr>
<td>At EDD</td>
<td>55 (47.80)</td>
<td>60 (52.20)</td>
<td>0.02</td>
</tr>
<tr>
<td>After EDD</td>
<td>119 (58.70)</td>
<td>169 (41.30)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age of women</th>
<th>SVD (%)</th>
<th>C/S (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;19</td>
<td>2 (50.00)</td>
<td>2 (50.00)</td>
<td>0.02</td>
</tr>
<tr>
<td>20-24</td>
<td>37 (52.90)</td>
<td>33 (47.10)</td>
<td></td>
</tr>
<tr>
<td>25-29</td>
<td>102 (52.50)</td>
<td>144 (47.50)</td>
<td></td>
</tr>
<tr>
<td>30-34</td>
<td>141 (58.10)</td>
<td>119 (41.90)</td>
<td>0.00</td>
</tr>
<tr>
<td>&gt;35</td>
<td>68 (58.10)</td>
<td>49 (41.90)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows those who delivered below the EDD 179 (59.9%) had SVD while 118(40.1%) had C/S secondary to cephalopelvic disproportion. Those who delivered at exactly 40 weeks, 55 (47.8%) had SVD and 60(52.2%) had C/S secondary to CPD. Among those who delivered above 40 weeks, 119(41.3%) had SVD and 169(58.7%) had C/S. This result shows that as the gestational age increases the risk of having C/S secondary to cephalopelvic disproportion. About 58.1% of babies born after EDD while 40.1% of those born below EDD had CPD (P=0.001). CPD was commoner in parturients aged 19years and below compared with those between 25-29 years (P=0.015).

**Discussion**

Cephalopelvic disproportion is a misfit between the fetal head and maternal pelvis for which the baby may not safely pass through\(^1\text{,}^4\). It is one of the leading causes of re-course to Caesarean Section in
Head circumference, as predictor of cephalopelvic disproportion

our environment. Diagnosis is usually made in the presence of prolonged labour (first stage > 12 hrs.) in spite of adequate uterine contractions with failure of descent and most especially with progressive moulding or prolonged second stage with fetal distress1, with comparable age groups of parturients. Parity and fetal weight, this substantiate the discussion in this work.

The mean age of patient with cephalopelvic disproportion in the study was 29.6 yrs. ± 4.2 years which was higher than 21.7 ± 3.7 years reported in a study conducted in several places3,4,6,7. This may be because early marriage was common there, or because of the inclusion of teenage pregnancy in their study, which could be a great co-founder as we know teenage pregnancy is a risk factor for CPD, this negate this study with mean age of parturients with CPD being 29.6±4.2 years. The occurrence of CPD in this study was about 14%, as a total of 350 parturients had CPD out of about 2500 parturients who delivered within the 5 year period of this study. This is higher than 10% found in Ethiopian Study4, “Age, anthropometric measurements and mode of delivery among primigravidae at Addis Ababa, Ethiopia”. This may be due to mixed population used in this study. Furthermore, its incidence is still lower than the incidence of CPD 32.3% reported by Benjamin et al.2.

The mean head circumference of 34.6 ± 1.7 cm in this study was in tandem with the mean infant head circumference of 34.44/−2.1 cm gotten by Pam et al. in their study9. Overall, this study shows that, when the head circumference is ≥ 35.1±1.5 cm, the probability of having Cephalopelvic disproportion is higher.

**Limitation**

No study has been able to correlate head circumference with possible bi-parietal diameter or occipito-frontal circumference since they are the only measurable parameters in-utero, unless transperineal scan will be done for its assessments. More studies are needed to correlate what BPD will equate head circumference of 35.1±1.5 cm.

**Conclusion**

The study demonstrated that when the mean head circumference of a baby is 35.1 cm and above the risk of having cephalopelvic disproportion leading to a C/S is high with sensitivity of 88% and specificity of about 74%. Also, if the parturient is a primigravida, age 29 years and above, and the expected date of delivery has passed, the risk of having CPD is high.

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**References**


