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 caesarean 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 caeserean section compared to those who had vaginal delivery was significantly greater (35.15±1.5 vs 34.1±1.8, mean difference 1.9±0.1, X^2,0.308 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[6s]: 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 céphalopelvienne 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 (35,15±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 céphalopelvienne 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 céphalopelvienne conduisant à un CS est élevé avec une sensibilité de 88 % et une spécificité d'environ 74 %. *(Afr J Reprod Health 2023; 27[6s]: 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-SaharanAfrica[1,2]. 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[2–4]. 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 jeopady[1]. it is the leading cause of obstructed labour with its attendant sequeale. 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 peuperal 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, mid-cavity and outlet as 13cm, 12cm and 11cm respectively and oblique diameter of inlet, mid-cavity, outlet 12cm,12cm and 12cm 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 ricket, 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 even the gait of the woman in addition macrosomia, 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 al*[1] concluded in their study in Ethiopia that studies on fetal head size and maternal age need to be researched in-depth to access their accuracy in predicting CPD[1].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[1]. 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 5year 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 X^2 =0.4, P<0.001.

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

Mean (×)	Vaginal delivery	Caesarean section	P-value
Maternal age	30.31	29.63	0.227
Parity	1.73	1.41	0.026
Head circumference	34.11	35.14	0.01
Weight	3.11	3.39	0.027

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

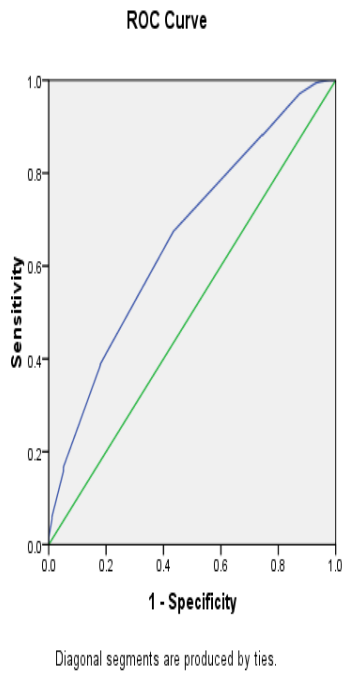

Figure 1: Cut off 34.75, specificity 74% sensitivity 88% AOC 66%

circumference of 34.8cm which has a specificity of about 74 % and sensitivity of 88%. This result was obtained with the area under the curve analysis being 66%.

Table 2: Compare mean age, parity and weight with CPD and SVD

	Mean	Std. Deviation	t-value	P-Value
Age				
CPD	29.63	4.23	-2.022	0.04
SVD	30.31	4.64		
Parity				
	1.41	0.49	-8.99	0.00[X]
CPD	1.73	0.44		
SVD				
Weight				
CPD	3.39	0.50	7.23	0.00[x]
SVD	3.11	0.53		

Table 2 illustrate the mean age of parturients with CPD was 29.6 years, it shows that the age group is comparable as the mean age group in SVD group was 30 while the age group for those who has C/S was 29 years. The parity for both group was 2, 1.7 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, paturients age and mode of delivery

	SVD (%)	C/S (%)	P-value
Expected Date of delivery			
Below EDD	176 (59.90)	118 (40.10)	0.00
At EDD	55 (47.80)	60 (52.20)	
After EDD	119 (41.30)	169 (58.70)	
Age of women			
< 19	2 (50.00)	2 (50.00)	
20-24	37 (52.90)	33 (47.10)	0.02
25-29	102 (41.50)	144 (58.50)	
30-34	141 (54.20)	119 (45.80)	
>35	68 (58.10)	49 (41.90)[x]	

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[1–4]. It is one of the leading causes of re-course to Caesarean Section in

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 distress[1], with comparable age groups of parturients. Parity and fetal weight, this substanciate 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 ±3.7years reported in a study conducted in several places[3,4,6,7]. 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±4.2years. The occurrence of CPD in this study was about 14%, as a total of 350 paturients had CPD out of about 2500 paturients who delivered within the 5 year period of this study. This is higher than 10% found in Ethiopian Study[1], "Age, anthropometric measurements and mode of delivery among primigravida 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 ± 1.7cm in this study was in tandem with the mean infant head circumference of 34.4+/-2.1cm gotten by Pam *et al* in their study[9]. Overall, this study shows that, when the head circumference is ≥ 35.1±1.5cm, 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 trans-perineal scan will be done for its assessments. More studies are needed to correlate what BPD will equate head circumference of 35.1±1.5cm.

Conclusion

The study demonstrated that when the mean head circumference of a baby is 35.1cm 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 29years and above, and the expected date of delivery has passed, the risk of having CPD is high.

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References

1. Solomon D, Dirar A and Getachew F. Age, Anthropometric Measurements and Mode of Delivery among Primigravidae Women at Addis Ababa Governmental Hospitals, Ethiopia. *J Women's Health Care*. 2018;07(01). doi:10.4172/2167-0420.1000418
2. Benjamin SJ, Daniel AB, Kamath A and Ramkumar V. Anthropometric measurements as predictors of cephalopelvic disproportion: Can the diagnostic accuracy be improved? *Acta Obstet Gynecol Scand*. 2012;91(1):122-127. doi:10.1111/j.1600-0412.2011.01267.x
3. Ayenew AA. Incidence, causes, and maternofetal outcomes of obstructed labor in Ethiopia: systematic review and meta-analysis. *Reprod Health*. 2021;18(1):1-14. doi:10.1186/s12978-021-01103-0
4. Konje JC and Ladipo OA. Nutrition and obstructed labor. *Am J Clin Nutr*. 2000;72(1):291S-297S. doi:10.1093/ajcn/72.1.291S
5. Bako. Prevalence, risk factors, and outcomes of obstructed labor at the University of Maiduguri Teaching Hospital, Maiduguri, Nigeria. Accessed May 13, 2022. https://www.smjonline.org/article.asp?issn=1118-8561;year=2018;volume=21;issue=3;spage=117;epage=121;aulast=Bako
6. Elimam M, Mohamed E, Abdalla S and Osman A. Age, anthropometric measurements and mode of delivery in nulliparous women at Omdurman Maternity Hospital. *Khartoum Med J*. 2010;3:489-493.
7. Shiferaw CB, Yallew WW and Tiruneh GT. Maternal Anthropometric Measurements Do Not Have Effect on Birth Weight of Term, Single, and Live Births in Addis Ababa City, Ethiopia. *J Pregnancy*. 2018;2018:e1982134. doi:10.1155/2018/1982134
8. Boucher T, Farmer L, Moretti M and Lakhi NA. Maternal anthropometric measurements and correlation to maternal and fetal outcomes in late pregnancy. *Womens Health*. 2022;18:17455065221076736. doi:10.1177/17455065221076737

9. Pam VC, Yilgwan CS, Shwe DD, Abok I, Shehu N, Gomerep SS, Ejiji IS, Ocheke A, Ajang FM, Mutihir JT, Gurumdimma N, Egah D and Oguche S. Head Circumference of Babies at Birth in Nigeria. *J Trop Pediatr*. 2019;65(6):626-633. doi:10.1093/tropej/fmz024
10. Allagoa DO, Oriji PC, Tekenah ES, Obagah L, Ohaeri SO, Mbah KM, Ikoro C, Wagio TJ, Nwanze NC and Atemie G. Caesarean section in a Tertiary Hospital in South-South, Nigeria - A 3-year review. European Journal of Medical and Health Sciences. 2021; 3. 122 - 127. 10.24018/ejmed.2021.3.2.778.
11. Akinola OI, Fabamwo AO, Tayo AO, Rabiu KA, Oshodi YA and Alokha ME. Caesarean section – an appraisal of some predictive factors in Lagos Nigeria. *BMC Pregnancy Childbirth* **14**, 217 (2014). https://doi.org/10.1186/1471-2393-14-217
12 Ubom AE, Ijarotimi OA, Ogunduyile IE, Omilakin A, Nyeche S, Igbodike EP, Emmanuel OO, Orji EO, Ikimalo JI and Adeyemi AB. Obstructed labour in a Nigerian tertiary health facility: a mixed-method study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2021; 10. 2937. 10.18203/2320-1770.ijrcog20212937.
13 Anikwe CC, Ikeoha CC, Ogah CO, Kalu CA and Anikwe IH. A five-year retrospective review of the maternal and feotal outcome of obstructed labour and its determinants in a tertiary hospital in Nigeria. Afri Health Sci. 2022;22(2): 500-510.