CLINICAL STUDY

Can Transvaginal Ultrasound Predict Cephalopevic Disproportion?

Kerime **BİNİCİ**, Gökhan **YILDIRIM**, Gonca **YILDIRIM**, Ali İsmet **TEKİRDAĞ**

Bakırköy Training and Research Hospital of Maternity and Children, Department of Obstetrics and Gynecology, Istanbul, Turkey

Received 12 November 2005; received in revised form 14 April 2006; accepted 29 April 2006

Abstract

Objective: To assess a method of antepartum diagnosis of cephalopelvic disproportion by comparing the diameters of fetal head with those of the maternal midpelvis.

Materials and Methods: Transvaginal ultrasound pelvimetry was performed on 205 healthy primigravidas with cephalic presentation at 24-35 weeks of gestation by measuring the mid-pelvis anteroposterior and transverse diameter. Fetal head measurements were taken within one week before delivery. The cephalopelvic diameter index, cephalopelvic circumference index and cephalopelvic area index were calculated and compared.

Results: Three of the indices exhibited the same sensitivity, specificity, positive and negative predictive values. In the cases, 93.7% of them with cephalopelvic area index more than 1113 mm^2 underwent vaginal delivery and 38.7% of cases with cephalopelvic area index less than 1113 mm^2 needed operative delivery. Accuracy for the cephalopelvic area index was calculated 77.1%.

Discussion: The cephalopelvic area index and the other indices may be used to identify cephalopelvic disproportion before labor. More sophisticated methods are needed for the prediction of cephalopelvic disproportion.

Keywords: ultrasound pelvimetry, transvaginal ultrasonography, cephalopelvic disproportion

Özet

Transvaginal Ultrasonografi Baş-Pelvis Uygunsuzluğunu Belirleyebilir mi?

Amaç: Maternal orta pelvis ve fetal kafa ultrasonografik ölçümlerinin karşılaştırılmasıyla antepartum dönemde baş-pelvis uygunsuzluğu öngörülüp öngörülemeyeceği araştırılmıştır.

Materyal ve Metot: İki yüz beş sağlıklı primigravid, baş prezentasyonu olan gebeye 24.-35. haftalar arasında transvajinal ultrasonografi ile pelvimetri yapılarak orta pelvis ön-arka ve transvers çapları ölçüldü. Doğumdan bir hafta önce fetal ultrasonografi yapılarak bipariyetal ve oksipito-frontal çaplar ölçüldü. Çap, çevre ve alan için sefalopelvik indeksler hesaplandı ve değerlendirildi.

Sonuç: İndekslerin üçü de benzer duyarlılık, özgüllük, pozitif ve negatif tanımlama değerleri gösterdi. Alana göre sefalo-pelvik indeks için hesaplanan değeri 1113 mm^2'nin üstünde olan hastaların %93.7'si normal vajinal doğum yaparken, alana göre sefalo-pelvik indeks değeri 1113 mm^2 ve altında olan hastaların %38.7'si operatif (sezaryen veya vakum ekstraksiyon) doğum yaptı. Alana göre sefalo-pelvik indeks için doğruluk değeri %77.1 hesaplandı.

Tartışma: Alana göre sefalo-pelvik indeks ve diğer sefalopelvik indeksler baş-pelvis uygunsuzluğu öngörüsünde, özellikle normal doğurabilecek hastaları ayırt ederek kalanlar üzerine yoğunlaşmayı sağlayarak yardımcı olabilir. Baş-pelvis uygunsuzluğu öngörüsünde kullanılacak ideal yöntemi bulmak için daha kapsamlı yöntemlere ihtiyaç vardır.

Anahtar sözcükler: ultrasonografik pelvimetri, transvaginal ultrasonografi, baş-pelvis uygunsuzluğu

Introduction

Dystocia, literally meaning difficult labor, is characterized by abnormally slow progress of labor. As a generalization, abnormal labor is common whenever there is disproportion between the presenting part of the fetus and the birth canal. In the cephalic presentation, dystocia is the most common current indication for primary cesarean delivery. CPD (cephalopelvic disproportion) arises from diminished pelvic size, excessive fetal size, or more usually combination of both. Any contraction of the pelvic diameters diminishing the capacity of the pelvis can result in dystocia during labor. There may be contractions of the pelvic inlet, the midpelvis, the pelvic outlet, or a generally contracted pelvic caused by combinations of those. Since CPD may occur at the levels

Corresponding Author: Dr. Gökhan Yıldırım
F. Kerim Gökay Cad. 250/18 Göztepe, 34730 İstanbul, Türkiye
Phone : +90 212 543 62 70/449
GSM : +90 505 387 02 86
E-mail : gokhan73yildirim@yahoo.com

of pelvic inlet, outlet and midcavity, its diagnosis relies on measurement of the three levels in combination with evaluation of the fetal head size. In order to estimate pelvic capacity, clinical pelvimetry, x-ray pelvimetry, computed tomographic scanning (CT) and magnetic resonance imaging (MRI) methods were used. X-ray pelvimetry may cause injury to the fetus. The accuracy of the computed tomographic scanning is greater than that of conventional x-ray pelvimetry, it is easier than to perform, and costs are comparable. The advantages of MRI include the lack of ionizing radiation, accurate pelvic measurements, complete fetal imaging, as well as the potential for evaluating causes for soft tissue dystocia (1). Currently its use is limited, because of expense, time involved for adequate imaging studies and equipment availability.

High frequency panoramic ultrasonography appears to be a promising alternative (2). It is relatively easy to perform and safe for fetus and can accurately assess the cephalic situation. In this study, we used transvaginal ultrasound pelvimetry and ultrasound measurement of fetal head to calculate the cephalopelvic index in order to help obstetricians for choosing the appropriate form of delivery and decrease the incidence of perinatal complications.

Materials and Methods

From May 2004 to October 2004, at the Department of Obstetrics and Gynecology, Bakırköy Training and Research Hospital of Maternity and Child, transvaginal ultrasound was performed on 231 healthy primigravidas with cephalic presentation at 24-35th weeks of gestation, and fetal biparietal diameter (BPD) was measured using ultrasound before delivery. Because pelvic diameters normally increase with gestational age we measured the pelvis at 24-35 weeks. After 35 weeks, the engaged fetal head may affect transvaginal ultrasound pelvimetry. The study protocol was approved by the institutional ethical committee (date: 09.09.2004, number:45), and written consent was obtained from all of the women.

We used Siemens Sonoline G-50. The frequency of the transvaginal probe is 6-9 MHz with a scanning angle of 140 degrees while the frequency of the abdominal linear probe is 2.5-5 MHz.

The transvaginal probe was inserted into vagina after the bladder was emptied. The longitudinal section was scanned first. To measure the anterior-posterior diameters of the midpelvis, both the pelvis and the sacrum had to be clearly shown in the same plane. The anterior-posterior diameter of the midpelvis (APDm) was defined as the distance between the internal bottom of the symphysis pubis and the midpoint of the fourth and fifth sacral vertebrae. To measure the transverse diameters, the probe was rotated 90 degrees and the handle was dropped so that both sides of pelvis can be visualized symmetrically. The transverse diameter of the midpelvis (TDm) was the interspinous distance. Every diameter was measured twice and the mean of the two values was then used. For measurement of fetal BPD (biparietal diameter), OFD (occipitofrontal diameter) and head circumference (HC), standard measurement of fetal head was used (Figure 1).

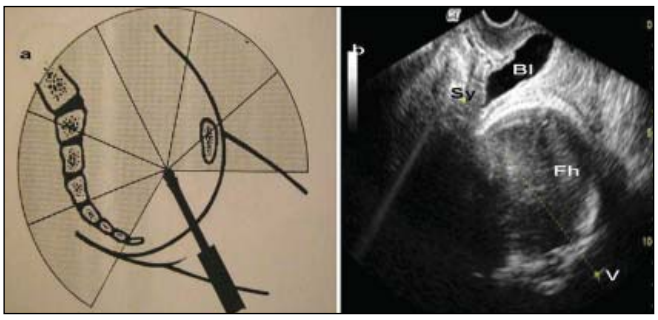

Figure 1a. Measurment of anterior-posterior diameter of midpelvis by transvaginal ultrasound
b. Transvaginal ultrasound image (Sy: internal bottom of the symphysis pubis; Bl: bladder; Fh: fetal head; V: fourth and fifth sacral vertebrae).

For definitions, standards and calculation of cephalopelvic diameter index, cephalopelvic circumference index and cephalopelvic area index, the midpelvic circumference (MC), midpelvic area (MA) and fetal head area (HA) were calculated according to the elliptic formula;

MC: (APDm + TDm) x 1.57
MA: APDm x TDm x 0.79
HC: (BPD x OFD) x 1.57
HA: BPD x OFD x 0.79

For prediction of cephalopelvic disproportion, formulas of Bian et al. were used. (3) Cephalopelvic diameter index was defined as the difference between the mean of APDm and TDm and BPD, i.e. [$^1/_2$ (APDm + TDm) - BPD]. CPD was suspected when cephalopelvic diameter index was equal to or less than 17.7 mm; if cephalopelvic diameter index was greater than 17.7 mm, no CPD was identified. Cephalopelvic circumference index was defined as the difference between midpelvic circumference and HC (MC–HC). CPD was suspected when cephalopelvic circumference index equal to or less than 24.18 mm; if cephalopelvic circumference index was greater than 24.18 mm, no CPD was identified. Cephalopelvic area index was identified as the difference between midpelvic area and fetal head area (MA–HA). CPD was suspected when cephalopelvic area index was equal to or less than 1113.04 mm^2; if cephalopelvic area index was greater than 1113.04 mm^2, no CPD was identified.

All patients were delivered in the same hospital. Twenty-six of them underwent cesarean section due to factors unrelated the pelvis, such as fetal distress, pelvic mass, ablatio placenta, intrauterine growth retardation, breech presentation etc. The rest, 205 cases, were divided into two

groups; vaginal delivery group, including 172 cases spontaneous vaginal delivery and operative vaginal delivery, including 30 cesarean sections and 3 vacuum extractions. The criteria for vacuum extraction were the true BPD being at or lower than the level of 2 cm below the ischial spine. The indications for cesarean sections were clinical suspected CPD. The three indices, cephalopelvic diameter index, cephalopelvic circumference index and cephalopelvic area index were compared in terms of their positive predictive value, sensitivity, specificity and accuracy. The t-test was used to determine statistical significance.

Results

The mean age of the patients was 22.94±2.99 (range 17-35). For vaginal and operative delivery, the mean patient age was 22.83±3.01 and 23.52±2.86 respectively. There were no statistical differences between the vaginal and operative delivery.

In study group, the measurement of APDm mean was 127.11 mm (range 92.40-163.80 mm). In vaginal and operative delivery groups, mean APDm was 127.6 mm and 125.9 mm, respectively. There were no statistical differences between the two groups. The mean of the BPD was 93.15 mm (range 82.00-105.30 mm). Vaginal and operative delivery groups, mean BPD was 92.77 and 95.15 mm, respectively. Differences between the two groups were statistically significant ($p<0.05$). The mean of the OFD was 114.65 mm (range 100-131.7 mm). Vaginal and operative delivery groups, mean OFD was 114.11 and 117.46 mm, respectively. Differences between the two groups were statistically significant ($p<0.05$) (Table 1).

In order to calculate the cephalopelvic indices, circumference and area measurements of pelvis and fetus were recorded. In table 2, mean and standard deviation of the results according to the birth route is shown. Results were statistically significant ($p<0.05$) (Table 2). The measurements of the fetus and the pelvis were used to calculate cephalopelvic diameter, cephalopelvic circumference and cephalopelvic area indices. For each indices positive predictive value, negative predictive value, sensitivity, specificity and accuracy were calculated (Table 3) (Figure 2).

Between the groups of vaginal and operative delivery, there were significant differences for the three cephalopelvic indices, cephalopelvic diameter, cephalopelvic circumference and cephalopelvic area index (Table 4).

The 205 primigravidas were classified into two categories in terms of their cephalopelvic diameter index values, i.e. cephalopelvic diameter index ≤17.7 mm and >17.7 mm. Out of 60 cases with cephalopelvic diameter index ≤17.7 mm, 20 (33.3%) underwent cesarean section, 2 (3.4%) underwent vacuum extraction and 38 (63.3%) resulted in spontaneous vaginal delivery. The cephalopelvic diameter index values of the rest 145 cases were greater than 17.7 mm. Of these cases, 10 (6.9 %) underwent cesarean section, 1 (0.7%) vacuum extraction and 138 (92.4%) spontaneous vaginal delivery (Table 5).

Table 1. Mean values and standard devitations of study groups

	Route of delivery	n	Mean	Standard deviation
APDm	VD	172	127.5	9.9
	Operative	33	125.3	9.4
TDm	VD	172	101.4	6.996
	Operative	33	98.9	7.3
BPD	VD	172	92.8	4.4
	Operative	33	95.1	4.9
OFD	VD	172	114.1	5.5
	Operative	33	117.5	4.5

APDm: antero-posterior diameter of the midpelvis; TDm: transverse diameter of the midpelvis; BPD: biparietal diameter, OFD: occipito-frontal diameter; VD: spontaneous vaginal delivery.

Table 2. Mean and standard deviations of the midpelvic circumference, head circumference, midpelvic area and head area values, calculated according to tha delivery route

	Route of delivery	n	Mean	Standard deviation	P value
MC	VD	172	359.3	18.3	<0.05
	Operative	33	351.99	19.6	
	Total	205	358.1	18.7	
MA	VD	172	10206.4	1018.0	<0.05
	Operative	33	9795.4	1091.0	
	Total	205	10140.2	1038.4	
HC	VD	172	324.8	13.7	<0.05
	Operative	33	333.8	12.6	
	Total	205	326.3	13.9	
HA	VD	172	8373.4	702.5	<0.05
	Operative	33	8837.02	682.1	
	Total	205	8448.03	718.2	

MC: midpelvic circumference; MA: midpelvic area; HC: head circumference; HA: head area; VD: spontaneous vaginal delivery.

Table 3. Predictive values for cephalopelvic disproportion of the cephalopelvic indices

	CID		CIC		CIA	
	%	n	%	n	%	n
Positive predictive value	36.7	22/60	33.8	24/71	38.7	24/62
Negative predictive value	92.4	134/145	93.3	125/134	93.7	134/143
Sensitivity	66.6	22/33	72.7	24/33	72.7	24/33
Specificity	77.9	134/172	72.7	125/172	77.9	134/172
Accuracy	76.1	156/205	72.7	149/205	77.1	158/205

CID: cephalopelvic diameter index; CIC: cephalopelvic circumference index; CIA: cephalopelvic area index.

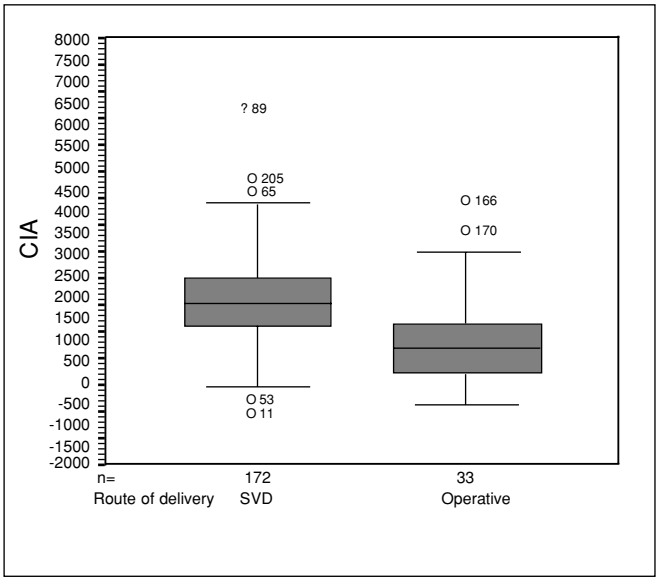

Figure 2. The distribution of the CIA according to route of delivery (95%) (CIA: cephalopelvic area index; SVD: spontaneous vaginal delivery).

Table 4. Mean and standard deviation values of cephalopelvic indices according to route of delivery

	Route of delivery	n	Mean	Standard deviation	P value
CID	VD	172	21.7	5.86	
	Operative	33	16.95	6.06	<0.001
	Total	205	20.9	6.14	
CIC	VD	172	34.5	17.81	
	Operative	33	18.2	20.25	<0.001
	Total	205	31.9	19.14	
CIA	VD	172	1832.99	962.56	
	Operative	33	958.34	1138.08	<0.001
	Total	205	1692.2	1040.99	

CID: cephalopelvic diameter index; CIC: cephalopelvic circumference index; CIA: cephalopelvic area index; VD: spontaneus vaginal delivery.

Table 5. The diagnosis of CID and delivery results

Route of delivery		CID				Total	
		≤17.7 mm		>17.7 mm			
Spontaneus vaginal delivery		n	%	n	%	n	%
		38	63.3	134	92.4	172	83.9
Operative	Cesarean section	20	33.3	10	6.9	30	14.6
	Vacuum	2	3.4	1	0.7	3	1.5
Total		60	100	145	100	205	100

CID: cephalopelvic diameter index

Discussion

Size and shape of the bony pelvis are important factors determining the progress of labor and delivery. In order to evaluate of size and shape of the bony pelvis, we use clinical, x-ray, ultrasonography, CT, and MRI pelvimetry. Clinical pelvimetry is set on relatively subjective data obtained from obstetrician's vaginal examination. Pelvimetry by CT and by MRI is an exact and simple technique with low or absent ionizing radiation. These new techniques offer distinct advantages over conventional x-ray pelvimetry. Among all these modalities, ultrasonographic pelvimetry is more objective than clinical pelvimetry; more safe than x–ray and CT because of not using ionizing radiation and cheaper and accessible than MRI. In order to identify CPD and choose the optimal method of delivery, various efforts have been made to set up cephalopelvic indices. O'Brien et al. calculated fetal-pelvic index by postpartum x-ray pelvimetry and this index can be used for subsequent labors. Their indices were based on comparisons between antepartum and postpartum measurements of the pelvis (4). Abitbol et al. combined the x-ray pelvimetry with fetal sonography to calculate cephalopelvic indices. The smallest pelvic diameter (either the anteroposterior of the inlet or bispinal of the midpelvis) was measured and compared to the biparietal diameter of the fetal head at term, in order to determine cephalopelvic disproportion. Vaginal delivery was impossible when index was less than 9 mm and impossible or very difficult when between 9 and 12 mm (5). However, in a review of 4 studies assessing the effect of pelvimetry, Pattinson determined that there is not enough evidence to support the use of x-ray pelvimetry in women whose fetuses have cephalic presentation (6).

Katanozaka et al. measured ultrasonographic obstetric conjugate twice at 28 and 36 weeks of pregnancy in 209 pregnant women. In 26 of these, there is medical indication measurement of the obstetric conjugate by x-ray pelvimetry. In patient with ultrasonic obstetric conjugate less than 12 cm cesarean section rate was 50%. According to them a close positive correlation exists between ultrasonic obstetric conjugate and x-ray pelvimetry (7). Bian et al. were calculated and compared cephalopelvic indices (the cephalopelvic diameter index, circumference and area) by transvaginal ultrasonography. The cephalopelvic index of diameter showed the highest degree of accuracy (77.9%) (3). As Bian et al., we used transvaginal ultrasound to measure both the midpelvis and fetal head and chose cephalopelvic area index as the main cephalopelvic index and the accuracy was 77.1%.

Usually, obstetricians consider CPD as a possibility when clinical pelvimetry reveals contracted pelvis or ultrasound measurement indicates that the fetal head is too large. Definite diagnosis can be made only after a sufficient trial of labor. In our study, the cephalopelvic area index in 62 cases was less than 1113.04 mm^2. Of these patients,

38 (61.3%) of them were delivered vaginally, 22 them were delivered by cesarean section, 2 of them were needed vacuum extraction, total of 24 patients were needed operative labor. Hundred and forty-three patients whom cephalopelvic area index value were higher than 1113.04 mm^2, 8 of them were delivered by cesarean section and 1 of them was delivered by vacuum extraction, total of 9 (6.3%) patients were delivered by operative delivery, the number of vaginal delivery was 134 (93.7%). Sensitivity 72%, specificity 72.9% and positive predictive value which means that operative route is necessary was 38.7%, negative predictive value which means that normal labor was 93.7%.

In conclusion the cephalopelvic area index as a predictor of CPD may help obstetricians to choose the appropriate way of delivery. When cephalopelvic area index value was greater than 1113.04 mm^2, 93.7% of our cases successfully completed vaginal delivery. When the cephalopelvic area index value was less than 1113.04 mm^2 (sensitivity 72.7%, specificty 77.9%), operative vaginal delivery or cesarean section rate increases (38.7%).

In summary, neither our results nor any other study in the literature could predict cephalopelvic disproportion with 100% probability. To predict cephalopelvic disproportion, both pelvic and fetal diameters must be evaluated together.

References

1. McCarthy S: Magnetic resonance imaging in obstetrics and gynecology. Magn Reson Imaging 1986;4:59.
2. Hiedegger H: Intrapartale sonographicshe Untersuchung bei klinischem Verdacht auf Missverhaeltnis. Zentbl Gynaekol 1987;109:1387.
3. Bian X, Zhuang J, Cheng X. Combination of ultrasound pelvimetry and fetal sonography in predicting cephalopelvic disproportion. Chin Med J (Engl) 1997;110:942-5.
4. O'Brien K, Rode M, Macones G. Postpartum x-ray pelvimetry. Its use in calculating the fetal-pelvic index and predicting fetal-pelvic disproportion. J Reprod Med 2002;47:845-8
5. Abitbol MM, Taylor UB, Castillo I, Rochelson BL. The cephalopelvic disproportion index. Combined fetal sonography and x-ray pelvimetry for early detection of cephalopelvic disproportion. J Reprod Med 1991;36:369-73
6. Pattinson RC. Pelvimetry for fetal cephalic presentations at term. Cochrane Database Syst Rev. 2000;CD000161.
7. Katanozaka M, Yoshinaga M, Fuchiwaki K, Nagata Y. Measurement of obstetric conjugate by ultrasonic tomography and its significance. Am J Obstet Gynecol 1999;180:159-62.