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International Journal of Current Research
Vol. 7, Issue, 05, pp.15781-15785, May, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ASSESSMENT OF THE VALUE OF X-RAY PELVIMETRY IN PREDICTING THE OUTCOME OF LABOUR IN RURAL UGANDA

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ARTICLE INFO

Article History:
Received 07th February, 2015
Received in revised form
07th March, 2015
Accepted 03rd April, 2015
Published online 25th May, 2015

Key words:
Pelvimetry,
Anteroposterior,
Diameter,
Transverse Diameter.

ABSTRACT

Introduction: Prolonged labor have been associated with increased fetal and maternal morbidity and mortality; therefore, it is essential to identify women who are at risk of dystocia and to choose the most appropriate way of delivery at an early stage in pregnancy. X-ray pelvimetry has thus been used to identify women at risk of dystocia especially in rural health facilities of developing countries such as Uganda. However, there is still a need to review how this practice is useful in predicting the outcome of labor, and whether or not its continued use is sustained or discouraged.
Material and methods: This was a retrospective study on 200 patients at near term or in early stages of labour who had undergone X-ray pelvimetry at Mbarara Regional Referral Hospital, Western Uganda. The pelvic dimensions including anteroposterior and transverse diameters of the pelvic inlet and pelvic outlet diameters were analyzed against the expected and final modes of delivery.
Results: The average antero-posterior diameter of the pelvic outlet was 12.95 ±0.95 whilst that of the transverse diameter was14 ±0.6 cm. Of all the cases, 80% ($^{160}/_{200}$) had large pelvic inlet however 20.6% ($^{33}/_{160}$) still underwent caesarian section. The average pelvic outlet diameter was 8.4±0.4 cm.
Discussion and conclusion: In this study, pelvimetry has shown to increase the chances of caesarian section. However, its value in early detection of obstetric complications is well appreciated.

INTRODUCTION

X-ray pelvimetry is a radiologic imaging technique in which the diameters of the osseous birth canal are compared with that of the infant's head to determine whether the pelvis is of sufficient diameter to allow a normal vaginal delivery (Irurhe *et al*., 2011). It is usually performed in the late stages of pregnancy in cases of suspected cephalopelvic disproportion (CPD), breech presentation, or post-partum in patients who have had a previous caesarean section(Peultier *et al*., 2010). It may be carried out in a number of ways, including conventional plain film radiography (up to three films); computed tomography (CT) using up to three views (lateral scanogram, antero-posterior scanogram, and an axial slice); or digital radiography (Daghighi *et al.,* 2013). Pelvimetric measurements can either be done at the pelvic inlet (Pelvic brim), midpelvic cavity or at the pelvic outlet. The size of the pelvic inlet (Pelvic brim) is commonly determined during pelvimetry because it is the most common site of obstruction (Narayan and Hyett 2013). The pelvic brim or inlet separates the "false" pelvisfrom the "true" pelvis (Figure 1).

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The inlet is round in shape, with the sacral promontory protruding into it posteriorly. The pubic bones form the anterior border of the pelvic brim; the iliac bones form the lateral borders, and the posterior border is formed by the sacral promontory and its alae (Figure 2) (Maharaj 2010). The antero-posterior diameter of pelvic outlet is measured from the tip of the coccyx to the lower border of symphysis pubis (Figure 1), while the intertuberous diameter is the distance between the ischial tuberosities (Joyce *et al.,* 1975). The pelvic inlet has 3 important diameters that can be measured during X-ray investigation:Anteroposterior (APD), transverse (TD), and oblique diameters (OD) (Figure 2). The anteroposteriordiameter or obstetrical conjugate extends fromthe sacrovertebral angle (sacral promontory) to thesymphysis pubis. It is themost important diameter of the pelvic inlet since it isthe shortest distance between the sacrum and the symphysis pubis; thusit is regarded as the main cause of CPD (Lenhard *et al.,* 2010). The width of the pelvic brim forms the TD and it is the widest part of the pelvic inlet; while there are two ODs which extend from the sacroiliac joint to the iliopectineal eminence (Figure 2). Obstetricians have become more aggressive in their management of labor with an increased use of induction and caesarean section, and therefore view pelvimetryas an aid in avoiding the theoretical risk of birth injury during vaginal

delivery through an abnormal pelvis. To accommodate these philosophical differences, some radiologists have modified their pelvimetry techniques to include an image of the entire uterine contour in the anteroposterior and erect lateral views in order to improve detection of fetal abnormalities (Campbell 1976). It often appears that obstetricians utilize pelvimetry as a means of reassuring themselves that the pelvic measurements are normal in much the same way as blood counts or urinalysis are used to exclude anemia or diabetes. The question raised by radiologists is whether pelvimetry is accurate enough in sorting out those cases which are at risk in vaginal delivery to justify itsuse(Badr *et al*. 1997).

Although the procedure is rare in urban areas, rural obstetrical services in Uganda still rely heavily on X-ray pelvimetry in the third trimester of pregnancy to determine which mode of delivery viz. either normal vaginal delivery or caesarian section may be necessary(Wanyonyi *et al*., 2010). The benefit of radiological pelvimetry in predictingthe outcome of labor in cases of suspected dystocia is controversial (Catling-Paull *et al*., 2011),whilst some authors (Sataf *et al*. 2014) mention that X-ray pelvimetry in women with one previous cesarean section increases the rate of subsequent delivery by cesarean section and is a poor predictor of the outcome of labor. Other authors are of the view that fewer caesarean sections are done when X-ray pelvimetry is not used to select the mode of delivery of uncomplicated singleton breech presentation at term;

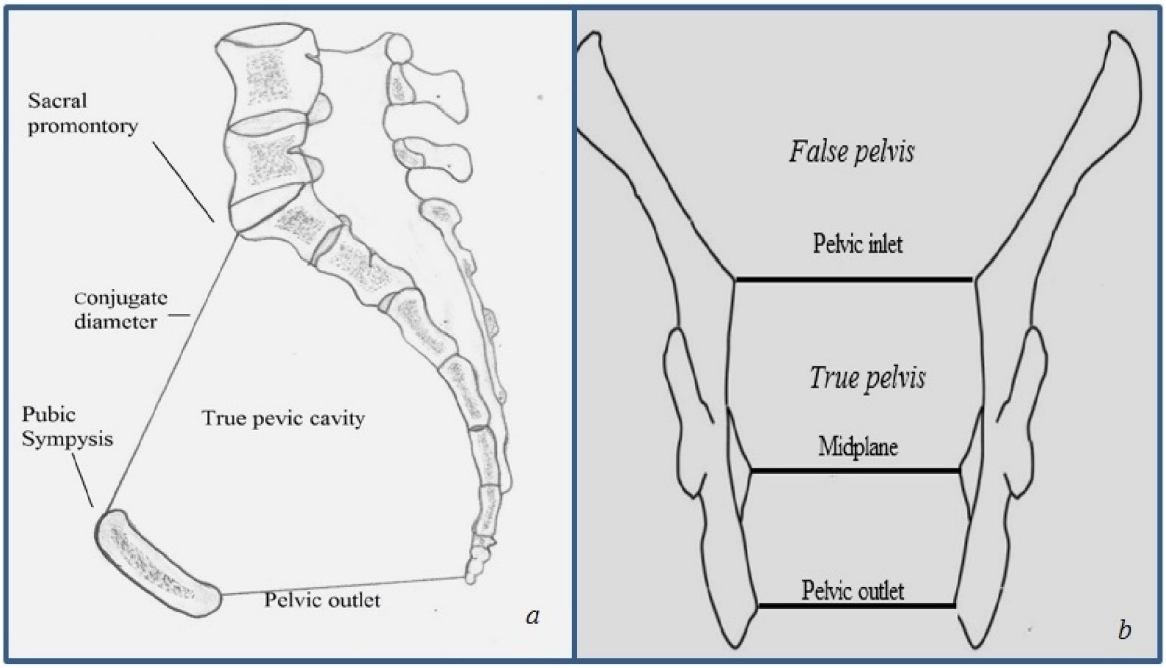

Figure 1. Sagittal (a) and Coronal (b) illustration of the pelvic outlet and inlet, the antero-posterior diameter of the pelvic inlet and outlet

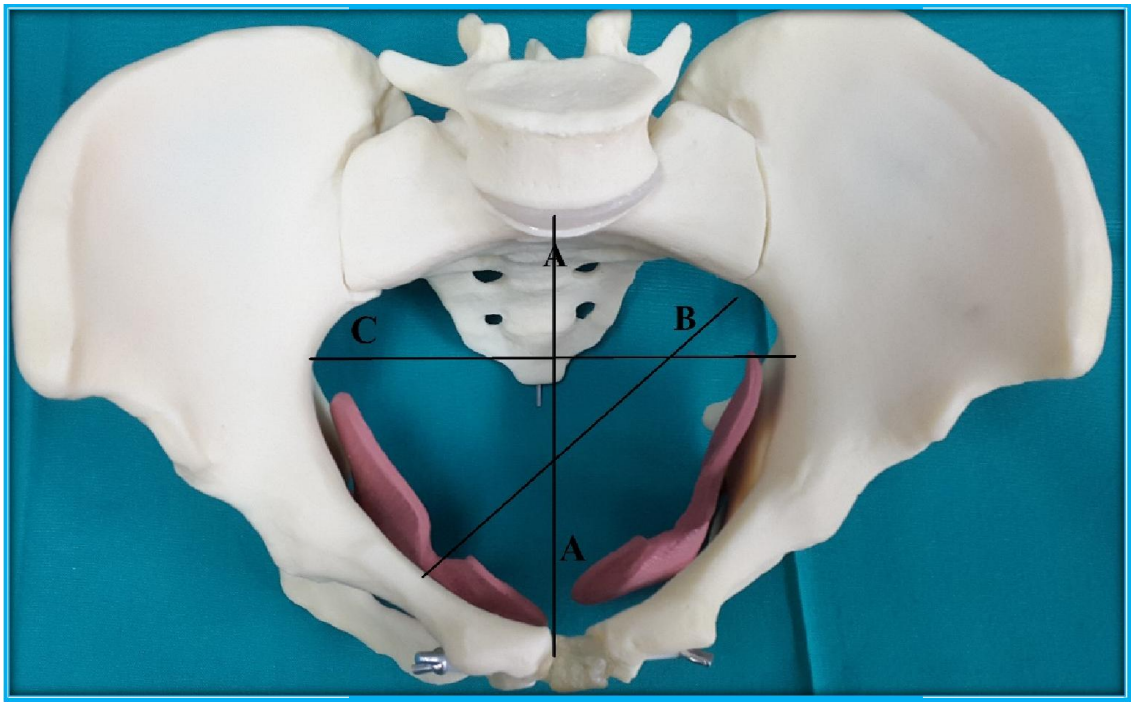

Figure 2. Pelvic brim showing conjugate diameter (A), oblique diameter (B) and transverse diameter (C) of the pelvic inlet

this occurs when the mother is given a trial of labour initially for normal delivery before caesarian section is recommended (Biswas and Johnstone 1993). However, other groups of authors (Raman *et al.,*1991; O'Brien *et al.,* 2002; Sibony *et al.,* 2006) supported the use of X-ray pelvimetry as they concluded that it tailors the information given to each patient about the likelihood of having a vaginal delivery or caesarian section. It can also be used to optimize the selection of patients allowed to enter labour.

Regardless of the procedure, pelvimetry is very important in assessing mothers who are at risk of obstructed labour, because its outcome may save the child and even the mother's life during delivery (O'Brien *et al.,* 2002). A mother whose pelvic outlet is found to be smaller than normal after pelvimetry is always recommended for caesarean section. Although the use of x-ray pelvimetry in predicting the outcome of labor has reduced, many hospitals in developing countries (especially rural health facilities) still rely on its use as other methods seems to be relatively expensive (Rozenberg 2007). The maternal and fetal mortality rates in developing countries may increase without such assessment. Hence, the main objective of this study was to assess the value of X-ray pelvimetry in predicting the outcome of labor in rural Uganda.

MATERIALS AND METHODS

This was a retrospective study conducted at the Radiology Department of Mbarara Regional Referral Hospitalin Uganda in which the files of 200 female patients with records of x-ray pelvimetry were studied. The case files were randomly picked and data forms were used to enter the age, APD (Figure 1) and TD of the pelvic inlet (Figure 2) from X-rays of mothers who had undergone X-ray pelvimetry before labour. A value of 10.5cm for the APD of the pelvic inlet was used as a benchmark to delineate patients for normal delivery or caesarian section. The pelvic outlet diameter (POD) was also recorded; this is done by measuring the distance between the tip of the coccyx and the lower border of the pubic symphysis. The expected and final modes of delivery were then recorded for each patient. For files still with x-ray films, the films were read to ascertain APD and TD of the pelvic inlet. The data was then subjected to analysis where the chi-test was used to determine the significance. A P< 0.05% was regarded as significant. Correlation between the data was determined using Pearson's correlation test.

RESULTS

The demographic details of the sample size were as follows:

- Mean age: 28.5 years ± 4.5 (range: 25–34 years);
- Mean height: 158.3 cm ± 4.6 (range : 153.7 -163 cm);
- Mean weight: 60.4 kg ± 9.2 (range: 50-71 Kg).

Pregnancy profile: A total of 51.5% ($^{103}/_{200}$) of the respondents were prime gravidas; 3.5% ($^{7}/_{200}$) had twins and1% ($2/_{200}$)had triplets. The latter two categories of patients underwent compulsory caesarian section. A total of 67% ($^{134}/_{200}$) of the cases underwent X-ray pelvimetry procedure due to suspicion of CPD.

Morphometry of the pelvic inlet (Table 1): Average APD was12.95 ±0.95cm ($^{160}/_{200,}$ 80%) and TD was 14 ±0.6cm ($^{121}/_{200,}$ 60.5%). The majority of patients (41%) had an APD that ranged between 12cm-13.9cm while 39.5% of patients had a TD that ranged between 14cm-15.9cm.

Table 1. Incidence of anteroposterior and transverse diameters of the pelvic inlet

Pelvic inlet diameterrange (cm)	Anteroposterior diameter (n=200)	Transverse diameter (n=200)
	Incidence (%)	Incidence (%)
8-9.9	22 (11)	13 (6.5)
10-11.9	36 (18)	27 (18.5)
12-13.9	82 (41)	39 (19.5)
14-15.9	39 (19.5)	79 (39.5)
16-17.9	21 (10.5)	42 (21)

Morphometry of the pelvic outlet (Table 2): The average APDwas 8.4±0.4cm. The majority of patients (28.5%) had an APD that ranged between9.5cm-10.4cm.

Table 2. Incidence of the antero-posterior diameter of the pelvic outlet

Antero-posterior diameter range of pelvic outlet (cm)	Incidence (%)
7.5-8.4	62 (31)
8.5-9.4	41 (20.5)
9.5-10.4	57 (28.5)
10.5-11.4	28 (14)
11.5-12.4	12 (6)

Expected mode of delivery versus final mode of delivery (Tables 3 and 4): Of all the respondents who underwent pelvimetry, 61% ($^{122}/_{200}$) were recommended for caesarian section while 39% ($^{78}/_{200}$) were recommended to have normal delivery (Table 3). However, contrary to the pelvimetry results, it was noted that 35.5% ($^{71}/_{200}$) of the respondents actually underwent caesarian section while 64.5% ($^{129}/_{200}$) of the respondents had normal birth after a trial of labor (Figure 3).

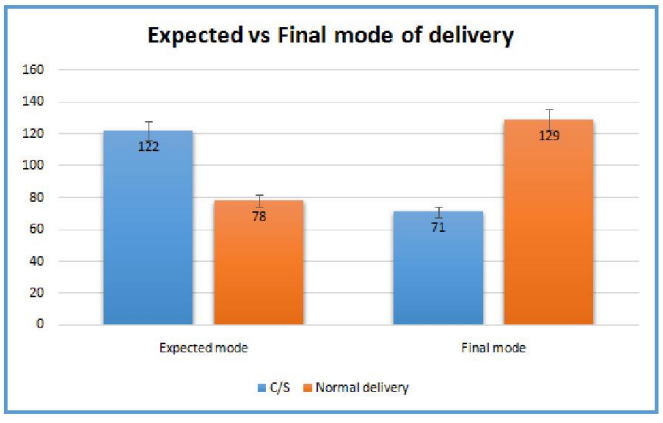

Figure 3: Expected and final mode of delivery after pelvimetry

DISCUSSION

It cannot be disputed that pelvimetry can identify women with smaller pelvic outlets and inlets as in the case of this study.

Table 3. Incidence (%) of expected mode of delivery after pelvimetric measurement of Pelvic outlet diameter (POD) and before trial of labor

Expected mode of delivery	Pelvic outlet diameter (cm)					
	7.5-8.4	8.5-9.4	9.5-10.4	10.5-11.4	11.5-12.4	Total
Caesarian section	58 (29)	36 (18)	18 (9)	8 (4)	2 (1)	122 (61)
Normal birth	4 (2)	5 (2.5)	39 (19.5)	20 (10)	10 (5)	78 (39)
Total	62(31)	41 (20.5)	57 (28.5)	28 (19)	12 (6)	200 (100)

Table 4. Incidence (%) of final mode of delivery after trial of labor

Final Mode of delivery	Pelvic outlet diameter (cm)					
	7.5-8.4	8.5-9.4	9.5-10.4	10.5-11.4	11.5-12.4	Total
Caesarian section	48 (24)	12 (6)	8 (4)	2 (1)	1 (0.5)	71 (35.5)
Normal birth	14 (7)	29 (14.5)	49 (24.5)	26 (13)	11 (5.5)	129 (64.5)
Total	62 (31)	41 (21.5)	57 (28.5)	28 (14)	12 (6)	200 (100)

Table 5. Comparison of pelvimetry results of various authors from different study areas

Author (year)	Sample	Country	Conjugate diameter	Transverse diameter
Orley (1938)	259	Britain	12	12.5
Barron *et al.* (1964)	66	Canada	12.5	13
Warner *et al.* (1980)	101	USA	10	13
Lilienfeld *et al*.(1949)	225	USA	11.7	12.5
Nasrat *et al*.(1990)	169	Saudi Arabia	10.4	13
Thomas *et al.* (1998)	227	UK	11.5	13.5
Michel *et al.*(2002)	35	Switzerland	12.4	14
Gilboa *et al.* (2011)	79	Israel	12.0	13.6
Silva *et al.* (2012)	59	Chile	11.9	12.11
Korhonen *et al*.(2014)	274	Finland	12.2	12.9
Sigmann *et al*.(2014)	18	France	11.14	13.05
Marera *et al*. (2014)	200	Uganda	12.8	14.2

The average normal APD recorded in the literature is 11.5±0.5cm ((Warner *et al*. 1980) whilst the average normal TD is recorded as 13.2±0.4cm (Warner *et al*. 1980). When the APD and TD of the pelvic inlet are 10.5cm or less, the pelvis is considered to be "small" for normal delivery and these patients are more susceptible to obstructive difficulties in labor.

In this study, 20% ($^{40}/_{200}$) of the cases had an APDof pelvic inlet less than 10.5cm and were automatically recommended for caesarian section. However, of the remaining 80% ($^{160}/_{200}$), with wide ADP diameter, 20.6% ($^{33}/_{60}$) still underwent caesarian section even though they were recommended for normal delivery. The average TD in this study was higher than 14cm, therefore the majority of the cases had a TD wider than normal. However, of the 121 cases that had wide TD, 15.7% ($^{19}/_{121}$) still underwent Caesarian section even after recommendation for normal delivery.

This shows that pelvic diameter alone may not determine the type of delivery, other additional factors such as force of uterine contractions, dimensions of the fetus, the presenting part of the fetus, flexion and molding also play a role in determining the choice of delivery. When comparing the variations between the respondent's age and pelvic outlet, it was noted that 56%) of the respondents between the age group of 15-24 had a small pelvic outlet, thisindicates that young adolescent patients had smaller pelvic dimensions than the older counterparts; therefore age should be taken into consideration when managinglabor inyoung women through pelvimetry. Most of the respondents had small obstetric pelvic outlets ranging from 7.7 to 8.4 cm (Table 2) while only 27% were within the normal range.

However, the APD of the pelvic outlet is not entirely static during the second phase of labor; at this stage the tip of the coccyx extends backwards to allow the baby to pass, although this study could not verify the extent to which the coccyx would extend, to at least give a mother a chance to run a trial labor. Some hospitals also still practice a midline episiotomy (perineotomy) which is a planned, surgical incision on the perineum and the posterior vaginal wall during second the stage of labor to increase the pelvic outlet. Due to the bony walls, the pelvic inlet on the other had is static and cannot change; therefore this may have a drastic consequence during labor. The variations in the APD and TD is well published from different authorsas recorded in Table 5.

The current study suggests that APD and TD of the pelvic inlet were well larger than most studies carried out in different countries (Table 5). A much larger study is therefore needed to determine if the pelvic dimensions of women in Africa are much larger than those from other continents as these results suggest. If the mothers indicated for caesarian section were not given a chance for a trial of labor, 41% ($^{51}/_{122}$) would have undergone unnecessary and risky surgical procedure. Therefore, in this study pelvimetry has shown to increase the chances of caesarian section. However, this type of obstetric assessment becomes an important clinical tool in that it decreases the chances of obstetric complications during delivery,thus reducing maternal and child mortality rates.

Conclusion

In the absence of safer and modern techniques like, computer tomographic scans and ultrasound as seen in rural settings like

Western Uganda, X-ray pelvimetry may still be a lifesaving procedure, especially in women suspected of CPD and pelvic injuries.

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