X-RAY PELVIMETRY IN MODERN OBSTETRICS **

by

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Though the art of midwifery must have been as old as childbirth, the science of obstetrics can be said to have been born in 1701 when Deventer published "Novum Lumen" in which he gave an accurate description of the pelvic anatomy and suggested a simple classification consisting of the generally contracted and inlet contracted pelves. Deventer is rightly called "the father of modern midwifery". Since the description of the 3 pelvic planes and the 3 inlet diameters by Levret in 1753, various measurements of the pelvis were ntroduced in clinical obstetrics and umerous external and internal pelvieters flourished for many years. lbert in 1897 was the first to study e female pelvis by x-rays. During the next 40 years or so various ingenious methods were devised for the radiological study of the pelvis, and x-ray pelvimetry reached a near perfection. Subsequent years have seen the evaluation of the x-ray pelvimetric studies in obstetrics. And although the interest in x-ray pelvimetry is diminishing in recent years, x-ray pelvimetry has firmly established itself as an indispensible part of modern obstetrics. We shall, today, lay before you our small experience in x-ray pelvimetry at this hospital.

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Material

The women whose pelves were studied radiologically belonged to 3 groups:

(1) *Antenatal Study.* In cases where difficult labour was feared on the basis of clinical examination or

past obstetric misbehaviour (18 cases).

(2) *Intranatal Study.* In cases of arrest of labour, either actual or feared (30 cases).

(3) *Postnatal Study.* In cases where there was an unexplained difficult labour (2 cases).

It was not possible to do an x-ray pelvimetric study in all cases where it was thought desirable. It must, therefore, be emphasized that the number of cases studied in this series is only a fraction of the total number of similar cases which should have been similarly studied.

Methods of Pelvimetry

In the earlier part of the study, 4 x-ray pictures were taken in each case (22 cases).

A Lateral View. The plate was exposed with the patient standing erect with one side touching the x-ray table and having a centimetre marked ruler in her nates (Isometric method of Thoms). (Tube-film distance of 36″. Potter Bucky diaphragm. Tube centred 1″ above and behind the highest point of the greater trochanter. KV 80. M.A. Seconds 500). Besides supplying the measurements for the various anteroposterior diameters and the depth of the pelvis, this plate gave information about the sacrum, sacrosciatic notches and the bore of the pelvis.

Superoinferior or Inlet Views. The patient was kept in a semi-recumbent position, supported on a back-rest kept at 45 degrees to the horizontal. 2 plates were taken with a longitudinal tube shift of 10 cms. in between them (5 cms. on either side of the central point of focus which is midway between the 2 anterior superior iliac spines). (Parallax method of Hodges and Ledoux). (Tube-film distance 36″. Potter Bucky Diaphragm. KV 80. M.A. Seconds 240). These plates gave the various transverse diameters and also the information about the shape of the pelvis, nature of the ischial spines and splay of the pelvic walls.

An Outlet Plate. This was taken on a stool designed after Moir and using the position of Chassard-Lapiné. This plate gave the transverse diameter of the outlet and the subpubic angle. (Tube-film distance 36″. Stationary grid. KV 80. M.A. Seconds 100).

During the latter part of the study only two plates were taken in each case (28 cases).

A Lateral Plate. As mentioned above. (Isometric method of Thoms).

An Anteroposterior Plate. This was taken with the patient standing erect and the tube centred on the midpoint between the 2 anterior superior iliac spines. The various transverse diameters were obtained from this film by proper correction by using a Schwarz slide rule after calculating the various object-film distances on the lateral plate (Ball method with Schwarz slide rule). (Tube-film distance 36″. Potter Bucky diaphragm. KV 100. M.A. Seconds 240).

Method of Prognostication

According to Weinberg et al., the sum of the anteroposterior and the transverse diameters at any given pelvic plane is a more reliable index of pelvic capacity than the separate

consideration of each, because they mutually compensate for each other. This arithmetic sum of the anteroposterior and transverse diameters of a particular plane is called the 'Index' for that plane.

At the inlet the obstetric conjugate was taken as the anteroposterior diameter and was measured from the sacral promontory to the most posterior point on the symphysis pubis. The widest transverse diameter of the inlet was taken as the transverse diameter of the inlet.

In the midcavity the interischial diameter was taken as the transverse diameter while the posterior sagittal of the midcavity was taken as the anteroposterior diameter. This latter is obtained by drawing a line parallel to the obstetric conjugate from the mid point of the interischial diameter and measuring the distance from the midpoint of the interischial diameter to the point where this line meets the sacrum. This diameter, also known as the posterior sagittal of Caldwell and Moloy, gives a good idea regarding the availability of space in the midcavity.

At the outlet, the intertuberous diameter was taken as the transverse diameter while the posterior sagittal of the outlet (from the tip of the sacrum to the midpoint of the intertuberous diameter) was taken as the anteroposterior diameter.

The index for each of the 3 pelvic planes was calculated and the pelvis placed into one of the four classes using the following criteria as the basis for classification.

It is obvious that the pelvis may not have the same classification at all levels, e.g. a pelvis with an index A at the inlet may have a midcavity and outlet index of B or even C, as in a funnel pelvis, and another pelvis with an inlet index C may have a midcavity and outlet index of A, as in a rachitic flat pelvis. In such cases, the following plan was adopted for the final classification of the pelvis.

For prognostication of labour:

Class A pelvis means there is no obstruction at any level and normal vaginal delivery is the rule. The patient should be left severely alone.

Class of pelvis	Inlet index cms.	Midcavity index cms.	Outlet index cms.
A	Above 22	Above 15	Above 16
B	21 to 22	14 to 15	15 to 16
C	20 to 21	13 to 14	14 to 15
D	Below 20	Below 13	Below 14

Indices	Classification of pelvis
Any 1 index B with other higher values	B
Any 1 index C with other higher values	B
Any 1 index D with other higher values	C
2 or more C indices	C
2 or more D indices	D

Class B pelvis means minor obstruction suspected. Normal vaginal delivery is usual though operative interference may be necessary. The patient should be submitted to a full trial of labour before any operative interference.

Class C pelvis means obstruction present. Operative interference is usual though a normal vaginal delivery may occur. Only a short trial is adequate.

Class D pelvis means live vaginal delivery is out of question and caesarean section is indicated.

It is obvious that this prognosis will hold good only for an average size baby, viz. one which weighs about 5 lbs. 8 ozs.

It must of course be added that whenever it was necessary, other factors like shape of the pelvis and gross reduction in one diameter were taken into consideration in addition to the index values.

Results

In this series of 50 cases there were 8 cases in Class A, 28 cases in Class B, 9 cases in Class C and 5 cases in Class D.

Class of pelvis	Number of cases
A	8
B	28
C	9
D	5
Total	50

Out of the 8 cases in Class A, one was submitted to an elective caesarean section because of unexplained antenatal intra-uterine fetal deaths in both the previous pregnancies, spontaneous vaginal delivery resulting on both the occasions. The remaining 7 had normal vaginal deliveries.

Class A	Number
Total cases	8
Elective caesarean section ..	1
Remaining cases	7
Normal vaginal delivery	7
Incidence of normal vaginal delivery	100%

Out of the 28 cases in Class B, 7 did not have a full trial. In one case elective caesarean section was done because of the history of cord prolapse followed by stillbirth in both the previous labours. In 5 cases caesarean section was done very early in labour because of previous caesarean section in 1, previous caesarean section and breech presentation in 1, breech presentation in 1, elderly primiparity with pre-eclampsia in 1, and elderly primiparity with uterine inertia in 1. In 1 case following sudden fetal death during the 1st stage due to cord round the neck, craniotomy was done early in the 2nd stage to spare the strain on the previous classical caesarean scar over the uterus. Out of the remaining 21 cases, in one case there was a mentotransverse position requiring a caesarean section while in 1 other case the baby was very large weighing 8 lbs. and required a caesarean section. Twelve cases, out of the remaining 19, delivered normally while 4 required midforceps and 3 required caesarean section.

Class B	Number
Total cases	28
Cases not submitted to a full trial of labour	7
Caesarean section for mentotransverse	1
Caesarean section for a large baby	1
Remaining cases	19
Caesarean after failure of full trial	3
Midforceps	4
Normal vaginal delivery	12
Incidence of normal vaginal delivery	63%

In Class C there were 9 cases out of which 6 required caesarean section (one was elective) and 1 required midforceps. Out of the remaining 2, 1 had a stillbirth after prolonged labour, while the other had a normal vaginal delivery.

Class C	Number
Total cases	9
Elective caesarean section ..	1
Remaining cases	8
Caesarean section after failure of trial	5
Midforceps	1
Stillbirth after prolonged labour ..	1
Normal vaginal delivery	1 (Baby 6 lbs.)
Incidence of normal vaginal delivery	12.5%

In Class D there were 5 cases out of which 4 required caesarean section after good trial. In the remaining case internal podalic version and breech extraction was done for a transverse lie with cord prolapse. Forceps was needed to extract the aftercoming head. The baby sustained a fracture of the skull and expired soon after delivery.

Class D	Number
Total cases	5
Caesarean section after failure of trial	4
Internal podalic version and breech extraction with forceps for the after-coming head (fracture of the baby's skull) ..	1
Normal vaginal delivery	Nil
Incidence of normal vaginal delivery	Nil

Discussion

Choice of the Technique of X-ray Pelvimetry. There are nearly two dozen different methods of x-ray pelvimetry vying with one another in the accuracy of their results. According to Steer, any of these methods correctly used gives a reasonably accurate measure of the various pelvic diameters. Weinberg et al. studied a series of 100 patients by 4 different methods and found that the pelvic diameters obtained by the precision stereoscopic method, the Thoms-torpin isometric scale method, the Snow ruler method, and the Ball nomogram method were in all cases, within 1 mm. of each other. Thus, as far as accuracy is concerned there is little to choose amongst the large number of well established standard methods. In our choice we were influenced mainly by three considerations, viz. (1) availability of equipment, (2) cost of study per patient, and (3) simplicity of the technique. In the early part of the study we used a

combination of isometric method and parallax method. The end points for measuring the bituberous diameter are not clear cut in a superoinferior film and so we used an additional outlet film obtained by Chassard-Lapiné method. Later, when we acquired a Schwarz slide rule we changed our technique to a combination of isometric method and Ball method. This change-over not only substantially reduced the radiation to the patient but also reduced the cost of the study. In addition, it permitted cephalometry to be done at the same time.

Choice of Method of Prognostication. There is no similarity between two workers as regards the method utilised for giving a radiological prognosis. One finds in the literature many different methods not differing much from one another in their complexity. Besides, we were handicapped by the fact that at our hospital we have no figures for average pelvic diameters based on a radiological study. We always wanted to undertake a mass study for establishing the standard figures but could not find the means to support the cost involved in such a study. In the absence of such standards, we have adopted a system which was followed by one of us (J.M.D.) in her previous studies. This system, though based on the work of Weinberg et al., is much modified especially to suit our Indian standards. Our results leave no doubt that this system is highly satisfactory. Yet, we feel that a mass study, referred to above, which we have in mind, might lead to some alterations in the system with still better results.

Prognosis Based on X-ray Pelvimetry and the Results. A successful spontaneous delivery is like a musical performance involving a harmonious contribution from various musical instruments, an erring by any one of which can spoil everything in toto. The various factors to be considered in the outcome of labour are the size, shape and architecture of the pelvis, the presentation and position of the fetus, the size and mouldability of the head, the uterine action, the behaviour of the cervix, and, last but certainly not the least, the experience and the patience of the obstetrician. A misbehaviour on the part of any one of these can upset all calculations. By x-ray pelvimetry we can study only one of the multitude of factors involved in the process of labour. It is obvious, therefore, that any amount of knowledge of the pelvis cannot tell us whether or not a particular woman will deliver normally. Those who expect a 'yes or no' prognosis from x-ray pelvimetry are to be sadly disillusioned. X-ray pelvimetry is not meant for forecasting a prophecy. It is too incompetent to predict the outcome of labour. It merely gives a prognosis as regards the possibility of a successful normal delivery. It can only provide a statistical probability of mechanical dystocia during labour, in the absence of any other pathology of labour.

In the light of above facts, let us study our results. The following Table gives the incidences of normal vaginal delivery, operative delivery, and live vaginal delivery, among those cases who had a trial of labour in the various classes of pelvis.

Class of pelvis	Incidence of normal vaginal delivery	Incidence of operative delivery	Incidence of live vaginal delivery (including operative)
A	100%	nil	100% (all spontaneous)
B	63%	37%	84%
C	12.5%	75%	25%
D	Nil	100%	Nil

It will be seen that live vaginal delivery resulted in 100% of Class A cases, 84% of Class B cases, 25% of Class C cases, and in none of Class D cases. Thus, to expect a live vaginal delivery is obligatory in class A, highly desirable in class B, a reasonable gamble in class C, and disastrous in class D.

Armed with this knowledge, we can determine the best method of delivery in a particular case after taking into consideration the other components of labour. However, though x-ray pelvimetry can help us decide upon a mode of delivery in an individual case it cannot by itself dictate one.

Dangers of X-ray Pelvimetry. Gone are the days of somatic damage to the patient resulting from diagnostic radiological procedures. Due to the atomic bomb fallouts our attention is now acutely focussed on the hazards to our future generations caused by radiations reaching the gonads during the various diagnostic and therapeutic procedures. According to Parlee, 80 r to the gonads seems to be the dose that would double the mutation rate and hence should be considered as alarming. Other estimates of this dose vary from 10 r to 400 r. According to most estimates, the radiation reaching the ovaries during the 2 to 4 exposures required for a pelvimetry varies from 1 to 3 r. Radiation received by fetal gonads is much smaller than this except in cases of breech presentation or when superoinferior films are taken. Thus, the implied hazards of X-ray pelvimetry seem to be grossly exaggerated. Yet, as Berman and Sonnenblick say, all ionizing radiation, no matter how small the dose may be, is potentially harmful genetically. And though none but the geneticists would be worried about our offsprings many generations hence, we cannot shed off our responsibility towards them. So we must reduce to the minimum the amount of radiation during any radiological investigation by various means like added filtration, higher KV, faster films, minimum number of films, reduction in the size of the field exposed, etc. But it would be sheer madness to eliminate or even discourage the proper use of x-rays in medicine. There is no reason to withhold x-ray pelvimetry when indicated.

Place of X-ray Pelvimetry in Modern Obstetrics. The former enthusiasm for x-ray pelvimetry when every primipara, nay every pregnant woman, was advocated the benefit of a radiological study of her pelvis, has now, fortunately, calmed down. Pelvimetry is now indicated during the prenatal period in cases of (1) clinically contracted pelvis, (2) cephalopelvic disproportion, (3) previous obstetric misfortunes, and (4) abnormal presentation. Intranatal pelvimetry is indicated in all cases of

obstructed labours and also in certain cases of standstill labours requiring a pitocin drip.

Secondly, in modern obstetrics cephalometry is becoming an inseparable part of pelvimetry. This is but natural because one is much more interested in knowing the probability of the particular head passing through the pelvis rather than of a hypothetical average head passing through. Cephalometry, unfortunately, has not yet approached the accuracy of pelvimetry. We have started cephalometric studies and hope to report to you our experience on some later occasion.

Lastly, the role of pelvimetry in the prognosis and management of labour is already discussed adequately and needs no repetition. One must, however, not forget that the prognosis, calculated on the basis not only of pelvimetry but of all available information put together, will on occasion be vitiated by factors like uterine action and mouldability of the head, the nature of which cannot be preassessed. Though, pelvimetry has been perfected to a sufficient mathematical accuracy, obstetrics is not and, perhaps, will never be.

Summary

(1) A series of 50 cases studied by x-ray pelvimetry has been analysed.

(2) The role of x-ray pelvimetry in relation to modern obstetrics has been discussed in its various aspects.

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