THE CLINICAL VALUE OF X-RAY PELVIMETRY

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Introduction

Routine radiographic studies of the pelvis in obstetrics have provided valuable information about the variations in shape and size of the female pelvis. Improvements in technique and increased experience of pelvimetry have made it possible accurately to predict the outcome of labour in a high proportion of cases (91 per cent. of 600 cases referred to the radiologist at Queen Charlotte's Hospital). It is an opportune time, therefore, to discuss the ways in which radiography may assist the clinician, and to assess the value and reliability of pelvimetric methods.

Radiography may be used to confirm the presence or absence of disproportion, but it must never be thought that it can supplant clinical methods. X-ray measurements of pelvic diameters may be more accurate than clinical measurements, but it must clearly be recognized that accurate prediction of the outcome of labour cannot be made in every case, however precise the measurements of the pelvis and foetal head may be. It is impossible to foretell the strength of the uterine contractions, the possible expansion of the pelvic diameters in labour and the mouldability of the foetal head. There must, therefore, be a borderline group of cases in which the outcome of labour depends on factors which are unknown until labour occurs. In such cases a successful outcome may depend on the skill of the obstetrician who will be better armed to overcome obstetric difficulties if he has accurate knowledge of the pelvic architecture. Furthermore, it must be remembered that dystocia is more often due to imperfect uterine action than to actual disproportion.

It is convenient to discuss problems of disproportion under two headings; disproportion at the brim and at the outlet. These present different problems both in diagnosis and management. Consideration of disproportion in midcavity is unnecessary if, firstly, brim disproportion is taken to include those cases which have an antero-posterior diameter shorter than and slightly below the level of the obstetric conjugate; and, secondly, if the outlet is considered not as a single plane, but as the lower pelvic strait.

Radiological Technique

The standard technique at Queen Charlotte's Hospital (Rohan Williams, 1943) in cases of sus-

pected disproportion includes the following projections:—

(1) *Antero-posterior projection*, with the patient supine. This film gives a general picture of the pelvis, from which gross contraction, tilting or asymmetry will be apparent, and from which the general convergence or otherwise of the side walls of the pelvis can be noted.

(2) *Supero-inferior projection*, with the patient sitting, but reclining backwards so that the brim is parallel to the cassette. This film shows the true shape of the brim and from it the brim diameters are calculated. Difficulty may be experienced in deciding which line on the film should be taken as the anterior margin of the sacrum, and in such cases the difficulty must be resolved by checking the measurement of the obstetric conjugate on the lateral film. As Chassar Moir (1947) has pointed out, the most prominent point on the sacrum is

FIG. 2.—Reconstruction chart of brim.

often below the promontory. A reconstruction chart is then drawn, which shows the exact size and shape of the brim, and on this chart a circle or ellipse with a diameter of 9.5 cm. may be superimposed, representing an average foetal head at term.

It will be seen that the greatest transverse diameter usually lies behind the mid point of the antero-posterior diameter, and is sometimes quite close to the sacrum. For this reason, Chassar Moir has designated the diameter which intersects the conjugate at the mid point as the *available* transverse diameter of the brim.

From these films also the prominence of the ischial spines can be observed, and the ischial bispinous diameter calculated, if the distance from the plane of the brim is worked out from the lateral

film. This diameter may also be determined from the antero-posterior projection.

(3) *Lateral projection*, with the patient erect. In this position the femoral shafts do not obscure the symphysis pubis, and the postural tone of the abdominal muscles tends to engage the foetal head into the brim. From this film measurements are made of the antero-posterior diameter of the brim (from the upper posterior margin of the symphysis to the most prominent anterior margin of the upper sacrum), and of the antero-posterior diameter of the outlet (from the lower posterior margin of the symphysis to the anterior margin of the lowest part of the sacrum, or to the coccyx if the sacro-coccygeal junction is fixed).

The lateral film also gives information on the inclination of the pelvic brim to the lumbar spine. This can be measured as the angle between the true conjugate and the anterior margin of the fifth lumbar vertebra. A very large angle may account for delayed engagement of the foetal head and perhaps asynclitism, but the angle will be considerably reduced by drawing up the knees, a point to be remembered in the management of the first stage of labour.

A reconstruction chart is made from the lateral film of the median or sagittal plane of the pelvis, and from this the curve of the pelvic canal can be

FIG. 4.—Lateral reconstruction chart.

studied, using a disc representing the average foetal head at term. It must, however, be remembered that part of the antero-posterior diameters may not be available to the foetal head, and it is best to observe the general shape and lie of the symphysis and descending pubic rami in front, and of the sacrum behind.

(a) The symphysis tends to slope backwards roughly parallel with the backward inclination of the sacrum; if it has a greater backward slope than usual, the antero-posterior diameter of the outlet will be shortened. The descending pubic rami normally slope backwards more than the symphysis, but this is variable, and a marked backward slope is particularly unfavourable when

the subpubic arch is narrow. In such a case the foetal head will be forced to emerge further back than usual, and much of the antero-posterior diameter is wasted.

(b) The anterior border of the sacrum is normally concave, but variations are common, so that it may be roughly straight or even slightly convex; in this case it is usually the second sacral segment which projects more than the promontory, forming a conjugate which must be considered instead of the true conjugate of the brim. There are two sacral variations which may shorten the antero-posterior diameter of the outlet; firstly, the deeply hollowed sacrum in which the sacro-coccygeal shelf projects forward to lie almost under the ischial spines; secondly, a long sacrum having perhaps six segments instead of five, which may be comparatively straight without a prominent sacro-coccygeal shelf, yet because it is often more vertical than normal, the antero-posterior diameter of the outlet may be seriously shortened.

(4) *Subpubic arch projection*, taken with the patient sitting well forwards, so that the arch is parallel with the cassette. The manner in which the foetal head will fit into the subpubic arch depends on the angle of the arch and on the curvature of the descending pubic rami. These factors are best assessed by using a disc with a diameter

FIG. 6.—Subpubic arch reconstruction chart.

9.5 cm. representing the average foetal head at term. When the arch is wider than normal (90° or more) the disc occupies the whole of the arch, with an average arch (about 85°) there is a gap of 0.5 to 1 cm. between the circumference of the disc and the symphysis; when the arch is narrow (less than 80°) there will be a still wider gap. The length of this gap is measured on the film and reduced to actual size, which will represent the distance an average-sized un moulded foetal head will lie from the lower border of the symphysis during delivery.

This distance can be marked off on the lateral

FIG. 1.—Supero-inferior projection.

FIG. 3.—Lateral projection, patient erect.

FIG. 5.—Subpubic arch projection ; narrow arch

FIG. 8.—Lateral X-ray. Head now engaged.

FIG. 9.—Lateral X-ray. Head free and occiput slightly posterior ; no disproportion.

reconstruction chart on the line of the descending pubic rami, and the available antero-posterior diameter is measured from the lowest anterior

FIG. 7.—Lateral reconstruction chart in same case as Fig. 6, showing available A.P. diameter.

margin of the sacrum to this point. Recently, Morris (1947), Allen (1947) and Rohan Williams (1949) have given considerable attention to this *available* antero-posterior diameter of the lower pelvic strait, and Morris considers the outlet is contracted when this diameter is less than 10 cm.

Forecast graphs. Chassar Moir (1947) has advocated the use of graphs to assess the capacity of the pelvis at three planes. He has prepared graphs for various biparietal diameters of the foetal head, determined by postnatal measurement, and has shown that a line may be drawn on each graph for different sizes of the foetal head, on the lower side of which a great preponderance of difficult deliveries will be plotted.

Cephalometry. As yet no series of forecasts have been published using antenatal cephalometry in conjunction with pelvimetry, and there are two difficulties. Firstly, many patients are X-rayed early in pregnancy before cephalometry is feasible; and, secondly, in patients X-rayed at or after the 36th week of pregnancy, measurements of the foetal diameters can only be made in about half the cases because of unfavourable positions of the head. Cephalometric methods are then only approximate, as is estimation of further growth in the last month.

Nevertheless, cephalometry should be practised whenever possible, and provided its limitations are recognized, the additional knowledge will further narrow down the borderline group. The clinical aphorism that 'the foetal head is the best pelvimeter' must be applied to radiology, if the best results are to be achieved. Even without

accurate cephalometry, the clinician can often compare cephalic diameters with the pelvis in the lateral film, provided the head is central, and more use might be made of radiography in the course of trial labour, to determine the progress of the head through the brim, and the degree of moulding.

Indications for Radiography

Although Munro Kerr (1942) has advocated routine radiography in all primigravidae, most obstetricians believe they can exclude disproportion with certainty in a large majority of cases by clinical methods. Yet most of them would admit that they have occasionally missed disproportion, even though they have applied their usual methods of examination, and some are ready to look for the cause of unexpectedly difficult labour in postnatal radiography.

X-rays may be used to confirm gross pelvic abnormality, to provide accurate information in cases of suspected disproportion, or to exclude disproportion with certainty when the pelvis is thought to be normal. In the latter group may be mentioned patients who are difficult to examine, primigravidae with breech presentations, and patients who have previously had a difficult or prolonged labour or a Caesarean section. It is certainly helpful to both obstetrician and patient to have X-ray evidence that disproportion will not occur, and this evidence will probably lessen unnecessary surgical procedures. A number of patients have now been delivered at Queen Charlotte's Hospital, as at other maternity hospitals, without undue difficulty, having previously had a Caesarean section for disproportion diagnosed without the benefit of X-rays.

Confirmation of obvious pelvic abnormality is nowadays almost a routine before deciding on Caesarean section, and in not a few of these cases X-rays show that normal delivery is feasible in spite of a flattened brim, an asymmetric pelvis or a narrow outlet.

One of the common indications for radiography is the high head that cannot be pushed into the brim. It is well known that this is often due to bad flexion and that engagement will readily occur when the patient is examined sitting up. But it may be difficult to feel the head in this position, and the obstetrician may be uncertain whether it will or will not quite engage. It is best to resolve this difficulty with a lateral X-ray in the erect position and a full pelvimetry if the head is not found to be engaged. If the biparietal diameter is smaller than the obstetric conjugate it may usually be stated that there is no brim disproportion. Such a procedure will often obviate the necessity for a trial labour, which is not infrequently accompanied by defective uterine action, when both

patient and obstetrician are wondering about the possibility of Caesarean section.

The Value of Radiography in Borderline Cases

Minor degrees of disproportion may be discovered by careful pelvic examination, because of a high head that cannot be pushed into the brim, or simply on routine radiographic examination. Evidence of such disproportion was found in about 18 per cent. of cases referred to the radiologist at Queen Charlotte's Hospital, and in these the chances of normal or difficult delivery are about equal. Problems at the brim must be considered separately from problems at the outlet, but both may give rise to uncertainty in the generally contracted pelvis.

(a) *Brim disproportion.* There is no doubt that clinical estimation of the shape and size of the brim is less accurate than pelvimetry. X-rays may be unnecessary when the head is engaged or can be pushed into the brim, but when this cannot be done radiography will provide more information than can be obtained by examination under an anaesthetic at the 36th week, with less discomfort to the patient. This procedure should be condemned as strongly as indiscriminate surgical induction.

Although the pelvic joints may expand somewhat during pregnancy, there is little evidence that appreciable expansion occurs during labour, and the mouldability of the foetal head cannot be assessed until labour occurs. Trial labour is, therefore, the best procedure for borderline brim disproportion, unless the age or history of the patient causes a bias in favour of elective Caesarean section. The outcome of trial labour must be determined mainly by clinical examination, but sometimes a head will mould to such an extent that the vertex reaches the pelvic floor before the greatest diameter has passed the brim. X-rays in labour may still be of value in assessing the progress of the head.

(b) *Outlet disproportion.* It is perhaps surprising that accurate measurements of the pelvic outlet are difficult to achieve by clinical methods, but X-rays sometimes show that this is so. Furthermore, the foetal head cannot be used as a pelvimeter except during delivery, and for this reason trial labour, as usually understood, has no place in outlet disproportion. Much greater expansion of the pelvic diameters is possible at the outlet than at the brim, and cases of absolute disproportion necessitating Caesarean section are rarely seen except in osteomalacic pelvises or in achondroplastic dwarfs. Caesarean section may, however, be the best treatment for a patient who has previously had a difficult forceps delivery with

perhaps a stillborn child. Labour may be surgically induced about the 38th week in cases of marked outlet contraction confirmed by X-rays, but in most cases of minor contraction this is unnecessary and it may reasonably be expected that forceps aid will overcome difficulty although occasionally at the expense of a dislocated coccyx.

When a persistent occipito-posterior occurs in labour it is an advantage to know if the pelvis is anthropoid, as then a face to pubes delivery may be safely achieved, whereas with an android pelvis it is better to rotate the occiput. The accepted teaching and practice in cases of deep transverse arrest is to rotate the head manually and deliver it through the lower pelvic strait with the long axis antero-posterior. Yet X-rays have shown that in 30 per cent. of these cases the ischial bispinous diameter is actually greater than the antero-posterior diameter of the outlet. This is a forcible argument in favour of drawing the head through this plane in the transverse diameter in these particular cases, allowing rotation to occur after the head has passed the ischial spines. Such practice might well reduce the high foetal mortality associated with deep transverse arrest.

Conclusions

The use of radiography in borderline cases has been criticized on the grounds that unnecessary interference will increase. This should not be so if X-rays are done well and are interpreted with intelligence. It is true that unnecessary Caesarean section has sometimes been done when the obstetrician has been misled by bad X-rays, but this should make us improve our X-ray diagnostic methods and learn from our mistakes. The chief value of radiology may be the exclusion of disproportion, but valuable information can also be gained in the borderline case, and forewarning of possible dystocia should at least ensure that these patients are confined in hospital, where facilities are available for a Caesarean section or difficult forceps delivery, and for resuscitation of the baby if the need arises.

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BIBLIOGRAPHY

- ALLEN, P. (1947), *Brit. J. Radiol.*, **20**, 45 and 205.
 CHASSAR MOIR, J. (1947), *J. Obst. and Gyn. Brit. Emp.*, **1**, 20.
 MORRIS, W. I. C. (1947), *Edin. Med. J.*, **54**, 90.
 MUNRO-KERR, J. M. (1948), *J. Obst. and Gyn. Brit. Emp.*, **4**, 401.
 ROHAN WILLIAMS, E. (1943), *Brit. J. Radiol.*, **16**, 173.