ESTIMATION OF FOETAL MATURITY BY RADIOLOGY

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Whilst the risks of genetic damage and of childhood malignancy due to ante-natal radiography are real, they are so small that the obstetrician should have no hesitation to ask for an X-ray film of the abdomen or pelvis when there is a valid indication. On the other hand, unnecessary radiography is to be strongly deprecated. Indeed, one should refrain from asking for such an investigation if the line of management will remain exactly the same irrespective of the information obtained.

Radiological estimation of foetal maturity is sometimes necessary when termination of pregnancy is contemplated in conditions such as postmaturity, toxaemia of pregnancy and diabetes mellitus. In the management of these conditions, it is important to strike a balance between the delivery of too premature a baby and the undue prolongation of pregnancy leading to intra-uterine death. Accurate knowledge of maturity is even more urgently required in cases where the date of the last menstrual period is not known, or cannot be relied upon and where there is apparent discrepancy between the size of the foetus and the given dates. But whilst it is the contention of Hartley (1957) that a reliable and progressive pattern of bony and epiphyseal development exists in the human foetus, many obstetricians and radiologists believe that the date of appearance and the development of the recognisable bony "landmarks" can be so variable as to give radiological estimation a margin of error of five to six weeks. According to Hartley, the ossification centre for the calcaneum appears between the 24th and the 26th weeks, that for the talus between the 26th and 28th weeks, that for the lower femoral epiphysis with quite astonishing constancy during or at the end of the 36th week and that for the upper tibial ephiphysis at 38 weeks.

As termination of pregnancy, whether by induction of labour or by caesarean section, is almost always carried out only after the 36th week, an accurate study of the ossification centres at the knees would be of great practical importance. In the study now presented an attempt has been made to study 224 plain X-rays of the abdomen which were taken at the Radiological Department, Kandang Kerbau Hospital, between 1st November, 1964 and 2nd March, 1965, to find out:—

1. how often the knees are clearly visualised in these 224 films which were taken for estimation of foetal maturity as well as for other indications such as confirmation of multiple pregnancy and foetal abnormality; and
2. from the cases where the knees can be visualised, the time of appearance of the ossification centres for the lower end of femur and upper end of tibia in Asian foetuses.

RESULTS

Of the 224 films, the knees cannot be clearly visualised in 70. They are not seen in 14 films because the foetal skeleton is ill-defined due most probably to inadequate exposure or foetal movement during exposure. In 50 films they are not seen because of the presence of superimposed maternal (the lumbar vertebrae and their transverse processes and the sacrum in particular) and foetal skeleton (the skeleton of the other twin or the bones of the upper limbs or feet of the same foetus). In the remaining 6, they are not seen because they are not included in the films. All these 6 are lateral views of X-ray pelvimetry. There are altogether 10 such films in this series: in one, the ossification centre for the lower end of femur can be seen; in two, the knees can be clearly visualised but no ossifica-

TABLE I

The Relationship between Maturity and the Presence of Ossification Centre in the

(a) Lower Epiphysis of Femur and

(b) Upper Epiphysis of Tibia

Maturity in Weeks	24 to 35 6/7	36—	38—	40—	42—	44—
Number of Cases	36	20	14	7	11	12
(a) O. C. in lower	NIL	3	5	3	5	5
end of femur		15%	35.7%	42.8%	45.4%	41.7%
(b) O. C. in upper	NIL	1	4	0	1	1
end of tibia		5%	28.5%		9.1%	8.3%

tion centres are present; in one the knees cannot be clearly seen because of the presence of superimposed foetal skeleton and in the remaining six they are not included in the films. As most of the lateral X-ray pelvimetry films do not show the knees (60 per cent to be exact), all the other pelvimetry films, which have been taken during the specified period, are not studied and therefore are not included in this series. Of the 224 films, the knees are clearly visualised in 154 (i.e. slightly more than two-thirds of the cases).

Of these 154 cases, the maturity is not known or is uncertain in 54, thus leaving exactly 100 cases from whom the time of appearance of the ossification centres for the lower end of femur and upper end of tibia may be found. The results are summarised in Table I.

It can be seen from Table I that both these ossification centres do not make their appearance before the 36th week. The ossification centre for the lower epiphysis of the femur can be identified in 21 or 32.8 per cent (or about one-third) of the 64 cases after the 36th week. The fact that the incidence remains practically the same at 38th, 40th, 42nd and 44th weeks suggests that this ossification centre either makes its appearance at 38th week (in one-third of cases) or does not appear at all (in the other two-thirds). The ossification centre for the upper epiphysis of the tibia can be identified in only 10.9 per cent (or about one-tenth) of the 64 cases after the 36th week. The ossification centre for the lower end of femur is also present in all these 7 cases.

TABLE II

The Relationship between Race and the Presence of Ossification Centre in the

(a) Lower Epiphysis of Femur and

(b) Upper Epiphysis of Tibia

Race	**Chinese**	**Malays**	**Indians**
Number of Cases	38	17	9
(a) O. C. in lower	9	7	5
end of femur	(23.7%)	(41.2%)	(55.5%)
(b) O. C. in upper	2	2	3
end of tibia	(5.3%)	(11.8%)	(33.3%)

An attempt is then made to see if there is any racial difference in the incidence of the presence of the ossification centres at the knees after the 36th week. The results are shown in Table II, from which it can be seen that the incidence is lowest among the Chinese and highest among the Indians.

DISCUSSION

The fact that the knees cannot be clearly visualised in almost a third of the films studied in this series confirms the statement made by Hartley (1957) that precise estimation of foetal maturity from radiographs taken for some other purpose will often prove impossible. If a higher success rate is to be achieved, the special technique described by him will have to be employed. The firmest possible compression to the maternal abdomen has to be applied, the maximum speed of exposure available should be used and because the knee centres not infrequently hide in front of the maternal spine, an oblique antero-posterior view may have to be taken.

As the ossification centres at the knee never make their appearance before the 36th week, one can imply from their presence that termination of pregnancy can be carried out without risk of gross prematurity. But their absence is of little value as they cannot be identified even in so many postmature cases. This is especially true among the Chinese. From this small series, the centre at the lower end of femur is found to be more useful and reliable than that at the upper end of tibia.

With the present available technique, radiological estimation of foetal maturity is of limited value among Asian patients, especially among the Chinese.

SUMMARY

Two hundred and twenty-four plain X-rays of the abdomen taken between 24th and 46th weeks of pregnancy have been examined for the presence of ossification centres at the knee. The knee can be clearly visualised in only 154 films. An analysis of the 100 cases where the maturity is certain reveals that the ossification centres around the knee never make their appearance before the 36th week, that the centre for the lower end of femur can be identified in one-third and that for the upper end of tibia in one-tenth of the 64 cases after the 36th week and that they are present more frequently in Indian foetuses. The technique and value of estimation of foetal maturity by radiology are then briefly discussed.

REFERENCE

HARTLEY, J.B. (1957): Radiological estimation of foetal maturity, Brit. J. Radiology, 30, 561-576.