Ante-partum localisation of the placenta with radioactive isotope Indium (^{113m}IN)

by K. H. Ng

MBBS (Malaya), FRCS (Edin), MRCOG

and

Professor K. S. Lau

MBBS (Malaya), MC Path. (Aust.)

Professor T. A. Sinnathuray

AM, MD (S'pore), BS (Malaya), FRCS (Edin), FRCS (Glasg.), FICS, MRCOG

Departments of Obstetrics & Gynaecology, and Pathology,
University of Malaya Medical Centre,
Kuala Lumpur

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PLACENTOGRAPHY FOR THE ANTE-PARTUM localisation of the placenta has been in use for about 20 years, ever since the radioactive isotope of sodium (^{24}Na) was available. Ante-partum placental localisation is presently undertaken more frequently not only for the confirmation of placenta praevia, but also as a pre-amniocentesis prerequisite. Placental localisation, in the management of clinical cases of ante-partum haemorrhage, is of tremendous benefit to both the hospital and the patient; for the exclusion of placenta praevia in these cases allows the expectant mothers, who are in hospital, to return home for social reasons or to free the acute hospital beds for other ante-natal cases. The inadequacy of ante-natal beds for expectant mothers is universal, but such deficiency is more marked in underdeveloped and developing countries of the world, in reference to which Malaysia and Singapore are no exception. If reliance is to be placed on the method of placental localisation, then it must not only be accurate, but also convenient and without undue risk to mother and foetus.

Materials and Method

All isotopic methods of ante-partum placental localisation depend upon the labelling of the maternal blood, and the subsequent detecting of the maternal blood pool in the placental "bed", i.e. in the chorio-decidual space and the decidua basalis area of the gravid uterus. Previously, various other radioactive isotopes, such as sodium ^{24}Na (Browne, 1951), iodine ^{131}I as iodinated serum albumin (Hibbard, 1969), and technetium ^{99m}Tc as technetium serum albumin (Walker et al., 1968, James et al., 1971) have been used. However, based upon the short half-life of the isotopes, the radiation dose (to both the mother and foetus) per useful photon, the quality of the isotopic scans obtained, and the availability of the radioisotopes, it is now felt that the radioisotope Indium ^{113m}In is the best for placental localisation studies (Buttfield et al., 1971).

Indium — 113m (^{113m}In), which is a radioactive isotope of indium, is derived by elution with

N/20 HCl from a 113Sn — 113mIn generator column. The radioactive isotope of indium (113mIn) has a very short physical half-life of 1.7 hours, in contrast to the physical half-lifes of 115 days for tin (113Sn), 8 days for radioactive iodine (131I), and 6 hours for technetium (99mTc). In addition, indium (113mIn) has a biologic half-life of 3 hours, and the effective half-life is only 1 hour. The radiation dose to the foetus from 1 mCi of 113mIn — Transferrin has been calculated as 36 mR* (total body) at 1 cm. from the placenta and 3 mR (total body) at 3 cm. from the placenta. The radiation dose to foetal blood is estimated to be 8 mR. This value is less than the calculated radiation dose to the foetus-in-utero from a plain X-Ray of the abdomen, and compares very favourably with the calculated radiation dose to the foetus of 100mR per X-ray abdomen or 1,000 mR for X-ray pelvimetry studies. The total maternal radiation dose from 1 mCi 113mIn is calculated to be 17 mR (Van de Mereve et al., 1970). Hence, the dosage of radioactive indium 113mIn used for a single placental scan is extremely small, and resultant radioactivity hazard to the mother and foetus is negligible.

The isotope 113mIn, in a HCl medium with a pH of about 1.6, is pre-mixed with maternal blood, and a dose of 0.5 to 1 mCi is injected via the ante-cubital vein into the maternal circulation. The isotope becomes readily bound to the plasma transferrin (B-globulin) molecule, as an indium-transferrin complex. This indium-transferrin complex does not appear to cross the placental membrane into the foetal circulation to any extent (Johnson et al., 1969).

Prior to the injection, the patient is instructed to empty her bladder completely. After the injection, with the patient in the supine position, the "uterine" area of the abdomen is outlined and carefully scanned to localise accurately the site of maximal pooling of the maternal blood at the site of the placental bed by measuring the site of maximal radioactivity. This would indicate the site of placental implantation. Photo-scan records showing the sites of placental localisation are made. In those cases, where the placental site is not fundal in position or is poorly seen, further scan studies are made with patient in the lateral position.

Results

This study is a joint project undertaken by the Departments of Obstetrics and Gynaecology and Pathology of the University of Malaya Medical Centre. It was started in August 1970 and is still in progress. In this paper is presented the analysis of the first 20 consecutive placental scans of the patients that had been followed to their delivery, during the first 8 months of the study period from August 1970 to March 1971 inclusive.

Figures 1 to 6 show examples of the various sites of placental localisation in the scans. The results of the first 20 placental scans are summarised in Tables I to IX. The accuracy of placental localisation is shown in Table X.

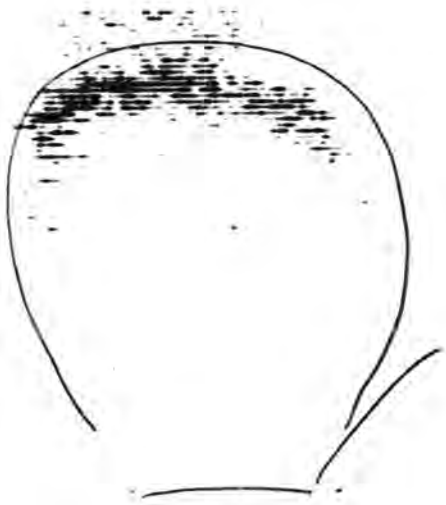

Fig. 1: Antero-posterior (A-P) view showing the placenta in the fundus of the uterus.

Fig. 2: A-P and left lateral view showing placenta in the upper uterine segment on the left side.

*mR = Mille Rads.

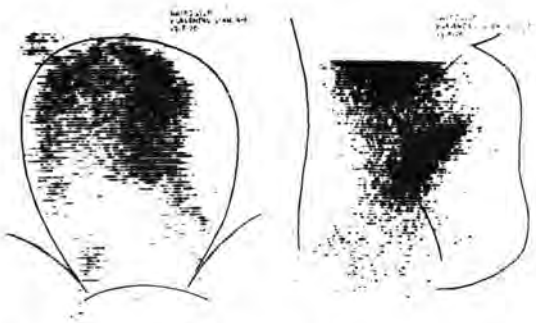

Fig. 3: A-P and right lateral view showing placenta in upper uterine segment and posterior wall.

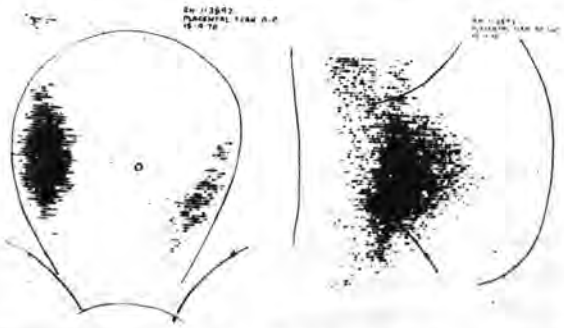

Fig. 4: A-P and right lateral view. The lower edge of the placenta dips down into the lower uterine segment — placenta praevia, type I.

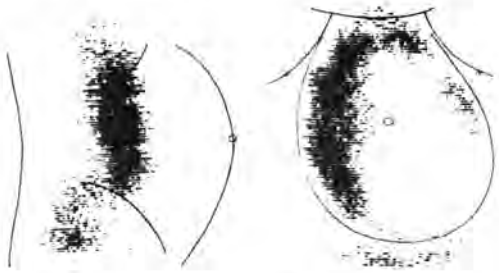

Fig. 5: A-P and left lateral view showing placenta partially covering the lower uterine segment — placenta praevia, type III.

TABLE I

ETHNIC PATTERN

	No. of Cases	Per cent
Chinese	12	60
Indian/Ceylonese	6	30
Malay	2	10

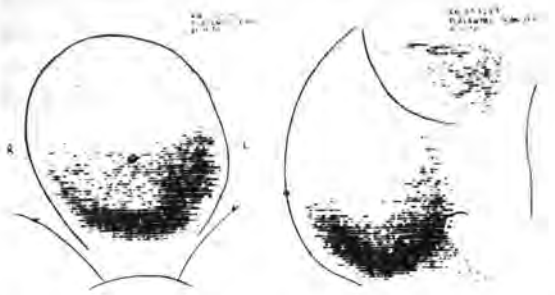

Fig. 6: A-P and left lateral view showing placenta completely covering the cervical os — placenta praevia, type IV.

TABLE II

MATERNAL AGE PATTERN

	No. of Cases	Per cent
Under 20 years	1	5
20 to 29 years	13	65
30 to 39 years	5	25
40 years and over	1	5

TABLE III

MATERNAL GRAVIDA PATTERN

	No. of Cases	Per cent
Primigravida	9	45
Gravida 2 to 4	7	35
Gravida 5 to 10	4	20

TABLE IV

CLINICAL PRESENTATION PATTERN

	No. of Cases	Per cent
Ante-partum Haemorrhage	10	50
Unstable Lie	6	30
High Presenting Part at Term	2	10
Pre-Amniocentesis Scanning	2	10

TABLE V

GESTATIONAL MATURITY AT SCANNING

	No. of Cases	Per cent
30 to 34 weeks	6	30
35 to 36 weeks	8	40
37 to 38 weeks	3	15
39 to 40 weeks	2	10
Over 40 weeks (41 weeks)	1	5

TABLE VI

PLACENTAL LOCALISATION ON SCAN

	No. of Cases	Per cent
In upper Uterine Segment (Fundus or Body)	14	70
Placenta Praevia (Minor Degree)	2	10
Placenta Praevia (Major Degree)	4	20

TABLE VII

MODE OF DELIVERY PATTERN

	No. of Cases	Per cent
S.V.D.	12	60
Forceps/Ventouse	2	10
Breech	1	5
L.S.C.S.	5	25

TABLE VIII

FOETAL MATURITY AT DELIVERY

	No. of Cases	Per cent
Under 35 weeks	1	5
35 to 36 weeks	2	10
37 to 38 weeks	7	35
39 to 40 weeks	6	30
Over 40 weeks	4	20

TABLE IX

CORRELATION OF CLINICAL PRESENTATION WITH SCAN FINDINGS

Clinical Presentation	U.U.S.	L.U.S.	No. of Patients	Per cent
Antepartum Haemorrhage	7	3	10	50
Unstable Lie	4	2	6	30
High Presenting Part at Term	1	1	2	10
Pre-Amniocentesis Scanning	2	0	2	10

TABLE X

ACCURACY OF PLACENTAL LOCALISATION IN STUDY

Site of Localisation	Initial Scan Localisation of Placenta	Final Clinical Localisation of Placenta
IN UPPER UTERINE SEGMENT (Fundus or Body)	15 cases	(14 cases In Upper Segment (1 case Placenta Praevia (Minor degree)

Inaccuracy Rate in Localising Minor Degree of Placenta Praevia of 6.7%

IN LOWER UTERINE SEGMENT (PLACENTA PRAEVIA):	5 Cases	5 Cases
Minor Degree of Placenta Praevia	2 Cases	2 Cases
Major Degree of Placenta Praevia	3 Cases	3 Cases

Inaccuracy Rate of Localisation — Nil

OVERALL INACCURACY RATE OF PLACENTAL LOCALISATION IN STUDY IS 5%

Summary and Conclusions

1. A study of the antepartum localisation of the placenta by the use of radioactive isotope Indium 113mIn scanning of the uterine area of the abdomen, as undertaken in the University of Malaya Medical Centre, is presented.
2. The major advantages of the method of placental localisation, as compared to all previous methods, are the very high degree of accuracy, feasability of localisation at an early period of gestation, ease of technique, ease of interpretation of results, and negligible hazard to the foetus and mother.
3. The accuracy of localisation is almost 100%.

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