PLACENTAL LOCALIZATION USING INDIUM-113M*

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In 1950 Browne and Veall[1] reported the use of radioactive sodium to localize the placental blood pool. Because of the rapid diffusion and excretion of the radioactive sodium, it was substituted by radioactive iodinated human serum albumin (RISA). The albumin was labelled with various isotopes of iodine, eg. ^{131}I[2-4] and ^{132}I.[5,6] Erythrocytes labelled with ^{51}Cr were also used.[7,8] With the use of these radio-isotopes point-count localization of the placenta is possible. In point-count localization the counting rates are recorded graphically on a strip of paper and only a gross estimation of the size and position of the placenta is provided. This method is not reliable in cases where the placenta is situated symmetrically on the posterior uterine wall.[3,6] Some difficulty is also experienced in deciding whether the placenta is situated on the anterior or posterior wall.[9] Because amniocentesis is so important in the management of rhesus iso-immunization we are no longer merely interested in whether or not the placenta encroaches on the lower segment; accurate localization is required to prevent further transplacental immunization.

In 1964 McAfee and his colleagues[10] introduced automatic scintillation scanning using ^{99M}technetium-labelled human serum albumin for the localization of the placental blood pool. This method immediately became popular, and numerous papers produced evidence of the accuracy of the results.[11-14]

In 1966 Stern *et al.*[15] introduced a new nuclide suitable for localization of the placental blood pool—^{113M}indium. This nuclide has certain definite advantages, including ease of preparation and a long half-life of the parent nuclide.

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MATERIALS AND METHOD

The parent nuclide of ^{113M}indium is ^{113}tin with a half-life of 118 days.

The preparation of ^{113M}indium is essentially a simple procedure requiring 30 minutes. The ^{113M}indium is eluted from a ^{113}Sn - ^{113M}In generator by the addition of 8 ml. dilute hydrochloric acid (pH 1·3). To this eluate one millilitre of sodium chloride is added. By the further addition of dilute NaOH the mixture is then titrated to pH 3·4. This mixture is sterilized by autoclaving at 15 lb./sq.in. (1·05 kg./sq.cm.) for 20 minutes. Regular tests using rabbits are undertaken to exclude pyrogenic contamination. We do not add gelatin to stabilize the ^{113M}indium as advocated by Wagner,[16] as we have not found that this omission adversely affects the resulting photoscans.

Scanning Procedure

Scintillation scanning is done using a Picker Magnascanner 2806 with a 3 × 2 in. thallium-activated sodium iodide crystal and a 19-hole focusing collimator. The pulse-height analyser is set at 350 - 420 kev. Scanning is done at 120 cm./min. with a line spacing of 0·5 cm. The time constant has been set at one-eighth of a second and the background cut-off at 20% of the maximum count rate. Scanning is started 1 cm. below the midpoint of the symphysis pubis.

RESULTS

A total of 98 placental localizations were done. The indications were rhesus iso-immunization in 4 cases and antepartum haemorrhage in 94 cases.

In the 4 cases of rhesus iso-immunization a total of 9 amniocenteses were done. In not a single case was blood obtained during the procedure, although the placenta was situated on the anterior uterine wall in all cases.

The group of patients where the photoscan was done because of antepartum haemorrhage comprised 94 patients. The diagnosis of placenta praevia on the photoscan was based on the radiological studies of Nelp and Larson.[17] They found the external cervical os 3·5 ± 0·7 cm. above the midpoint of the symphysis pubis when the patient was in the recumbent scanning position. Although the position of the internal os will vary with the degree of effacement of the lower uterine segment, the internal os was usually 1 - 2 cm. higher than the external os. In the lateral scanning projection the external cervical os was an average of 2·4 cm. cephalad to a line drawn from the greater trochanter to the pubic symphysis. For orientation we place a mark on the scan image directly over the midpoint of the symphysis pubis, over the greater trochanter, over the umbilicus and over the upper margin of the uterus. In some of our cases the anterior superior iliac spines are also marked. In most cases a placenta praevia can be excluded without any doubt (Fig. 1). We believe that in all doubtful cases or cases where the placental position is not clearly seen a lateral scan is most useful in confirming placental position and size (Figs. 2 and 3). This is particularly applicable to cases where the placenta is situated posteriorly or laterally.

So far 71 patients have been delivered. In 45 cases the placental position was diagnosed antepartum as not being placenta praevia. In each of these cases the placenta praevia was also excluded by vaginal examination in theatre at the time of induction of labour. This indicates the value of this procedure in excluding placenta praevia. In the remaining 26 patients the diagnosis of placenta praevia was made on the photoscan.

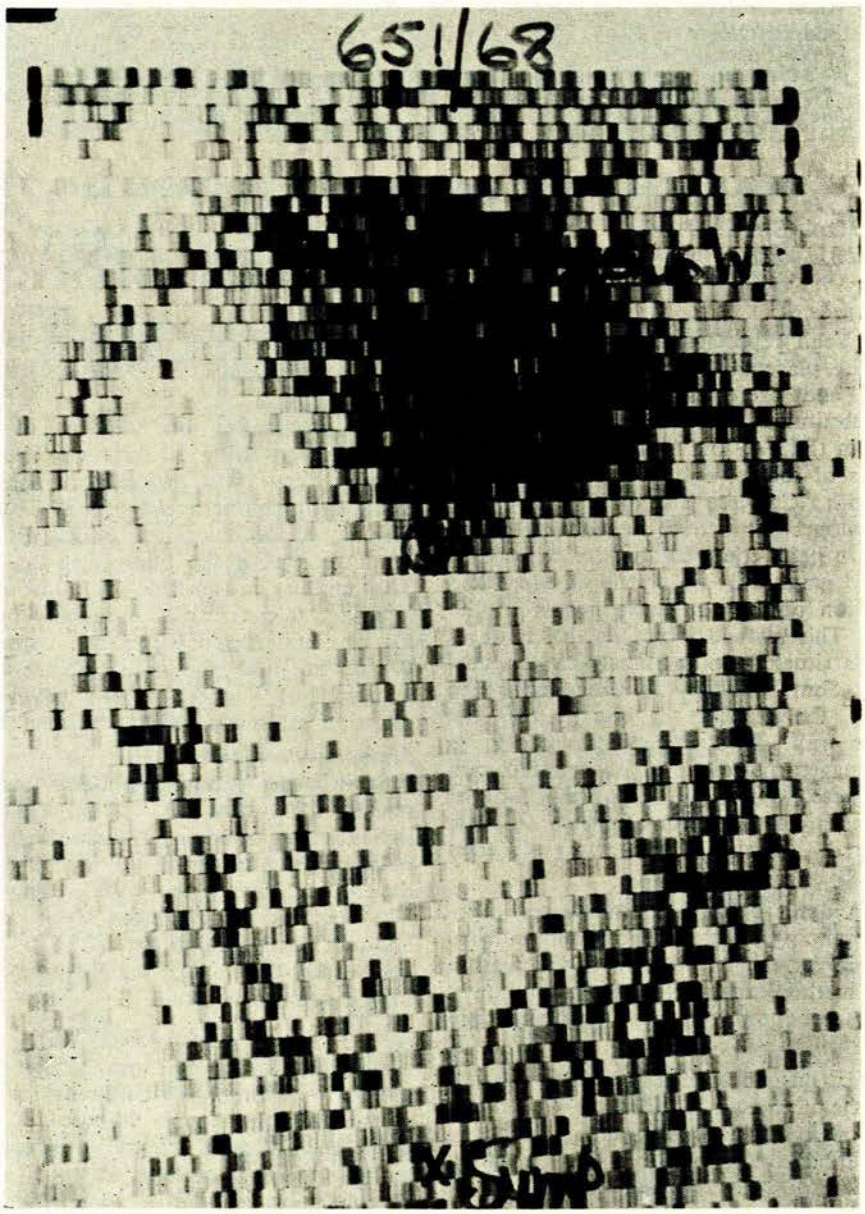

Fig. 1. Anterior photoscan at the 34th week of pregnancy. Placenta situated in the fundus. Markings placed over the midpoint of the symphysis pubis and over the umbilicus.

In 12 patients a caesarean section was done, and the diagnosis of placenta praevia was confirmed at operation. In an additional 2 patients the placenta was felt with vaginal examination in theatre. These patients delivered vaginally, because the degree of placenta praevia was a minor one. In the other 12 patients the diagnosis of placenta praevia on the photoscan could not be confirmed by vaginal examination. However, minor degrees of placenta praevia are difficult to feel on vaginal examination. In 9 of the 12 patients retrograde aortic placentography had also been done and in 6 of these cases this latter examination also showed a placenta praevia.

In all of the remaining 23 patients with antepartum haemorrhage who have not yet delivered, a photoscan and retrograde aortic placentography have been done. In 19 patients the placenta was situated in the upper segment of the uterus with both techniques. In 3 patients according to both techniques the diagnosis of placenta praevia was made. The one remaining patient was diagnosed as placenta praevia on the photoscan, but this diagnosis could not be confirmed by retrograde aortic placentography.

If we summarize all the results of radio-isotope placental localization in cases of antepartum haemorrhage we find that of the 94 photoscans, 64 were diagnosed as not being placenta praevia. There were 45 diagnoses confirmed as not being placenta praevia by vaginal examination and 19 by retrograde aortic placentography. Thirty cases were diagnosed as placenta praevia and the diagnoses were confirmed at caesarean section or by vaginal examination in 14; and by retrograde aortic placentography (cases not delivered) in 3. There were 13 diagnoses of placenta praevia that were not confirmed.

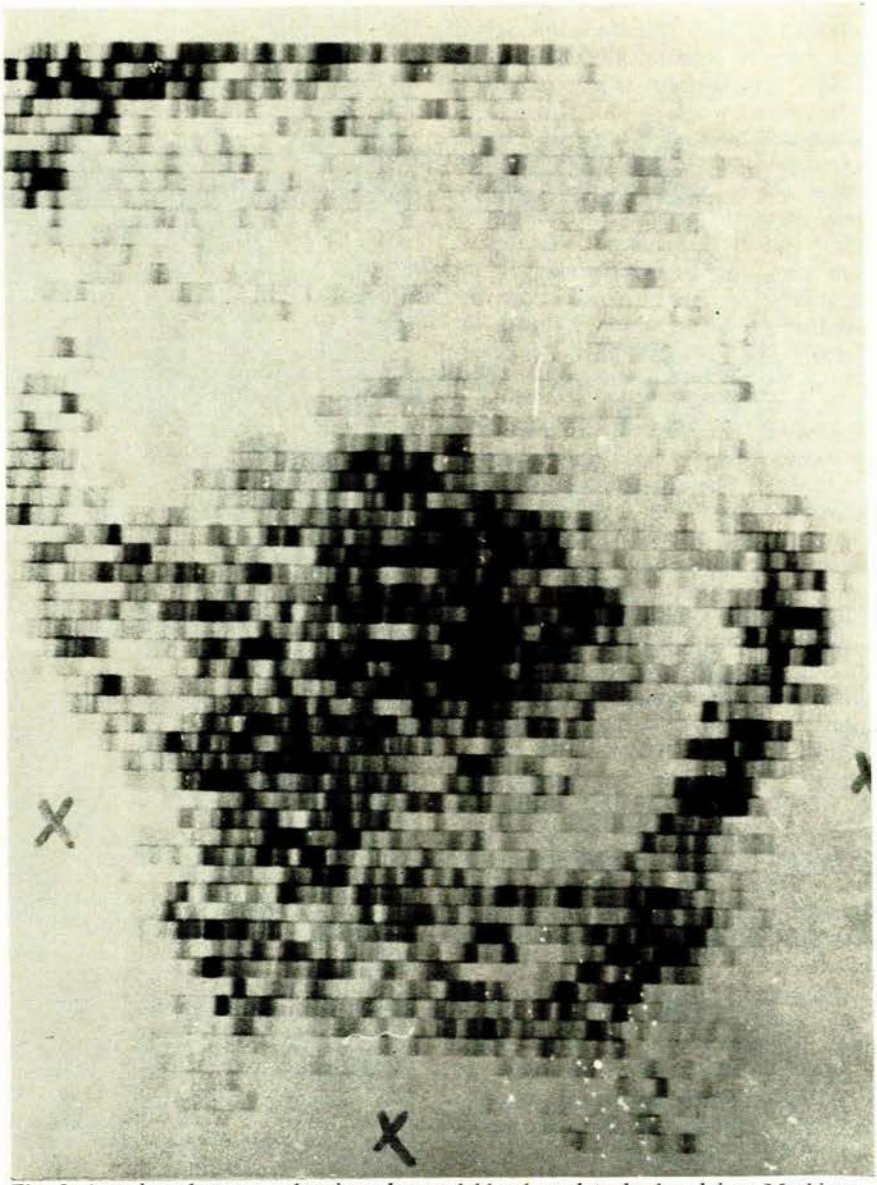

Fig. 2. Anterior photoscan showing placental blood pool to be low-lying. Markings over the midpoint of the symphysis pubis and anterior superior iliac spines.

DISCUSSION

Although Law and Hartley[18] could demonstrate the placental site in 90 - 95% of cases with soft-tissue placentography, an analysis of cases at Karl Bremer Hospital showed an error in diagnosis of at least 20% with soft-tissue placentography.[19] A more accurate method for demonstrating the placental site was sought and in 1961 the technique of retrograde aortic placentography was introduced and very promising results were obtained.[19] In a series of 87 aortic placentograms no case of placenta praevia subsequently proved at caesarean section or vaginal examination under anaesthesia was missed radiologically. This method entails certain definite disadvantages:

(*i*) A certain amount of manipulation of the patient is required, disqualifying this procedure in an actively bleeding patient.

(*ii*) The Seldinger method of catheterization[20] of the femoral artery is technically more difficult than a simple venepuncture.

(*iii*) One must bear in mind the possibility of iodine sensitivity.

(*iv*) Although the patients are usually relatively young, with normal healthy arteries, arterial complications must be expected.

(*v*) Arteriography is critically time dependent. A visible roentgenographic image can only be obtained when the initial bolus of injected dye is passing through the placental blood pool.

^{99M}Technetium is available, but we decided to use ^{113M}indium, because it has certain definite advantages: The ^{113}Sn - ^{113}In generator has a half-life of 118 days, whereas the ^{99}Mo - ^{99M}Tc generator has a half-life of 67 hours. Because of the long half-life the generator can be replaced every 6 months instead of the weekly replacement of the ^{99}Mo - ^{99M}Tc generator. Because of the geographical remoteness of the Republic of South Africa from the centres producing these isotopes the longer half-life generator eliminates many of the problems and costs of transportation.

Urinary excretion of ^{113M}indium is minimal (0·08 - 0·1%).[16] This eliminates continuous bladder drainage which is advised when using ^{99M}technetium. The preparation of ^{113M}indium is essentially a simple procedure requiring 30 minutes. Preparation of ^{99M}Tc-labelled human serum albumin is a laborious procedure requiring a full hour.[12] Because of the simplicity of preparation there is less danger of contamination with pyrogenic substances when using ^{113M}In.

The preparation of choice must have a short half-life to diminish the radiation dosage to the patient. ^{113M}Indium has a physical half-life of 1·7 hours and emits a mono-energetic photon with energy of 390 kev., which is suitable for most of the available apparatus.[15]

Placental transfer of ^{113M}In is minimal, and the radiation received by both mother and foetus is of an extremely low order.[21]

A few incidental references to the use of ^{113M}indium for placental localization have appeared in the literature.[16,22,23]

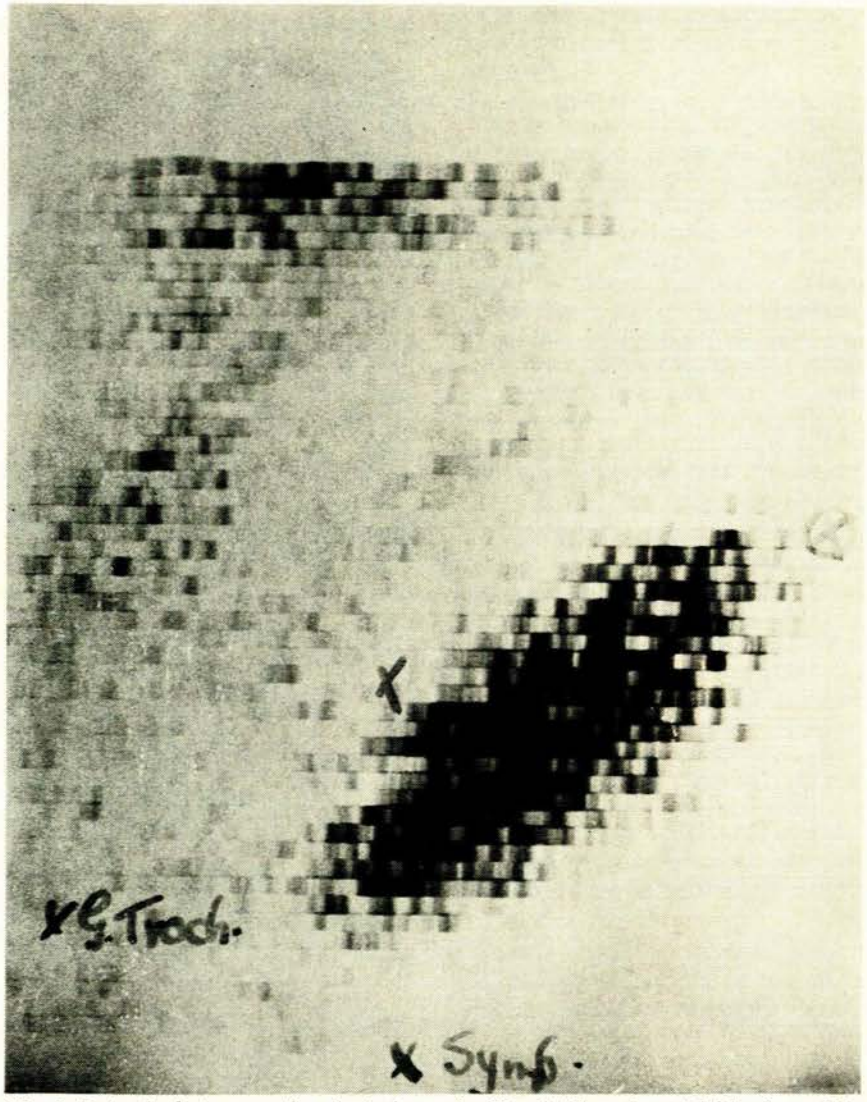

Fig. 3. Lateral photoscan of patient shown in Fig. 2. The placental blood pool is low-lying and on the anterior uterine wall. Markings over the umbilicus, the midpoint of the symphysis pubis, the greater trochanter and the anterior superior iliac spine.

SUMMARY

With the use of ^{113M}indium exclusion of a placenta praevia is extremely reliable. However, in the positive diagnosis of placenta praevia there is probably an element of over-diagnosis when confirmation is sought by vaginal examination. These cases are essentially low-lying placentas as confirmed by simultaneous retrograde aortic placentography.

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REFERENCES

1. Browne, J. C. McC. and Veall, N. (1950): J. Obstet. Gynaec. Brit. Emp., **57**, 566.
2. Hibbard, B. M. (1961): J. Obstet. Gynaec. Brit. Cwlth, **68**, 481.
3. Te Groen, F. W., Jansen, C. R., Van der Merwe, C. J. and Geldenhuys, F. G. (1965): S. Afr. J. Obstet. Gynaec., **3**, 46.
4. Weinberg, A., Rizzi, J., McManus, R. and Rivera, J. (1957): Obstet. and Gynec., **9**, 692.
5. Hibbard, B. M. and Herbert, R. J. T. (1960): Clin. Sci., **19**, 337.
6. Pool, K. R. S., Leach, K. G. and Hawkins, L. A. (1965): J. Obstet. Gynaec. Brit. Cwlth, **72**, 706.
7. Paul, J. D., Gahres, E. E., Albert, S. N., Terrell, W. D. and Dodek, S. M. (1963): Obstet. and Gynec., **21**, 33.
8. Vrettos, A. S., Megapanos, E., Costamis, P. and Binopoulos, D. (1965): Amer. J. Obstet. Gynec., **93**, 957.
9. Shanabrook, D. W. (1966): Ohio St. Med. J., **62**, 677.
10. McAfee, J. G., Stern, H. A., Fueger, G. F., Boggish, M. S., Holzman, G. B. and Zolle, I. (1964): J. Nucl. Med., **5**, 936.
11. Larson, S. M. and Nelp, W. B. (1965): Amer. J. Obstet. Gynec., **93**, 950.
12. Walker, R. H. S. and Kohorn, E. I. (1968): J. Obstet. Gynaec. Brit. Cwlth, **75**, 464.
13. Pieterse, P. J., Lötter, M. G. and Den Hartog, L. J. (1966): S. Afr. J. Obstet. Gynaec., **4**, 87.
14. Sonnendecker, E. W. W., Du Toit, D. and Jansen, C. R. (1967): *Ibid.*, **5**, 35.
15. Stern, H. S., Goodwin, D. A., Wagner, H. N. and Kramer, H. H. (1966): Nucleonics, **24**, 57.
16. Wagner, H. N. (1968): *Principles of Nuclear Medicine*. Philadelphia: W. B. Saunders Co.
17. Nelp, W. B. and Larson, S. M. (1967): J. Amer. Med. Assoc., **200**, 148.
18. Law, R. G. and Hartley, J. B. (1959): Proc. Roy. Soc. Med., **52**, 557.
19. Basson, J. M. M. and De Villiers, J. N. (1963): Clin. Radiol., **14**, 230.
20. Seldinger, S. I. (1953): Acta radiol. (Stockh.), **39**, 368.
21. Van der Merwe, E. J., Lötter, M. G., Van Heerden, P. D. R., Slabber, C. F. and Bester, J. (1969): J. Nucl. Med. (in the press).
22. Potchen, E. J., Adatepe, M., Welch, M., Archer, E. and Studer, R. (1968): J. Amer. Med. Assoc., **205**, 208.
23. Stern, H. S., Goodwin, D. A., Scheffel, U., Wagner, H. N. and Kramer, H. H. (1967): Nucleonics, **25**, 62.