Percentage Increase in FEV_1 after Administration of Salbutamol Aerosol by I.P.P.V. or Inhalation according to Pretreatment FEV_1

Pretreatment FEV_1 (l)	<0·75	0·75 –	1·0 –	1·25 –	⩾1·5	Mean
No. of patients	13	26	18	12	9	
% Increase in FEV_1 after:						
I.P.P.V.	42·5	32·5	36·5	34·4	32·3	34·48
Inhalation	18·2	23·5	20·8	21·6	32·6	23·07

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PRELIMINARY COMMUNICATIONS

Placental Scanning with Computer-linked Gamma Camera to Detect Impaired Placental Blood Flow and Intrauterine Growth Retardation

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Summary

By retrospective analysis of 65 placental localization studies by a computer-linked gamma camera the isotope uptake patterns were correlated with the eventual outcome of the pregnancies. The uptakes by anterior and lateral placentae were reduced in pregnancies which resulted in growth-retarded babies and statistically unrelated to the gestation of the pregnancy. This simple representation of placental blood flow could be a clinically useful index of placental function.

Introduction

Current diagnosis and management of intrauterine growth retardation are based on the direct measurement of fetal growth by clinical examination and sonar cephalometry and the indirect measurement of placental function by determining its ability to produce enzymes and hormones. These techniques depend on an accurate estimate of the gestation of the pregnancy and require serial recordings to establish a definite diagnosis. No single test can predict accurately intrauterine malnutrition on one sampling.

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The amount of oxygen and calories delivered to the feto-placental unit is limited primarily by the blood flow to the intervillous space. Though it is generally accepted that the placental blood flow is decreased in pregnancies in which intrauterine growth is retarded only a few studies have tried to substantiate this claim. Investigations have been limited to the clearance of ^{22}Na or ^{24}Na injected into either the intervillous space or the myometrium of affected women.[1-3] These techniques are impracticable and hazardous and have never been used in the clinical diagnosis and management of intrauterine growth retardation. After experience with radioisotope uptake methods designed to localize the placental site recent studies[4 5] have attempted to obtain a functional index of placental flow from retrospective analysis of dynamic imaging of the placental site with ^{99m}Tc or ^{113m}I using a gamma camera linked to a digital computer.

We present here a retrospective analysis of placental-site isotope uptake patterns using a computer-linked gamma camera. The analysed patterns were then correlated with the outcome of the pregnancies. Our aim was to determine whether this representation of blood flow through the placental site could provide a useful index of placental function to help in the diagnosis and management of intrauterine growth retardation.

Patients and Methods

Sixty-five placental-site isotope uptake patterns were studied. The placental localization studies had been requested for variable lie of the fetus in seven cases, a high presenting part in 10, amniocentesis for Rhesus incompatibility in three, and amniocentesis to estimate fetal lung maturity in eight. Over half the studies, however, were in patients with antepartum haemorrhage (37 cases) as the diagnosis or exclusion of placenta praevia is the major clinical indication for placental localization. The recent indication to perform amniocentesis to estimate the phospholipid content of the liquor and hence fetal lung maturity has permitted the study of placental isotope uptake patterns in pregnancies with proved intrauterine growth retardation. In six pregnancies more than one study was performed.

MEASUREMENT OF PLACENTAL ISOTOPE UPTAKE

A dose of 1 mCi of ^{99m}Tc-albumin in about 1 ml was injected into an antecubital vein in one second. The abdomen was scanned with a Scinticamera gamma camera with diverging collimator (Nuclear Enterprises) interfaced with a data processing system (Computer Corporation of America). The system is based on a PDP-8/1 microcomputer with 8192 words of memory. The site of the placental blood

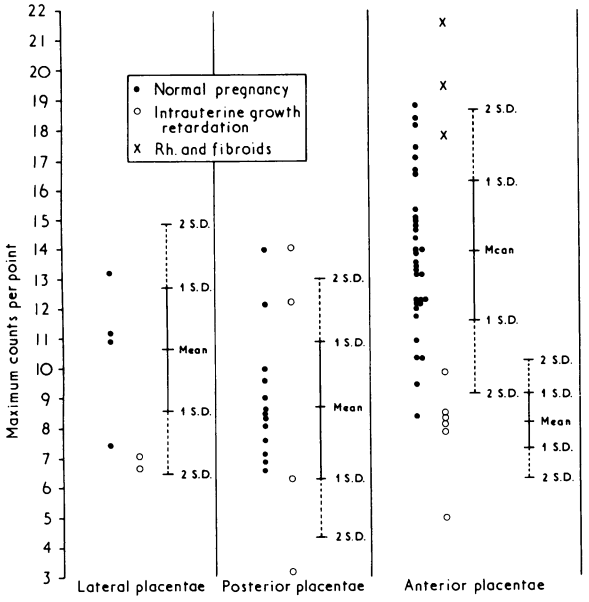
pool was determined on direct visualization of the flow pattern. Thirty four-second sequential frames were taken of the passage of isotope into the placenta. These were stored on industry-compatible magnetic tape for later analysis. The stored scan images are digitized into a 32 × 32 matrix of points.

The isotope uptake was determined by programming the computer to choose an area of interest consisting of 8 × 4 points from the placental image and including the central "hottest" area of the scan. The maximum counts per point (m.c.p.) were calculated by dividing the maximum counts obtained by the number of matrix points—namely, 32. This calculation was performed for each frame and the maximum uptake at two minutes taken for use in this study. The maximum was usually reached after one to one and a half minutes and remained steady thereafter.

As the position of the placenta on the uterine wall was relevant to the isotope uptake recorded anterior, lateral, and posterior positions of the placenta were considered separately. The calculated gestation at the time of the blood-flow study and at delivery was noted and checked with all available information. A pregnancy was considered to be normal where the baby's weight at delivery was above the 25th percentile for gestational age on the birth-weight charts of Lubchenco *et al.*[6] Intrauterine growth retardation was considered to be present when the weight was below the 25th percentile or between the 10th and 25th percentile and there was marked clinical evidence of intrauterine malnutrition at birth.

Results

The mean uptakes of ^{99m}Tc by placental sites on the anterior, lateral, and posterior uterine walls in all pregnancies studied are shown in the fig. There was no correlation between isotope uptake and week of gestation in the 50 pregnancies with a normal outcome (r = 0·144 for anterior placentae (33 studies); r = 0·140 for all placental sites).



Distribution of uptakes in all pregnancies.

The clinical details of all the pregnancies resulting in growth-retarded babies are shown in the table. Where the placentae were anterior the difference between these pregnancies and normal ones was significant (Student's *t* test: t = 4·91; P<0·001). There were too few studies with lateral and posterior placental sites for statistical analysis, though the isotope uptake by posterior placentae with normal and abnormal pregnancies is unlikely to be significantly different.

To assess the significance of antepartum haemorrhage occurring in pregnancies resulting in normal-weight babies the uptakes by anterior placentae associated with bleeding and by those not associated with bleeding were compared. The mean for patients who had bled was 13·42 and 13·96 for those who had not bled. There was no significant difference between the two groups (*t* = 0·73; P>0·05).

Isotope Uptake in Pregnancies Resulting in Growth-retarded Babies

Case No.	Uptake (m.c.p.)	Week of Gestation at Study	Week of Gestation (+Day) at Delivery	Birth Weight (g)
		Anterior Placentae		
1	9·8	32	35	1915 Dysmature
2	7·9	35	38	1913
	4·85	36		
3	8·4	32	32+4	900 I.U.D.
4	8·3	34	36+1	1183 I.U.D.
	8·25	36		
		Lateral Placentae		
5	7·0	31	35	1575
6	6·6	37	38	2270
		Posterior Placentae		
7	6·1	35	35+1	1264 I.U.D.
8	3·1	37	38	2533 Dysmature
9	13·9	34	37	2240
10	12·3	34	36	1980

I.U.D. = Intrauterine Death.

In the anterior placentae group one case with a normal outcome had an uptake of 8·3 m.c.p., which was below 2 S.D. of the mean for that group. The study was performed at 42 weeks and a normal baby weighing 128 oz (3629 g) was delivered one week later. In three cases uptakes were above 2 S.D. of normal. They included a severely affected Rhesus-sensitized pregnancy associated with hydrops fetalis (19·5 m.c.p.), a pregnancy coexistent with massive uterine fibroids necessitating caesarean hysterectomy (21·6 m.c.p.) and a type III anterior placenta praevia (18·8 m.c.p.). In a less severe Rhesus-sensitized pregnancy in which three exchange transfusions were needed there was an uptake of 17·8 m.c.p.

Discussion

This technique of calculating the isotope uptake of the placental site using a maximum count per point two minutes after intravenous injection of the isotope is possible only with a computer-linked gamma camera. The computer is essential to record, store, and recall the flow patterns, so allowing for retrospective study of the data. These computer-gamma camera complexes are fortunately becoming more widely available as nuclear medicine develops and should become increasingly accessible to obstetric units.

The radiation dose to the fetal blood from the 1 mCi of ^{99m}Tc albumin used in these localization studies is 14 mR, compared with 100 mR received from a routine *x*-ray pelvimetry. If the placental investigation is indicated by the patient's obstetrical problem the fetal risk is acceptable, and repeat studies would be justified.

We considered that the maximum count per point isotope uptake after two minutes was the only practical index to be assessed. It probably represents the placental blood pool size and not the actual rate of blood flow through the placenta, but this may still be a functional index of the placental blood available for fetal nutrition. A direct study of the rate of isotope uptake and hence the rate of blood flow will be possible only in a prospective study where the rate, and completeness of injection of the isotope can be standardized and the uptake probe positioned to offset discrepancies arising from varying placental sites.

If the isotope uptake at two minutes does represent a functional index of placental blood flow it must be supported by clinical correlation. Pregnancies with complications associated with impaired placental blood flow would be expected to have significantly low isotope uptakes and, conversely, conditions with high flows would have high uptakes. In two cases (3 and 4) there was essential hypertension, and failing placental function monitored by oestriol excretion and sonar cephalometry, which resulted in the intrauterine death of growth-retarded babies. The placentae were small and grossly infarcted and blood flow was inevitably impaired. The isotope uptakes in these cases were 8·4 m.c.p. and 8·3 m.c.p. respectively—both values lying below 2 S.D. of normal. The patient with severe Rhesus sensitization and resulting fetal loss who had a very

large placenta would be expected to have a high placental flow to compensate for anaemic anoxia of the fetus. The uptake was 19·5 m.c.p.—above 2 S.D. of normal. The patient with the large fibroid uterus would have a distorted and abnormally high uterine flow superimposed on the placental flow, and her uptake was 21·6 m.c.p.

With this supporting clinical evidence we felt justified in relating the uptake to the outcome of the pregnancy. Analysis of the results showed that the isotope uptake by anterior placentae was significantly reduced in pregnancies resulting in growth-retarded babies. This association also seemed to apply to lateral placentae but not to posterior placentae. As we did not adjust the probe to try to eliminate erratic absorption from posterior placentae by the fetus, liquor, and uterine muscle these factors may explain the inconsistency.

We appreciate antepartum haemorrhage may be expected to interfere with and impair placental function but it was essential to include these cases in a retrospective study of this type. Their inclusion was supported by the fact that there was no significant difference in uptakes between patients delivering normal babies who had bled and those who had not.

The isotope uptake by the placenta was statistically unrelated to the gestation of the pregnancy. This is of considerable potential clinical value because all available serial placental function tests depend on an accurate estimation of the maturity of the pregnancy, which it is often impossible to make. If our results are substantiated by a prospective study then random single sample tests of placental function and fetal wellbeing could be performed regardless of estimated maturity.

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SHORT REPORTS

Uterine Rupture in Labour

Rupture of the uterus may result from obstetric mismanagement; dehiscence of a previous caesarean scar; hyperstimulation of the intact uterus; direct trauma during delivery; or a combination of these factors. The policy of allowing women who have had a previous caesarean section for non-repetitive causes to have a trial of spontaneous labour has meant that more women are at risk of uterine rupture: thus of 143 cases, 43 followed a previous caesarean section.[1] Only two of the 18 maternal deaths from uterine rupture reported in the most recent maternal mortality report[2] were scar ruptures and only three of the 18 had received intravenous oxytocin but this report covers 1967-9, before the current tendency to use high doses, with resultant risk of hyperstimulation of the uterus.

The danger of rupture may be increased when epidural analgesia is used because hyperstimulation is less easily detected. Difficult vaginal delivery and intrauterine manipulation may tear the lower uterine segment, particularly if it has been weakened by a previous caesarean section, or is very thin because of high parity or hyperstimulation. A combination of any two of these factors is especially dangerous. We have therefore reviewed five cases of uterine rupture in labour occurring in the King's College Hospital Group during an 18-month period in 1973-4.

Patients

The total number of deliveries during this period was 5835, an incidence of rupture of 1 in 1166. All patients were multigravida; oxytocin stimulation was used in three of the five cases and intravenous prostaglandin E.2. in another. Three patients (cases 1, 3, and 5) had epidural analgesia. The clinical features and treatment are analysed in the table.

Discussion

Delfe and Eastman reported an incidence of uterine rupture of 1 in 1000 at Johns Hopkins Hospital.[3] Three decades later the incidence of rupture at King's College Hospital is 1 in 1166. The traditional view that the combination of oxytocin and high parity is dangerous should still be respected—as the experience of two grandmultipara bears out, especially when oxytocin is given in high dosage.[4] When oxytocin is used in grandmultipara or in patients with a previous caesarean scar very careful supervision is called for.

The commonly held view that epidural analgesia is unsuitable for a patient with a previous caesarean section scar has been challenged.[5] Nevertheless, the removal of pain as a warning symptom may lead to delay in diagnosis, even though the local analgesia induced permits palpation of the lower segment during the course of vaginal examination.

The difficulty in diagnosis is the crux of the problem and is well illustrated by cases 4 and 5. In case 4 the diagnosis of uterine rupture was unsuspected until an emergency caesarean section was performed because of a prolapsed cord. In case 5 the possibility that the previous scar might rupture was kept constantly in mind and the lower segment palpated at regular intervals during labour. Nevertheless, the rupture was missed on palpation even when the fetus developed an unexplained tachycardia suggesting that rupture had occurred.

Continuous monitoring of the uterine contractions and fetal heart rate offer the best chance of avoiding hyperstimulation and of diagnosing fetal distress indicating that rupture may be occurring.

Analysis of Five Cases of Uterine Rupture

Case no.	Age	Parity	Previous Caesareans	Induction	Stimulation	Duration of labour	Hyper-stimulation	Monitoring in labour	Mode of delivery	Diagnosis	Treatment
1	32	4	Nil	Yes	PG.E.2 2mgm/ 500 ml	6 hours 30 min	Yes	Yes	Forceps	III stage PPH E.U.A.	Hyster-ectomy
2	33	4	Nil	No	Oxytocin 4 units/ 500 ml	8 hours 15 min	Yes	No	Abdominal	I stage Fetal death	Repair of rent. Steriliz-ation
3	32	4	One	Yes	Oxytocin 4 units/ 500 ml	22 hours	No	Yes	Vaccum ext.	III stage P.P.H. E.U.A.	Hyster-ectomy
4	25	2	One	No	None	1 hour 30 min	No	No	Abdominal	I stage Cord prolapse	Repair of rent. Steriliz-ation
5	31	1	One	Yes	Oxytocin 8 units/ 500 ml	7 hours 10 min	No	Yes	Abdominal	I stage Fetal tachy-cardia	Repair of rent. Steriliz-ation

P.P.H. = Postpartum haemorrhage. E.U.A = Examination under anaesthesia.