proportions. There was special training in both occupational and physiotherapy for the therapists, 40 of whom completed the course each year. New scoring methods for the continued assessment of hand function and of disability in children and adults were under investigation. About 7,000 patients received treatment annually there with some 1,200 new referrals each year. A recent venture had been the purchase and equipping of several mobile workshops to take C.A.R.S. therapists into the patients' homes in certain remote areas such as Prince George to the north of British Columbia. Social workers were also active in the psychosocial field of chronic joint disease.

The Children's Hospital contained 100 beds, providing a complete paediatric service with day-care surgery and metabolic laboratory; and also the Pearson Hospital Poliomyelitis Pavilion for postacute cases of

poliomyelitis requiring long-term mechanical respiratory aid.

During the Meeting a full programme of medical films was shown daily at the conference venue in the Hotel Vancouver.

Other Events

On Sunday, 17 June, a religious service was held at Christ Church Cathedral, the first and second lessons being read by Dr. Gustave Gingras and Sir Thomas Holmes Sellors, Presidents of the C.M.A. and the B.M.A., respectively. The sermon was preached by The Right Reverend T. David Somerville, Bishop, Diocese of New Westminster.

On the same day a west coast salmon barbecue was held at the Pacific National

Exhibition grounds. This included a demonstration of logging sports, a buffet dinner, and a dance. After the installation of the President of the B.M.A. and the C.M.A. in the Regency Ballroom in the Hyatt Regency Hotel on 18 June, a reception and ball were held. On the following night visitors to the meeting were entertained privately in the homes of local doctors. On Wednesday, 20 June, a Christian Medical Fellowship breakfast was held in the Hotel Vancouver, and in the evening a cocktail party took place there also.

The ladies' programme included tours of local tourist attractions, mystery trips by coach, and a fashion show of Canadian furs. A young people's programme included a tour of a fish hatchery, Vancouver harbour, and the City Museum and Maritime Museum—as well as private splash and supper parties. Photographs by Inn Studios, Vancouver.

Occasional Survey

Intrauterine Transfusion: 101 Consecutive Cases treated at Queen Charlotte's Maternity Hospital

E. M. HOLT, I. E. BOYD, C. J. DEWHURST, J. MURRAY, C. H. NAYLOR, J. H. SMITHAM

British Medical Journal, 1973, 3, 39–43

Summary

Intrauterine transfusion was performed or attempted in 101 cases during a period of four and a half years. After exclusion of six cases, for reasons detailed in the text, 95 cases are considered in detail. Intrauterine transfusion was successfully performed in 93 of these, with a mean of 2.8 transfusions each. Forty-four babies (46.3%) survived and all but one are so far developing normally.

Introduction

The problem of the fetus so severely affected by rhesus isoimmunization that it would die in utero before it became sufficiently mature to survive delivery was first tackled by Liley when in 1963 he reported a successful intrauterine transfusion.¹ Since then many centres have adopted this approach to a hitherto insoluble problem.

Intrauterine transfusion was first performed in Queen Charlotte's Maternity Hospital in 1965, and over the next three years about 30 of these transfusions were performed by various operators. With the appointment of one of us (C.J.D.) in late 1967, and a revision of the indications for transfusion at that time,² a more concerted approach to the problem was adopted. This paper reports the results of in-

trauterine transfusions in this hospital during four and a half years and discusses variations in our practice from that employed in other reported series.

Patients

Intrauterine transfusion was performed on 101 patients who delivered between October 1967 and March 1972 at Queen Charlotte's Maternity Hospital. These cases comprised patients initially booked at the hospital and those referred from other centres later in pregnancy because of severe rhesus isoimmunization. Selection of cases for intrauterine transfusion was made on the basis of liquor studies. The indication for amniocentesis was an indirect Coombs titre greater than 1 in 16. Ultrasonic localization of the placenta was performed before the procedure, and later in the series amniocenteses were done in the ultrasonic department. The initial amniocentesis was usually performed at 20 to 22 weeks of gestation or later if the patient was referred late.

Patients were selected according to the criteria of Murray *et al.*²—namely, a bile pigment to protein ratio above 0.4 between 20 and 26 weeks or above 0.3 between 27 and 32 weeks. In only two cases was transfusion first performed after 32 weeks; in both cases the bile pigment to protein ratio was above 0.8 and both fetuses were stillborn. Early in the series two fetuses with bile pigment to protein ratios of less than 0.4 were transfused before 26 weeks; however, we would regard this as unnecessary.

Technique

The transfusions are performed in a room reserved for the purpose. The x-ray machine is equipped with television image intensification and is able to screen vertically or horizontally.

Queen Charlotte's Maternity Hospital, London W6 0XG

E. M. HOLT, F.R.C.S., M.R.C.O.G., Resident Obstetrician

I. E. BOYD, F.R.C.S., M.R.C.O.G., Senior Registrar

C. J. DEWHURST, F.R.C.S., F.R.C.O.G., Professor of Obstetrics

J. MURRAY, M.D., F.R.C.O.G., Director of Pathology

C. H. NAYLOR, M.R.C.O.G., Senior Registrar (Present appointment: Consultant Obstetrician and Gynaecologist, Central Middlesex Hospital)

J. H. SMITHAM, D.M.R.E., F.F.R., Consultant Radiologist

Videotape recording of the x-ray screening is available so that immediate review of the findings may be made without further irradiation of the patients.

The mother is given 2 g cephaloridine intramuscularly before the procedure and a further 2 g 10 hours later. Premedication with pethidine 150 mg and promethazine 50 mg is given one hour before the procedure.

The maternal abdomen is screened vertically and, if necessary, horizontally and the fetal skull, spine, and femora are identified. If this is difficult an x-ray picture is taken to help in identification. Particularly with a small fetus it is advisable to take a picture to ensure that the fetus is, so far as one can determine, normal, as it is extremely difficult in a fetus of this size to detect skeletal abnormalities on the screen.

X-ray appearances we believe to indicate hydrops include an angle between the fetal femur and spine of more than 90°, loss of the characteristic pattern of dye spreading between loops of gut, giving an opaque "snowball" appearance, and pooling of dye in the lower part of the peritoneal cavity on lateral screening. Fluid may be aspirated or emerge under pressure from the needle or catheter, but in many cases in which the fetus died shortly after transfusion and proved to be hydropic at necropsy we were unable to aspirate fluid.

If the fetal back is lateral or posterior the site directly above the fetal lower abdomen judged by the angle between fetal spine and femora is marked on the mother's skin. If the fetal back is anterior we usually postpone the transfusion for two days in the hope that the fetus will assume a more favourable position. If the transfusion is urgent an oblique approach is used, sometimes under direct vision.

With full sterile precautions and under local anaesthesia an 18-cm 16-gauge B.D. Yale Luer-lok thin-walled needle is passed vertically through the maternal abdominal and uterine walls into the fetal abdomen. Suction is applied to the needle and if any ascitic fluid is present as much as possible is removed. When it is considered that the needle is within the fetal peritoneal cavity a vinyl catheter (internal diameter 0.028 cm) is threaded through the needle and 5 to 10 ml of Conray 280 is injected, when characteristic crescentic shadows of dye between loops of gut and the outline of the peritoneal cavity will be seen. If the peritoneal cavity is not entered at the first attempt the patient is screened again to determine the placing of the needle and it is disengaged and redirected. Sometimes with a very small or mobile fetus, if the peritoneal cavity is not entered at the first attempt we find it useful to leave the original needle impaling the fetus to fix it in position and pass a second needle into the peritoneal cavity.

When the intraperitoneal location of the catheter has been confirmed fresh Rh-negative blood, packed to give a haemoglobin of 18 to 20 g/100 ml, of either the fetal group (if compatible with the maternal group) or group O is injected through

the catheter using a syringe. The needle is left in situ throughout the procedure. The quantity given varies with gestation and is shown in fig. 1. The rate of injection is usually between 5 and 10 ml/min, but we make no special effort to inject slowly, as the speed of injection is limited by the fine bore of the vinyl catheter.

In the first half of the series repeat transfusions were given at fortnightly intervals, the last being given at 32 weeks and labour being induced at 35 weeks. During the second half of the series this was modified so that the last two transfusions were given at 30½ and 33 weeks and labour was induced near 36 weeks in an attempt to reduce the hazards of prematurity, especially the respiratory distress syndrome.

The mother is kept at rest in hospital for 48 hours after the transfusion, as most fetal deaths and other complications seem to take place within this period.

Results

Intraperitoneal transfusion was attempted on 101 fetuses and succeeded in 99. Forty-seven babies survived the neonatal period, giving a gross survival rate of 46.5%.

In further consideration of the results six patients were excluded.

Three Rh-negative fetuses were treated in error; all survived. One with a bile pigment to protein ratio of 0.415 at 20 weeks had an unsuccessful transfusion at 22½ weeks. A liquor specimen taken at the time showed AB Rh-negative cells (mother was group A). A normal delivery of a healthy Rh-negative fetus at term ensued. The second patient was referred to this hospital after amniocentesis elsewhere. A further amniocentesis showed a bile pigment to protein ratio of 0.450 at 22 weeks. Unfortunately the S.P. 800 spectrophotometric curve showing evidence of a large amount of altered blood in the liquor was not considered, and the fetus had five transfusions between 24 and 33 weeks. Induction was performed at 34 weeks five days and a live baby was delivered with a cord haemoglobin of 20.8 g/100 ml. The Kleihauer test showed the presence of 40% fetal cells. The baby recovered from severe respiratory distress and did well. The third patient, early in the series, had a bile pigment to protein ratio of 0.360 at 25 weeks. Four transfusions were performed and labour was induced at 36 weeks. A healthy baby with a cord haemoglobin of 20.4g/100ml and Kleihauer test showing 47% fetal cells was delivered and made normal progress. The mother failed to attend paediatric follow-up after 13 weeks, but the baby was almost certainly Rh-negative.

Two stillbirths are excluded. One was recognized on x-ray film at the time of the second transfusion to have severe spina bifida and further treatment was abandoned. The other mother had one transfusion at 24 weeks and failed to attend for the rest of the course. She was delivered of a hydropic stillborn fetus at 32 weeks at another hospital. One neonatal death is excluded because the baby was found to have severe microcephaly and was not treated. Studies failed to show evidence of cytomegalovirus or toxoplasmosis and the condition was not thought to be due to the rhesus isoimmunization or its treatment.

Of the remaining 95 babies 44 survived the neonatal period, giving a corrected survival rate of 46.3%.

PREVIOUS PREGNANCIES

These are summarized in table I. The 95 mothers had lost a total of 75 pregnancies from rhesus isoimmunization. In

FIG. 1—Amount of blood transfused at different periods of gestation. (Taken from *Queen Charlotte's Textbook of Obstetrics*.)

TABLE I—History of Previous Pregnancies in Patients Studied

	No. of Patients
Stillbirth or late miscarriage from rhesus disease	35
Neonatal death from rhesus disease	25
Moderately affected pregnancy requiring early induction	57
Mildly affected pregnancy, no induction	6
No living child	5

only four cases was intrauterine transfusion necessary in the first affected pregnancy. In this series the mothers of surviving infants had lost a mean of 0.68 pregnancy each, compared with 0.88 pregnancy in mothers whose babies were stillborn or died neonatally.

PRESENT PREGNANCY

Of the 95 cases 93 were successfully transfused one or more times. In all 272 successful transfusions were performed, making an average of 2.8 transfusions each. The number of transfusions in relation to the outcome of pregnancy is shown in table II. The overall mortality rate of each transfusion was 15.4%, but when the fetus survived the first two transfusions the outlook was greatly improved. After the second transfusion the mortality rate of each transfusion fell to 5%.

TABLE II—Relation of Number of Successful Intrauterine Transfusions to Outcome of Pregnancy

No. of Intrauterine Transfusions	Intrauterine Death	Born Alive	
		Neonatal Death	Survived
1	15	1	3
2	15	2	10
3	4	2	9
4	3	2	8
5	2	1	9
6	1	1	3
7	0	0	2
Average No.	2.0	3.2	3.6

Attempts at intrauterine transfusions failed on 24 occasions in 21 patients, equivalent to a failure rate of 8.1%. In 15 cases the failure was the first attempt at transfusion and two fetuses died from the attempt. The others had at least one successful transfusion after the failed attempt and only one other fetus died immediately subsequent to a later unsuccessful attempt. The main reasons for failure were, firstly, poor visualization of the very small fetus, as nine failures were earlier than 24 weeks, and, secondly, the unfavourable back anterior position.

Our aim was to transfuse as early as possible in the course of the disease before hydropic changes occurred. In general we prefer not to transfuse before 24 weeks because of technical difficulties, but in some cases (fig. 2) this was done because of the past history of abortion of a hydropic fetus.

Twenty per cent. of the first transfusions were done before 24 weeks, 36.8% from 24 to 26 weeks, 21.0% between 27 and 30 weeks, and 22.1% after 30 weeks. The outcome in each of these groups is shown in table III. The results were

TABLE III—Relation of Gestational Age at First Intrauterine Transfusion to Outcome of Pregnancy

Time of 1st Intrauterine Transfusion	No.	Intrauterine Deaths		Born Alive		Survived	
		No.	%	No.	%	No.	%
Before 24 weeks	19	11	57.8	8	42.1	5	26.3
24 to 26 weeks	35	16	45.7	19	54.3	16	45.7
27 to 30 weeks	20	6	30.0	14	70.0	12	60.0
After 30 weeks	21	9	42.8	12	57.1	11	52.3

much poorer when transfusion was attempted before 24 weeks, and we are tending to reduce the number of these. Of the 19 early transfusions only six were performed in the second half of the series.

FIG. 2—Bile pigment to protein ratio and time of first intrauterine transfusion. X=Intrauterine death. O=Survived. ●=Neonatal death. ▲=Intrauterine death after unsuccessful attempt.

HYDROPS

This was diagnosed on x-ray appearances at the time of intrauterine transfusion, at postmortem examination after stillbirth, or on clinical grounds in liveborn infants (table IV). The overall survival rate of hydropic fetuses was 31.5%. In the remaining fetuses, who showed no signs of hydrops at any time, the survival rate was 65.8%.

TABLE IV—Relation Between Intrauterine Hydrops and Outcome of Pregnancy

Method of Diagnosis	No. of Intrauterine Deaths	No. of Neonatal Deaths	Alive
X-ray signs at intrauterine transfusion	20	6	17
Aspiration of >10 ml fluid at intrauterine transfusion	4	2	3
Postmortem examination	28	5	1
Clinical signs at birth	..	..	..
All hydrops	30	7	17

MATERNAL COMPLICATIONS

Premature labour occurred in 16 (30.2%) out of 53 cases where the infant was born alive. All but two infants were delivered after 32 weeks. There were six neonatal deaths in this group, but three infants were grossly hydropic and would probably not have survived to the time when labour would have been induced. Two non-hydropic babies delivered at 26 and 32 weeks died from hyaline membrane disease due to prematurity. One infant, delivered at 34 weeks, died of enterocolitis not connected with prematurity.

Several patients leaked liquor vaginally for varying times during a course of transfusions. One such patient leaked liquor and had repeated premature labour threats requiring intravenous alcohol infusions from 26 weeks while a

further four transfusions were done. She was eventually induced at 35 weeks and delivered normally of a live child which survived.

Abruptio placentae occurred in two patients. One had a mixed type of abruptio at 28 weeks of gestation, six days after the first transfusion, and a stillborn fetus was delivered. Another patient had a concealed abruptio immediately after transfusion and delivered a stillborn fetus six days later. Two other patients had slight vaginal bleeding after transfusions. There were no appreciable maternal infections.

FETAL COMPLICATIONS

Of the 42 intrauterine deaths 30 (71.4%) occurred within 48 hours of a transfusion. Seven fetuses died between 3 and 10 days after transfusion, and in the remaining five the time of death could not be established with certainty.

Only five of the stillborn fetuses (11.9%) showed unequivocal signs at necropsy that direct trauma to chest, heart, or abdominal organs caused death. Another three fetuses were exsanguinated by perforation of a major fetal vessel in an anterior placenta. Significant intraperitoneal adhesions in stillborn fetuses were found in only one case.

Several surviving fetuses had had needles inserted into the chest, gut, or bladder, and in one case dye was seen to be injected direct into the heart. One surviving fetus had severe scarring behind a knee which required physiotherapy to prevent contracture. In one hydropic fetus, which delivered prematurely at 31 weeks (six days after a failed transfusion) and died shortly after birth, *Clostridium welchii* was cultured from the heart blood.

LIVEBORN INFANTS

The cord haemoglobin, number of exchange transfusions, and outcome are summarized in table V. Nine surviving infants (20.4%) did not require exchange transfusions at birth, although three of these subsequently required simple transfusion for anaemia.

TABLE V—Relation of Cord Haemoglobin Levels and Exchange Transfusions to Outcome of Pregnancy

Cord Haemoglobin	No.	Exchange Transfusions				Neonatal Death
		0	1	2	3+	
Less than 40%	4	2	1	1		4
40 to 59%	3	1	1	1		1
60 to 79%	10		5	3	2	
80 to 99%	26	3	8	7	8	4
More than 100%	10	6	2	0	2	

The percentage of fetal red cells in the cord blood was calculated in 45 liveborn infants by the method of Kleihauer.³ Thirteen babies (28.9%) had less than 1% fetal cells, 20 (44.4%) had between 1 and 10%, and 12 (26.6%) had more than 10%. The highest proportion of fetal cells found was 48% in one case after a single intrauterine transfusion. Twenty-five cases, on cord blood testing, appeared Rh-negative and Coombs-negative although all were subsequently shown to be Rh-positive.

Of the nine infants that died in the neonatal period five were grossly hydropic. Three of these died before treatment could be instituted and two died after exchange transfusion. Two infants, delivered at 26 and 32 weeks, died of hyaline membrane disease. One infant delivered at 35½ weeks in apparently good condition deteriorated suddenly during the second exchange transfusion and died of cardiac failure.

The remaining infant survived six exchange transfusions, then on the eighth day of life developed a necrotizing enterocolitis and died on the tenth day after laparotomy and gut resection.

Follow-up of the surviving babies from 3 months to 4 years showed all but one, who was severely retarded, to be developing normally. It is obviously too early to give a final assessment.

Discussion

The perinatal survival rate of 46.3% in this series compares favourably with other reported rates of 36 to 40.6%⁴⁻⁷ but we are unable to approach the 62% survival reported in the second half of the Winnipeg series.⁸ It is difficult to compare our criteria for transfusion with those of other centres, as we use the bile pigment to protein ratio rather than one of the modifications of Liley's method. Murray *et al.*,³ however, showed a close correlation between severity predicted by the bile pigment to protein ratio and outcome in 19 severely affected cases.

In this series 56.8% of the initial transfusions were performed before 27 weeks of gestation and only 22.1% after 30 weeks. This is similar to the pattern in the Winnipeg series⁸ but earlier than most others, which had a much greater proportion of their transfusions starting later in pregnancy. Few would disagree that after 27 weeks of gestation, when the procedure is technically easier, intrauterine transfusion may save the severely affected fetus, but several workers have suggested that earlier than 27 weeks the results hardly justify the risks. Survival rates of 10.7 to 18.7% in fetuses first transfused before 27 weeks have been reported.^{4,7,9} Our survival rate for fetuses first transfused before 27 weeks was 38.8%; moreover, when the fetuses first transfused before 24 weeks are excluded the survival rate in fetuses first transfused from 24 to 26 weeks inclusive was 45.7%.

In both the groups receiving their first intrauterine transfusion from 24 to 26 weeks inclusive and from 27 weeks onwards the fetuses which did not survive had a significantly higher mean bile pigment to protein ratio (table VI). This was not so in the fetuses first transfused before 24 weeks, suggesting that in the very early transfusions trauma played a more important part in causing death than severity of disease, whereas after 24 weeks the most severely affected tended to die. When the fetuses first transfused before 24 weeks are excluded there is no significant difference in the numbers of fetuses surviving and dying in the other two groups; $\chi^2 = 0.4522$, $P > 0.50$. We conclude that it is seldom worth while performing transfusions before 24 weeks of gestation but that between 24 and 27 weeks some fetuses may be saved which would die in utero or become too severely affected to be helped if the initial transfusion were delayed until after 27 weeks.

TABLE VI—Difference between Mean Bile Pigment (B) to Protein (P) Ratio of Survivals and Deaths in Different Gestation Groups calculated by Student's *t* test

Gestation at 1st Intrauterine Transfusion	Mean B/P Ratios $\pm$ S.D.		Significance
	Survivors	Death	
Less than 24 weeks ..	0.626 $\pm$ 0.194	0.679 $\pm$ 0.200	$t = 0.4819$, $P > 0.30$
24 to 26 weeks ..	0.525 $\pm$ 0.094	0.663 $\pm$ 0.136	$t = 3.2936$, $P < 0.0025$
27 weeks or more ..	0.662 $\pm$ 0.229	0.913 $\pm$ 0.302	$t = 2.8876$, $P < 0.005$

The advisability of proceeding with intrauterine transfusion when the fetus appears to be hydropic at the time of the initial transfusion has been questioned. Green *et al.*¹⁰ felt that the results were so poor as to make the risk to the

mother unjustifiable, and others have agreed with this view.^{11,12} The major difficulty in assessing results lies in proving that a fetus is hydropic in utero. Our radiological criteria succeeded in diagnosing intrauterine hydrops in only 18 out of 28 fetuses who died shortly after intrauterine transfusion and were found to be hydropic at postmortem examination. This suggests that we have not overdiagnosed the condition and that our survival rate of 31.5% in hydropic fetuses justifies our policy of transfusing fetuses with apparent hydrops. In support of this view, Bowman *et al.*,⁸ using similar diagnostic criteria, reported a 32% survival rate in hydropic fetuses, and Hutchinson and Horger,¹³ using more stringent criteria requiring a free flow of ascitic fluid on paracentesis, reported three survivals among 17 severely hydropic fetuses.

Our practice differs from others in the simplicity of the technique for localizing and transfusing the fetus. We have not found the injection of radio-opaque contrast medium into the amniotic sac to be necessary or helpful, as the very small fetus does not swallow enough to outline the gut convincingly, and the larger fetus can be visualized adequately without this. Many workers,^{5-7,14} emphasize the importance of injecting the blood slowly; rates of 1 ml/min or less are recommended. It is difficult to see why, when blood is injected into the peritoneal cavity to be later absorbed, this very slow rate should benefit the fetus. We have been unable to show any consistent variation in fetal heart rate or intraperitoneal pressure with varying rates of injection. When studying the fetal intraperitoneal pressure rise during injection of blood¹⁵ we found that in most cases the maximum pressure occurred at the end of the transfusion and was independent of its rate. We therefore conclude that the quantity of blood injected is of more importance. Our system of giving 60% of the estimated fetal blood volume (fig. 1) was chosen arbitrarily but agrees well with quantities given in most recent series. Larger volumes may cause an intraperitoneal pressure rise sufficient to obstruct the umbilical venous circulation and cause death, as was found experimentally in baboon fetuses by Crosby *et al.*¹⁶

We also feel that if the transfusion is protracted over several hours or days the presence of the catheter, in addition to being distressing to the patient, may stimulate premature labour, especially if it becomes dislodged and blood is transfused into the liquor. Premature labour occurred in 16 (30%) of our cases where the infant was born alive, but in only two was the infant delivered before 32 weeks of gestation and in only two neonatal deaths was prematurity judged to have been a major factor.

It is difficult to assess accurately the value to surviving fetuses of the blood they have received in utero. Apparent intrauterine hydrops was reversed by the time of birth in 18 liveborn infants, 17 of whom survived. Only seven out of 54 liveborn infants had cord haemoglobin levels of less than 60%, and five of these were severely hydropic and died. Fairweather *et al.*¹⁷ suggested that the prolonged anaemia and low reticulocyte count found in many babies who have had intrauterine transfusion are due to depression of haemopoiesis, and Queenan,⁹ agreeing with this view, stated that the amount of transfused blood in the neonate is not proof of the efficacy of the procedure. We contend that the ap-

parent depression of erythroproiesis in the neonate could equally well be due to destruction of the newly formed red cells by remaining antibody in the circulation, as 20% of our surviving infants did not require exchange transfusion and a further 36% had only one.

We have, in fact, considered the possibility of using exchange transfusion to remove the large amount of circulating antibody, even in babies with normal cord haemoglobin levels, because we have found that it is not until the γ -G antibody falls to a titre of less than 1 in 8 that the baby's own red cells begin to appear in its circulation. This may be as long as 60 to 100 days after birth.

The maternal complication rate apart from premature rupture of membranes and labour was low in this series. In particular we had no appreciable maternal infections and only two patients had significant vaginal bleeding. This contrasts with infection rates of about 10% reported by Whitfield *et al.*⁷ and Queenan.⁹ Our policy of giving the mother cephaloridine before transfusion seems to be worth while.

The major problems of difficulty in transfusion and trauma to the fetus are largely dependent on the skill of the operator. We attempt to increase the experience of the operators by restricting transfusions to one of us (C.J.D.) and two senior registrars at any one time, but because of the transience of the latter during the four and a half years of this survey no fewer than seven operators performed transfusions. Clearly skill came only with experience, and units where only one person performed transfusions would, in time, achieve better results.

We thank the consultants at Queen Charlotte's Maternity Hospital for allowing us to study their patients, and the consultants from other hospitals who referred patients to us for treatment. We also thank the radiographers and nursing staff who have helped with the intrauterine transfusions.

References

- Liley, A. W., *British Medical Journal*, 1963, 2, 1107.
- Murray, J., Norrie, D. L., and Ruthven, C. R. J., *British Medical Journal*, 1970, 4, 387.
- Kleihauer, E., and Betke, K., *Internist*, 1960, 1, 292.
- Liley, A. W., *Annali di Ostetricia e Ginecologia*, 1970, special number, p. 130.
- Walker, W., and Ellis, M. I., *British Medical Journal*, 1970, 2, 223.
- Karnicki, J., *Journal of Obstetrics and Gynaecology of the British Commonwealth*, 1968, 75, 1209.
- Whitfield, C. R., Thompson, W., Armstrong, M. J., and Reid, M. McC., *Journal of Obstetrics and Gynaecology of the British Commonwealth*, 1972, 79, 931.
- Bowman, J. M., *et al.*, *Journal of the American Medical Association*, 1969, 207, 1101.
- Queenan, J. T., *American Journal of Obstetrics and Gynecology*, 1969, 104, 397.
- Green, G. H., Liley, A. W., and Liggins, G., *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 1965, 5, 53.
- Little, B., McCutcheon, E., and Desforges, J. F., *New England Journal of Medicine*, 1966, 274, 232.
- Bishop, E. H., Weber, L. L., and Israel, S. L., *American Journal of Obstetrics and Gynecology*, 1967, 99, 615.
- Hutchinson, D. L., and Horger, E. O., *American Journal of Obstetrics and Gynecology*, 1969, 103, 967.
- Fong, S. W., Margolis, A. J., Westberg, J. A., and Johnson, P., *Pediatrics*, 1970, 45, 576.
- Holt, E. M., Boyd, I. D., Gillmer, M. A., Naylor, C. J., and Thomas, G., *Journal of Obstetrics and Gynaecology of the British Commonwealth*, 1972, 79, 255.
- Crosby, W. M., Brobmann, G. F., and Chang, A. C. K., *American Journal of Obstetrics and Gynecology*, 1970, 108, 135.
- Fairweather, D. V. I., *et al.*, *British Medical Journal*, 1967, 4, 189.