

Transplacental Haemorrhage and the Mode of Placental Delivery*

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SUMMARY

A study was undertaken to determine whether the incidence and degree of transplacental haemorrhage would be affected by the following methods of placental delivery: Brandt-Andrew's manoeuvre, spontaneous or natural delivery, and manual removal. A total of 445 patients were studied, 10.1% of whom were found to have had evidence of a clinically significant foeto-maternal haemorrhage. Except for manual removal, foeto-maternal transfer was not affected by the method of handling of the third stage.

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Provided that a mother has not been previously sensitized to the Rh factor, Rh haemolytic disease may now be regarded as a preventable condition. This has most recently been confirmed by the report of the Rh study group,¹ which demonstrated that maternal iso-immunization can be prevented by the intramuscular injection of an appropriate dose of immunoglobulin into every Rh-negative mother delivered of an Rh-positive infant.

Rh immunization is usually caused by the transplacental passage of foetal red blood cells into the maternal circulation.^{2,3} Foetal erythrocytes carrying the D antigen promote the formation of anti-D antibody in an Rh-negative mother, which, when diffused back into the foetal circulation, will result in varying degrees of haemolytic anaemia in the foetus.

Although foeto-maternal haemorrhage severe enough to cause Rh iso-immunization can occur in the antenatal period, the transfusion is usually small^{4,5} and is not thought to be clinically significant. The majority of evidence indicates that most sensitizing transplacental haemorrhages are seen during labour and at delivery.²

The objective of our study was to see whether the method of delivery of the placenta affected the degree or incidence of foeto-maternal transplacental haemorrhage. As a secondary objective, the effect of hypertension during labour and assisted vaginal delivery, was to be assessed.

MATERIAL AND METHODS

The subjects studied attended the Obstetric Unit at Addington Hospital, and were randomly selected as far as their ABO grouping was concerned. All Rh-negative patients were excluded. The results are based on patients confined at term, the placenta being delivered vaginally by one of three techniques: (i) the so-called 'natural method' where the placenta was allowed to deliver spontaneously without interference; (ii) the Brandt-Andrew's technique in which controlled traction on the umbilical cord is combined with the upward displacement of the contracted uterus; and (iii) manual removal of the placenta when either of these techniques failed, or for other obstetrical indications. With the 'natural' method, oxytocics (oxytocin 5 units, ergometrine 0.5 mg) were administered intramuscularly *after* delivery of the placenta, whereas with the Brandt-Andrew's technique, the same dose was given intramuscularly with the delivery of the anterior shoulder.

A total of 445 patients were delivered, of whom 21 required manual removal of the placenta, 103 were managed conservatively using the 'natural' method, while the placentae of the remaining 321 were delivered by the Brandt-Andrew's manoeuvre. The latter group was divided into three sub-groups, namely: 221 patients in whom there were no complications antenatally or during labour; 44 patients in whom blood pressures of 140/90 mmHg or more were recorded antenatally or during labour; and 44 patients delivered by forceps or vacuum extraction. A further 12 patients had hypertension and also required assisted delivery.

Age and parity were similar in all the patients.

Two specimens of blood were taken from each patient; the first was taken early in labour up to and including a cervical dilatation of 6 cm, and the second usually within 30 minutes of delivery of the placenta.

The technique used to demonstrate foetal cells in the maternal circulation was based on a modification of the acid elution method, as described by Kleinhauer and Betke.⁶ Briefly, the test depends upon the fact that if a sample of blood is treated with a dilute acid, the adult haemoglobin, being acid-soluble, is denatured, whereas the foetal haemoglobin is not. On staining the blood slide with haematoxylin and eosin, the foetal cells appear dark

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red and the adult cells appear as easily differentiated ghost cells. With a low-powered lens 100 fields, giving an approximate count of 300 000 cells, were screened by one technician. This was performed on a 'blind' basis, the technician being unaware of the method of delivery of the placenta or the presence or absence of antenatal complications. The number of foetal cells found was regarded as the 'foetal score'.

According to this method, a foetal score of 1 cell is equivalent to 0.01 ml of foetal blood being passed into the maternal circulation; a score of 2 cells would be equivalent to a volume of 0.02 ml, etc. The minimum volume of foetal blood required to induce a primary sensitization in the mother has usually been taken as 0.2 ml. It has been shown, however, that with a foetal cell score of 10 or more, the estimated volume transfused into the mother (0.1 ml) becomes clinically significant with regard to primary Rh sensitization.^{7,8} We have therefore taken this volume to be significant for our present study.

RESULTS

The interpretation of the 'foetal score' was based on the following criteria: a postpartum foetal score greater than the prepartum specimen was regarded as a positive transfer; if the difference in the count between the two specimens was greater than 2 foetal cells/50 mm², the transfusion between the pre- and postpartum specimens was regarded as being significant. Only if the volume transfused exceeded 0.1 ml was the transfusion regarded as being significant with regard to iso-immunization.^{7,8}

In 3 instances, foetal cells were detected prepartum and not postpartum, and were probably related to the occasional instances where adult erythrocytes contained foetal haemoglobin (see later).

Comparison of Antepartum and Postpartum Transplacental Haemorrhage

As reflected in Table I, the incidence of detectable transplacental haemorrhage in 445 postpartum patients was 24.2% as compared with only 7.8% of antepartum blood

TABLE I. A COMPARISON OF ANTEPARTUM AND POSTPARTUM TRANSPLACENTAL HAEMORRHAGES

	No. of patients	Foetal cells in maternal circulation	Significant† transfusion
Antepartum	445	35 (7.8%)	13 (2.9%)
Postpartum	445	110 (24.2%)	45 (10.1%)

† Volume of foetal cells transfused 0.1 ml or more.

samples. The incidence of transplacental haemorrhage greater than the equivalent of 0.1 ml of foetal blood, and therefore significant with regard to iso-immunization, was 10.1% in the postpartum group and 2.9% in patients during the first stage of labour.

Method of Delivery of the Placenta

The incidence and quantity of transplacental haemorrhage associated with various methods of delivery of the placenta is listed in Table II. With spontaneous delivery of the placenta, the values of transplacental haemorrhage were slightly lower than those in patients whose placentae were delivered by the Brandt-Andrew's manoeuvre, but the difference was not of statistical significance. Thus, 24.5% of patients confined by the 'natural' method had positive evidence of transplacental haemorrhage, the transfusion being greater than the 0.1-ml immunizing dose in approximately one third (8.7%). The respective incidence in patients whose third stage of labour was dealt with by the Brandt-Andrew's technique was 26.2% and 10.4%.

In 21 patients obstetrical indications necessitated manual removal of the placenta. Although the numbers involved were small, and were therefore not suitable for statistical analysis, the incidence of positive transplacental haemorrhage (52.4%) and the volume of significant transfusions (23.8%) was strikingly greater than in the other two groups.

It has recently been shown that the size of the transplacental transfusion is clinically important in that it may indicate the dose of immunoglobulin required to prevent iso-immunization.¹ Analysis of the size of placental transfusion associated with the various methods of placental management in our series showed wide variations. Large

TABLE II. TRANSPLACENTAL HAEMORRHAGE FOLLOWING VAGINAL DELIVERY OF THE PLACENTA USING DIFFERENT TECHNIQUES

Method of placental delivery	Total number	Positive transfer (%)	Significant† transfer pre- vs. post-delivery (%)	Significant†† transfer volume (%)
Natural	103	24.5	13.6	8.7
Brandt-Andrew	221	26.2	15.4	10.4
Manual removal	21	52.4	33.3	23.8

† Foetal cells in post- vs. pre-delivery sample 2 or more.

†† Volume of foetal cells transfused 0.1 ml or more.

transfusions occurred randomly in each of the three categories.

Subsequent to the 'natural' delivery of the placenta, 3 patients had 'large' transplacental haemorrhages of more than 100 foetal cells/50 mm² as compared with 2 cases following manual removal, and 3 cases after the Brandt-Andrew's method. The largest individual haemorrhage recorded in each of the above groups were 351, 161, and 900 cells/50 mm² respectively.

Transplacental Haemorrhage Associated with Assisted Delivery and Hypertension

The Brandt-Andrew's method of placental delivery was employed in 100 patients whose labours were either complicated by hypertension, associated with an assisted delivery, or both. When the incidence and degree of transplacental haemorrhage of this group is compared with equally matched controls (Table III), a small increase in foeto-maternal transfusion is noted, viz. a 30.0% incidence of positive foetal cell transfer in 'abnormals' compared with 26.2% in the control group. The percentage of significant transfusion (volumes >0.1 ml) was almost identical—11.0% and 10.4% for the 'abnormal' and 'normal' groups respectively (Table III). The differences are not of statistical significance.

When the abnormal group is subdivided into those delivered by forceps and vacuum extraction alone, the increase in foetal transplacental haemorrhage is slightly greater than in the control group, but the difference still does not approach statistical significance. Thus, 13.6% of patients delivered by forceps or vacuum extraction had significant transplacental transfusions compared with 10.4% of the controls (Table III). Patients whose only abnormality was hypertension in labour actually had a lower incidence of transplacental haemorrhage—9.1% as against 10.4%.

DISCUSSION

With the development of the Kleinhauer technique,⁸ small quantities of foetal red cells can be detected in the maternal circulation, thus permitting an assessment of foeto-

maternal transfusion. The test is based upon a histochemical technique which identifies foetal erythrocytes, which contain foetal haemoglobin (HbF) in contrast to maternal red cells which contain adult haemoglobin (HbA).

Distinguishing foetal erythrocytes from adult reticulo-cytes can be difficult at times⁹ and may produce false positive results. Thus Sullivan and Jennings⁹ recently demonstrated the presence of small numbers of Kleinhauer-positive erythrocytes in blood smears from 12 of 100 adult males and concluded that there may be an inherent error of 10-12% in the calculation of foeto-maternal haemorrhage in any group of women. This phenomenon may have accounted for the 3 patients in our series who demonstrated 'foetal cells' antepartum and not postpartum.

Several authors have reported on transplacental haemorrhage in both the antepartum and the postpartum periods.^{5,9-12} The higher incidence of foetal cells noted in the maternal blood of our postpartum specimens is in agreement with the reports of Sullivan and Jennings,⁹ Freeze and Titel,¹¹ and Keenan and Pearse,¹² who all reported on an incidence of postpartum transplacental haemorrhage which was two or three times that observed antepartum. There is however, no unanimity of opinion on this subject, as other workers^{5,10} have recorded incidences which were approximately equal.

Large foeto-maternal transfusions are not necessarily accompanied by iso-immunization, but it is likely that an increased production of 'immune' antibodies will develop as the size of the foeto-maternal haemorrhage increases.^{13,14} This emphasizes the importance of the increased volumes of postpartum as opposed to antepartum transplacental haemorrhage obtained in this and other series. In short, it may be concluded that though transplacental haemorrhage can be detected throughout pregnancy, most of the larger (and therefore clinically significant) haemorrhages occur at delivery. This is probably due to damage to the placenta associated with its separation during labour.²

The Brandt-Andrew's technique of delivering the placenta was introduced to clinical practice some years ago and has, together with the routine use of oxytocic agents, considerably reduced the incidence of maternal postpartum haemorrhage. As such, it has become a standard

TABLE III. TRANSPLACENTAL HAEMORRHAGE FOLLOWING BRANDT-ANDREW'S DELIVERY (NORMAL CONFINEMENTS vs. CONFINEMENTS COMPLICATED BY HYPERTENSION AND/OR ASSISTED DELIVERY)

	Total number	Positive transfer (%)	Significant† transfer pre- vs. post-delivery (%)	Significant†† transfer volume (%)
Normal	221	26.2	15.4	10.4
Hypertension and assisted delivery	100	30.0	16.0	11.0
Assisted delivery only	44	34.1	18.2	13.6
Hypertension only	44	22.7	11.4	9.1

† Foetal cells in post- vs. pre-delivery sample 2 or more.

†† Volume of foetal cells transfused 0.1 ml or more.

procedure in clinical obstetric practice. The method is based upon the mechanical assistance of the already separated placenta and should not be associated with a greater liability to transplacental haemorrhage. Although 15.4% of patients delivered by this technique showed definite evidence of a significant postpartum versus prepartum foeto-maternal transfusion (Table II), the same was true of 13.6% of patients delivered by the natural method. Similarly, when volumes of transfused foetal cells greater than 0.1 ml were compared, the incidence resulting from the two methods did not differ statistically—10.4% and 8.7% for the Brandt-Andrew's and 'natural' groups respectively. Reilly,¹⁵ in a speculative review of problems relating to Rh sensitization, suggested that the increased pressure at the placental site resulting from the clamping of the umbilical cord at delivery, might favour the transfer of foetal cells into the maternal circulation and that this might be reduced by allowing the maternal end of the divided umbilical cord to drain freely.

Our results may therefore have been influenced by the practice of leaving the umbilical cord unclamped during the third stage of labour only in those patients delivered by the Brandt-Andrew's manoeuvre. However, in a recent study Scott *et al.*³ found that no significant difference in the frequency of haemorrhage was detected according to whether the cord was clamped or not.

Thus it may be concluded that the Brandt-Andrew's technique *per se* does not result in an increased foeto-maternal transfusion. A similar study comparing the mode of delivery of the placenta with transplacental bleeding was recently reported by Sullivan and Jennings.⁹ In their article they did not define what they meant by the 'expressed' method of delivering the placenta, but if this technique is used synonymously with the Brandt-Andrew's manoeuvre, the same conclusions would be reached.

Hypertension and pre-eclamptic toxæmia are said to be significant predisposing factors to the development of Rh antibodies resulting from an increased foeto-maternal transfusion.¹⁶

Although our numbers were small it was surprising to note that the incidence of both positive foetal cell transfer and foetal cell volume was lower in the hypertensive group when compared with the controls (Table III). Similarly, whereas Devi *et al.*¹⁷ found a significantly higher incidence of transplacental haemorrhage in ABO-compatible pregnancies terminated by forceps delivery, the incidence of foetal cell transfusion in our assisted deliveries, although higher than in the control group, was not clinically or statistically significant.

There is disagreement regarding the incidence of foeto-maternal transfusion associated with manual removal of the placenta.^{9,10,17} Only 21 of our patients required manual removal of the placenta, but the incidence of 'positive transfer' was more than twice that of the 'natural' group (52.4% compared with 24.3%). Of even greater clinical importance is the observation that the chance of inducing an iso-immunizing dose was increased almost threefold by this procedure (23.8% compared with 8.7%) (Table II). In the series reported by Sullivan and Jennings,⁹

foeto-maternal haemorrhage was observed in 38% of patients who had had a manual removal of the placenta—an incidence which was only slightly higher than that observed in their entire postpartum group. The difference is probably accounted for by the indication for manual removal: where manual removal of the placenta is necessary because of its morbid retention, then the incidence of transplacental haemorrhage is high. The manual removal of the already separated placenta is not associated with trauma at the placental site and hence is less likely to result in an increased foetal cell transfusion. The same is probably true for placentae removed electively at caesarean section.¹⁸

CONCLUSION

We found that 7.8% of foeto-maternal bleeding occurred in early labour and 24.2% after the third stage, thus confirming that most sensitizing haemorrhages occur at the time of delivery. As judged by the number of foetal cells in the maternal circulation postpartum, 10.1% of an unselected group of 445 patients were found to have clinically significant foeto-maternal haemorrhage. Except for manual removal of the unseparated placenta, the incidence and degree of foeto-maternal haemorrhage is not affected by different methods of handling of the third stage of labour.

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