

PLACENTAL TRANSMISSION OF FOETAL ERYTHROCYTES IN NORMAL PREGNANCY AND LABOUR

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Levine (1940) detected the phenomenon of maternal sensitization resulting from transplacental escape of the foetal red cells into the maternal circulation and named this phenomenon as Isoimmunisation. He put forward the view that foetal blood at a higher pressure enters the maternal circulation which is comparatively at a lower pressure through thinning of the placental barrier. Weiner (1948) detected severe anaemia in new borns which he thought was due to occult transplacental haemorrhage. This view was further supported by Wickster (1952), Chown (1955), Bromberg (1956), Cooperman (1958), Finn *et al* (1961), Fraser & Raper (1962), Zipursky *et al* (1959, 1963), Tepper & Verso (1964), Gordon & Bhoyroo (1966), Ghosh & Agarwal (1970) and Parekh *et al* (1971). The present study was undertaken to study the placental transmission of foetal cells during normal pregnancy and labour.

Material and Methods

Two hundred and fifty cases of normal pregnancy and labour were studied. The history of every patient was taken in detail and a careful clinical examination was done. The ABO & Rh grouping of the mothers and babies was done. The foetal cells were detected by the acid elution technique (Kleihauer *et al* 1957). Each slide was scanned for five minutes. The adult cells appeared as 'ghost' cells while foetal red cells stood out clearly as pink refractile cells. The counting of the foetal cells in relation to 1000 adult ghost cells was done.

On the basis of the quantity of foetal cells in the maternal circulation, the transplacental haemorrhage can be classified into four groups, (Parekh *et al* 1971). Cases showing 1-4 foetal cells per 1000 adult cells were classified as having a mild type of haemorrhage amounting to 0.4 ml. In the cases in which 5-6 foetal cells per 1000 adult cells were found, the haemorrhage was said to be intermediate, and the volume of blood loss was 0.4 to 2.5 ml. The cases which showed 8-15 cells/1000 adult cells were labelled as those with a severe haemorrhage and the volume of blood loss was 2.5-10 ml. The cases showing more than 15 cells/1000 adult cells had a haemorrhage which was

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massive and the volume of foetal blood loss was more than 10 ml.

Sixty-five male donors and 30 infertile females were also studied as controls.

Observations

The cases were distributed according to parity (Table 1). The maximum number of cases of this series were multipara 58.34%. The foetal cell transmission was slightly higher in primipara (40.0%) as compared to multipara (30.8%).

The incidence of foetal cell appearance at different periods of gestation was also variable (Table 1). No foetal cells were found upto 8 weeks of gestation. After 13 weeks to full term and early labour the incidence was slightly variable and ranged from 30.3% to 37.2%, while a sudden increase in the incidence of foetal

cells was found in the postpartum group of cases (52.8%).

The frequency of ABO compatible and incompatible combinations of the blood groups of mothers and babies were studied. The commonest ABO incompatible combination (32.5%) was between 'O' group mothers and 'B' group babies, while the commonest compatible combination (34.6%) was between 'B' group mothers and 'O' group babies.

The effect of ABO compatible and incompatible blood groups on foetal cell transmission in maternal circulation was also studied. The percentage of foetal cell positive cases was higher in the ABO compatible group (56.66%) as compared to the ABO incompatible group of cases (47.0%) Table II.

TABLE I
Distribution of Cases at Different Periods of Gestation

Period of gestation in weeks	Total No. of cases	Foetal cell positive cases	
		Number	Percentage
4-8	14	—	—
9-12	37	8	21.6
13-16	33	10	30.3
17-20	64	20	31.2
21-24	78	26	33.3
25-28	82	28	34.1
29-32	94	35	37.2
33-36	108	38	35.1
36-40	120	40	33.3
During labour	460	162	35.2
Postpartum	540	304	56.3

TABLE II
Foetal Cell Transmission in ABO Compatible and Incompatible Group

Type of cases	Total No. of cases	Positive foetal cell cases			
		Ante partum		Post partum	
		Number	Per- centage	Number	Per- centage
ABO Incompatible	100	31	31.0	47	47.0
ABO Compatible	150	65	43.3	85	56.66
	250	96	38.4%	132	52.8%

TABLE III
Foetal Cell Score in Relation with Periods of Gestation in ABO Compatible and Incompatible Groups (In the regular follow up cases)

Period of gestation in weeks	Total No. of cases	Less than 1/1000		1-2 cells/1000		3-4/1000		5-6/1000		8-15/1000		15-25/1000	
		Incom.	Com.	Incom.	Com.	Incom.	Com.	Incom.	Com.	Incom.	Com.	Incom.	Com.
9-12 wks.	7	1	4	—	2	—	—	—	—	—	—	—	—
13-16 "	9	1	4	1	2	1	—	—	—	—	—	—	—
17-20 "	14	4	6	1	2	—	—	—	—	—	—	—	—
21-24 "	21	5	13	—	2	1	—	—	—	—	—	—	—
25-28 "	15	3	8	1	3	—	—	—	—	—	—	—	—
29-32 "	14	4	8	1	1	—	—	—	—	—	—	—	—
33-36 "	29	4	14	2	7	—	—	—	—	—	—	—	—
36-term & early labour	71	10	27	10	8	3	4	1	5	—	—	—	—
Post partum	89	10	20	15	20	3	5	2	5	2	5	—	—

On the basis of foetal cell score, the transplacental haemorrhage was calculated according to combinations of blood groups of mothers and babies, and the period of gestation in cases who were delivered normally (Table III).

In the regular follow-up group of cases a mild type of transplacental haemorrhage was found in 30 out of 34 foetal cell positive cases (88.24%) in the ABO incompatible group, while it was found in 45 out of 55 (81.8%) cases with positive foetal calls in the ABO compatible group of cases. Intermediate type of haemorrhage was found in (11.76%) of cases in the ABO incompatible group and in (9.09%) cases in ABO compatible group. Severe type of haemorrhage was found in 2 (5.80%) cases of ABO compatible group only. No severe haemorrhage was seen in the incompatible group.

Foetal blood loss was also studied in cases admitted in labour as emergency cases having had normal pregnancy and labour. All these cases (1.00%) admitted as emergency in labour showed mild type of transplacental haemorrhage, 1 hour after delivery, a mild type of haemorrhage was seen in 12 out of 13 (92.3%) cases in ABO incompatible pregnancies and 26 out of 30 (86.6%) in ABO compatible pregnancies. An intermediate type of haemorrhage was seen in only 4 cases (13.3%) in the ABO compatible group. No. case of severe haemorrhage was found (Table IV).

Discussions

In this study, blood smears from 250 mothers were studied during pregnancy, labour and in postpartum period. Foetal cells were positive in 56.6% of cases, while other workers have reported 17% to 56% of foetal cells in maternal circulation in their studies (Taylor and Kull-

TABLE IV
Foetal Cell Score in Emergency Group

Time of taking blood	Less than 1/1000	1-4/1000	5-7/1000	8-15/1000	15-23/1000
During labour incompatible	4	4	—	—	—
Compatible	8	9	—	—	—
One hour after post partum incompatible	4	8	1	—	—
Compatible	8	18	4	—	—
Upto	0.4 ml	0.4 to 2.5 ml.	2.5 to 10 ml.	More than 10 ml.	

man, 1961; Keeman and Pearse, 1963; Pilkington *et al*, 1966; and Ghosh and Agarwal, 1970).

In the control study of 65 male donors and 25 infertile women, no foetal cells were found. Similar findings were reported by Zipursky *et al* (1959), Pilkington *et al* (1966) and Ghosh and Agarwal (1970), while Taylor and Kullman (1961), Zipursky *et al* (1963) and Cohen *et al* (1964) have reported 2%, 4.3% and 3.03% of foetal cells in adult men and non-pregnant females. However, Clayton *et al* (1962) thought that these were most probably adult reticulocytes which they confirmed by modifying the technique of Kleihaur *et al* (1957) by adding new methylene blue to the acid phosphate buffer.

Dependance of Foetal Cell appearance on Parity

The incidence of foetal cell appearance was slightly higher in primipara (40.8%) than in multipara (30.8%). Identical findings were also noted by Taylor and Kullman (1961) and Zipursky *et al* (1962), while Freese *et al* (1963), Cohen *et al* (1964) and Parekh *et al* (1971) found no correlation with parity.

Dependance of Foetal Cell appearance on Time of Gestation

In this study, foetal cells were noted between 9 and 13 weeks of gestation in 21.6% of cases. Freese and Titel (1963) and Ghosh and Agarwal (1970) noted the presence of cells after the 8th week, while Taylor and Kullman (1961), Clayton *et al* (1964, 66) detected it after 16 weeks. Mclarey & Fish (1966) were not able to demonstrate it upto the 21st week. The foetal cell percentage ranged from 30.3% to 37.2% from 13 weeks to term and early labour showing no rising tendency with advancing gestation, but a sudden increase to 56.3% was noted in the post partum period. Freese *et al* (1963), Zipursky *et al* (1963), and Mclarey and Fish (1966) found no variation in foetal cell appearance with the gestation period, while Clayton *et al* (1966, 69), Gordon and Bhoyroo (1966), and Ghosh and Agarwal (1970) found increasing incidence of foetal cells in maternal circulation with advancing gestation.

Foetal cell appearance in relation to blood group of mother and baby

The incidence of foetal cell positive

cases was 28.09% in ABO incompatible and 43.3% in ABO compatible cases during antepartum period and 47.0% in incompatible and 56.6% in compatible cases one hour after labour showing a higher incidence of foetal cells in compatible group as compared to the incompatible group both in ante and post partum periods. Freese *et al* (1963), and Pilkington *et al* (1966) found no correlation between the appearance of foetal cells and blood group of baby while a lower incidence of foetal cells in ABO incompatible group as compared to the ABO compatible group has been reported by Knox and Walker (1957), Finn *et al* (1961), Reepmaker *et al* (1962), Zipursky *et al* (1963), Brown (1963), and Parekh *et al* (1971).

Foetal Cell Score and Transplacental Haemorrhage

Foetal cell score upto 4/1000 amounting to transplacental haemorrhage of 0.4 ml (mild type) was found in 92.7% of cases of incompatible and 93.9% of compatible group. Such mild type of haemorrhage in most pregnancies was also reported by Zipursky *et al* (1933), Mclarey and Fish (1966), Cohen *et al* (1967), Ghosh and Agarwal (1970), and Parikh *et al* (1971).

No significant increase of foetal cell score and transplacental haemorrhage was found with advancing gestation in this study, while Mclarey and Fish (1966), and Ghosh and Agarwal (1970) noted increasing volume of foetal blood loss with advancing gestation.

There was no significant increase in foetal cell score and transplacental haemorrhage during labour, but one hour after delivery a significant and sudden increase in incidence and amount of foetal cell score and transplacental haemorrhage was noted. Similar results

have been reported by Kleihaur *et al* (1957, 61), Queenan *et al* (1962), Brown (1963), Freese *et al* (1963), and Cohen *et al* (1964).

The mean volume of foetal blood loss was 0.4 ml. in this study, while Zipursky *et al* (1963), Mclarey and Fish (1966) and Ghosh and Agarwal (1970) noted 0.1 ml., 0.45 ml, and 0.1 ml of foetal blood loss in their respective group of cases.

Summary

250 cases of normal pregnancy and labour were studied. Foetal cell scores and transplacental haemorrhage were correlated with parity, gestation period and blood group of mother and baby. The Kleihaur technique was employed for counting the number of foetal cells per 1000 adult cells utilizing five minutes in scanning.

1. The foetal cells appeared in 40.8% primiparae and 30.8% multiparae.

2. The foetal cells were detected after 9 weeks of gestation and were found in 21.6% of cases between 9-12th week of gestation.

3. The incidence of foetal cell positive mothers ranged from 30.3% to 37.2% between 13 weeks and term. There was no significant rise in the incidence of foetal cell transmission in mothers during the entire antenatal period and during early labour.

4. A sudden rise in the incidence of foetal cell transmission was noted in the post partum period 56.3%.

5. 31.0% of ABO incompatible and 43.3% of ABO compatible mothers showed foetal cells in the ante partum period, while in the postpartum period 47.0% ABO incompatible and 56.6% ABO compatible cases showed evidence of foetal cells in the maternal circulation.

6. There was no significant increase of foetal cell score with advancing preg-

nancy till at term when a sudden rise was found in the immediate post partum period.

7. In the post partum period a mild type of transplacental haemorrhage (less than 0.4 ml) was found in 51 out of 55 (92.7%) cases and an intermediate type of blood loss (0.4 ml to 2.5 ml) was found in 7.2% of cases in the ABO incompatible group, while in the ABO compatible group mild intermediate and severe foetal haemorrhages were seen in 93.7%, 4.5% and 1.8% of cases respectively.

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