SYMPTOMATIC NEONATAL POLYCYTHEMIA: COMPARISON OF PARTIAL EXCHANGE TRANSFUSION WITH SALINE VERSUS PLASMA

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ABSTRACT

A prospective study to evaluate efficacy and safety of partial exchange blood transfusion (PEBT) with normal saline or plasma was conducted in 30 symptomatic polycythemic newborns. Babies were randomly assigned to receive PEBT either with normal saline or plasma. Both groups were comparable in terms of birth weight, gestational age, preexchange hematocrit and viscosity. A significant fall in hematocrit and viscosity was noticed at 6 hours following PEBT which persisted even at 24 hours (P <0.001). Hematocrit and viscosity were comparable in the two groups at 6 and 24 hours (p >0.05for both). Majority of babies became asymptomatic after 24 hours of PEBT, but one baby in the saline group remained polycythemic and symptomatic requiring repeat PEBT. No complications related to the procedure were encountered in the two groups. Partial exchange with normal saline was as effective and safe as plasma in symptomatic polycythemic newborns

Key words: *Hematocrit, Polycythemia, Viscosity.*

Polycythemia in newborn babies may manifest with serious, sometimes life threatening insults to brain, heart, kidneys, lungs and intestines(l-3). Symptoms in polycythemia are related to increased blood viscosity and decreased blood flow to various organs. Babies with symptomatic polycythemia are often subjected to partial exchange blood transfusion (PEBT) either with colloid (Plasma) or normal saline(4-6). Plasma is feared to carry risks of viral infections, *viz.,* cytomegalo virus, Hepatitis B and acquired immuno deficiency syndrome. Above all, the viscosity of adult plasma is reported to be higher than that of newborn blood(7,8). Normal saline is a cheap, readily available substitute. The present prospective study was carried out to evaluate the efficacy and safety of normal saline versus plasma in correcting viscosity and hematocrit values in symptomatic polycythemic neonates.

Material and Methods

Thirty newborn babies over a period of two years with symptomatic polycythemia were randomized to receive PEBT either by normal saline or adult plasma.

Polycythemia was defined as a capillary hematocrit (Hct) of >70% and confirmed with venous Hct of>65%.

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It is a routine practice in the Neonatal Intensive Care Unit (NICU) to screen high risk neonates (small-for-dates, large-for-dates, infants of diabetic mothers, twins) for polycythemia and blood sugar at 2 h, 8 h, 24 h, 48 h ± 1 h. In addition, neonates having symptoms attributable to hyperviscosity (transient tachypnea of newborn, jitteriness, plethora, priapism, *etc.)* are also screened for polycythemia.

In symptomatic neonates, septicemia was excluded by a negative screen for sepsis and blood culture. Jitteriness was attributed to polycythemia when metabolic conditions (hypoglycemia, hypocalcemia), drug withdrawal and hypoxia in the neonate were excluded. Respiratory distress in the absence of usual causes and normal roentgenogram was considered to be due to polycythemia.

Symptomatic neonates with polycythemia were enrolled into the study. The symptoms of hyperviscosity were carefully recorded. Babies with congenital malformations, on IV fluid therapy and those who received blood transfusion were excluded from the study. Based on random allocation, the baby was subjected to PEBT either with physiological saline or plasma. The aim of the procedure was to reduce the Hct to 55%. The amount of partial exchange done was calculated by the formula(4):

$$\text{Amount to be exchanged} = \frac{\text{Observed Hct} - \text{Desired Hct}}{\text{Observed Hct}} \times \text{Blood volume}$$

The blood volume was calculated by weight in kg x 85 ml.

Following exchange transfusion, the symptoms of hyperviscosity were again looked for at 6 and 24 hours after the procedure. Venous hematocrit and viscosity were measured immediately before exchange, and 6 and 24 hours after PEBT.

Asymptomatic newborns with venous hematocrit above 75 were subjected to PEBT but not enrolled in the present study. The efficacy of treatment modality was judged by lowering of Hct, viscosity and disappearance of symptoms. The safety of procedure was assessed by changes in oxygen saturation, heart rate and blood pressure.

Hematocrit was measured with the help of REMI-12C microcentrifuge, at 14000 rpm for 3 minutes using heparinized (mucaps) capillary tube. While viscosity was measured with the help of brook field's Cone Plate Viscometer at 12 rpm (shear rate 46 sec-1).

Statistical analysis was done using student's "t" test and a probability of <0.05 was considered to be statistically significant.

Results

Of the 30 symptomatic polycythemic neonates, 15 received PEBT with saline and 15 with plasma based on random allocation. Majority of PEBT were done from umbilical vein (n=22) while eight procedures were performed through peripheral veins.

Both the groups were comparable with respect to birth weight, gestation and clinical characteristics (*Table* I).

The hematocrit and viscosity values in two groups are shown in *Tables II & III.* There was a significant decrease in the Hct from a mean valve of 70.8% to 57.4% ($p < 0.001$) at 6 hours following PEBT in the saline group and this change persisted at 59.6% after 24

TABLE 1- *Clinical Characteristics of Symptomatic Polycythemic Neonates*

Characteristic	Saline Group (n=15)	Plasma Group (n=15)
Birth weight (range)	2.0-3.8 kg	2.2-4.0 kg
Term	12	10
Preterm	3	5
SFD	4	5
LFD	5	4
AFD	6	6
One of twins	0	2

hours. The viscosity of blood decreased from 13.5 cps to 7.5 cps (p <0.001) at 6 hours following PEBT in the saline group and persisted at *7.7* cps after 24 hours. The viscosity of blood decreased from 13.5 cps to 7.8 cps (p <0.001) at 6 hours following PEBT in the plasma group and it persisted at 7.8 cps after 24 hours. The changes in Hct and viscosity following PEBT in the two groups were identical. In majority of infants, the symptoms disappeared within 24 hours of PEBT. However, one baby in the saline group continued to be hypoglycemic and had venous Hct of 66% after 24 hours. A second PEBT was

TABLE II-*Changes in Hematocrit After Partial Exchange.*

	Venous hematocrit (%)					
Group	Pre-exchange 0 h	6h	24h	pre *vs 6*	Pre *vs* 24	*6 vs* 24 h
Saline Group (n=15)	70.8±4.5	57.4±3.3	59.5±2.4	<0.001	<0.001	NS
Plasma Group (n=15)	69.9±3.4	56.9±2.7	57.9±3.0	<0.001	<0.001	NS
	NS	NS	NS			

NS = Not significant

TABLE III-*Changes in Viscosity After Partial Exchange.*

	Viscosity in centipoise					
Group	Pre-exchange 0 h	6h	24h	Pre vs 6	Pre vs 24 h	6 vs 24 h
Saline Group (n=15)	13.6±0.8	7 .5±0.9	7.7±0.6	<0.001	<0.001	NS
Plasma Group (n=15)	13.5±0.6	7.8±0.9	*7.8*±1.1	<0.001	<0.001	NS
	NS	NS	NS			

NS = Not significant

performed using plasma following which his symptoms disappeared and Hct declined to 53%. Another baby in the saline group continued to have vomiting and abdominal distension at 24 hours but became normal after another 24 hours. Two babies in both the groups continued to be jittery the 24 hours after PEBT *(Table IV)*.

The procedure which was carried out in the NICU under strict monitoring did not cause any significant changes in heart rate, oxygen saturation and blood pressure.

Discussion

Blood viscosity increases linearly with rising hematocrit upto 65%, but subsequently viscosity rises exponentially. A high viscosity is associated with decreased tissue perfusion, oxygenation and multiple organ dysfunction(9,10). PEBT in symptomatic polycythemics with normal saline or plasma ameliorates the symptoms and signs of hyperviscosity(ll,12). In majority of NICU's,, it is a routine practice to use plasma for correcting polycythemia. In view of the fact that adult plasma has higher viscosity as compared to newborn blood, PEBT with plasma may lower the Hct to the desired level but viscosity may remain unaltered. In addition, plasma transfusion is associated with risks of transmission of serious viral infections. In recent years, normal saline has been shown to be a promising alternative to plasma(13,14).

The present study showed a significant fall in the hematocrit and viscosity following PEBT which persisted even at 24 hours in both normal saline and plasma groups. The drop in hematocrit and viscosity in both the groups were comparable. Similar observations on fall of hematocrit have been made by others(13,14).

The symptoms of polycythemia disappeared in majority of babies following PEBT. Only one baby required second PEBT in the saline group for symptomatic polycythemia (Hct 66%). In a study by Sarkar *et al.* four-but of 18 babies in the saline group required second PEBT(15).

' No complications occurred in babies undergoing PEBT through umbilical venous or peripheral venous routes. Babies withstood the procedure without significant changes in oxygen saturation, heart rate and blood pressure.

TABLE IV -*Symptoms of Polycythemia Before and After PEBT.*

Symptom	Saline group		Plasma group	
	Before PEBT	24 hours after PEBT	Before PEBT	24 hours after PEBT
Hypoglycemia	6	1	7	0
TTNB	5	0	4	0
Jitteriness	8	2	10	2
Abdominal distension/vomiting	2	1	1	0
Priapism	2	0	1	0

It is concluded that PEBT with normal saline is as safe and effective as PEBT with plasma. The changes in hematocrit and viscosity were comparable in both normal saline and plasma groups. There is no apparent benefit of performing exchange transfusion with plasma in symptomatic polycythemic newborns. Normal saline.is cheap, readily available, safe and effective substitute for management of neonates with symptomatic polycythemia.

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