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Polycythemia in Neonates: Incidence, Maternal and Fetal Risk Factors, Clinical Profile, Umbilical Cord Blood Haematocrit as a Screening Test for Polycythemia

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Abstract: ***Objectives: This study was aimed to determine the incidence of polycythemia in newborns delivered from December, 2014 to December, 2015, to study fetal and maternal risk factors, clinical profile and to determine the role of umbilical cord blood haematocrit as a screening test at birth for neonatal polycythemia. Methods: In this descriptive analytical study, umbilical cord blood haematocrit was determined, detailed history was taken, anthropometry and examination was done. Venous haematocrit was determined at 2 hours in neonates having cord haematocrit ≥55% and these neonates were followed up. Venous haematocrit was determined at 24 hours in neonates whose venous haematocrit at 2 hours was ≥65% (polycythemic neonates). Other laboratory tests were done as and when indicated. Symptomatic polycythemic infants were subjected to interventions accordingly. Results: The incidence of neonatal polycythemia was 1.18%, higher in preterm neonates, LGA babies, in babies of diabetic mothers; 66.7% of the polycythemic babies were symptomatic, Plethora was the commonest followed by refusal to feeds, jitteriness, jaundice, lethargy, cyanosis and dyspnoea. Hypoglycaemia and hyperbilirubinemia were the commonest laboratory abnormalities detected, followed by thrombocytopenia. 5 (31.25%) of the 16(66.67%) symptomatic polycythemic neonates required intervention in our study. Conclusion: Umbilical cord blood haematocrit was found to be a reliable screening test for polycythemia in neonates. A cut off value of umbilical cord blood haematocrit ≥60% should be followed up. Long term follow-up of these polycythemic neonates is required to know the late complications.***

Keywords: polycythemia, neonate, umbilical, haematocrit, plethora.

1. Introduction

Polycythemia defined as central venous haematocrit of ≥ 65% in the first 7 days of life, is common in the neonatal period with incidence varying from 0.4 to 14.5% in various studies[1,2,3,4]. Its predisposing factors are IUGR babies (chronic intrauterine hypoxia), Infants of diabetic mothers,Chromosomal anomalies such as trisomy 13,18 and 21, Neonatal thyrotoxicosis, Congenital adrenal hyperplasia, Beckwith Weidemann syndrome, mothers having cyanotic heart disease, chronic lung diseases, pregnancy induced hypertension, those taking propranolol, maternal smoking during pregnancy[5]; Placental factors such as delayed cord clamping, twin-twin transfusion [6,7,8] maternal-fetal transfusion and holding the baby below the level of introitus at the time of delivery. Babies born, at high altitude [9] are also at a higher risk. Clinical manifestations include CNS manifestations such as lethargy, Poor feeding, Tremors, Jitteriness; Renal –Oliguria; Cardiopulmonary- tachypnoea, Cyanosis, Congestive heart failure; Gastrointestinal -Poor feeding, abdominal distension, Necrotizing enterocolitis [4,10]. Long term sequelae are- Significant gross motor, fine motor and speech delays, neurological abnormalities- spastic diplegia,hemiparesis, monoparesis. Laboratory abnormalities include hypoglycemia, hyperbilirubinemia, hypocalcemia, hypomagnesemia and thrombocytopenia [4,11,12,13]. Importance of neonatal polycythemia is more in a developing country like India (30% of the newborns are SGA), where neonatal polycythemia is a significant problem, but is hidden due to the lack of awareness and paucity of literature. Hence, this study was planned to find out the incidence, clinical profile and role of umbilical cord blood haematocrit as a screening test for neonatal polycythemia, so that there is a regular screening of all neonates and the serious acute and long term sequelae of this easy to treat disorder are prevented.

2. Methods

In this descriptive analytical study, umbilical cord blood haematocrit was determined, detailed maternal history was taken, anthropometry and examination was done. Venous haematocrit was determined at 2 hours in neonates having cord haematocrit ≥55% and these neonates were followed up for 7 days or uptil their discharge, whichever was earlier. Venous haematocrit was determined at 24 hours in neonates whose venous haematocrit at 2 hours was ≥65% (polycythemic neonates). Other tests like CBC, electrolytes, KFTs, sepsis screen, urine analysis, ABG were done as and when indicated, by respective treating units. Symptomatic polycythemic infants were subjected to interventions accordingly. Results were tabulated and **statistically analysed.** Chi-square test was applied to test the association between two categorical factors.

3. Results

A total of 2035 babies were delivered in Subharti Medical College and Hospital, Meerut from December 2014 to December 2015. Umbilical cord blood sample was collected at the time of delivery in all the newborns.

Table 1: Demographic Analysis Of Study Subjects

CATEGORIES	NO. OF NEONATES	PERCENTAGE OUT OF TOTAL CASES
(a) SEX		
MALE	979	48.11%
FEMALE	1056	51.89%
(b) TYPE OF DELIVERY		
LSCS	1158	56.90%
VAGINAL	837	41.13%
INSTRUMENTAL VAGINAL	40	1.96%
(c) GESTATIONAL AGE		
PRE-TERM (<37wks)	508	24.96%
TERM (37-42wks)	1495	73.46%
POST-TERM (>42wks)	32	1.57%
(d) BIRTH WEIGHT		
AGA	1628	80%
SGA (<10th percentile)	367	18.03%
LGA (>90th percentile)	40	1.96%
(e) ANTENATAL CARE		
BOOKED CASES	579	28.45%
UNBOOKED CASES	1456	71.54%
(f) ANTENATAL PROBLEM		
(1) HYPERTENSIVE MOTHER (including PIH)	407	20%
(2)DIABETIC MOTHER (including gest. diabetes)	61	2.99%
(3)APH	101	4.96%
(4)OTHERS (PROM, TORCH etc..)	162	7.96%
NO ANTENATAL PROBLEMS	1304	64.07%
(g) TWIN DELIVERY	61	2.99%
(h) BIRTH ASPHYXIA	102	5.01%

Table 2: Incidence Of Polycythemia In Neonates

TOTAL CASES	CASES WITH UMBILICAL CORD BLOOD HAEMATOCRIT ≥55%	POLYCYTHEMIC NEONATES (venous haematocrit≥65% at 2 hrs of life)	INCIDENCE
2035	228	24	1.18%

Table 3: Incidence of Neonatal Polycythemia in Relation to the Sex of the Baby

SN	SEX	SEX DISTRIBUTION OF TOTAL CASES	SEX DISTRIBUTION OF POLYCYTHEMIC CASES	INCIDENCE (%)
1.	MALE	979 (48.10%)	13 (54.16%)	1.33
2.	FEMALE	1056 (51.89%)	11 (45.83%)	1.04
3.	TOTAL	2035	24	1.18

χ^2 -Value =0.01, p-Value = Not Significant

Table 4: Incidence of Neonatal Polycythemia In Relation to the Gestational Age:

SN.	GESTATIONAL AGE	NO.(%)OF NEONATES	NO.(%) OF POLYCYTHEMIC NEONATES	INCIDENCE (%)
1.	PRE-TERM (<37wks)	508 (24.96%)	14 (58.33%)	2.76
2.	TERM (37-42 wks)	1495 (73.46%)	10 (41.67%)	0.67
3.	POST-TERM (>42wks)	32 (1.57%)	-	-
4.	TOTAL	2035	24	1.18

1 Vs 2 ,χ^2 -Value =13.484 p-Value = 0.0002 (Significant)

Table 5: Incidence of Neonatal Polycythemia in Various Birth Weight Categories:

SN	BIRTH WEIGHT	NO. (%) OF NEONATES	NO. (%) OF POLYCYTHEMIC NEONATES	INCIDENCE (%)
1.	AGA	1628 (80%)	19 (79.17%)	1.17
2.	SGA (<10th percentile)	367 (18.03%)	-	-
3.	LGA (>90th percentile)	40 (1.97%)	5 (20.83%)	12.5

1 Vs 3 χ^2 -Value =31.060 p-Value = 0.0001 (Significant)

Table 6: Incidence of Neonatal Polycythemia in Babies (of Mothers Having Various Antenatal Problems):

SN.	ANTENATAL PROBLEMS	NO. (%) OF NEONATES	NO. (%) OF POLYCYTHEMIC NEONATES	INCIDENCE (%)
1.	HYPERTENSIVE MOTHER	407 (20%)	6 (25%)	1.47
2.	DIABETIC	61 (2.99%)	2 (8.33%)	3.27
3.	APH	101 (4.96%)	1 (4.17%)	0.99
4.	OTHERS (PROM, TORCH etc.)	162 (7.96%)	-	-
5.	NONE	1304 (64.07%)	15 (62.5%)	1.15

χ^2 -Value =4.453 p-Value = 0.3482 (Not Significant)

Table 7: Proportion of Symptomatic Cases in Neonatal Polycythemia:

SN	Category	No. of polycythemic neonates	Percentage
1.	ASYMPTOMATIC	8	33.3%
2.	SYMPTOMATIC	16	66.7%
3.	**Total**	**24**	**100.0**

Table 8: Clinical Presentation in Cases of Neonatal Polycythemia

SN	CLINICAL FEATURES	NO. OF POLYCYTHEMIC CASES	PERCENTAGE OUT OF TOTAL CASES
1.	PLETHORA	12	50%
2.	LETHARGY	6	25%
3.	REFUSAL TO FEEDS	8	33.33%
4.	JITTERINESS	8	33.33%
5.	CYANOSIS	5	20.83%
6.	DYSPNOEA	2	8.33%
7.	JAUNDICE	8	33.33%
8.	DECREASED URINE OUTPUT	-	-
9.	NEC	-	-

Table 9: Laboratory Abnormalities In Cases Of Neonatal Polycythemia

SN.	LAB. ABN.	NO. OF POLYCYTHEMIC CASES	PERCENTAGE OUT OF TOTAL CASES
1.	HYPOGLYCEMIA (RBS<40mg%)	8	33.33%
2.	HYPERBILIRUBINEMIA (S.Bil. ≥12mg%)	8	33.33%
3.	THROMBOCYTOPENIA (PLT. COUNT <1 LAKH/mm^3)	6	25%
4.	NO LAB. ABN.	9	37.5%

4. Discussion

In the present study, the incidence of neonatal polycythemia was found to be **1.18%** (Tudehope et al[14];Stevens et al[1];Singh M et al[15] reported the incidence to be 2.1%, 1.80% and 1.2% respectively). 58.33%(14) of the polycythemic neonates were found to be premature (Singh M et al[15] and Lalitha Krishanan et al[16] reported lower percentages-18.5% and 14.8% respectively). When compared with the babies of mothers having no antenatal problems, the incidence of neonatal polycythemia in babies of hypertensive mothers (none of the mother was on propanolol) was 1.47% ($p>0.01$), which was statistically not significant(in contrast to studies by Kurlat I and Sola A[17] -incidence of 9.4% in babies of hypertensive mothers ($p<0.001$)). In infants of diabetic mothers, the incidence of neonatal polycythemia was 3.27% and was significantly higher than that in babies of normal mothers ($p<0.01$)(Mimouni F[18] and Kurlat I et al[17] reported that the incidence in these babies was 29.3% and 20% respectively).

All the babies in the present study were delivered in Subharti hospital, Meerut (225 m above sea level) and in all the cases umbilical cord was clamped within 60 seconds. So, factors of high altitude and placental transfusion were not applicable in the present study. No case of polycythemia was observed in twin babies in our study, only one polycythemic baby had birth asphyxia, only one case of Down's syndrome was present, no case of sepsis was present.

Of the 24 polycythemic neonates, 16 (66.7%) were found to be symptomatic and 8 (33.3%) had no overt clinical findings (Wiswell TE et al[19] found that 61.8% of polycythemic babies in their study were symptomatic, 38.2% had no overt clinical finding and 14.5% had neither clinical nor laboratory abnormalities). Plethora was the commonest clinical finding noted in the present study (50%) followed by refusal to feeds, jitteriness and jaundice (33.33% each). Other findings observed were lethargy (25%), cyanosis (20.83%) and dyspnoea (8.33%). Wiswell TE et al[19] and Lalitha Krishanan et al[16] also reported refusal to feeds, plethora and lethargy, in that order as the commonest clinical findings. NEC, decreased urine output and seizures were not observed in any case of polycythemia in our study. Hypoglycaemia (i.e. RBS<40 mg%) and hyperbilirubinemia (Serum bilirubin >12 mg% in the absence of any other cause of jaundice) were the commonest laboratory abnormalities in polycythemic neonates found in 8 (33.33%) cases each (Goldberg et al[36] ; Wiswell et al[5] ; Bada et al[29] and Lalitha Krishanan et al[16] reported hypoglycaemia in 40%, 40%, 29% and 53% of their polycythemic neonates respectively). Thrombocytopenia, defined as platelet count <1 lakh/mm^3 was found in 6(25%) polycythemic neonates in the present study (Goldberg et al[20]; Katz et al[21] and Lalitha Krishanan et al[16] reported thrombocytopenia in 25%, 19% and 27.6% of the polycythemic neonates respectively). Nine (37.5%) of the polycythemic babies had no laboratory abnormality.

The mean umbilical cord blood haematocrit in the screened neonates(neonates who had umbilical cord blood haematocrit ≥ 55%) was 64.79±6.05% with a range of 56%-82% whereas the mean umbilical cord blood haematocrit in the polycythemic neonates was 77.9±2.7% (clubbed value) with a range of 71%-82%. The mean venous haematocrit at 2 hours of life in the screened neonates was found to be 58.25±6.71% with a range of 42-78.90% whereas in the polycythemic neonates it was 73.8±3.0% with a range of 70%- 78.9% and the mean venous haematocrit at 24 hours of life was found to be 68.2±1.5% with a range of 65.9%-71.2%. In the present study, an attempt was made to assess the role of umbilical cord blood haematocrit as a screening test for polycythemia in newborns. For this purpose, both umbilical cord blood haematocrit and venous haematocrit (at 2 hrs) values were determined in all these babies. From the present study we concluded that cord blood haematocrit and venous haematocrit influence each other in a positive manner and the umbilical cord blood haematocrit can be used as a reliable screening test for polycythemia in all the neonates as only those neonates developed polycythemia in later hours who had a higher umbilical cord blood haematocrit at birth (preferably ≥ 55%).

5. Conclusion

Combining the results of the past studies with the present study and considering the fact that the cord blood haematocrit determination is a simple and non-invasive procedure it can be concluded that the umbilical cord blood haematocrit is a good and reliable screening test for polycythemia in neonates.

lt was noted that all the babies who had cord blood haematocrit < 60% were found to be normocythemic on venous haematocrit determination at 2 hrs of life, whereas all the babies who developed polycythemia had umbilical cord haematocrit ≥60%. Thus, it is concluded in the present study that polycythemia should be suspected in a neonate if the cord blood haematocrit is ≥ 60%. This should be confirmed by venous haematocrit determination. Though we started screening babies with hct≥55%, but we observed that babies with cord blood hct ≥ 60% later on developed polycythemia. In the present study, the consent from the parents, clearance from ethical committe and any economic support was not required.

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