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Correlates of Pulse Oximetry Saturation in Asymptomatic Newborn Babies

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Abstract
There is steep rise in prevalence of reported CHD due to prenatal sonographic examination and screening by echocardiography. Reporting by these screening tools may also detect CHD lesions of little clinical importance like small ASD, small muscular VSD etc. This was a hospital based prospective observational study. All neonates fulfilling selection criteria, born and admitted in postnatal ward during study period were included in the study. Mean birth weight of neonates with pulseoximetry saturation of <90%, was significantly lesser (2428 ± 0.17 grams) than the mean birth weight of neonates with pulseoximetry saturation of >90% (2772±0.02 grams). There was no significant difference noted in the mean length, head circumference, heart rate and respiratory rates among pulse oximetry positive and pulseoximetry negative neonates.

INTRODUCTION

The average worldwide incidence of CHD is approximately 0.8% of live births.

There is wide difference in reported incidence worldwide, ranging from 4-50 per thousand live births. This largely depends upon the type of the study population selected and mainly due to the results of variations in ascertainment methods. The birth prevalence for CCHD is 2-3/1000 live births globally[1,2].

There is steep rise in prevalence of reported CHD due to prenatal sonographic examination and screening by echocardiography. Reporting by these screening tools may also detect CHD lesions of little clinical importance like small ASD, small muscular VSD etc[3].

According to a status report CHD accounts for 10% of the present infant mortality in India.

There have been many studies some of them either hospital based or community based showing incidence of CHD varying from 0.8-5.2 cases per thousand births in India at different locations and incidence of various lesions has varied in these studies[4].

About 2-3 in 1000 newborn infants will be symptomatic with a congenital heart disease in the 1st year of life. The diagnosis is established by 1 week of age in 40-50% of patients and by 1 month of age in 50-60%. Despite advances in both palliative and corrective surgery and increase in the number of survivors it still remains the leading cause of mortality in children with congenital malformations[5].

CHD causes high morbidity and mortality among infants and affects the quality of life during childhood and adulthood, depending on the progression of the disease. It also affects social interactions and the quality of life for parents of children with CHD[6].

Congenital heart defects are classified into two broad categories acyanotic and cyanotic.

MATERIALS AND METHODS

Study Setting: The study was conducted in the post natal ward in the tertiary care hospital, S. Nijalingappa Medical College, Bagalkot.

Study Design: This was a hospital based prospective observational study. All neonates fulfilling selection criteria, born and admitted in postnatal ward during study period were included in the study.

Study Method: In Asymptomatic new borns measurement of saturations using pulse oximeter on the Right hand and foot was carried out after 24hrs of birth.73 Saturations above 95% was regarded as having negative screen. Those with saturation below 90% were subjected to Echocardiography. Patients with saturations between 90 and 95% were subjected to a second pulse oximetry screen 6-12 hrs later. Screening was done after 24 hrs of birth.

Detailed clinical examination was done in all newborns after pulse oximetry.
Any positive findings in CVS was noted.

Sample Size: All asymptomatic consecutive neonates born during the study duration (including late preterm neonates) were included in the study.

The incidence of CCHD has been found to be ranging from 4-10/10000 in India[2].

With the incidence of CCHD 0.9/100 population at 95% confidence interval and plus or minus one margin of error, the calculated sample size is 342.
N = z alpha*p*(1-p)/d2

Therefore, a minimum of 342 cases were included in the study.
Where,
N = sample size
p = incidence rate
d = margin of error plus or minus one zalpha=z value at 95%

Inclusion Criteria:

- All the asymptomatic newborn neonates (term and late preterm) delivered in the tertiary care hospital.
- Parents who gave informed consent.

Exclusion Criteria:

- Newborn with respiratory symptoms and signs. Newborn with symptomatic cardiac diseases.
- All neonates with prenatal sonographic diagnosis of duct dependent circulation.

RESULTS AND DISCUSSIONS

In this study, those neonates who were subjected to pulse oximetry saturation test were found to have a saturation of >95% in 97.5%, 90-95% saturation in 0.8% and <90% saturation in 1.8%.

Mean birth weight of neonates with pulseoximetry saturation of <90%, was significantly lesser (2428±0.17 grams) than the mean birth weight of neonates with pulseoximetry saturation of >90% (2772±0.02 grams). There was no significant difference noted in the mean length, head circumference, heart rate and respiratory rates among pulse oximetry positive and pulseoximetry negative neonates.

Higher percentage of male babies (2.2%) had positive pulse oximetry (O2 saturation <90%) when compared to female babies (1.1%). This association was found to be statistically significant.

Table 1: Distribution of neonates according to the Pulse Oximetry Saturation

Pulse Oximetry Saturation	Frequency	Percent
<90%	7	1.8
90%-95%	3	0.8
>95%	390	97.5
Total	400	100

Table 2: Comparison of pulseoximetry findings with the anthropometric parameters, heart rate and respiratory rate of study population

Characteristics	Pulse Oximetry Positive (Oxygen saturation <90%) [N=7]		Pulse Oximetry Negative (Oxygen saturation >90%) [N=393]		p value
	Mean	SE	Mean	SE	
Birth weight (gm)	2428	0.17	2772	0.02	0.044*
Length	48.93	0.60	48.62	0.08	0.613
Head circumference	34.43	0.23	34.35	0.03	0.759
HR	137.43	0.72	137.51	0.12	0.929
RR	38.57	0.57	38.58	0.09	0.996

Note: *significant at 5% level of significance

Table 3: Distribution of Pulse Oximetry Saturation according to sex of neonates

Sex of Neonates	Pulse Oximetry Positive (N=7)		Pulse Oximetry Negative (N=393)		Total	Chi square p value
	N	percentage	N	percentage		
Male	5	2.2%	220	97.8%	225 (100%)	<0.001*
Female	2	1.1%	173	98.9%	175 (100%)	

Note: *significant at 5% level of significance.

Table 4: Distribution of Pulse Oximetry Saturation according to gestational age of neonates

Gestational age	Pulse Oximetry Positive (N=7)		Pulse Oximetry Negative (N=393)		Total	Chi square p value
	N	percentage	N	percentage		
Late Pre term	1	7.1%	13	92.9%	14 (100%)	<0.001*
Term	6	1.6%	380	98.4%	386 (100%)	

Note: *Significant at 5% level of significance.

Table 5: Distribution of Pulse Oximetry Saturation according to birth weight of neonates

Birth weight	Pulse Oximetry Positive (N=7)		Pulse Oximetry Negative (N=393)		Total	Chi square p value
	N	percentage	N	percentage		
LBW and very low birth weight	4	3.2%	120	96.8%	124 (100%)	<0.001*
>2500 gm	3	1.1%	273	98.9%	276 (100%)	

Note: *Significant at 5% level of significance.

Higher percentage of Late pre term babies (7.1%) had positive pulse oximetry (O2 saturation <90%) when compared to term babies (1.6%). This association was found to be statistically significant.

Higher percentage of Low birth weight and very low birth weight babies (3.2%) had positive pulse oximetry (O2 saturation <90%) when compared to babies with birth weight >2500 grams (1.1%). This association was found to be statistically significant.

The study population consisted of 56.2% male and 43.8% female neonates. Among babies who had CCHD (4 in number) 25% were males and 75% were females were diagnosed which was consistent with a study by Shiwei Liu *et al*. and Chaddha[7,8].

No gender was considered to be a risk factor for one year survival with CCHD.

Majority of the neonates (96.5%) were born full term. There were only 13 late preterm babies.

Critical congenital heart diseases were noticed in 7.1% of late preterm and 1.6% of term neonates. This was similar to Laas[9] and Godfrey[10] who found significant association between prematurity and congenital heart disease.

This means if all preterms are included in study, more chances of detection of CCHD is possible. We included only late preterm in our study.

The mximum number of neonates (45%) observed in the study fell in the weight group between 2.5-3 Kg. It was observed that the majority of neonates who had critical congenital heart disease were having low birth weight. (3.2% vs 1.1% p<0.05). The weights of the babies with diagnosed CCHD were respectively 2.3, 1.9, 2.3, 2.06kg.

Archer[11] also found serious congenital heart disease was more common in neonates with very low birth weight. Mortality was also higher amongst those in very low birth weight group.

In a other study done by Krammer HH *et al.,* birth weights of 843 children with congenital heart disease were compared to the respective data of a normal west German population. On average, CHD group had significantly lower birth weights, but the weight deficit was far less obvious then in previous studies. The decrease in birth weight was distinct only in children with TOF and ASD. Hence this study showed that patients with CHD were more often small for

gestational age (15%) or had a low birth weight (8.6%)[12].

Other parameters like head circumference, heart rate, respiratory rate were comparable in both group in our study as all were apparently normal babies.

Congestive heart failure is the primary concern in infants with acyanotic heart disease. In infants with cyanotic heart disease, hypoxia is more of a problem than congestive heart failure.

Suspicion of a congenital heart defect should be raised by the presence of feeding difficulties in association with tachypnoea, sweating over forehead and subcostal retractions, or severe growth impairment.

If not diagnosed early in life, many of these defects may result in life threatening events or significant morbidity like end organ damage to major organs like kidneys, brain or eyes or congestive cardiac failure, cardiogenic shock and sudden death.

Sometimes when an infant is born, fetal (before birth) blood-pumping system can continue to work hiding the signs and symptoms of CCHD. This makes it possible for an infant with CCHD to appear healthy and be discharged home without knowing they have a heart defect.

With early diagnosis of CCHD, Infants can benefit from successful surgical repair or palliation that is available with advances in paediatric cardiology. But missed or late CCHD diagnosis continues to be a clinical problem.

CONCLUSION

There was no significant difference noted in the mean length, head circumference, heart rate and respiratory rates among pulse oximetry positive and pulseoximetry negative neonates.

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