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To study the comparison of oxygen saturation in preterm and term newborns

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Abstract

Background: There is a paucity of data on comparison of oxygen saturation of healthy preterm and term babies after birth who do not require any resuscitation. Hence, there is a need of defining the reference range for oxygen saturation for healthy preterm newborns in comparison to term infants after birth

Results: The medianSpO_2value at 1, 3,7 and 10minutes after birth, respectively, for newborn gestation less than 37weeks (preterm neonates) was 78%(73%-80%), 89%(85%-91%), 95%(94%-96%) and 96% (95%-97%). The median SpO_2 value at 1, 3,7, and 10 minutes afterbirth born at, respectively, for newborns born at gestation more than or equal to 37 weeks (term neonates) was 80% (75%-82%), 90%(85%-92%) , 96%(95%-97%) and 96%(96%-97%). There is a statistically significant difference in SpO_2 Values in the two groups (p value < 0.05). Thereby that SpO_2 values were significantly lower in healthy preterm babies than healthy term babies.

Conclusion: There is a statistically significant difference inSpO_2 Values at 1 to 10 minutes after birth in preterm and term neonates ($p \leq 0.05$), the values being lower in preterm neonates as compared to term neonates.

Keywords: SpO_2, Term, Pre-term

Introduction

All neonates are cyanotic at birth, the arterial oxygen tension in the normal foetuses approximately 20mmHg, equivalent to an oxygen saturation of 60%.[1] During the first few minutes of life. oxygen saturation (Saturation by pulseoximetry, SpO_2) increases from intrapartum levels of 30-40%. Several small studies using pulse oximetryin the delivery room have documented that ittakes more than 5 minutes for a new born undergoing normal postnatal trans ition to attain an oxygen saturation more than 80%[2,3] and almost 10 minutes to reach 90%.[4-5] American experts Leone and Finer [6] advocate a target "SpO_2 of 85 to 90 % by three minutes after birth for all infants except in special circumstances" e.g. diaphragmatic hernia or cyanotic congenital heartdisease.

Healthy new barns have relatively low oxygen saturation in the first few minutes of life. Blood oxygen concentration, measured by pulse oximetry, often is used to determine the need of neonatal resuscitation.[3]

International Surveys show that oximetry is increasingly used during neonatal resuscitation.[7] Various studies have found that SpO_2in the first 5 minutesof life is much lower in babies delivered by caesarean section when compared to those delivered vaginally.[8]

Material and methods

Source of data: This prospective observational study was done on neonates born in J L N Medical College, Ajmer under the care of Division of neonatology, Department of Pediatrics at J L N Medical College, Ajmer. The resuscitation room was equipped with all necessary equipments required for neonatal resuscitation. SpO_2 data were gathered from 200 healthy, preterm and term newborns.

Method of collection of data

Inclusion criteria

All healthy, preterm and term newborns delivered vaginally or by caesarean section under the care of division of neonatology of Department of Pediatrics, J L N Medical College, Ajmer.

Newborns who were active, with good respiratory effort and heart rate; not requiring any resuscitation or supplemental oxygen were included in the study.

Exclusion criteria

- Any neonate that showed sign of distress, Including persistent central cyanosis, apnea, gasping, or bradycardia, which required supplemental oxygen, assisted ventilation , or resuscitation in the first few minutes after birth.
- Congenital anoma lies that might interfere with normal transition to extra uterine life.

Study Design: This was a prospective, observational study.

Methods: This study was conducted in the labour room of a tertiary care hospital and a total of 200 babies fulfilling the inclusion criteria were enrolled.

Results

Table 1: Compariso N of Spo_2 Values At 1 To 10 Minutes After Birth According To Gender Of Newborn (n=200)

Time	SpO_2 (%)		Z	P value
	F	M		
1 min	78(74-81)	78 (74-82)	-1.384	0.166
2 min	84 (79-86)	83 (80-86)	-0.587	0.557
3 min	89 (85-92)	89 (84-91)	-1.000	0.318
4 min	92 (89-94)	92 (89-94)	-0.761	0.446
5 min	94 (92-95)	94 (91-95)	-1.312	0.190
6 min	95 (94-96)	95 (93-96)	-0.532	0.594
7 min	95 (94-96)	95 (94-96)	-0.830	0.407
8 min	96 (94-97)	96 (95-97)	-1.643	0.100
9 min	96 (95-97)	96 (95-97)	-0.346	0.729
10 min	96 (95-97)	96 (95-97)	-0.005	0.996

Table 1 shows Comparison ofSpO_2Values at 1 to 10 Minutes after birth for female and male newborns. The mean SpO_2 value at 1, 5, and 10 minutes after birth, respectively, for female newborns was 78% (74%-

81%), 94%(92%- 95%) and 96% (95%-97%). The mean SpO_2 value at 1, 5, and 10 minutes after birth, respectively for male newborns was 78%(74%-82%), 94% (91%-95%) and 96% (95%-97%). The difference between the SpO_2 values at 1 to 10 minutes attained by female and male newborns was statistically insignificant (p value>0.05).

Table 2: Apgar score at 1 and 5 Minutes after Birth in Different Gestations (n=200)

APGAR Score	Gestation Weeks	N	Mean	SD	95% Confidence interval for Mean	
					Lower Bound	Upper Bound
1 min	< 34	31	7.94	.442	7.77	8.10
	34-(36+6)	66	8.08	.563	7.94	8.21
	≥ 37	103	8.31	.657	8.18	8.44
	Total	200	8.18	.613	8.09	8.26
5 min	< 34	31	8.81	.402	8.66	8.95
	34-(36+6)	66	9.17	.543	9.03	9.30
	≥ 37	103	9.50	.558	9.40	9.61
	Total	200	9.29	.588	9.20	9.37

Table 2 shows Mean APGAR at 1 and 5 minutes for newborns with gestation less than 34 weeks was 7.9±0.4 and 8.8±0.4 respectively. The mean Apgarvalues at 1 and 5 minutes for newborns with gestation 34 weeks to 36+6weeks (late preterm neonates) was 8.0±0.5 and 9.1±0.5 respectively. The mean Apgar values at 1 and 5 minutes for newborns with gestation more than 37 weeks (term neonates) was 8.3±0.6 and 9.5±0.5.

Table 3: Comparison of Apgar score at 1 And 5 Minutes after Birth in Different Gestations (n=200)

ANOVA						
APGAR AT		Sum of Square	df	Mean Square	F	Sig
1 min	Between groups	4.325	2	2.162	6.038	0.003
	Within Groups	70.550	197	0.358	-	-
	Total	74.875	199	-	-	-
5 min	Between groups	13.002	2	6.501	22.971	0.000
	Within Groups	55.753	197	0.283	-	-
	Total	68.755	199	-	-	-

Table 3 shows comparison of APGAR score at 1 and 5 minutes after birth for newborns born at gestation <34 weeks, 34-(36+6) weeks and >37 weeks. Mean APGAR score in healthypreterm babies was significantly lower than the healthy term babies. (p value <0.05).

Table 4: Comparison Of Spo_2values At 1 To 10 Minutes After Birth In Preterm And Term Babies (n=200)

Delivery Type	Gestational Age Group		Z	P value
	< 37	≥ 37		
1 min	78(73-80)	80(75-82)	-3.123	0.002
2 min	83(80-86)	84(80-88)	-1.907	0.057
3 min	89(85-91)	90(85-92)	-2.334	0.020
4 min	91(89-93)	92(89-94)	-1.367	0.172
5 min	94(92-95)	94(92-96)	-1.980	0.049
6 min	95(93-96)	95(94-96)	-2.055	0.040
7 min	95(94-96)	96(95-97)	-2.566	0.010
8 min	95(95-97)	96(95-97)	-2.640	0.008
9 min	96(95-97)	96(95-98)	-1.793	0.073
10 min	96(95-97)	96(96-97)	-2.941	0.003

Table 4 shows comparison of SpO_2 Values at 1 to 10 Minutes after birth in preterm and term newborns. The medianSpO_2value at 1, 3,7, and 10minutes after birth, respectively, for newborns gestation less than 37weeks (preterm neonates) was 78%(73%-80%), 89%(85%-91%), 95%(94%-96%) and 96% (95%-97%). The median SpO_2 value at 1, 3,7, and 10 minutes afterbirth born at, respectively, for newborns born at gestation more than or equalto 37 weeks (term neonates) was 80% (75%-82%), 90%(85%-92%) , 96%(95%-97%) and 96%(96%-97%). There is a statistically significant difference in SpO_2 Values in the two groups (p value < 0.05). Thereby that SpO_2 values were significantly lower in healthypreterm babies than healthyterm babies.

Table 5: SpO_2 Percentiles for All Newborns Not Requiring Any Resuscitation at Birth (n=200)

Percentiles	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min
3^{rd}	62.06	69.03	74.00	80.00	84.00	89.00	91.00	92.00	93.00	93.00
10^{th}	68.00	75.10	80.10	85.00	89.00	91.00	92.00	94.00	94.00	94.00
25^{th}	74.00	80.00	85.00	89.00	92.00	93.00	94.00	95.00	95.00	95.00
50^{th}	78.00	83.50	89.00	92.00	94.00	95.00	96.00	96.00	96.00	96.00
75^{th}	82.00	86.00	91.00	94.00	95.00	96.00	96.00	97.00	97.00	97.00
90^{th}	84.00	89.00	93.00	95.00	96.00	97.00	98.00	98.00	98.00	98.00
97^{th}	89.00	92.00	94.97	96.00	98.00	98.00	98.00	98.00	99.00	99.00

Table 5 shows the Third, 10th, 25th, 50th, 75th, 90th, and 97th SpO_2 percentiles for newborns not requiring any resuscitation at birth. At 1 minute, the 3rd, 10th,50th, 90th, and 97th percentiles were 62%, 68%, 78%, 84%, and 89% respectively; at 2 minutes, 69%, 75%, 83%, 89%, and 92% and at 5minutes, 84%, 89%, 94%, 96%, and 98%. At 10 minutes the 3rd, 10th, 50th,90th and 97th percentiles were 93%, 94%, 96%, 98% and 99% respectively.

Discussion

This study reports the changes in preductal SpO_2 during the first 10 minutes after birth in 200 healthy preterm and term infants. To avoid bias and to acquire corrective data in the measurement of SpO_2 in the first 10 minutes after birth in a safe and accurate manner. We used pulseoximeter calibrated for its higher sensitivity and accuracy for each minute. With this method, thepreductalSpO_2, which is considerably higher than postductalSpO_2, could be recorded rapidly following delivery. Thus, we optimized our data so that they were least likely to be affected by artifacts.

The present Study			
	NRP guidelines 2017	PRETERM< 37 weeks	TERM ≥ 37 weeks
1 min	60-65%	73-80%	75-82%
2 min	65-70%	80-86%	80-88%
3 min	70-75%	85-91%	85-92%
4 min	75-80%	89-93%	89-94%
5 min	80-85%	92-95%	92-96%
10 min	85-95%	95-97%	96-97%

The SpO_2 ranges for term newborns at each minute in our study were widerthan those specified in the guidelines. These results supported the data presented by Dawson et al [8] Furthermore, for a more accurate comparison, we constructed a tenth percentile for SpO_2values to assess the accuracy of the lowest limits [9]; our data demonstrated that the 10th percentiles for SpO_2 at each minute after birth were considerably higher than the lowest limits of SpO_2 specified in the guidelines for the first 10 minutes.

SpO_2 measurements should not be used in isolation when making decisions about oxygen administration. Instead SpO_2 should be part of a constellation ofclinical signs including: heart rate, respiratory effortand tone used to determine management. The NRP textbooks recommends adjusting the oxygen concentration from the blender either up or down to achieve an oxyhemoglobin concentration that gradually increases towards 90%. During the first few minutes, saturations of 70 to 80% may be acceptable as long as the heart rate is increasing[10] Deciding the right centile or SpO_2 to use to guide oxygen administration is a fine balance between giving oxygen to thoseinfants who need it and not giving it to those who don't. Our aim is to prevent hypoxaemia and hyperoxia and hence the complications associated with hyperoxia and hypoxemia because both are dangerous and can produce fatal complications.

Conclusion

There is a statistically significant difference inSpO_2 Values at 1 to 10 minutes after birth in preterm and term neonates ($p \leq 0.05$), the values being lower in preterm neonates as compared to term neonates.

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