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Original Article

The Role of Pulse Oximetry in Resuscitation of Asphyxiated Neonates

Abid Amin[1], Hakim Irfan Showkat[2], Javed Chowdhary[3], Shayiq Wani[5], Arif Hussain Sarmast[4], Rayees Ahmad Bhat[5] Basharat Jan[1]

ABSTRACT

Pulse oximetry has emerged as a convenient and readily available tool for monitoring of resuscitation. This study was done to evaluate the ability of the pulse oximetry to record oxygen saturation of asphyxiated neonates as well to note serial changes in oxygen saturation during their resuscitation. The main outcome was time taken to reach 90% saturation as recorded by pulse oximeter. The other variables were the time when first recording could be taken by pulse oximeter and time taken to reach 75% saturation. 100 cases (asphyxiated newborns) and 30 controls (normal newborns) were included in the study. The mean heart rate at one minute of age was significantly lower in the asphyxiated group (91±5.24 per minute) as compared to controls (125.2±4.5 per minute). The mean oxygen saturation at one minute of age was also significantly lower for asphyxiated group (47.5%±1.42) as compared to controls (50.5%±2.08). The median (inter quartile range) time taken in seconds to reach 75% and 90% saturation was 290 (275-295) and 490(480-510) seconds in the asphyxiated group was significantly higher ($p<0.05$) as compared to controls where it was 205 (190-212) and 375 (357-398). Both Asphyxiated and normal newborns remain relatively desaturated in early minutes of life. Pulse oximetry could detect these significant differences in the oxygen saturation and heart rate during initial periods of resuscitation, but as resuscitation continued these differences became non significant indicating the adequacy of resuscitation in asphyxiated newborn. This can be utilized as a cost effective tool in the neonatal unit in peripheral centers with less facilities in developing countries as ours to check for adequacy of resuscitation and intensive care referrals if needed , particularly for the primary care physicians who need to be well versed about the adequacy of resuscitation.

Key words: *Oximetry, asphyxia, neonate*

Asfiksi Gelişen Yenidoğan Resüsitasyonunda Pulse Oksimetrenin Rolü

ÖZET

Pulse oksimetre resüsitasyonun izlenmesi için kullanışlı bir araç olarak ortaya çıkmıştır. Bu çalışma resüsitasyon sırasında seri değişiklikleri kaydetmek ile birlikte asfiksi gelişen yenidoğanların oksijen satürasyonunu kaydetmek ve pulse oksimetrenin kullanılabilirliğini değerlendirmek için yapıldı. Ana sonuç pulse oksimetre ile % 90 doygunluğa ulaşmak için alınan zaman oldu. Değerlendirilen diğer değişken ise ilk kayıtta alınan pulse oksimetre ile % 75 doygunluğa ulaşmak için alınan zaman idi. 100 olgu (asfiksi gelişen yenidoğan) ve 30 kontrol (normal yenidoğan) çalışmaya dahil edildi. Ortalama kalp hızı doğumun ilk dakikasında asfiksi grbunda (91±5.24/dk) anlamlı olarak kontrol grubuna (125.2±4.5/dk) göre düşüktü. Ortalama oksijen satürasyonu doğumun ilk dakikasında asfiksi grbunda (47.5%±1.42) anlamlı olarak kontrol grubuna (50.5%±2.08) göre düşüktü. Ortanca (çeyrekler arası aralık) olarak %75-90 oksijen satürasyonuna ulaşma zamanı asfiksi grubunda 290 (275-295) ve 490 (480-510) saniye olup kontrol grubuna (205 (190-212) ve 375 saniye (357-398) göre belirgin olarak yüksekti. Asfiksi gelişen ve normal yeni doğanların hepsi yaşamın ilk saniyelerinde eksijensiz kalırlar. Pulse oksimetre resüsitasyonun başlangıcında oksijen saturasyonu ve kalp hızında önemli farklılıkları tespit edebilir. Ancak resüsitasyon devam ederken bu farklılıklar asfiksi gelişen yenidoğanlarda resüsitasyonun yeterliliğini göstermede önemli olmazlar. Gelişmekte olan ülkelerd pulse oksimetreler periferik merkezlerde yenidoğan ünitelerinde maliyet etkinlik açısından uygun olabilir.

Anahtar kelimeler: *Oksimetre, asfiksi, yenidoğan*

[1]SKIMS Medical College and Hospital Bemina. [2]SKIMS Soura Srinagar, Internal Medicine. [3]Department of Pediatrics Govt Medical College Srinagar. [4]SKIMS Soura Srinagar, General Surgery, [5]MBBS Govt Medical College Srinagar.

Correspondence: *Dr Hakim Irfan Showkat*
Senior resident, SKIMS Soura Srinagar
Tel: +91-9419028326
E-mail: docirfanshahi512@gmail.com

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INTRODUCTION

Asphyxia neonatorum or birth asphyxia is the respiratory failure in newborn a condition caused by inadequate intake of oxygenbefore during or just after birth. It is defined as the failure to start regular respiration within one minute of birth.It is a neonatal emergency as it may lead to hypoxia and brain damage. Newborn infants normally start to breathe without assistance and usually cry after birth. If an inewborn fails to establish sustained respiration at birth, the newborn is diagnosed with birth Asphyxia (1). he incidence of birth asphyxia in western hemisphere is 1-1.5% of livebirths and is inversely related to gestational age and birth weight (2). Birth asphyxia accounts for an estimated 0.92 million neonatal deaths annually and is associated with another 1.1 million intrapartum still births (3). Keeping in view the Mortality and morbidity associated with neonatal asphyxia, prompt assessment and resuscitation of asphyxiated newborns assumes great significance. All resuscitation efforts should aim at achieving adequate level of oxygenation of newborns in order to prevent any hypoxic damage. Pulse oximetry provides a real time non ivasive method of measuring oxygenation and thus has emerged as a useful tool for monitoring resuscitation.

The present study has been done to assess the usefulness of puse oximetry in delivery room resuscitation of newborns. Further this study also designed to assess the serial changes in oxygen saturation durinr resuscitation. In the resuscitation of asphyxiated newborns neonatal resuscitation guidelines as recommended by American heart association were followed (4).

MATERIALS AND METHODS

The study was done over a period of 6 months in the delivery room of lala Ded hospital an associated maternity hospital of Government Medical College Srinagar. A total of 100 cases(asphyxiated newborns) with birth weights between above 999 grams were included. The neonates with lethal congenital anamalies and congenital heart disease were excluded from the study. Thirty Healthy newborns born within the study without asphyxia were taken as controls.

The resuscitation of asphyxiated newborns was monitored with a “Co Medair Pulse Sense LSIP” pulse oximeter. The sensors were placed on the ulnar aspect of the right palm of the neonate immediately after baby was dried and placed on radiant warmer (5). Pulse oximetry recordings were taken continuously till oxygen saturation reached 90%.The SpO_2 recordings at 1, 3, 5 and 10 minutes were noted on proforma.The time to first recording and time taken to reach 75% and 90% saturation were also noted. Puse oximetry recording of matched controls for same variables were also recorded and compared with values obtained during resuscitation of asphyxiated neonates.

The primary outcome variable of this study was the time taken to reach a saturation of 90%. The secondary outcome variables were the time taken to first recording and time taken to reach 75% saturation.In babies needing resuscitation standard protocols as per guidelines of AHA- AAP were used (4).

Statistical analysis

The statistical analysis of the data continuous normally distributed variables like age ,parity, gestation and birth weight was done by using students t-test for difference of means.Non parametric data i.e time to different saturation values was analysed by Mann- Whitney’s-U- test. For nominal data Chi Square test and Fisher’s exact test were used. These test were referenced for the P value. P values less than 0.05 was taken as significant.

RESULTS

There were 100 cases (asphyxiated newborns)and 30 controls(normal newborns). In the asphyia group 59 neonates were born by vaginal route and 41 were delivered by ceserean section. In the control Group 18 were born by vaginal delivery and 12 by ceserean section. The cases and controls were comparable with regards to gestation, birth weights and mode of delivery. The number of cases(%) in whom pulse oximetry recordings could be obtained at 1 minute, 3 minutes, 5 minutes and 10 minutes was 8(8.00%), 36(36.00%), 62(62.00%) and 92(92.00%), respectively as compared to the controls in whom the number (%0) of pulse oximetry records obtained at same intervals were 4(13.3%), 22(73.30%) 29(96.70%)and 29(96.70%), respectively.The percentage of pulse oximetry recordings obtained at 3 and 5 minutes was significantly lower ($p<0.01$) in cases than the controls. The median time (inter quartile range) for the first recording to detect oxygen saturation was also sig-

***Table 1**. Comparison of Median times to different Spo2 values between cases and controls*

Time To		Median Time(seconds)	Inter quartile Range(Q1-Q3)	p value
First Record	cases	260	175-310	.001
	controls	100	95-184	
75% saturation	cases	290	275-295	.001
	controls	205	190-212	
90% saturation	cases	490	480-510	.001
	controls	375	357-398	

nificantly longer in asphyxiated neonates 260 (175-310 sec) than controls 100(95-184 sec), (p<0.05).The Median (interquartile range) time to reach 75% saturation was 290(275-295 sec) in the asphyxia group compared to 205(190-212 sec) in the control group (p<0.001). This trend was also reflected in achieving 90% saturation. The median (interquartile range) time to reach 90 % saturation in the cases was 490(480-510 sec) as compared to 375(357-398 sec) in controls (p<0.001)

The mean heart rate (±SD) at 1minute of life was significantly lower in the asphyxiated group (91±5.24) as compared to the controls (125.25±4.57) (p<0.05). The mean Spo2(± S.D)at 1 minute of life was also significantly lower in the asphyxia group (47.50±1.42%) as compared to controls (50.50±2.08%). The differences there after were not statistically significant. Table 1,2 and 3 respectively demonstrate the comparison of median times taken to different SpO_2 values, Heart rates and corresponding SpO_2 values between cases and controls.

DISCUSSION

The previous studies done by House et al. (6) on normal newborns infants ,initial oximetry recordings were obtained in 43% of infants at 1 minute of age and by 5 minutes this percentage increased to about 98% similar percentage of recordings were obtained by Meier-Strauss et al. (5). In this study the percentage of normal newborns whose pulse oximetry recordings were obtained at 1 minute was 13.3 which was much lower as compared to those obtained in previous studies. However, percentage of recordings obtained in this study in normal newborns at 5 minutes of age was 96.75 %which is similar to that obtained in previous studies. The percentage of asphyxiated infants whose pulse oximetry recordings were obtained at 1 minute of age was only 8% which was lower than than those of normal newborns.This lower percentage could be due to several reasons including , decreased peripheral pulse volume during post neonatal adaptation, movement artifacts, probe malposition, excess pressure applied while securing the probe and time taken by instrument to detect the pulsatile wave forms (5,7).

In the study conducted by Rakesh and Ramji (8) on asphyxiated newborns in delivery room , initial oximetry recordings in asphyxiated newborns were obtained in 6.3%, 36.5%, 63.1%, and 80% respectively at 1, 3, 5,and 10 minutes. In the normal newborns (control group) they obtained initial recordings in 10%, 80%,90% and 90% respectively at 1,3,5 and 10 minutes. This results obtained in this study were similar. Further the percentage of recordings obtained at 3 and 5 minutes of age I asphyxiate newborns was significantly lower (p<0.05) as compared to controls at similar ages. These results vindicate the results obtained by Rakesh and Ramji (8).

Studies done by House et al. (6), Deckardt et al. (9), Porter et al. (10) reported normal aterial oxygen saturation of normal newborns in the hypoxic range (<90%). In this study the mean Spo2 in normal newborns increased from 50.50% at 1 minute of life to about 72% at 3 minutes, 81% at 5 minutes and 93% at 10 minutes . The mean

***Table 2**. Comparison of Heart rates between asphyxia group and controls at different time intervals*

Heart rate	Cases Mean(±SD)	Controls Mean(±SD)	t value	p value
At 1 minute	91.00(±5.24)	125.25(±4.57)	11.08	0.0001
At 3 minutes	122.11(±7.97)	125.64(±6.40)	1.76	0.085
At 5 minutes	134.90(±4.44)	137.14(±6.78)	1.94	0.056
At 10 minutes	146.28(±5.13)	147.55(±3.94)	1.23	0.224

Table 3. *Comparison of Spo2 between asphyxia group and controls at different time intervals*

SpO_2	Cases Mean(± SD)	Controls Mean(± SD)	t value	p value
At 1 minute	47.50(±1.42)	50.50(±2.08)	2.98	0.014
At 3 minutes	71.53(±1.96)	72.18(±1.76)	1.28	0.203
At 5 minutes	81.13(±1.24)	81.83(±2.99)	1.78	0.076
At 10 minutes	92.51(±3.07)	93.07(±1.72)	1.31	0.193

SpO_2 of asphyxiated newborns increased from 47.5% at 1 minute to 71.5% at 3 minutes,81% at 5 minutes and 92% at 10 minutes of life . This indicates that both normal and asphyxiated newborns remain relatively desaturated in first few minutes of life. The mean SpO_2 at 1 minute was significantly lower ($p<0.05$) in the asphyxiated group as compared to controls.The differences in SpO_2 subsequently decreased due to timely resuscitation of asphyxiated newborns.

In this study the right upper limb (right Hand) was used for sensor placement. This was done because of earlier study done by Meir-Stauss et al. (5), Who noted faster signal detection in right hand as compared to foot. This study also found significant difference ($p<0.05$) between the asphyxiated neonates and normal neonates in the time taken to the first recording and time taken to reach 75% and 90% saturation (Table 1). This result was similar to that obtained by Rakesh Rao and S ramji (8).In the present study all the asphyxiated neonates received supplemental oxygen and none of the controls received oxygen. The differences in SpO_2 between the supplemented and non supplemented group was non significant beyond 1 minute of age. This vindicates the results of previous study obtained by House et al. (16) who failed to demonstrate any difference in SpO_2 in infants who received oxygen and those who did not.

Maxwell et al.(11) evaluated oxygenation during resuscitation of four preterm neonates. They were able to demonstrate adequacy of resuscitation by rising SpO_2levels .In the present study too rising SpO_2 levels were demonstrated in asphyxiated newborns in a trend similar to rising SpO_2 levels found in normal newborns indicating the efficacy and adequacy of resuscitation and the utility of pulse oximetry in detecting the changing serial trends in oxygenation during resuscitation.

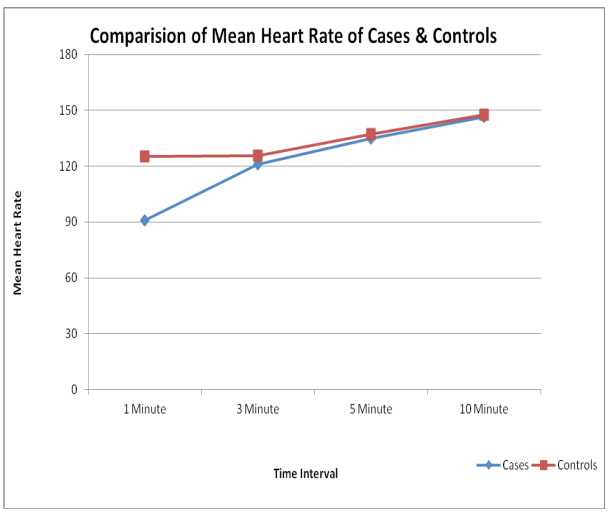

Figure 1. *The above curve shows significant difference in heart rate at 1 minute between cases and controls which disappears after 3 minutes of resuscitation thus showing the adequacy of resuscitation.*

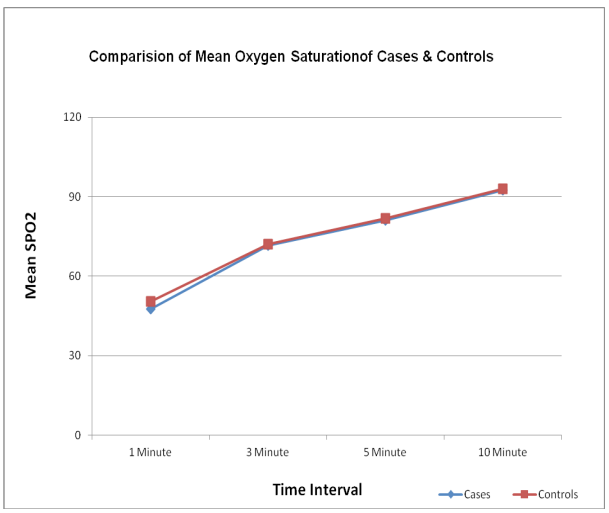

Figure 2. *The above curve shows significant difference in SpO_2 at 1 minute between cases and controls which disappears after 3 minutes of resuscitation thus showing the adequacy of resuscitation.*

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