



ORIGINAL RESEARCH PAPER

Paediatrics

RETROSPECTIVE STUDY ASSESSING THE RELATIONSHIP BETWEEN APGAR SCORE AND PULSE OXIMETRY

KEY WORDS: Apgar Score, pulse Oximetry

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ABSTRACT

INTRODUCTION – APGAR Score (AS) is widely used in assessment of newborn which comprises of 5 components – heart rate, respiratory efforts, muscle tone, reflex irritability and colour with a maximum possible score of 10 and a minimum score of 0. AS is a standardized, validated tool used for neonatal assessment at 1 minute and 5 minutes of life to record the fetal to neonatal transition. The skin colour component of AS is regarded to be indicative of oxygen saturation at birth but is graded subjectively. Pulse oximetry is a non-invasive objective method of assessing arterial oxygen saturation with the added advantage of provision of continuous monitoring.

OBJECTIVE – This study aims to study the relationship between APGAR Score and pulse oximetry in term neonates.

METHODOLOGY – Our retrospective study included 105 term neonates born through cesarean-section at Meenakshi Medical College Hospital and Research Institute, Kanchipuram between August 2018 and August 2019. Pre-term; neonates born to eclamptic, pre-eclamptic, diabetic, hypothyroid, Rh-incompatible mothers, perinatal fetal distress and respiratory distress were excluded from the study. The data collected included birth weight, gestational age, Apgar score at 1 minute, Apgar score at 5 minutes, Heart rate, respiratory rate and four limb pulse oximetry recordings. Data was tabulated and analysed using SPSS v16.

Results – The mean gestational age of the study population was 268.05±6.25 days and mean birth weight was 2.997±0.36 kgs. The mean AS at 1 minute was 7.71±0.65. The mean AS at 5 minutes was 8.85±0.54. A statistically significant positive association was noted between 1 minute AS and mean pre-ductal oxygen saturation (r= 0.58, p<0.00001) and 1 minute AS and mean post-ductal oxygen saturation (r= 0.59 p<0.00001). Statistically significant positive associations were noted between 5 minute AS and mean pre-ductal oxygen saturation (r=0.54 p<0.00001) and 5 minute AS and mean post-ductal oxygen saturation (r=0.58 p<0.00001). However, there was no association between AS and Heart rate as well as AS and respiratory rate.

CONCLUSION – Our study has shown a significant association between APGAR score and pulse oximetry in term neonates.

INTRODUCTION –

APGAR Score (AS) is widely used in assessment of newborn which comprises of 5 components – heart rate, respiratory efforts, muscle tone, reflex irritability and colour with a maximum possible score of 10 and a minimum score of 0. AS is a standardized, validated tool used for neonatal assessment at 1 minute and 5 minutes of life to record the fetal to neonatal transition^[1]. An AS of <6 is suggestive of perinatal asphyxia which is often associated with other manifestations such as seizures and cerebral palsy. The skin colour component of AS is regarded to be indicative of oxygen saturation at birth but is graded subjectively^[2]. Pulse oximetry is a non-invasive objective method of assessing arterial oxygen saturation with the added advantage of provision of continuous monitoring^[3]. There are limited studies assessing the relationship between AS and pulse oximetry, while simultaneously there is a debate as to whether pulse oximetry can replace or be added to the conventional AS. Table 1 describes the scoring of various parameters coming under the purview of AS.

Table 1 – APGAR Score^[1]

Sign	0	1	2
Heart Rate	Absent	<100 bpm	>100 bpm
Respiratory Effort	Absent	Slow (irregular)	Good crying
Muscle Tone	Limp	Some flexion of extremities	Active motion
Reflex Irritability	No Response	Grimace	Cough or sneeze

Colour	Blue, Pale	Pink body, blue extremities	All pink

OBJECTIVE –

This study aims to study the relationship between APGAR Score (AS) and pulse oximetry in term neonates.

METHODOLOGY –

The study was conducted as a retrospective study at Meenakshi Medical College Hospital and Research Institute, Kanchipuram considering neonates born between August 2018 and August 2019. Inclusion criteria was neonates delivered through cesarean-section between 37-42 weeks gestational age (term neonates), with weight appropriate for age, irrespective of gender difference and with 1 minute AS ≥7. Exclusion criteria were pre-term; neonates born to eclamptic, pre-eclamptic, diabetic, hypothyroid, Rh-incompatible mothers, perinatal fetal distress and respiratory distress neonates. The data collected included birth weight, gestational age, AS at 1 minute, AS at 5 minutes, Heart rate, respiratory rate and four limb pulse oximetry recordings. Data was coded and tabulated into computer using Microsoft Excel 2013. Statistical tests employed were descriptive statistics, Pearson's Correlation by using SPSS v16. p value of <0.05 was considered to be statistically significant.

RESULTS –

The mean gestational age of the study population was

268.05±6.25 days and mean birth weight was 2.997±0.36 kgs. Of the 105 neonates included in the study, 55 neonates were male while the other 50 neonates were female. The mean AS at 1 minute was 7.71±0.65. The mean AS at 5 minutes was 8.85±0.54. The mean pre-ductal saturation was 94.4 ±1.7 %. The mean post-ductal saturation was 93.3±2.39%. The mean heart rate measured was 146.92 ± 9.2 beats per minute and mean respiratory rate was 52.3 ± 4.82 cycles per minute. Table 2 summarizes the characteristics of the study population. A statistically significant positive association was noted between 1 minute AS and mean pre-ductal oxygen saturation (r= 0.58, p<0.00001) and 1 minute AS and mean post-ductal oxygen saturation (r= 0.59, p<0.00001). Statistically significant positive associations were noted between 5 minute AS and mean pre-ductal oxygen saturation (r=0.54 p<0.00001) and 5 minute AS and mean post-ductal oxygen saturation (r=0.58 p<0.00001). There was no association between 1 minute AS and Heart rate (r= 0.039, p= 0.692) as well as 5 minute AS and Heart Rate (r= 0.054, p= 0.58). There was no association between 1 minute AS and respiratory rate (r = 0.0004, p = 0.96) as well as between 5 minute AS and respiratory rate (r= 0.0008 p= 0.99). There was no association was noted between 1 minute AS and gestational age (r= 0.14, p=0.15)

Table -2 Characteristics of Study Population

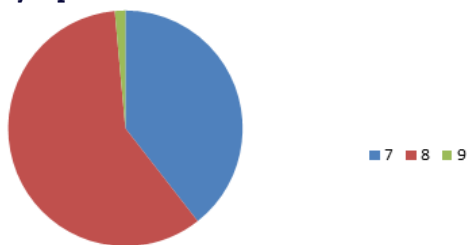
Sl No.	Parameter (units)	Mean ± SD
1	Gestational Age (days)	268.06 ± 6.2
2	Birth Weight (kgs)	2.99 ± 0.36
3	1 minute AS	7.71 ± 0.65
4	5 minute AS	8.85 ± 0.52
5	Heart Rate (beats/minute)	146.92 ± 9.42
6	Respiratory Rate	52.38 ± 4.82
7	Pre-Ductal Saturation (%)	94.4 ± 1.7
8	Post-Ductal Saturation (%)	93.3±2.39

A statistical description of AS of the study population is presented in Table -3.

Table -3 Description of AS of Study population

Sl No	Time (minutes)	Mean	SD	Median	IQR
1	1	7.71	0.65	8	7-9
2	5	8.85	0.52	9	8-10

Graph 1 - Pie Chart depicting distribution of 1 minute AS in Study Population



Pie Chart distribution of 1 minute AS in Study Population is illustrated in Graph 1.

Graph 2 - Pie Chart depicting distribution of 5 minute AS in Study Population

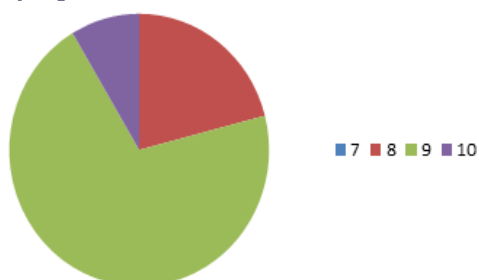


Table -4 Description of Heart Rates and Respiratory Rate of Study Population

Sl No	Parameter (units)	Mean	SD	Median	IQR
1	Heart Rate (beats per minute)	146.92	9.42	144	126-172
2	Respiratory Rate (cycles per minute)	52.3	4.82	52	44-64

Table 4 describes heart rates and respiratory rates of study population. Tables 5 and 6 present Frequency distribution of heart rates and respiratory rates of study population respectively.

Table -5 Frequency distribution of Heart Rates of Study Population

Sl No	Heart Rate (beats per minute)	Frequency
1	121-130	2
2	131-140	19
3	141-150	36
4	151-160	32
5	161-170	15
6	171-180	1

Table -6 Frequency distribution of Respiratory Rates of Study Population

Sl No	Respiratory Rate (cycles per minute)	Frequency
1	41-50	45
2	51-60	57
3	61-70	3

DISCUSSION-

AS is a standardized, validated tool used for neonatal assessment at 1 minute and 5 minutes of life to record the fetal to neonatal transition^[4]. It is critical to evaluate oxygenation status at birth due to physiologically persistence of right to left shunt at arterial level, bi-directional shunting thru ductus arteriosus, physiological ventilation perfusion mismatch^{[5][6][7]}. AS indirectly measures oxygenation status by considering body colour. However, prior studies have shown that skin colour is a poor predictor and thus it can be misleading^[8]. In our study, there was a difference between mean pre-ductal vs post-ductal saturation (94.4 ± 1.7% vs 93.3±2.39 %) but is not statistically significant.

A study by Richmond et al^[9] showed that babies who had a normal AS at birth and did not require any post natal assistance were taken ill as early as 2nd hour of birth due to a variety of causes such as transient tachypnoea of newborn, congenital heart diseases, spontaneous pneumothorax etc^[10]^[11]. It is probable that the cause of the above conditions was subclinical hypoxemia which could have been detected on pulse oximetry.

In our study, AS as a composite numerical value was strongly associated with both pre-ductal and post-ductal saturation values [r= 0.58, p<0.00001) and (r= 0.59, p<0.00001) respectively]. This is opposite to the findings of a study conducted by Chauhan S et al.^[12] wherein the AS score correlated with only the respiratory effort and not with the overall composite numerical value.

Thus, pulse oximetry may also be considered along with AS to record the fetal to neonatal transition.

However, larger multi-centric, prospective studies are required to validate the findings of our study as our study

considered only term neonates born in Kanchipuram.

CONCLUSION-

Our study has shown a significant association between APGAR score and pulse oximetry in term neonates.

Sources of Funding – Nil

Conflicts of Interest - Nil

REFERENCES-

1. Apgar V. , A Proposal for a new method of evaluation of the Newborn Infant, *Curr Res AnasthAnalg* 1953;32:260-267
2. Dawson JA, Davis PG, O'Donnell CP, Kamlin CO, Morley CJ. Pulse oximetry for monitoring infants in the delivery room: A review. *Arch Dis Child Fetal Neonatal Ed.* 2007;92:F4-7.
3. Hay WW, Jr, Brockway JM, Eyzaguirre M. Neonatal pulse oximetry: Accuracy and reliability. *Pediatrics.* 1989;83:717-22
4. Papile LA. The Apgar score in the 21st century. *N Engl J Med.* 2001;344:519-20.
5. Lind J, Wegelius C. Human fetal circulation: Changes in the cardiovascular system at birth and disturbances in the post-natal closure of the foramen ovale and ductus arteriosus. *Cold Spring Harb Symp Quant Biol.* 1954;19:109-25
6. Eldridge FL, Hultgren HN, Wigmore ME. The physiologic closure of the ductus arteriosus in newborn infants: A preliminary report. *Science.* 1954;119:731-2.
7. Dimich I, Singh PP, Adell A, Hendler M, Sonnenklar N, Jhaveri M. Evaluation of oxygen saturation monitoring by pulse oximetry in neonates in the delivery system. *Can J Anaesth.* 1991;38:985-8.
8. Rüdiger M, Aguilar M. Newborn Assessment in the Delivery Room. *Neoreviews.* 2012;13:e336-42
9. Richmond S, Reay G, Abu Harb M. Routine pulse oximetry in the asymptomatic newborn. *Arch Dis Child Fetal Neonatal Ed.* 2002;87:F83-8.
10. Poets CF, Southall DP. Noninvasive monitoring of oxygenation in infants and children: practical considerations and areas of concern. *Pediatrics.* 1994 May;93(5):737-746.
11. Bonnet D, Coltri A, Butera G, Fermont L, Le Bidois J, Kachaner J, Sidi D. Detection of transposition of the great arteries in fetuses reduces neonatal morbidity and mortality. *Circulation.* 1999 Feb 23;99(7):916-918
12. Chauhan S, Singh PK, Gahalaut P, Prasad PL. Correlation of pulse oximetry and apgar scoring in the normal newborns. *J Clin Neonatol.* 2013;2(1):20-24. doi:10.4103/2249-4847.109241