ORIGINAL ARTICLE

Knowledge and application of APGAR score among residents in a tertiary hospital

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ABSTRACT

Introduction: The APGAR score rapidly assesses the condition of the newborn at birth and is a predictor of neonatal mortality. Despite the fact that this scoring system is limited by inter and intra-observer variation, its knowledge is essential to residents involved in newborn care at delivery. This study was therefore carried out to determine the knowledge and application of the APGAR score by these residents. **Materials and Methods:** The questionnaire-based survey was conducted at the Jos University Teaching Hospital and administered to all consecutive residents in pediatrics, obstetrics and gynecology (O and G), anesthesia, family medicine and public health. Domains assessed both knowledge and application of the APGAR scoring system. Data analyzed with the Epi Info 3.5.1 and $P < 0.05$ was considered as statistically significant. **Results:** Of the 74 completed questionnaires, 21 were filled by Pediatric residents, 27 by O and G residents and 26 by other residents. Residents with 10-15 years of work experience had a significantly higher mean score on their knowledge compared with those with <10 years work experience ($P = 0.015$). The mean application score was significantly higher among the Pediatric residents compared with the O and G and other residents ($P = 0.015$). Using linear regression, there was a significant association between the knowledge and application of the APGAR scoring system – coefficient = 0.179, $P \leq 0.001$. **Conclusion:** Adequate knowledge and application of the APGAR scoring system by residents who use it frequently is necessary to avoid its misuse. Training and retraining of these residents on the correct use of the APGAR score during neonatal resuscitation is important to ensure adequate knowledge and its proper application.

Key words: APGAR score, knowledge and application, residents

INTRODUCTION

The APGAR score, a 10-point assessment score devised by Dr. Virginia APGAR in 1952 has been used rapidly to assess the condition of newborns.[1] The score is usually reported at 1 and 5 min after birth and comprises of five components: Heart rate, respiratory effort, muscle tone, reflex irritability, and color; each of which is given a score of 0, 1, or 2.[1]

Despite the proposition of other more modern objective methods of assessing the newborn, investigators came to the conclusion that the APGAR score remains a relatively simpler and relevant method for the prediction of neonatal survival now as it was earlier.[2-4] Furthermore, in this environment where lack of facilities limits the assessment of umbilical cord artery pH, the APGAR score is used in addition to the presence of neonatal seizures, coma, or hypotonia and multiple organ dysfunction to make a diagnosis of severe birth asphyxia. Despite the convenience and practicality of using the score, some health care providers who attend to newborns at birth sparingly use it or misuse it.[4,5] Despite the fact that some studies have shown that it is limited by inter and intra-observer variation,[2,6,7] the knowledge of this scoring system is important to residents training in pediatrics and other specialties that come in contact with the newborn at birth – obstetrics and gynecology (O and G), anesthesia, family medicine and community medicine. It is therefore crucial that these doctors are acquainted with the APGAR scoring system and its correct application.[2]

Documented studies of the knowledge and application of the APGAR score among residents in pediatrics

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and other specialties contact with newborns at birth are however scarce. This study was undertaken to determine the knowledge, application and association between knowledge and application of the APGAR score by residents in pediatrics, O and G, anesthesia, family medicine and public health.

MATERIALS AND METHODS

The study was a cross-sectional questionnaire survey of resident doctors in Jos University Teaching Hospital over a period of 3 months in 2011. Subjects were resident doctors from the Departments of Pediatrics, O and G, and Family Medicine, Anesthesia and Community Medicine who were involved in the care of the newborn at delivery. Participation was voluntary and informed consent obtained. All consecutive subjects who consented were enrolled.

Self-administered questionnaires were used to assess the knowledge of the use of the APGAR score by residents in the specified departments as well as their application of this knowledge. Information on specialty, age, gender, number of years of work experience and rank of the residents were obtained. Domains assessed included the knowledge of the information the APGAR score provides, timing of the 1st and 5th min scores, parameters assessed, scores assigned to the individual parameters, highest and lowest scores that could be obtained and when additional scores should be obtained. The questions were both in the form of "best of five" and "true/false" pattern.

In order to assess the application of the APGAR scoring system, the residents were to assign scores for eight clinical scenarios described in the study proforma with five of these scenarios assessing individual APGAR parameters. The remaining were three cases of newborn with three different clinical presentations at birth and residents were to assign scores at 1 min and 5 min for each case. Scores were assigned for the residents overall knowledge and application.

The data was analyzed with the Epi Info (CDC Atlanta, Georgia, USA) 3.5.1 and results were expressed as proportions for discrete variable and means for continuous variables. The Chi-square and the Fisher's exact (when a cell was <5) was used to compare proportions of pediatrics, O and G and other (anesthesia, public health and family medicine) residents with respect to their knowledge and application of the APGAR score. The Student's *t*-test was used to compare the means of the total scores for the knowledge and application of the APGAR score in pediatric, O and G and other residents. $P < 0.05$ was considered as statistically significant.

RESULTS

Characteristics of the subjects
Of the 104 questionnaires distributed, 74 (21 pediatric residents, 27 O and G residents and 26 other residents from the Departments of Anesthesia, Public Health and Family Medicine) were returned completed. There were 49 (66.2%) males and 25 (33.8%) females with a male: female ratio of 2:1. Registrars constituted 51 (68.9%) of the subjects and 40 (54.1%) subjects were aged between 30 and 35 years. 48% (48.6%) and 47.3% had 6-10 years and 1-5 years of work experience, respectively [Table 1].

Knowledge of APGAR score
Only 19 (25.7%) of the subjects knew the exact timing of the 1st min APGAR score in relation to newborn resuscitation. Furthermore, 17 (23.0%) were aware that this APGAR score did not determine the need to start newborn resuscitation, the knowledge being significantly higher in the Pediatric residents compared with other residents ($P = 0.005$). 54% (54.1%) were sure that the 1st min APGAR is a useful index of the effectiveness of newborn resuscitation, while 55 (74.3%) knew that it does not correlate well with future neurologic outcome. The subjects in 83.8% of cases were aware that a low score may be due to other factors other than birth asphyxia. There was no significant difference in knowledge on its usefulness as an index of effectiveness of resuscitation, correlation with future neurologic outcome and factors responsible for a low score among the residents. Only 25% of the subjects knew when additional scores

Table 1: Characteristics of subjects				
Subject characteristics	Total	Paediatrics	O and G	Others
Number	74 (100.0)	21 (28.4)	27 (36.5)	26 (35.1)
Age range				
25-29	3 (4.1)	2 (9.5)	0 (0.0)	1 (3.8)
30-34	40 (54.1)	9 (42.9)	13 (48.1)	18 (69.2)
35-39	26 (35.1)	9 (42.9)	11 (40.7)	6 (23.1)
40-44	5 (6.7)	1 (4.8)	3 (11.1)	1 (3.8)
Sex				
Male	49 (66.2)	10 (47.6)	24 (88.9)	15 (57.7)
Female	25 (33.8)	11 (52.4)	3 (11.1)	11 (42.3)
Ranking				
Registrar	51 (68.9)	14 (66.7)	19 (70.4)	18 (69.2)
Senior registrar	23 (31.1)	7 (33.3)	8 (39.6)	8 (30.7)
Years of experience				
1-5	35 (47.3)	7 (33.3)	15 (55.6)	13 (50.0)
6-10	36 (48.6)	13 (61.9)	11 (40.7)	12 (46.2)
11-15	3 (4.1)	1 (4.8)	1 (3.7)	1 (3.8)

should be obtained beyond the 5th min and this was not significantly different among the different groups of residents ($P = 0.66$) [Table 2].

Application of APGAR scores using case scenarios

The Pediatric residents were observed to correctly assign scores for the individual parameters more frequently than the O and G and other residents for the parameters "appearance," "pulse rate," "grimace" and "respiratory effort." This difference was only statistically significant for the grimace parameter where 19 (90.5%) pediatric residents but only 16 (59.3%) O and G residents and 15 (57.7%) other residents correctly assigned its score ($P = 0.03$). A significantly higher number of Pediatric as well as O and G residents assigned the correct score for the "activity" parameter compared with the other residents where 66.7% of both the Pediatric and O and G residents assigned the correct score compared with 38.5% of the other residents ($P = 0.046$).

For the clinical case scenarios, the Pediatric residents assigned the correct 1st and 5th min APGAR scores more frequently compared with the O and G and other residents. This difference was statistically significant for the third clinical case scenario ($P = 0.007$) but not for the first ($P = 0.20$) and second ($P = 0.16$).

Relationship of mean knowledge and application scores with rank, number of years of work experience and specialty

Senior registrars had a statistically significant higher mean score for their knowledge on the APGAR score compared with registrars ($P = 0.04$). Similarly, residents with 10-15 years of work experience had a significantly higher mean score on their knowledge compared with those with <10 year work experience ($P = 0.04$). The mean knowledge score was 66.5 ± 15.1 for all residents studied and did not differ significantly among the different groups of residents (72.5 ± 10.1, 63.2 ± 14.5 and 65.1 ± 18.1 for the Pediatric, O and G and other residents respectively) ($P = 0.11$) [Table 3].

The mean application score was only 45.4 ± 32.6, but this value was significantly higher among the Pediatric residents (65.2 ± 26.9) compared with the O and G (43.1 ± 33.2) and other residents (31.9 ± 29.1) ($P = 0.0014$). There was however no significant relationship between the mean application score of a resident in relation to their rank and number of years of work experience ($P = 0.68$ and 0.19 respectively) [Table 3].

Using linear regression, there was a significant association between the knowledge and application

Table 2: Knowledge and application of the APGAR score					
Parameter assessed	**Number correct**				
	Total number (%)	**Paediatrics number (%)**	**O and G number (%)**	**Other number (%)**	**P value**
Knowledge of the APGAR score					
1st APGAR score					
Timing of 1st APGAR score	19 (25.7)	5 (23.8)	8 (29.6)	6 (23.1)	0.84
Information provided by 1st at APGAR score					
Indicates the need to start resuscitation	17 (23.0)	9 (42.9)	1 (3.7)	7 (26.9)	0.005
Useful index of effectiveness of resuscitation	40 (54.1)	9 (42.9)	15 (55.6)	16 (61.5)	0.43
Correlates well with future neurologic outcome	55 (74.3)	20 (95.2)	17 (63.0)	18 (69.2)	0.03
Low score due to factors other than asphyxia	62 (83.8)	15 (71.4)	23 (85.2)	24 (92.3)	0.15
2nd APGAR score					
Information provided by 2nd APGAR score					
Indicates the need to start resuscitation	56 (75.7)	17 (81.0)	18 (66.7)	21 (80.8)	0.39
Useful index of effectiveness of resuscitation	64 (86.5)	18 (85.7)	22 (81.5)	24 (92.3)	0.51
Correlates well with future neurologic outcome	18 (24.3)	9 (42.9)	6 (22.2)	3 (11.5)	0.043
Scoring system					
Highest scores	74 (100.0)	21 (100.0)	27 (100.0)	26 (100.0)	
Lowest scores	69 (93.2)	21 (100.0)	27 (100.0)	21 (80.8)	0.007
When additional scores are obtained	19 (25.7)	4 (19.0)	7 (25.9)	8 (30.8)	0.66
Application of the APGAR score					
Individual parameter clinical scenarios					
Appearance	69 (93.2)	20 (95.2)	26 (96.3)	23 (88.5)	0.48
Pulse rate	56 (75.7)	18 (85.7)	19 (70.4)	19 (73.1)	0.43
Grimace	50 (67.6)	19 (90.5)	16 (59.3)	15 (57.7)	0.03
Activity	42 (56.8)	14 (66.7)	18 (66.7)	10 (38.5)	0.046
Respiratory effort	67 (90.5)	21 (100.0)	23 (85.2)	23 (88.5)	0.19
Clinical case scenarios					
Case 1	27 (36.5)	11 (52.4)	8 (29.6)	8 (30.8)	0.20
Case 2	47 (63.5)	16 (76.2)	18 (66.7)	13 (50.0)	0.16
Case 3	29 (39.2)	14 (66.7)	9 (33.3)	6 (23.1)	0.007

Parameter assessed	Mean±SD	P value
Table 3: Relationship of mean knowledge and application scores with rank, number of years of work experience and specialty		
Knowledge of APGAR score		
Rank		
Registrar	69.1±13.0	0.04
Senior registrar	71.9±18.3	
Years of work experience		
1-5	63.2±12.7	0.03
6-10	68.1±16.5	
11-15	86.0±8.2	
Specialty		
Paediatrics	72.5±10.1	0.11
O and G	63.3±14.5	
Others	65.1±18.1	
Application of APGAR score		
Rank		
Registrar	44.4±31.2	0.68
Senior registrar	47.8±36.1	
Years of work experience		
1-5	39.0±28.7	0.19
6-10	50.0±35.3	
11-15	66.7±33.5	
Specialty		
Paediatrics	65.2±26.9	0.0014
O and G	43.1±33.2	
Others	31.9±29.1	

SD: Standard deviation

of the APGAR scoring system – coefficient = 0.179, $P \leq 0.001$.

DISCUSSION

The study reveals a general paucity of knowledge of when the 1st min APGAR score should be taken, with only 19 (25.7%) of 74 subjects correctly identifying the timing. It is therefore not surprising that only 17 (23.0%) residents were aware that the 1st min APGAR score does not determine the need for resuscitation because a greater proportion of the subjects thought that this score is taken immediately after birth. Hence, since resuscitation starts as soon as the baby is born, it would be conceived by these residents that the 1st min APGAR score determines the need for resuscitation. Though pediatric residents fared significantly better in identifying that resuscitation starts 1 min before the first APGAR score is taken, it is a concern that <½ (42.9%) were able to identify this correctly. Non- pediatric resident fared better than the pediatric residents in their knowledge that other factors other than asphyxia may be responsible for a low 1st min APGAR score. It is important to note that other factors including maternal medication and fetal neuromuscular disorders can result in low 1st min APGAR.[8] Hence, in an environment where pH analysis is not readily available, the reason for a low 1st min APGAR could be due to these other causes and not asphyxia alone.

For the 2nd APGAR score taken at the 5th min of birth, only 18 (24.3%) were aware that the score does not correlate well with future neurologic outcome. This is a common misconception as prediction of long term outcomes including neurologic was never a goal of this scoring system.[9] Although many researchers have tried to correlate the APGAR score with neurologic development in later life, there is no scientific basis to support the use of this scoring system in this regard.[8,10,11] Regardless of the limitations of the APGAR score, recent studies show that it accurately predicts risk in the general population, but is not clinically useful for individual patients.[12,13]

The mean knowledge of the APGAR score significantly improved if the resident had at least 10 years work experience compared with those with <10 years work experience. This is similar to a study by Enabudoso and Gharoro[14] in Benin where the better knowledge of the APGAR score was detected among labor ward personnel with at least 10 years work experience compared with the opposite group.

Less than a quarter of all Pediatric residents knew that additional scores should be obtained if the 5th min APGAR score is <7. This is in concordance with the Neonatal Resuscitation Program guidelines which states that assessment should be repeated every 5-20 min.[15]

More residents were able to correctly apply scores for the individual parameters appearance, pulse rate and respiration which is similar to a study among midwives in rural Pakistan.[16] The latter study however studied their knowledge and not application. This may be because the other two parameters - "grimace" and "activity" are more subjective in terms of assessment compared with "pulse rate," "appearance" and "respiratory effort."[17,18] Hence, the assessment of "grimace" and "activity" is likely to improve with experience. In the present study, a higher number of pediatric residents assigned correct individual parameter scores compared with O and G and other residents with significant differences for the parameter "grimace" which may show better experience using this scoring system.

Pediatric residents had significantly better application scores compared with O and G and other residents ($P = 0.0014$). This is similar to the study by Enabudoso *et al*. among labor ward personnel where pediatric residents were more accurate scoring the clinical scenario used.[14] Clark and Hakanson[7] also showed that pediatricians and pediatric house staff had a higher rating in terms of assigning correct scores

compared with Obstetricians and obstetric house staff, intensive care nursery staff and community nurses. However, even though these clinical scenarios attempts to capture actual practice by medical personnel, it may not reveal what would actually happen in real life situation when busy resuscitating the newborn.[13]

CONCLUSION

The APGAR score remains valid though subjective method of assessing the newborn immediately after birth. Adequate knowledge of this scoring system by residents who use it frequently is necessary to avoid its misuse. Training and retraining of these residents in the use and application of the APGAR score is important to ensure adequate knowledge and its proper application.

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