ASSESSMENT OF CANINE NEONATE BY APGAR SCORING SYSTEM AND ITS VALUE AS AN INDEX OF SHORT TERM NEONATAL SURVIVAL

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ABSTRACT

Early recognition of neonatal distress is crucial for optimal neonatal health, which envisages the assessment of the newborn for its viability status. The study aimed to evaluate the worth of Apgar score system in assessment of the clinical status of the newborn in dogs and its efficiency in timely neonatal care. The value of the Apgar score system in predicting the neonatal survivability was also assessed. The study confirmed the significance of Apgar scoring as a simple and reliable evaluation system in canine neonates that may help in identifying the distressed puppies and thereby reduce the incidence of neonatal mortality. The relevance of Apgar scoring system for short term survival prognosis in canine neonates was also established.

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Key words: Neonate, Canine, Apgar score, Survival

INTRODUCTION

For more than half a century, the Apgar score system has gained widespread application by obstetricians throughout the world as a quick means of evaluating the clinical status of the newborn baby and the need for timely intervention. It offered a simple, standardized, efficient and convenient evaluation system based on five easily identifiable components like color, heart rate, respiratory rate, muscle tone and reflex irritability. An Apgar score of more than seven or higher suggested that the state of the baby is good to excellent. As compared to other species of animals, the incidence of neonatal mortality following normal delivery is reported to be as high as 9 per cent to 26 per cent (Davidson, 2014) and even higher (30% to 40%), (Mosier, 1986) following complicated whelping in dogs. Hence, there is an urgent need for a simple and reliable evaluation system in canine neonates that may help in identifying the distressed puppies and thereby reduce the incidence of neonatal mortality. The aim of this study was to evaluate the worth of Apgar score system in assessment of the clinical status of the newborn and its value in predicting the neonatal survivabilityin dogs.

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MATERIALS AND METHODS

The present investigation was conducted in dogs presented to the obstetrical unit of the Department of Veterinary Gynecology and Obstetrics, Veterinary College, Bengaluru. The study was carried out in seven animals undergoing spontaneous whelping (Group I: SW), 18 dogs subjected to elective cesarean section (Group II and III) and 44 dystocic dogs presented by the owners for relief of dystocia (Group IV to VIII). The 18 animals subjected to elective cesarean was allotted to two groups, wherein either under total intravenous anesthesia (Groups II, EICSIV, n = 11) or under gaseous anesthesia (Group III, EICSG, n = 7) was employed. For elective cesarean under intravenous anesthesia (EICSIV), the animals were premedicated with Glycopyrolate (Inj. PYROLATE®, 0.2mg/ml, Neon Laboratories Ltd.) at a dose rate of 0.02 mg/kg body weight administered intravenously ten minutes before induction of anesthesia and anesthesia was induced by intravenous bolus injection of propofol (Inj. PROFOL®, 1% w/v, Claris Life Sciences Ltd.) at a dose rate of 6 to 7 mg/ kg.wt, intravenously. Following delivery of all the puppies, anesthesia was subsequently maintained using a combination of propofol and ketamine in the ratio 1:1 (v/v). For elective cesarean

under gaseous anesthesia (EICSG), premedication and induction of anesthesia was similar to EICSIV group. However, anesthesia was maintained by 1 to 2% Isoflurane (FORANE®, Abbott Laboratories Ltd., England) delivered through a Boyles' apparatus and oxygen at 1.5% concentration.Group IVconsisted of animals in which vaginal manipulative procedures were successful in relief of dystocia with subsequent spontaneous expulsion of the remaining fetuses (AW, n = 7).The medical treatment employed for complete and partial primary uterine inertia (Group V, CPUI, n = 6 and Group VI, PPUI, n = 10) consisted of intravenous infusion of Dextrose 10 % (1gm/kg b.wt), followed by 10% calcium gluconate (CALCIUM-SANDOZ®, Novartis India Limited) @ 0.2 ml / kg b.wt I/V, but not exceeding a total dose of 10 ml and oxytocin @ 2 units, I/M fifteen minutes after calcium administration. The treatment was considered successful if a pup was delivered within 30 minutes following injection of oxytocin. The animals assigned to emergency cesarean consisted of cases of dystocia in which vaginal manipulative procedures or medical treatment protocols completely failed to relieve dystocia or were partially successful. Emergency cesarean was carried out using two anesthetic protocols, namely intravenous anesthesia (Group VII, EmCSIV, n = 12) and gaseous anesthesia (Group VIII, EmCSG, n = 9) as detailed for elective cesarean section.

Assessment of the neonatal viability status using Apgar scoring system scoring was modified and adopted for canine neonates by Groppetti *et al.* (2010). It was used to classify newborn health and viability immediately after birth to determine its value in differentiating vigorous and unhealthy puppies(Table I).

Neonates identified to be in distress on the basis of Apgar score were immediately subjected to resuscitation procedures like clearing the airways using a bulb syringe, vigorous massaging using dry towels, stimulation of Ren Zhong acupoint (GV 26) using a 25-gauge needle inserted into the nasal philtrum at the base of the nostrils and rotated when bone is contacted (Traas, 2008). Oxygen was administered through facial mask was attempted if the neonate failed to respond to any of the resuscitation procedures stated above.Neonates which did not respond satisfactorily to the above resuscitation procedures received one to two drops of central respiratory stimulant, doxapram sub-lingually. All the newborn puppies were kept in a baby incubator which provided warmth of 30^0 C to 32^0 C and a humidity of 55 % to 60 % upto 60 minutes after birth.Reassessment of Apgar score was carried out again at 30 and 60 min of birth to determine the influence of resuscitation procedures carried out in distressed puppies.

The data generated from neonatal evaluation carried out on 253 live puppies born of SW n=28), AW (n=23), successful medical management to CPUI (n=17) and PPUI (n=22), EmCSIV (n=45) and EmCSG(n=39) and EICSIV (n=42) and EICSG (n=37) respectively was statistically analyzed. The variations among groups with respect to the type of delivery and mean Apgar score at birth, 30 min and 60 min and the influence of duration of labor on Apgar score at birth was compared by one way analysis of variance (ANOVA), whenever the 'F' ratio was found significant, the comparison of means among the groups was tested by Bonferroni post hock test as per the methods of Stell and Torrie (2000) using SPSS software package for an explanatory and inferential assessment. The influence of neonatal resuscitation procedures in the transition of low and medium Apgar graded pup and association of low, medium and high Apgar score pups on survival and mortality at 24 hr were statistically analyzed by Pearson Chi-square (Stell and Torrie, 2000) and a 'P' value of 0.05 was considered as significant.

RESULTS AND DISCUSSION

The mean Apgar scores at birth, 30 and 60 minutes in different categories of delivery are presented in Table II. At birth, 30 and 60 minutes of assessment, the maximum Apgar score was recorded in puppies which had been delivered spontaneously and was significantly higher than the Apgar scores recorded in puppies delivered from other groups of animals(8.57

± 0.58, 11.21 ± 0.66 and 11.21 ± 0.65, respectively). It was also observed that in the spontaneously delivered puppies, every puppy which had an Apgar score of minimum eight at birth remained alive by day 14 after birth and the Apgar score of such puppies improved further by 30 and 60 minutes after birth without any resuscitation procedures. Considering this observation, it is recommended that a healthy neonate should have an Apgar score of atleast eight at birth.In puppies born of both emergency and elective cesarean sections irrespective of type of anesthesia, the mean Apgar score recorded at birth was significantly lower. Similarly, Silva *et al.* (2009) also reported lower Apgar values in puppies born of cesarean section. The low Apgar scores at birth in puppies born of elective cesarean might be attributed to the effect of anesthetic agents on the cardiac, respiratory and nervous systems. Further, the effect of the fetal distress arising from dystocia, or the fetus retained for long time in the uterus or birth canal or exposed to the effect of ecbolics, besides being affected by anesthetic agents cesarean may have contributed to the significantly lower Apgar scores in animals subjected to emergency cesarean section. The degree of nervous system depression as evinced by a reduced reflex irritability, vocalization, mobility, suckling and muscle tone were also evident in the puppies born of cesarean as compared to the vaginally delivered puppies. Apart from afore said factors causing depression, Silva *et al.* (2009) opined that lack of compression stimuli along the birth canal in cesarean born puppies or even in those cases of uterine inertia may contribute to low Apgar scores at birth.

Table III presents the influence of duration of labor on the mean Apgar score at birth in puppies delivered from dystocic animals. An inverse relationship on the mean Apgar score at birth existed with the duration of labor as observed from the present study. These observations concur with those of Groppetti *et al.* (2010) who were of opinion that the Apgar score worsened with prolonged parturition. Moreover, Lucio *et al.* (2009) also confirmed that canine newborns born after prolonged labor exhibited higher degrees of depression at birth, which reflects the stress associated with dystocia affecting the vitality of newborns and thereby low Apgar scores at birth.Herpin *et al.* (1996) stated that prolonged or intermittent asphyxia in-utero or during labor decreases newborn's vitality and reduces their ability to adapt to extra uterine life.

For a rapid and simple assessment of neonatal viability based on the Apgar scoring, puppies were subdivided as high score for those totaling more than 8 (healthy pups), medium score for those totaling 5 to 8 (moderately stressed) and low score for those totaling 0 to 4 (severely stressed). Based on this classification, it was observed that different grades of Apgar scores were significantly associated with the type of delivery as evinced by the distribution of puppies in each. Significant difference between the groups in the improvement from low and medium Apgar grade to high grade at 30 and 60 minutes of re-evaluation following resuscitation was observed (Table IV). The beneficial effects of resuscitation procedures were more apparent in improving the Apgar score of puppies born with low or medium Apgar score from dystocic animals. Though dystocia promotes a long-lasting bradycardia and slows down Apgar score progression in pups (Lucio *et al.*, 2009), resuscitation measures help in attaining satisfactory improvement, which otherwise would have a fatal outcome. The results obtained in this study assured the merit of resuscitative measures that would decrease the time required for low viable pups born of dystocic deliveries to recover without delay and to adapt to extra uterine life and attain higher and satisfactory Apgar scores indicating the improvement in vitality. Pups delivered following gaseous anesthesia in both emergency and elective cesarean showed a rapid transformation compared to intravenous anesthesia as evident from their improvement of 82.05 per cent and 91.89 per cent as against 57.78 per cent and 73.81 per cent at 30 min of re-evaluation. After 30 minutes, their improvement was almost the same in both the anesthetic procedures, as evident from the Table V. The relatively high proportions of pups acquiring high scores in the cesarean under gaseous

anesthesia at 30 minutes could be attributable to the rapid clearance of gaseous anesthetic from the circulation as compared to intravenous anesthetics. Moon *et al.*(2000) reported that neonates rapidly eliminate inhalation anesthetics with the initiation of spontaneous respiration.

In the present study, it was observed that the most critical period for neonatal mortality is the first 24 hr after birth. As the Apgar score at birth was subjected to sudden changes between time points, Apgar score at 60 minutes was used to assess its predictive value in neonatal survivability at 24 hr after birth. The survival and mortality at 24 h after birth of 194 high Apgar score graded pups and 28 each of low graded and medium graded pups available at 60 minutes, irrespective of groups, is depicted in Table V. Chi-square analysis revealed significant variation between survival and mortality rates at 24 hr within different Apgar grades. Also, significant difference between low, medium and high Apgar grade pups within survival and mortality rates at 24 hr were recorded.The results of present study revealed that the puppies with high Apgar scores at 60 minutes had a survival advantage at 24 hr after parturition over those with lower scores and puppies with low Apgar scores had high probability of death within 24 hr. These findings were in conformity with the results of Casey *et al.* (2001) in human babies, who reported a mortality rate of 24 per cent for babies with low Apgar score (0 to 3) compared to neonatal death rate of 0.02 per cent, when Apgar scores were 7 to 10. They are in concordance with the reports of Palmer (2007) in foalsand Veronesi *et al.* (2009) and Groppetti *et al.* (2010) in dogs that Apgar score is an important tool in differentiating healthy and stressed puppies. It also verifies the effectiveness of resuscitation and also is predictive of short term survival prognosis.

In conclusion, the adoption of Apgar scoring allowed for differentiation of puppies as healthy and those which require concentrated resuscitation. Furthermore, the present study confirmed the trustworthiness of Apgar scoring at birth in identifying the vulnerable puppy that required targeted resuscitation while Apgar scoring at 30 minutes was more prospective of recognizing the improvement to resuscitation so as to adopt further aggressive resuscitation; if needed. The importance of resuscitation procedures in revival of puppies with low Apgar score at birth was signified by a reduced incidence of neonatal mortality. The study determined that puppies with an Apgar score of 8 were at low risk for neonatal mortality. Although a good Apgar score did not guarantee newborn survival per se, pups with high scores had a survival advantage over those with lower scores.

Table I. Assessment of newborn viability using modified Apgar scoring system (Groppetti *et al.*, 2010)

Parameters	Score 0	Score 1	Score 2
Mucus membrane	Cyanotic	Pale	Pink / Reddish
Heart Rate	≤ 120	120- 180	≥ 180
Respiratory rate	≤ 15	15 - 30	≥ 30
Reflex Irritability	None	Feeble	Active
Mobility	None	Hypo mobility	Active mobility
Suckling reflex	None	Weak	Energetic
Vocalization	None	Mild	Vigorous

Table II.Association of type of delivery with mean Apgar score at birth, 30 min and 60 min

Apgar (n = 253)	SW (n=28) (Mean ± SE)	EICSIV(n=42) (Mean ± SE)	EICSG(n=37) (Mean ± SE)	AW(n=23) (Mean ± SE)	CPUI(n=17) (Mean ± SE)	PPUI(n=22) (Mean ± SE)	EmCSIV(n=45) (Mean ± SE)	EmCSG(n=39) (Mean ± SE)
At Birth	8.57 ± 0.58^{ya}	2.92 ± 0.09^{zef}	3.13 ± 0.12^{zef}	6.43 ± 0.65^{yb}	5.41 ± 0.47^{zbc}	3.77 ± 0.47^{zcdf}	2.31 ± 0.14^{zef}	3.79 ± 0.23^{zcde}
30 min.	11.21 ± 0.66^{xa}	5.73 ± 0.31^{yde}	8.70 ± 0.39^{yabc}	9.73 ± 4.49^{xab}	9.23 ± 0.83^{yac}	6.68 ± 0.82^{ybcd}	4.37 ± 0.26^{yd}	7.17 ± 0.44^{ybce}
60 min.	11.21 ± 0.65^{xa}	9.64 ± 0.32^{xab}	11.72 ± 0.43^{xab}	10.86 ± 0.84^{xab}	12.13 ± 0.56^{xab}	9.54 ± 0.88^{xab}	8.60 ± 0.50^{xb}	10.15 ± 0.61^{xab}

*Superscripts in column: xyz *Superscripts in row: abcdef

*Means bearing any one common superscript in column and row did not differ significantly with each other.

Table III. Influence of type of delivery on distribution of puppies in low, medium and high Apgar score

Type of delivery	No. of pups	Number of pups with Apgar Score (%)								
		At birth			30 min.			60 min.		
		0 to 4	5 to 8	> 8	0 to 4	5 to 8	> 8	0 to 4	5 to 8	> 8
Group I (SW)	28	5 (17.86)	4 (14.29)	19 (67.86)	3 (10.71)	2 (7.14)	23 (82.14)	3 (10.71)	1 (3.57)	24 (85.71)
Group II (EICSIV)	42	42 (100)	0	0	11(26.19)	31 (73.81)	0	2 (4.76)	11 (26.19)	29 (69.04)
GroupIII (EICSG)	37	37 (100)	0	0	3 (8.11)	20 (54.05)	14 (37.84)	2 (5.56)*	0	34 (94.44)
Group IV (AW)	23	5 (21.74)	14 (60.87)	4 (17.39)	4 (17.39)	3 (13.04)	16 (69.57)	3 (13.64)*	2 (9.09)	17 (77.27)
Group V (CPUI)	17	4 (23.53)	13 (76.47)	0	2 (11.76)	6 (35.29)	9 (52.94)	1 (6.25)*	0	15 (93.75)
Group VI (PPUI)	22	15 (68.18)	7 (31.82)	0	5(22.73)	12 (54.55)	5 (22.73)	4 (18.18)	2 (9.09)	16 (72.73)
Group VII (EmCSIV)	45	45 (100)	0	0	19 (42.22)	26 (57.78)	0	7(15.56)	9 (20)	29 (64.44)
Group VIII (EmCSG)	39	19 (48.72)	20 (51.28)	0	7 (17.95)	29 (74.36)	3 (7.69)	6 (15.38)	3 (7.69)	30 (76.92)
Total	**253**	**172 (67.98)**	**58 (22.92)**	**23 (9.10)**	**54 (21.34)**	**129 (50.99)**	**70 (27.67)**	**28 (11.20)**	**28 (11.20)**	**194 (77.60)**

* One pup each from AW, CPUI and EICSG died between 30 and 60 minutes

Table IV. Efficiency of neonatal resuscitation in improvement of low and medium Apgar pups

Type of delivery	No. of pups with low and medium Apgar score at birth	Number of pups (%)			
		Improved to higher scores at 30 min.	Improved to higher scores at 60 min.	Not improved to higher scores at 60 min.	Died within 60 min.
Group I (SW)	9	6 (66.66)	6 (66.66)	3 (33.34)	0
Group II (EICSIV)	42	31 (73.81)	40 (95.24)	2 (4.76)	0 (0)
GroupIII (EICSG)	37	34 (91.89)	34 (91.89)	2 (5.41)	1 (2.70)
Group IV (AW)	19	15 (78.95)	15 (78.95)	3 (15.79)	1 (5.26)
Group V(CPUI)	17	15 (88.24)	15 (88.24)	1 (5.88)	1 (5.88)
Group VI (PPUI)	22	17(77.27)	18 (81.82)	4 (18.18)	0 (0)
Group VII (EmCSIV)	45	26 (57.78)	38 (84.44)	7 (15.56)	0 (0)
Group VIII (EmCSG)	39	32 (82.05)	33 (84.62)	6 (15.38)	0 (0)
Total	230	176 (76.52)	199 (86.52)	28 (12.18)	3 (1.30)
$X^2_{14\ df}$		58.52*			

*Significant at 0.05 level

Table V. Influence of low, medium and high Apgar score at 60 min on survival and mortality of pups at 24 hr

Score	Total number of pups	Viability at 24 hours n (%)		X^2_{2df}
		Survival	Mortality	
0 to 4	28	3 (10.71)	25 (89.29)	
5 to 8	28	25 (89.29)	3 (10.71)	
> 8	194	193 (99.48)	1 (0.52)	
Total	250	221 (88.40)	29 (11.60)	211.83*
X^2_{2df}		70.97*	181.21*	

*Significant at 0.05 level

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