Full Length Research Article

MODIFIED APGAR SCORING SYSTEM FOR PREDICTION OF NEONATAL SURVIVAL IN PUPPIES DELIVERED THROUGH CESAREAN SECTION

*Bharathidasan, M., Ravi Sundar George, Mohamed Shafiuzama, Kannan, T.A. and Ramesh, S.

Tamil Nadu Veterinary and Animal Sciences University, Chennai – 51, Tamil Nadu, India

ABSTRACT

The study was designed access the neonatal survival rate in puppies delivered through Cesarean Section (CS) under diazepam- propofol-isoflurane anesthesia. A total of 15 newborn puppies delivered through 8 CS were grouped into two groups. Puppies delivered through CS within four-and-half hour after the onset of second stage of labour (7 puppies) and puppies delivered through CS after four-and-half hour after the onset of second stage of labour (8 puppies) were grouped as Group I and II respectively. New-born puppy survivability was predicted by modified Apgar Scoring system. The results revealed that the puppies which got an Apgar score of 6 and above at the time of delivery survived better when compared to puppies with a score of < 6. However, time lapse and number of inductions had direct effect on the Apgar Score and survivability indicating that CS should be performed within four-and-half hour after the onset of second stage of labour and the number of inductions should be limited to one.

INTRODUCTION

In 1952, Virginia Apgar, developed the Apgar scoring system which provides a method to document the newborn's condition at specific intervals after birth in human. This is an useful objective indicator to determine effectiveness of resuscitative efforts in newborns. The criteria for evaluation in newborns were skin colour and appearance, pulse rate, reflex irritability (Grimace), muscle tone and respiration (Drage *et al.*, 1966). Each of these is evaluated on a scale from 0 to 2, with the sum of the five values resulting in an Apgar score that ranges from 0 to 10. In humans, the survival rate of newborn with an Apgar score < 3 is usually considered as critical, from 4 to 6 is graded as less critical and over 7 is regarded as normal (Apgar and James, 1962). Though, Apgar scoring system was introduced in Veterinary medicine to assess the clinical status of newborns such as foals, calves and piglets (Veronesi *et al.,* 2009) with modifications to address the newborn viability and effective perinatal asphyxia detection (Vaala, 1999). The bitches are polytocus in nature and puppy mortality may occur either *in-utero*, during expulsion, after birth, in the first two hours of parturition, in the first week of life or even after weaning.

*Corresponding author: Bharathidasan, M.,
Tamil Nadu Veterinary and Animal Sciences University, Chennai – 51, Tamil Nadu, India.

Predisposing factors for puppy death could be due to malnutrition, malformation, dystocia, type and time of interventions during birth, genetic defects, environmental conditions and infectious origin (Mü̈nnich, 2008). Apgar scoring system has not been used widely used to evaluate newborn puppies, mainly due to the polytocous condition of the dog. However, the economic value of pure-breed puppies, as well as the increasing emotional involvement of owners in their pets' birthing process, has increased interest in improving puppy survival. The aim of the current study was to evaluate the reliability of a modified Apgar score system for evaluation of viability and survival prognosis of newborn puppy delivered through CS within four-and-a-half hours and after four-and-a-half hours under diazepam-propofol-isoflurane anesthesia. The objective of the study was to access the reliability of Apgar score on puppy survival rate delivered through CS.

However, the Apgar score as such cannot be used in Veterinary practice as the incidence of perinatal asphyxia was less, but could be considered as an easy method for assessing the overall condition and to some degree, the viability of the infant immediately after delivery and the effectiveness of resuscitation (Finster and Wood, 2005). The modified Apgar score for puppies was evolved based the reference range of heart rate, respiration, irritability reflex, motility and membrane mucus color according to the physiology of the canine neonate (Veronesi *et al.,* 2009).

MATERIALS AND METHODS

The present study was conducted on 15 puppies delivered through 6 bitches of different breeds that were referred to the Small Animal Operation theatre, Department of Veterinary Surgery and Radiology, Madras Veterinary College Teaching Hospital for CS. All the bitches were anaesthetized with diazepam- propofol-isoflurane anesthetic regimen during surgery (Casey et al., 2001). The viable puppies were subjected to Apgar score assessment. The puppies delivered through CS were grouped into Group I and II based on the time between the onset of second stage of labour and delivery of puppy through CS. The critical time fixed for survivability was four-and-half hour as indicated by Darvelid and Linde-Forsberg (1994). Group I consisted of puppies delivered through CS before four-and-half hour after the onset of second stage of lab our and Group II included puppies delivered after four-and-a-half hour after the onset of second stage of labour. The puppies were kept under observation for 2 hours after CS under observation in the present study.

Modified Apgar score parameters

The viable puppies were subjected to Modified Apgar Scoring System as proposed by Veronesi*et al.* (2009) as per Table 1.
Heart rate above 220 beats per minute (bpm) was rated as 2, between 180 and 220 bpm was rated as 1 and less than 180bpm was rated as 0. In the evaluation of the respiratory effort, the most important factor considered was the presence and clearness of puppy vocalization at birth, a neat index of vitality in puppies.

However, for better evaluation of respiration, the respiratory frequency was also calculated in association with vocalization. Clear crying associated with more than 15 respiratory rates per minute was rated as 2, mild crying with 6 to 15 respiratory rates per minute was rated as 1, and no crying with less than 6 respiratory rates per minute was rated as 0. The reflex irritability was evaluated by the gentle compression of the tip of a paw, evaluating the degree of new-born reaction: crying and quick leg retraction was rated as 2, weak leg retraction and no or just weak vocalization was rated as1, and no leg retraction and no vocalization was rated as 0. Motility was evaluated by observing the strength of spontaneous movement of the new-born.

The rating was 2 for strong movements, 1 for mild movement, and 0 for very weak or no attempt of newborn movement. The mucous membrane colour was evaluated that pink mucous membranes were considered as normal in newborn puppies and rated as 2, pale mucous membranes could have been related to several cardiovascular troubles and thus rated as 1, whereas cyanosis should be considered as the severest expression of respiratory failure and rated as 0. Assigning a rate from 0 to 2 to each parameter, the total sum provided a final Apgar score. The scores were used to identify three levels of newborn distress: 7 to 10 - no distress; 4 to 6 - moderate distress; and 0 to 3 - severe distress. The puppies were evaluated for Apgar score within 5 minutes after delivery through CS. The other parameters included in the study were number of induction before CS, number of puppies in each CS, age of the bitch and survival rate of the puppies (percentage of survival after two hours of recording Apgar Score against the number of puppies viable at the time of CS).

Table 1. Modified Apgar scoring system used in this study

Parameters	Score		
	0	1	2
Heart rate bpm	<180 bpm	180 to 220	>220 bpm
Respiratory effort	No crying / <6 / minute	Mild crying /6 to 15 / minute	Crying/ > 15 / minute
Reflex irritability	Absent	Grimace	Vigorous
Motility	Flaccid	Some flexions	Active motion
Colour of Mucous membrane	Cyanotic	Pale	Pink

Table 2. Modified Apgar score of newborn puppies in group I and II

Group	Puppy No[#]./ CS[*]	No. of Inductions	Parameters					
			Heart rate (bpm)	Respiratory effort	Reflex irritability	Motility	Mucous membrane colour	Total
I	1/1	1	2	2	2	1	2	9
	2/2	2	2	1	1	1	2	7
	3/2	2	2	1	1	1	2	7
	4/3	1	2	2	1	1	2	8
	5/3	1	1	2	2	2	2	9
	6/3	1	2	1	1	2	2	8
	7/4	2	1	2	1	1	0	5[a]
Mean ± SE		1.43	1.71	1.57	1.29	1.29	1.71	7.57± 0.53
II	8/5	2	1	1	1	1	1	5
	9/5	2	1	1	0	0	1	3[a]
	10/5	2	2	1	1	1	2	7
	11/6	2	2	1	1	1	1	6
	12/7	1	1	1	1	0	1	4[a]
	13/7	1	1	1	1	1	1	5[a]
	14/8	2	2	2	1	1	1	7
	15/8	2	2	1	1	1	1	6
Mean ± SE		1.75	1.50	1.13	0.88	0.75	1.13	5.38± 0.50

[#] Number of puppies - 15; [*] Number of CS – 8; [a] died within 2 hours

Table 3. Mean±SE age of the bitches, Apgar Score and Percentage of Survivability in Group I and II

Group	Age of bitches (Mean) years	Apgar Score (Mean)	Percentage of survivability
I	1.75	7.57±0.53	85.71
II	2.00	5.38±0.50	62.50

Table 4. Statistical Analysis of Apgar Score between groups and number of inductions

Variables	GROUP - X			GROUP - Y			t - Test	P - Value	Result
	N	MEAN	±SE	N	MEAN	±SE			
Group	7	7.57	0.5281	8	5.38	0.4978	3.02	0.0098	**
Induction	6	7.17	0.8724	9	5.89	0.4547	1.42	0.1782	NS

RESULTS AND DISCUSSION

In the present study, puppies that were delivered by CS within four-and-a-half hour after the onset of second stage of labour had significantly higher from 5 to 9. The puppy which had an Apgar score of 5 died within 2 hours after delivery by CS in Group I (Table 2 and 4). The survival percentage after 2 hours was 85.71 in Group I (Table 3 and 4). Similar findings were made by Darvelid and Linde-Forsberg (1994) reported that the crucial time for performing Cesarean Section (CS) was before four-and-a-half hour after the onset of second stage labour, where in the mortality of puppies was only 5.8 per cent. In Group II, the mean Apgar score of puppies delivered after four-and-half hour (7.57±0.53), after the onset of second stage of labour was 5.38±0.50. Puppies had the Apgar score of 3, 4 and 5 died in this study (Table 2). The survival percentage after 2 hours was 62.50 Group II (Table 3 and 4). Similar observations made with Groppetti *et al.* (2010) and Jayakumar et al., (2015) who stated that reduced Apgar score with prolonged parturition. 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.

The number of induction before CS was one in 6 cases and two in 9 cases (Table 4). The Apgar score in relation to the number of induction was 7.17±0.87 in one induction and 5.89±0.45 in two inductions without statistical significance (Table 4). In the present study, still birth in both the groups was nil during CS which is contradict to the findings of Moon-Massat and Erb (2002) and Veronesi *et al.,* (2009). In the present study, new-born puppies which had an Apgar score of 6 and above, irrespective of inductions and time after the onset of second stage of labour survived and those puppies with Apgar score < 6 died within two hours after CS. But the number of inductions and time lapse between second stage of labour and surgical intervention had significant influence on the Apgar score of puppies. The mean Apgar score in puppies delivered by CS within four-and-half hour after start of second stage of labour and with a mean induction of 1.43 got significantly higher Apgar score when compared with puppies delivered after four-and-half hour of onset of second stage labour with a mean induction of 1.73. The finding of the present study revealed that when dystocia is suspected the number of inductions may be limited to one and the surgical intervention should be made at the earliest preferably within four-and-half hour after the start of second stage of labour to get more number of viable puppies with Apgar score above 6.

Though the present study was conducted in relatively small number of puppies, the data concerning the high probability of death of puppies with low Apgar scores which is in agreement with the findings of Casey *et al.,* (2001) in human babies. The study also revealed that the modified Apgar score is an ideal indicator to predict the survivability of the new-born puppies.

Conclusion

The study revealed that the puppies which had an Apgar score of 6 and above at the time of delivery through CS survived, irrespective of time lapse and number of inductions; however, time lapse and number of inductions had direct effect on the Apgar Score and survivability indicating that CS should be performed within four-and-half hour after the onset of second stage of labour and the number of inductions should be limited to one.

Acknowledgement

REFERENCES

Apgar, V. and James, L.S. 1962. Further observations of the newborn scoring system. *Am. J. Dis. Child.*104:419–28.

Casey, B.M., McIntire, D.D. and Leveno, K.J. 2001.The continuing value of the Apgar score for the assessment of newborn infants. *N. Engl. J. Med.,* 344(7):467–71.

Darvelid, W.A. and Linde-Forsberg, C. 1994. Dystocia in the bitch: A retrospective study of 182 cases. *JSAP.,* 35(8): 402-407.

Davidson, A.P. 2001. Uterine and fetal monitoring in the bitch. *Vet. Clin. North Am. Small Anim. Pract.,* 31: 305–314.

Drage, J.S., Kennedy, C. Berendes, H. Schwarz, B.K. and Weiss, W. 1966. The Apgar Score as an Index of Infant Morbidity, *Developmental Medicine & Child Neurol.,* 8(2):141-148.

Fayyaz, S., Kerr, C.L. Dyson, D.H. and Mirakhur, K.K. 2009. The cardiopulmonary effects of anesthetic induction with isoflurane, ketamine-diazepam or propofol-diazepam in the hypovolemic dog. *Vet. Anaesth. Analg.,* 36(2):110-23.

Finster, M. and Wood, M. 2005. The Apgar score has survived the test of time. *Anesthesiol.,* 102:855–857.

Groppetti, D., Pecile, A., Del, A. P., Copley, K., Minero, M. and Cremonesi, F. 2010. Evaluation of newborn canine viability by means of umbilical vein lactate measurement, apgar score and uterine Tocodynamometry. *Theriogenol.,* 74:1187-1196.

Gunn-Moore, D. 2006. Techniques for neonatal resuscitation and critical care. *WSAVA /FECAVA World Congress,* Praque, Proc, pp. 707–713.

Herpin, P., Le Dividich, J., Hulin, J.C., Fillaut, M., De Marco, F. and Bertin, R. 1996. Effects of the level of asphyxia during delivery on viability at birth and early postnatal vitality of new born pigs. *J. Anim. Sci.*, 74: 2067-2075.

Jayakumar,C, A. Krishnaswamy , G.Sudha and T. G. Honnappa, 2015. Assessment of Canine Neonate by Apgar Scoring System and Its Value As An Index of Short Term Neonatal Survival. *Indian J. Anim.Reprod.* 36 (2): *14-20.*

Moon, P.F., B.J. Massat and Pascoe, P.J. 2001. Neonatal critical care. *Vet. Clin. North Am. Small Anim. Pract.,* 3: 343–368.

Moon-Massat, P.F. and Erb, H.I.N. 2002. Perioperative factors associated with puppy vigor after delivery by CS. *J. Am. Anim. Hosp. Assoc.* 38: 90–96.

Mu¨nnich, A. and U. Ku¨chenmeister, 2009. Dystocia in numbers: evidence-based parameters for intervention in dogs: causes for dystocia and treatment recommendations. *Reprod. Domest. Anim.* 44(Suppl 2), 141– 147.

Mu¨nnich, A., 2008. The pathological newborn in small animals: the neonate is not a small adult. *Vet. Res. Commun.,* 32:S81–85.

Nayci, A., S. Atis, G. Ersoz and A. Polat, 2004. Gut decontamination prevents bronchoscopy-induced bacterial translocation. An experimental study in rats. *Respiration, 71:* 66–71.

Raju, T.N., R. Bhat and Vidyasagar, D. 1982. Age-related difference in cerebral perfusion pressure response to acute hypoxia in neonatal puppies. *Biol. Neonate,* 41: 258– 264.

Rohlicek, C.V., Saiki, C., Matsuoka, T. and Mortola, J.P. 1998. Oxygen transport in conscious newborn dogs during hypoxic hypometabolism. *J. Appl. Physiol.,* 84: 763–768.

Vaala, W.E. 1999. Peripartum asphyxia syndrome in foals. In: Proceedings of the Annual Convention of the 45th *AAEP;* p. 247– 253.

Van Der Weyden, G.C., M.A. Taverne, S.J. Dieleman, Y. Wurth, M.M. Beavers and H.A. van Oord, 1989. Physiological aspects of pregnancy and parturition in dogs. *J. Reprod. Fertil. Suppl.* 39: 211–224.

Veronesi, M.C., S. Panzani , M. Faustini and A. Rota, 2009. An Apgar scoring system for routine assessment of newborn puppy viability and short-term survival prognosis. *Theriogenol.,*72: 401–407.

Zone, M.A. and M.M. Wanke, 2001. Diagnosis of canine fetal health by ultrasonography. *J. Reprod. Fertil. Suppl.* 57: 215–219.

****