Apgar scoring of puppies delivered by different delivery management systems for the assessment of neonatal outcome[#]

K. Lavanya[1], K. Promod[2]*, C.P. Abdul Azeez[3], Leeba Chacko[4] and K. Jinesh[5]
Department of Animal Reproduction, Gynaecology and Obstetrics
College of Veterinary and Animal Sciences, Pookode, Wayanad-673576
Kerala Veterinary and Animal Sciences University
Kerala, India

Abstract

Apgar scoring of 97 puppies from 18 litters delivered either by medical induction (Group I, n=9) or emergency caesarean section (Group II, n=9) was carried out. A total of 54 and 43 puppies were delivered in group I and II, respectively and their Apgar scores measured at 5min and one hour after birth. The mean ± SE Apgar scores measured at 5min of birth in group I and group II were 3.96 ± 0.38 and 4.84 ± 0.39, respectively. The mean ± SE Apgar scores of puppies at one hour of birth in group I and group II were 6.09 ± 0.31and 6.93 ± 0.33, respectively. Apgar scores at different time periods did not vary significantly between groups but varied significantly within the group. The association between Apgar score at one hour and survivability of puppies at 24 h of birth was analysed. The puppy mortality rate was significantly (p<0.01) higher (63.64 per cent) among those which scored 0-3 than other Apgar scores in group I. The puppy mortality rate and survival rate did not vary significantly (p>0.05) between different Apgar scores of puppies within group II.

Keywords: *Apgar score, survivability, medical induction, emergency caesarean section, mortality*

Apgar scoring was first introduced by a physician, Virginia Apgar, in the year 1952, for assessment of the viability of human babies immediately after the birth and to provide additional health support based on the clinical status of the neonate. The method has been adopted in veterinary practice as modified Apgar scoring method, based on the heart rate, respiratory rate, irritability reflex, mucous membrane colour and mobility of the new-borns. Each of these indices

J. Vet. Anim. Sci. 2023. 54 (3) : 623-628

Lavanya *et al.*   623

is assigned scores from 0 to 2 and the sum of these five indices give the Apgar score of the neonate, which ranges from 0 to 10 (Veronesi *et al.,* 2009). In another method, Apgar scoring can be measured based on seven parameters which include two more additional parameters, *viz*. suckling ability and vocalisation of puppies (Groppetti *et al.*, 2010). In the present study, Apgar score of new-born pups delivered by medical induction and emergency caesarean section was assessed at 5 min and at one hour after birth, evaluated the prognosis on survivability at 24 h of neonatal life.

Materials and methods

Selection of animals

Female dogs (n=18) presented at Teaching Veterinary Clinical Complex, Pookode with the history of dystocia, which required assisted whelping or emergency caesarean section, were selected for the study. The selected dogs were divided into two groups comprising nine animals each and were subjected to medical management (Group I, n=9) or emergency caesarean section (Group II, n=9) based on the condition of dam, foetal heart rate and number of foetuses *in utero*. The uterus and its contents were imaged by real time B mode ultrasonography using convex trans-abdominal transducer (3.5-5.0 MHz) and the foetal heart rate was evaluated by pulsed wave Doppler facility (CHISON ECO 6®, CHISON Medical Technologies, USA) to determine the viability of foetuses. Heart rates (HR) > 220 beats per min (bpm) were regarded as normal while those between 180 and 220bpm were considered to be moderately distressed; HR below 180 bpm were considered as severely distressed and subjected to emergency caesarean section.

In group I, the dogs were treated for medical induction of whelping using oxytocin (0.1-0.2 units/kg BW) as slow intravenous infusion (IV) after mixing with DNS based on body weight. Oxytocin dose was decided based on the foetal heart rate. If no puppies were delivered within 30 min, calcium gluconate (10 per cent; 0.2 mL/kg BW) was administered as slow IV accompanied by auscultation of heart (Johnston *et al*., 2001). A second dose of 0.1 units/kg of oxytocin was administered after 30 min of calcium administration to facilitate parturition. The total dose of oxytocin and calcium gluconate injections did not exceed 20 units/dog and 20mL/dog, respectively. Oxytocin was given for increasing the frequency of uterine contractions and calcium was given for the strength of contractions. Animals in group II, were subjected to emergency caesarean section based on the health of dam, foetal heart rate (<180 bpm), litter size (>5 no.), chances for obstructive dystocia or foetal malpresentation or positions, foeto-maternal disproportion and uterine inertia (uterine inertia in bitch was confirmed based on the age, obesity, malnutrition and non-responsive to medical induction). Anaesthesia was induced using propofol (3-4 mg/kg BW) and maintained by inhalant anaesthetic, isoflurane (2 per cent).

Apgar scoring

In both the groups, delivered live puppies were subjected to viability scoring at 5min and at one hour of birth using modified Apgar scoring system (Veronesi *et al.*, 2009), as presented in Table 1. The survivability and non-survivability of puppies at 24 h of birth was correlated with the different Apgar scores and was used for assessing survival prognosis.

Table 1. Apgar score card used in the study for evaluating neonates

Parameters	Score 0	Score 1	Score 2
Mucous membrane colour	Cyanotic	Pale	Pink
Heart rate (bpm)	<180	180-220	>220
Respiratory rate (BPM)	<6	6-15	>15
Reflex irritability	No leg retraction and vocalisation	Weak leg retraction and weak vocalisation	Quick leg retraction and crying
Mobility	None	Weak hypo-mobility	Strong active mobility

bpm bpm- bebpm- beats per minute, BPM- breaths per minute

Results and discussion

During the study, a total of 114 puppies were delivered by 18 female dogs belonging to eight different breeds, out of which 66 and 48 puppies were of group I and II, respectively. The number and proportion of live puppies in group I and II were 54 (81.82 %) and 43 (89.58 %), respectively.

Number and percent of puppies with different Apgar scores at 5 min and one hour of birth in group I and II

The number and proportion of puppies in group I and II with Apgar scores evaluated at 5 min and one hour of birth is presented in Table 2. Apgar scores of puppies recorded at 5 min and one hour of birth did not vary significantly (p>0.05) between groups. Low Apgar scores of pups born by caesarean section might be due to anaesthetic agent propofol as it caused cardiac and respiratory depression which increased pCO_2 levels. Subramani *et al.* (2020) recorded a greater number of puppies with low and medium Apgar scores delivered by caesarean section and, medium and high scores in puppies born by assisted whelping. Groppetti *et al.* (2010) observed that all the pups (100%) born by emergency caesarean section had low Apgar scores and low vitality at birth whereas, 30.30 per cent of the puppies born by vaginal delivery were recorded with low Apgar scores. In the present study, number and proportion of puppies with different Apgar scores at 5min and one hour in both the groups did not vary significantly. However, the recovery rate was found to be better in group II than group I, as indicated by lesser proportion of puppies with low Apgar scores (0-3) at 1 h in the former group (9.30%) than the latter (20.37%). Although such reduction was noticed in group I, it was lesser (reduced from 22 to 11). High recovery rates in emergency caesarean section (group II) might be due to immediate resuscitation procedures and neonatal procedures followed after removal of the puppies from uterus. In medical management (group I), the delayed delivery time, premature placental separation and constriction of umbilical vessels due to the use of uterotonic drugs like oxytocin might have caused foetal hypoxia and reduced recovery rate in puppies with poor Apgar scores, as described by Smith (2012).

Apgar scores (Mean ± SE) at 5min and one hour of birth in group I and group II

The mean ± SE of Apgar scores of puppies at 5min and one hour of birth in group I were 3.96 ± 0.38 and 6.09 ± 0.31, respectively and the respective values in group II were 4.84 ± 0.39 and 6.93 ± 0.33. There existed no significant difference (p>0.05) in mean Apgar scores between the groups in either of the time interval from birth. In both the groups, there existed a significant difference (p<0.01) in the mean Apgar scores between the two-time intervals (Table 3).

Antonczyk *et al.* (2021) reported that majority of puppies had low Apgar scores at birth (4-6 in 38.10% and ≤ 3 in 57.10% of the

Table 2. Number and proportion of puppies with different Apgar scores at 5 min and one hour of birth in female dogs underwent medically assisted whelping (GI) vs emergency caesarean section (GII)

APGAR score	At 5 min of birth		At 1 h of birth	
	*Group I	**Group II	Group I	Group II
	No. and % of puppies	No. and % puppies	No. and % puppies	No. and % puppies
0-3	22 (40.74)	18 (41.86)	11 (20.37)	4 (9.30)
4-6	19 (35.19)	15 (34.88)	18 (33.33)	13 (30.23)
7-10	13 (24.07)	10 (23.26)	25 (46.30)	26 (60.47)
Total	54 (100)	43 (100)	54 (100)	43 (100)
χ^2 Value = 4.589[ns]; p-value = 0.1008			χ^2 Value = 2.882[ns]; p-value = 0.236	

ns: non-significant (p>0.05); *Puppies from female dogs underwent medically assisted whelping; ** Puppies from female dogs underwent emergency caesarean section

Table 3. Comparison of mean Apgar score of puppies in medically assisted whelping and emergency caesarean section

Group	Mean ± Apgar score		Z-value (p-value)
	5 min	1 h	
Group I	3.96 ± 0.38	6.09 ± 0.31	3.96[**](0.0001)
Group II	4.84 ± 0.39	6.93 ± 0.33	4.15[**](0.0001)
Z-value (p-value)	1.468[ns](0.142)	1.815[ns](0.070)	

Significant[**] (p<0.01), ns-non-significant (p>0.05)

neonates) after elective caesarean section, but most of them (85.70%) improved by 20 min time and reached Apgar scores of 7. Moreover, puppies with lower Apgar scores (≤ 3) were at higher risk of death within first 24h (20.8% did not survive). Vassalo *et al.* (2015) evaluated mean Apgar scores of puppies delivered by elective caesarean section at birth and at 1h, which were 4.30 ± 0.30 and 8.80 ± 0.30, respectively and that of vaginal delivery were 7.60 ± 0.30 and 8.60 ± 0.30, respectively. They found a significant improvement in Apgar scores of puppies at different time period after birth within the groups. Oliva *et al.* (2018) reported that the sum of the Apgar scores differed between two time points. The means of Apgar score at different time points were, 2.30 ± 1.27 at one minute and 9.00 ± 2.40 at 10 min after birth and the results were significantly different (p<0.05). They demonstrated that pups born with notable depression recovered to a better status within the first 10 min of life after receiving routine neonatal care.

Association of the Apgar scoring at one hour and survivability and non-survivability at 24h after birth

Apgar scores of puppies were recorded at one hour of birth and the proportion of puppy survivability and mortality at 24 h were recorded in both the groups (Table 4). Mortality rate of puppies in group I was significantly (p<0.01) higher in new-born which had Apgar scores between 0-3 (63.64%) than other Apgar score groups. Survival rate of the puppies was significantly (p<0.01) higher when the range of Apgar scores were between 4-6 (77.78%) and 7-10 (88.00%) in group I dogs.

In group II, the puppy mortality rate and survival rate at 24 h of birth did not vary significantly (p>0.05) between different Apgar

scores of puppies at one hour. Since propofol and isoflurane were used for the maintenance of anaesthesia and puppies were provided with oxygen and adequate neonatal care, the survival of puppies was good in group II. Moon *et al.* (2000) also reported that propofol with isoflurane anaesthesia had puppy survival rates equivalent to epidural anaesthesia and was associated with a positive effect on neonatal survival at 7 days after birth.

While comparing overall puppy survival rate at 24 h with an Apgar score of 0-3, 4-6 and 7-10, significantly (p<0.01) high puppy survival rate observed in those scored between 7-10 (88.24%) as compared to that of puppies with Apgar scores ranged between 0-3 (46.67%), while in 4-6 scores survival rate were 74.20 per cent. Comparing overall mortality rate at 24 h with Apgar scores of 0-3, 4-6 and 7-10 were 53.33 per cent, 25.80 per cent and 11.76 per cent, respectively. A high mortality rate was observed in Apgar score 0-3. The observations were in agreement with Veronesi *et al.* (2009) who found significantly (p<0.05) higher neonatal mortality (50 per cent) in puppies with Apgar scores of 0-3 and 4-6 (50 per cent) and no puppy mortality was observed when the scores were 7-10). Puppies with high Apgar scores had a survival advantage over those with low scores. Similarly, Casey *et al.* (2001) also reported high probability for death in those puppies with low Apgar scores. They observed 24 per cent mortality rates in puppies with Apgar scores of 0-3 when compared to 0.02 per cent mortality in 7-10 scores. Fusi *et al.* (2020) reported that the Apgar score of new-born puppies is recognised as a prognostic indicator for its survival in the first 24-48 h of life. The authors also observed that survival rate reported ranged between 43 and 91 per cent in puppies which scored 0-3 and between 88 and 100 per cent, for those scored above four.

J. Vet. Anim. Sci. 2023. 54 (3) : 623-628

626 Apgar scoring of puppies for assessment of neonatal outcome

Table 4. Association of Apgar scores at one hour of birth on puppy survivability at 24 hours

Group	Survival at 24 h of birth	No. and per cent of puppies with different Apgar scores at 1 h after birth						Total		p-value
		0-3		4-6		7-10				
		No.	%	No.	%	No.	%	No.	%	
[1]**Group I**	Not survived	7	63.64	4	22.22	3	12.00	14	25.93	0.0045**
	Survived	4	36.36	14	77.78	22	88.00	40	74.07	
	Total	11	100	18	100	25	100	54	100	
[2]**Group II**	Not survived	1	25.0	4	30.77	3	11.54	8	18.60	0.327ns
	Survived	3	75.0	9	69.23	23	88.46	35	81.40	
	Total	4	100	13	100	26	100	43	100	
Overall	Not survived	8	53.33	8	25.80	6	11.76	22	22.68	0.0029**
	Survived	7	46.67	23	74.20	45	88.24	75	77.32	
	Total	15	100	31	100	51	100	97	100	

** Significant ($p<0.01$); ns- non-significant

In the present study, highest overall mortality was observed in puppies with low Apgar score range of 0-3 (53.33%), followed by 4-6 (25.80%) and 7-10 range (11.76%).

Conclusion

In conclusion, Apgar scoring at one hour of birth was found useful for the prognostic evaluation of the survivability of puppies at 24 h of birth. Apgar scoring could be used to identify weak puppies so that adequate health support and special neonatal care could be provided to improve its survival rates. After assisted whelping, weaker pups can be subjected to resuscitation procedures to improve Apgar scores which could help to reduce the puppy mortality.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Apgar, V. and James, L.S. 1952. Further observations of the new-born scoring system. *Am. J. Dis. Child.* **104**: 419-428.

Antonczyk, A., Ochota, M., and Nizanski, W. 2021. Umbilical cord blood gas parameters and Apgar scoring in assessment of newborn dogs delivered by caesarean section. *Animals* **11**:685.

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**: 467-471.

Fusi, J., Faustini, M., Bolis, B. and Veronesi, M.C. 2020. Apgar score or birthweight in Chihuahua dogs born by elective Caesarean section: which is the best predictor of the survival at 24 h after birth? *Acta. Vet. Scand.* **62**, 39: 1-8.

Groppetti, D., Pecile, A., de Carro, 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. *Theriogenology*. **70**: 1187-1196.

Johnston, S.D., Root-Kustritz, M.V. and Olson, P.N.S. 2001. *Canine and Feline Theriogenology.* (1st Ed.). Saunders, Philadelphia, pp. 120-121.

Moon, P.F., Erb, H.N., Ludders, J.W., Gleed, R.D. and Pascoe, P.J. 2000. Peri-operative risk factors for puppies delivered by cesarean section in the United States and Canada. *J. Am. Anim. Hosp. Assoc.* **36**: 359-368.

Oliva, V.N.L.S., Carolina, M., Queiroz, U.G. and Veronica, B. 2018. Vitality evaluation

methods for new-born puppies after caesarean section performed after general inhalation anaesthesia. *Pesq. Vet. Bras.* **38**(6): 1172-1177.

Smith, F.O. 2012. Guide to emergency interception during parturition in the dog and cat. *Vet. Clin. North Am. Small Anim. Pract.* **42**(3):489-499.

Subramani, A., Arunmozhi, N., Sridevi, P., Shafiuzama, M., Joseph, C. and Krishnakumar. K. 2020. Type of whelping and its influence on Apgar score. *Indian. J. Vet. Anim. Sci. Res.* **49**: 1-6.

Vassalo, F.G., Simoes, C.R.B., Sudano, M.J., Prestes, N.C., Lopes, M.D., Chiacchio, S.B. and Lourenco, M.L.G. 2015. Topics on routine assessment of newborn puppy viability. *Top. Companion Anim. Med.* **30***:* 16-21.

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

■

J. Vet. Anim. Sci. 2023. 54 (3) : 623-628

628 Apgar scoring of puppies for assessment of neonatal outcome