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Effectiveness of obstetrical interventions and quality of labor on neonatal viability in dogs

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ABSTRACT

Pup mortality is considered a significant problem in the dog. The present study aimed to evaluate the incidence of neonatal loss in eutocic and dystocic canine deliveries and also the influence of various obstetrical interventions and course of labor on the neonatal viability in dystocic dogs and in animals subjected to elective cesarean. Also, the study aimed to determine the random blood glucose, serum total calcium and progesterone in dogs experiencing dystocia. The present study established that hypoglycemia and hypocalcemia is an infrequent cause of maternal dystocia and that the neonatal viability is maximum when an elective cesarean section is carried out when the serum progesterone concentrations are very close to basal levels. The incidence of stillbirths and neonatal mortality in canines was found to be fairly high and even higher following difficult births. The present investigation confirmed that pup mortality cannot be divorced from the assessment of the influence of whelping process and that the first 24 hours after birth was found to be the most critical period for the neonatal mortality and was closely related to the duration of labor and the type of obstetrical intervention employed to relieve dystocia. The importance of resuscitation in improving the vitality of pups born of dystocic deliveries was established and also suggested that elective cesarean in dogs is a safe technique for obtaining maximum neonatal survival.

Keywords: Neonate, Survival, Dystocia, Obstetrical interventions, Dog

I. INTRODUCTION

Canine parturition is considered normal when the dams deliver full term, healthy puppies without assistance. Dystocia is defined as difficult birth or inability to expel the fetus without assistance and the incidence of dystocia described for the female dog is around 5% (4). Dystocia is a frequent problem in canine reproduction with regard to various causes of maternal, fetal or combined origin (6). The canine neonatal period, defined as first two weeks after whelping (4), is accompanied by a high mortality rate among puppies which accounts to substantial economic loss to the dog breeders. While pup mortality is considered to be a significant clinical problem, the investigation of causes of losses has been poorly documented in the veterinary literature. Pup mortality has been attributed to a wide variety of causes including dystocia, stillbirths, congenital defects, low birth weight or runting, trauma and fading puppy syndrome. For the neonate, labor represents the most critical phase contributing to the first minutes after birth (10). Bibliography (13) specified dystocia and prolonged labor and associated hypoxia or anoxia as significant causes of early death, while infectious diseases accounted for only a small percentage of deaths. The nature of parturition has a significant effect on the incidence of neonatal mortality in dogs and several studies have documented increased neonatal mortality following complicated deliveries (4 and 6). The present study aimed to evaluate the impact of quality of labor like length, ease of the birth

process and type of obstetric manipulation on neonatal survival in dogs. Also the results of normal whelping were compared to conservative methods and surgical methods of obstetrical interventions.

II. MATERIALS AND METHODS

The present investigation was conducted in two phases on female dogs presented to the obstetrical unit of the Department of Veterinary Gynecology and Obstetrics, Veterinary College, Bangalore.

The first phase of the study was carried out in seven animals undergoing Spontaneous Whelping (Group I: SW). The second phase of the study was conducted in 18 female dogs subjected to elective cesarean section (Group II and III) as well as 44 dystocic dogs presented by the owners for relief of dystocia (Group IV to VIII). The causes for subjecting the animals for elective cesarean section included previous cesarean section (n = 5); previous dystocia (n = 4); gestation in excess of 64 ± 1 day based on ultrasound (n = 3); single pup syndrome (n = 4) and excessive litter size (n = 3). The eighteen animals selected were randomly allotted to two groups, wherein elective cesarean section was carried out either under total intravenous anesthesia (Groups II: ElCSIV) or under gaseous anesthesia (Group III: ElCSG). For elective cesarean under intravenous anesthesia (ElCSIV), 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 the animals were prepared for aseptic surgery. 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. Immediately after induction, the animals were intubated and 100% oxygen was delivered for 5 minutes. Cesarean section was carried out using a ventral midline approach and the puppies were delivered as rapidly as possible. Following delivery of all the puppies, the anesthesia was subsequently maintained using a combination of propofol and ketamine in the ratio 1:1 (v/v). For elective cesarean under gaseous anesthesia (ElCSG); premedication, surgical preparation and induction of anesthesia was similar to those followed for the animals assigned to the previous group (ElCSIV). 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.

Each case with complaint of dystocia presented during the course of the investigation was subjected to clinico-obstetrical evaluation to identify the cause of dystocia and was categorized as maternal or fetal. A detailed clinical history regarding the gestational age, age and parity of the animal, previous parturition abnormalities, clinical symptoms of parturition observed by the owner, the nature of vaginal discharges, the approximate time of onset of parturition process, the number of puppies delivered on presentation as well as was the time of delivery of last puppy was obtained at the time of presentation.

Animals diagnosed with dystocia, fetal or maternal in origin, were further subjected to the diagnostic procedures like a) Abdominal ultrasonography to identify fetal viability an fetal distress b) Vaginal Endoscopy using a rigid fibro-optic vaginal endoscope (STORZ, KARL STORZ-ENDOSCOPY) to confirm presence or absence of Chorio-allantoic sac, fetal appendages, patency of the cervix and also the nature of discharge and c) Gloved finger examination of the vagina to identify abnormalities of the vagina, pelvis or and presentation, position or posture of the fetus.

Among the animals diagnosed as a case of dystocia, 14 animals as dystocia due to malpresentation, position or posture of the fetus; 16 animals diagnosed as cases of complete primary uterine inertia and another 14 as cases of partial primary uterine inertia were randomly selected and subsequently, they were allotted to the following obstetrical intervention procedures and the stillbirth rate and neonatal viability status of the puppies delivered successfully and completely was correlated

with the obstetrical intervention employed. Attempts were made to correct the malposture of the fetus using gloved finger or sponge forceps following copious lubrication with a sterile water soluble lubricating jelly. Vaginal manipulative procedures were successful in relief of dystocia with subsequent spontaneous expulsion of the remaining fetuses in only seven animals and hence the maternal and neonatal evaluation of puppies born after Assisted Whelping (AW) was restricted to these seven animals only. The medical treatment employed for complete and partial primary uterine inertia (CPUI and PPUI) consisted of intravenous infusion of Dextrose 10 % (1gm/kg b.wt), followed by 10% calcium gluconate (Calcium-Sandoz®, Novartis India Limited containing 50 mg/ml of calcium gluconate and 87.5mg/ml of calcium lactobionate equivalent to 9 mg of elemental calcium) @ 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. A total of 21 such animals were randomly allotted to two different groups in which emergency cesarean section was carried out using two anesthetic protocols, namely intravenous anesthesia (12 animals in EmCSIV) and gaseous anesthesia (9 animals in EmCSG) as detailed for elective cesarean section.

In both the phases, prior to initiation of any treatment, the concentration of blood glucose was estimated (ONE TOUCH GLUCOMETER, Johnson & Johnson Ltd.), serum total calcium determined spectrophotometrically (TRIVITRON LABMATE 10 plus) using standard diagnostic kit (Accucare-Calcium reagent, Lab- Care Diagnostic (India) Pvt. Ltd.) and serum progesterone determined by ePro Check 2.0® (Minitube, Germany) instrument using progesterone test kit for canine serum based on Enzyme Linked Immunosorbent Assay (ELISA). The influence of type of whelping and duration of labor on the incidence of stillborn births and incidence of mortality at different stages of the neonatal period following delivery in animals with dystocia, during the first 24 hours and subsequently by 48 hours, 7 days and 14 days of the neonatal period were recorded.

To determine the influence of duration of labor on the puppy survivability rate, the duration of dystocia was categorized as less than 6 hours, 6 to 8 hours, 8 to 12 hours and more than 12 hours and the incidence of stillbirth rate of puppies delivered from dystocic dams was related to duration of dystocia. Neonates identified to be in distress were immediately subjected to the following resuscitation procedures in order to improve their vitality and to reduce the chances of neonatal mortality. a) An attempt was made to clear the airways using a bulb syringe. b) To encourage the onset of spontaneous breathing, the newborn puppy with low and medium Apgar score was vigorously massaged using dry towels. c) Stimulation of Ren Zhong acupoint (GV 26) was attempted using a 25-gauge needle inserted into the nasal philtrum at the base of the nostrils and rotated when bone is contacted. d) Neonates which did not respond satisfactorily to the above resuscitation procedures received one to two drops of Doxapram sub-lingually. e) Oxygen administered through facial mask was attempted if the neonate failed to respond to any of the resuscitation procedures stated above. f) All the newborn puppies delivered spontaneously, irrespective of whether they required resuscitation procedure or not, were kept in a human 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. The influence of resuscitation procedures in improving the vitality of puppies was also investigated. The data generated from the present investigation were tabulated and mean and standard error was computed. The association between type of delivery on puppy survival at birth, at 24h, 48h, 7d and 14d, duration of labor on still birth rate, influence of neonatal resuscitation procedures in improving the vitality of newborn puppies were statistically analyzed by Pearson Chi-square (26) and a 'P' value of 0.05 was considered as significant.

III. RESULTS

The maternal blood glucose was found to be within the physiological limits in 86.96 per cent of the dogs under present investigation. While, none of the animals irrespective of the group to which they belong to exhibited hypoglycemia, hyperglycemia was encountered in 23.14 per cent of animals and all of them were dystocic animals. The mean random blood glucose concentration was recorded as 96.0 ± 3.40 mg/dl in Spontaneously Whelping (SW) female dogs, and although this concentration appeared to be slightly lower than the concentration recorded in animals with dystocia or the concentration in those animals subjected to elective cesarean section, the differences, however, was not statistically significant (Table III).

The mean total calcium concentration in the serum of animals exhibiting Spontaneous Whelping (SW) was determined as 10.00 ± 0.29 mg/dl. A similar concentration was also recorded in dystocic dogs assigned to different obstetrical interventional procedures as well as in animals subjected to elective cesarean section. The study revealed that a majority (92.75%) of the animals employed for the present study were also normocalcemic with hypercalcemic and hypocalcemic condition recorded only in 4.35 and 2.90 per cent of the animals. The present study clearly established that hypoglycemia and / or hypocalcemia is an infrequent finding and cause of maternal dystocia in canines (Table IV).

The mean progesterone concentration in serum of seven female dogs which completed the process of parturition without any assistance (SW) was determined as 0.22 ± 0.04 ng/ml. The concentration of progesterone in the serum of female dogs presented with complaint of dystocia was also similar. On the other hand, animals subjected to elective cesarean section had mean progesterone levels between 1 to 2 ng/ml suggesting imminent onset of labor and five dogs (27.78%) showed serum progesterone levels between 2 to 4 ng/ml, suggesting that they were very close to the onset of parturition (Table V).

The puppy survival rate at birth and incidence of stillbirth following Spontaneous Whelping (SW), Elective Cesarean (ElCSIV and ElCSG) and relief of dystocia (CPUI, PPUI, EmCSIV and EmCSG) is presented in Table I. A total of 281 pups were delivered from 69 bitches and 253 (90.04%) were born alive. The overall incidence of stillbirths was determined as 9.96 per cent, irrespective of the type of delivery. A total of 79 puppies were delivered from dams subjected to Elective cesarean section and none of the puppies were stillborn. The incidence of stillbirths delivered from dams assigned to the other groups ranged from 3.45 per cent (SW) to 20.68 per cent (AW). A total of 173 puppies were delivered from dams diagnosed as cases of dystocia and subjected to Assisted Whelping, medical treatment protocol or cesarean section (Group IV to VIII) and 146 of these were delivered live following relief of dystocia. The incidence of stillbirth delivered from animals with dystocia (Assisted Whelping, Medical management and Emergency cesarean section) in the present study was recorded as 15.61 percent. This incidence was about 12 per cent higher than the incidence observed in Spontaneously Whelping (SW) group of animals. Although the incidence of stillbirth was high from the group of animals subjected to Assisted Whelping, Chisquare test revealed that this incidence of stillbirth was not significantly different from those recorded in other groups.

The incidence of neonatal mortality of puppies at various stages of the neonatal period following Spontaneous Whelping as well as in those subjected to various interventional obstetrical procedures is shown in Table I. It was observed that a total of 253 puppies were delivered live at birth and between birth and 24 hours, 32 puppies had undergone mortality and the incidence of neonatal mortality within the first twenty four hours of birth was determined as 12.65 per cent. Between 24 to 48 hours, another 10 puppies were lost and the incidence of neonatal mortality from birth to 48 hours had risen to 16.60 percent. Further, 9 more puppies were again lost between 48 hours and seven days of birth and the

overall neonatal mortality by seven days after birth was determined as 20.16 per cent. No further mortality was recorded after seven days and the overall puppy survival rate by 14 days after birth was recorded as 79.84 percent.

The lowest overall incidence of neonatal mortality was recorded in puppies which were delivered following elective cesarean section (9.52%, Group II and 10.81%, Group II). The overall incidence of neonatal mortality in puppies by 14 days after birth in puppies delivered spontaneously was recorded as 14.29 per cent. The corresponding incidence of neonatal mortality by 14 days after birth in puppies which had been delivered through Assisted Whelping, in cases of Complete uterine inertia, Partial primary uterine inertia, Emergency Cesarean under intravenous and gaseous anesthesia was recorded as 34.78 per cent, 17.65 per cent, 31.82 per cent, 28.89 per cent and 20.51 per cent. The present study further revealed that out of 146 puppies which were delivered alive from animals with dystocia, 39 puppies were lost between birth to 14 days of the neonatal period and by 14 days after birth, only 107 puppies remained live. The overall incidence of neonatal mortality in puppies delivered in the dystocic group was determined as 26.71 per cent. Statistical analysis revealed significant variations between groups in mortality rate of puppies at different intervals of time.

The influence of duration of labor on the incidence of stillbirth was recorded and presented in Table II. In the present study, a total of 28 puppies were stillborn and the stillbirth puppies were obtained from only those dams wherein the dams had been experiencing dystocia for a minimum of four hours. Further, the incidence of stillbirths which was 17.86 per cent in animals with a duration of dystocia of four to eight hours dramatically rose to 39.29 per cent when the dams were presented between 8 to 12 hours after the onset of labor and almost a similar incidence (42.86%) was recorded when the duration of dystocia was over 12 hours.

IV. DISCUSSION

Hypoglycemia is commonly believed to be a major cause of dystocia, particularly uterine inertia and many of the clinicians routinely use dextrose infusion in an attempt to relieve uterine inertia. The belief that hypoglycemia is an important cause of dystocia could not be substantiated by the observations made in the present study as a majority (86.96 per cent) of the dogs were found to be normoglycemic and the random blood glucose concentration in dystocic animals was similar to those recorded in the spontaneously whelping animals (Table III) . The results of the present study are in agreement with the reports of (15), (1) and (29) that were of the opinion that dystocic dogs may not be hypoglycemic, as it is commonly believed. This observation may also explain why many cases of dystocia, particularly cases of uterine inertia do not respond to routine administration of dextrose, as many of them are not hypoglycemic. While none of the animals examined in the present study exhibited any evidence of hypoglycemia, hyperglycemic status was recorded in 13.04 per cent of the animals. All the animals exhibiting hyperglycemia belonged to those wherein the process of parturition was diagnosed to be abnormal. Bibiliography (1) and (29) have similarly reported that some dogs with dystocia may be hyperglycemic rather than hypoglycemic. It is possible that these animals were extremely stressed due to the process of parturition being abnormal resulting in higher release of cortisol and the hyperglycemic effect of cortisol is well known. In support of this statement is the observation made by (22) who reported that the cortisol concentration in animals with dystocia was higher than normal indicating of a stressful condition. The absence of a clear evidence of hyperglycemia in all dystocic animals is probably related to the degree of stress a dystocic animal is subjected to, particularly the duration of labor and the degree of anxiety. Interestingly, (16) has proposed hyperglycemic condition may initially occur in dystocic patients secondary to stressful conditions and cortisol release, but an endocrine control through the acute release of insulin maintains the normoglycemic status. `

The observations made in the present study that a majority of the dogs with dystocia are normocalcemic is in accordance with the reports of (1) and (29). Bibliography (12) and (11) were of the opinion that serum calcium concentrations in many bitches with primary inertia were similar to those with normal myometrial contractions, making a diagnosis of hypocalcemia difficult unless ionized calcium level is available.

The mean serum progesterone concentration in seven animals exhibiting Spontaneous delivery was determined as 0.22 ± 0.04 ng/ml, suggestive of complete luteolysis. Similarly, the serum progesterone concentration in animals wherein the cause of dystocia was determined as fetal in origin or primary partial or complete uterine inertia was also comparable to the concentration recorded in the spontaneously whelping animal, suggesting that even in these animals, the CL had ceased to be functional. These observations suggest that the parturition may be initiated in every animal when the serum progesterone concentration declines to levels lower than 1 ng/ml and then it may not be related to the course of parturition. Serum progesterone concentration was also determined in 18 other animals in which an elective cesarean section was planned. The history and clinical examination of these animals were suggestive that they were in their advanced pregnancy and serum progesterone concentration was determined to confirm that the selected animals were in the close to the time of parturition and the planned elective cesarean section was not carried out prematurely compromising the neonatal viability. In the present study, the assessment made that these animals were indeed close to the time of parturition was reflected by the serum progesterone concentration being lower than 2 ng/ml suggesting the imminent onset of parturition. Following elective cesarean section, the viability of the neonates was 100 percent irrespective of the type of anesthesia employed. The observations made in the present study strongly suggest that elective cesarean section is best carried out when the serum progesterone concentration declines to less than 2 ng/ml for obtaining optimum survival rates. Bibliography (24) has similarly opined that estimation of serum progesterone concentration could be taken up to plan elective cesarean section as the puppy survival rate could be related to the stage at which the cesarean section was employed.

Although the overall incidence of stillbirth was recorded as 9.96 per cent, its incidence was nil in puppies delivered after an elective cesarean section. The incidence of stillbirths was also very low (3.45%) after Spontaneous Whelping (Table I). The maximum puppy survival rate at birth through elective cesarean section observed in the present study corroborates well with the findings of (24), who also observed no fetal death during the surgical procedure and a higher survival rate (34/37) at 15 days after elective cesarean as compared to 25/40 for emergency cesarean. Bibliography (17) observed that the likelihood of all fetuses remaining alive at birth after emergency surgery is only 30 per cent of that when surgery is planned. Bibliography (18) reported that puppy mortality associated with elective cesarean was only 3.6 per cent compared to 12.7 per cent for delivery by emergency cesarean. High survival rate of pups at birth delivered by elective cesarean section irrespective of anesthesia employed in the present study could be subscribed to the optimum perioperative preparation of the dam coordinated with well orchestrated anesthetic, intraoperative and neonatal resuscitation protocols followed simultaneously together with the benefit of planned cesarean over emergency surgery. The results of the present study suggested that elective cesarean in dogs is a safe technique for obtaining maximum neonatal survival.

The incidence of stillbirth delivered from animals with dystocia (Assisted Whelping, Medical management and Emergency cesarean section) in the present study was recorded as 15.61 per cent. This incidence was about 12 per cent higher than the incidence observed in Spontaneously Whelping (SW) group of animals. The still birth rate recorded in the present study is higher than the reported value of 2 per cent (23), 5.5 per cent (21) and 4.8 per cent (7), but the values of the present study are comparable to

the reported incidence of 8 per cent (17) and 10.9 per cent (10) respectively. However, it's lower than the overall still birth rate of 22.3 per cent observed by (2) and an overall 14 per cent independent of the type of delivery observed by (28). The average incidence of stillbirths during both complicated and uncomplicated vaginal deliveries is reported to range from 5.55 per cent to 33.0 per cent (3). Bibliography (14) established that stillbirths should be less than 30 per cent of full-term puppies that do not survive to weaning. A reported still birth rate of 11.54 per cent by (27) correlate to the observations of the present study.

The overall incidence of neonatal mortality by 14 days after birth, irrespective of whether the puppies have been spontaneously delivered or following obstetrical interventions was determined as 20.16 per cent (Table I). Nearly two thirds (62.75 %) of all the neonatal mortalities recorded during the first 14 days after birth were observed within the first 24 hours after birth and by 48 hours, it had risen to 82.35 per cent of all neonatal mortalities. It was further observed that no neonatal mortality was seen after 7 days of birth. These observations suggest that the first 24 hours after birth is an extremely critical period for the survivability of the pup and by day seven, the puppies have the greatest chances of surviving further. Bibliography (3) also observed that the neonatal mortality rates upto three weeks of age ranged from 9.23 to 26.0 per cent subsequent to complicated and uncomplicated whelping and the mortality was greatest during the first week of life. Mortality rates of 10-30 per cent by weaning (13) and 15 - 40 per cent in the first 12 weeks of life (14) were reported. However, a few studies also indicated a very high mortality of 17 to 30 per cent within the first eight weeks of life of which stillbirth and mortality within the first week post partum was responsible for the majority of the puppy losses in these studies (21).

The present study also established that the overall incidence of neonatal deaths is considerably higher following difficult births as compared to those in the Spontaneously Whelping (SW) groups (26.71% vs. 14.29%). It was further observed that a major number of neonatal mortalities occurred during the first twenty four hours after birth (17.12%) which was about seven per cent more than those that recorded in spontaneously whelping animals. There are also many reports which have recorded a higher incidence of neonatal mortality after difficult births (13, 17 and 4). Medical managements before reference to the emergency clinic followed by emergency cesareans in unproductive cases would have contributed to dam exhaustion or distress of the puppies and / or dam contributing to the high neonatal mortality of 12.65 per cent at 24 hours as observed in the present study. Also, the puppy survival rate by 14 days after birth was highest in animals subjected to elective cesarean section and the type of anesthesia that had been employed for the surgery appeared to have no significant effect on the overall neonatal mortality by 14 days. The higher survival rates at different intervals observed in elective cesarean could be attributed to the lack of key factors contributing to neonatal death like prolonged labor, dystocia and resultant hypoxia (17 and 24). This also signifies the safety of elective cesarean as a technique of maximizing neonatal survival in dogs.

The present investigation documented a significant and linear increase in the still birth rate as the duration of labor increased beyond four hours. The still birth percentage at 4 to 8 hours, 8 to 12 hours and more than 12 hours were 17.86 per cent, 39.29 per cent and 42.86 per cent respectively. It was further documented that no still birth was recorded in puppies born of dams with duration of labor less than four hours. These findings are in agreement with the findings of (11) who also observed that the outcome for the bitch and the puppies is favorable when the duration of labor is less than 12 hours. The observations of the present investigation further confirms the finding of another study that, if the delivery was complete within 1 to 4.5 hours from the onset of second stage labor, puppy mortality was 5.8 per cent; whereas neonatal mortality increased to 13.7 per cent if the second stage lasted more than 5 to 24 hours (15). Bibliography (19) in a study involving 530 cases of dystocic dogs further confirmed

that the duration of second stage labor had the most important influence on puppy survival, irrespective of the mode of obstetrical aid. Furthermore, this finding supports the retrospective findings (6 and 2) that identified increased puppy mortality with prolonged labor. Timing of obstetrical aid appeared to be vital and also critical for the survival of puppies. The survival of the puppies was significantly higher when obstetrical aid started within the first 6 hours after the beginning of the second stage labor (20). The observations in the present study as well as those made in the previous reports suggest that the duration of parturition or dystocia are critical for neonatal viability. The absence of still births in puppies born of dams with duration of labor less than four hours as observed in the present study further supports the hypothesis that neonatal survival is associated with the duration of labor and also assures the benefit of maximizing neonatal survival in dogs.

The observations made in the present study confirm the beneficial effects of resuscitation procedures on newborn puppies with poor vitality at birth. Though dystocia promotes a long-lasting bradycardia and slows down progression of vitality in pups (16), resuscitation measures helps in attaining satisfactory improvement, which otherwise would have a fatal outcome. Bibliography (8) also reported that prolonged or severe asphyxia in-utero or during labor decreases newborn's vitality and reduces their ability to adapt to extra uterine life. Moreover, dystocia affects adaptation period of the neonate and lengthens the duration of hypoxia and anaerobiosis (16). Pups born following dystocia had slower development of the respiratory pattern. If neonates remain within the birth canal for a longer period of time than normal and is associated with total or partial placental detachment, fetal pCO_2 increases, inspiration may be then triggered. Subsequently, initial attempts to breathe will fill the expanded lung with liquid. Consequently, the volume of pulmonary liquid that must be absorbed by the lymphatic system after birth increases (25). 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 improve its vitality. Pups delivered following cesarean section also showed the same improvement pattern following resuscitation. However, the pups delivered following gaseous anesthesia in both emergency and elective cesarean showed a rapid transformation compared to intravenous anesthesia. Moreover, the studies conducted on the effect of various intravenous anesthetics relative to neonatal survival justifies the findings of this study that propofol was found to be safe for induction of general anesthesia for cesarean section, owing to its rapid metabolism in the liver (9). Although propofol crosses the placental barrier, however, it is rapidly cleared from the neonatal circulation (5). The relatively high proportions of pups acquiring satisfactory vitality in the cesarean under gaseous anesthesia could be attributable to the rapid clearance of gaseous anesthetic from the circulation as compared to intravenous anesthetics. Neonates rapidly eliminate inhalation anesthetics with the initiation of spontaneous respiration (17). Similarly studies of (18) have also observed an improvement in puppy vigor and newborn survival rates in pups whelped by cesarean with propofol induction and maintenance with isoflurane, which they considered that effect was almost equal to epidural anesthesia.

Furthermore, pups delivered of emergency cesarean under intravenous and gaseous anesthesia showed poor response to resuscitation compared to pups delivered of elective cesarean. The poor response even following resuscitation in those puppies delivered by emergency cesarean in comparison to those delivered by elective cesarean was ascribed to the increased stress in puppies due to prolonged labor as well as to the ecbolics which may compromise fetal well being from hypotension and increased fetal stress thereby a decreased response to resuscitation (16).

V. CONCLUSION

The present study clearly established that hypoglycemia and/or hypocalcemia is an infrequent finding and cause of maternal dystocia in canines. The present study also established that the incidence of stillbirths and neonatal mortality in canines is fairly high and even higher following difficult births substantiating the need to identify puppies at risk for neonatal mortality and determine procedures to save them. Well programmed obstetrical intervention and timely performed cesarean section is effective in maximizing neonatal survival. A majority of the neonatal deaths was found to occur in the first 24 hours after birth and the first 24 hours after birth was considered the most critical period for the neonate. Duration of labor was found to have a significant effect on the incidence of stillbirths and neonatal mortality. The study identified that the most important factor in the management of dystocia is time, as rapid intervention is critical for optimizing neonatal survival. The use of resuscitation procedures in puppies with low vigor at birth, particularly in puppies born of dystocic deliveries, significantly reduced the incidence of neonatal mortality, signifying their importance in revival of puppies.

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Table I: Effect of type of delivery on puppy mortality at birth, 24h, 48h, 7d and 14d

Type of whelping	No. of dogs	Total no. of Pups born	Live at birth n (%)	Still born n (%)	Neonatal mortality			Total neonatal mortality from birth to 14d n (%)	$\chi^2_{14\ df}$ value
					Within 24h after birth n (%)	within 48h after birth n (%)	within 7d after birth n (%)		
Group I (SW)	7	29	28 (96.55)	1 (3.45)	3 (10.71)	3(10.71)	4(14.29)	4(14.29)	
Group II (ElCSIV)	11	42	42 (100)	0 (0)	1(2.38)	4 (9.52)	4 (9.52)	4 (9.52)	
GroupIII (ElCSG)	7	37	37 (100)	0 (0)	3 (8.11)	3 (8.11)	4(10.81)	4 (10.81)	
Group IV (AW)	7	29	23 (79.31)	6 (20.69)	6 (26.09)	6 (26.09)	8 (34.78)	8 (34.78)	
Group V (CPUI)	6	19	17 (89.47)	2 (10.53)	2 (11.76)	2 (11.76)	3 (17.65)	3 (17.65)	

Group VI (PPUI)	10	26	22 (84.62)	4 (15.38)	5 (22.73)	5 (22.73)	7 (31.82)	7 (31.82)	
Group VII (EmCSIV)	12	51	45 (88.24)	6 (11.76)	6 (13.33)	12 (26.67)	13(28.89)	13(28.89)	
Group VIII (EmCSG)	9	48	39 (81.25)	9 (18.75)	6 (15.38)	7 (17.95)	8 (20.51)	8 (20.51)	
Total	**69**	**281**	**253(90.04)**	**28 (9.96)**	**32 (12.65)**	**42 (16.60)**	**51(20.16)**	**51(20.16)**	
$\chi^2_{7\ df}$ value	**5.18^{NS}**				**29. 68***	**67. 33***	**24.12***	**31.44***	**82.60***

•Significant at 0.05 level) NS: Non significant at 0.05 level

SW: Spontaneous Whelping
CPUI: Complete Primary Uterine Inertia
EmCSIV: Emergency Cesarean under Intravenous anesthesia
ElCSIV: Elective Cesarean under Intravenous anesthesia
AW: Assisted Whelping
PPUI: Partial Primary Uterine Inertia
EmCSG: Emergency Cesarean under gaseous anesthesia
ElCSG: Elective Cesarean under gaseous anesthesia

Table II: Influence of duration of labor on still birth rate

Duration (hours)	**Total**	**< 4**	**4 - 8**	**8 -12**	**>12**	**$\chi^2_{3\ df}$ value**
Still born n (%)	28	0 (0)	5 (17.86)	11 (39.29)	12 (42.86)	23.7857*

* Significant at 0.05 level

Table III: Maternal random blood glucose concentration (mg/dl)

Type of delivery	**No. of dogs**	**Maternal Blood Glucose (mg/dl)**		
		Mean ± SE (mg/dl)	**Normoglycemic n (%)**	**Hyperglycemic n (%)**
Group I (SW)	7	96.0 ± 3.40 [a]	7 (100)	0 (0)
Group II (ElCSIV)	11	95.0 ± 4.40 [a]	12 (100)	0 (0)
GroupIII (ElCSG)	7	98.0 ± 4.00 [a]	8 (100)	0 (0)
Group IV (AW)	7	112.0 ± 5.80 [a]	5 (62.5)	3 (37.5)
Group V (CPUI)	6	113.0 ± 4.20 [a]	5 (71.43)	2 (29.57)
Group VI	10	107.0 ± 5.50 [a]	8 (72.73)	3 (27.27)

(PPUI)				
Group VII (EmCSIV)	12	113.0 ± 4.70 [a]	8 (61.54)	5 (38.46)
Group VIII (EmCSG)	9	114.0 ± 4.30[a]	7 (70)	3 (30)
Total	69	106.0 ± 1.80	60 (86.96)	16 (23.14)

*Superscript in column: a
*Means bearing common superscript in column did not differ significantly with each other (P < 0.05)

Table IV: Maternal total serum calcium concentration (mg/dl)

Type of delivery	No. of dogs	Maternal serum total calcium (mg/dl)			
		Mean ± SE	Normocalcemic n (%)	Hypercalcemic n (%)	Hypocalcemic n (%)
Group I (SW)	7	10.00 ± 0.29[b]	6 (85.71)	1 (14.28)	0 (0)
Group II (ElCSIV)	11	9.70 ± 0.15 [b]	11 (100)	0(0)	0 (0)
GroupIII (ElCSG)	7	10.00 ± 0.33 [b]	6 (85.71)	1 (14.28)	0 (0)
Group IV (AW)	7	9.90 ± 0.33 [b]	6 (85.71)	1 (14.28)	0 (0)
Group V (CPUI)	6	9.40 ± 0.23 [b]	5 (83.33)	0 (0)	1 (16.66)
Group VI (PPUI)	10	9.60 ± 0.21 [b]	9 (90)	0 (0)	1 (10)
Group VII (EmCSIV)	12	9.60 ± 0.11 [b]	12 (100)	0(0)	0 (0)
Group VIII (EmCSG)	9	9.90 ± 0.20 [b]	9 (100)	0(0)	0 (0)
Total	69	9.70 ± 0.07	64 (92.75)	3(4.35)	2 (2.90)

* Superscript in column: b
* Means bearing common superscript in column did not differ significantly with each other (P < 0.05)

` Table V: Maternal Serum progesterone concentration (ng/ml)

Type of delivery	Group I (SW)	Group II (ElCSIV)	Group III (ElCSG)	Group IV (AW)	Group V (CPUI)	Group VI (PPUI)	Group VII (EmCSIV)	Group VIII (EmCSG)
n	7	11	7	7	6	10	12	9
Mean ± SE (ng/ml)	0.22 ± 0.04[b]	1.68 ± 0.21[a]	1.45 ± 0.41[a]	0.25 ± 0.05 [b]	0.66 ± 0.06 [b]	0.25 ± 0.04 [b]	0.54 ± 0.10 [b]	0.41 ± 0.07 [b]

Superscript in row: ab

*Means bearing common superscript in row did not differ significantly with each other (P < 0.05)

