PESQUISA VETERINÁRIA BRASILEIRA
Brazilian Journal of Veterinary Research
ISSN 0100-736X (Print)
ISSN 1678-5150 (Online)

Pesq. Vet. Bras. 40(4):289-292, April 2020
DOI: 10.1590/1678-5150-PVB-6260

Original Article
Small Animal Diseases

Effect of pre-anesthetic fasting on gastric emptying and plasma glucose in healthy dogs of different age groups[1]

Danielle R. Lecheta[2], Dheywid K.M. Silva[3], Guilherme A. Santos[3], Marcelo S. Cunha[4], Tamiris T. Gaspar[2], Bruno A. Lopes[4], Sandriele G.C. Deboleto[5] and Paulo H. Braz[6]*

ABSTRACT.- Lecheta D.R., Silva D.K.M., Santos G.A., Cunha M.S., Gaspar T.T., Lopes B.A., Deboleto S.G.C. & Braz P.H. 2020. **Effect of preanesthetic fasting on gastric emptying and plasma glucose in healthy dogs of different age groups.** *Pesquisa Veterinária Brasileira 40(4):289-292*. Centro Universitário da Grande Dourados, Rua Balbina de Matos 2121, Jardim Universitário, Dourados, MS 79824-900, Brazil. E-mail: paulo.braz@iffarroupilha.edu.br

Gastric emptying and plasma glucose were evaluated in young and adult dogs, fed with dry and wet food, submitted to different periods of pre-anesthetic fasting (6, 8, and 12 hours). Forty healthy dogs were selected, which were segmented into four groups according to the age group and type of diet. It was evaluated the gastric emptying by ultrasound and serum glycemia. Only 17.5% presented complete gastric emptying, and no significant differences were found between the 6 and 8-hour fasting evaluations, or between the age groups and the diets, considering significance level $p<0.05$. Mean plasma glucose values from the groups indicated normal glycemia at all times of evaluation. A significant difference was found between the means of glycemia in young and adult dogs, with the 8-hour fasting with wet diet ($p=0.03$) and with 12 hours with dry diet ($p=0.04$). Healthy young and adult dogs, in physiological equilibrium, maintain average values of plasma glucose despite prolonged periods of pre-anesthetic fasting, which may be necessary, since 8-hour fasting for solid food is not enough to provide complete gastric emptying.

INDEX TERMS: Preanesthetic fasting, gastric emptying, plasma glucose, healthy dogs, age, anesthesia, hypoglycemia, dogs.

RESUMO.- [**Efeito do jejum pré-anestésico sobre o esvaziamento gástrico e a glicemia plasmática em cães hígidos de diferentes faixas etárias.**] Avaliou-se o esvaziamento gástrico e a glicemia plasmática em cães jovens e adultos, alimentados com ração seca e úmida, submetidos a diferentes períodos de jejum pré-anestésico (6, 8 e 12 horas). Foram selecionados 40 cães hígidos, os quais foram segmentados em 4 grupos de acordo com a faixa etária e o tipo de dieta administrada. Foi avaliado o esvaziamento gástrico por ultrassonografia e a glicemia sérica. Apenas 17,5% apresentaram completo esvaziamento gástrico, não sendo encontradas diferenças significativas entre as avaliações com 6 e 8 horas de jejum, ou entre as faixas etárias e dietas, considerando nível de significância $p<0,05$. Os valores médios da glicose plasmática dos grupos indicaram normoglicemia em todos os momentos de avaliação. Foi encontrada diferença significativa entre as médias da glicemia dos cães jovens e adultos, no período de 8 horas de jejum com dieta úmida ($p=0,03$) e com 12 horas nos animais com dieta seca ($p=0,04$). Conclui-se que cães hígidos jovens e adultos, em equilíbrio fisiológico, mantêm valores normais de glicemia plasmática apesar de períodos prolongados de jejum pré-anestésico, os quais podem ser necessários, tendo em vista que 8 horas de jejum alimentar de sólidos não é suficiente para proporcionar completo esvaziamento gástrico.

TERMOS DE INDEXAÇÃO: Jejum pré-anestésico, esvaziamento gástrico, glicemia plasmática, cães hígidos, anestesia, hipoglicemia, caninos.

[1] Received on September 9, 2019.
Accepted for publication on November 7, 2019.

[2] Veterinary Medicine Course, Centro Universitário da Grande Dourados (Unigran), Rua Balbina de Matos 2121, Jardim Universitário, Dourados, MS 79824-900, Brazil.

[3] Professor, Veterinary Medicine Course, Centro Universitário da Grande Dourados (Unigran), Rua Balbina de Matos 2121, Jardim Universitário, Dourados, MS 79824-900, Brazil.

[4] Veterinarian, Clínica Veterinária, Centro Universitário da Grande Dourados (Unigran), Rua Balbina de Matos 2121, Jardim Universitário, Dourados, MS 79824-900, Brazil.

[5] Biomedic Professional, Clínica Veterinária, Centro Universitário da Grande Dourados (Unigran), Rua Balbina de Matos 2121, Jardim Universitário, Dourados, MS 79824-900, Brazil.

[6] Professor, Veterinary Medicine Course, Instituto Federal Farroupilha (IFFar), Linha 7 de Setembro, BR-386 Km 40, Centro, Frederico Westphalen, RS 98400-000, Brazil. *Corresponding author: paulo.braz@iffarroupilha.edu.br

INTRODUCTION

There are few studies on the effect of pre-anesthetic fasting after the administration of different types of diet and its glycemic and physiological relationship. Preanesthetic fasting is a common practice in both medicine and veterinary medicine. The fasting aimed to reduce the volume and acidity of stomach contents, decreasing the risk of reflux and aspiration of gastric contents into the respiratory tract during surgery. Also, reducing the risk of postoperative complications, such as gastroesophageal reflux, esophagitis, and aspiration pneumonia (Brady et al. 2009, Castro et al. 2016).

The short fasting period in surgical patients can lead to metabolic disorders that directly interfere with the animal's response to inhalation anesthesia and surgical intervention (Castro et al. 2016). Prolonged fasting increases the risk of hypoglycemia (Nogueira et al. 2003).

Hypoglycemic animals may experience depression, prolonged recovery from anesthesia, weakness, muscle tremors, changes in blood pressure, changes in behavior, and seizures (Cortopassi et al. 2002, Futema 2002). Blood glucose concentrations depend on the interaction of multiple factors, including the time since the last meal, hormonal influences, and the use of glucose by peripheral tissues, such as skeletal muscle (Allison 2015).

The fasting time varies according to the type of diet, the volume of food, and variations between patients of different species and digestive conditions (Castro et al. 2016). Another relevant factor for the definition of adequate pre-anesthetic food fasting time is the age of the animal. Food should not be restricted to young animals for more than 4 to 6 hours, which can cause hypoglycemia to the patient (Fossum 2014).

The objective was to evaluate the glycemic variations of healthy dogs, of different age groups, with the supply of dry and wet diets and their influence on gastric emptying time.

MATERIALS AND METHODS

This research was approved by the Ethics Committee for Animal Use of the "Centro Universitário da Grande Dourados" (CEUA-Unigran), under protocol 005/16. Forty dogs were selected, regardless of breed, of both sexes, with the following inclusion criteria: be on the waiting list for the Castration Project; be aged between six months and eight years old; weigh between two and 15kg; be healthy, according to the results of hematological, biochemical (renal, hepatic and pancreatic) and ultrasound examinations (abdominal and pelvic evaluation); and, having authorization from the dog's tutor in an informed consent form.

Animals under treatment for any previously diagnosed disease or condition, using any medication, or animals that did not feed spontaneously on the day of the experiment were excluded from the study.

For experimental design, four groups of 10 animals were formed, according to the age group and the type of diet administered, as shown below. The group was defined according to the order of arrival for surgical care:

Group I - Young dogs, from 6 months to 2 years old, with a wet diet;

Group II - Young dogs, from 6 months to 2 years old, with a dry diet;

Group III - Adult dogs, from 2 years and 1 month to 8 years old, with a wet diet;

Group IV - Adult dogs, from 2 years and 1 month to 8 years old, with a dry diet.

All animals were hospitalized the day before the experiment. At this time, the patients underwent physical examination, with measurement of rectal temperature, heart rate, and respiratory rate, as well as the assessment of mucosal color and capillary refill time. Each dog was kept in individual stalls, with free access to water, having received the last meal of the day at 6 p.m.

The following morning, at 7 a.m., all dogs were fed wet or dry food, according to the group to which they belonged. The dry food offered was Golden® (PremierPet, Brazil), for dogs of small to medium size, composed of 10% moisture, 23% crude protein, 12% fat, 3.0% fiber, 0.2% sodium, and 0.5% potassium. The wet food offered was the same food previously described, but added with water in an amount equivalent to 70% moisture, and later homogenized in a blender to achieve the desired consistency. The amount of feed offered was equivalent to half of the daily recommendation, according to the manufacturer (Golden - PremieR Pet®), since the dog's food is offered in one to three times a day.

After the ingestion of the feed, all animals remained fasting. Then, dogs were submitted to three blood samples by venipuncture in the jugular vein for glycemic analysis, six, eight, and 12 hours after the beginning of the fast. For the glycemic test, the blood was placed in a glass tube containing sodium fluoride, being centrifuged for 5 minutes at 2,000rpm. The determination of the concentration of serum glucose was made using an enzymatic-colorimetric method, at an absorbance of 505nm, with a reagent of the Gold Analisa® brand and reading on a semi-automatic spectrophotometer.

After 6 hours of solid fasting and 2 hours of water fasting, the ultrasound study was performed through abdominal scanning with Mindray® ultrasound device, model M5-VET, with microconvex transducer and frequencies between 5.0, 6.5 and 8.0MHz, according to the size of the animal.

After the general examination of the organs, the dog's gastric emptying was evaluated for the presence or absence of any luminal content in the stomach, and gastric motility. The transducer was placed in a sagittal plane in the epigastric region. Then, the antrum and gastric body were scanned by moving the transducer from right to left, to obtain an overall qualitative impression of the cavity and gastric content.

The den has a wall characterized by multiple layers, and its visibility has been assessed in a binary way (visible or not). A single sonographer performed qualitative assessments of the gastric antrum. The antrum was considered empty if it appeared with the anterior and posterior walls juxtaposed. It was considered as containing liquid if it had an endocavity with a hypoechoic content inside and with distended walls. It was considered to have solid content if it appeared distended with an echogenic content similar to the liver parenchyma. If the dog had food content in the stomach, the ultrasound was repeated after 2 hours, then totaling 8 hours of fasting.

Statistical analysis was performed with the aid of the BioEstat software version 5.3, using Fisher's Exact Test to assess gastric emptying, comparing the groups of young and adult dogs, as well as those with dry food and wet food. As for blood glucose, we calculated the means and standard deviations of each group concerning the different periods of pre-anesthetic fasting, and then the Friedman test compared the values over time. When variables with a statistically significant difference, the Chi-square test verified the pairs of groups in which a difference was found. The Mann Whitney non-parametric test assessed the differences in plasma glucose between pairs of groups. For all, we considered a significance level of $p<0.05$.

RESULTS

As for gastric emptying, 25% of the animals (n=5) with a wet diet (Groups I and III) had no food content with 6 hours of fasting. Dogs submitted to the dry diet (Groups II and IV) were represented by only 10% (n=2), with no significant difference (p=0.40) between groups.

When assessing the influence of age on this variable, among the 20 animals under 2 years old (Groups I and II), only 20% (n=4) had complete gastric emptying in 6 hours, while in the groups of adult animals (Groups III and IV) were 15% (n=3), not being statistically significant (p=0.70).

Animals that had food content during abdominal ultrasound after 6 hours of fasting were reevaluated after 2 hours. In all cases, 8 hours of waiting were not enough for the dogs to have complete gastric emptying, with no difference between gastric emptying occurring after 6 or 8 hours of fasting.

The mean values of glycemia indicated normoglycemia at all times of assessment (Table 1). Among the 40 animals evaluated, only six dogs presented hypoglycemia, two animals from Group I (the first with 8 hours and the second with 12 hours of fasting), one animal from Group III (with 12 hours of fasting) and three dogs from Group IV (with 6, 8 and 12 hours of fasting, respectively). When comparing the mean blood glucose values of each group over time, considering the different fasting periods (6, 8, and 12 hours), we found a statistically significant difference only in Group III, between the mean values of 8 and 12 hours.

When comparing the different groups to assess the interference of age or diet in the glycemia of the animals (Table 2), a significant difference was found in dogs with 8 hours of fasting. In Groups I and III, age interfered in their blood glucose in dogs fed with a wet diet. Between Groups III and IV, the diet interfered with the glycemia of adult animals. Also, in individuals with 12 hours of fasting, we found a significant difference between Groups II and IV, indicating age interference in the plasma glucose of dogs fed a dry diet.

When observing the results of the four experimental groups with the same fasting time, we noticed that after 8 hours of fasting, the dogs tend to present significant glycemic changes. The most considerable changes were found when comparing Groups I and III, taking into account the changes due to age, and between Groups III and IV due to the type of diet offered.

DISCUSSION

Recommendations regarding fasting before anesthetic and surgical procedures vary according to some authors, who report a minimum of 6 hours (Bednarski 1996), 6 to 12 hours (Fossum 2014), 8 to 12 hours (Futema 2002), 12 to 16 hours (Massone 2011) and up to 18 hours of fasting (Guimarães et al. 2007). However, regarding water restriction, there is a recommendation to suspend water for 2 to 3 hours before the intervention (Massone 2011).

Fasting induces low levels of plasma glucose, mobilizes the liver's glycogen stores, and reduces the circulation of fatty acids, which can alter the rate of biotransformation of drugs (Thurmon et al. 1996). Prolonged fasting can result in severe hypoglycemia and metabolic acidosis, the acid-base imbalance, more common in carnivores (Luna 2002), in addition to stress and discomfort (Guimarães et al. 2007).

According to Savvas et al. (2009), the standard compound paste ration, in the portion of half of the daily recommendation, administered 3 hours before anesthesia does not significantly increase the gastric content of dogs and keeps the pH of this content high. Dogs fasted for 10 hours have more acidic gastric contents than dogs fasted for 3 hours. After 10 hours of food consumption, stomach contents are not found to exert its known buffer effect on gastric acidity (Herdt 1999).

The high acidity of gastric contents can contribute to the increase in the incidence of gastroesophageal reflux in dogs during anesthesia, after prolonged pre-anesthetic fasting, as it decreases the pressure of the lower esophageal sphincter (Savvas et al. 2009). However, when comparing gastric emptying with eating canned meats and dry cereals, gastric emptying occurs in about 10 hours and water after 52 minutes of ingestion, with observations of individual variations (Ambrósio 2002), which can reach this value 18 hours of solid food fasting (Guimarães et al. 2007).

The presence of pain, stress, and the animals' emotional condition can delay gastric emptying (Guimarães et al. 2007). It is possible that animals in a hospital environment, under confinement, and undergoing procedures that are not part of their routine have the physiological function of the gastrointestinal tract altered, in addition to the absence of the tutor, reflecting on the speed of gastric emptying.

Regarding glycemia, the maintenance of stable blood glucose concentrations involves finely regulated mechanisms

Table 1. Mean plasma glucose values in dogs submitted to different periods (DP) of pre-anesthetic fasting

Groups	Plasma glycemia (mg/dl) - DP			
	Fasting 6h	Fasting 8h	Fasting 12h	p-value
Group I	69.5 ± 7.11	72.7 ± 10.37	73.6 ± 12.95	0.49
Group II	75.2 ± 19.57	80.1 ± 9.10	75.5 ± 7.43	0.20
Group III	$74.4^{a,b}$ ± 9.79	78.8^{a} ± 5.92	71.4^{b} ± 7.97	0.036
Group IV	69.5 ± 9.14	73.6 ± 11.17	68.9 ± 10.80	0.20

[a,b] Different superscript letters have statistical differences; equal letters have no statistical difference.

Table 2. Comparison of plasma glucose between groups

Fasting period	Groups analyzed	p-value
6 hours	G1 x G3	0.16
	G2 x G4	0.41
	G1 x G2	0.36
	G3 x G4	0.17
8 hours	G1 x G3	0.03
	G2 x G4	0.05
	G1 x G2	0.07
	G3 x G4	0.01
12 hours	G1 x G3	0.23
	G2 x G4	0.04
	G1 x G2	0.38
	G3 x G4	0.12

G1 = Group 1, young dogs with wet diet; G2 = Group 2, young dogs on a dry diet; G3 = Group 3, adult dogs with a wet diet; G4 = Group 4, adult dogs on a dry diet.

in which the liver, extrahepatic tissues, and various hormones, such as insulin, glucagon, epinephrine, glucocorticoids, and thyroid hormone, play a fundamental regulatory role (Beitz 2012). Glucose is provided by the intestinal absorption of this monosaccharide present in the diet or by the liver production from its precursors, for example, carbohydrates and amino acids. After intestinal absorption, liver production is the main source of glucose input for maintaining healthy blood glucose (Nogueira et al. 2003).

Animals use different proportions of the body's stock of carbohydrates, fat, and protein to maintain glycemic levels during fasting, maintaining vital functions for as long as possible (Remillard, 2000). The hormones epinephrine and glucagon promote the release of glucose from glycogen. In fasting situations, insulin levels decrease, proteolysis increases, and the release of amino acids increases. Fatty acids are also mobilized during fasting (Nogueira et al. 2003).

Hypoglycemic changes are essential for anesthetic evaluation since animals in these conditions may have changes in blood pressure and prolonged anesthetic recovery (Cortopassi et al., 2002; Futema, 2002). There were no evident clinical signs of hypoglycemia in anesthetized animals, which can only be diagnosed by measuring blood concentration. That is why it is crucial to detect hypoglycemia during the preoperative period (Nogueira et al., 2003).

There are undoubtedly individual variations in physiological adaptation to fasting. When Nogueira et al. (2003) evaluated 31 dogs at different times of pre-surgical fasting, 6 to 8 hours of fasting, 12 to 14 hours, or above 16 hours, there were no differences in the glycemic level in the pre- and post-anesthetic, while Guimarães et al. (2007) found glycemic changes in animals with 12 hours of pre-anesthetic fasting.

Regarding the glycemia variation due to the age of the animals, it is vital to have different clinical monitoring of the animal's glycemic condition. No previous studies were found that emphasize the differentiation of pre-anesthetic fasting according to the age of the animal. However, it is recommended to avoid restricting food to young animals for more than 4 to 6 hours, due to the risk of hypoglycemia (Fossum 2014).

The handling of the patient produces a typical stress response with hormonal and metabolic changes in animals, including elevated glycemic values (Luna 2002). However, it appears that in this study, the manipulation of animals for serial venipuncture and ultrasound, in addition to the confinement they were subjected to during the experiment period, did not interfere with neuroendocrine responses to stress, as described by Guimarães et al. (2007). In this way, the selection of healthy individuals contributed to the physiological balance of dogs, resulting in efficient compensatory mechanisms concerning glucose metabolism.

CONCLUSIONS

A period of 8 hours of pre-anesthetic fasting is not enough to provide complete gastric emptying in dogs fed both dry and wet food.

Healthy young animals and adults, in physiological balance, maintain average plasma glucose values despite prolonged periods of pre-anesthetic fasting.

Conflict of interest statement.- The authors have no competing interests.

REFERENCES

Allison R.W. 2015. Avaliação laboratorial do pâncreas e metabolismo da glicose, p.367-380. In: Thrall M.A. (Ed.), Hematologia e Bioquímica Clínica Veterinária. Guanabara Koogan, Rio de Janeiro.

Ambrósio A.M. 2002. Anestesia e sistema digestório, p.260-270. In: Fantoni D.T. & Cortopassi S.R.G. (Eds), Anestesia em Cães e Gatos. Roca, São Paulo.

Bednarski R.M. 1996. Dogs and cats, p.591-598. In: Thurmon J.L., Tranquilli W.J. & Benson G.J. (Eds), Lumb and Jones' Veterinary Anesthesia. 3rd ed. William and Wilkins, Baltimore.

Beitz D.C. 2012. Metabolismo dos carboidratos, p.462-475. In: Reece W.O. (Ed.), Dukes' Fisiologia dos Animais Domésticos. 12ª ed. Guanabara Koogan, Rio de Janeiro.

Brady M., Kinn S. & Ness V. 2009. Preoperative fasting for preventing perioperative complications in children. Cochrane Database Syst. Rev. 7(4):1-5. <http://dx.doi.org/10.1002/14651858.CD005285.pub2> <PMid:19821343>

Castro J.L.C., Santalucia S. & Ferreira A.A. 2016. Determining the optimal time of gastric emptying in cats using dry or wet food. Acta Scient. Vet. 44:1-6. <http://dx.doi.org/10.22456/1679-9216.80958>

Cortopassi S.R.G., Fantoni D.T., kitahara F.R., Santos P.R. & Conti A. 2002. Complicações da anestesia, p.349-361. In: Fantoni D.T. & Cortopassi S.R.G. (Eds), Anestesia em Cães e Gatos. Roca, São Paulo.

Fossum T.W. 2014. Cirurgia de Pequenos Animais. 4ª ed. Elsevier, Rio de Janeiro. 5008p.

Futema F. 2002. Avaliação pré-anestésica, p.60-63. In: Fantoni D.T. & Cortopassi S.R. (Eds), Anestesia em Cães e Gatos. Roca, São Paulo.

Guimarães S.M., Oliva V.N.L.S. & Maia C.A.A. 2007. Correlação de diferentes períodos de jejum com níveis séricos de cortisol, glicemia plasmática, estado clínico e equilíbrio ácido-base em cães submetidos à anestesia geral inalatória. Braz. J. Vet. Res. Anim. Sci. 44(Supl.):96-102.

Herdt T. 1999. Movimentos do trato gastrintestinal, p.220-233. In: Cunningham J.G. (Ed.), Tratado de Fisiologia Veterinária. 2ª ed. Guanabara Koogan, Rio de Janeiro.

Luna S.P.L. 2002. Equilíbrio ácido-básico, p.120-129. In: Fantoni D.T. & Cortopassi S.R. (Eds), Anestesia em Cães e Gatos. Roca, São Paulo.

Massone F. 2011. Anestesiologia Veterinária. 6ª ed. Guanabara Koogan, Rio de Janeiro. 305p.

Nogueira L.C., Cortopassi S.R.G. & Intelizano, T.R. 2003. Efeitos do jejum alimentar pré-cirúrgico sobre a glicemia e o período de recuperação anestésica em cães. Braz. J. Vet. Res. Anim. Sci. 40(Supl.):20-25. <http://dx.doi.org/10.1590/S1413-95962003000700003>

Remillard R.L. 2000. Parenteral nutriion, p.465-482. In: Dibartola S.P. (Ed.), Fluid Therapy in Small Animal Practice. 2ª ed. W.B. Saunders, Philadelphia.

Savvas I., Rallis T. & Raptopoulos D. 2009. The effect of pre-anaesthetic fasting time and type of food on gastric content volume and acidity in dogs. Vet. Anaest. Analg. 36(6):539-546. <http://dx.doi.org/10.1111/j.1467-2995.2009.00495.x.> <PMid:19845925>

Thurmon J.C., Tranquilli W.J., Benson G.J. & Martin D.D. 1996. Anesthesia for special patients: neonatal and geriatric patients, p.844-848. In: Thurmon J.C., Tranquilli W.J. & Benson G.J. (Eds), Lumb and Jones' Veterinary Anesthesia. 3rd ed. William and Wilkins, Baltimore.