THE INFLUENCE OF ISOFLURANE ANAESTHESIA ON INTESTINAL PERMEABILITY IN HEALTHY DOGS

Barbara Lukanc[1], Janoš Butinar[3], Alenka Nemec Svete[1], Mirko Prošek[2], Alenka Seliškar[1]*

[1]Veterinary Faculty, University of Ljubljana, Gerbičeva 60, [2]National Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, [3]Animal Hospital Postojna, Cesta v Staro vas 20, 6230 Postojna, Slovenia

*Corresponding author, E-mail: alenka.seliskar@vf.uni-lj.si

Abstract: This study investigated the most appropriate blood sampling time for determining the lactulose/mannitol (L/M) index, and whether isoflurane anaesthesia increases intestinal permeability in dogs, in terms of changes in the L/M index. Six dogs were given 100 ml of sugar solution (3.6 g lactulose and 3.4 g mannitol) with orogastric tube. Blood samples for determination of basal plasma L/M index were taken 90, 120, and 180 minutes later. The next day, the dogs were administered methadone, induced with midazolam mixed with ketamine, followed immediately by propofol, and anaesthesia maintained with isoflurane in oxygen for 200 minutes. The same sugar solution as the day before was administered at the end of anaesthesia and 12 and 24 hours post-anaesthesia. Blood samples were taken 90, 120 and 180 minutes after administration of sugar solution. HPLC-MS was used for plasma determination of lactulose and mannitol and the results expressed as L/M index. The highest concentrations of lactulose and mannitol were detected 120 minutes after administration of sugar solution. Lactulose/mannitol index significantly increased at the end of anaesthesia, regardless the sampling time, when compared to basal values from non-anaesthetized dogs. The increase of L/M index due to anaesthesia with isoflurane was short-lived as there was no significant difference between L/M index at 12 hours after the anaesthesia and basal values. The most appropriate blood sampling time for determining the L/M index is 120 minutes after oral administration of dual sugar solution.

Key words: dog; isoflurane; intestinal permeability; L/M index

Introduction

The gastrointestinal tract forms a barrier between the contents of its lumen and the systemic circulation. Epithelial cells lining the digestive tube, linked together by tight junctions, form the basis of the gastrointestinal barrier. The tight junctions are the main determinant of gastrointestinal permeability. The intestinal barrier allows absorption of nutrients while preventing passage of many potentially harmful particles such as bacteria, bacterial and food antigens, and compounds that could be toxic, antigenic or carcinogenic (1).

Intestinal damage may be assessed by non-specific and non-invasive intestinal permeability tests, where one or more probes are given orally and then measured in urine or blood (2, 3, 4). Collection of urine sample is impractical when compared to blood sampling because it takes five to six hours (5) and the results of test may be false due to incomplete urine collection (6). One of the tests used for determination of intestinal permeability is the dual sugar test. The advantage of this test is that all variables that alter intestinal permeability or absorption will equally affect both

markers and are cancelled out when results are expressed as index (2, 4, 7, 8).

Conventionally, a disaccharide and monosaccharide are used together. Lactulose is the most widely used disaccharide probe, and is completely metabolised in the colon. Its absorption reflects small intestinal permeability (7). Lactulose is absorbed paracellularly, between the enterocytes through pores in the area of the tight junctions (10) or via damaged epithelium (11). A maximum of 0.4 – 2% lactulose permeates through pores (10). This amount can be increased when lactulose is given in hyperosmolar solution (12). The monosaccharide mannitol is a low molecular weight sugar alcohol, which is thought to diffuse through water-filled pores in the enterocyte membrane (13). The ratio between plasma lactulose and mannitol concentrations is expressed as lactulose/mannitol (L/M) index.

Changes in intestinal permeability may occur due to major surgery (14) or trauma (15), ingestion of non-steroidal anti-inflammatory drugs (16), and intestinal ischemia. Partial intestinal ischemia, where blood flow is reduced to one third of the resting control level, induces increased mucosal permeability to macromolecules within one hour and obvious morphological injury to the small intestinal villi. In disease states that compromise the mucosal barrier, microorganisms and their toxins may escape from the intestinal lumen to the lymph, the portal vein and systemic circulation or to the peritoneal cavity, producing deleterious effects (8, 17).

General anaesthesia with isoflurane decreases intestinal tissue perfusion to varying degrees during systemic hypotension in the dog (18), which in turn might increase intestinal permeability. The aim of this study was to investigate whether general anaesthesia with isoflurane increases intestinal permeability in dogs, in terms of changes in the L/M index, and to establish the most appropriate blood sampling time for determining the L/M index.

Materials and methods

Animals

Six healthy, intact adult male beagle dogs weighing 15.3 to 21.7 kg were included in the study. The dogs were judged to be healthy on the basis of clinical examination and normal blood work, i.e., complete blood count, white cell differential count and serum biochemistry profile including blood urea nitrogen, creatinine, inorganic phosphate, total protein, albumin and electrolytes, i.e., potassium, sodium, and chloride (data not shown). The dogs were housed in couples, fed a commercial dry and canned diet twice a day with unlimited access to water and walked in pairs at least 20 minutes three times per day. Social contacts between the caretakers and dogs were carried out during the day.

The study complied with applicable Slovenian governmental regulations (Animal Protection Act UL RS, 43/2007) and obtained ethical approval by the Ministry of Agriculture, Forestry and Food, Veterinary Administration of the Republic of Slovenia; license No 323-02-80/01.

Experimental design

The dogs were given 100 ml iso-osmolar sugar solution containing 3.6 g lactulose (Portalak, Belupo, Koprivnica, Croatia) and 3.4 g mannitol (Manit 20 %, Pliva, Zagreb, Croatia) via the orogastric tube. Blood samples for determination of basal plasma lactulose and mannitol concentrations were collected in heparinized tubes (Vacutainer Systems, Becton Dickinson, Franklin Lakes, New Jersey, USA) at 90, 120 and 180 minutes after administration of dual sugar solution.

The influence of general anaesthesia on intestinal permeability was investigated the next day. The same sugar solution as the day before was administered at the end of anaesthesia that lasted 200 minutes and 12 and 24 hours post-anaesthesia and blood samples were taken at 90, 120 and 180 minutes after each administration of dual sugar solution.

Access to water was unlimited until the dogs were given dual sugar solution, while the food was withheld for 12 hours before administration of dual sugar solution on both days. After the last blood sampling at 180 minutes, the dogs were offered food and water.

Determination of L/M index

Blood samples were centrifuged at 3000 g for 15 minutes at 4 °C immediately after collection and stored at –70 °C until analysis.

Plasma lactulose and mannitol concentrations were determined by high performance liquid chromatography-mass spectrometry (HPLC-MS) and L/M index calculated as the ratio between plasma lactulose and mannitol concentrations. Plasma samples (150 µL) prepared for quantitative determinations of sugars were diluted with 750 µL distilled water and freeze-dried. Dehydrated samples were redissolved in 150 µL of methanol (Merck, Darmstadt, Germany), centrifuged and supernatant injected into HPLC–MS system. Separation and quantitative determinations of lactulose and mannitol were performed with a Surveyor LC system (Thermo Finnigan, Riviera Beach, CA, USA) equipped with LCQ mass detector (Finnigan MAT, San Jose, CA, USA). Quantitative determinations of lactulose and mannitol were done in one run on Thermo Hypersil APS-2, 150 x 4 mm, 3 µm column (Thermo Electron Corporation, CA, USA) at room temperature. The isocratic mobile phase consisted of methanol/ethanol/water (MeOH/EtOH/H_2O), 52:35:13 (v/v/v), the run time was 9 minutes, and the flow rate was 1.0 mL/minute. The retention time of mannitol was 4.33 ± 0.2 minutes, and for lactulose 6.63 ± 0.2 minutes. MS identification and quantification was done in negative APCI ionization mode. Ionization discharge current was 6.0 µA, and source temperature 500 °C. Capillary voltage was 23.0 V, tube lens offset was 35.0 V, capillary temperature was 200 °C, sheath gas pressure was 2.7 bar, and auxiliary gas flow was 1.6 L/minute.

Anaesthesia

The dogs were premedicated with methadone (Heptanon, Pliva, Zagreb, Croatia) 0.2 mg/kg subcutaneously and 15 minutes later induced to anaesthesia with midazolam (Dormicum, F. Hoffmann-La Roche, Basel, Switzerland) 0.2 mg/kg mixed with ketamine (Ketanest 10%, Parke-Davis, Freiburg, Germany) 1 mg/kg, followed immediately by propofol (Diprivan, Zeneca Pharmaceuticals, Wilmington, Delaware, USA) 3 mg/kg, all of them given intravenously. The dogs were endotracheally intubated and anaesthesia maintained with isoflurane (Forane, Abbott Laboratories, Baar, Switzerland) at end-tidal isoflurane concentrations (EtIso) of 1.1 - 1.4% in oxygen for 200 minutes. The dogs were mechanically ventilated (Ventilog, Dräger, Lübeck, Germany) with tidal volume of 15 mL/kg. The respiratory rate was adjusted to maintain end-tidal carbon dioxide (EtCO$_2$) in the normal range (35 - 45 mmHg). Lactated Ringer's solution (Sestavljen natrijev laktat, B Braun Melsungen AG, Melsungen, Germany) was infused at a rate of 10 mL/kg/h during anaesthesia. The dogs were positioned in dorsal recumbency on a heated surgical table (33 °C) during the anaesthesia. The temperature of the air in the operating theatre was maintained at 20 to 24 °C.

EtIso, EtCO$_2$, arterial oxygen saturation measured with pulse oximetry (SpO$_2$), respiratory rate and airway pressure within the breathing circuit were continuously monitored during anaesthesia (RGM 5250, Ohmeda, Louisville CO, USA). Tidal volume and minute volume of respiration were measured by means of mechanical volumetry (Ventilog, Dräger Tiberius 800, Lübeck, Germany). Direct arterial blood pressure (catheter placed in the femoral artery), heart rate (Table 3) and body core temperature were measured (HP Model 78354A, Hewlett Packard GmbH, Hamburg, Germany). At the end of anaesthesia, the dogs were allowed to recover from anaesthesia and returned to their cages.

Statistical analysis

Data were analysed with commercial software (SPSS 15.0, Chicago, Illinois, USA). Results are expressed as means ± SD. To test whether the data were normally distributed, histograms were generated and inspected visually and Shapiro-Wilk tests were performed. Repeated measures ANOVA (RMANOVA) with Bonferroni correction was used to compare basal values of lactulose, mannitol and L/M index to later measurements (end of anaesthesia and 12 and 24 hours later). The same method (RMANOVA with Bonferroni correction) was used to test for statistically significant differences of lactulose and mannitol between different blood sampling times (90, 120 and 180 minutes after administration of sugar solution) at each measurement (end of anaesthesia and 12 and 24 hours later). The value of $p < 0.05$ was considered significant.

Table 1: Plasma mannitol concentration (mol/L; mean ± SD) 90, 120 and 180 minutes after administration of sugar solution at basal values, end of anaesthesia, 12 and 24 hours after the end of anaesthesia

time	basal values	end of anaesthesia	12 h	24 h
90 min	3.985E-05 ± 1.64E-05	2.278E-05 ± 1.08E-05[a]	3.643E-05 ±1.09E-05	3.292E-05 ± 9.78E-06
120 min	5.910E-05 ± 2.47E-05[b]	3.348E-05 ± 1.62E-05[a,b]	5.398E-05 ± 1.63E05[b]	4.860E-05 ± 1.47E-05[b]
180 min	5.475E-05 ± 2.16E-05[b]	2.995E-05 ± 1.44E-05[a,b]	4.817E-05 ±1.45E-05[b]	4.350E-05 ± 1.31E-05[b]

[a] significantly lower plasma mannitol concentration compared to basal value ($p < 0.05$)
[b] significantly higher plasma mannitol concentration compared to blood sampling at 90 minutes ($p < 0.05$)

Table 2: Plasma lactulose concentration (mol/L; mean ± SD) 90, 120 and 180 minutes after administration of sugar solution at basal values, end of anaesthesia, 12 and 24 hours after the end of anaesthesia

time	basal values	end of anaesthesia	12 h	24 h
90 min	2.29E-07 ± 3.31E-08	2.24E-07 ± 2.43E-08	1.83E-07 ± 7.41E-09[a]	1.80E-07 ± 6.75E-09[a]
120 min	2.92E-07 ± 5.97E-08[b]	2.83E-07 ± 4.4E-08[b]	2.09E-07 ± 1.33E-08[a,b]	2.02E-07 ± 1.26E-08[a,b]
180 min	2.85E-07 ± 5.7E-08[b]	2.64E-07 ± 4.16E-08[b]	2.6E-07 ± 1.27E-08[a,b]	2.01E-07 ± 1.12E-08[a,b]

[a] significantly lower plasma lactulose concentration compared to basal value ($p < 0.05$)
[b] significantly higher plasma lactulose concentration compared to blood sampling at 90 minutes ($p < 0.05$)
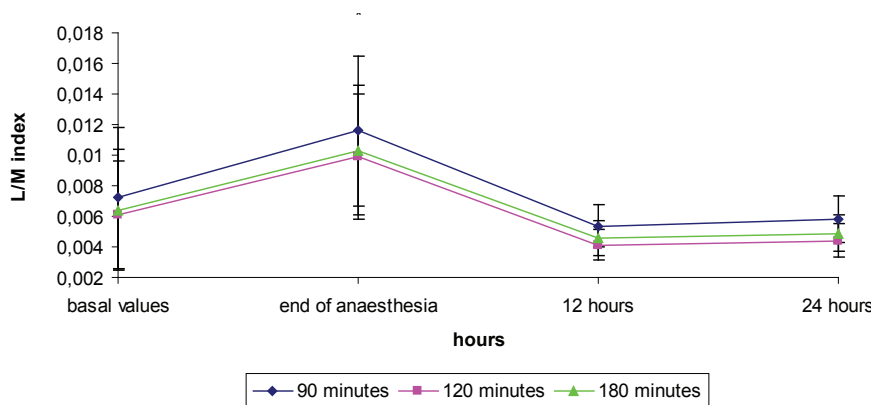

Figure 1: L/M index (mean ± SD) 90, 120 and 180 minutes after administration of sugar solution. *Significant difference compared to basal values ($P < 0.05$)

Table 3: Systolic (SAP), diastolic (DAP) and mean (MAP) blood pressure (mean ± SD) and heart rate (HR; mean ± SD) during anaesthesia

Time (min)	20	40	60	80	100	120	140	160	180	200
SAP (mm Hg)	103 ± 9	107 ± 12	127 ± 13	128 ± 11	124 ± 13	132 ± 22	128 ± 17	138 ± 15	132 ± 11	133 ± 16
DAP (mm Hg)	57 ± 7	61 ± 8	65 ± 8	64 ± 5	64 ± 7	70 ± 11	64 ± 6	71 ± 7	67 ± 7	67 ± 12
MAP (mm Hg)	71 ± 7	73 ± 5	80 ± 7	82 ± 5	79 ± 7	86 ± 13	81 ± 8	88 ± 7	84 ± 6	80 ± 9
HR (beats/minute)	115 ± 26	107 ± 19	106 ± 22	107 ± 20	106 ± 18	109 ± 18	105 ± 20	110 ± 17	104 ± 23	113 ± 24

Results

The highest concentrations of lactulose and mannitol were detected 120 minutes after administration of sugar solution. Plasma mannitol and lactulose concentrations, determined at both 120 and 180 minutes after administration of sugar solution, were significantly higher than at 90 minutes (Table 1 and 2). Comparing to basal values, plasma mannitol concentration

was significantly lower at the end of anaesthesia at all three sampling times (Table 1), while the concentration of lactulose was significantly lower 12 and 24 hours after anaesthesia at all three blood sampling times (Table 2).

Compared to basal values in non-anaesthetized dogs, the L/M index increased significantly due to a decrease of plasma concentration of mannitol at the end of anaesthesia at all blood sampling times (90, 120 and 180 minutes). Lactulose/ mannitol index decreased as early as 12 hours after anaesthesia on account of significantly lower plasma lactulose concentration and there was no significant difference when compared to the basal values (Figure 1).

Discussion

In the present study, dual sugar test with iso-osmolar solution of lactulose and mannitol was used, as described by Papasouliotis at al. (19). The advantage of determining the ratio between disaccharide and monosaccharide is the enhanced sensitivity of the test, since the ratio evaluates not only the raised permeability to a disaccharide, due to opening of intercellular pathway, but also the effect of decreased absorption of a monosaccharide, due to reduced surface area or villous atrophy (2, 4).

Most investigators use physiological iso-osmolar tests rather than hyperosmolar test solutions (7, 20) because permeation of lactulose is markedly increased when the osmolarity of sugar solution increases beyond 1500 mOsm/L (12). Hyperosmolar sugar solution may also cause osmotic diarrhoea, distended abdomen and flatulence, while large volumes of iso-osmolar solutions may affect intestinal motility and alter the contact time between the sugar and the intestinal mucosa (21).

Lactulose and mannitol were detected in plasma with HPLC-MS at all three sampling times, the highest values being obtained 120 minutes after sugar administration. The concentrations of mannitol and lactulose were significantly higher at 120 and 180 minutes than at 90 minutes after sugar administration, which is in agreement with the results of Cox et al., (6) who used lactulose and mannitol to test intestinal permeability in humans. The levels of lactulose and mannitol in serum in their study were relatively stable from 60 to 120 minutes, and the lowest values were detected at 30 minutes after administration. An increased concentration of lactulose in dog serum from 30 to 180 minutes after administration of iso-osmolar sugar solution was also demonstrated by Rodriguez et al. (22).

Factors that can increase intestinal permeability to lactulose include increased perviousness of the intercellular tight junctions and increased accessibility of the luminal content to the intestinal crypts (21).

In the present study, L/M index increased at the end of the anaesthesia on account of decreased plasma mannitol concentration, despite a decrease of plasma lactulose concentration. Splanchnic ischemia is one of the factors that increase gut permeability by reduction of villous flow of up to 10% to 30%. Permeability abnormalities are mainly reflected by a decrease in the excretion of mannitol, while a decrease in the absorption of mannitol suggests a decrease of the functional absorptive area. The decrease in the absorption of mannitol with no increase in lactulose absorption, as observed in the present study, suggests a less severe injury of the mucosa than when both types of absorption are affected (23).

Anaesthesia induced hypotension, mainly due to decreased systemic vascular resistance, may be responsible for splanchnic hypoperfusion (18) and intestinal mucosal damage (24). Although in the present study the mean arterial pressure was maintained above 70 mmHg (Table 3), a value that enables adequate renal and splanchnic perfusion 25), the absorption of mannitol decreased.

Transitory increase in L/M index at the end of anaesthesia in this study may be a consequence of decreased gut motility and therefore reduced delivery of mannitol to the absorptive surfaces. Isoflurane results in a reduced frequency of occurrence of motility periods in rats (26) and gastro-caecal transit time in humans. The addition of ketamine to isoflurane anaesthesia delays gastric emptying and small-bowel transit time in humans (27). Moreover, a delay in gastric emptying and intestinal transit time can be found after intravenous, but not epidural morphine administration in dogs (28). A prolonged delay in gastro-caecal transit time has been also reported for other opioids, such as nalbuphine (27) and pethidine (29) in humans. Long-term methadone use prolongs oral-caecal transit time in humans (30), while no data on single-dose methadone

influence on gastro-caecal transit time is available. We may only assume that methadone which was used in our study, similarly as other opioids, contributed to the reduced delivery of mannitol to the absorptive surfaces.

Conclusions

The most appropriate time for determining plasma lactulose and mannitol concentration in dogs was determined to be 120 minutes after oral administration of dual sugar solution. The transitory increase of L/M index in the present study suggests that general anaesthesia with isoflurane after premedication with methadone and induction with midazolam, ketamine and propofol increases intestinal permeability in healthy normotensive dogs for less than 12 hours.

Acknowledgements

References

1. Hollander D. Intestinal permeability, leaky gut, and intestinal disorders. Curr Gastroenterol Rep 1999; 1: 410–6.

2. Fleming SC, Duncan A, Russell RI, et al. Measurement of sugar probes in serum: an alternative to urine measurement in intestinal permeability testing. Clin Chem 1996; 42: 445–8.

3. Garden OA, Manners HK, Sørensen SH, et al. Intestinal permeability of Irish setter puppies challenged with a controlled oral dose of gluten. Res Vet Sci 1998; 65: 23–8.

4. Sørensen SH, Proud FJ, Rutgers HC, et al. A blood test for intestinal permeability and function: a new tool for the diagnosis of chronic intestinal disease in dogs. Clin Chim Acta 1997; 264: 103–15.

5. Steiner JM, Williams DA, Moeller EM. Kinetics of urinary recovery of five sugars after orogastric administration in healthy dogs. Am J Vet Res 2002; 63: 845–8.

6. Cox MA, Iqbal TH, Cooper BT, et al. An analytical method for the quantitation of mannitol and disaccharides in serum: a potentially useful technique in measuring small intestinal permeability in vivo. Clin Chim Acta 1997; 263: 197–205.

7. Bjarnason I, MacPherson A, Hollander D. Intestinal permeability: an overview. Gastroenterology 1995; 108: 1566–81.

8. Deitch EA, Morrison J, Berg R, et al. Effect of hemorrhagic shock on bacterial translocation, intestinal morphology, and intestinal permeability in conventional and antibiotic-decontaminated rats. Crit Care Med 1990; 18: 529–36.

9. Craven M, Chandler ML, Steiner JM, et al. Acute effects of carprofen and meloxicam on canine gastrointestinal permeability and mucosal absorptive capacity. J Vet Intern Med 2007; 21: 917–23.

10. Huchzermeyer H, Schumann C. Lactulose--a multifaceted substance. Z Gastroenterol 1997; 35: 945–55.

11. Lambert GP. Stress-induced gastrointestinal barrier dysfunction and its inflammatory effects. J Anim Sci 2009; 87: E101–8.

12. Laker MF, Menzies IS. Increase in human intestinal permeability following ingestion of hypertonic solutions. J Physiol 1977; 265: 881–94.

13. Fleming SC, Kynaston JA, Laker MF, et al. Analysis of multiple sugar probes in urine and plasma by high-performance anion-exchange chromatography with pulsed electrochemical detection. Application in the assessment of intestinal permeability in human immunodeficiency virus infection. J Chromatogr 1993; 640: 293–7.

14. Kanwar S, Windsor AC, Welsh F, et al. Lack of correlation between failure of gut barrier function and septic complications after major upper gastrointestinal surgery. Ann Surg 2000; 231: 88–95.

15. Liverani E, Silveri NG, Gasbarrini G, et al. Intestinal permeability increases with the severity of abdominal trauma: a comparison between gas liquid chromatographic and enzymatic method. Hepatogastroenterology 2000; 47: 1037–41.

16. Roškar T, Nemec Svete A, Jerin A, et al. Effect of meloxicam and meloxicam with misoprostol on serum prostaglandins and gastrointestinal permeability in healthy beagle dogs. Acta Veterinaria 2011; 1: 33–47.

17. Rowlands BJ, Soong CV, Gardiner KR. The gastrointestinal tract as a barrier in sepsis. Br Med Bull 1999; 55: 196–211.

18. Hartman JC, Pagel PS, Proctor LT, et al. Influence of desflurane, isoflurane and halothane on regional tissue perfusion in dogs. Can J An-

aesth 1992; 39: 877–87.

19. Papasouliotis K, Gruffydd-Jones TJ, Sparkes AH, et al. Lactulose and mannitol as probe markers for in vivo assessment of passive intestinal permeability in healthy cats. Am J Vet Res 1993; 54: 840–4.

20. Davies NM. Review article: non-steroidal anti-inflammatory drug-induced gastrointestinal permeability. Aliment Pharmacol Ther 1998; 12: 303–20.

21. Randell SC, Hill RC, Scott KC, et al. Intestinal permeability testing using lactulose and rhamnose: a comparison between clinically normal cats and dogs and between dogs of different breeds. Res Vet Sci 2001; 71: 45–9.

22. Rodríguez H, Berghoff N, Suchodolski JS, et al. Kinetic analysis of 5 sugar probes in dog serum after orogastric administration. Can J Vet Res 2009; 73: 217–23.

23. Velasco N, Hernandez G, Wainstein C, et al. Influence of polymeric enteral nutrition supplemented with different doses of glutamine on gut permeability in critically ill patients. Nutrition 2001; 17: 907–11.

24. Derikx JPM, Luyer MDP, Heineman E, et al. Non-invasive markers of gut wall integrity in health and disease. World J Gastroenterol 2010; 16: 5272–9.

25. Mandell DC, King LG. Fluid therapy in shock. Vet Clin North Am Small Anim Pract 1998; 28: 623–44.

26. Ailiani AC, Neuberger T, Brasseur JG, et al. *Quantifying* the *effects* of *inactin vs Isoflurane anesthesia* on *gastrointestinal motility* in *rats* using dynamic magnetic resonance imaging and spatio-temporal maps. Neurogastroenterol Motil 2014; 26: 1477–86.

27. Freye E, Sundermann S, Wilder-Smith OH. No inhibition of gastro-intestinal propulsion after propofol- or propofol/ketamine-N_2O/O_2 anaesthesia. A comparison of gastro-caecal transit after isoflurane anaesthesia. Acta Anaesthesiol Scand 1998; 42: 664–9.

28. Nakayoshi T, Kawasaki N, Suzuki Y, et al. *Epidural administration of morphine facilitates time* of appearance of first gastric interdigestive migrating complex in dogs with paralytic ileus after open abdominal surgery. J Gastrointest Surg 2007; 11: 648–54.

29. Freye E, Helle G. Der Agonist-Antagonist Nalbuphin verlängert die gastro-coekale Transitzeit und induziert kurzfristig Schmerzen nach Neurolepanasthesie mit Fentanyl. Anästhesist 1988; 37: 440–5.

30. Slattery PJ, Mark A, Couch RAF. Analgesic and gastrointestinal effects of nalbuphine: a comparison with pethidine. Anaesth Intensive Care 1986; 14: 121–5.

VPLIV ANESTEZIJE Z IZOFLURANOM NA PREPUSTNOST ČREVESJA PRI ZDRAVIH PSIH

B. Lukanc, J. Butinar, A. Nemec Svete, M. Prošek, A. Seliškar

Povzetek: Namen raziskave je bil ugotoviti najprimernejši čas odvzema krvi za določanje razmerja med laktulozo in manitolom (indeks L/M) in za ugotavljanje ali anestezija z izofluranom zveča indeks L/M in s tem prepustnost črevesne bariere pri psih. Šestim psom smo z orogastrično sondo dali 100 ml sladkorne raztopine, in sicer 3,6 g laktuloze in 3,4 g manitola. Za določitev bazalne vrednosti indeksa L/M smo psom odvzeli kri 90, 120 in 180 minut po dajanju sladkorne raztopine. Naslednji dan smo jih premedicirali z metadonom, v anestezijo pa uvedli z midazolamom s ketaminom in propofolom. Anestezijo smo vzdrževali z izofluranom v kisiku 200 minut. Enako sladkorno raztopino smo psom dali še trikrat, in sicer na koncu anestezije ter 12 in 24 ur po anesteziji. Po vsakem dajanju sladkorne raztopine smo po 90, 120 in 180 minutah odvzeli kri za določitev indeksa L/M. Laktulozo in manitol v plazmi smo določali z metodo HPLC-MS in rezultat izrazili kot indeks L/M. Najvišjo koncentracijo laktuloze in manitola smo zaznali 120 minut po dajanju sladkorne raztopine. Indeks L/M se je, v primerjavi z bazalnimi vrednostmi pri neanesteziranih psih, na koncu anestezije značilno zvišal ne glede na čas odvzema krvi. Anestezija z izofluranom kratkotrajno zveča indeks L/M, saj že 12 ur po anesteziji ni bilo značilne razlike v primerjavi z bazalno vrednostjo. Najprimernejši čas odvzema krvi za določitev indeksa L/M je 120 minut po dajanju sladkorne raztopine.

Ključne besede: pes; izofluran; prepustnost črevesja; indeks L/M