Summary of PhD thesis

INVESTIGATION INTO THE DISEASES OF EXOTIC MAMMALS IN RELATION TO AGE

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1. Introduction

We can get an impression of the frequency of exotic pet species in Hungary when examining the pathological examinations conducted on exotic pets at the Department of Pathology at the University of Veterinary Medicine Budapest between 1993 and 2016. The majority were rabbits and from the rodents guinea pigs

If we examine which organ systems were the cause of death in these two species, we can see that in both rabbits and guinea pigs death was most commonly caused by gastrointestinal or respiratory disease.

In my dissertation I will present my research from the three most major studies on the two most commonly kept exotic pets, rabbits and the guinea pigs, which are also connected to the gastrointestinal and respiratory system.

Since the three studies only have the species in common they will be handled as separate parts.

2. The causes and occurrence of gastric dilatation and volvulus in guinea pigs (*Cavia porcellus*)

2.1. Aim of the study

My hypotheses on the development of gastric dilatation and volvulus in guinea pigs are the following:

a. Gastric torsion is not a disease of female animals, it is not sex dependant
b. Gastric torsion is not a disease of young animals, but the numbers increase with age

2.2. Materials and methods

We diagnosed gastric dilatation and volvulus in 8 cases at the Department of Exotic Animal and Wildlife Medicine, University of Veterinary Medicine Budapest between 2012 and 2018.

A physical examination and a radiographic examination was conducted on all animals. Diagnosis was made during explorative laparotomy

in 7 cases, while 1 case was diagnosed during dissection.

2.3 Results and discussion

The findings of the animals diagnosed with gastric dilatation and volvulus can be seen in **table 1**.

In 4 other cases gastric torsion could be suspected, but the owner of the animal declined explorative laparotomy, nor did they allow dissection after euthanasia. These cases are presented in **table 2.**

Table 1. Cases diagnosed with gastric dilatation and volvulus.

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Age (year)	4,5	5	3,5	2,5	3,5	4	5	2
Sex	Female	Male	Female	Male	Female	Male	Female	Male
Malocclusion	Yes	No	No	Yes	No	No	No	Yes
Anamnesis	Anorexia, weight loss, salivation, tympany	Anorexia, inactivity, tympany, crusty eyes, lack of faeces	Anorexia, weight loss, little amount of faeces,	Anorexia, weight loss	Ovarian cysts, arrived for surgery ó	Anorexia	Anorexia, lack of faeces	Arrived for skin tumour removal
Clinical signs	Painful abdomen, dehydration	Painful abdomen, epiphora, tachycardia, tachypnoe, gas and fluid filled stomach, diarrhoea	Gas-filled intestines, poor condition tachypno e	Painful abdomen, poor condition, dehydration, mass in front of the right nipple	Poor condition, bloat 1 day after surgery	Large gas-filled non painful abdomen, next day the stomach was large and palpable and the condition declined	Painful abdomen tachycardia, tachypnoe, gas-filled stomach	Started bloating after dorsal recumbency
The degree of the torsion	Partial (<180°)	180°	Partial (<180°)	Partial (<180°)	Partial (<180°)	Partial (<180°)	Partial (<180°)	180°

Table 2. Cases in which gastric torsion was suspected

	Case 9	Case 10	Case 11	Case 12
Age (year)	6,5	3	5	3
Sex	Female	Female	Female	Male
Malocclusion	Yes	Yes	No	No
Anamnesis	Change in feed, tympany, syringe feeding not possible after a while	Arrived for ovariohysterectomy	Bloody urine	Been vocalizing for 4 days, received antibiotics
Clinical signs	anorexia, cachexia, tympany, mammary tumour	Condition declines day after surgery, painful tympanic stomach, swallowing difficulty	Poor condition, suspected urolith in bladder	Large abdomen, the animal is lying on its side
Gastric torsion suspected	Based on physical and radiological findings	Based on physical and radiological findings	Based on physical and radiological findings	Based on physical and radiological findings

The owner opted for euthanasia in case 3. In the other 7 cases after a radiographic examination explorative laparotomy was undertaken. Cases 2, 4, 5, 6, and 7. died during surgery or within a day. Case 1 died 94 days after surgery. Case 8 made a full recovery and was well after 500 days post-surgery.

Gastric torsion has been reported in various mammal species already. Morbidity and mortality are high in case of gastric dilatation and volvulus and prognosis is

poor to grave in these cases. Most of the literature is on canine, swine and human cases (Dudley and Boivin, 2011). Diagnosis of gastric torsion is very rare in guinea pigs and is often done post mortem (Dudley and Boivin, 2011).

We performed radiological examinations in every case. In case of a 180° gastric torsions the fundus was on the right side of the abdomen and the gastric volvulus could be immediately suspected. Explorative laparotomy should be performed in every case where the stomach can be seen on the right side of the abdomen on the radiograph.

Summarizing our findings, we can conclude that our hypothesis was correct. Gastric dilatation and volvulus in guinea pigs is not the disease of young female animals but is more commonly seen in middle aged and older animals unrelated to sex. This is a severe, acute and usually fatal disease, with a multifactorial cause. The only way this disease can be cured is by surgical reposition. In our experience chance of survival is low, which can be increased with quick diagnosis and immediate surgery.

2.4. New and novel results

In my first study I concluded that the cause of gastric torsion in guinea pigs is multifactorial. Fewer meals per

day, eating quickly, smaller particle size of the feed, exercise, stress after feeding, competition for pellets, age and an aggressive or fearful nature are all probably risks in the development of gastric torsion in guinea pigs just like in dogs. Gravidity, malocclusion, anatomical anomalies and pain can also be potential factors. Gastric dilatation and volvulus is not the disease of young female guinea pigs. It can be seen in both sexes and is more commonly seen in middle-aged and older animals.

3. The effect of warming anaesthesia gas on the intraoperative body temperature of rabbits (*Oryctolagus cuniculus*) and guinea pigs (*Cavia porcellus*)

3.1. Aim of the study

My hypothesis on warming the anaesthesia gas is the following:

a. Hypothermia during anaesthesia can be decreased in rabbits and guinea pigs by immersing 80 cm-s of the breathing circuit in a 40°C water chamber

The aim of the study was to investigate a method to decrease intraoperative heat loss when using inhalational anaesthesia with a facemask in rabbits and guinea pigs, which is cheap and safe and easy to use in everyday veterinary practice. The method should decrease hypothermia and with this the risk of anaesthesia and complications.

3.2. Materials and methods

The study was conducted at the Department of Exotic Animal and Wildlife Medicine, University of

Veterinary Medicine Budapest. 20 rabbits and 20 guinea pigs were examined. All animals were pets, which arrived to the clinic for a surgical intervention. All surgical patients took part in the research until reaching the numbers needed for the study. The rabbits and guinea pigs were both divided in two random groups. The control group inhaled a gas mixture on room temperature, while the other group inhaled warmed gas mixture. 80 cm-s of the inhalational breathing circuit was immersed in a 40 ±1°C heated water chamber. The water temperature was constantly monitored. The rectal temperature of the patients was noted every 10 minutes and compared with the temperature at the beginning of the surgery.

3.3. Results and discussion

In the 40th minute of anaesthesia, the drop in body temperature in guinea pigs in the non-heated group reached 2.2°C, while this was only 1.2°C in the group inhaling anaesthesia gas from the heated circuit. In case of rabbits, the tendency was similar. In the 40th minute the temperature drop in the non-heated group reached 2.4°C while this was only 1.1°C in the group where the circuit was heated.

When using a face mask the whole head of the patient is covered and so the animal is exposed to the cooling of the room temperature anaesthesia gas mixture (Hawkins and Pascoe, 2012; Grint, 2013). There are various systems on the medical market that can heat and humidify. These are usually expensive and increase dead space. The 40°C gas mixture does not burn the skin and airways of the patients but decreases hypothermia. The system used in my study is cheap and doesn't increase the dead space. Preventing hypothermia and not treating it should be the primary goal during anaesthesia (Grint, 2013). The risk of hypothermia increases with age.

Summarizing our findings, the hypothesis that heating 80 cm-s of the anaesthesia circuit with a 40°C water chamber decreases hypothermia in rabbits and guinea pigs proved to be correct.

3.4. New and novel results

I found that heating 80 cm of the inhalational breathing circuit with a 40 ±1 °C water chamber influences the body temperature of rabbits and guinea pigs and decreases heat loss and with this intraoperative hypothermia. Heat loss was much higher when using anaesthesia gas on room

temperature. The average drop of body temperature in rabbits was 1.01 ℃ by the 40th minute, and 0.6 °C in guinea pigs, when comparing the heated circuit group with the group inhaling room temperature gas mixture. This new method is not only cheap, but an easy way to decrease hypothermia. Negative effects of anaesthesia can be prevented. The risk of hypothermia in older animals is higher, so in their cases it is even more important to prevent hypothermia, which with the use of this method can be achieved.

4. Measurement of tear production and establishment of reference values in guinea pigs (*Cavia porcellus*) using a modified Schirmer tear test

4.1. Aim of the study

My hypotheses on the tear production of guinea pigs are the following:

The modified Schirmer tear test (mSTT) strip can be used in guinea pigs and after establishing reference values can help diagnose keratoconjunctivitis sicca (KCS) in these animals.

a. There is a connection between the tear production of the right and left eye, but both eyes should be measured

b. Usable results can be achieved measuring tear production for only 30 seconds instead of 60 seconds

c. Tear production in guinea pigs is connected to age, tear production in guinea pigs under 1 year of age is lower

4.2. Materials and methods

I examined 81 patients arriving at the clinic of Exotic Animal and Wildlife Medicine, University of Veterinary Medicine Budapest. 68 animals were older and 13 were younger than 1 year of age. 38 animals were male, and 43 were female. Physical and ophthalmologic examinations were undertaken at all animals. Only animals with healthy eyes or diseases that don't influence tear production were used in the study. The body weight and sex of the animals were noted. All measurements were conducted with the use of Eickemeyer (Tuttlingen, Germany) tear test strips from one lot (Art No. 173589). I measured the width of the tear test strip in two places with the help of a ruler and marked it with a pencil on the paper with the help of the calculations of Wieser et al (2013). I cut the 5x35 mm test strip into two 2,5x35 mm pieces with straight, clean, dry scissors. When measuring tear production, the results were noted at 30 seconds and 60 seconds. Just like in the cases of non-modified STTs in other animals I measured tear production from 0 mm-s where 0 mm counted as 0 mm.

4.3. Results and discussion

The average age of the animals was 3.37 ±2.12 years, the average weight was 0.85 ±0.19 kg. The average ±SD (standard deviation) STT results of the right eye were 7.69 ±3.10 mm-s at 30 seconds and 10.46 ±3.84 mm-s at 60 seconds, and 7.85 ±3.25 mm-s at 30 seconds and 10.65 ±4.05 mm-s 60 seconds on the left eye. The average ±SD STT result on both eyes was 7.77 ±3.16 mm-s at 30 seconds and 10.56 ±3.93 mm-s at 60 seconds. The median was 8 mm-s at 30 seconds and 10 mm-s at 60 seconds on both eyes.

Sex and age showed a significant correlation with tear production of the right eye at 30 seconds, while body weight did not. The average tear production of males was 1.4 mm-s less than that of females. Guinea pigs above 1 year of age had a 2.87 mm higher tear production than the animals younger than 1 year of age. The same results were seen when examining the tear production of the left eye at 30 seconds. The average tear production of males was 1.39 mm-s less than in females and the animals above 1 year of age had a 2.41 mm higher tear production than the younger animals. When examining the right eye at 60 seconds the results were similar, but the differences were

larger, than in the measurements at 30 seconds. The average tear production of males was 1.91 mm-s less than in females and the animals above 1 year of age had a tear production increase of 3.81 mm-s. When examining the left eye at 60 seconds the results are similar but there were small differences to the previous results. The average tear production of males was 1.49 mm-s less than in females, which shows a smaller amount of tears. And the animals above 1 year of age had an increased tear production of 3.19 mm-s compared with the young animals. When measuring for 30 seconds, the average tear production of the right eye was 0.16 mm less than that of the left, but this difference was not significant. When measuring for 60 seconds the average tear production of the right eye was 0.20 mm-s less than that of the left eye, but this difference was not significant.

The standard 5 mm STT strips currently used in everyday veterinary practice are too wide for smaller eyed animals, like rodents, and don't give clinically relevant results due to the low amount of tear production in these animals. These strips are not adequate for the measurement of tear production in guinea pigs.

Tear production values above 8 mm-s at 30 seconds and above 10 mm-s at 60 seconds can be considered normal when using the modified STT strip. There are ambiguous areas at 5-8 mm-s at 30 seconds and 6-10 mm-s at 60 seconds where results should be combined with clinical symptoms and judgement as they may be low for some and normal for others without causing any clinical signs of keratoconjunctivitis sicca.

My hypotheses concerning the tear production of guinea pigs proved to be correct. The tear production of young animals is lower than in animals over 1 year of age. The mSTT strip can be used to diagnose keratoconjunctivitis sicca. There is correlation between the tear production of the right and left eye, but both should be measured when possible and if possible then for 60 seconds, but if that is not possible 30 seconds can also be used to diagnose keratoconjunctivitis sicca with the help of the reference values.

4.4. New and novel results

I measured tear production in guinea pigs in my third study and developed a new method to measure the small amount of tears produced by guinea pigs. I developed reference

values so diseases involving reduced tear production like keratoconjunctivitis sicca can be diagnosed. I showed, that the tear production of the right and left eye is connected to the sex of the guinea pig, but not to the weight. There is a correlation in tear production of the two eyes but measurements should be conducted on both, when possible, if we suspect disease. I showed that measuring tear production with a mSTT strip for 30 seconds instead of 60 seconds can also be enough, but since the strip used for 60 seconds can be easier to interpret, measuring for 60 seconds is advised. I found that age influences the mSTT results. Young animals under 1 year of age had lower tear production values, than older animals.

5. References

Dudley E.S., Boivin G.P.: **Gastric volvulus in guinea pigs: comparison with other species.** J. Am. Assoc. Lab. Anim. Sci., 50. 526–530. 2011.

Grint N.: **Anaesthesia**. In: Harcourt-Brown F., Chitty J. (eds,): BSAVA Manual of Rabbit Surgery, Dentistry and Imaging. BSAVA. Gloucester, UK. 1–38. 2013.

Hawkins M.G., Pascoe P.J.: **Anesthesia, Analgesia, and Sedation of Small Mammals** In: Quesenberry K.E., Carpenter J.W. (eds.): Ferrets, Rabbits, and Rodents: Clinical Medicine and Surgery, 3rd ed. Elsevier Saunders. St. Louis, USA. 429–451. 2012.

Wieser B., Tichy A., Nell B.: **Correlation between corneal sensitivity and quantity of reflex tearing in cows, horses, goats, sheep, dogs, cats, rabbits, and guinea pigs.** Vet. Ophth., 16. 251-262. 2013.

6. Scientific publications

Publications in peer-reviewed scientific journals with an impact factor

Nógrádi A.L., Szentgáli Zs., Battay M., Cope I., Gál J., Németh T.: **Measurement of tear production and establishment of reference values in guinea pigs (Cavia porcellus) using a modified Schirmer tear test.** Veterinary Record, 186. 321. 2020.

Nógrádi A.L., Battay M., Cope I., Gál J., Dunay M.P.: **Az inhalációs gázkeverék melegítésének hatása nyulak (*Oryctolagus cuniculus*) és tengerimalacok (*Cavia porcellus*) intraoperatív testhőmérsékletére**. Magyar Állatorvosok Lapja, 141. 93-100. 2019.

Nógrádi A.L., Cope I., Balogh M., Gál J.: **Review of gastric torsion in eight guinea pigs (Cavia porcellus).** Acta Veterinaria Hungarica. 65. 487-499. 2017.

Nógrádi A.L., Csikó Gy., Gál J.: **Gyomormegterhelés és helyzetváltozás tengerimalacban (Cavia porcellus). Esetismertetés.** Magyar Állatorvosok Lapja. 137. 159-165. 2015.

Publications in peer-reviewed scientific journals without an impact factor

Nógrádi A.L., Battay M., Cope I., Németh T**.: The effect on the anaesthetised rabbit (*Oryctolagus cuniculus*) by warming 60 or 80 centimetres of the anaesthetic circuit with a 40°C surrounding liquid.** UK Vet Companion Animal: elfogadva 2020.05.18.

Conference presentations

Nógrádi A.L., Szentgáli Zs., Battay M., Cope I., Gál J.: **Using the modified 2.5 mm Schirmer tear test strips in Guinea Pigs in exotic practice: Personal experience of the technique**. International Conference on Avian Herpetological and Exotic Mammal Medicine 28.04.-02.05.2019, London, United Kingdom

Nógrádi A.L., Battay M., Cope I., Gál J.: **The effect on the anesthetised rabbit patient of warming 60 centimetres of the anesthetic circuit during inhalation anesthesia with a 40°C surrounding liquid**. International Conference on Avian Herpetological and Exotic Mammal Medicine 28.04.-02.05.2019, London, United Kingdom

Nógrádi A.L., Balogh M., Gál J.: **Heveny gyomormegterhelés és következményes**

gyomorcsavarodás okainak és kialakulásának vizsgálata tengerimalacban (*Cavia porcellus*). Akadémiai beszámoló 25-28.01. 2016, Budapest, Hungary

Posters

Nógrádi A.L., Marosán M., Ziszisz Á, Gál J: **Tengerimalacok (*Cavia porcellus*) időskori elhullási okainak retrospektív vizsgálata 1993-2001 között.** Magyar Laborállat-tudományi Egyesület CEELA-III Conference, 28.11.2015, Budapest, Hungary.

Nógrádi A.L., Marosán M., Vad Á., Gál J: **Időskorú csincsillák (*Chinchilla lanigera*) elhullási okainak retrospektív vizsgálata 1993-2001 között.** Magyar Laborállat-tudományi Egyesület CEELA-III Conference, 28.11.2015, Budapest, Hungary.

Nógrádi A.L., Marosán M., Gál J: **Időskorú aranyhörcsögök (*Mesocricetus auratus*) elhullási okainak retrospektív vizsgálata 1993-2001 között.** Magyar Laborállat-tudományi Egyesület CEELA-III Conference, 28.11.2015, Budapest, Hungary.