UNIVERSIDADE DE ÉVORA

ESCOLA DE CIÊNCIAS E TECNOLOGIA

Departamento de Medicina Veterinária

Clínica de Animais de Companhia

Seizures:

An intracranial arachnoid cyst as cause with surgical treatment

Diana Isabel Carvalho Lavareda

Orientador: Profª Dr.ª Joana Reis
Co- orientadores: Dr. John Culvenor
Dr. Luís Montenegro

Mestrado Integrado de Medicina Veterinária

Relatório de Estágio

Évora, 2014

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A. Acknowledgement

All in our lives is about to make dreams come true, step by step. In each step, we have important people, staying with us since the beginning or coming to us in specific moments of our life-line with support, love, good energies, with friendships and without asking anything back. These people are important people and make our life-way easier and happier. So, I can't start writing my thesis without say thank you to my *important people*.

The first acknowledgment is for my parents, Firmo and Maria Lavareda, who make me an independent person and give me the opportunity to study the MSc of Veterinary Medicine in the University of Evora. Thank you for make me a stronger and a trustful person; to make me believe in my dreams, even if they've seemed much too huge. However, everything in life is possible if we really want it, because if we can dream it so we can do it.

The second acknowledgment is for my sister, Debora Lavareda, for all phone calls and conversations without counted time, talking about my challenges during the university-time, for all support and positive sight of things. Each time I stopped to see the good side of the most difficult moments, she was there for me and I'm thankful for it.

One of my biggest thank you is also for my closest friends as well, because without them I couldn't be the same person who I am today. It's true I've been doing decisions by myself, but these decisions have been based in my life experiences and my friends always have a high role on it. They know who they are.

A big thank you to my supervisor Joana Reis (University of Evora) and my co-supervisors John Culvenor (North Shore Veterinary Hospital) and Luis Montenegro (Montenegro Veterinary Hospital) as well. Thank you for all the support along this last year of my MSc degree.

My last and huge acknowledgment is to Joao Ferreira, there are no words to describe your importance in my life since the last 4 years. If I'm writing this Internship Report, is because you made me see there are no obstacles in life with reason enough to stop us dreaming. Thank you to show me how to love neurology, because the way you've been talking about its issues make me admire more and more this beautiful field. If the monograph is about neurology, it's because you've been my neurology's mentor.

It has been a hard way to finish the internship report, but with my *important people*'s support, now it's already done. I'm very thankful to have all of you in my life.

However, there is a certainty I'd like to share with you. This internship report is not a milestone of the end; this is only the beginning of my life as veterinarian.

B. Abstract:

The last year of Veterinary Medicine's MSc degree is reserved to do an internship where the veterinary student has the opportunity to improve his skills. This internship report is the final result from six months of internship done in two different veterinary hospitals, one from Sydney (Australia) and the other one from Oporto (Portugal).

The first part of this document is focus on the activities undertaken along the internship, outlined by graphs and tables. There are also descriptions of those activities, using figures and some bibliography to complement it.

A monograph about seizures – an intracranial arachnoid cyst as cause with surgical treatment makes up the second part of this internship report. It starts with literature review about seizures and ends with one successful case report followed by the internal medicine and surgery specialists of the veterinary hospital in Sydney.

Key-words: seizures, space occupying lesions, intracranial arachnoid cyst, cystoperitoneal shunt.

C. Resumo:

"Clínica de Animais de Companhia" – Convulsões: uma causa quística intracraniana com tratamento cirúrgico.

O último ano do Mestrado Integrado em Medicina Veterinária é reservado à realização do estágio curricular, onde o qual o estudante de medicina veterinária tem a oportunidade de desenvolver e melhorar os seus conhecimentos. Este presente relatório é o resultado final de seis meses de estágio, realizado em dois hospitais veterinários, um deles localizado em Sidney (Austrália) e o outro no Porto (Portugal).

A primeira parte deste documento está direcionada às atividades desenvolvidas durante o estágio, esquematizadas em gráficos e tabelas. Também foram acrescentadas descrições às mesmas, recorrendo ao uso de imagens e bibliografia de maneira a documentá-las da melhor maneira possível.

Uma monografia perfaz a segunda parte deste relatório de estágio, com o tema "Convulsões: uma causa quística intracraniana com tratamento cirúrgico". Esta inicia-se com uma revisão bibliográfica sobre convulsões, terminando com um relato de um caso de sucesso seguido pelos especialistas do hospital veterinário de Sidney.

Palavras-chave: convulsões, lesões ocupantes de espaço, quisto intracranial, ligação quisto-peritoneal.

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G. Abbreviators

ACVIM- American college veterinary internal medicine;

ALP- Alkaline phosphatase;

ALT- Alanine aminotransferase;

ARF- Acute renal failure;

AST- Aspartato transaminase;

BAL- Bronchoalveolar lavage;

BAR- Bright, alert and responsive;

BID- Two times a day;

BUN- Blood urea nitrogen;

CCLR- Cranial cruciate ligament rupture;

CCoV- Canine coronavirus;

CHOP- Cyclophosphamide, vincristine, doxorubicin, prednosine;

CKD- Chronic kidney disease;

CPE- Cardiogenic pulmonary edema;

CPS- Cystoperitoneal shunt;

CPV- Canine parvovirus;

CREA- Creatinine;

CRI- Constant rate infusion;

CSF- Cerebrospinal fluid;

CT – Computed tomography;

CTR- Capillary time refill;

DNA- Deoxyribonucleic acid;

DVHD- Degenerative valvular heart disease;

ECG- Electrocardiography;

EDTA- Ethylenediaminetetraacetic acid;

FB – Foreign body;

FeLV- Feline leukemia virus;

FIP – Feline infectious peritonitis;

FLAIR- Fluid attenuation inversion recovery;

FLUTD – Feline lower urinary tract disease;

FNA- Fine needle aspirates;

GABA- Gamma-aminobutyric acid;

GD- Gastric dilatation;

GDV- Gastric dilatation volvulus;

GGT- Gamaglutamiltranspeptidase;

GP – General practice;

IAC- Intra arachnoid cyst;

IBD – Inflammatory bowel disease;

ILAE- International League Against Epilepsy;

IM- Intramuscular route;

IRIS- International Renal Interest Society;

IV- Intravenously route;

MCHC- Mean cell hemoglobin concentration;

MCV- Mean cell volume;

MM- Mucosal;

MRI – Magnetic resonance imaging;

MVH – Montenegro Veterinary Hospital;

NCPE- Non cardiogenic pulmonary edema;

NSVH – North Shore Veterinary Hospital;

OD- Right eye;

OE- Otitis externa;

OS- Left eye;

PD- Periodontal disease;

PO- *Per os;*

PU- Polyuria;

PZI- Protamine zinc insulin;

QID- Four times a day;

SC- Subcutaneous route;

SID- One time a day;

T1/2- Half-time;

T3- Triiodothyronine;

T4- Thyroxine;

TAS- Tick antiserum;

TID- Three times a day;

TPLO- Tibial plateau leveling osteotomy;

TTA- Tibial tuberosity advancement;

TWO- Tibial wedge osteotomy;

USG- Urine specific gravity.

I. Introduction

The last year of MSc Veterinary Medicine consists on internship with the goal of improving the veterinary student skills through practice and "hands-on" approach.

This particular internship was done in two different places and had a total period of six months. The first part of this internship was started in Sydney, Australia, in a referral veterinary hospital called North Shore Veterinary Hospital (NSVH). The co-supervisor from this hospital was Dr. John Culvenor. For two months (the internship was started at 23rd September 2013 and it was finished at 23rd November 2013), five days a week, ten hours a day, the co-supervisor and all veterinary team shared their knowledge and vastly experience with the trainee.

The second part of the internship was in Oporto, Portugal, in the Montenegro Veterinary Hospital (MVH), where it lasted four months. Dr. Luis Montenegro (the clinical director) was the co-supervisor. The schedule done at Montenegro Veterinary Hospital was eight hours a day, one night-shift per week and one twenty-four hours shift (at the weekends), once or twice a month. It was started at 3rd December 2013 and it finished at 31st March 2014.

This internship aimed at improving the veterinary practice and reinforcing the theory learned at the university. Opportunity was given to deal with the pet's owners, improving communication skills and the best manner to proceed to the consult. It was the trainee's responsibility to do the clinical exams and the treatments on the hospitalized animals, to help on the complementary exams [it includes blood work, ultrasound, echocardiography, electrocardiography (ECG), x-ray, computed tomography (CT scan), endoscopy, others] and to be the surgeon's assistant when it was required.

After six months working with animals and people, there is a lesson to learn about these type of internships: they're not only about to improve veterinary practice, but also they give the opportunity to improve the work team, the communication and make the veterinary student a better and more responsible person.

This internship's report describes all the activities done in both hospitals. The first part refers the developed activities, presented in graphics and tables. An attempt to cross some data as age, genre, reproduction state and breeds was made in this internship's

report because there was enough number of cases to get some interesting conclusions about the most common diseases.

The second part of this internship's report is reserved to the monograph: Seizures – an intracranial cyst as a cause with surgical treatment. The reason for this subject selection was the passion for neurology and neurosurgery fields. The neurological diseases in veterinary medicine are likely under diagnosed, most of time because the complementary exams are expensive and sometimes the treatments aren't good enough to cure the cause or to give a good life quality to the patient.

The monograph has the goal to show another insight of the neurological diseases. If we don't give up on our patients, successful treatment is possible.

II. Hospital's description and activities' description

1. North Shore Veterinary Hospital:

The North Shore Veterinary Hospital is a referral veterinary hospital located at the Atchison Street in the North of Sydney city. It's a three floor building open 24 hours a day, 365 days a year. It has five offices where veterinarians receive their patients, one treatment room, two internment rooms and one kennel, two operating theaters, one ultrasound room, one x-ray room, one CT scan room and one pharmacy. All the rooms were superbly equipped providing a standard care and expertise appropriate optimal health care. The hospital has a remarkable veterinarian's specialist's team, divided by veterinary areas: internal medicine, surgery, ophthalmology, exotic animals, general practice and critical care (after hours).

The co-supervisor, Dr. John Culvenor (one of the surgeons specialists), organized the first ten weeks of the internship by veterinary areas. It was started with three weeks in surgery, two weeks in general practice (GP), one week in veterinary emergencies (also called after hours) and to finish it, four weeks in internal medicine. Since two months of internship is a short time period in a new place with new routines, the decision to put aside the fields as ophthalmology and exotic animals was made.

In surgery there was the opportunity to see the most complex surgeries usually done in that hospital. The two surgery specialists in NSVH are John Culvenor and Craig Bailey. It was the trainee's responsibility to help the surgery's nurses to prepare the animal for the surgical intervention, to calculate and prepare the dose of pre-surgical medication and anesthetics, to fill the anesthesia form, and when it was needed, to be the surgeon's assistant.

During the time dedicated to general practice, the trainee attended consults and surgeries with the GP veterinarians Bronwyn Walker, Naomi Morgan, Mikala Welsh and Peter Chitty.

The GP team is responsible for preventive medicine consults and they usually do the first approach of the most common diseases when it wasn't needed a specialist to see the patient. Routine surgeries, as neutering, are done by them as well.

The veterinary emergency was the third veterinary area. Over one week a night shift was done from 9:00 pm to 7:00 am (ten hours) following the overnight veterinarians and nurses.

Night work is harder because there are many different tasks to do. The hospitalized animals from all the NSVH veterinary areas were to be treated, emergencies were received, medical support provided to the new critical patients and phone calls of concerned owners were answered. However, the work was well distributed by all afterhours' team.

The last and most interesting veterinary area of the internship was internal medicine. For four weeks it was possible to follow the veterinary's specialists of this area: Richard Churcher and Jody Braddock. The internal medicine team treats complicated cases and has had a high success in cardiac and oncologic diseases. However, during these weeks, it was possible to see not only cardiac and oncologic cases, but also cases from neurology, nephrology/urology, endocrinology and gastroenterology. In this area, the trainee's role was to help the veterinarians in exams as endoscopy, bronchoscopy, colonoscopy, ECG, echocardiography, abdominal ultrasound, thorax and abdominal x-rays, check pacemakers. The interpretation of CT scan and magnetic resonance imaging (MRI) results in neurological patients and chemotherapy in oncologic patients were also done.

Every Thursday's mornings, in each 15 days, the NSVH veterinarians and other invited veterinarians have had a meeting at the hospital to discuss the most interesting cases of the fortnight. There was the opportunity for the trainee to do two presentations to exhibit in these meetings; the first one was about *FLUTD – Feline Lower Urinary Tract Disease* and the second one was about *Chronic Hepatopathy in cats*.

The next two figures (fig.1 and 2) show the front of the North Shore Veterinary building and part of veterinary staff of the night shift in the treatment room.

Fig.1 - North Shore Veterinary Hospital building

Fig.2 – Mishka, the vet nurse (on the left); Diana; Natalie, the vet nurse; Mikala, the GP veterinarian (on the right) in the treatment room after one night shift

2. Montenegro Veterinary Hospital:

The Montenegro Veterinary Hospital is a referral veterinary hospital in the north of Portugal, located in Oporto. The MVH has two buildings, the hospital and a small clinic. The hospital is situated at Povoa Street, no. 34 and the clinic at Pereira Reis Street, no.121, both of them in Oporto.

The hospital is duly equipped to receive the critical patients and referral cases. The building has three offices, two internment rooms, two operating theaters, one ultrasound room, one x-ray room, one CT scan room and one laboratory.

The clinic is only prepared to receive consults of preventive medicine, general practice and has a kennel for pets' hotel. The building has two offices, two internment rooms, one operating theater, and one room for x-ray and ultrasound.

The co-supervisor, Dr. Luis Montenegro (the director of the MVH) suggested to his trainees two day shift schedules: the first one was from 9:00 am to 5:00 pm and the second one was from 2:00 pm to 10:00 pm. All the MVH trainees had a distribution of these two schedules along the week and between the buildings with the aim to get experience in diverse veterinary areas.

During the day shift, the priority of the trainees was to take care of the hospitalized animals, giving the medication, doing the physical exams to the patients and helping the veterinarians on specific treatments. When these treatments were done in the internment room, it was given the opportunity to attend to the consults with the veterinarians Luis Montenegro, Daniel Gonçalves, Bruno Tavares, Marta Pinto, Rui Pereira, Filipe Oliveira, Nuno Silva, Rafaela Rego and Ana Cota. In these consults, the trainee's role was doing physical exams to the patients, helping with anamnesis and the animal contention.

Daily, it was also possible to attend to the complementary exams as x-rays, abdominal ultrasound, endoscopy, CT scan. The trainees could take part of those exams' interpretation and follow team discussion.

One night per week a night shift was done with a schedule from 5:00 pm to 9:00 am of next day. During the overnight the after hour's team received critical patients and took care of the hospitalized animals, giving them the medication and doing the physical exams.

Along the internship in MVH it was given the opportunity to be the surgeon's assistant and the anesthetist on interesting surgeries under fields as oncology, neurosurgery, orthopedy, reproduction and gastroenterology with surgeons Marta Pinto and Luis Montenegro.

The next figure (fig.3) shows the front of the Montenegro veterinary hospital and its team.

Fig.3 – Front of Montenegro Veterinary Hospital and its team

III. Internship's developed activities

This part of the internship report is reserved to analyze the developed activities in the North Shore Veterinary Hospital and Montenegro Veterinary Hospital. In order to better reflect, the differences found in between the two hospitals, a decision was made to organize the clinical cases in separate. However, the graphics and tables are the same for both hospitals with the aim to visualize differences from the results.

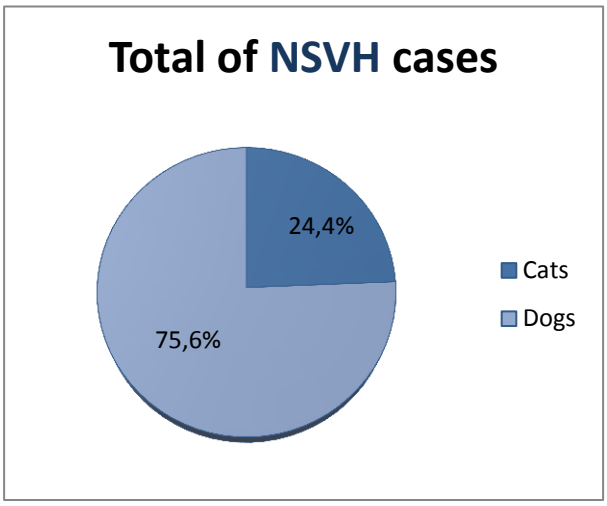
A general approach of the total followed up cases is presented and then absolute and relative frequencies of observed specific conditions are described. They were called conditions, not diseases, because not all cases that came to the hospitals obtained a definitive diagnosis, some of them only received symptomatic treatment.

To make this internship's report more interesting, after presenting the case data some conditions/diseases were developed.

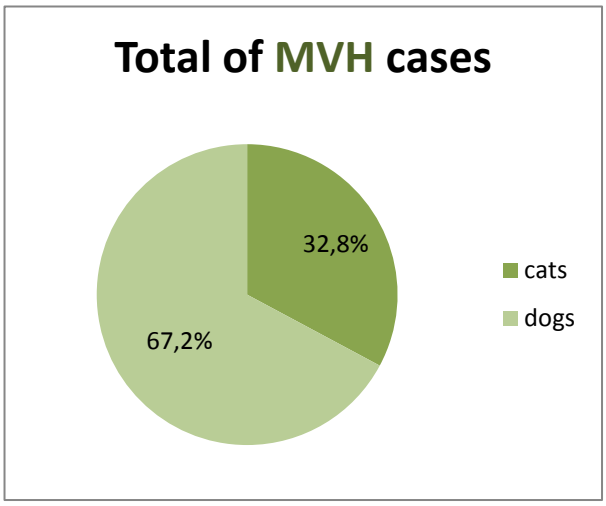
The condition's choice was made based on the larger number of cases or on the cases thought to be more interesting.

In six months of internship, a total of 482 cases (100%) were followed: during the two months at the NSHV a total of 156 cases (32.4%) were seen, whilst during the four months at MVH a total of 326 cases (67.6%) were observed.

The graphic no.1 and the graphic no.2 show the total of the followed cases, separated by dogs and cats.



Graphic no.1 - Distribution of total of NSVH followed cases (n=156) between species

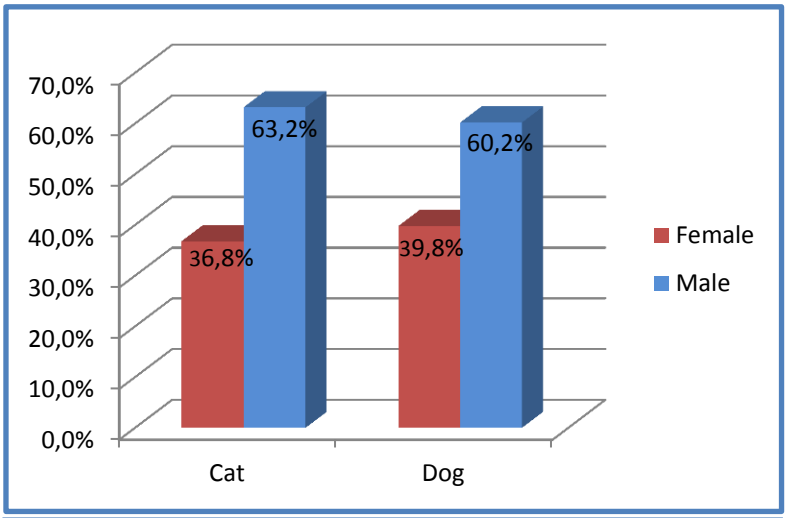


Graphic no.2 - Distribution of total of MVH followed cases (n=326) between species

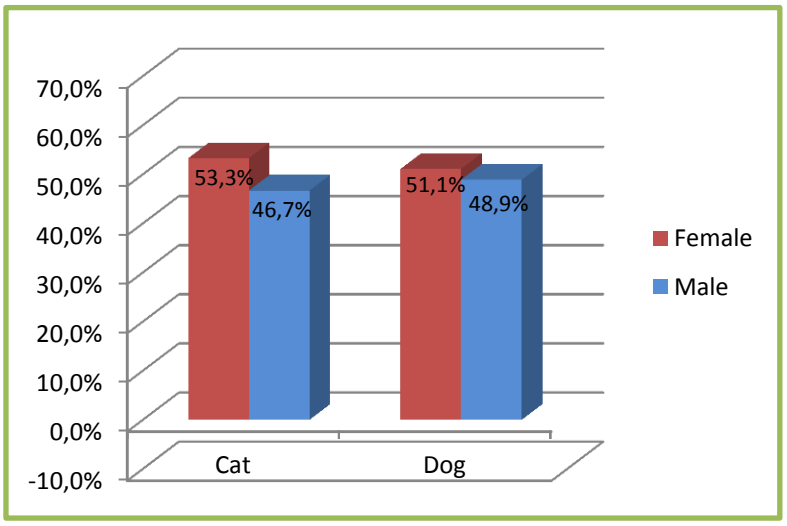
The graphic no.1 shows the percentage of dogs and cats which were followed in the North Shore Veterinary Hospital. From 156 of total cases (100%), 75.6% were dogs (n= 118) and 24.4% were cats (n=38).

With the graphic no.2 we can see the percentages belonging to the Montenegro's Veterinary Hospital. 67.8% (n=219) of a total of 326 cases (100%) were dogs and 32.8% (n=107) were cats.

The graphics no.3 and no. 4 represent the total of females and males of dogs and cats followed in both hospitals, NSVH and MVH.



Graphic no.3 - Distribution of total of NSVH followed cases (n=156) by genre in each specie



Graphic no.4 - Distribution of total of MVH followed cases (n=326) by genre in each specie

The graphic no.3 shows the amount of females and males of both species at the NSVH. As it could be seen, into the total of cats (n=38), 36.8% (n=14) were females and 63.2% (n=24) were males. In the total of dogs (n=118), the percentage of females was 39.8% (n=47) and males was 60.2% (n=71). Both of species, dogs and cats, have a predominance of male genre.

The graphic no.4 represents the percentages of genres in cats and dogs at MVH. The percentage of female cats was 53.3% (n=57), and male cats made up 46.7% (n=50) of the total followed cats (n=107). Relatively to the dogs (n=219), 51.1% (n=112) were females and 48.9% (n=107) were males.

Picking up the information of graphics above, it could hold true there is a predominance of dog's specie, in both hospitals. The NSVH has had a higher percentage of male cats and male dogs followed up cases, unlike the MVH which has had more female cats and female dogs as patients. Perchance, there is no scientific reason for this statistics, once enumerable causes as owner's genre preference, country culture, the most common diseases in each country, diseases with predisposition of genre, etc., could be the reason for the differences.

The table no.1 has a resume of the previous graphics and it will include the amount of entire and spayed/neutered animals from NSVH.

Table no.1 – Resume of the graphics information above and distribution of reproduction state by specie and genre of NSVH treated animals

Total of treated Animals NSVH 100% (n=156)	Cats	24.4% (n=38)	female	36.8% (n=14)	spayed	85.7% (n=12)
					entire	14.3% (n=2)
			male	63.2% (n=24)	neutered	95.8% (n=23)
					entire	4.2% (n=1)
	Dogs	75.6% (n=118)	female	39.8% (n=47)	spayed	89.4% (n=42)
					entire	10.6% (n=5)
			male	60.2% (n=71)	neutered	88.7% (n=63)
					entire	11.3% (n=8)

As it could be seen, spayed female cats were 85.7% (n=12/14), while entire female cats were 14.3% (n=2/14). Among of male cats, 95.8% (n=23/24) were neutered and the 4.2% (n=1/24) were entire.

In the dog species, the spayed female predominates with 89.4% (n=42/47), while entire female were 10.6% (n=5/47). The results for the male dogs were similar: 88.7% (n=63/71) of male dogs were neutered and 11.3% (n=8/71) were entire.

The table no.2 lists a resume of the graphics and includes the amount of entire and spayed/neutered animals from MVH:

Table no.2 – Resume of the graphics information above and distribution of reproduction state by specie and genre of MHV treated animals

Total of treated animals MVH 100% (n=326)	Cats	32.8% (n=107)	female	53.3% (n=57)	spayed	33.3% (n=19)
					entire	66.7% (n=38)
			male	46.7% (n=50)	neutered	14% (n=7)
					entire	86% (n=43)
	Dogs	67.2% (n=219)	female	51.1% (n=112)	spayed	27.7% (n=31)
					entire	72.3% (n=81)
			male	48.9% (n=107)	neutered	16.8% (n=18)
					entire	83.2% (n=89)

In the MVH, most of cats, both male and female, were entire. The same trend was observed amongst the canine patients.

Analyzing the information about the reproduction state in both tables, the percentages of entire and spayed/neutered cats and dogs are clearly different between hospitals. In the NSVH, 92.1% of total cats (n=38) and 89% of total dogs (n=118) were spayed/neutered.

These are high percentages if we compare with the MVH percentages: 24.3% of total cats (n=107) and 22.4% of total dogs were spayed/neutered.

There are a few reasons for higher desexing percentages in Australia: people are taught by veterinarians about the advantages of neutering their animals (unwanted pregnancies, prevention of behavioral issues and diseases, etc.); usually Australian people have dogs and cats not for breeding purposes or working but as pets at home and desexing their animals, in fact, improves their lives together; other reason is because all animals must

be registered with the council by the age of six months and the cost of this registration is higher for entire animals; dogs and cats that come from a rescue are desexed before they are handled to their new owners.

In Europe the animal welfare is closer to animal rights and the culture is vastly different in this respect. But in the trainee's opinion, Portugal is improving the desexing issue, however, to get higher percentages of spayed/neutered animals we need to have more enforces as veterinarians to improve the knowledge of the owners about the advantages of neutering. Economical restrictions may also influence the owners' willingness to neuter their animals.

The next two tables (table no.3 and no.4) have the goal to list the amount of dog and cat breeds of the treated animals in the NSVH:

Table no.3 –Dog breeds of NSVH followed cases

Breed	No. dogs	Breed	No. dogs
Australian Terrier	1	**Labradoodle**	4
Beagle	3	**Labrador**	18
Border Collie	3	**Ihasa Apso**	1
Boxer	5	**Maltese Crossed**	1
English Bull Dog	1	**Maltese Shih Tsu**	1
Cattle Dog	2	**Mini fox terrier**	1
Cattle Dog x Kelpie	1	**Mini Labradoodle**	1
Chihuahua	5	**Miniature Border Collie**	1
Cocker Spaniel	3	**Miniature Dachshund**	1
Crossed Breed	8	**Miniature Schnauzer**	1
Fox Terrier	3	**Poodle**	5
French Bull Dog	7	**Pug**	2
German Shepherd	3	**Rhodesian Ridgeback**	2
Golden Retriever	7	**Rottweiler**	1
Great Dane	1	**Shih Tsu**	1
Havanese	1	**Staffordshire Terrier**	2
Hungarian Vizla	1	**Schnoodle**	1
Jack Russel	2	**Tibetan Spaniel**	1
Japanese Spitz	1	**Toy Poodle**	2
Keeshand	1	**West Highland**	1
Kelpie	3	**Wheaten Terrier**	1
Cavalier King Charles	7		
Total of dogs: 118			

Table no.4 - Cat breeds of NSVH followed cases

Breed	No. cats
Birman	1
British Short Hair	7
Burmese	2
Domestic Short Hair	26
Long Hair	1
Persian	1
Total of cats: 38	

The most common dog breed received at NSVH was the Labrador retriever. The Crossed breed was the second most common breed, followed by King Charles Cavalier, Golden Retriever and French Bulldog. Relatively to the cat breeds, the most common was the Domestic Short Hair and the second one was the British Short Hair.

The table no.5 and no.6 show the amount of dog and cat breeds in the MVH:

Table no.5 –Dog breeds of MVH followed cases

Breed	No. dogs	Breed	No. dogs
Basset hound	4	**Labrador**	19
Beagle	3	**Maltese Bichon**	4
Belgian Shepherd	1	**Miniature Schnauzer**	1
Bernese Mountain Dog	1	**New Foundland**	1
Boxer	5	**Pekingese**	2
Cane Corso	2	**Portuguese Pointer**	2
Chihuahua	1	**Pincher**	3
Cocker Spaniel	3	**Pitt bull**	1
Collie	3	**Poodle**	10
Crossed Breed	86	**Pug**	3
Dalmatian	1	**Rottweiler**	5
Doberman	3	**St Bernard**	2
English Bulldog	4	**Schnauzer**	2
French Bulldog	3	**Serra da Estrela**	1
German Shepherd	11	**Shar Pey**	1
Golden Retriever	3	**Shih Tzu**	2
Grand Noir	5	**Spitz**	2
Herdsman Bern	1	**Teckel**	2
Husky	2	**Weimaraner**	1
Jack Russel	1	**Whippet**	1
Cavalier King Charles	2	**Yorkshire Terrier**	8
Castro Laboreiro	1		
Total of dogs: 219			

Table no.6 - Cat breeds of MVH followed cases

Breed	No. cats
Common European	95
Persian	9
Scottish Duchound	1
Siamese	1
Sphinx	1
Total of cats: 107	

With the table no.5 we can see the Crossed breed as the most common dog breed in the MVH. The second most common breed was the Labrador retriever, followed by German Shepherd and Poodle. Looking at the table no.6, the cat breed with more number of cases was the Common European, followed by Persian.

There are a high number of different breeds in each hospital and also between them. During the internship the NVSH received 43 different dog breeds and six cat breeds. Some of these breeds are from Asia and Australia and for that reason the trainee had the opportunity to improve her breed's knowledge. The MVH received 43 different dog breeds and five cat breeds, most of them European breeds. With this breed's information we could get closer to the owner's breed preference. Better knowledge on the most popular breeds improves clinical practice through knowledge on the most common diseases.

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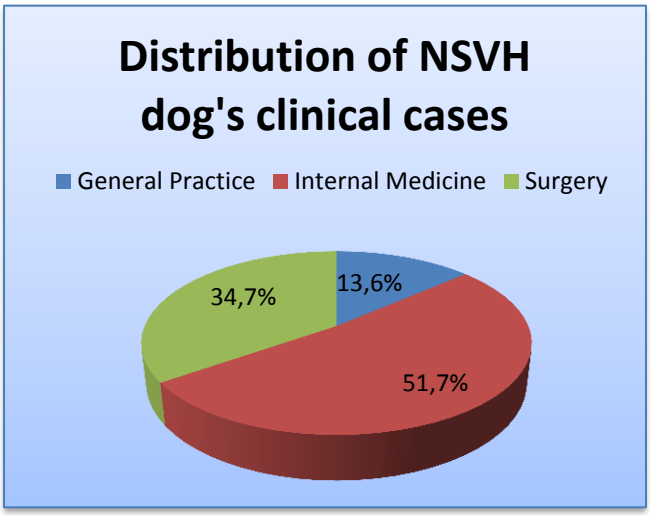
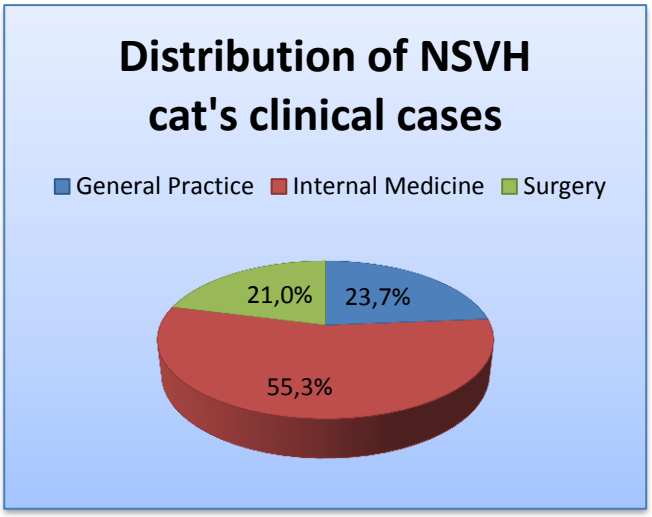
The NSVH followed cases were separated them by general practice, internal medicine and surgery. The graphics no.5 and no.6 show the percentages of cases between the fields aforementioned belonging to the NSVH.



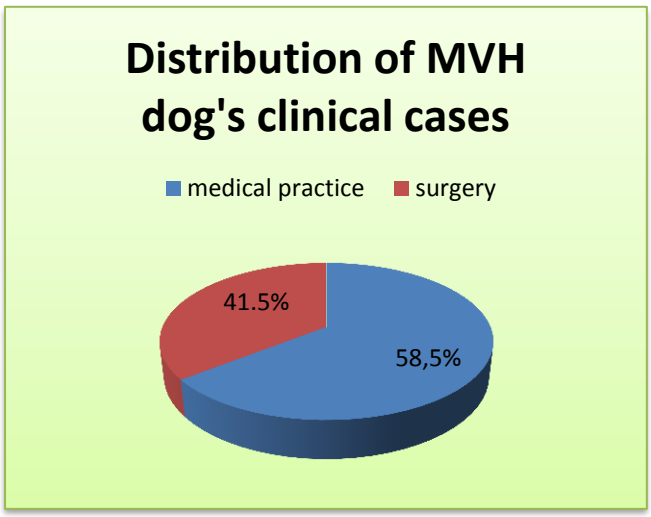
Graphic no.5 – Distribution of NSVH dog's clinical cases by veterinary areas



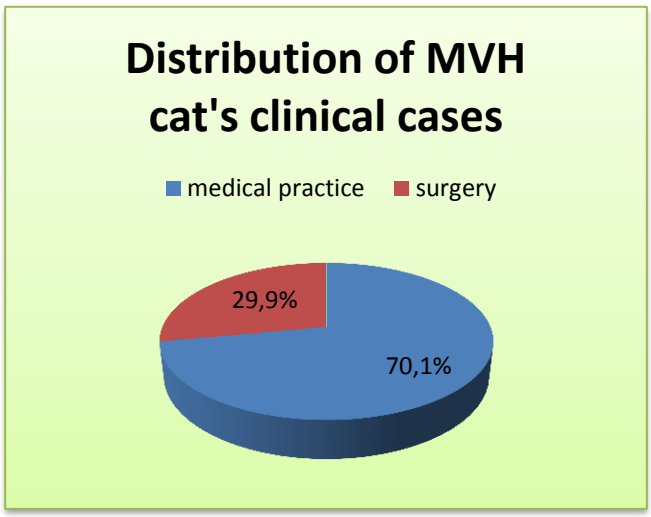
Graphic no.6 – Distribution of NSVH cat's clinical cases by veterinary areas

As it could be seen on the graphic no.5 and no.6, internal medicine was the veterinary area with more number of cases amongst cats and dogs. NSVH is a referral hospital centre, for this reason the general practice usually has a fewer number of patients.

The distribution of MVH clinical cases was made between two veterinary areas: medical practice and surgery. The next two graphics (graphic no.7 and no.8) represent the percentages of distribution of dogs and cat's clinical cases by these areas.



Graphic no.7 – Distribution of MVH dog's clinical cases by areas



Graphic no.8 – Distribution of MVH cat's clinical cases by areas

As we can see on the graphics no.7 and no.8, the predominant veterinary area was the medical practice, in dogs (n=128) and cats (n=75).

1. Veterinary Area data:

In each veterinary area, the followed up animals were separated by fields with the aim to better understand how clinical cases were distributed. The table no.7, no.8 and no.9 organize the absolute frequency of clinical cases by specie and genre among several fields in each veterinary area at the NSVH.

Table no.7 – Absolute frequency of NSVH clinical cases of General Practice separated by fields

NSVH clinical cases of General Practice					
Fields	Dogs		Cats		Total
	Females	Males	Females	Males	
Dermatology	2	1	2	1	6
Gastroenterology	3	-	-	-	3
Preventive medicine	-	2	1	-	3
Reproduction	2	1	-	1	4
Dentistry	-	2	-	-	2
Toxicology	2	-	-	-	2
Nephrology/Urology	-	1	-	4	5

Table no.8 – Absolute frequency of NSVH clinical cases of Internal Medicine separated by fields

NSVH clinical cases of Internal Medicine					
Fields	Dogs		Cats		Total
	Females	Males	Females	Males	
Cardiology	2	3	1	1	7
Dermatology	2	1	-	-	3
Endocrinology	2	-	1	1	4
Gastroenterology	3	13	2	3	21
Neurology	7	13	4	4	28
Oncology	5	3	-	2	10
Ophthalmology	-	1	-	-	1
Orthopedics	-	1	-	-	1
Pneumology	2	-	1	1	4
Toxicology	2	-	-	-	2
Nephrology/Urology	1	-	-	-	1

Table no.9 – Absolute frequency of NSVH clinical cases of surgery separated by fields

NSVH clinical cases of Surgery					
Fields	Dogs		Cats		Total
	Females	Males	Females	Males	
Cardiology	1	1	-	-	2
Dermatology	-	1	-	-	1
Gastroenterology	-	5	1	-	6
Neurology	2	5	-	-	7
Oncology	2	5	-	-	7
Orthopedics	5	9	1	5	20
Theriogenology	1	1	-	-	2
Nephrology/Urology	1	2	-	1	4

In GP, the field with more percentages of cases was dermatology with 24% (n=6) and nephrology/ urology with 20% (n=5). However, in internal medicine, neurology was 34.2% (n=28) followed by 25.6% (n=21) from gastroenterology, being the two fields with more number of cases. In surgery, the orthopedics was 41.8% (n=20), being considered the main reason for more surgical interventions.

The table no.10 and no.11 organize absolute frequency of MVH clinical cases of medical practice and surgery areas by specie and genre among several fields.

Table no.10 – Absolute frequency of MVH clinical cases of Medical Practice separated by fields

MVH clinical cases of Medical Practice					
Fields	Dogs		Cats		Total
	Females	Males	Females	Males	
Cardiology	-	3	5	1	9
Dermatology	-	8	1	3	12
Endocrinology	2	1	1	1	5
Gastroenterology	8	13	8	6	35
Hematology	5	-	-	-	5
Infectious diseases	6	8	3	2	19
Neurology	7	8	1	1	17
Oncology	6	5	1	3	15
Ophthalmology	1	1	1	1	4
Orthopedics	6	2	-	1	9
Preventive medicine	4	6	3	1	14
Theriogenology	1	-	-	-	1
Pneumology	3	2	3	4	12
Toxicology	1	-	-	-	1
Nephrology/Urology	11	8	9	10	38
Others	-	2	2	2	6

Table no.11 – Absolute frequency of MVH clinical cases of Surgery separated by fields

MVH clinical cases of Surgery					
Fields	Dogs		Cats		Total
	Females	Males	Females	Males	
Dentistry	5	11	2	-	18
Dermatology	-	1	-	-	1
Gastroenterology	6	3	-	-	9
Neurology	5	5	-	-	10
Oncology	7	4	1	2	15
Ophthalmology	-	1	-	1	2
Orthopedics	7	9	1	2	19
Theriogenology	19	4	14	8	45
Pneumology	1	2	-	-	3
Nephrology/Urology	1		-	1	2

Among medical practice cases, nephrology/urology was 19% (n=38) and gastroenterology was 17.1% (n=35), being considered the fields with more observed clinical cases, followed by 9% (n=19) of infectious diseases, 8.1% (n=17) of neurology and 7.1% (n=15) of oncology. In surgery, the field with more surgical interventions was the theriogenology with 37.1% (n=45), followed by orthopedics with 15.3% (n=19) and dentistry with 14.5% (n=18).

The veterinary areas with more cases, basically, were the same in both hospitals.

2. Medical field statistics:

The conditions were similar between the hospitals, for that reason it was decided to join all cases of the internship (n=482). To calculate the prevalence of some conditions it will be used the initial population of dogs (n=337) and cats (n=145).

2.1 Cardiology:

Cardiology is the medical field responsible for the study of heart disorders. It includes the medical diagnosis and plan treatments for several heart diseases as valvular disorders, congenital heart defects, heart failure and electrophysiology.

To aid the diagnosis, tests and procedures could be done as follow: auscultation, blood tests, echocardiography, electrocardiography (ECG) and cardiac stress tests. There are more procedures, but these ones are the most common complementary exams done in veterinary medicine.

Heart surgeries are also possible when indicated.

The next table (table no.12) shows all the cardiologic conditions seen along the internship. The percentage of patients with cardiologic conditions was 3.7% (n=18/482).

Table no.12 – Absolute frequency of cardiology conditions by specie and genre

Cardiology cases					
Condition	**Dogs**		**Cats**		**Total**
	Females	Males	Females	Males	
Degenerative valvular heart disease	1	4	1	1	7
Mitral valve dysplasia	-	-	-	1	1
Patent ductus arteriosus	-	1	-	-	1
Tricuspide valve replacement	1	-	-	-	1
Dilated cardiomyopathy	-	1	3	-	4
Ascites secondary to cardiac disease	-	1	2	-	3
Cardiac output failure	1	-	-	-	1

The cardiac disease more frequently diagnosed was the degenerative valvular heart disease (DVHD) with a total of seven cases: five dogs and two cats. The middle age of the animals for this disease was 11.5 years old for dogs and 7.5 years old for cats.

The breeds of the patients with DVHD were Cavalier King Charles and Crossed breed for dogs and Common European for cats.

Degenerative valvular heart disease is the most common cause of heart diseases in dogs. This condition could have other definitions as endocardiosis, mucoid or myxomatous valvular degeneration and chronic valvular fibrosis.[1]

The incidence of valve involvement in dogs was reported as follows: 62% incidence of mitral valve alone, 32.5% incidence of mitral and tricuspid valves, and 1.3% incidence

of tricuspid valve alone.[2] The prevalence is higher in smaller (< 20 kg) dogs; however large breeds occasionally are affected.[3]

Some authors have said that this type of disease is rare in cats, although as it's possible to see on the cardiovascular followed up cases table, we had two cats with DVHD diagnosis confirmed by echocardiography. Both of them haven't taken any medication, once the disease was in stage B2.

The American College of Veterinary Internal Medicine (ACVIM) formulated guidelines for the diagnosis of canine chronic valvular heart disease, describing 4 basic stages of heart disease and failure.[3]

- ***Stage A*** *identifies patients at high risk for developing heart disease but that currently have no identifiable structural disorder of the heart (e.g., every Cavalier King Charles Spaniel without a heart murmur);*
- ***Stage B*** *identifies patients with structural heart disease (e.g., the typical murmur of mitral valve regurgitation is present), but that have never developed clinical signs caused by heart failure. Because of important clinical implications for prognosis and treatment, the panel further subdivided Stage B into Stage B1 and B2. The* ***Stage B1*** *refers to asymptomatic patients that have no radiographic or echocardiographic evidence of cardiac remodeling in response to CVHD.*

  The ***Stage B2*** *refers to asymptomatic patients that have hemodynamically significant valve regurgitation, as evidenced by radiographic or echocardiographic findings of left-sided heart enlargement.*
- ***Stage C*** *denotes patients with past or current clinical signs of heart failure associated with structural heart disease. Because of important treatment differences between dogs with acute heart failure requiring hospital care and those with heart failure that can be treated on an outpatient basis, these issues have been addressed separately by the panel. Some animals presenting with heart failure for the 1st time may have severe clinical signs requiring aggressive therapy (eg, with additional afterload reducers or temporary ventilatory assistance) that more typically would be reserved for those with refractory disease.*
- ***Stage D*** *refers to patients with end-stage disease with clinical signs of heart failure caused by CVHD that are refractory to ''standard therapy'' (defined*

later in this document). Such patients require advanced or specialized treatment strategies in order to remain clinically comfortable with their disease. [3]

The two dogs Cavalier King Charles with DVHD presented an advanced disease (stage C) with right and left valves affected. They presented heart murmurs IV/VI and V/VI. The therapy they have taken includes furosemide (1-4mg/kg) and pimobendan (0.25-0.3mg/kg) with the doses changing with the patient needs and the manifested clinical signs.

As it is known, there is a higher prevalence and rate of progression of degenerative valvular heart disease in Cavalier King Charles than in other breeds.[4]

2.2 Dentistry:

This field is responsible for making the diagnosis, prevent and treat the oral cavity disorders. Periodontal disease is the most common disease of dentistry in veterinary medicine. Treatments realized to oral cavity disorders could be the removal of bacterial plaques; tooth extraction; dental pulp devitalization and surgeries to solve maxilla facial defects. X-rays and CT scan can be the best complementary exams to evaluate the oral cavity disorders.

The next table (table no.13) represents the dentistry conditions during the internship which had a percentage of 4.1% (n=20/482) of the total followed up cases.

Table no.13 – Absolute frequency of dentistry conditions by specie and genre

Dentistry cases						
Condition	Dogs			Cats		Total
	Females	Males		Females	Males	
Periodontal disease	5	11		2	-	18
Brachygnatia	-	1		-	-	1
Dental pulp devitalization	-	1		-	-	1

The dentistry condition with more cases was the periodontal disease with a total of 18 cases. Dogs have 16 cases, whereas cats only have two cases. The median of age of followed up cases was 6.6 years old for dogs and 7.8 years old for cats.

Periodontal disease (PD) is an inflammatory disease caused by bacterial plaque in the periodontium. A percentage of 80% of dogs with 2 years old or older could develop PD.[5] It's considered the most common disease in domestic carnivores.[6] Bacterial plaques could be the first cause of periodontal disease, however, others factors as teeth overcrowding, soft foods, absence of oral hygiene and malocclusions could be involved at the plaque accumulation or at the decrease of resistance to infections.[5, 7]

Pets, usually, presented to both hospitals (MVH and NSVH) with reported clinical signs as halitosis, less interest to eat dry food, pain when eating, weight loss. Small breeds did the highest part of these patients with periodontal disease (e.g. Poodle, French Bull Dog, Fox terrier, Yorkshire terrier).

There is a classification system, created by Loe and Silness[7], which evaluates the plaque accumulation and gingival inflammation: ***Stage 0*** *- healthy gingival without signs of gingivitis probing depth 0.0– 1.0 mm;* ***Stage 1*** *- Gingivitis with slight swelling and mucosa turning reddish, probing depth 0.0– 1.0 mm;* ***Stage 2*** *- Early periodontal disease with swelling and mucosa turning reddish, probing depth less than 2.5 mm;* ***Stage 3*** *- Moderate periodontal disease with swelling and red mucosa, often with hemorrhages, probing depth of less than 5.0 mm;* ***Stage 4*** *- Severe periodontal disease with red and swollen mucosa, alveolar bone loss, probing depth more than 5.0 mm.*

The next figure (fig.4) represents the periodontal disease classified with stage 2.

Fig.4 –Stage 2 of periodontal disease (MVH)

The PD treatment consists to remove the plaque and calculus from the tooth crown, involving scaling and closed root debridement. To get better results and to make the process safer for the veterinarian and also for the animal, this non-surgical periodontal therapy is done under anesthesia.

The figure no.5 exhibits a dog being treated on MVH with a non-surgical therapy, under anesthesia.

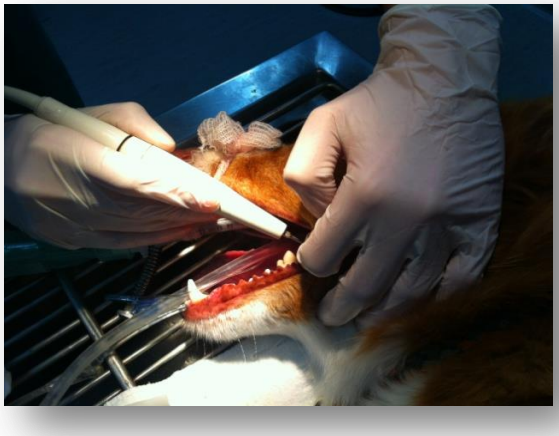


Fig.5 – Non-surgical therapy of periodontal disease (MVH)

2.3 Dermatology:

Dermatology is a medical field specialized on the diagnosis and treatment of companion animals with skin diseases, management of chronic ear diseases and immunological dermatoses as atopic dermatitis, food reactions and autoimmune skin diseases. Microscopic examination is the most important complementary exam in dermatology to aid the diagnosis and treatment.

The percentage of dermatological followed up cases was 4.8% (n=23/482). The next table (table no.14) lists the dermatological conditions during the internship.

Table no.14 – Absolute frequency of dermatology conditions by specie and genre

Dermatology cases						
Condition	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Atopia	-	1		1	-	2
Otitis Externa	1	3		1	1	6
Otitis interna/ otohematoma	-	3		-	-	3
Dermic cyst	-	-		-	1	1
Skin wounds	2	1		-	1	4
Skin necrosis/ multiple infections	1	-		-	-	1
Suture infection	-	2		1	-	3
Limb abcess	-	-		-	1	1
Wet dermatitis	-	2		-	-	2

The condition with more followed up cases was the otitis externa (n=6) and the second one was the skin lesions (n=4).

Otitis Externa (OE) was presented in more dogs than cats, with a middle age of 4.1 years old. The two cats had an average age of 5.2 years old. The dog breeds presented to the hospitals with OE were French Bulldog, Labrador and Crossed breed. The cat's breed was the Domestic Short Hair.

This disease is common in dogs, and could represent 10-20% of canine patients in veterinary medicine.[8] There are several causes responsible for the development of OE: the conformation of ear pinnae and external ear, trauma and obstruction are considered predisposing factors because they can increase the risk for this condition. However, they do not cause the disease directly. Ectoparasites, foreign bodies, allergies, keratinization disorders and endocrinopathies are considered primary causes; they initiate the inflammation on ear canal. Inflammations caused by primary causes may become worst with bacterial and yeast infections (considered secondary factors).[8, 9]

Two of followed up canine otitis externa cases in this internship were caused by bacterial/yeast infection (cocci and *Malassezia* spp), one caused by mites and other one caused by allergy. Both of feline OE cases had an allergic etiology. The typical clinical signs presented by patients were pruritus on the ear region, head shaking and ear

scratching. The animal's history, the otoscopic examination and cytology are the diagnostic procedures to try to find the cause.

The treatment of this condition consists on administrations of topic and systemic medications as antibiotics, antifungal, corticosteroids or combinations between them. A commercial cleaning product or products containing Tris-EDTA could be a good choice. However, in cats may be safer to use the sterile physiologic saline as cleansing agent.[10]

Veterinarians, in both hospitals, used sterile physiologic saline and swabs to clean the ear canal and then the commercial cleaning products with combinations of antibiotic, antifungal and corticosteroids over 10 days. After the treatment animals were re-checked.

The most complicated dermatologic case seen during the internship was the skin necrosis/multiple infections. The patient was a Labrador female dog with nine years old, and the figure 6 shows the gravity of her skin lesions.

Fig.6 – Skin lesions with necrosis (NSVH)

The assessment of this case was cellulitis and vascular infarction with skin/tissue sloughs – due to multi-resistant E.coli (post mucosal breach with haemorrhagic gastroenteritis). The skin areas affected were the right thoracic limb, right lateral body wall, right axilla and left distal limb. There was also a left carpal instability due to loss of dorsal ligaments and extensor tendons by necrosis (associated with cellulitis). The dog had sepsis and myonecrosis; hypoproteinemia due to tissue losses and negative protein balance. The treatment plan was to control the pain, giving analgesics; clean the

wounds under sedation with the aim to make them as clean as possible, combination of antibiotics with the goal to control the infection. The dog was hospitalized over 9 weeks and returned home with a reserved prognosis.

2.4 Endocrinology:

This medical field deals with the endocrine system. Endocrine disorders cause alteration on the hormone´s secretion and its concentrations on the body. The clinical signs in animals with this type of diseases are unspecific and when there is a suspicion of one endocrinology condition, the hormone's secretion of endocrine organs as pituitary, thyroid, adrenals, pancreas and gonads should be tested. The diagnosis and treatment of these diseases are usually guided by laboratory tests like *excitation/stimulation* or *inhibition/suppression* tests. However, other complementary exams as ultrasound, CT scan or MRI could also help to find out the cause of the endocrine disorder and blood tests, serum chemistry and urinalysis could evaluate the severity of the disease.

The table below (table no.15) lists all the endocrinology conditions along the internship which had a percentage of 1.9% (n=9/482) of the total followed up cases.

Table no.15 – Absolute frequency of endocrinology conditions by specie and genre

Endocrinology cases					
Issue	**Dogs**		**Cats**		**Total**
	Females	Males	Females	Males	
Hyperparathyroidism	-	-	-	1	1
Hyperthyroidism	-	-	2	-	2
Hypoadrenocorticism	1	-	-	-	1
Hyperadrenocorticism	2	-	-	-	2
Diabetes mellitus	1	1	-	1	3

The condition with more patients was diabetes mellitus with three cases (two dogs and one cat). The dogs were a 15 years old female Crossed breed and a six years old male Pincher. The cat was 15 years old Common European.

The clinical signs presented in all patients were polyuria, polydipsia and polyphagia. The cat also presented weight loss and his body condition was classified as 2/5. To get

to the diagnosis, the glycaemia was measured and the result was hyperglycaemia in all of patients as well as glycosuria when the urinalysis was realized.

The laboratory findings as hyperglycemia and glycosuria could make the diagnosis of diabetes mellitus; however, other tests should be performed to help to confirming the diagnosis. Biochemistry analysis to measure the cholesterol, alanine aminotransferase (ALT) and alkaline phosphatase (ALP) should be done because a diabetes patient may have hypercholesterolaemia, resulting from fat stores mobilization; increased ALT and ALP due to secondary fatty changes in the liver. The urinalysis aids to confirm not only the glycosuria but also to find out if there is any evidence of urinary tract infection.[11]

Animals with diabetes mellitus could develop ketoacidosis, and for this reason ketones in urine or blood should be also measured, because the treatment is different between the nonketotic-diabetes mellitus and ketotic-diabetes mellitus patients.[11, 12]

All the patients had nonketotic diabetes mellitus, insulin-dependent and the treatment was made administrating porcine insulin (30% as amorphous zinc insulin and 70% as crystalline zinc insulin), with the trade name Caninsulin®. Dogs have received the insulin once a day and the cat twice a day. However, the disease was difficult to control; monitoring the blood glucose nadir and make new insulin dose adjustments were frequently necessary. The unsuccessful control of diabetes mellitus may be associated to the insulin, to the owners or to the patient.

The insulin is a peptide and, when exposed to the heat or cold extreme temperatures, could deteriorate itself; it's also possible suffer a bacterial contamination or loss its potency and efficacy when subjected to agitation (e.g. when transported) or dilution. When an animal is responding well to the insulin treatment and suddenly the efficacy of treatment is lost, the insulin should be substituted for a new one.[13]

The owners could also be a reason for the unsuccessful treatment: they could prepare wrong doses, the insulin syringe may not be the right syringe and administrations could be mismanaged. When the disease is recently diagnosed, these problems could happen. Ultimately, if there is any problem with the insulin or with the owner, the patient should be studied with the goal to find out a reason for its unsuccessful treatment. Problems associated to the patients are, commonly, deficits on his body regulation or are insulin

resistance. When the problem is identified, new solutions should be thought to solve it.[13]

2.5 Gastroenterology:

Digestive system and its disorders are diagnosed and treated by this medical branch. Organs from the mouth to anus are included on this field, as well as liver, pancreas and biliary tree. There is a large variety of clinical signs and also different disorders making hard to obtain a diagnosis. The animal's history is the first step to it.

Complementary exams as routine blood test, serum chemistry, urinalysis, x-rays, ultrasound, endoscopy, biopsy, fine needle aspirates (FNA), faecal analysis, CT scan or even the MRI could be done. They can help finding the cause of the disorder, evaluate its severity and aid the veterinarian to decide if a medical treatment is enough to solve the problem or if a surgical treatment is also necessary.

The percentage of gastroenterology followed up cases was 15.4% (n=74/482). The next table (table no.16) lists the conditions of this field over the internship.

Table no.16 – Absolute frequency of gastroenterology conditions by specie and genre

Gastroenterology cases						
Condition	Dogs			Cats		Total
	Females	Males		Females	Males	
Active hepatitis	1	1		-	-	2
Cholecystitis	-	1		-	-	1
Cholestasis	2	1		-	-	3
Colitis	-	2		-	-	2
Constipation	-	1		2	1	4
Dietary indiscretion	3	7		1	3	14
Foreign body ingestion	2	5		4	1	12
Gastroenteritis	5	10		1	-	16
Gastric dilatation volvulus	3	4		-	-	7
Intestinal bowel disease	-	-		2	2	4
Intestinal intussusception	1	-		-	-	1
Lymphocytic colangiohepatitis	-	-		-	1	1
Pancreatitis	3	1		1	1	6
Porto-systemic shunt	-	1		-	-	1

The condition with more number of cases was the gastroenteritis (n=16), followed by dietary indiscretion (n=14) and foreign body (FB) ingestion (n=12).

The most common clinical signs of gastroenteritis and dietary disorders were vomiting, diarrhea, anorexia and abdominal pain. All of followed up patients responded well to the symptomatic treatment used.

Relatively to foreign body ingestion condition: after collecting the patient history, x-rays were done by routine with the goal to find the localization of the FB and to understand the impact of this problem on the patient. When the x-rays didn't give enough information, the ultrasound was the next step. Exploratory laparotomy was always the last resource. From seven dogs, four of them did surgery to remove the foreign body (one gastrotomy, one enterotomy and two enterectomies), one dog did endoscopy and the other two dogs only did hospitalization up to eliminate the FB by faeces. From five cats that ingested foreign bodies, three of them did endoscopy (oesophageal FB) and the other two cats only needed hospitalization until the FB being eliminated by faeces. The foreign bodies were vastly different from patient to patient and between species: in dogs, bones, toys, plastic, socks and soft material were found; whilst cats ingested wires and needles.

The next figures (fig.7, 8 and 9) show one case seen in NSVH, a two year old male dog, Labrador, who ingested his small toy when he was playing with it.

Fig.7 – Dog lateral abdominal radiograph (NSVH)

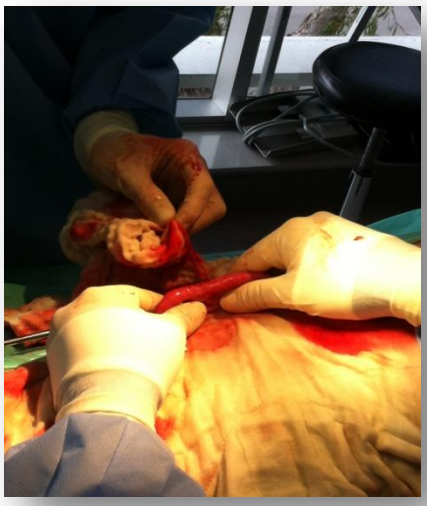


Fig.8 – Enterotomy to remove the FB (NSVH)

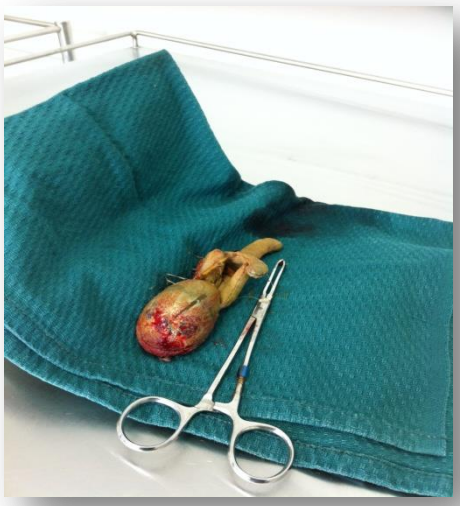


Fig.9 – Foreign body: toy (NSVH)

After the surgery, this dog recovered well as expected and went home with his owners on the next day.

There was other condition in gastroenterology field that was classified as more interesting: gastric dilatation volvulus; and for that reason the decision to include it on the internship's report was made.

Both hospitals received patients diagnosed with gastric dilatation volvulus (GDV). Literature usually reports large and giant breeds as a risk factor to develop this condition [14]. The prevalence of this disease was 1.8% (n=6/337) along this internship. From six dogs presented to the emergencies with GDV, all of them were large breed dogs: two German Shepherds, two Labrador Retrievers, one Golden Retriever and one Rottweiler. The average age of patients with this condition was 10.2 years old.

The next figures are from the Rottweiler patient, with 10 years old, which came to MVH at night with a gastric dilatation (GD). The presented clinical signs were listless, abdominal distension, abdominal pain and increased capillary time repletion (CTR).

The first step to do was starting with aggressive fluid therapy. The reason for this step is because GD and GDV are responsible for a hypovolaemic shock, caused by caudal vena cava obstruction. [15] The fluid therapy rate used on this case was 90ml/kg during the first 30 minutes with two large catheters on the jugular veins. A first stomach decompression was done with trocharization.

After the decompression, two x-ray projections (fig.10 and 11) were done with the aim to find out if it was only a gastric dilatation or a gastric dilatation volvulus.

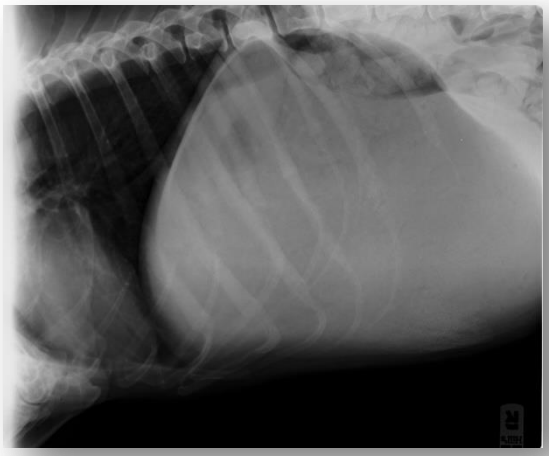


Fig.10 – Right lateral radiograph showing a gastric dilatation (MVH)

Fig.11 – Dorsoventral radiograph showing a gastric dilatation (MVH)

The x-rays confirmed a gastric dilatation and the next step was starting a second method of decompression by the orogastric intubation (showed on the figures 12 and 13), before the surgery.

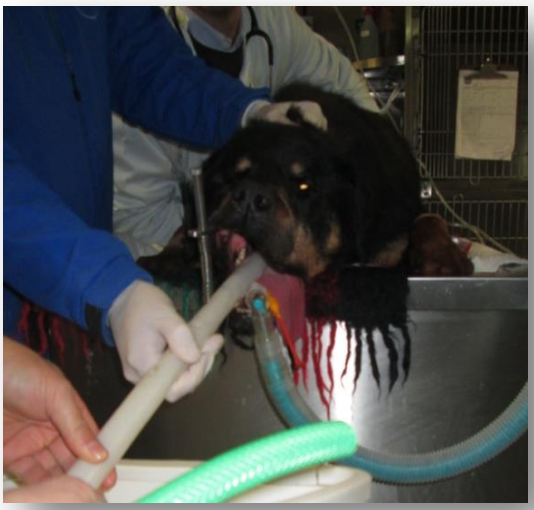


Fig.12 – Orogastric intubation (MVH)

Fig.13 – Removed content from the stomach (MVH)

The dog did a prophylactic gastropexy (incisional gastropexy) to prevent recurrences in the future.[16] He recovered uneventfully from surgery and the food was introduced in his diet slowly: the first 12 hours he only drank fluids, then, 12 hours after surgery he started with small amounts of canned food and then the dry food was introduced.

2.6 Hematology:

Hematology is a medical field which studies the blood, blood disorders and blood-forming organs with the goal to find the etiology, diagnosis and treatment. Hematology conditions affect the production of blood and its components (e.g. erythrocytes, leukocytes, hemoglobin, blood proteins, platelets, etc) and complementary exams as blood-tests, microscopic examination of blood films, bone marrow slides or bone marrow biopsies are helpful on the diagnosis. However, because these disorders may have other causes, more complementary exams may be necessary.

The next table (table no.17) represents the hematology conditions during the internship which had a percentage of 1.1% (n=5/482) of the total followed up cases.

Table no.17 – Absolute frequency of hematology conditions by specie and genre

Hematology cases						
Condition	Dogs			Cats		Total
	Females	Males		Females	Males	
Erythroid hypoplasia	1	-		-	-	1
Immunomediated hemolytic anemia	1	-		-	-	1
Immunomediated thrombocytopeny	1	-		-	-	1
Megakaryocytic erythroid hyperplasia	1	-		-	-	1
Thrombocytopenia	1	-		-	-	1

All the hematology conditions had the same number of cases, one case each. The most interesting condition of the hematology field was the erythroid hypoplasia, because it was a finding. The patient was a Dalmatian female dog with 12 years old who had come to MVH as a referral case with a suspicion of pyometra. An ovariohysterectomy was suggested and when the physical exam was started, a pallid mucosal was found.

The figures no.14 and no.15 present the pallid mucosal found on this patient.

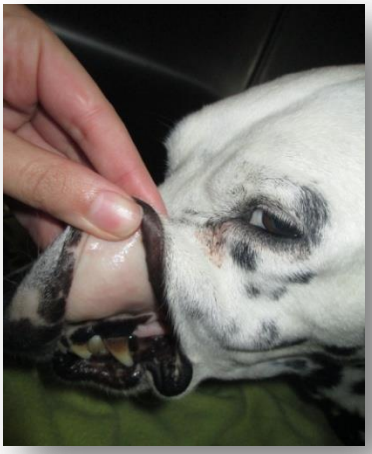


Fig.14 – Pallid mouth mucosa (MVH)

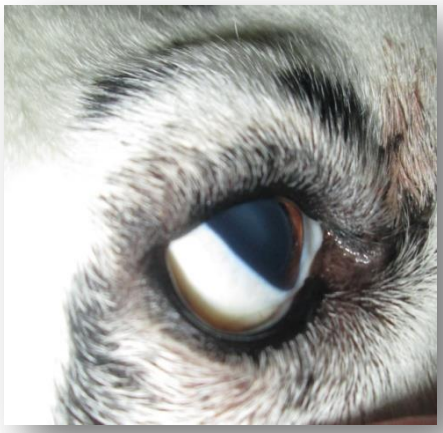


Fig.15 – Pallid conjunctiva mucosa (MVH)

The anemia was confirmed with the routine blood analysis for the surgery (decreased hematocrit with 18% of value, decreased number of erythrocytes and hemoglobin, increased mean cell volume (MCV) and decreased mean cell hemoglobin concentration (MCHC)). Although an increase of MCV may be suggestive for regenerative anemia, the last results of counting of reticulocytes and the blood film study were compatible with a non regenerative anemia.

The anemia can be found by clinical signs and laboratory findings and it represents a sign of other disease (anemia is not a disease *per se*).[17] Differential diagnoses of non-regenerative anemia could be erythropoietin related-causes (e.g. chronic kidney disease), endocrinopathies or metabolic disorders, bone marrow disorders (e.g. myelofibrosis, myelodysplasia), inflammatory diseases, infectious diseases and tumors. Hemorrhages and hemolysis are non-regenerative only in acute stages, after 72 hours they become regenerative if the cause was solved.[17, 18]

The surgery was done after a blood transfusion. However, one month after, the dog returned to the hospital with 15.2% of hematocrit. The case was studied by diagnosis of exclusion and bone marrow disorder was the last suspicion. To confirm the bone marrow disorder suspicion, medullar cytology was done, confirming erythroid hypoplasia. The dog received other two blood transfusions during three months and the hematocrit remained low. The prognosis was reserved.

2.7 Infectious diseases:

Infectious diseases include all disorders caused by organisms (bacteria, viruses, fungi or parasites) which are common in small animals. Clinical signs of infectious diseases, per se, don't evidence any specific disorder, however, with the patient's history and physical examination findings the veterinarian can list the differential diagnosis ranking the most likely infectious agents involved. Some complementary exams could aid to get to the diagnosis: faecal examination, cytology, cultures using blood or tissue samples and immunologic techniques (e.g. antibodies detection).

The next table (table no.18) shows all the infectious diseases conditions seen in whole internship. The percentage of patients with these conditions was 3.9% (n=19/482).

Table no.18 – Absolute frequency of infectious diseases by specie and genre

Infecto/parasitology cases						
Condition	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Babesiosis	-	2		1	-	3
Erlichiosis	-	2		-	-	2
FIP	-	-		-	2	2
Hemorrhagic gastroenteritis	-	2		-	-	2
Leishmaniosis	3	1		-	-	4
Parvovirosis	3	-		-	-	3
Rhynotracheitis	-	-		2	-	2
Ricketsiosis	-	1		-	-	1

The most common condition was the hemorrhagic gastroenteritis where three patients had a confirmation of final diagnosis- parvovirosis. On the other two dogs, the suspicion for parvovirosis was high; however, the test confirming the disease wasn't performed. For that reason, the condition only was classified as hemorrhagic gastroenteritis. The median age was 0.4 years old and three of them did serology with canine parvovirus positive. All of young dogs had come to the hospital with high fever (39.9- 40.2º C), prostration, anorexia, vomiting, diarrhea and dehydration (≈10%).

The owners described the onset of their dog's clinical signs as an acute process. None of them had completed the vaccination protocol.

Canine parvovirus enteritis usually affected dogs at young age (younger than 6 months) and is caused by canine parvovirus-2 (CPV) and coronavirus (CCoV). The transmission can occur by oronasal route when exposed to contaminated faeces.[19]

When this infection is left untreated, the result is a progressive and rapid dissemination of CPV throughout the body causing disseminated intravascular coagulation, bacterial translocation and sepsis achieving high levels of mortality (90%).[20]

However, CPV enteritis could be treated doing aggressive supportive care.[20] Fluid-therapy to restore the fluid and electrolytes balance (the IV fluids should have additives as glucose and potassium chloride in case of hypoglycemia and hypokalemia); antibiotics to prevent secondary bacterial infections (e.g. third generation cephalosporin as ceftiofur, dose 2.2-4.4 mg/kg, SC), antiemetic drugs to stop the vomiting and subsequently the fluids losses (e.g. metoclopramide 1-2 mg/kg, IV); ranitidine (2-4 mg/kg, SC or IV) could also be given as gastric protectant.[19] Because CPV infections cause severe changes on the patient's hematologic values, other treatments as whole blood or plasma transfusion should be considered.[19, 20]

All of five dogs with canine parvovirus enteritis did aggressive supportive care at the hospital and the average number of hospitalized days was six days. All of them survived.

2.8 Neurology:

Neurology is a medical field responsible for studying disorders of the nervous system. It diagnoses and treats conditions/diseases involving the central and peripheral nervous system. The most common neurological clinical signs in pets are paresis/paralysis, balance disorders, vision disorders, seizures and pain. However, they don't identify the cause and complementary exams should be done to understand what and where the cause is. The objectives in neurology are: to determine if the neurological problem present on the patient has its cause in the nervous system; estimate the extent of the problem and its prognosis. Complementary exams as x-rays, myelography, computed tomography and magnetic resonance imaging are helpful to diagnose neurological conditions.

The percentage of neurological followed up cases was 13% (n=62/482). The next table (table no.19) lists the conditions of this field over the internship.

Table no.19 – Absolute frequency of neurological conditions by specie and genre

Neurologic cases						
Condition	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Vestibular Syndrome	-	-		1	-	1
Seizures	6	5		1	1	13
Cervical herniated disk	-	4		-	-	4
Toracolombar herniated disk	4	5		-	-	9
Back pain	-	2		-	-	2
Neck pain	2	3		-	-	5
Hind limbs paralysis	2	-		-	-	2
Hind limbs paresis	2	1		-	-	3
Medullar trauma	-	1		-	-	1
Tick paralysis	3	6		3	4	16
Polyneuropathy	-	3		-	-	3
Chiari-like malformation	1	-		-	-	1
Intracranial cyst	-	1		-	-	1
Miastenia gravis	1	-		-	-	1

The condition with more neurological patients with a total of 16 cases was the tick paralysis, all of them followed at North Shore Veterinary Hospital. Seizures and herniated disk were 13 cases each, being considered both as the second conditions with more number of cases.

Tick paralysis is a serious neurological condition promoted by neurotoxins from ticks *Ixodes holocyclus* and *Ixodes cornuatus* in Australia. This disease seems to be seasonal, with more affected animals during spring.[21] The major incidence is along the eastern seaboard of Australia.[21, 22] First clinical signs include loss of voice (caused by laryngeal paresis), hind limb incoordination, changes in breathing rhythm, gagging, regurgitation or vomiting and dilated pupils.[23]

There is a classification system based on the limbic systemic activity represented on the tables no.20 and no.21.[23]

Table no.20 – neuromuscular classification of tick paralysis

Neuromuscular score	Clinical signs
Stage 1	Dysphonia, weakness but he can still stand and walk
Stage 2	No walk but he can stand
Stage 3	No stand but can right itself
Stage 4	No right itself

Table no.21 – respiratory classification of tick paralysis

Respiratory score	Clinical signs
A	No clinical respiratory compromise
B	Increased heart rate (HR) and respiratory rate (RR)
C	Restrictive breathing, gagging, retching
D	Severe compromise – expiratory grunt, dyspnoea, cyanosis

The major number of followed up cases with tick paralysis was classified between stage 2B and 3C. All the patients had a tick or more hidden on their hair coat, found after to do a full shearing of the animal. The patient usually improves his clinical signs when the tick is removed. One of the 16 animals died because of his serious condition and reserved prognosis.

The treatment for tick paralysis consists on to administrate *tick antiserum* (TAS) with the goal to neutralize the toxin and stabilize the animal. TAS minimum dose is 0.5-1 mL/Kg, slowly IV, throughout at least 20 minutes. Most of the time, animals are in stress and acepromazine (0.03mg/kg; IV) could be given to reduce it. If the animal is vomiting, should metoclopramide (0.5-1mg/kg; IV or IM) or maropitant (1mg/kg; SC) be given. The body temperature needs to be checked, at least twice daily; oxygen therapy should be started if the animal has a respiratory compromise; tear substitue are necessary in these patients because the tick's toxin causes eyelid paresis; the urine production should be monitored during the hospitalization, because the animal may not

be able to evacuate the urine; tick search repeated to make sure there's no more hidden ticks.[23]

When a patient appeared to the veterinary centre with clinical signs as described above, there are other differential diagnoses responsible for causing lower motor neuron or neuromuscular disorders which mustn't be forgotten: acute polyradiculoneuritis, botulism, acute myasthenia gravis, snakebite, hypokalemia.[23, 24] But when in an endemic geographic region like Sydney (eastern seaboard of Australia), after collecting the patient's history (outdoor pet or indoor pet walking outside; pet using prophylactic treatment for fleas and ticks or not; tick seen on the pet; when was the first clinical sign manifested, etc.) when presenting the described clinical signs, tick paralysis is the first differential diagnosis of that list to think about.

As it's possible to visualize on the table with neurological conditions (table no.19), two cases with neck pain and five cases with back pain are listed. The reason to include these cases without a more specific diagnosis was because it wasn't possible to study these patients until to the final diagnosis. They only did symptomatic treatment for pain: gabapentin (10-100 mg/kg, PO), prednisolone (0.5-2 mg/kg, IV) and buphenorphine. However, the differential diagnoses include herniated disk, steroid-responsive inflammation (eg.meningitis, arteritis), immune-mediated polymyositis, diskospondylitis, musculoskeletal trauma, atlantoaxial luxation or subluxation (only for neck pain), wobbler syndrome (only for neck pain).[25]

2.9 Oncology:

This medical specialty deals with tumors, including the diagnosis, treatment and prognosis. Tumors could be benign or malign and to do a proper classification of them a biopsy or cytology should be done. However, other diagnostic methods as x-rays, ultrasound, CT scan, MRI and endoscopy are helpful to localize the tumor, metastasis and guide biopsy or fine needle aspirates (FNA).

When the cancer is not classified (e.g. osteosarcoma) by biopsy or FNA, the designation is done using the word tumor or mass and the localization of it (e.g. cutaneous mass).

The cancer treatment could be curative or palliative and usually is done by chemotherapy, surgery or both. Radiotherapy (e.g. for brain tumors) and other treatments as DNA vaccines (e.g. for melanoma) are also available to treat specific types of cancer.

The next table (table no. 22) represents the oncology conditions during the internship which had a percentage of 9.5% (n=46/482) of the total followed up cases.

Table no.22 – Absolute frequency of oncologic conditions by specie and genre

Oncologic cases						
Condition	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Anal carcinoma	-	1		-	-	1
Cutaneous mass	3	-		-	-	3
Fibrosarcoma	1	-		1	-	2
Gland mammary tumor	3	-		1	-	4
Heart tumor	-	1		-	-	1
Hemangiosarcoma	3	3		-	-	6
Hepatic tumor	-	1		-	1	2
Intestinal mass	-	-		-	1	1
Lymphoma	5	4		-	2	11
Mammary carcinoma	2	-		-	-	2
Mastocytoma	-	1		-	-	1
Neoplastic lymphadenopathy	-	-		-	1	1
Osteosarcoma	-	1		-	-	1
Perianal tumor	-	1		-	-	1
Pulmonary carcinoma	-	1		-	-	1
Sarcoma	2	3		-	-	5
Scamous cells carcinoma	1	-		-	1	2
Trachea mass	-	-		-	1	1

As it's possible to visualize on the table above, not all conditions have the classification of the type of tumor/mass, not all of them did biopsy or FNA for histopathological characterization. For that reason some conditions were designated using the word tumor (when it's considered malign) or mass (when it's considered benign) and the localization of it.

Lymphoma was the condition with highest number of cases with 11 patients, followed by gland mammary tumor and hemangiosarcoma with six patients each.

The prevalence of animals with lymphoma during the internship was 2.7% for dogs and 1.4% for cats. The middle age of dogs with this condition was 10.8 years old and for cats was 8.5 years old. The most common dog's breeds have come to the veterinary hospitals with lymphoma were Labrador, Golden retriever and Crossed breed; one cat was a British Short Hair and the other one was a Common European.

Literature on dog breed predisposition to lymphoma refers a higher relative risk for purebreds as bulldog breeds, bullmastiff and boxers than other breeds. However, English Springer Spaniel, Golden Retriever and Rottweiler have had an over expectation incidence.[26]

Lymphoma is one of the most common cancers in dogs with middle age or older (range: 6-12 years old). Cats have a bimodal age presentation: young cats with approximately three years old, FeLV positive and older cats FeLV negative (mean age is 7-8 years old). [27] Whereas cats could have a retrovirus infection as etiology, dogs don't have a known etiology to develop lymphoma.[28] This condition has been classified by five anatomic distributions: multicentric, alimentary, mediastinal, extranodal and cutaneous.[28]

Multicentric lymphoma was the most common lymphoma type presented along this internship; enlarged lymph nodes as the most suspitious clinical sign.

To get the final diagnosis, a fine needle aspirates (FNA) of enlarged lymph nodes of the animal were done. These FNA's allow doing a cytopathological diagnosis of lymphoma.[29]

The figure 16 shows a cat doing chemotherapy at the North Shore Veterinary Hospital.

Fig.16 – Oncological patient doing chemoteraphy at the NSVH

The chemotherapy for multicentric lymphoma could be constituted by cyclophosphamide, doxorubicin, vincristine and prednisone (usually recognized as CHOP). [30] This is considered the best protocol to obtain better results of tumor's remission which it may go up 90% in dogs and 75% in cats. Approximately 20% of treated cats could live more than 1 year and some of treated dogs have lived two years after the diagnosis.[28]

Hemangiosarcoma is a highly malignant tumor and targets blood vessels, frequently having visceral organs like spleen and liver as primary site to develop itself.[26] Six dogs of the observed dogs had developed this condition.

The next two figures (fig.16 and fig.17) are from two different patients diagnosed with hemangiosarcoma.

Fig.17 – Spleen ultrasound with measurements of a splenic mass (MVH)

Fig.18 –Spleen involved with multiple masses (NSVH)

The fig.17 represents a spleen ultrasound where a mass was found with approximately 24.4 mm- 31.3mm of diameter on a crossed breed female dog with nine years old.

The fig.18 represents the spleen full of metastasis after doing the splenectomy on a Labrador male dog with nine years old.

The gland mammary tumor had six females as patients, five of them were dogs and one was a cat. The fig.19 shows a radiograph of a 10 years old female dog with pulmonary metastasis from a mammary carcinoma and the fig.20 shows an ulcerative gland mammary tumor of a female dog with nine years old.

Fig.19 – Dog thoracic radiograph showing pulmonary metastasis (MVH)

Fig.20 – Ulcerative gland mammary tumor on a female dog (MVH)

All the patients with mammary gland tumor were from Montenegro Veterinary Hospital. It has been reported that the risk of gland mammary tumors have been increased by ovarian hormone stimulation and this risk could be decreased in the future if an ovariohysterectomy was done before two years of age.[28]

As it was represented on the table no.1, the NSVH has had a high percentage of spayed females because the ovariohysterectomy is usually done into the first two years of animal's age. For this reason, it's uncommon to see gland mammary tumors on their female patients.

To finalize the oncology field of the internship's report, it will be shown figures of two sarcoma removals (figures 21-24), using the flap technique and the mesh graft both on distal limbs of two dogs.

Fig.21 – Mass removal on dog's distal left forelimb with approx. 2cm of borders (NSVH)

Fig.22 – Flap technique after the mass removal (NSVH)

The flap technique used on the case reported with figures above was the superficial brachial axial pattern flap. It's usually used when there are antebrachial wounds with the goal to closure them.[31]

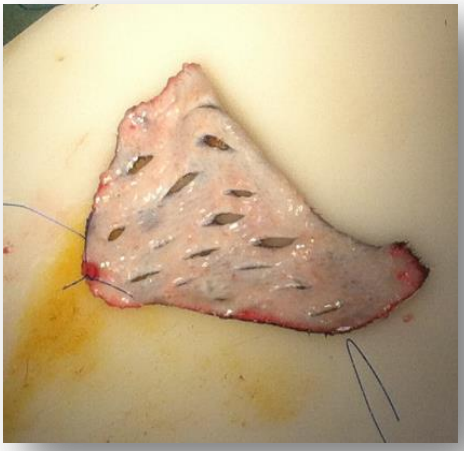


Fig.23 – Mesh graft (NSVH)

Fig.24 – Mesh graft positioned on the antebrachial wound (NSVH)

The mesh graft has been used when the donor site doesn't have adjacent tissues to cover its wound (flap). The slits could be made by a special mesh graft expansion unit or by freehand.[32] On this case the sheet graft was meshed by freehand using a scalpel blade.

2.10 Ophthalmology:

Ophthalmology is a medical field that deals with the eye, studying its anatomy, physiology and identifying abnormal processes affecting it. To get to the diagnosis an ophthalmologic exam is required and the veterinarian may need the disposables: Schirmer tear test papers, fluorescein paper test strips, gauze swabs, tropicamide 1% (pupil dilatation) topical anesthetic (e.g. proxymetacaine), sterile saline, lacrimal cannulae, bacterial swabs and transport media, slides and laboratory equipment. The ophthalmoscope (to do direct or indirect ophthalmoscopy) and tonometer are also two instruments used on this exam, aiding to evaluate the eye fundus and to measure the eye pressure. Other complementary exams as eye ultrasound could be done.

The next table (table no.23) represents all the ophthalmology cases received during the internship. The percentage of this field was 1.4% (n=7/487).

Table no.23 – Absolute frequency of ophthalmology conditions by specie and genre

Cases of Ophthalmology						
Condition	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Chronic keratoconjuntivitis sicca	-	1		-	-	1
Eye infection	-	1		-	-	1
Glaucoma	1	-		-	-	1
Keratoconjunctivitis	-	-		-	2	2
Retrobulbar abcess	-	-		1	-	1
Third eye protusion	-	1		-	-	1

The condition with more number of cases was the keratoconjunctivitis with two male cats as patients. All the others had the same number of cases, one each.

The chronic keratoconjunctivitis sicca was the most interesting ophthalmologic case seen on the internship. A Spaniel Cocker male dog with 13 years old has come to the hospital with chronic keratoconjunctivitis sicca. The figures no.24 and no.25 show the dog when he was admitted to the hospital.

Fig.25 – Dog presented to the MVH with chronic keratoconjunctivitis sicca

Fig.26 – Left eye findings (MVH)

An ophthalmologic examination was done and it revealed on the left eye (OS): itching, blepharitis, chemosis, corneal opacity and irregularity, neovascularization and lateral pigmentation. On the right eye (OD): keratoconjunctivitis sicca with purulent discharge.

The therapeutic plan of keratoconjunctivitis sicca includes giving eye lubricants with the goal to hydrate and lubricate the corneal surface.[33] On this specific case, topical and systemic drugs as antibiotics and anti- inflammatory were also given to treat the secondary infection and to reduce the eye and eyelids inflammation. The treatment for this dog was combined with systemic antibiotic (cephadrine), eye drops antibiotics (fusidic acid and tobramycin), eye drops non-steroidal anti-inflammatory drug (flurbiprofen sodium) and systemic non-steroidal anti-inflammatory drug (mavacoxib) and eye lubricants between the eye drops medications.

After one week the right eye was improved but because this condition was chronic and severe the left eye remained the same and the owner made the decision to do the eye enucleation.

Keratoconjunctivitis sicca is an ophthalmic disorder resulting from a dysfunction on the lacrimal glands, ocular surface or on the interconnection innervations (lacrimal functional unit). The most common cause, in dogs, is the immune-related lacrimal grand disease. There is a high prevalence (≈20%) of this condition in purebreds as English Bulldogs, Cavalier King Charles, Cocker spaniels and Pugs.[33]

In this internship, the prevalence of keratoconjunctivitis sicca in Cocker Spaniels were 16.7% (n=1/6), being similar to the prevalence found in the researched bibliography.

2.11 Orthopedics and Traumatology:

This medical branch is responsible for diagnosis and treatment of musculoskeletal disorders, including the musculoskeletal trauma, degenerative diseases, infections, tumors and congenital disorders. The x-rays and CT scan are the two most common imaging exams used on this field. The treatment of these conditions could be surgical or nonsurgical, depending of the type and gravity of injury.

The percentage of orthopedic medicine followed up cases was 10.2% (n=49/482). The next table (table no.24) lists the conditions of this field over the internship.

Table no.24 – Absolute frequency of Orthopedics and traumatology conditions by specie and genre

Orthopedics and traumatology cases						
Condition	Dogs			Cats		Total
	Females	Males		Females	Males	
Traumatic abdominal hernia	1	-		-	-	1
Artrosis	-	1		-	-	1
Axis fracture	1	-		-	-	1
Coronoid process fracture	1	-		-	-	1
Cruciate ligament rupture	3	4		-	1	8
Elbow dysplasia	2	1		-	-	3
Hemoabdomen (trauma)	1	-		-	-	1
Hip dysplasia	-	4		-	-	4
Hip fracture	1	3		-	-	4
Humerus fracture	-	-		-	2	2
Left forelimb trauma	-	1		-	-	1
Left hock injury	-	-		-	1	1
Multiple fracture	1	1		-	-	2
Multiple trauma	1	1		-	1	3
Olecraneon fracture	-	1		-	-	1
Patella luxation	-	1		-	-	1
Radius fracture	1	1		-	-	2
Septic arthritis	1	-		-	-	1
Tail fracture	-	1		-	1	2
Tarsus fracture	-	1		-	-	1
Tibial fracture	3	-		1	2	6
TMA luxation	-	-		1	-	1
Lumbar vertebrae fracture	-	1		-	-	1

The condition with more number of cases was the cranial cruciate ligament rupture (CCLR) with 8 patients. The range of age in orthopedic patients was large, the incidence of fracture and trauma cases was higher in younger and middle age patients (0.7- 10 years old), however the cruciate ligament rupture was with a middle age of 7.9 years old for dogs and the only cat was four years old. Most of orthopedic injuries have had a running over, falling or tumbling and fights between animals as causes.

The next figure (fig.27) is a radiograph from a four years old male dog that has come to the NSVH with weight-bearing lameness. Radiographs were realized to confirm the diagnosis after to do the orthopedic examination, including the cranial drawer test (positive to cruciate ligament injury).

Fig.27 – Lateral radiograph of a dog showing joint effusion, confirming cruciate ligament rupture (NSVH)

The surgical treatment was suggested and the dog was submitted to it, using the tibial tuberosity advancement (TTA) as technique. The next two figures show the material used in this technique (fig.28) and the TTA technique application (fig.29), showing the final result of it before closing the surgical wound.

Fig.28 – TTA material: plates and screws (NSVH)

Fig.29 – TTA technique (NSVH)

There are other surgical techniques to repair the cranial cruciate ligament rupture: tibial plateau leveling osteotomy (TPLO), tibial wedge osteotomy (TWO).[34]

The technique used to treat patients with CCLR at NSVH was the tibial tuberosity advancement, whilst at MVH the tibial plateau leveling osteotomy was the most commonly used technique.

After the surgery a soft bandage with a lateral split is maintained and exercise restriction to the patient is required. However, 24 hours post-surgery simple physical rehabilitation should begin.[34]

Tibial fracture was the second most common condition during the internship. The next figures (fig.29 and 30) are from a female dog with 6 years old, who suffered a running over on the day she was admitted at the NSVH. She presented lameness on her right hind limb and when radiographs were taken a nonreducible comminuted tibial fracture was found. The first radiograph (fig.29) shows the fracture and the second one (fig.30) shows the fracture repair using a combination with an intramedullary pin, a bone plate and screws.

Fig.30 – Lateral radiograph of a dog showing a tibial fracture (NSVH)

Fig.31 – Lateral radiograph showing the tibial fracture repair (NSVH)

The tibial fracture could be repaired using other surgical techniques and the decision of choice is made based on the type of fracture.[35] The figures 32 and 33 are from a female dog with two years old with a reducible comminuted tibial and fibular fracture after five weeks of her fracture repair. In this case an external fixator was used.

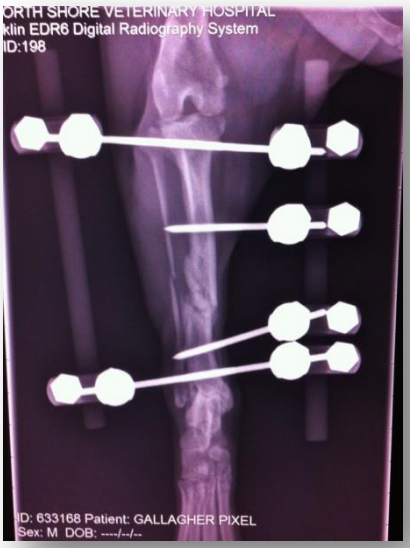


Fig.32 – Anteroposterior radiograph of tibial and fibular fracture repair with external fixator (NSVH)

Fig.33 –External fixator (NSVH)

After the fracture repair, a Robert Jones bandage was applied to ensure a limb immobilization. Analgesics as buprenorphine (0.02 mg/kg, IV) and methadone (0.1- 0.5 mg/kg, IV) were chosen to control the pain on these patients during the perioperative period while they were at hospital.

2.12 Preventive medicine:

Preventive medicine is the field responsible for avoiding the illness, using preventive methods to maintain and improve the health on the animal. The administration of vaccines, internal and external deworming are preventive methods used with the goal to prevent infectious diseases on the pets, promoting not only their health but also the public health.

The next table (table no.25) represents the preventive medicine methods during the internship which represented 3.5% (n=17/482) of the total followed up cases.

Table no.25 – Absolute frequency of preventive medicine methods by specie and genre

Preventive medicine cases						
Method	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Vaccination/ deworming	4	8		4	1	17

All of pets have come to the preventive medicine consults for vaccination. Some of these pets also receive internal and/or external deworming.

In Australia, the core vaccines for dogs are parvovirus (canine parvovirus enteritis), canine distemper virus (distemper disease) and canine adenovirus (canine infectious hepatitis). Puppies are vaccinated against these three threats. The core vaccines for cats are parvovirus (panleucopenia/enteritis), feline herpesvirus (infectious rhinotracheitis) and feline calicivirus. Kittens are vaccinated to prevent these three diseases.[36]

Puppies and kittens should receive the first vaccination between six and eight weeks of age, followed up with a second vaccination at 12 weeks and a third one at 16 weeks of age. After that, dogs and cats only need an annual booster.[36]

However, there are non-core vaccines that should be required if the dog or cat is in risk to contract specific infections. Dogs could also be vaccinated against parainfluenza virus, *Bordetella bronchiseptica* and *Leptospira interrogans*, while cats may be vaccinated against feline leukaemia virus, *Chlamydophila felis* and *Bordetella bronchiseptica*.[36]

In Portugal, the core vaccines for cats are the same as in Australia; however there is an obligatory vaccine for dogs against rabies that could be administered after three months of age and its booster should be done each three years.

From 17 animals which have come to the hospitals to receive the vaccines, 11 of them were puppies and kittens receiving their first vaccination and the others six animals received their vaccine's boosters.

2.13 Theriogenology:

The theriogenology field includes the andrology, gynecology and obstetrics medical branches. It studies disorders from the female and male reproductive systems and deals with pregnancy, parturition and postpartum period; making diagnosis and treatments. Helpful complementary exams in this field are the gynecological examination using the speculum, vaginal cytology, biopsies, abdominal ultrasound, blood analysis and biochemistry analysis, x-rays and spermogram. The treatment on this field could be medical or surgical, depending of the disorder. The most common surgeries are the ovariohysterectomy on the female and the main reason to do it is to prevent undesired pregnancies (however, there are other reasons to do this surgery); and the orquiectomy on the males with the goal to help prevent animal from experiencing behavioral changes caused by the presence of testosterone.

The next table (table no.26) represents all the theriogenology cases received during the internship. The percentage of this field was 10.5% (n=51/487).

Table no.26 – Absolute frequency of theriogenology conditions by specie and genre

Cases of theriogenology						
Condition	Dogs			Cats		Total
	Females	Males		Females	Males	
Caesarean	3	-		-	-	3
Hermaphroditism	1	-		-	-	1
Orchiectomy	-	6		-	8	14
Ovarian remnant syndrome	1	-		-	-	1
Ovariohysterectomy	15	-		14	-	29
Placental retention	1	-		-	-	1
Pyometra	1	-		-	-	1
Uterine rupture	1	-		-	-	1

Ovariohysterectomy and orquiectomy were the two procedures with more number of cases with 29 and 14 cases, respectively.

The most interesting case of theriogenology seen along the internship was the hermaphroditism. The figure 34 is from a two years old female French Bull dog that has come to the NSVH presenting an enlarged clitoris, diagnosed with hermaphroditism.

Fig.34 – Enlarged clitoris of the intersex animal presenting as female (NSVH)

When a dog presents an enlarged clitoris or an underdeveloped penis and prepuce, it could be a strong suspicion of intersexuality. Intersexuality occurs when gonads contain combinations of ovarian and testicular tissues (functional or not) and when there is androgens stimulation of the genital tubercle (embryological structure, androgen sensitive, common to both sexes which becomes either a clitoris or penis). If there is no androgens stimulation, the clitoris remains a vestigial structure. On the other hand, if there is a testicular material stimulating, the clitoris becomes enlarged or even an improperly developed penis.[37]

The dog presented to the hospital with this condition appears to be female since little; however she had an enlarged clitoris exposed out of the vulval lips. On that case, because it remains vulnerable to damage, the surgery to remove the clitoris was done.

The fig.35 shows the clitoris removal during the surgery.

Fig.35 – Clitoris after its removal from the animal (NSVH)

The dog recovered uneventfully from the surgery and returned home on the next day.

2.14 Pneumology and otorhinolaryngology:

Pneumology and otorhinolaryngology field deals with the respiratory tract including the upper and lower airways. A cardiopulmonary auscultation has an important role to find changes on the respiratory tract; however, to get to the diagnosis, there are a few complementary exams that could be done: blood tests, including arterial blood gas, x-rays, rhinoscopy, bronchoscopy, bronchoalveolar lavage (BAL), CT scan or MRI and echocardiography (some respiratory conditions have a cardiac disease as cause).

The next table (table no.27) shows all the pneumology and otorhinolaryngology conditions seen along the internship. The percentage was 3.9% (n=19/482).

Table no.27 – Absolute frequency of pneumology and otorhinolaryngology conditions by specie and genre

Pneumology and otorhinolaryngology cases						
Condition	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Acute upper airways obstruction	1	-		-	1	2
Aspiration pneumonia	1	-		-	-	1
Brachycephalic syndrome	1	1		-	-	2
Larynx paralisis	-	1		-	1	2
Lung atelectasy	-	-		1	-	1
Pleural effusion	1	-		1	2	4
Pneumonia	1	-		-	1	2
Pneumotorax	-	-		2	-	2
Noncardiogenic pulmonary edema	1	2		-	-	3

The condition with more number of cases was the pleural effusion with four cases: one female dog, Poodle, with eight years old; one female cat with 10 years old; two male cats with 1.5 and 2.4 years old. All cats were Common European. Pleural effusion was caused by neoplasia on the dog, heart failure on the female cat and trauma on the two male cats. The clinical signs presented were cough, breathing effort more evident during the inspiration. Radiographs were taken confirming the condition and thoracocentesis was done to decrease the respiratory distress on the animals.

The definitive treatment for this problem consists on the elimination of the underlying cause and on the execution of thoracocentesis and thoracostomy to improve the breathing (however, they don't treat the cause).[38] Other causes for pleural effusion are: right sided heart failure, pericardial disease, hypoalbuminemia, diaphragmatic hernia, neoplasia, FIP, neoplasia, lobe lung torsion, pyothorax, trauma, bleeding disorder. The differential diagnosis should be based on the type of the fluid removed during the thoracocentesis (pure or modified transudate, exudates, hemorrhagic or chylous).[39]

The second condition with more number of cases was the pulmonary edema with three cases. The median age of these patients was 9.9 years old. One dog was a Maltese Bichon and the other two dogs were Crossed Breed.

There are two pulmonary edema types: cardiogenic and noncardiogenic. The cardiogenic pulmonary edema (CPE) is secondary to cardiac disease, where an increase of the left atrial pressure promotes an elevation of pressures in pulmonary venous and capillary pressures. Otherwise, the noncardiogenicpulmonary edema (NCPE) involves an elevation of the capillary membrane permeability.[40] Differential diagnoses of NCPE are: kidney and liver diseases, overhydration, neoplasia, trauma, sepsis, pancreatitis, upper airways obstruction, drug-induced, uremia, disseminated intravascular coagulation, and any cause responsible to increase the capillary membrane permeability.[41]

The three animals have come to the hospital with cough, tachypnoea and dyspnoea. Radiographs were taken and an interstitial pattern was found mixed with an alveolar pattern. To stabilize the animal oxygen therapy was done improve his breathing and solve hypoxia (fig.36). Because none of the patients had hypotension, furosemide was given to reduce the edema.

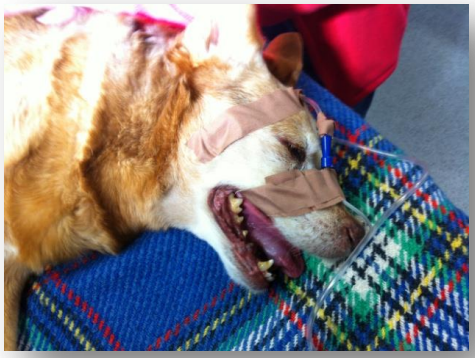


Fig.36 – Dog with dyspnoea receiving oxygen therapy (MVH)

One of the patients was admitted because he suffered a running over and the pulmonary edema was classified as noncardiogenic caused by trauma. The other two patients the cause wasn't found, but cardiac disease was excluded. For that reason, they were also classified as noncardiogenic pulmonary edema.

2.15 Toxicology:

Toxicology is a branch of medicine, biology and chemistry that studies the clinical signs, mechanisms, treatments and detection of toxins. In veterinary medicine, the patient's history has a high importance to understand the clinical signs to get close to diagnosis. The next table (table no. 28) represents all the toxicology conditions during the internship which had a percentage of 1.1% (n=5/482) of the total followed up cases.

Table no.28– Absolute frequency of toxicology conditions by specie and genre

Toxicological cases					
Condition	Dogs		Cats		Total
	Females	Males	Females	Males	
Brunfelsia plant intoxication	1	-	-	-	1
Chocolate intoxication	2	-	-	-	2
Paracetamol intoxication	1	-	-	-	1
Raw potato intoxication	1	-	-	-	1

The chocolate intoxication occurred in two patients, being classified as the condition with more cases. The two dogs have lived at the same house and they ate together two big milk chocolate tablets. Both of dogs were prostate, and presented abdominal pain on palpation. Emesis was promoted using apomorphine hydrochloride (20-40 micrograms/kg, IV). Activated charcoal was also used to decrease the half-time of theobromine.

Chocolate has theobromine and caffeine on its composition and these two methylxantines are toxic to animals. There's no antidote and the treatment is supportive. The objective of treatment is to promote emesis using activated charcoal; if the emesis is partially or contraindicated, gastric lavages should be done. The animal with chocolate intoxication could present tremors or even seizures. On that case diazepam is a good choice as well.[42]

The dogs were hospitalized during the day to ensure clinical stabilization and in the end of the afternoon they went home with their owners.

2.16 Nephrology/ Urology:

Nephrology and Urology are both medical fields which deal with kidney, ureter, bladder and urethra disorders. The clinical signs of urinary tract disorders are most of the time vague, for that reason, patient's history and physical examination are important to the diagnostic workup, but other complementary exams should be done. Urinalysis, biochemistry analysis (especially creatinine and blood urea nitrogen values), ultrasound and x-rays are the most important complementary exams to get to diagnosis in this field. Sometimes a biopsy is also required to classify the disease.

The table no.29 represents all the nephrology/urinary cases received during the internship. A total of 50 patients, 25 were dogs and the other 25 were cats. The percentage of this field was 10.3% (n=50/487).

Table no.29 – Absolute frequency of nephrology/ urology conditions by specie and genre

Nephrology/ Urology cases						
Condition	**Dogs**			**Cats**		**Total**
	Females	Males		Females	Males	
Acute renal failure	4	1		2	2	9
Chronic kidney disease	6	5		7	5	23
Feline lower urinary tract disease	-	-		-	9	9
Glomerulonephritis	-	1		-	-	1
Hydronephrosis	1	-		-	-	1
Incontinence	-	1		-	-	1
Lower urinary tract infection	1	-		-	-	1
Urinary obstruction	1	1		-	-	2
Uroabdomen	1	-		-	-	1
Uroliths	-	2		-	-	2

The condition with more number of cases received at the hospitals was the chronic kidney disease (CKD) with 11 dogs and 12 cats as patients. The two other conditions with significant amount of cases were acute renal failure (ARF) and feline lower urinary tract disease (FLUTD) with 9 cases each.

The prevalence of chronic kidney disease was 3.3% (n=11/337) for dogs and 8.3% (n=12/145) for cats. The middle age was 11.2 years old for dogs and 7.4 years old for cats. The most common clinical signs for CKD were polyuria, polydipsia, prostration, anorexia and vomiting. As it is known, those signs are nonspecific for any disease, so to get to the right diagnosis, it was important to suggest to the owners the permission to do biochemical analysis, urinalysis and abdominal ultrasound.

In all patients with chronic kidney disease findings as increased creatitine and BUN were found on the biochemical analysis; the urinalysis presented a decreased urine specific gravity (USG) with lower values than 1.035 and the kidney ultrasound revealed changes on the kidney structure.

The next two figures (fig.37 and 38) show the right and left kidney ultrasound of a male cat with 5 years old, diagnosed with chronic kidney disease.

Fig.37 – Cat's left kidney ultrasound (MVH)

Fig.38 – Cat's right kidney ultrasound (MVH)

The fig.37 represents the left kidney and the fig.38 the right kidney. The size was normal in both kidneys but there was a loss of resolution of the border between renal cortical and renal medullary, which it's suggestive of chronic kidney disease, complemented with anamnesis and biochemical values: increased creatinine and increased blood urea nitrogen (BUN). A non regenerative anemia and a decreased total protein (TP) were found as well.

CKD is a progressive condition where the function and the structure of renal tissue are lost. This damage may be present in one or both kidneys for over 3 months.[45] This disease could affect any age; however, older pets are likely affected, commonly 5-6

years upward.[43] It has been reported in literature there is an important checklist for managing a patient with chronic kidney disease. First of all a confirmation that the patient has kidney disease should be done by renal function tests, urinalysis and imaging exams, also confirming with the owners the patient history to understand if the disease is chronic or not. Then a stage classification

of CKD is the second step. [44] There is a system stage made by IRIS (International Renal Interest Society) based on serum or plasma creatinine concentration, presence or absence of proteinuria and/or hypertension, represented on the table no.30.[44, 45]

Table no.30 – IRIS system stage classification (adapted from Bartges, 2012)

	Plasma Ccreatinine, umol/L, mg/dL		
Stage	Dogs	Cats	Comments
1	<125 <1.4	<140 <1.6	Nonazotemic; Some other renal abnormality present such as inadequate concentrating ability without identifiable nonrenal cause; abnormal renal palpation and/or abnormal renal imaging findings; proteinuria of renal origin; abnormal renal biopsy results.
2	125-179 1.4-2.0	140-249 1.6-2.8	Mild renal azotemia (lower end of the range lies within the reference range for many labs but the insensitivity of creatinine as a screening test means that animals with creatinine values close to the upper limit of normality often have excretory failure); Clinical signs usually mild or absent.
3	180-439 2.1-5.0	250-439 2.9-5.0	Moderate renal azotemia; Many systemic clinical signs may be present
4	>440 >5.0	>440 >5.0	Severe renal azotemia; Many extrarenal clinical signs present

Substage of CKD based on presence or absence of proteinuria determinate by UPC			
UPC Value			
Dogs	Cats	Substage	
<0.2	<0.2	Nonproteinuric	
0.2-0.5	0.2-0.4	Borderline proteinuric	
>0.5	>0.4	Proteinuric	
Substage of CKD based on presence or absence of systemic arterial hypertension and risk of systemic arterial hypertension-related complication			
Systolic blood pressure, mmHg	Diastolic blood pressure, mm Hg	Adaptation when breed-specific reference range is available	Substage
<150	<95	<10 mm Hg above reference range	AP0: minimal risk (N)
150-159	95-99	10-20 mm Hg above reference range	AP1: low risk (L)
160-179	100-119	20-40 mm Hg above reference range	AP2: moderate risk (M)
>180	>120	>40 mm Hg above reference range	AP3: high risk (H)

Once the CKD stage classified, the treatment plan on the patient should be started.[44] To help on this issue, an acronym was created to assist in treating CKD based on excesses and deficiencies promoted by this condition: NEPHRONS. The meaning of it is: N- nutrition; E- electrolytes; P- pH or blood (acid-base status) and proteinuria; H- hydration; R- retention of wastes; O- other renal insults- avoid; N- neuroendocrine function (hyperparathyroidism, anemia, hypertension) and S- serial monitoring (CKD is irreversible and progressive).[45] The animal needs to be followed up regularly, to assess the response to therapy.[44]

When CKD condition is severe, the body has lost its capacity to eliminate waste solutes or fluids, causing a fluid overload, uremia and toxin retention. A peritoneal dialysis or haemodialysis could be indicated as the next step. The next figure (fig.39) shows a catheter placement into the abdomen of the cat with CKD. The aim of it is to accomplish an infusion of dialysate into the abdomen where it stays for awhile and then the fluid is drained into a waste bag.[46]

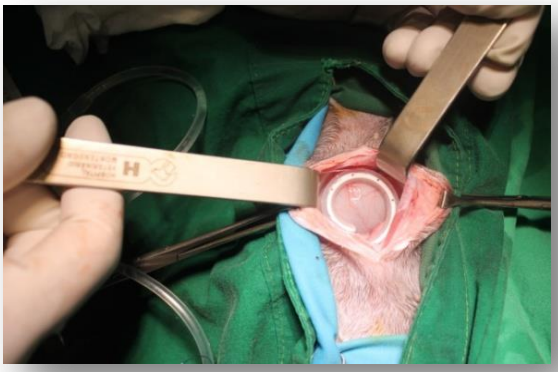


Fig.39 – Peritoneal dialysis on a cat with CKD

2.17 Other conditions and clinical signs with unknown causes:

The table no.31 lists other conditions as angioedema, hypoglycemic and hypotension shock and clinical signs as dysphagia and epistaxis without definitive diagnosis. These animals only did supportive treatment. These cases represent 1.9% of all internship cases.

Table no.31 – Absolute frequency of other conditions and clinical signs without known causes by specie and genre

Other conditions and clinical signs without known causes						
Condition	Dogs			Cats		Total
	Females	Males		Females	Males	
Angioedema	-	2			-	2
Dysphagia	-	-		1	-	1
Epistaxis	-	-		1	-	1
Hypoglycemic shock	-	-		-	1	1
Hypotension shock	1	-		1	1	3

The two dogs with angioedema, both were German Shepherd males, have come to the hospital with face edema. There was a suspicion of a vaccination side effect in one of them, but the cause for the other one was never found. The fig.40 shows the dog with angioedema on the face from unkown cause.

.

Fig.40 – Dog with angioedema on his face from unknown cause (MVH)

To reduce the angioedema, which is a hypersensibility reaction to antigens or substances that can act as antigens and appearing suddenly to the allergen exposition, it was given metylprednisolone intravenously on the dog.

For the other conditions/clinical signs, a list of differential diagnosis was made; however the causes weren't found.

3. Complementary exams/ Medical and surgical procedures:

This part of the internship report is reserved to list all the complementary exams, medical and surgical procedures done along the internship. Most of times, patient's history and physical exams aren't enough to understand the disorder presented. For that reason, complementary exams have a high role on the diagnosis searching; helping the veterinarian on the differential diagnoses exclusion, to find the cause and definitive diagnosis and, finally, to give the treatment the patient needs.

The table no. 32 represents the absolute frequency of the imaging exams that were attended and executed by trainee at NSVH and MVH.

Table no.32 – Absolute frequency of imaging exams

Imaging Exams				
	Procedures	Attended	Executed	Total
Ultrasound	Abdominal	111	6	117
	Echocardiography	19	1	20
	Ophtalmological	2	0	2
X-rays	Abdominal	16	25	41
	Limbs	46	13	59
	Thorax	19	12	31
CT scan	Brain	17	0	17
	Fore limbs	4	0	4
	Spinal cord	26	0	26
Fluoroscopy	Fore limbs	2	5	7
	Hind limbs	2	2	4
	Portosystemic shunt	1	0	1
Endoscopy	Bronchoscopy	3	0	3
	Colonoscopy	1	0	1
	Digestive endoscopy	4	1	5

A total of 338 imaging exams were done during all the internship not only with the aim to diagnose but also to recheck patients. The ultrasound was the most common imaging exam performed. In total of 139 ultrasound exams, 117 were abdominal (including stomach, intestine, liver, pancreas, kidney, ureters, bladder, spleen and abdominal cavity in general), 20 were echocardiographies and two were ophthalmological. The trainee attended 132 ultrasounds and did seven.

X-rays was the second most imaging exam performed. In total of 131 x-rays, 41 were abdominal (projections: lateral, dorsoventral and ventrodorsal), 59 were made to the limbs (projections: lateral, mediolateral, anteroposterior) and 31 were to the thorax (projections: lateral, dorsoventral and ventrodorsal). The trainee attended 81 x-rays and executed 38.

Both hospitals were a neurology referral and both had equipped with CT scan. This exam was done 47 times, 17 CT scan were done to the brain and 26 to the spinal cord. Four were done on the fore limb with the goal to find coronoid fractures of the ulna (orthopedic medicine). All 47 CT scan exams were attended by trainee.

Fluoroscopy was realized 12 times at NSVH aiding on the orthopedic surgeries and the portosystemic shunt surgery. Five fluoroscopy exams were attended and seven were done by the trainee.

The endoscopy exam was executed nine times. Three of them were bronchoscopies, one was colonoscopy and five were digestive endoscopies. The trainee performed this exam one time.

The table no. 33 lists the absolute frequency of the complementary exams where the trainee was involved at NSVH and MVH (attended and executed herself).

Table no.33 – Absolute frequency of complementary exams

Complementary Exams				
	Procedures	Attended	Executed	Total
Biopsies	Intestine	2	1	3
	Kidney	1	0	1
	Liver	2	0	2
	Skin	6	0	6

Cytologies	Blood	6	3	9
	Ear	7	2	9
	Skin	2	0	2
	Vagina	2	1	3
Centesis	Abdominocentesis	4	0	4
	Pericardiocentesis	1	0	1
	Thoracocentesis	3	1	4
Clinical Analysis	Biochemestry analysis	97	45	142
	Blood tests	80	32	112
	Urinalysis	54	24	78
Blood pressure measurement		40	6	46
Electrocardiography		8	0	8
Schirmer test		2	0	2
Fluorescein test		2	0	2

As it's possible to visualize on the table above, 772 complementary exams were executed on the patients at NSVH and MVH along the internship. Clinical analysis was the most common complementary exam performed. In total of 332 exams, 142 were biochemistry analysis, 112 blood tests and 78 were urinalysis. From all clinical analysis, the trainee attended 231 tests and did 101.

The cytology was the second most required complementary exam, done in both hospitals 23 times. Cytologies were done to the blood, ear wax, skin and vagina. 17 of them were attended and 6 were performed by trainee.

12 biopsies were also done during the internship, including intestine, kidney, skin and liver biopsies. One intestine and one stomach biopsy was done by trainee, all the others were attended.

The centesis was done nine times. Four of them were abdominocentesis, one was a pericardiocentesis and the other four were thoracocentesis. The trainee attended eight centesis and did one.

Blood pressure measurement was performed 46 times and six of them were accomplished by trainee. Electrocardiography was done eight times.

Shirmer and fluoresceine tests were also done, two times each, in patients with ophthalmologic conditions suspicion. All of them attended by trainee.

The table no. 34 represents the absolute frequency of procedures in surgery performed during the internship in both hospitals, where the trainee had the opportunity to attend it, to be the surgeon's assistant or the anesthetist when it was required.

Table no.34 – Absolute frequency of procedures in surgery

Procedures of Surgery				
	Attended surgery	**Surgeon's assistant**	**Anesthetist**	**TOTAL**
Cardiology	2	-	-	**2**
Dentistry	16	-	2	**18**
Dermatology	-	2	-	**2**
Gastroenterology	9	3	3	**15**
Neurology	9	4	4	**17**
Oncology	11	9	2	**22**
Ophthalmology	2	-	-	**2**
Orthopedics	30	4	5	**39**
Theriogenology	40	6	1	**47**
Pneumology/Otorhinolaryngology	3	-	-	**3**
Nephrology/Urology	6	-	-	**6**
TOTAL	**128**	**28**	**17**	**173**

A total of 173 surgeries were performed at NSVH and MVH during the internship. There were 128 attended surgeries by trainee. In 28 surgeries there was the opportunity for trainee to be the surgeon's assistant in fields of dermatology, gastroenterology, neurology, oncology, orthopedics and theriogenology.

The trainee was also anesthetist in 17 of all surgeries where there was a responsibility to make sure the patient was anesthetized and stable during the surgery.

The table no.35 lists the type of surgeries done in each veterinary field in both veterinary hospitals.

Table no.35 – Types of surgery in each veterinary field

Field	Types of Surgery
Cardiology	Patent ductus arteriosus occlusion (n=1); tricuspid valve replacement (n=1).
Dentristry	Bacterial plaque removal (n=17), dental devitalization (n=1).
Dermatology	Dermic cyst removal (n=1), total ear canal ablation (n=1).
Gastroenterology	Gastrotomy (n=2); enterotomy (n=3); enterectomy (n=4); portosystemic shunt occlusion (n=1); cholecystectomy (n=1); gastropexy (n=4).
Neurology	Ventral slot (n=5); hemilaminectomy (n=10); cystoperitoneal shunt (n=1); chiari-like malformation resolution (n=1).
Oncology	Mass removal (n=11); splenectomy (n=5); parathyroidectomy (n=1), skin flaps (n=3) and skin grafts to close the surgical wounds (n=2).
Ophthalmology	Third eyelid flap (n=1); third eyelid protrusion resolution (n=1).
Orthopedics	TTA (n=6), TPLO (n=2), fractures repair (n=24), carpal arthrodesis (n=1), triple pelvic osteotomy (n=3), femur head recession (n=1); fore and hind limb amputation (n=2).
Theriogenology	OVH (n=28), orquiectomy (n=14), ovariectomy using laparoscopy (n=1), enlarged clitoris removal (n=1), caesarian (n=3).
Pneumology/ Otorhinolaryngology	Brachycephalic syndrome resolution (n=2); arytenoid lateralization (n=1).
Nephrology/ Urinary	Cystotomy for uroliths removal (one of them by laparoscopy) (n=6).

As it possible to visualize on the table no.35, there were a large number of different surgeries done during the internship. In fact, it was an excellent opportunity for trainee to learn the most possible about surgery area and its techniques.

IV. Seizures: An intracranial cyst as cause with surgical treatment

1. Seizures - Literature Review

1.1 General considerations

Seizures could be defined as non-specific abnormal body's event resulting of abnormal synchronous electrical activity in the cerebral cortex.[47- 49] There is a estimated seizure's prevalence in dogs of 1% to 2% at referral veterinary hospitals, being classified as the most common neurologic disorder encountered in small animal practice.[54]

According with the literature, there is an ictal phenomenology characterization used for seizures. They are epileptic and non-epileptic seizures, epilepsy and *status epilepticus*. When an epileptic seizure is referenced, it means the seizure had a specific neural origin. [49] However, not all seizures are considered epileptic;[49, 50] some of them are non-epileptic seizures because they do not involve abnormal, rhythmic discharges of cortical neurons. Non-epileptic seizures usually results in changes on the patient behavior, neurological status or body movements mimicking a real epileptic seizure;[48] however, causes responsible for these episodes could be cardiovascular dysfunction, syncope, electrolyte unbalances, hepatic dysfunction, hypoglycemia, acute vestibular "attacks", myasthenic syndromes, hyperthyroidism, pyrexia.[52, 50, 48]

An epileptic seizure has four phases/components, separating its clinical features. The *prodome* is the first component and precedes the seizure activity. Changes on animal behaviors as increased anxiety and attention seeking, panting or hiding are usually described by owners as a milestone of the seizure's onset.[47, 48, 49] The second component of the epileptic seizure is the *aura* and represents the onset of seizure manifestation (could have a duration of seconds, minutes or hours) and the animals exhibit stereotypical sensory or motor activity, autonomic patterns and unusual psychic events (e.g. licking, swallowing, pacing, vomiting, urinating, salivating, excessive barking).[48, 49] The *ictal* period corresponds to the epileptic seizure per se and is the third component of it.[47, 49] This phase can last seconds or minutes with the animal presenting signs as involuntary muscle tone or movement, jaw chomping, salivation, loss of consciousness, involuntary urination and defecation.[48] The last component of an epileptic seizure is the *postictal* period and can last minutes or even days. In this phase the animal presents

abnormal behavior as disorientation, increased or decreased appetite and thirst, weakness, blindness and motor disturbances, inappropriate intestine or bladder activity.[48, 49]

Epilepsy can be defined as neurological disorder characterized by recurrent epileptic seizures,[50, 51, 56] caused by acquired or congenital brain lesions (symptomatic or secondary epilepsy) or genetic mutations (idiopathic epilepsy).[56] When there is a persistent state of epileptic seizure lasting longer than five minutes or when the animal doesn't return to normality within 30 minutes between seizures the condition is classified as *status epilepticus*.[49, 50]

The epileptic seizures could be classified as self-limiting (if it may occur as a single event); clusters (if there are two or more seizures along 24 hours) and status epilepticus (it was already described above).[49, 50]

1.2 Pathophysiology:

The pathogenesis of epilepsy is multifactorial.[49] However, it has been studied in humans and animals, since decades, using the electroencephalography (EEG) to understand the normal electrical activity of the cerebral cortex and the changes on the neural networks when the seizure onset.[57, 58] Cortical neurons can exhibit alterations on their membrane potential and discharge patterns. Paroxysmal depolarizing shift is classified as prolonged and abnormal post-synaptic depolarizing which can cause other neuronal discharges, exciting other neurons. The result of this event is an adoption of abnormal pattern of synchronized crises from neuronal aggregates in the brain.[51] In other words, when an imbalance between excitation and inhibition exists (increased excitation or decreased inhibition), an epileptiform activity in the brain is created and the epileptic seizure starts.[57, 49] The dynamic stability of neural networks on the brain are maintained by synaptic neurotransmissions: excitatory amino acids (e.g. glutamate), gamma-aminobutyric acid (GABA), acetylcholine, glycin, catecholamines, neuropeptides and adenosine; and ion channels as sodium, potassium and calcium.[59, 57, 51, 49] Found veterinary literature only refers the glutamate and GABA neurotransmitters on the small animals on the epileptogenesis. In the central nervous system, glutamate is its main excitatory neurotransmitter, whilst GABA is the main inhibitory neurotransmitter. When their inhibition in the brain by GABA is blocked, there are another neuronal

networks being excited by thalamocortical recruitment, a synchronized depolarization starts and the epileptic seizure happens.[49, 57, 59]

Mutations of ion channels are starting to be linked to familial epilepsies of some dog breeds (Belgian Tervueren, Vizla, Keeshond, Retriever and Shetland Sheepdog). Those mutations have been studied and described in human medicine, as a cause of several idiopathic epilepsies; however, they are still poorly understood in veterinary medicine.[57, 49, 59]

1.3 Classification of epileptic seizures:

In 1981, the International League Against Epilepsy (ILAE) made the first classification for epileptic seizures in humans, based in two major classes: *focal or partial seizures* (originate from a localized area in the cerebral cortex. They could also be simple or complex) and *generalized epileptic seizures* (which originate and affect both cerebral hemispheres simultaneously). In 2001, a task force was made with new concepts, improving the first classification.[49, 50, 51, 57]

The last ILAE epileptic seizures classification is completed and highly characterized in human medicine.[51, 50, 54] However, it's restricted in veterinary medicine by some limitations, as the required ability of veterinarian to classify the seizure on his patient, based on the owner's observation; most of the time it wasn´t possible to perform the EEG to classify the seizure itself, as well as it's not always possible to have a confirmation of etiology. Thus, Podell provided an adaptation of the ILAE classification to veterinary medicine as it's below described.[49, 54]

1.3.1 Focal seizures: sensory and motor (elementary and automatism):

Sensory seizures are manifested with elementary somatosensory clinical signs (e.g. paraesthetic and painful sensations as numbness and burning) generated by activation of the primary sensory cortices in the parietal lobes.[50, 55]

Motor seizures could be described as clonic elementary movements of flexion and extension, or contraction and relaxation of the affected muscle groups and automatisms; or austomatisms when the movements are repetitive, resembling voluntary movements. In dogs, examples of automatisms are usually running movements of their legs or chewing movements.[50, 55]

The figure 41 shows a schematic representation of focal origin of epileptic seizure.

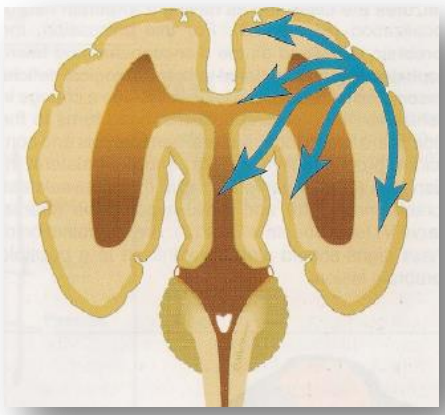


Fig. 41 - Focal origin of epileptic seizure
(adapted from Podell, 2004)

1.3.2 Generalized seizures: tonic-clonic, clonic, myoclonic and atonic

Generalized tonic-clonic seizures are the most dramatic seizure type. The motor manifestations are bilateral and synchronous. In these type of seizure there is a sequence consisting of a tonic phase where the animal sustained contraction of all skeletal muscles, producing a brief initial phase of flexion forwards followed by a longer phase of extension backwards; and the clonic phase which comprises continuously repetitive, massive, symmetrical and synchronous flexor chronic convulsions of muscle groups.[50, 55, 57]

Generalized clonic seizures are, by definition, manifest with bilateral rhythmic and repetitive clonic convulsions only. They are commonly prolonged.[50, 55]

Generalized myoclonic seizures, that could be also called myoclonic jerks, occur suddenly. Instead of clonic seizures, the myoclonic jerks are simple or multiple irregularly recurrent contractions of a muscle or a group of it. They are brief and random.[50, 55, 57]

Generalized atonic seizures manifest with brief and sudden loss or decrease of muscle tone involving the head, jaw, or limb musculature without tonic or myoclonic events. Clinical manifestation of atonic seizure is a fall from the standing position. The consciousness is usually intact.[50, 57]

A schematic representation of generalized origin of epileptic seizure is showed on the figure 42.

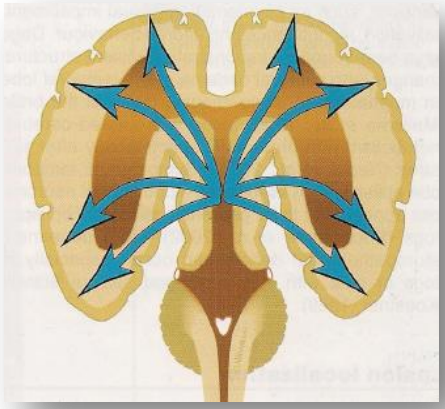


Fig. 42 - Generalized origin of epileptic seizure (adapted from Podell, 2004)

1.4 Differential diagnoses

The differential diagnoses for epileptic seizures developed underlying of neurological disorder (epilepsy) are made based on four main aetiological terms. They are idiopathic, symptomatic or secundary, probable symptomatic or cryptogenic and reactive.[54, 57, 49]

Idiopathic epilepsy is used when there's no identifiable cause, or in other words, there is no evidence of structural brain lesion.[54, 55] All complementary and imaging exams are normal, as well as the neurological exam which is normal between epileptic seizures (interictal period). The first seizure, usually, occurs in dogs with age from 6 months to 6 years.[57] However, animals out of this age range could have seizures as well.[54, 57] Heritable basis is defended to be a possible cause of idiopathic epilepsy and dog breeds as Australian Shepherd, Belgian Tervuren, Dachsund, German Shepherd, Retriever, Shetland Sheepdog, Vizla, Dalmatian are on the list.[54] The table no.36 lists the differential diagnosis for idiopathic seizures.

Table no.36 – Differential diagnosis for idiopathic epilepsy (adapted Podell, 2004)

Aetiological Category	Differential diagnosis
Idiopathic epilepsy	Ion channel disorders
	other genetic conditions

Symptomatic or secondary epilepsy refers to brain disorders with known and identified cause.[49, 54, 55, 50] The clinical manifestation depends of the cerebral lobe involved.[50] Causes of these disorders could be congenital or acquired and are visualized on MRI. There's no specific age or breed to develop symptomatic epilepsy, however, it should be noted that younger dogs have higher susceptibility to developmental and encephalitic conditions, while older dogs are more prone to intracranial neoplasia.[49, 55, 57] On probable symptomatic epilepsy there is the belief that epileptic seizures are caused by a brain disease, but in reality, it wasn't identified.[55] The table no.37 identifies differential diagnosis for symptomatic epilepsy.

Table no.37 – Differential diagnosis for symptomatic epilepsy (adapted Podell, 2004)

Aetiological Category	Differential diagnosis	
Symptomatic Epilepsy	Developmental anomaly	Hydrocephalus
		Cortical dysplasia
		Lissencephaly
	Neoplasia	Extra-axial: meningioma, bone tumors
		Intra-axial: glial tumors, metastasis
		Intraventricular: ependymoma, choroid plexus tumors
	Infectious diseases	Viral, bacterial, rickettsial, fungal, protozoal, parasitic
	Inflammatory diseases	Granulomatous meningoencephalitis
		Eosinophilic meningoencephalitis
		Breed-specific meningoencephalitis
		Corticosteroid-responsive inflammatory disease
	Toxicity	Organophosphates; carbamates; pyrethrins
		Ethylene glycol; household cleaners
		Rodenticides
		Chocolat, onions
		Lead
		Poisonous plants
	Traumatic	
	Vascular	Ischaemic
	Hemorrhagic	Hypertension related
		Coagulopathy

Reactive epileptic seizure is a term used to describe seizures with an extra-cranial cause. These seizures can be an aftermath of physiological stresses, intoxications or systemic/metabolic insults in animal. It could happen at any age in any breed; however, smaller breeds have a higher risk to develop reactive epileptic seizures due to

portosystemic shunts when young.[49, 55] The table no.38 lists the differential diagnosis of reactive epilepsy.

Table no.38 – Differential diagnosis for reactive epilepsy (adapted Podell, 2004)

Aetiological Category	Differential diagnosis	
Reactive Epilepsy	Organ failure	Hepatic
		Renal
	Electrolyte imbalance	Hyponatremia
		Hypernatremia
		Hypocalcemia
	Energy deprivation	Hypoglycemia
		Thiamine deficiency

2. Intracranial space occupying lesions (SOLs)

Intracranial space occupying lesions are responsible for expansion in volume of the intracranial contents. They could have several causes based on developmental anomalies, neoplasias, trauma and some infectious diseases. Consequences of SOLs can be vast: raised intracranial pressure, intracranial shift and herniation, epilepsy, hydrocephalus or even systemic effects.[60]

To find out which intracranial space occupying lesion is present, imaging exams as MRI or CT scan need to be performed. In case of neoplasias, the biopsy of the mass is the only exam that permits the tumor classification (depending of localization in the brain, not all neoplasias could be biopsies). CSF analysis is also important to execute for ruling out infectious diseases.[47]

Only intracranial space occupying lesions able to develop epileptic seizures will be referred in this monograph.

2.1 Developmental anomalies:

2.1.1 Congenital hydrocephalus

Stenosis of the mesencephalic aqueduct, resulting in fusion of the rostral colliculi is the most reported cause of hydrocephalus in dogs. Its consequence is a cerebral cortical atrophy secondary to the cerebrospinal fluid accumulation, rostral to obstruction. Dome-shaped head or persistent fontanelle in young animals are also considered a

developmental anomaly and may be responsible for increasing the cerebrospinal fluid (CSF) volume, being a cause of hydrocephalus as well, specially, in toy and brachiocephalic breeds.[47, 62]

2.1.2 Arachnoid cyst

A split of the arachnoid membrane in the brain is other developmental anomaly, causing arachnoid cysts.[63]

2.2 Neoplasias:

2.2.1 Intraventricular neoplasias

Choroid plexus tumors are benign tumors from the epithelium of the choroid plexus and are usually found in the lateral, third or fourth ventricles. They represent 10% of the primary intracranial tumors in dogs with middle-aged. Typically, males and Golden Retrievers are overrepresented.[64]

Ependymoma is a glioma tumor which arise the epyndima, rare in dogs (only eight cases were reported since 1985), occurring mainly in the lateral ventricle.[67]

2.2.2 Extra-axial neoplasias

Meningioma is the most common brain tumor in dogs. It's benign and defined as primary tumor of meninges, situated outside of the brain parenchyma. Golden Retrievers, Boxers and Miniature Schnauzer, with 10-11 years of age are cases commonly reported.[65]

2.2.3 Intra-axial neoplasias

Astrocytomas and oligodendrogliomas are both glial tumors and are the second most common intracranial tumors in dogs. [66] The mean age of patients is eight years old and the most common affected breeds are Boxer, Boston Terriers and Bulldogs (brachycephalic breeds).[65] In 2010, an imaging study in 30 dogs was made with the goal to understand the localization of these tumors and it concluded that almost all of oligodendrogliomas and astrocytomas were located in the cerebrum or thalamus. And most of these tumors were associated with both gray and white matter metastasis.[68]

Secondary neoplasms make up 50% of all intracranial tumors in dogs and usually are metastic offshoots from hemangiosarcoma, histiocytic sarcoma, lymphoma, metastic carcinoma, nasal neoplasms and pituitary tumors.[65]

2.3 Trauma

2.3.1 Cerebral edema and hematoma

Head trauma in dogs usually results from a running over, missile injuries (e.g. gunshot wounds), falls and animal bites.[79, 80] The brain injury could be primary if a physical disruption of intracranial structures happens in the moment of traumatic event or could be secondary if a hemorrhage or edema continues after the damages of primary brain injury.[79] Resulting on activation of biochemical pathways included the production of proinflammatory cytokines, generation of reactive oxygen species and stimulation of excitatory neurotransmitters activity. All of them contribute to brain cell damage.[80]

Hematoma and cerebral edema are both space occupying lesions caused by primary or secondary brain injuries;[79, 80] however, hematoma is more likely seen in primary brain injury and cerebral edema in secondary brain injuries. Axial hematomas could occur in the parenchyma brain and extra-axial hematomas in the subarachnoid, subdural and epidural spaces, all of them are responsible to compress the brain and neurologic dysfunctions.[80] Cerebral edema is considered an excess of accumulation of fluid in the intra and extra brain spaces, being classified as generalized condition, resulting of cytokines release, infiltration and accumulation of inflammatory cells after the brain trauma.[80, 79]

2.4 Abscesses caused by infectious diseases

Infectious diseases are only classified as cause of space occupying lesions if a brain abscess develops. These brain abscesses could have primary causes as ear infection, blood-borne infection, and more rarely, odontogenic infections. In human medicine, some types of bacteria are reported as responsible for brain abscesses. They are Spreptococcus spp, Staphylococcus aureus, Bacteroides fragilis. Toxoplasma gondii and aspergilla may also be etiologic agents. [96]

3. Intracranial cysts

3.1 General considerations

By definition intracranial arachnoid cysts (IACs) are cavities filled with cerebrospinal fluid between arachnoid layers.[72, 63, 70, 52] It has been considered a developmental abnormality in dogs and occurs mainly in their caudal fossa, more specifically, in the quadrigeminal cistern. For that reason they are also called *quadrigeminal cysts* in this species.[69] Intracranial arachnoid cysts in humans have been reported in other localizations.[63, 72, 75] In all reported human cases, 50% of IACs developed in the middle fossa, 10% suprasellar and 10% cerebellopontine angle.[52] Quadrigeminal cistern, hemispheric convexity and the posterior fossa were the less common localizations.[72, 52] This condition represents 1% of intracranial space occupying lesions in humans [70] and has been characterized as congenital origin, however, it also has been documented as acquired lesion, resulting of trauma, hemorrhage, tumors, iatrogenic causes, inflammation or connective tissue disorders.[72]

Veterinary medicine only had 11 clinical reports of intracranial cysts up to 2009, presenting a total of 56 dogs with this condition.[63]

Small breeds, specially, brachiocephalic breeds and male genre may be considered predisposing factors to develop IACs and the average age is 4 years old. In total of 56 dogs, represented breeds were Shih tzu (n=15), Maltese (n=4), Pug (n=4), Lhasa apso (n=4), Cavalier King Charles Spanial (n=4), Yorkshire Terrier (n=4), Chihuahua (n=3), Sttafordshire bull terrier (n=3), Bulldog (n=3), Pekingese (n=2), West Highland (n=2), Bichon (n=1), Pomeranian (n=1), Cairn terrier (n=1), Jack Russell terrier (n=1), Terrier mix (n=1), Beagle (n=1), Miniature Schnauzer (n=1) and German shorthaired pointer (n=1).[63]

3.2 Pathogenesis of congenital intracranial arachnoid cysts

The brain and spinal cord are covered by three layers called meninges. Dura mater is the outmost followed by arachnoid which is closely applied to the inner surface of the dura mater. The third layer is the pia mater lying on the surface of the brain and spinal cord. There is a virtual space between arachnoid and pia mater called subarachnoid space, where the cerebrospinal fluid is contained.[53] During the embryogenesis the pia mater and arachnoid are formed by a mesenchymal tissue named perimedullary mesh (that

involves the neural tube) and the CSF flow from the choroid plexus contributes for the development of the arachnoid and pia mater,[63] forming trabeculae that shape the "web" structure of the subarachnoid space. When a split in the arachnoid membrane occurs during this phase, an arachnoid cyst is formed.[72] These cysts could communicate or not with subarachnoid space or the ventricular system, and for that reason, they could be defined as *communicating* or *noncommunicating cysts*.[63, 72] The mechanism of expansion of arachnoid cysts is poorly understood, however, there are hypotheses trying to explain it. One of them is a ball-and-valve mechanism that allows CFS pulsations from adjacent normal arachnoid cisterns. Another one is secretion of fluid from the cyst wall or the cyst wall permits the cross of osmotic gradients.[78]

3.3 Clinical manifestations

Some of arachnoid cysts are discovered incidentally in dogs submitted to imaging exams. In these dogs there are no clinical manifestations of the IAC.[71]

However, reported clinical signs are generalized or partial seizures, abnormal mentation, head tilt, ataxia, strabismus, nystagmus, paraparesis or tetraparesis, tremors, visual deficits and neck pain.[74, 71, 63] Those manifestations are mainly reflective of forebrain and central vestibular dysfunction.[63]

In 2003, there was a report on five dogs diagnosed with quadrigeminal cistern arachnoid cysts using the MRI as method of diagnostic. The dog no.1 presented tonic-clonic seizures, circling the left, paresis of the right pelvic limbs and deficit on the menace reaction (associated with encephalitis); the dog no.2 had seizures; the dog no.3 presented tonic spasm of right limb and seizures, the dog 4 was having a history of ataxia in thoracic limbs and paraparesis and the dog no.5 had lower motor neuron signs in right thoracic limb (associated with disc disease). In the dog no.1 and no.5 the IAC was a MRI finding.[71]

3.4 Methods of diagnosis

The diagnosis of intracranial arachnoid cyst in dogs is made based on imaging exams as MRI or CT.[71, 74] Ultrasonography is less used, however, it has been reported in literature, specially in humans, as being the imaging exam of choice to monitor intracranial cysts and hydrocephalus after a decompressive surgery.[75]

A CSF examination may be done, because some of IACs are incidental findings, and for that reason inflammatory/infectious diseases need to be ruled out. If the intracranial arachnoid cyst is the only brain disorder, the CSF is normal. It should be noted that hydrocephalus can appear on the imaging exams as well, because IACs can produce mechanical obstruction of normal CFS flow.[63]

3.4.1. Magnetic resonance imaging

MRI exam offers the highest tissue resolution when comparing with other imaging exams.[76, 77] The concept of this exam is to align the hydrogen protons within the patient with the magnetic field from the MRI equipment. A radiofrequency pulse stimulates the protons of the patient to emit a radio signal, which differs in strength, frequency and phase from point to point. The local molecular environment is on the base of those differences of emitted signal. The image generated by the strength of the signal is displayed on a gray scale. Pulse sequence results from the combination of stimulating radiofrequency, secondary radiofrequency pulses and applied magnetic field gradients. [76] T1 and T2 weight images are the "standard "MRI constants used in veterinary medicine. The FLAIR (fluid attenuation inversion recovery) is also used when the CSF needs to be nullified, using a contrast agent named gadolinium.[77, 76] Unlike CT scan, the lack of ionizing radiation decreases artifacts, providing a better characterization of the cyst content. MRI images have the advantage to provide a better definition of brain anatomy, allowing differentiations between extra and intra axial lesions.[74] Intracranial cysts on the T1-weight images appear as hypointense well-delineated, cyst appearing structure, while on the T2-weight images they appear hyperintense. On FLAIR images the cyst appears with non-contrast enhacing.[63, 74]

The figure 43 shows the MRI exam of the IAC in a dog.

Fig. 43 – Midsagittal T1-weighted brain MRI, showing a cystic structure (white arrow), associated with the third ventricle instead of the quadrigeminal cistern (black arrow). (Adapted from Dewey, 2009)

However, it should be noted that there are differential diagnosis for intracranial arachnoid cysts; epidermoid cysts and chronic subdural hematoma have to be distinguished on MRI. On FLAIR MRI sequence, epidermoid cysts are hyperintense distinctively of arachnoid cysts which have low signal intensity. The chronic subdural hematoma doesn't have the same signal of intensity as CSF on the MRI exam, while arachnoid cysts have.[81]

3.4.2. Computed tomography

CT scan imaging is based on direct cross-sectional imaging of the brain and spine, done by an x-ray tube which emits a thin and collimated x-ray beam around the region of interest in a rotating mode. X-ray detectors also rotate on the opposite side of the patient and measure how much the r-ray beam is attenuated at the several positions of the x-ray tube. A relative attenuation coefficient is calculated for each volume element of the patient's body, correlating with x-rays blocked by tissues, representing the electron density of the tissue. In the end, the image of a slice of brain or spine is created on a gray shadow scale assigned by this coefficient.[76] Iodinated contrast agents can be administered intravenously to demonstrate the larger brain vessels.[77]

CT scan exams are more often executed than MRI in veterinary medicine, because they are less expensive and also capable of diagnosing the intracranial conditions, being more easily available.[74]

The figure 43 represents a transaxial computed tomography in a dog with IAC.[63]

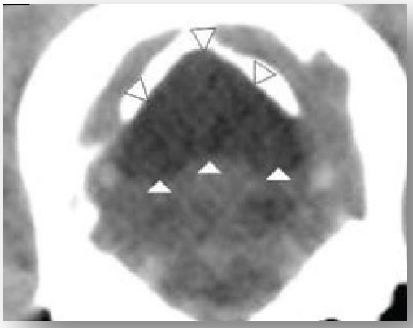


Fig. 44 – Transaxial CT in a dog with IAC: the arrow heads are outlying the cystic structure (Adapted from Dewey, 2009)

The diagnosis using the CT scan is based on a visualization of a well circumscribed large, fluid filled structure between the rostral cerebellum and caudal cerebrum.[73] The cyst has the same signal intensity as CSF (isodense). The walls of the cyst don't enhance after the intravenous contrast administration on the patient. [74]

3.4.3. Ultrasonography

Transcranial ultrasonography is an ultrasound–based diagnostic imaging for arachnoid cysts, non-invasive, less expensive and readily available at any veterinary hospital. It doesn't need general anesthesia as MRI or CT scan require. The ultrasound imaging is usually done via foramen magnum, the persistent fontanelle (when existing) and the temporal window. The ultrasound images show a well delineated anechoic area, compatible with fluid-filled structure between the occipital lobe and rostral lobe of cerebellum. The next figure shows an ultrasound image of intracranial arachnoid cyst in a dog.[75]

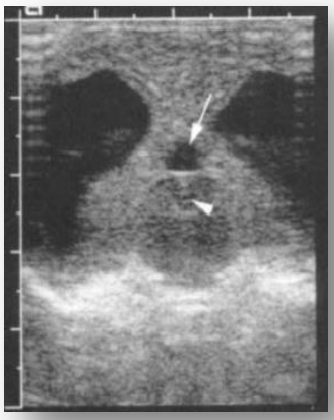


Fig. 45 – Transverse image at level of midbrain: ventromegaly of both lateral ventricles; well-defined, anechoic, cystic lesion (arrow); msencephalic aqueduct (arrowhead). (adapted from Saito, 2001)

3.5 Medical treatment

The medical treatment for intracranial arachnoid cysts is recommended when is considered the primary cause of seizures on the patient. Medical therapy with anticonvulsivants, diuretics and medication to decrease the CSF production may be considered.[63, 86, 70]

Otherwise, if the IAC is only an imaging finding during the search of other disorder, the treatment for the suspected primary disease should be done.[63]

3.5.1 Anticonvulsivant drugs:

There are several anticonvulsivants drugs described for seizures management in veterinary medicine; however, for this monograph it was decided to list only the anticonvulsivant drugs supported with recent literature, showing the real efficacy on the treatment in dogs.

Phenobarbital is a phenyl barbiturate used on the first-line treatment of seizures in small animals as mono or combined therapy. It acts potentiating the inhibition portsynaptic effects of $GABA_A$ and the glutamate activity and also decreasing the presynaptic calcium which are dependent of action potentials.[47, 49, 54] This mechanism of action contributes to increase of seizure threshold and decrease the spread to surrounding neurons.[47] Phenobarbital has approximately 90% of bioavailability, its half-time (T1/2) is 37 to 74 hours after oral dosing with the high maximal plasma concentration occurring in four-eight hours. The most part of its metabolism happens in the liver, auto-induced by cytochrome P450, that can be reduced with chronic dosing.[47, 54] Phenobarbital therapy causes side effects as sedation, polyphagia, polyuria and polydipsia, ataxia and increased liver enzymes. For this reason the liver monitoring (measurement of ALT, ALP, AST, GGT, bile acid testing and abdominal ultrasound) is recommended after two weeks of the therapy onset, three months later and then every six months. [54] It should be noted that Phenobarbital decreases total T4 and free T4 values and for this reason the assessment of hypothyroidism could be difficult. Hypercholesteronemia may also occur in patients receiving this drug.[49] It has also been reported that phenobarbital causes unpredictable adverse drug reactions (e.g. pancytopenia) and drug interactions.[93]

Furthermore, the efficacy of phenobarbital on the seizures control and its inexpensive therapy are advantages for its utilization in small animals. The dose recommended for dogs is 3-5 mg/kg, *per os*, twice a day.[63] However, the dose should be adjusted based on the clinical response, side effects and serum levels in each patient.[47, 54, 49]

In 2012, a study with the aim to compare the phenobarbital with bromide as a first-choice antiepileptic drug in dogs for epilepsy management was done in 46 dogs and concluded both drugs were reasonable first-choices; however phenobarbital had more efficacy on the eradication or duration of seizures during six months of treatment when compared with bromide. [93]

Potassium bromide has also been considered a first-choice anticonvulsivant drug in dogs for long-term seizures management.[93] The mechanism of action is focused on the hyperpolarization of the postsynaptic membrane.[47] The T1/2 is between 21 and 24 days and it's excreted by kidneys, being increased when the dietary has high levels of salt. Bromide bioavailability is, approximately, 46% after oral dosing and is not protein-bound.[54] Sedation, ataxia, polyphagia, gastrointestinal effects (with possible association with pancreatitis) and polyuria/polydipsia are considered adverse effects of bromide.[93, 54, 49, 47] The dose recommended for dogs is 35 mg/kg, *per os*, divided twice a day, administered with food.[63]

Gabapentin is an antiepileptic drug. Its mechanism of action is not completely understood.[49] Some suggest the antiepileptic effect is based on the binding to a specific modulatory protein of voltage-gated calcium channels, decreasing the intracellular calcium influx.[54] 33% of the absorbed dose is metabolized in the liver prior to renal excretion.[47] The T1/2 is approximately three to four hours. Gabapentin can be used as an adjunctive on therapy for refractory idiopathic epilepsy. Side effects as sedation and ataxia could occur.[49, 54, 47] In 2005 a study was reported with the aim to understand if the gabapentin improved the seizure control in dogs with refractory epilepsy. It was concluded the addition of gabapentine to Phenobarbital or bromide increased the interictal period and decreased post-seizure recovery time in some dogs. The short T1/2 of gabapentin has advantages for seizures control.[92]

The dose recommended for dogs is 10 mg/kg, *per os*, three times a day.[63]

Zonisamide is a sulfonamide drug which blocks the propagation of epileptic discharges and suppresses focal epileptogenic activity (blocks T-type calcium channels, inhibits voltage-gated sodium channels, enhances GABA release and inhibits glutamate release).[47, 54] The T1/2 is 15 hours for dogs.[47] It's metabolized by hepatic microsomal enzymes and excreted by kidneys. Side effects in dogs could be sedation, ataxia and loss of appetite.[54] It also was reported hepatoxicity and renal tubular acidosis in few cases. Zonisamide could be a well tolerated drug in dogs with recurrent generalized seizures refractory to phenobarbital or bromide therapy.[49] The dose recommended for dogs is 5 mg/kg, *per os*, twice a day.[63]

Levetiracetam is the S-enantioner of the ethyl analogue of pirocetam. It modulates the release of neurotransmitters, by selective binding to the presynaptic protein SVA2.[47] The exact mechanism is not completely understood, it may inhibit the release of calcium and the burst firing of neurons, suppressing hypersynchronization and propagation of seizure.[47, 54] Levetiracetam is rapidly absorbed when given PO or IM. It's minimally protein bound (<10%). T1/2 in dogs is four hours; its metabolism doesn't depend on the hepatic P450 system and is eliminated by renal excretion.[91] This anticonvulsivant drug is used as adjunctive therapy. Side effects as sedation and ataxia can occur, but they are minimal and uncommon. The dose recommended for dogs is 20 mg/kg, *per os*, three times a day.[63]

Pregabalin or (S-[+]-3-isobutyl GABA) is a newly introduced GABA analogue to treat epileptic seizures. It's structurally similar to gabapentin but more potent as anticonvulsivant and antinocive agent, being considered the successor to gabapentin. Its mechanism of action is believed to involve interaction with the α2δ subunit of neuronal voltage-gated calcium channels. Thus, pregabalin decreases intracellular calcium ion reflux, reducing the release of excitatory neurotransmitters into the synaptic cleft. In humans, this anticonvulsivant has a high oral bioavailability and long elimination T1/2 as well. A study, done in 2009, used the pregabalin as an adjunct to phenobarbital and potassium bromide to control idiopathic epilepsy in dogs and concluded that pregabalin may be a promise adjunct anticonvulsivant drug for epileptic dogs poorly controlled with standard monotherapy. The dose recommended for dogs is 3-4 mg/kg, *per os*, twice or three times a day.[88]

Imepitoin is a new antiepileptic drug and has been reported as potent anticonvulsive and anxyolitic drug. It acts as a low-affinity partial agonist at the benzodiazepine site of the $GABA_A$ receptor.[90] In 2014 a study was reported in dogs, with the administration of imepitoin twice daily in doses of 10, 20 and 30 mg/kg for 26 weeks, with the aim to compare its efficacy, as anticonvulsivant drug, to phenobarbital. The results of the study concluded that imepitoin is similarly effective as phenobartibal in the seizures control; however, imepitoin demonstrated a superior safety profile. While the phenobarbital-treated group, the levels of ALP, ALP, AST and gamma-glutamyltransferase increased, on the imepitoin-treated group those effects have not been observed. The study demonstrated that imepitoin is a potent and safe anticonvulsivant in dogs.[89, 90]

3.5.2 Glucocorticoids

Prednisone is usually used to decrease the CFS production. Affected animals often improve with steroid therapy. The dose recommended for dogs is 0.25-0.5 mg/kg, *per os*, twice a day.[86]

3.5.3 Diuretics options

Acetazolamide is a carbonic anhydrase inhibitor which decreases the production of CSF. It could be given alone or with furosemide. The dose recommended for dogs is 10 mg/kg *per os*, three or four times a day.[86, 63]

Furosemide is given in dogs on a dose of 0.5-4 mg/kg, *per os*, twice or once a day. It also decreases the CSF production. When the animal is receiving diuretics the electrolytes and hydration should be monitored. This is not a long-term therapy because the risk of adverse effects is superior to its benefits.[86, 63]

3.5.4 Proton pump inhibitors

Omeprazole on a dose of 10 mg/kg, per os, once daily for dogs with body weight inferior to 20 kg and 20 mg/kg, per os, once daily for dogs with body weight superior to 20 kg is reported to decrease the CFS formation. However, the literature about this subject is not solid.[86]

3.6 Surgical treatment

For symptomatic cases that don't response to the medical/conservative treatment, there are surgical methods to manage the IAC in people and dogs.[63, 73, 82, 83] Some operative procedures in humans have been proposed: cyst excision, stereotactic aspiration, cystocisternostomy, cystoperitoneal shunt placement, ventriculocystomy and cyst fenestration.[83] As it was mentioned above, in humans there are more possible localizations for IACs,[63, 72, 75, 52] unlike dogs, which the only localization that has been reported is the quadrigeminal cistern.[63, 73] For that reason, in humans, the choice of surgical method depends of the arachnoid cyst localization.[83] In dogs, there are two surgical methods reported for IACs: cystoperitoneal shunt placement and cyst fenestration.[63, 73]

3.6.1 Cystoperitoneal shunt placement (CPS)

In 2007, the first cystoperitoneal shunt placement with craniotomy was reported in veterinary medicine: 4 dogs were submitted to the CPS as surgical method for IAC treatment. The clinical signs presented on these dogs were central and vestibular dysfunction, neck pain and forebrain dysfunction. After the surgery, the follow-up was done in three dogs using the MRI, CT scan and ultrasonography and the results were: resolved cyst in two dogs and one still had a small fluid pocket, however, with no definable cyst. The surgical method resulted in good outcome with no shunt-related complications.[73]

The surgical technique consists of performing a left-side caudolateral craniotomy and the transverse sinus on the operated side sacrificed and occluded with bone wax (proximally and distally). The caudolateral craniotomy is constituted by a lateral and suboccipital craniotomy. The rostral extent of the lateral aspect of the craniotomy should be approximately 1-2cm caudal to the bregmatic suture. The cyst is identified and the next step is to puncture it with a #11 scalpel blade. A low pressure device should be inserted transversely into the cyst cavity, perpendicular to the axis and anchored to the skull, using a 3/0 propylene in a Chinese finger trap pattern. The distal end of the shunt is tunneled subcutaneously until the last rib and ventral to the hypaxial musculature. The distal aspect of the shunt is placed into the peritoneal cavity, using a paracostal approach. The distal shunt is also anchored to the body wall musculature

using the same technique as the skull. Once the shunt is placed, the cranial and abdominal incisions should be closed as routine.[73]

In humans the CPS has had high rates of cyst elimination.[84, 73] This technique is considered a non-complicated surgical procedure and offers the advantage of gradual reduction in cyst cavity avoiding acute shifts in cyst pressure dynamics.[84] However, CPS has been shown limited because of its associated complications as infections, shunt dependency, obstruction and unexpected hemorrhage.[84, 85, 73] A study done in 2012, which included 110 children with intracranial cysts that underwent surgeries to treat the cysts, used surgical techniques as endoscopic cyst fenestrations, craniotomy with cyst excisions and cystoperitoneal shunts. This study has concluded that the patients treated with cystoperitoneal shunt were more prone to complications than others.[85] Shunt dependency is considered a complication of CPS because the normal intracranial CFS absorptive mechanisms become permanently inactive during prolonged CSF shunting. The issue is if the shunt gets blocked or fails, the patient could develop intracranial hypertension. There's no more ability to absorb the CSF which is producing.[73]

In 2014 a report about comparative effectiveness of surgical options in pediatric intracranial arachnoid cysts was made. It concluded there is no significant difference in the outcome of patients between CPS, endoscopic and microsurgical treatment of IACs. The reason for this conclusion is because each patient and pathology characteristics combined with the experience and armamentarium of the surgeon are unique.[84]

In dogs, there were no apparent shunt-related complications in the reported literature; however, potential complications were suggested: occlusion shunt and increased risk of hemorrhage associated with the sacrificing the transverse sinus. Further information about long-term functionality of cystoperitoneal shunt in dogs is necessary to conclude that CPS is a technique of choice to treat IACs and to prevent recurrences in veterinary medicine.[73]

3.6.2 Cyst fenestration

In 2002, cyst fenestration was reported as performed treatment in two dogs with intracranial arachnoid cyst (being considered the primary disease). One dog developed acute tetraparesis with decreased mental status as clinical signs and the other dog presented progressive paraparesis, lethargy and episodes of reduced responsiveness. In

both dogs the IAC was confirmed by MRI and the cyst fenestration was performed. After the surgery, dogs improved their neurological conditions. One dog was reimaged 3 years after the cyst fenestration surgery and a refilled cyst was found. The other dog developed generalized seizures after 2.5 years after surgery and was euthanized.[95]

Three other cases of IACs solved with cyst fenestration were reported in veterinary medicine literature. Two of them were reimaged by MRI after the surgery, and one had evidence of cyst persistence and it was required reoperation. [63]

In human medicine, cyst fenestration has been considered the first surgical treatment of choice; however the surgical outcomes of it are unclear. There are two type of arachnoid cyst fenestration used in humans: microscopic fenestration and endoscopic fenestration.[83-85] Endoscopic fenestration has been a preference because is less invasive.[83] In veterinary medicine only the microscopic arachnoid cyst fenestration is reported.[95]

The technique of microscopic fenestration is performed with a small-sized craniotomy, opening the dural; then the outer cyst wall is incised to penetrate the inner cyst wall into the basal cisterns. Between the cyst and the cisterns are made several windows with the goal to have smooth flow of cyst fluid to the neighborhood cisterns. The dura is closed by primary repair or by duraplasty. To finish it, the bone flap is re-positioned with a titanium mesh.[94]

The cyst fenestration has the advantage of leaving the patient shunt-independent; however, in humans, it has been reported that this procedure is not effective because of cyst recurrences.[84] This surgical failure results in the need of additional operations, as CPS or a second fenestration, on the arachnoid cyst. [94]

V. Case Report

Tank is an entire French bulldog male with 6 months of age that has come to the North Shore Veterinary Hospital with neurological signs.

1. History:

Two weeks ago before presentation, the dog had a seizure where he developed opisthotonus, vocalized and appeared dissociated for several seconds with limb spasticity before recovering normal mental status and remaining tachypnoeic for 1-2 hours. He usually does get exhausted and tachypnoeic after running up stairs and outside. The dog seemed intermittently uncomfortable around ears with head shaking and scratching. Over the past few days he had developed a persistent right head tilt.

2. Physical and neurological exam findings:

On the physical exam the dog was in good body condition, bright, alert and responsive (BAR) with a persistent and moderate right head tilt. No ataxia was seen and no neck pain on palpation. The mucosal (MM) were pink and the capillary refill time (CRT) was 1 second. Femoral pulses were normal.

The neurological examination presented the following results: right head tilt, diminished menace OS, normal OD; palpebral reflex normal in both eyes; symmetrical pupil size; remainder of cranial nerves examination unremarkable. Relatively to the postural reactions, it was found a mildly impaired proprioceptive positioning on the left forelimb (1-2+) and left hind limb (1-2+); there was a normal right forelimb (2+) and right hind limb (2+). Reflexes: for all limbs they were normal and symmetrical.

The neurologic assessment, after finding right vestibular signs with left long tract signs, was consistent with paradoxic vestibular syndrome, due to left caudal fossa lesion. The differential diagnoses were arachnoid cyst, atypical Chiari malformation and inflammatory or neoplastic conditions. The plan was to do a brain MRI.

3. Magnetic Resonance Imaging exam findings:

The owners agreed with the execution of MRI exam and the next figures (fig.46, 47, 48 and 49) show the imaging findings.

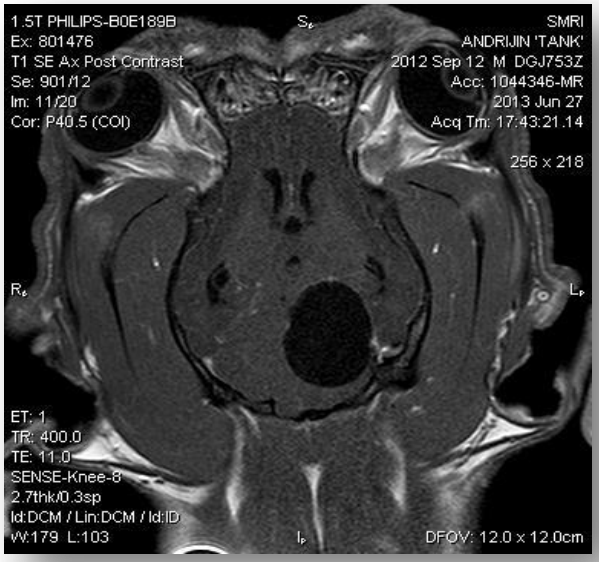


Fig. 46 – Midaxial T1-weighted brain MRI

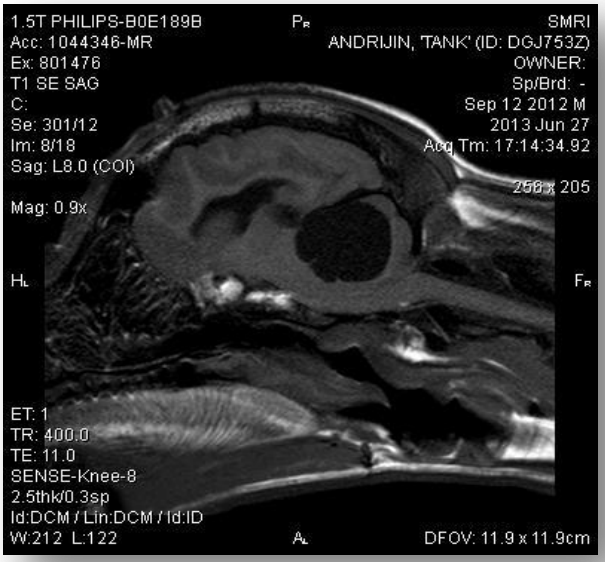


Fig. 47 – Midsagittal T1-weighted brain MRI

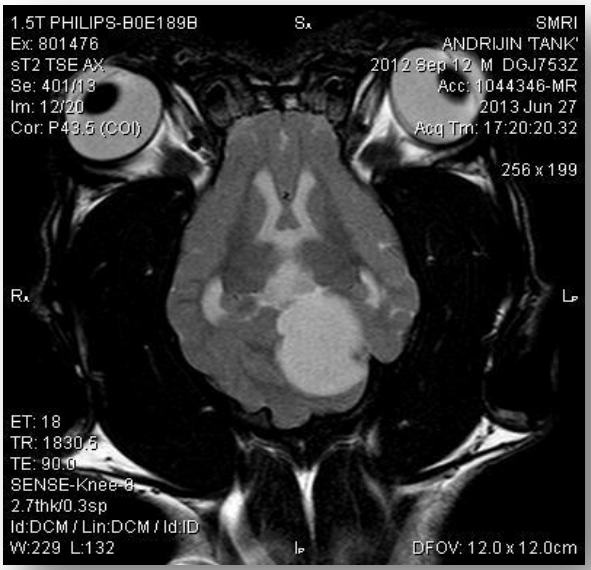


Fig. 48 – Midaxial T2-weighted brain MRI

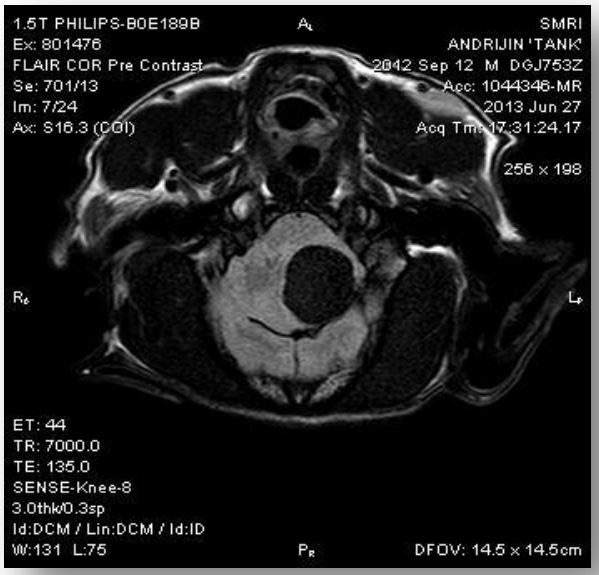


Fig. 49 – Midsagittal FLAIR MRI

A cyst-like lesion was found, measuring 2.4cm in length, 2.1cm in height and 1.7 cm in width, presented in the caudal fossa with associated marked compression of the left side of the cerebellum and compression of the 4th ventricle, pons and brainsterm. The third ventricle was dilated. There was a marked periventricular FLAIR hyperintensity associated with lateral ventricles. The conclusions were a large cyst-like lesion in the left side of the caudal fossa with severe compression or ablation/ atrophy of the left side of the cerebellum. Associated compression of the 4th ventricle, pons and brainstem, with suspect obstructive dilation of the 3rd ventricle.

4. Medical treatment:

Tank started a medication with a combination of an antiepileptic drug, diuretic and glucocorticoids with the goal to control the seizures and to reduce the CSF production. phenobarbital (15mg, BID), furosemide (10mg, BID) and prednisolone (5mg, BID) were the selected medications for this specific case.

It was also suggested to the owners to return to the hospital in two weeks for evaluation. However, even with medication, seizures continued and increased their frequency, duration and recovery time. For that reason, the surgery to treat the arachnoid cyst using a cystoperitoneal shunt was suggested and agreed by owners.

5. Surgical treatment:

The anesthetic protocol used in this situation included sedation with midazolam (0.2mg/kg, IV) and fentanyl (10 ug/kg, IV); cephazolin (20mg/kg, IV) to prevent bacterial infections; propofol (4mg/kg, IV) for induction and it was maintained with propofol and fentanyl in continuous rate infusion (CRI), and isoflurane (0.5%).

The CRI of propofol and fentanyl used during the surgery provides a low rate of isoflurane and make a better stability of cardiovascular funtction.

Before the surgery, a CT scan was done to obtain clearer bony landmarks, using specific software for it. The aim was to measure the depth of the temporal bone where the craniotomy will be done and the distance between the arachnoid cyst centre and the local of craniotomy at temporal bone. These measurement allow a correctly catheter placement within the cyst. The next two images show the CT scan exam.

Fig. 50 – Midsagittal brain CT scan of the dog before the CPS

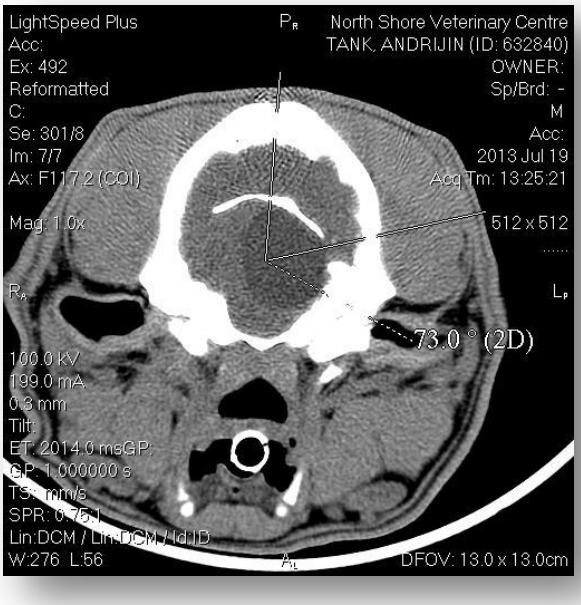


Fig. 51 – Midaxial brain CT scan of the dog before the CPS

After measuring the distances on CT scan in 2D, an image in 3D is reconstructed for knowing exactly the local of craniotomy in the temporal bone.

5.1 Cystoperitoneal shunt placement technique

The surgery was started on the left side, rostrotentorial approach to the skull, with a subperiosteal ventral reflection of temporalis muscle. A high speed neuro burr was used to make the craniotomy, doing a 5-6 mm hole in ventrolateral caudal aspect on the left side of the parietal bone, over the pre-calculated cyst position. A ventricular shunt catheter was introduced perpendicular to long axis of the body through this hole into pre-calculated depth from CT scan (approx. 20 mm). There was a good flow of fluid from catheter, confirming placement in the cyst. The catheter was connected to Medtronic CSF flow control valve (contoured small-medium pressure), further secured with 3/0 Surgipro®. Peritoneal catheter tunneled subcutaneously from head to the left side of abdomen, caudal to the ribs, and the fenestrated tubing was placed into abdomen. It was secured with 3/0 Surgipro® to the soft tissue.

The next figures (fig.54, 55, 56, 57, 58, 59, 60 and 61) demonstrate, step by step, the surgical procedures of cystoperitoneal shunt on this dog.

Fig. 52 – Patient, on sternal recumbency, under anesthesia, before the surgical procedure

Fig. 53 –Measurement of window's landmarks for craniotomy

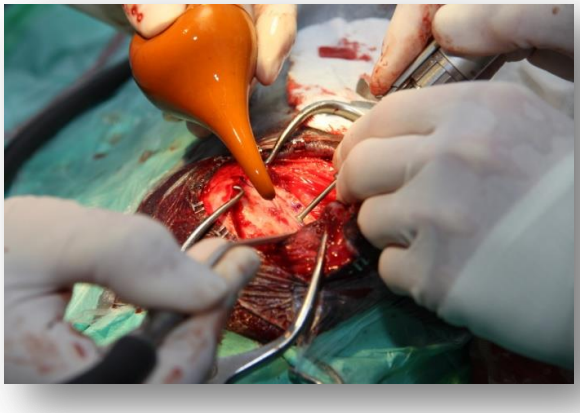


Fig. 54 –Craniotomy

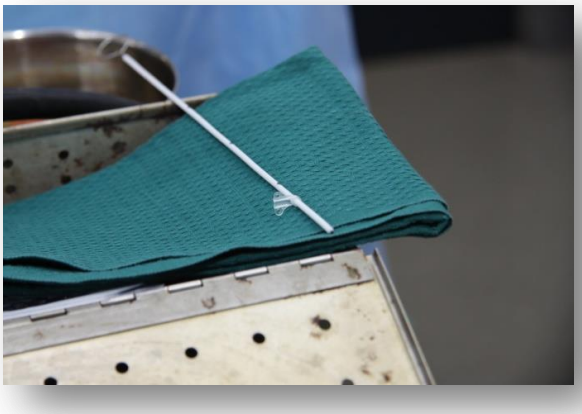


Fig. 55 –Catheter used for cystoperitoneal shunt

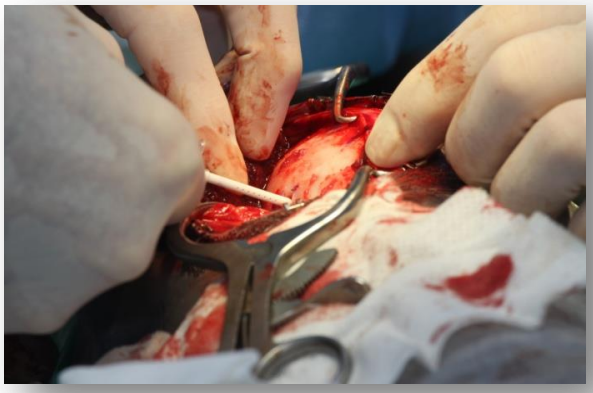


Fig. 56 – Introduction of catheter, perpendicular to long axis of the body

Fig. 57 – Connection of the Medtronic CSF flow control valve to catheter

Fig. 58 – Subcutaneous tunnel's creation

Fig. 59– Surgical wound on the skull closed

After the surgery another CT scan was performed on this dog, to make sure the cystoperitoneal shunt was well placed. The figure 60 represents the 3D image of CT scan, showing the cystoperitoneal shunt on the dog.

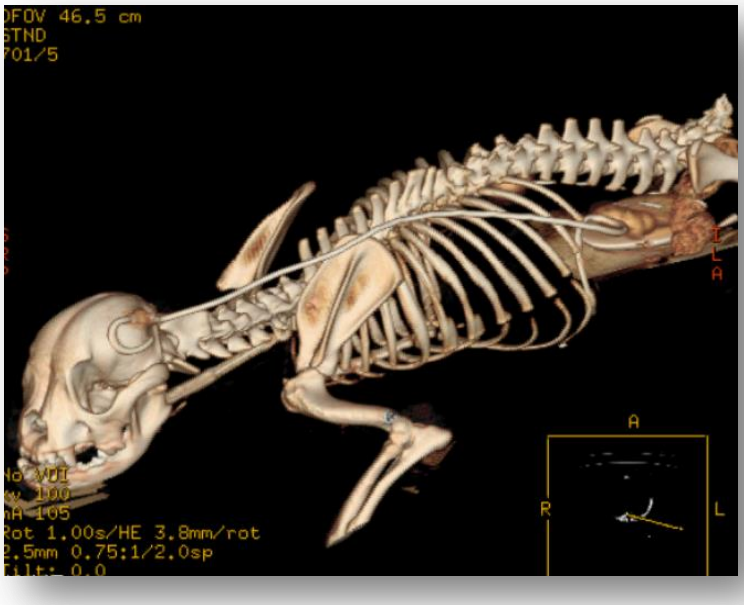


Fig. 60– 3D image of CT scan, after the cystoperitoneal shunt placement

The dog recovered well from the surgery. During four days he was hospitalized, under veterinarian's observation: two days at North Shore Veterinary Hospital and two days at the clinic that referred the case.

The medical plan at NSVH on the day of surgery was to maintain the animal with fluidteraphy (ringer lactate) at maintenance rate and to promote analgesia giving fentanyl in continuous rate infusion (0.4-1.0ml/h of 50ug/ml).

The day after Tank improved his neurological condition, the head tilt was still present but only slight. The fentanyl was changed to buprenorphine (0.3ml) in the morning of the second day at NSVH and the fluidteraphy was stopped before the animal transfer to the clinic. Tank returned to the clinic where he's usually followed and remained hospitalized for more two days and went home with no head tilt.

6. Follow-up:

One month after the surgery, the dog presented other seizure and came to the hospital. A CT scan was performed showing an intracranial cyst-like lesion smaller than on the CT previous examination; however a new finding was reported: a fluid-filled lesion presented in the soft tissues, dorsal to the occipital bone, measuring 2cm in length and 1cm in height, compatible with abscess or seroma. Gabapentin (200mg, PO, TID) was introduced on his medication as adjunct to antiepileptic medication.

Three months after the surgery, the head tilt returned and another CT scan was executed, showing a cyst regression. A shunt revision was done founding the upstream catheter (into the cyst) blocked with small blood clots. It was substituted for a new one similar as the previous one. The CSF was sent for analysis and the results showed there were no leucocytes and negative microbiological culture.

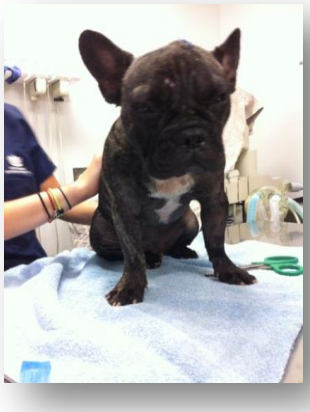


Fig. 61– Tank, after the first shunt revision. It should be noted the head tilt improved.

The catheter blocked one more time and the blockage was solved again with another shunt revision. After this last surgery the dog is doing well with no more changes on the neurological exam until April (the last re-evaluation).

7. Discussion of case report

Intracranial arachnoid cysts are rare in dogs; only 56 cases are reported in veterinary literature. Brachiocephalic breeds are considered predisposed breeds to develop arachnoid cysts. [63] The diagnostic methods likely used are MRI and CT scan [71, 74] and when an arachnoid cyst is diagnosed there are two options of treatment: medical or surgical. The medical aims to control the seizures and decrease the CSF production, improving the animal neurological condition. [63, 86, 70] The surgical treatment is done with the goal to eradicate the cyst. [73] In veterinary medicine, there are two surgical techniques possible: cystoperitoneal shunt and cyst fenestration, both with advantages and disadvantages. [63, 73] Tank, the dog of this case report, was a representative case of canine intracranial arachnoid cyst. He's a French bulldog that developed seizures and head tilt (both clinical manifestations compatible with previous literature). [74, 71, 63] When a MRI was done it was found the arachnoid cyst, being considered a congenital anomaly of the meninges development. [69] Seizures were medically controlled; however, medical treatment didn't improve his neurological condition and the cystoperitoneal shunt was performed. Complications, as obstruction, occurred in this case and were expected, after analysis of current literature. [73]

The surgery team at NSVH explained the blockage could be associated to the low pressure one way valve. This valve was designed for humans. In quadruped, the pressure generated by gravity may not be enough to ensure a proper CSF drain, increasing the risk of blockage.

The shunt has been unblocked and six months after the last shunt revision, the dog has had no neurological complications. However, six months is considered a short time of follow-up and in the future the shunt may block again.

The literature about arachnoid cysts in veterinary medicine is scarce; for that reason, more cases with IAC diagnosis like this one should be report. There are no reliable conclusions about the outcome of these patients after the surgical treatment. [63]

Seizures are considered the most common neurological condition in referral hospitals; [54] most of them only receive medical treatment without searching the seizure's main cause. If the MRI and CT scan as diagnostic methods are more often used to search for the primary cause of seizures, probably more intracranial arachnoid cysts would be found, concluding that this condition has been under diagnosed.

VI. Final Conclusion

This internship done at the North Shore Veterinary Hospital and Montenegro Veterinary Hospital was a unique opportunity for trainee to learn more about veterinary issues.

In fact, doing an internship in two different countries with different cultures and distinct ways to work, different diagnosis and therapeutic approaches, made this internship as complete as possible. In the trainee's opinion, the places chosen to do this internship were an excellent representation of reality in veterinary practice in both countries, making the choice brilliant.

It was possible to follow cases from several veterinary fields, contributing for a good insight of the medical and surgical approaches for the trainee's future.

The trainee's mission was to see and to accomplish veterinary procedures as much as possible and this mission was fulfilled.

The monograph was chosen based on the trainee´s interest and for that reason it contributed for an improvement of her neurology knowledge.

In general, this internship is considered a milestone in veterinary medicine, separating the conclusion of the academic phase and the onset of the professional phase. In fact, this internship prepared the trainee not only to handle with veterinary issues but also taught the best way to work in team and how to communicate with customers, which is an important part of work as veterinarian.

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