Observational study on the prevalence, predisposing factors, diagnosis, treatment, and recurrence rate of feline anal sac disease

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1. Abstract

Currently, a limited amount of information is available regarding (feline) non-neoplastic anal sac disease (i.e. impaction, inflammation, and an abscess). Therefore, the aim of the present observational study was to obtain data on the prevalence, possible predisposing factors, diagnosis, treatment, and recurrence rate of feline anal sac disease. To this end, a questionnaire was distributed among veterinarians throughout the Netherlands and several other countries in Europe. 78 responses were counted, of which 48 (61.5%) completed responses and 30 (38.5%) partial responses. The reported prevalence for anal sac impaction was 0.25%, for anal sac inflammation 0.06%, and for an anal sac abscess 0.07%. Investigated predisposing factors included: gender, castration, age, obesity, type of coat, breed, type of diet, season, and underlying dermatological and gastrointestinal problems. The only category that was indicated by a majority of participants as predisposing factor for feline anal sac disease was age, with a higher prevalence in mature cats. The remaining factors were not considered predisposing factors of feline anal sac disease by the majority of participants. The participants used several different factors for diagnosing non-neoplastic feline anal sac disease. The presence of clinical symptoms, and the size of the anal sac were most frequently used. Also, the nature, consistency, and amount of contents were used relatively frequent, as well as pain and color of the contents. Furthermore, criteria most often used for differentiating between the three types of non-neoplastic anal sac disease included: nature of the anal sac contents, pain during palpation of the anal sac, size of the anal sac, and the presence of draining fistulas in the perianal area. Manual evacuation and treating any potential underlying disease were important treatments for all three types of non-neoplastic anal sac disease. Additionally, flushing the anal sacs and prescribing a systemic antibiotic were often used in case of an anal sac inflammation and an anal sac abscess. The majority of participants indicated to proceed to surgical removal of the anal sacs in case of frequent recurrence of anal sac disease. 61.7% of participants had never executed an anal sacculectomy before and of the remaining participants, 61.1% used the closed technique in case of an anal sacculectomy. Recurrence of anal sac impaction was reported to be 40.5%, of anal sac inflammation 30.1%, and of an anal sac abscess 17.8%. The average period of time until recurrence was 5.4 months for anal sac impaction, 4.6 months for anal sac inflammation, and 4.9 months for an anal sac abscess. Few studies have been performed on feline anal sac disease, therefore there is still much to investigate. Hence, further research could investigate possible predisposing factors, the effect of different treatments, and the rate of recurrence of feline anal sac disease.

2. Introduction

Currently, a limited amount of information is available on feline anal sac disease, whereas more research has been executed on the same disease in dogs. This observational research focused on feline anal sac disease and refers to as much feline literature as possible. However, when not available, canine literature is used for comparison.

2.1 The anal sacs

Nearly all carnivores possess a pair of anal sacs, also known as the paranal sinuses (Jung et al., 2016). The anal sacs are two relatively small structures located between the internal and external sphincter of the anus. Each sac is connected to the skin surface on both lateral sides of the anus through a single duct (Fig. 1F) (Culp, 2013; Jung et al., 2016; Van Duijkeren, 1995). In cats and dogs, the anal sacs lie ventrolateral to the anus, approximately at four and eight o'clock (Zoran, Washabau, Freda, & Goldschmidt, 2012). Anal sacs occasionally get incorrectly referred to as anal glands. The anal glands are located in the submucosa around the anus at the anocutaneous junction. Hence, anal sacs and anal glands are two different structures that should not get mixed up (Van Duijkeren, 1995). The primary function of anal sacs in dogs is for territorial scent marking in the wild (Zoran et al., 2012). The exact function of feline anal sacs has not been investigated thoroughly, however, the anal sacs are not necessary for a good healthy life (Scott, Miller, & Griffin, 2001).

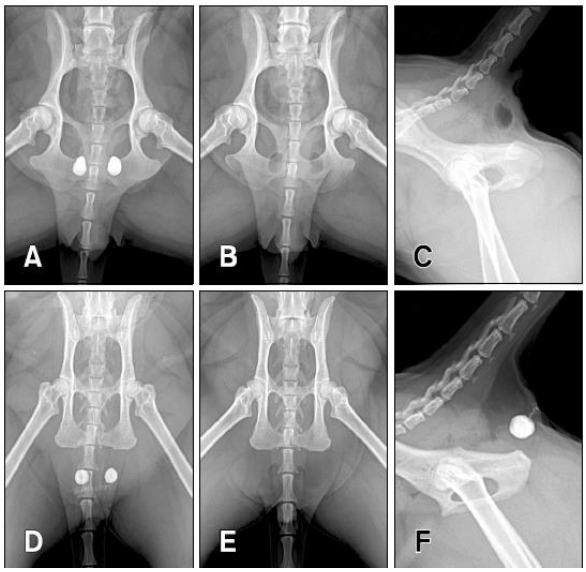


Fig. 1: Ventro-dorsal (A, B, D, E) and lateral (C, F) view on radiograph of canine (A, B, C) and feline (D, E, F) pelvic region. A (positive contrast) and B (negative contrast) show that the anal sacs of dogs are superimposed over the ischial table region (tabula ossis ischia). D (positive contrast) and E (negative contrast) show that the anal sacs in cats are located more caudally than in dogs. F (positive contrast) shows a feline anal duct as a white radiopaque line. This figure is obtained from 'Diagnostic imaging features of normal anal sacs in dogs and cats' (Jung et al., 2016).

Shape, size, and location of the anal sacs are different in dogs and cats. Contrarily to the ellipsoidal shape in dogs, feline anal sacs have a more round shape to them (Fig. 2) (Jung et al., 2016). In cats, a size range has been reported of 0.6 - 1.3 cm for anal sacs (Jung et al., 2016). In dogs, a size variation of 0.6 - 1.8 cm has been reported (Jung et al., 2016). A different research in dogs found a range from 0.5 - 3.0 cm (Pappalardo, Martino, & Noli, 2002), however, these anal sacs were assessed in a more subjective way, instead of the diagnostic imaging tools that were used by Jung et al. Furthermore, the anal sacs in cats are located more caudally compared to dogs (Fig. 1) (Jung et al., 2016) and the ducts

open in a more lateral position; two mm lateral to the anus (Culp, 2013; Fossum et al., 2019; Ragni, 2012).

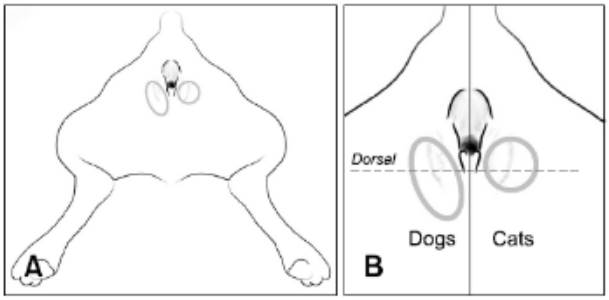


Fig. 2: Schematic view of oval-shaped canine anal sacs and round-shaped feline anal sacs. This figure is obtained from 'Diagnostic imaging features of normal anal sacs in dogs and cats' (Jung et al., 2016).

The anal sacs and their corresponding ducts are lined with stratified squamous epithelium and surrounded by fibrous connective tissue. These fibrous connective tissues contain apocrine and sebaceous glands, which are distributed in a different way among the anal sacs of dogs versus cats (Jung et al., 2016; Ragni, 2012; Van Duijkeren, 1995). In dogs, most of the glands are apocrine glands (Rutherford & Lee, 2015). These apocrine glands are located in the fundus of the anal sacs, whereas the sebaceous glands are concentrated near the ductal area of the anal sacs (Fig. 3). In cats, the sebaceous and apocrine glands are both distributed over the whole area of the anal sacs (Jung et al., 2016; Ragni, 2012; Van Duijkeren, 1995). Consequently, anal sac contents consist of secretory products of the sebaceous and apocrine glands and desquamated keratinocytes. The contents also contain lipids, proteins, glycogen, acid mucopolysaccharides, and occasionally, melanin, bacteria, yeasts, and leukocytes (Frankel, Scott, & Erb, 2008; Van Duijkeren, 1995). Erythrocytes and intracellular bacteria are not part of normal feline anal sac contents (Frankel et al., 2008).

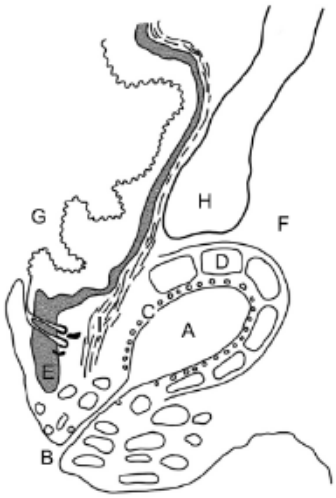


Fig. 3: Schematic diagram of the dorsal section of a canine anal sac. A = anal sac lumen. B = anal duct opening. C = apocrine glands. D = external sphincter muscle. E = Internal sphincter muscle. F = fat of rectoischial fossa. G = anal canal. H = levator ani muscle. L = longitudinal muscle layer of rectum. This figure is obtained from 'Diagnostic imaging features of normal anal sacs in dogs and cats' (Jung et al., 2016).

The anal sacs are innervated by the perianal nerve, which is a branch from the external pudendal nerve (Culp, 2013). The external anal sphincter is innervated by the caudal rectal nerves, which branch from the external pudendal nerve and pass close to the sacs. This nerve is accompanied by the deeper caudal rectal artery, which branches from the internal pudendal artery and supplies the anus with arterial blood (Charlesworth, 2014; Zoran et al., 2012).

During defecation, anal sac contents get discharged through the anal sac ducts on both lateral sides of the anal opening, due to the anal sphincter contraction. Consequently, a high amount of stress or pressure on the sacs can also lead to expulsion of anal sac contents (Fossum et al., 2019; Frankel et al., 2008; Pappalardo et al., 2002; Ragni, 2012). The anal sacs are clinically important whilst the anal sac contents can get impacted because of e.g. an anatomic obstruction of the anal ducts or if the anal sac contents become too thick to be emptied (Zoran et al., 2012).

2.2 Anal sac disease

Anal sac disease can be divided in neoplastic and non-neoplastic conditions (also called inflammatory anal sac disease) (Jung et al., 2016; Rutherford & Lee, 2015). The present study focusses on non-neoplastic conditions, which can be divided in three types: impaction, inflammation, and abscessation (Frankel et al., 2008; Van Duijkeren, 1995). From here on, the shorter term 'anal sac disease' will be used instead of 'non-neoplastic anal sac disease'. An anal sac impaction is characterized as an enlargement of the sacs due to retention of anal sac content, without showing any signs of inflammation (Van Duijkeren, 1995). The sacs are filled with a thick content that can be difficult to express (Culp, 2013). Anal sac inflammation, also called anal sacculitis, is defined as an enlargement combined with inflammation of the anal sac (Van Duijkeren, 1995). The anal sac and perianal region often become red, swollen, and painful (Culp, 2013). Anal sac impaction can occur unilateral, but most often it presents itself as bilateral (Van Duijkeren, 1995). In case of an anal sac abscess pyrexia is often present, however, pyrexia can also occur in case of severe anal sac inflammation (Fossum et al., 2019). Furthermore, an inflamed and often alopecic area of the anal sacs can be observed in case of an anal sac abscess, again accompanied with swelling and pain. Additionally, discharge contaminated with blood or purulent material can occur (Culp, 2013; Rutherford & Lee, 2015). As an anal sac abscess progresses, the abscess can rupture and draining fistulas can develop that may be noted on the perineum (Culp, 2013; Van Duijkeren, 1995).

Anal sac disease is more common in dogs compared to cats (Jung et al., 2016; Lake, Scott, Miller Jr., & Erb, 2004). In practice, veterinarians get confronted with dogs suffering from anal sac disease on a regular basis, however, feline anal sac disease is a rarely seen phenomenon. The clinical signs in cats suffering from anal sac disease have, to the authors' knowledge, not yet been clinically examined. Nonetheless, clinical symptoms of canine anal sac disease have been investigated before and include: 'scooting', discomfort when sitting down, licking/biting of the anal area or tail-base region, tail chasing, tenesmus, perianal discharge, redness of the tail area, moist dermatitis of the perianal region, and back rubbing against an object (Frankel et al., 2008; Halnan, 1976a; James, Griffin, Polissar, & Neradilek, 2011; Jung et al., 2016)

2.3 Predisposing factors

It is believed that impaction, inflammation, and an abscess are three stages of the same process (Van Duijkeren, 1995). Anal sac impaction can develop when the anal sac does not get completely emptied. The fluid can then become too dry and thick to be emptied and can plug the anal ducts, causing impaction (Jung et al., 2016; Van Duijkeren, 1995; Zoran et al., 2012). Whilst retention of anal sac

contents does not reduce the secretory rate and forms an ideal medium for bacterial growth, it can be the initiating factor of anal sac inflammation and an anal sac abscess (Fossum et al., 2019; Ragni, 2012). This retention can be due to different factors, such as: stenosis/obstruction of the anal sac ducts, changes in anal sac content, or malfunction concerning the anal sphincter mechanism. Factors that can lead to stenosis of the anal sac ducts include: obesity, scar tissue as a result from former surgery, perianal fistulas (causing perianal swelling), inflammatory bowel disease (also causing perianal swelling), and anatomic conformation (e.g. a small duct). Furthermore, generalized seborrheic disorders can lead to change in quantity and/or quality of the anal sac gland secretions, leading to changes in anal sac content. On top of that, functional anal sphincter disorders, which can be caused by pudendal nerve dysfunction, and the presence of diarrhea, could lead to less contraction of the anal sphincter (Ragni, 2012; Van Duijkeren, 1995; Zoran et al., 2012). Since contraction of the external anal sphincter results in emptying the anal sac content, less contraction can lead to impaction.

It has been mentioned that many dogs with anal sac disease have a history of recent diarrhea or soft stools (Fossum et al., 2019; Zoran et al., 2012). Also, a high fiber diet has been suggested to have a positive effect on the emptying of anal sac contents (Ragni, 2012; Van Duijkeren, 1995; Zoran et al., 2012). However, no experimental data exists about the effect of diet on the occurrence and prevention of anal sac disease. Furthermore, Pappalardo et al. investigated anal sac contents of normal dogs and dogs with dermatological diseases (pyoderma, uncomplicated atopic dermatitis, and atopic dermatitis with a concurrent Malassezia skin infection) (Pappalardo et al., 2002). Their findings included that dogs with pyoderma and dogs with dermatitis (with and without concurrent Malassezia infection) had significantly more bacteria in their anal sacs compared to healthy dogs. This could mean that these dogs have a higher risk of infection of the anal sacs (Pappalardo et al., 2002; Zoran et al., 2012). Furthermore, small sized dog breeds are suggested to be at higher risk for developing anal sac disease because of their anatomically small anal sac ducts, which are more likely to get obstructed by thicker anal sac contents (Fossum et al., 2019; Van Duijkeren, 1995; Zoran et al., 2012). In dogs, it has been suggested that Poodles and Chihuahuas, are predisposed for developing anal sac disease (Charlesworth, 2014; Rutherford & Lee, 2015). In cats, no predisposed breeds have been mentioned yet.

2.4 Diagnosis and treatment

The diagnosis of anal sac disease is a complicated process that is based on the presence of clinical symptoms and on physical examination (Culp, 2013; Van Duijkeren, 1995). However, clinical signs are quite non-specific, in cats even more than in dogs (Jung et al., 2016). Moreover, other diseases such as parasites, flea allergies, perianal tumors, perianal fistulae, and pyoderma can cause similar symptoms (Fossum et al., 2019; Van Duijkeren, 1995; Zoran et al., 2012). Executing a rectal examination and careful palpation of the anal sacs are very important in making a diagnosis (Culp, 2013; Van Duijkeren, 1995). In case of anal sac disease, a visible or palpable perianal swelling at four or eight o'clock lateral to the anus can be noted. An impacted anal sac will often feel firm and enlarged when palpated, however, with pressure the anal sac contents can often be expressed, using the appropriate technique (Culp, 2013). In case of anal sac inflammation the perianal area becomes swollen, red, and painful. An anal sac abscess is often presented as a painful perianal swelling in the area of the anal

sacs that cannot be expressed (Zoran et al., 2012). In case of an abscess, the anal sac and perianal area can be that painful that any palpation in the area is not allowed by the patient (Culp, 2013). When the patient does not allow examination of the anal sacs, sedation may be necessary, which is often the case in cats (Zoran et al., 2012). Pyrexia and the presence of an abscess often go together, however, measuring the rectal temperature can be difficult as affected individuals often do not tolerate insertion of a rectal thermometer (Culp, 2013). After some time, the skin overlying an abscessed anal sac will get thin, erythematous, and edematous. When an abscess is not treated it can eventually burst and develop draining fistulas, which can be noted on the perineum (Zoran et al., 2012). Purulent and/or hemorrhagic discharge may be present on the perianal area (Fig. 4) (Rutherford & Lee, 2015). Bacteriological examination, cytological examination, color, and consistency of the anal sac contents appear to be unreliable factors in the diagnosing of anal sac disease (Frankel et al., 2008; Rutherford & Lee, 2015). Altogether, these factors make it difficult to get to a diagnosis and to differentiate between the three types of anal sac disease.

Fig. 4: Dog with perianal erythema and a draining tract ventral to the left anal sac duct. The anal sac ducts have been cannulated. This figure is obtained from: ''Anal sac disease in dogs'' (Rutherford & Lee, 2015).

The indicated treatment for a patient depends on which type of anal sac disease is diagnosed (impaction, inflammation or an abscess). Therapeutic options include: manual expression, flushing, local antibiotics, systemic antibiotics, and, eventually, surgical removal of the anal sacs (anal sacculectomy). A sacculectomy can be an option when frequent relapse of anal sac disease occurs after treatment (Fossum et al., 2019; Rutherford & Lee, 2015; Van Duijkeren, 1995). A possible complication of an anal sacculectomy can be short or long term fecal incontinence. Fecal incontinence can occur when the perianal nerves are damaged or when more than 50% of the external anal sphincter muscle is injured (Charlesworth, 2014; Fossum et al., 2019; Zoran et al., 2012).

2.5 Research goals

Currently data and information about feline anal sac disease is lacking. Research about the possibility of certain predisposing factors in cats (e.g. gender, type of coat, obesity) is, to the author's knowledge, non-existent. The same goes for how veterinarians diagnose anal sac disease and how they differentiate between the three different types of anal sac disease (impaction, inflammation, and abscess). Because veterinarians in practice do get confronted with anal sac disease in cats, it is an important first step to collect more data regarding this issue. Therefore, the present study is an observational study in which data was collected about the prevalence, possible predisposing factors, diagnosis, treatment and recurrence of feline anal sac disease.

The purpose of this observational study was to obtain data on the prevalence of anal sac disease in cats in the Netherlands, and other countries in Europe, and to find out whether there is a correlation with: gender, castration, age, obesity, type of coat, breed, type of diet, type of season, and underlying dermatological and gastrointestinal problems. Furthermore, data was collected on criteria used by veterinarians to diagnose the three different types of anal sac disease (impaction, inflammation, and abscesses), what therapies are used for each type, and the rate of recurrence.

For the present study the following hypotheses have been composed:
H_0: Gender, castration, age, obesity, type of coat, breed, type of diet, type of season, and underlying dermatological and gastrointestinal problems are not associated with feline anal sac disease according to the veterinarians participating in the present study.
H_1: Gender, castration, age, obesity, type of coat, breed, type of diet, type of season, and underlying dermatological and gastrointestinal problems are associated with feline anal sac disease according to the veterinarians participating in the present study.

H_0: There is no difference in diagnosing the three types of feline anal sac disease by veterinarians participating in the present study.
H_1: There is a difference in diagnosing the three types of feline anal sac disease by veterinarians participating in the present study.

H_0: There is no difference in treatment for every type of feline anal sac disease by veterinarians participating in the present study.
H_1: There is a difference in treatment for every type of feline anal sac disease by veterinarians participating in the present study.

3. Materials and methods

3.1 Survey

This observational study was conducted in the form of an online open survey, which was created in Qualtrics according to the Cherries Guidelines (Eysenbach, 2004). These guidelines help to improve the quality of web surveys and contain a checklist for reporting results of online questionnaires. Information that should be provided to participants in advance, according to the Cherries Guidelines, included: length of time of the questionnaire, the purpose of the study, and who the investigators of the study were. The participants were also informed that their data would be handled with great care and that the data would be deleted after processing. Participants that continued with the questionnaire after reading this information (included in the introduction), gave their informed consent. Furthermore, the checklist included in the Cherries Guidelines was used for reporting the materials and methods section of the present study. This included: reporting the approval of an Institutional Review Board (IRB), how the survey was advertised, the time frame of collecting the data, numbers of questions per page, number of pages the questionnaire contained, and whether the participants could review and change their answers. Furthermore, the guidelines were used to report and calculate the completion and participation rate in the result section. The participation rate was calculated by dividing the number of people that filled in the first survey page, by visitors who visited the informed consent page (introduction) of the survey. The completion rate was calculated by the number of people who filled in the last page of the questionnaire, divided by the number of people who submitted the first survey page. Thus, the Cherries Guidelines were used for creating the questionnaire, for composing the materials and methods section of this study, and for a part of the results section.

The present study has been approved by prof. Dr. Björn Meij (representing the institutional review board of Utrecht University). The questionnaire was voluntary and consisted of 44 questions, which were divided in six main sections. These six main sections were:

1.	6 questions about the prevalence of feline anal sac disease.
2.	12 questions about possible predisposing factors for feline anal sac disease.
3.	5 questions about the criteria that veterinarians use to diagnose feline anal sac disease.
4.	9 questions about the treatment of feline anal sac disease.
5.	8 questions about the effect of treatment of feline anal sac disease.
6.	4 general questions about which country the veterinarian works in, their graduation year and whether they would like to receive the final results of this study.

The original Dutch questionnaire was translated to English, German, Italian, Spanish, and French. Before the link of the questionnaire was shared among veterinarians, it was first tested by calling three veterinarians that volunteered to verbally test the survey and to share ideas and opinions about it. In this way, the survey was tested and potential missing answers or questions could be noticed and changed/added.

The questionnaire consisted of nine pages with a maximum of six questions per page. The duration of the questionnaire was approximately 10-15 minutes. Participants were able to return to previous questions. The full questionnaire, consisting of 21 open-ended, 23 closed-ended questions and an introduction, is depicted in Attachment 3 (Dutch) and 4 (English). In closed questions were the participants were able to choose more than one option, the answers are preceded by a square. In closed questions were the participants were able to only choose one option, the answers are preceded by a circle (Attachment 3 and 4).

3.2 Participants

The target population for this survey consisted of practicing veterinarians in Europe. Initially, the plan was to only distribute the survey in the Netherlands, but the survey ended up being spread among several countries in Europe.

3.3 Distribution

The questionnaire was distributed through several platforms. First, the survey was shared on the Facebook pages 'Het Dierenartsengilde' and a similar Italian Facebook group. Later, five reminders were posted on ''Het Dierenartsengilde'' and four reminders on the Italian Facebook group. Also, a small piece in the ''Tijdschrift voor Diergeneeskunde'' was dedicated to the survey and contained the links to the questionnaires. Furthermore, the survey got shared among veterinarians within AniCura. They shared the survey within their company in the Netherlands and also in Belgium, Spain, Norway, Sweden, and Denmark. On top of that, European College of Veterinary Surgeons (ECVS) helped with distributing by sending the survey to the small animal Diplomates and Residents and 40 cat friendly clinics were contacted though email.

Data was collected during a time frame of 4.5 weeks (11-09-2020 until 13-10-2020). During this period several reminders were sent/posted to obtain the highest rate of response. The prior goal was set at a response of 50. With a sample of this size, it was assumed that predictions could be made about the whole population and this number of filled in questionnaires seemed reasonable to obtain.

3.4 Data processing

Data from the questionnaires was imported to Microsoft Excel. Both completed surveys and partial surveys were included in the analysis, resulting in a different sample size (n) for every question. When answers contained a range instead of a number, the average was calculated and used. Answers such as ''a lot'', ''varying'' or ''I don't know'' instead of a number, were excluded. The answers to closed questions were analyzed and displayed in tables and graphs. Answers to open questions were first categorized and then displayed in graphs as well.

In the prevalence section, questionnaires that did not mention a number for the total of cats treated were excluded. Furthermore, surveys in which the total amount of treated cats was equal (or almost equal) to the amount of cats presented with an anal sac disorder, were also excluded, whilst this would indicate a prevalence of 100%, which is very unlikely. If the total number of cats with anal sac disease (including

impaction, inflammation, and abscess) and the three different types added did not match, a new total was calculated by adding the three different types of anal sac disease.
Answers to open questions and answers to text boxes in closed questions were translated and are listed in Attachment 1. Text box answers in the predisposing factors section that showed that the participant does not know the answer (e.g. ‘’no idea’’), were excluded from the analysis of this section.

Regarding the figures, closed questions in which participants were only able to choose one answer, show percentage of participants on the y-axis. Closed questions in which more than one answer could be chosen and open questions that were categorized, show the number of times chosen on the y-axis.

4. Results

After closing the questionnaire, 78 responses to the survey were counted, of which 48 (61.5%) were completed responses and 30 (38.5%) were partial responses. From the completed questionnaires, 35 were originated from the Netherlands, two from Sweden, two from Belgium, two from France, one from Austria, and one from Romania (Table 1). Whilst the last part of the questionnaire contained the question about which country the veterinarian was active in, it was not recorded where the partial responses were originated from. 47 participants answered the question about their graduation year. Ten participants graduated between 1991 and 2000, 18 participants between 2001 and 2010, and 19 participants between 2011 and 2020. The completion rate was calculated at 0.62 (48/78). 188 participants visited the first page of the survey. The participation rate was therefore calculated at 0.41 (78/188). Note that participants could have looked at the survey more than one time, so the number of unique first survey page visitors might not be accurate, resulting in a possibly inaccurate participation rate.

Country	**Number of questionnaires**
The Netherlands	35
Sweden	2
Belgium	2
France	2
Austria	1
Romania	1

Table 1: Different countries that the questionnaires are originated from.

4.1 Prevalence

57 questionnaires were used for calculating the prevalence of feline anal sac disease. The prevalence was calculated by dividing the total number with the condition by the total number of treated cats, times one hundred. The prevalence for anal sac disease in general (impaction, inflammation, and abscess) was calculated at 0.38%. For anal sac impaction, the prevalence was 0.25%, for anal sac inflammation 0.06% and for anal sac abscess 0.07% (Table 2). From these 57 participants, 20 (35%) worked in a cat friendly practice.

Condition	**Prevalence (%)**
Anal sac disease (impaction, inflammation, abscess)	0.38%
Anal sac impaction	0.25%
Anal sac inflammation	0.06%
Anal sac abscess	0.07%

Table 2: Prevalence for anal sac disease, anal sac impaction, anal sac inflammation, and anal sac abscess in cats (n=57).

4.2 Predisposing factors

In total, 62 questionnaires were used for analyzing predisposing factors of anal sac disease in cats. The questionnaire contained 12 questions about different predisposing factors in cats.

Gender and castration

Table 3 shows the outcome of which gender anal sac disease is most often seen in by the participants. Furthermore, Table 4 and Table 5 depict whether anal sac disease is more frequently observed in castrated vs uncastrated male and female cats, or whether castration does not make a difference. In Attachment 2 (Fig. 33, 34 and 35), these outcomes are depicted in diagrams.

Gender	**Percentage of participants**
Male cats	12.9%
Female cats	8.1%
No difference	79.0%

Table 3: Gender in which anal sac disease is most often observed (n=62).

Castration	**Percentage of participants**
Uncastrated male cats	1.6%
Castrated male cats	27.4%
No difference	71.0%

Table 4: Castrated vs uncastrated male cats and the occurrence of anal sac disease (n=62).

Castration	**Percentage of participants**
Uncastrated female cats	0%
Castrated female cats	24.2%
No difference	75.8%

Table 5: Castrated vs uncastrated female cats and the occurrence of anal sac disease (n=62).

Age

59 participants stated in which age group anal sac disease was diagnosed most often. 44.1% said they diagnosed anal sac disease mostly in mature cats (between 3 and 10 years old). 32.2% noted no difference between age groups, 13.6% noted that anal sac disease occurred mostly in cats older than 10 years and 3.4% saw the disease mostly in cats younger than 3 years (Fig. 5). For the list of notes that were added to ‘’Other’’ see Attachment 1.1.

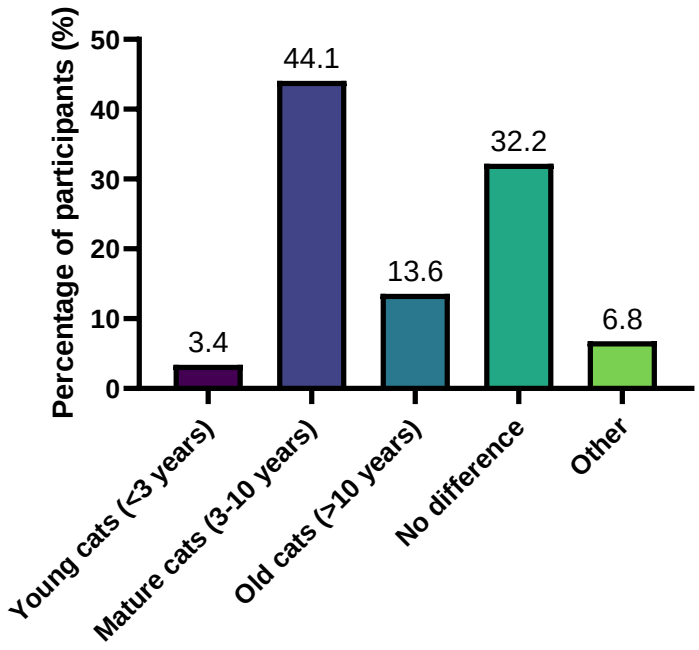
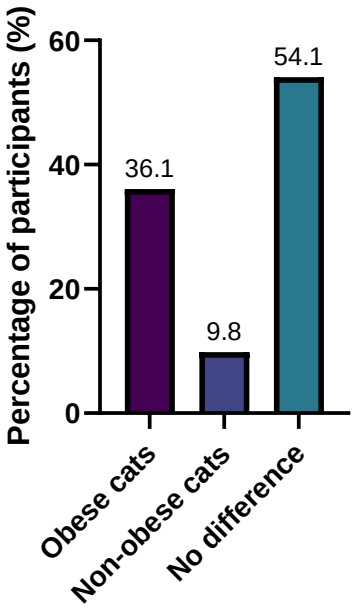


Fig. 5: Age groups and the occurrence of anal sac disease in cats (n=59).

Obesity

61 participants answered the question about obesity as a predisposition factor for anal sac disease in cats. The majority (54.1%) stated there was no difference between obese and non-obese cats regarding anal sac disease. On the other hand, 36.1% of the participants thought cats suffering from anal sac disease were more likely to be obese (body condition score (BCS) of: 7 or higher on a 9 point scale / 4 or higher on a 5 point scale). Whereas 9.8% thought cats with anal sac disease were more likely to be non-obese (BCS of: 6 or lower on a 9 point scale / 3 or lower on a 5 point scale) (Fig 6).



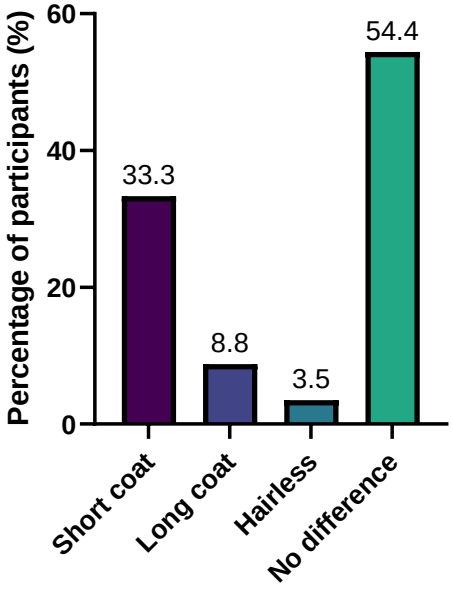


Fig. 6 (left): Obese versus non-obese cats and the occurrence of anal sac disease (n=61).

Fig. 7 (right): Different types of coat and the occurrence of anal sac disease in cats (n=57).

Type of coat

Figure 7 shows that 54.4% of participants indicated that a cat's type of coat does not make a difference regarding the development of anal sac disease. Furthermore, 33.3% thought cats suffering from anal sac disease are often short haired. A smaller percentage chose hairless (3.5%) or long coat (8.8%) (Fig 7). The total amount of participants that answered this question was 57.

Breed

As shown in Figure 8, 32/61 participants stated there was no difference between the occurrence of anal sac disease and different cat breeds. 23/61 participants noted a higher occurrence of anal sac disease in European shorthairs and 10/61 in British shorthairs.

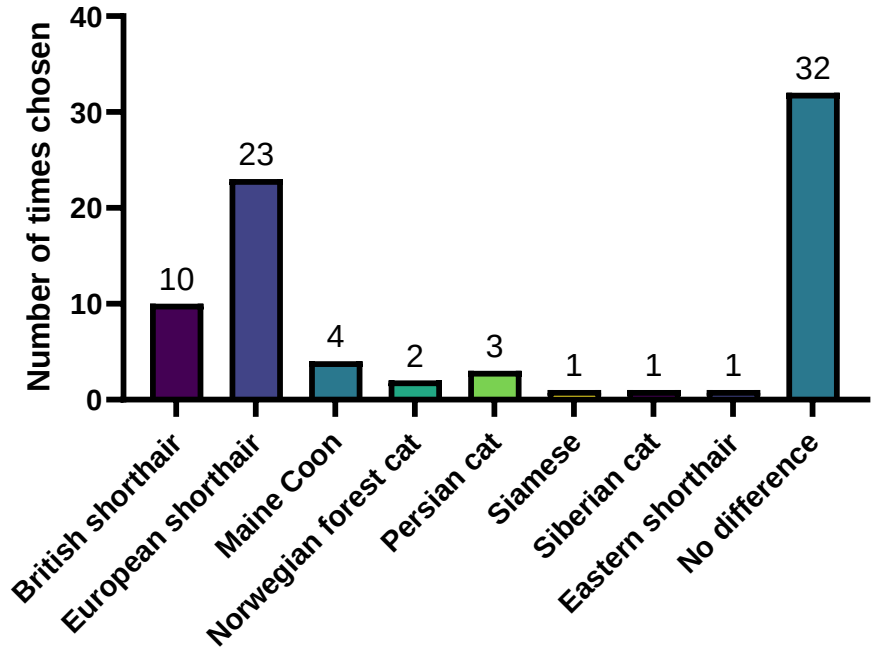


Fig. 8: Cat breeds in which anal sac disease is often observed (n=61).

Diet

No difference was observed between the occurrence of anal sac disease and different types of diet by a majority of the participants (84.9%) (Attachment 2, Fig. 36). 3.8% chose the option 'Other', however, none of them added a comment. A total of 53 participants answered this question.

Season

93% of the participants that answered this question saw no relation between anal sac disease and a certain season (Attachment 2, Fig 37). 57 participants answered this question. For the list of comments see Attachment 1.1.

Dermatological diseases

44/58 participants noted no relation between different types of skin disease and feline anal sac disease. However, 12/58 participants noted a relation between cutaneous adverse food reaction or food allergy and anal sac disease. Also, 6/58 participants saw a relation between atopic dermatitis and anal sac disease and 5/58 participants noted flea hypersensitivity or flea allergy dermatitis in cats with anal sac disease (Fig. 9).

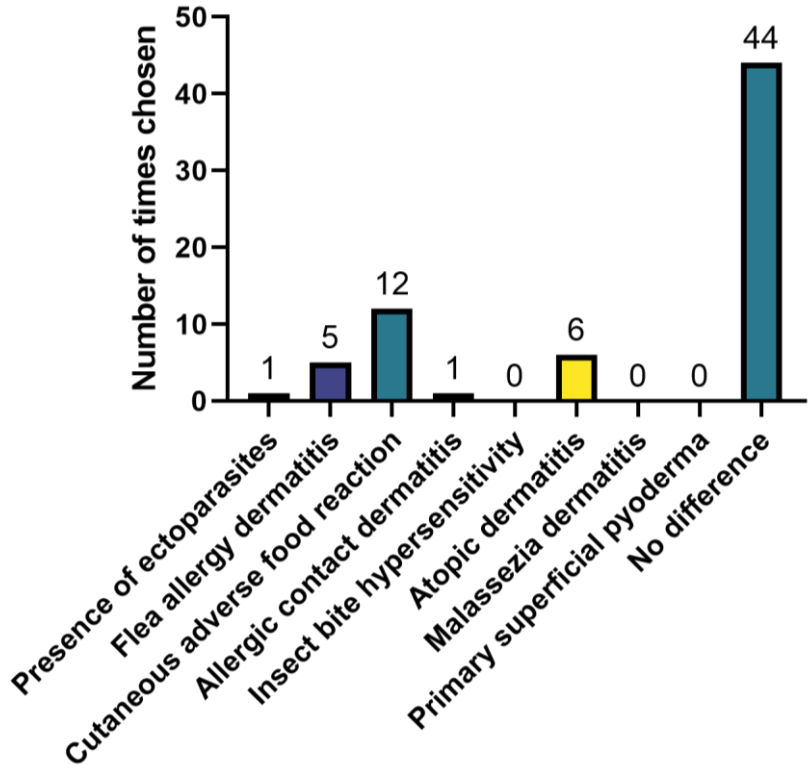


Fig. 9: Anal sac disease in combination with different types of dermatological diseases in cats (n=58).

Gastrointestinal diseases

42/56 participants indicated anal sac disease was not more often observed in combination with a gastrointestinal disease. However, 10/56 participants diagnosed anal sac disease more frequently in cats with cutaneous adverse food reaction and 6/56 participants saw it in combination with viral of bacterial enteritis (Fig 10). Also, 58 participants answered the question regarding diarrhea as a predisposing factor for anal sac disease. However, 70.7% saw no relation between the occurrence of anal sac disease and diarrhea (Attachment 2, Fig. 38).

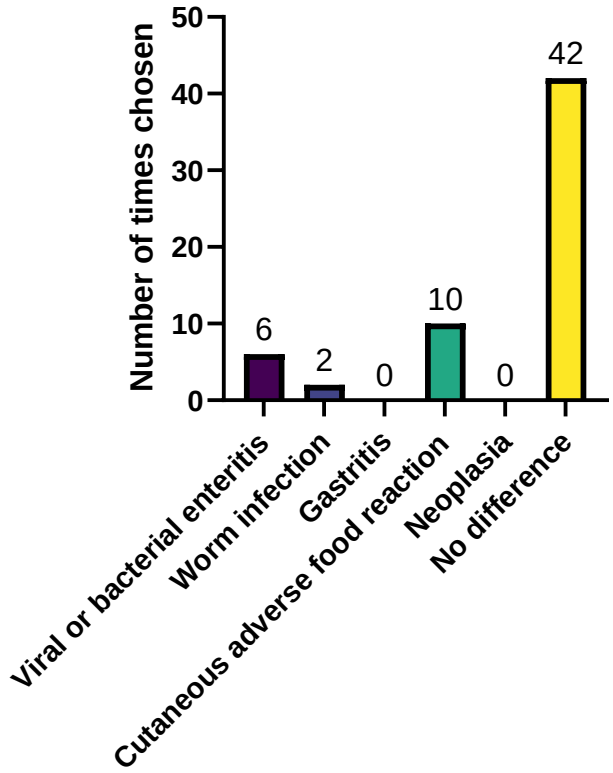


Fig. 10: Anal sac disease in combination with different types of gastrointestinal diseases in cats (n=56).

4.3 Diagnosis

Reported symtoms for anal sac disease in cats were: frequently licking or biting the anal area (44/50 participants), frequently licking or biting the tail region (24/50 participants), tail chasing (3/50 participants), scooting (22/50 participants), rubbing the anal area against objects (16/50 participants), discomfort when sitting down (7/50 participants), perianal discharge (30/50 participants), perianal swelling (2/50 participants), tenesmus (11/50 participants), and foul odor (5/50 participants) (Fig 11). For the list of comments see Attachment 1.2.

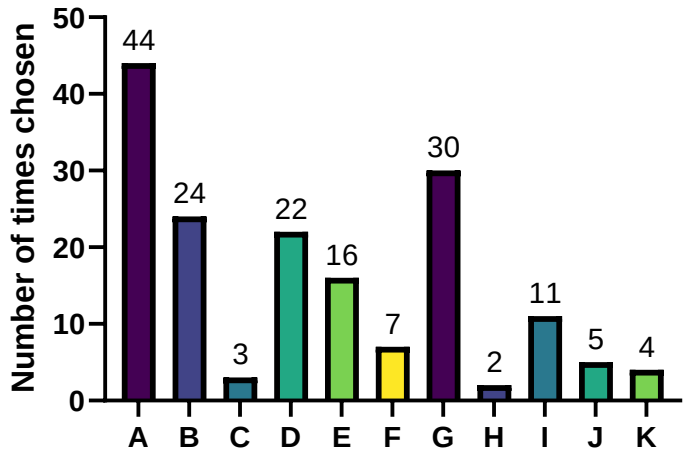


Fig. 11: Clinical signs observed in cats with anal sac disease (n=50). A = frequently licking or biting the anal area, B = frequently licking or biting the tail region, C = tail chasing, D = scooting, E = rubbing the anal area against objects, F = discomfort when sitting down, G = perianal discharge, H = perianal swelling, I = tenesmus, J = foul odor, K = other.

In Figure 12 the criteria used for diagnosing anal sac disease (impaction, inflammation, and an abscess) in cats are shown. The presence of clinical symptoms and size of the anal sacs were mentioned most for diagnosing anal sac disease in cats (both by 40/50 participants). Moreover, nature of the anal sac contents (34/50 participants), consistency of the contents (33/50 participants), and amount of contents (32/50 participants) were chosen often. After that, pain when palpating the anal sac (30/50 participants), color of the contents (27/50 participants), and consistency of the anal sac (25/50 participants) were mentioned relatively frequent. For the list of comments see Attachment 1.2.

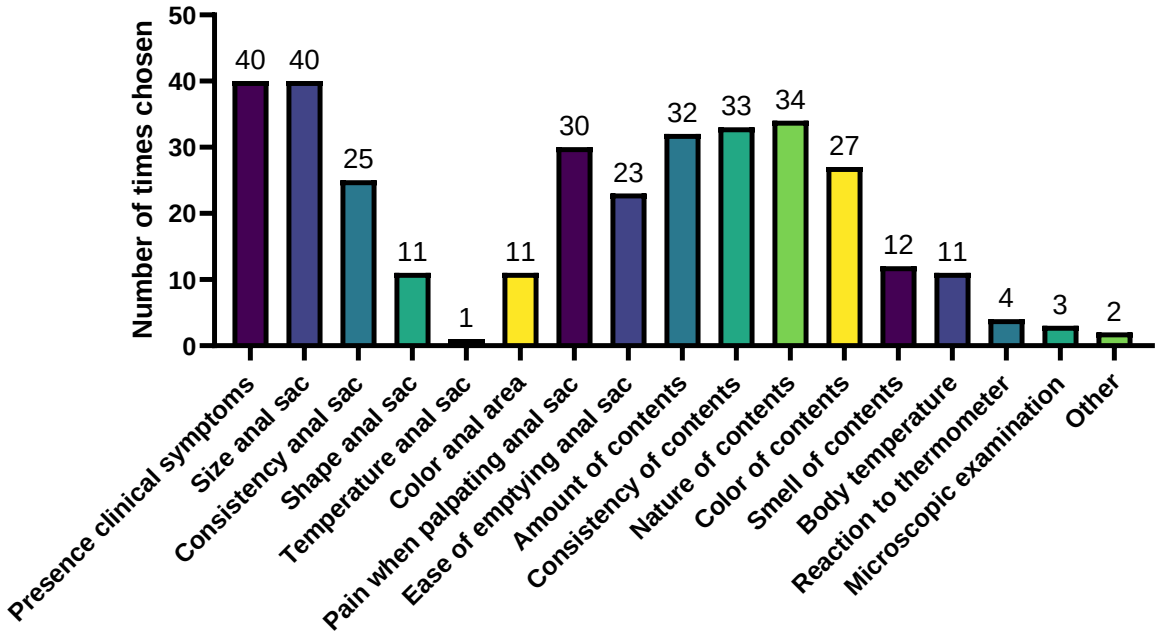


Fig. 12: Criteria used for diagnosing anal sac disease in cats (n=50). For 'The presence of clinical symptoms', the included symptoms were: licking or biting the anal area frequently, scooting, tail chasing, tenesmus, rubbing the anal area against objects, discomfort when sitting down and/or perianal discharge. Microscopic examination of the anal sac contents includes: the presence of bacteria, amount of bacteria and presence of polymorphonuclear leukocytes and/or erythrocytes).

In Figure 13, 14 and 15 criteria used in practice are shown for differentiating, respectively, anal sac impaction and inflammation, inflammation and abscess, and impaction and abscess. For the full list of answers see Attachment 1.2. The answers to the open questions of this section were categorized. Note that participants could formulate their own answer to these questions, making categorization somewhat hard because some participants formulated their answer more precisely than others. This is why ''consistency, nature, color and smell of anal sac contents'' are all different categories and ''anal sac contents'' by itself is a category as well.

The most commonly used criteria for differentiating between anal sac impaction and anal sac inflammation were: pain during palpation of the anal sac (18/49 participants), nature of anal sac contents (17/49 participants), and consistency of anal sac contents (14/49 participants) (Fig. 13). Furthermore, criteria most often used for differentiating between anal sac inflammation and anal sac abscesses were found to be nature of the anal sac contents (17/48 participants), presence of draining fistulas in the perianal area (15/48 participants), and size of the anal sac (11/48 participants) (Fig. 14). Criteria most mentioned for differentiating anal sac impaction and anal sac abscesses were; nature of the anal sac contents (16/48 participants), pain during palpation of the anal sac (13/48 participants), and the anal sac contents in general (11/48 participants) (Fig. 15). As Figure 12, 13, and 14 show, for every differentiation between two types of feline anal sac disease, one participant indicated not to differentiate. This was a different person every time. A veterinarian from France said not to differentiate between anal sac impaction and anal sac inflammation. The other two were veterinarians from the Netherlands.

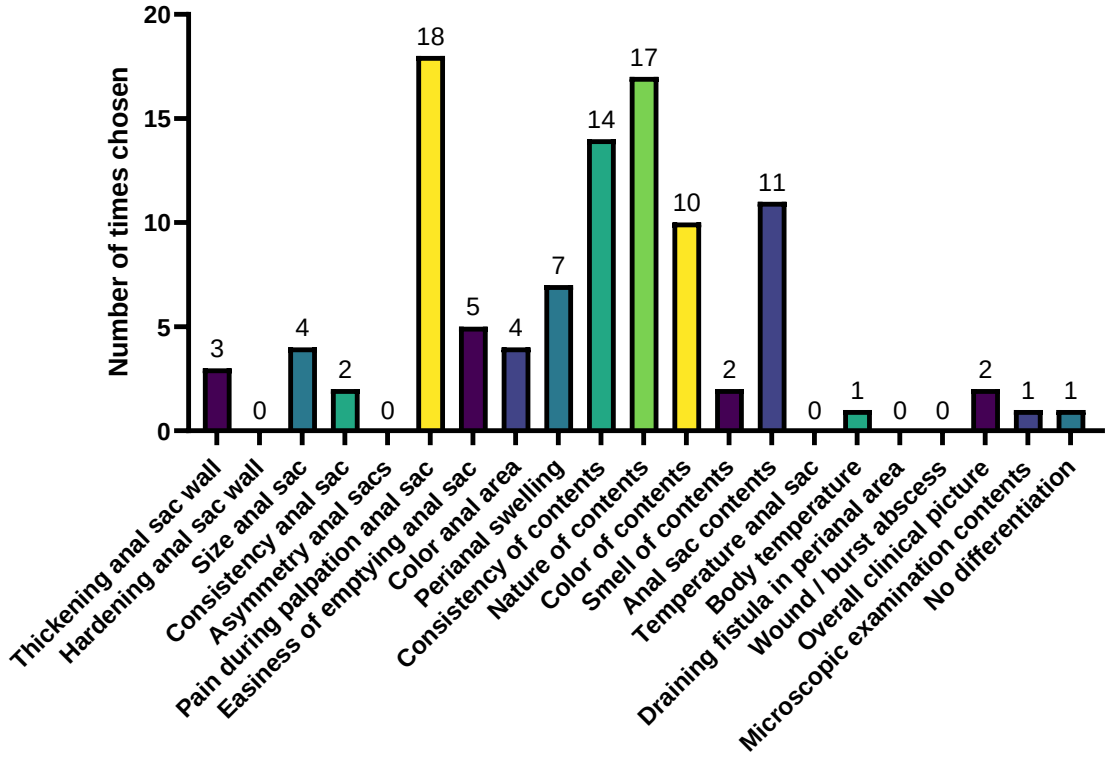


Fig. 13: Criteria used in practice for differentiating anal sac impaction and anal sac inflammation in cats (n=49).

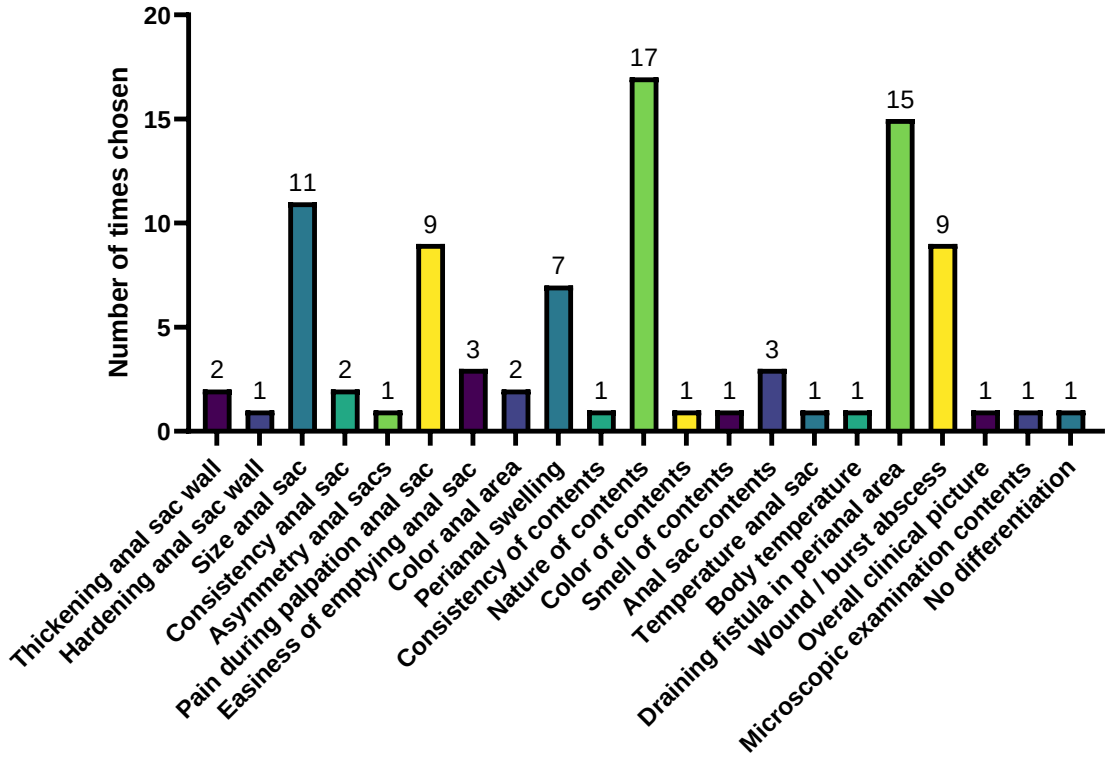


Fig. 14: Criteria used in practice for differentiating anal sac inflammation and anal sac abscess in cats (n=48).

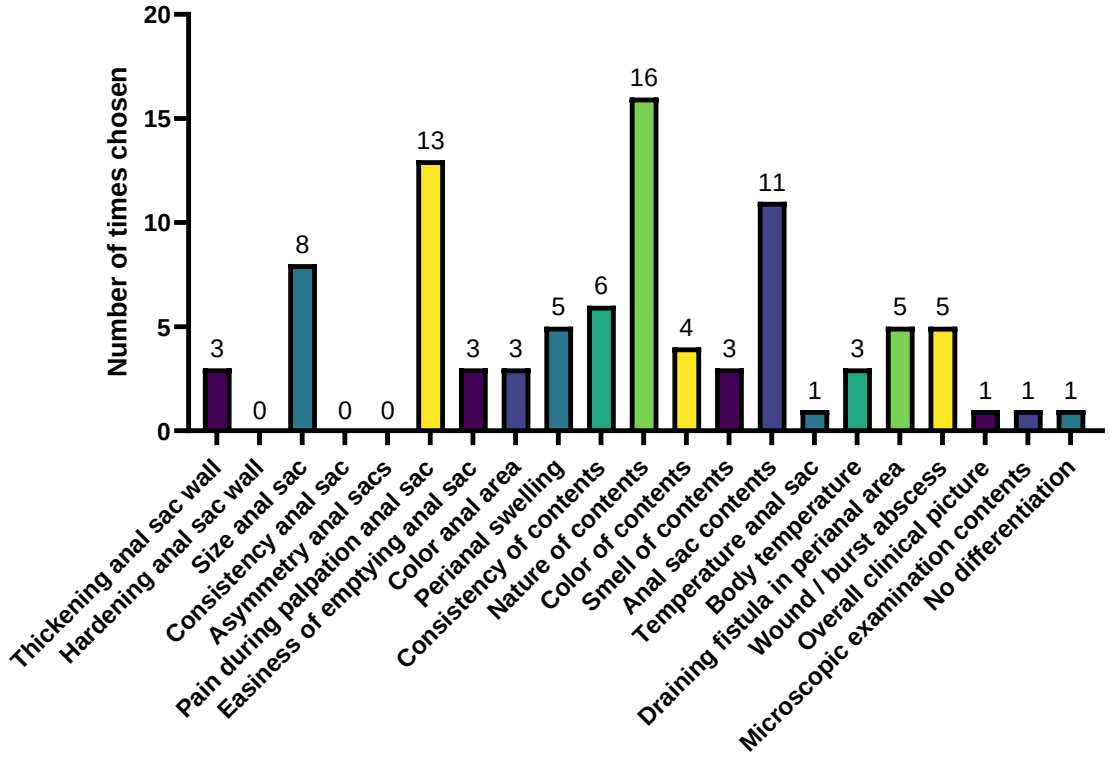


Fig. 15: Criteria used in practice for differentiating anal sac impaction and an anal sac abscess in cats (n=48).

4.4 Treatment

In Figure 16, 17, and 18, treatments used in practice for respectively, anal sac impaction, anal sac inflammation, and an anal sac abscess in cats are depicted. Manual evacuation of the anal sacs was chosen most often for treatment of anal sac impaction (47/50 participants) as well as for anal sac inflammation (44/49 participants). The second most mentioned treatment was treating a potential, underlying cause for impaction (17/50 participants) and prescribing a systemic antibiotic for inflammation (21/49 participants). Most used treatments for an anal sac abscess appeared to be prescribing a systemic antibiotic (36/50 participants), manual evacuation of the anal sacs (35/50 participants), and flushing the anal sacs (23/50 participants).

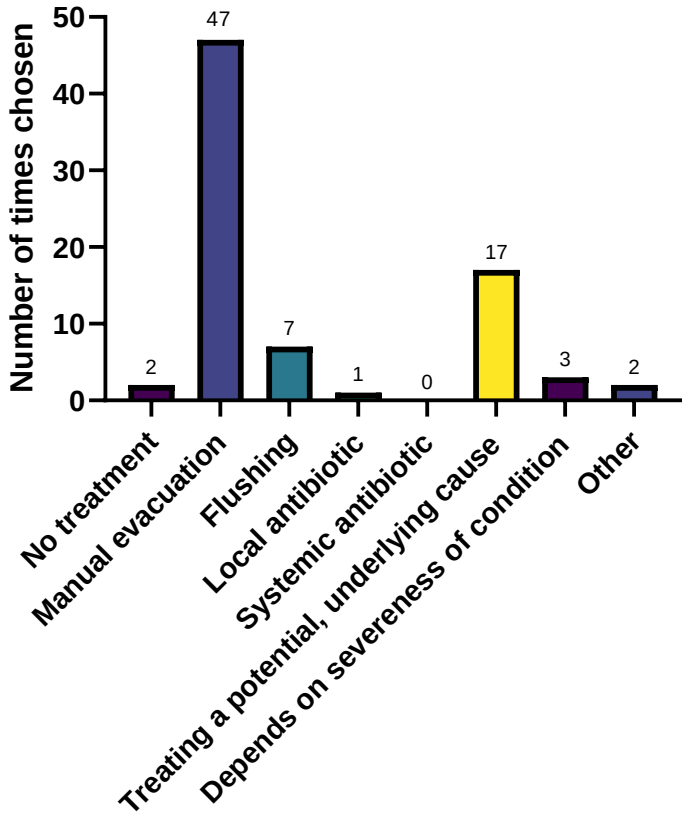


Fig. 16: Treatments used in practice for feline anal sac impaction (n=50).

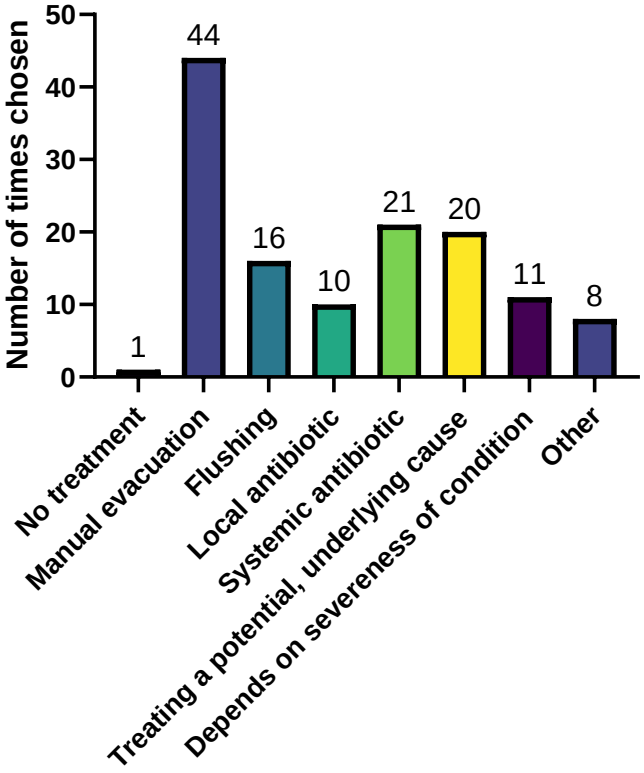


Fig. 17: Treatments used in practice for feline anal sac inflammation (n=49).

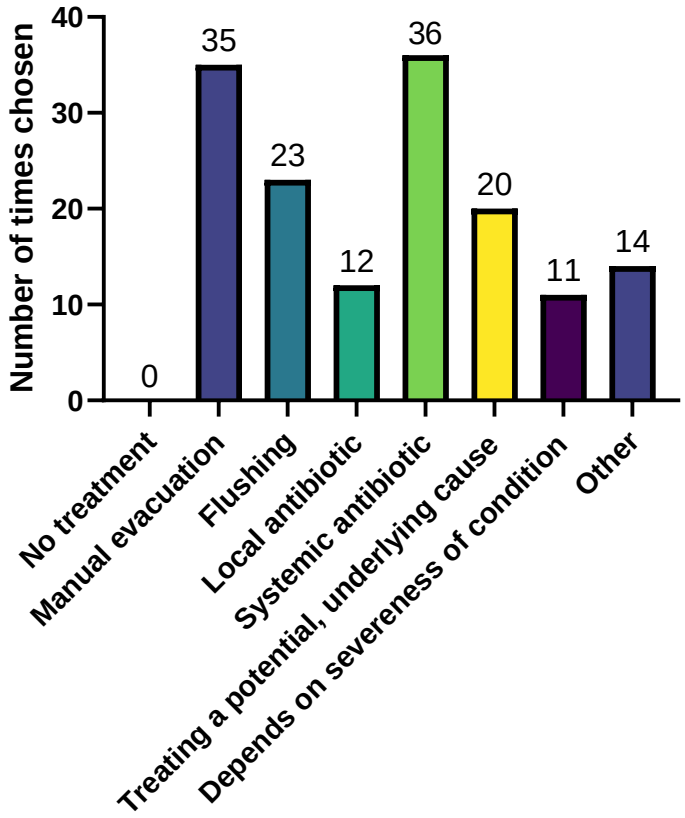


Fig. 18: Treatments used in practice for feline anal sac abscess (n=50).

Furthermore, 98% of the participants indicated that treatment of anal sac impaction is comparable in cats and dogs, 85.7% indicated this is also the case for the treatment of inflammation and 88% said the same for treating an abscess. A total of 49 answers were included (Attachment 2, Fig 39).

One of the possible treatments of anal sac disease is flushing the anal sacs, Figure 19 shows the solutions that participants said they use for flushing the anal sacs in case of impaction, inflammation or an abscess in one diagram. As this figure shows, isotonic saline was mostly used for flushing for every type of anal sac disease (7/7 participants for impaction, 11/15 participants for inflammation and 12/20 participants for abscess). For the full list of answers see Attachment 1.3.

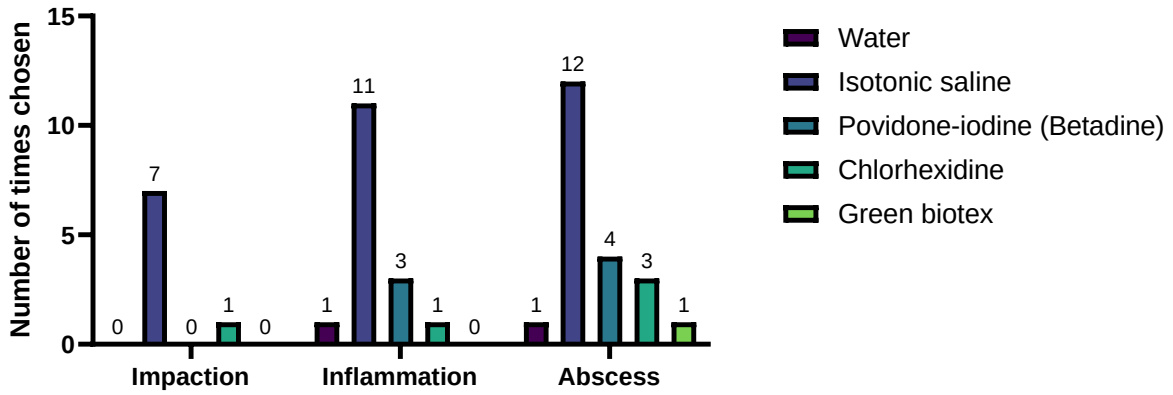


Fig. 19: Solutions used for flushing the anal sacs in cats (n=7 for impaction, n=15 for inflammation, n=20 for abscess).

Another type of treatment is applying antibiotics, local and/or systemic. Figure 20 and 21 show different types of, respectively, local and systemic antibiotics that were used by the participants. The most used local antibiotic was chloramphenicol for both inflammation (6/11 participants) and abscess (6/8 participants). One participant stated that amoxicillin was prescribed in case of an anal sac impaction, this result has been omitted from the chart. Furthermore, the most used systemic antibiotic was spiramycin-metronidazole for inflammation (14/20 participants), as well as abscesses (17/32 participants). For the list of answers see Attachment 1.3.

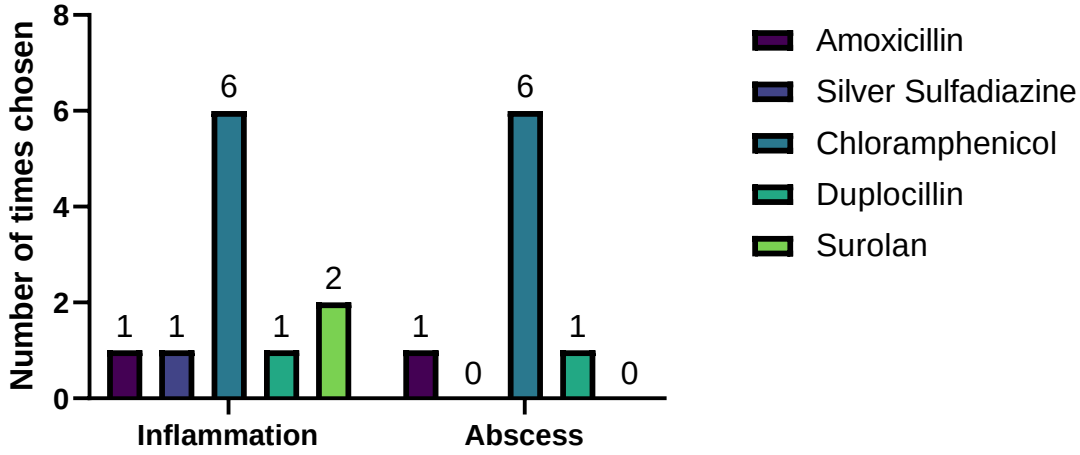


Fig. 20: Local antibiotics that are applied in the anal sacs for anal sac inflammation and anal sac abscess in cats (n=11 for inflammation, n=8 for abscess). One participant stated that amoxicillin was prescribed in case of an anal sac impaction, this result has been omitted from the chart.

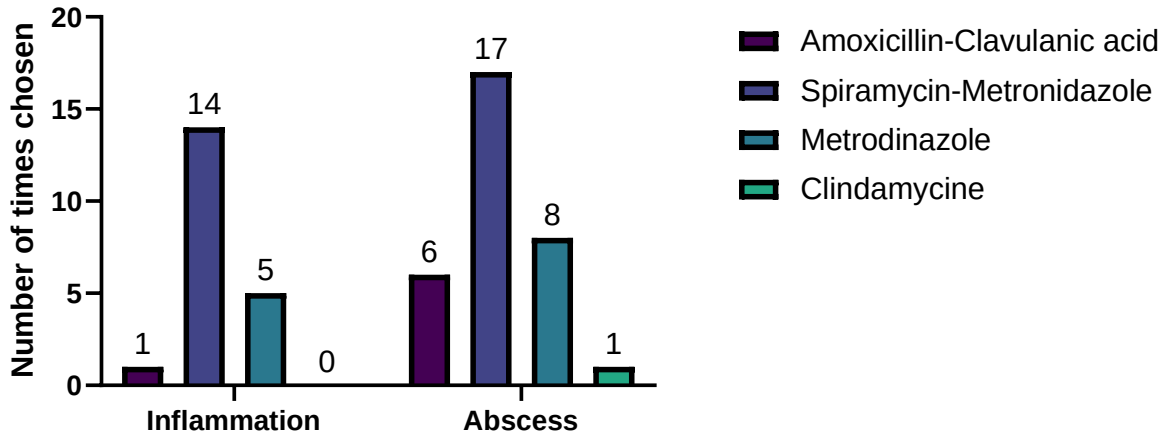


Fig. 21: Systemic antibiotics prescribed for anal sac inflammation and an anal sac abscess in cats (n=20 for inflammation, n=32 for abscess).

Criteria used for deciding whether to remove the anal sacs or not, were categorized and are depicted in Figure 22. Frequent recurrence was the most chosen reason to proceed to surgical removal of the anal sacs (16/23 participants). Also, 4/23 participants indicated to proceed to surgical removal when no improvement was observed, even when an underlying cause had been treated/excluded. There are two methods that can be used for surgical removal of anal sacs, the open and closed method. 61.7% of the participants indicated they had never removed the anal sacs before at all in cats (n=47). Of the remaining participants, the closed method was most often chosen (61.1%) (Fig 23). For a full list of the answers see Attachment 1.3.

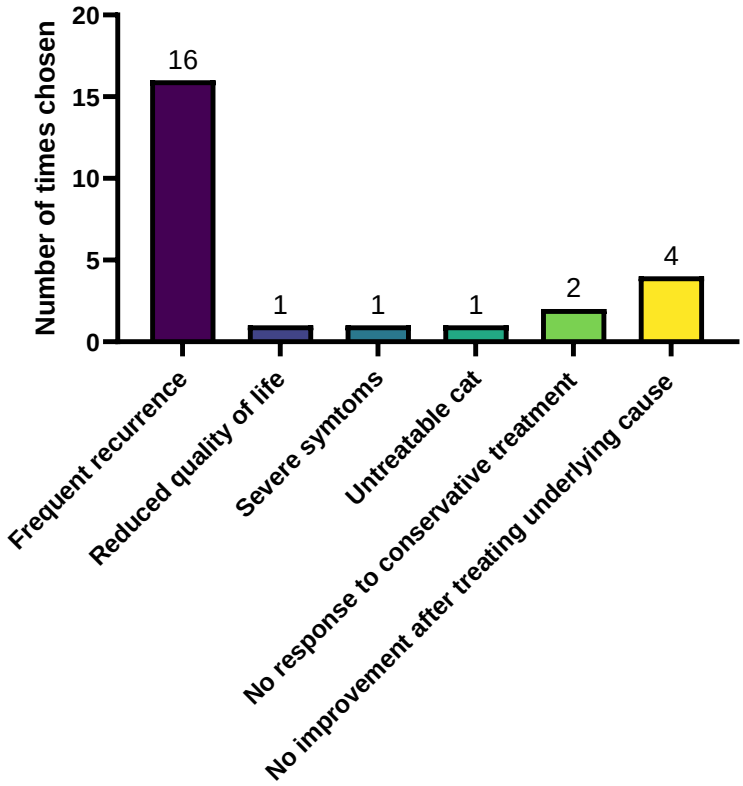


Fig. 22: Criteria for when to proceed to surgical removal of feline anal sacs (n=23).

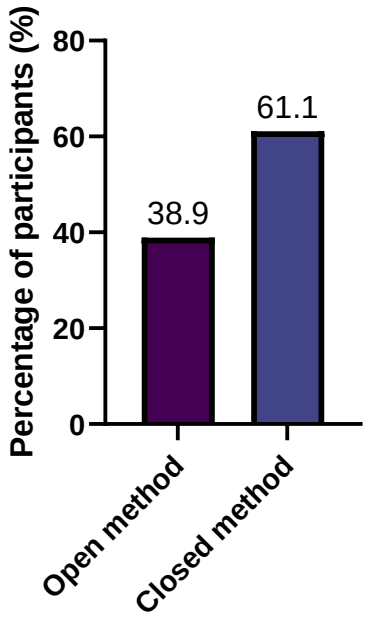


Fig. 23: Type of method used for surgical removal of the anal sacs in cats (n=18).

4.5 Effect of treatment

As shown in Figure 24, 40.5% of cats with anal sac impaction show a relapse after treatment. Furthermore, recurrence of inflammation in cats was reported at 30.1% and recurrence of an abscess 17.8%.

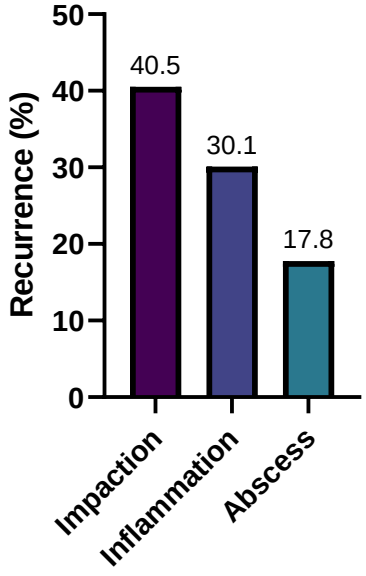


Fig. 24: Recurrence of anal sac impaction, inflammation, and an abscess after treatment in cats (n=34 for impaction, n=28 for inflammation, n=26 for abscess).

Figure 25-28 show histograms of the period until recurrence of, respectively, anal sac disease, anal sac impaction, anal sac inflammation, and an anal sac abscess. In table 6, the average period until recurrence is shown for each condition.

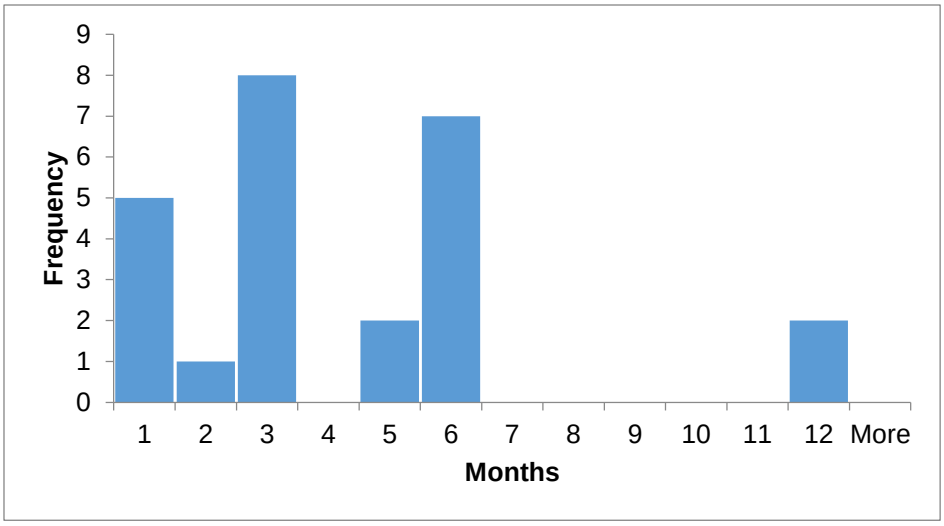


Fig. 25: Period until recurrence of anal sac disease (impaction, inflammation, and abscess) (n=25).

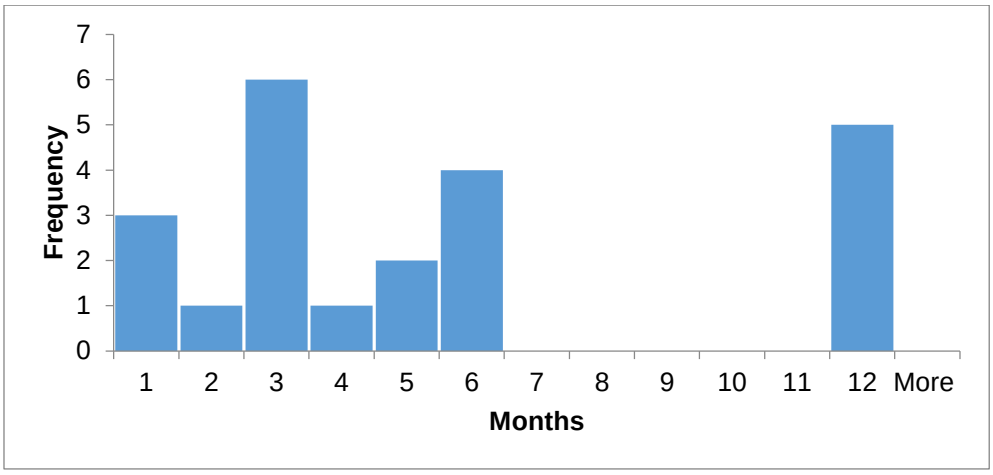


Fig. 26: Period until recurrence of anal sac impaction (n=22).

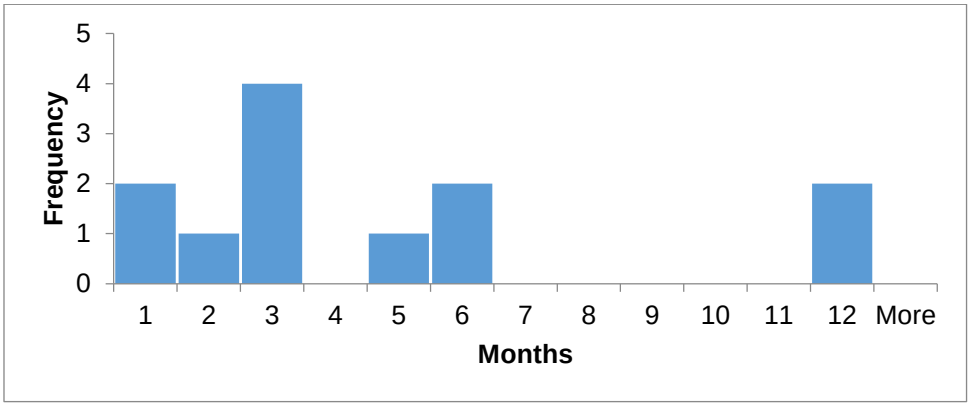


Fig. 27: Period until recurrence of anal sac inflammation (n=12).

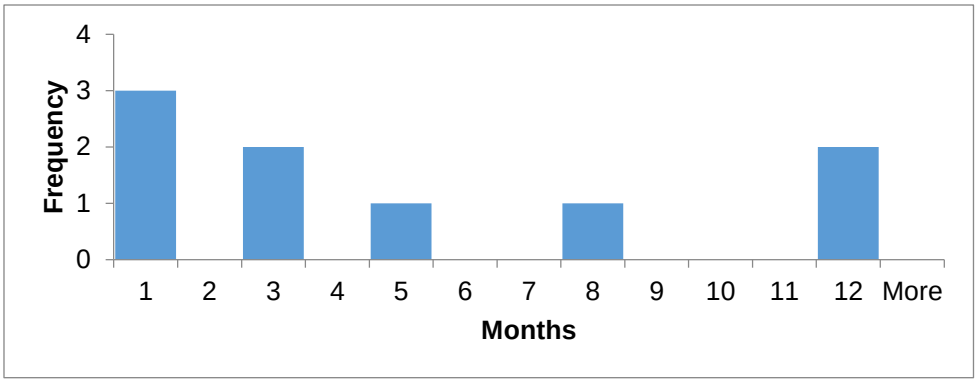


Fig. 28: Period until recurrence of an anal sac abscess (n=9).

Disease	Average number of months until recurrence
Anal sac disease (impaction, inflammation, and abscess)	4.2 months
Anal sac impaction	5.4 months
Anal sac inflammation	4.6 months
Anal sac abscess	4.9 months

Table 6: Average number of months until recurrence for anal sac disease, impaction, inflammation, and abscess in cats (n=25 for anal sac disease, n=22 for impaction, n=12 for inflammation, n=9 for abscess).

5. Discussion

5.1 Prevalence

According to existing literature, the prevalence of anal sac disease in cats is considerably lower than in dogs (Jung et al., 2016; Lake et al., 2004). It has been suggested this could be due to the difference in composition of anal sac contents and location of the anal duct opening. As mentioned before, the apocrine glands are bigger in number in dogs than the sebaceous glands. Whereas in cats, these glands are more equally distributed, in location as well as in number. Since the sebaceous glands produce a more lipid secretion, this results in more lipid anal sac contents. Together with a more lateral location of the anal duct opening in cats, this could explain the lower prevalence of anal sac disease in cats (Jung et al., 2016; Ragni, 2012; Zoran et al., 2012). The prevalence of feline anal sac disease has, to the author's knowledge, not been reported yet. However, Halnan found a prevalence of 12.5% of anal sacculitis in a study that included 3053 dogs, presented in two different clinics (one in England and one in Australia). Also, Hill et al. investigated dermatological diseases in small animals in the United Kingdom. A total of 2322 dog consultations were included from which 559 dogs had dermatological problems. From these 559 dogs, 49 were diagnosed with anal sac impaction, resulting in a prevalence of 2.1%. Cats and their dermatological diseases were also investigated in this study, however, anal sac disease was not diagnosed in any of the cats involved (Hill, P. B. et al., 2006). Another study that took place in the UK found a prevalence of 4.9% of anal sac impaction among Chihuahuas (O'Neill et al., 2020). Furthermore, besides the present study on anal sac disease in cats, a similar study has been executed on dogs at the same time (Woldring, H., master thesis, "An observational, retrospective, study on the prevalence, predisposing factors, diagnostic tools, treatment options, and recurrence rate of anal sac disease in dogs"). The prevalence in this study in canines appeared to be 15.7% for anal sac disease in general (impaction, inflammation, and an abscess), 8.9% for anal sac impaction, 4.1% for anal sac inflammation, and 2.8% for an anal sac abscess.

In the present study, the prevalence of anal sac disease in general (impaction, inflammation, and an abscess) were reported to be 0.38%, of anal sac impaction 0.25%, of anal sac inflammation 0.06%, and of an anal sac abscess 0.07%. This corresponds to the statements in available literature that the prevalence of feline anal sac disease is considerably lower than the prevalence of canine anal sac disease. It should be noted that 35% of the participants worked in a cat friendly practice. The percentage of cats with anal sac disease presented at these clinics should be similar to normal clinics. However, it might be possible that veterinarians working at such cat friendly clinics are better at diagnosing anal sac disease in cats, as they are confronted with more cats in total and therefore more cases of feline anal sac disease in total. This would contribute to a slightly higher prevalence than in normal practices. As a result, the calculated prevalence would be higher if only cat friendly practices were included. Additionally, veterinarians often indicated that the prevalence they filled in was a rough estimate, which could lead to an error in the overall calculated prevalence.

5.2 Predisposing factors

In the present study, several predisposing factors and their possible relation with anal sac disease were explored. According to the results, a vast majority of participants did not see a difference in occurrence of anal sac disease in combination with gender (79%) or castration (71% for males, 76% for females). Gender has been investigated as a predisposing factor in dogs by Halnan, but appeared not to be related to anal sac disease in this research (Halnan, 1976b). Being castrated or not and the effect on anal sac disease has not been investigated yet.

Age category was the only predisposing factor in which an alternative option was chosen more often than the option ‘’no difference’’. 32.2% of the participants noted no difference between age groups regarding anal sac disease. However, 44.1% diagnosed anal sac disease mostly in mature cats (between 3 and 10 years old). A study in which the aim was to investigate gross and cytological characteristics of anal sac secretions of healthy cats, found that cats younger than one year appeared to have significantly more watery secretions in contrast to older cats. This may contribute to the higher occurrence of anal sac disease observed in mature cats, since watery secretions are easier to empty than thicker secretions (Frankel et al., 2008). However, age is not described as a predisposing factor for anal sac disease in current literature. Therefore, it would be interesting to investigate the effect of age on anal sac disease in further research.

Furthermore, participants predominantly saw no relation between anal sac disease and obesity as a predisposing factor (54.1%). However, 36.1% did see a higher occurrence of anal sac disease in obese individuals. Obesity has been mentioned as a predisposing factor in current literature (Ragni, 2012; Van Duijkeren, 1995; Zoran et al., 2012). Perianal fat can lead to compression of the anal sac ducts, resulting in retention of anal sac contents. Whilst only a small majority of participants did not see obesity as a predisposing factor, and obesity is mentioned in the literature as a predisposing factor for dogs, obesity might be a possible predisposing factor in cats that should be further investigated.

32/61 participants did not mention type of cat breed as a predisposing factor for anal sac disease. However, 23/61 participants noticed a higher occurrence of anal sac disease in European shorthairs. In dogs, Poodles and Chihuahuas are suggested to be predisposed to anal sac disease (Charlesworth, 2014; Rutherford & Lee, 2015). However, in cats no predisposed breeds have been mentioned yet. Attention has to be brought to the fact that the Dutch/European cat population consists of a large amount of European shorthairs, which could lead to a larger number of European shorthairs presented with anal sac disease in practices. Another examined predisposing factor was type of coat. 54.4% did not note type of coat to be a predisposing factor. Nevertheless, 33.3% believed short haired individuals are more likely to suffer from anal sac disease. Again, this relatively large percentage could be due to the fact that the population of cats in the Netherlands/Europe largely consists of short haired cats.

A vast majority of participants did not notice any relation between type of diet and feline anal sac disease (84.9%). This is in contrast with current literature, in which a low fiber diet is mentioned to increase the

risk of anal sac disease (Fossum et al., 2019; Halnan, 1976a; Ragni, 2012; Van Duijkeren, 1995; Zoran et al., 2012). A high fiber diet created more bulky feces, which enhances the emptying of the anal sacs (Fossum et al., 2019). Halnan studied predisposing factors in 300 dogs and found that 60% of dogs with anal sacculitis were on an all meat diet, which implies they had very little consumption of crude fibers (Halnan, 1976a). Even though a high fiber diet has been recommended to prevent anal sac disease in several articles and textbooks, no more published research exists, to the authors' knowledge. While this potential predisposing factor is mentioned numerously, it would be interesting to investigate this predisposing factor in further research.

The question about the possible effect of season on anal sac disease was included in the questionnaire, whilst atopic dermatitis has been mentioned to predispose animals to anal sac disease in literature and the occurrence of atopic dermatitis can be season bound. 93% of participants did not notice a relation between anal sac disease and certain seasons of the year. Above that, season has not been mentioned as a predisposing factor in literature yet.

In contrast to existing literature, diarrhea (70.7%), other gastrointestinal diseases (42/56 participants), and dermatological conditions (44/58 participants) were not observed as predisposing factors by a great majority of participants in the present study. Cutaneous adverse food reaction was the second most common answer on the question about dermatological diseases, as well as on the question about gastrointestinal diseases. Diarrhea, an inflamed skin, and perianal itching are included symptoms of cutaneous adverse food reaction, and may explain why this factor was the most popular choice after the option ''no difference'' (Villaverde & Hervera, 2015). These symptoms are similar for atopic dermatitis, which was the third most chosen option for the question about dermatological diseases in combination with anal sac disease. 70.7% of participants did not note the presence of diarrhea as a predisposing factor for anal sac disease in cats. Contrarily, Halnan found that 75% of 300 investigated canine anal sac disease cases had mild, short-lasting diarrhea (1-2 days) between 7 and 21 days prior to the start of clinical signs that led to the diagnosis of anal sac disease (Halnan, 1976a). To get more clearness, the presence of diarrhea and cutaneous adverse food reaction as predisposing factors could be investigated in further research.

5.3 Diagnosis

Symptoms

Frequently licking or biting the anal region (44/50 participants) and perianal discharge (30/50 participants) were most often observed in cats suffering from anal sac disease by the participants. Also, frequently licking or biting the tail region (24/50 participants), scooting (22/50 participants), rubbing the anal area against objects (16/50 participants), tenesmus (11/50 participants), and discomfort when sitting down (7/50 participants) were seen. Tail chasing (3/50 participants) and perianal swelling (2/50 participants) were least often observed. 5/50 participants noticed foul odor as a symptom of feline anal sac disease. To the author's knowledge, clinical signs of cats with anal sac disease have not been officially examined in an experimental setup yet. However, clinical signs of dogs associated with anal sac disease have been investigated before (Halnan, 1976a; James et al., 2011). The feline clinical

symptoms that resulted from current study are largely consistent with the reported clinical symptoms of canine anal sac disease in literature (Frankel et al., 2008; Halnan, 1976a; James et al., 2011; Jung et al., 2016).

Diagnosis

In the current study, the presence of clinical symptoms and the size of the anal sac were most often used for diagnosing anal sac disease (impaction, inflammation, and abscess). After that, nature, consistency, and amount of anal sac contents were among the most chosen criteria. Regarding the nature in diagnosing anal sac disease, the participants often described blood or puss. Also, the presence of pain when palpating the anal sac and the color of anal sac contents were relatively often mentioned in the survey. As Figure 11 (n=50) shows, a lot of participants chose several criteria for diagnosing anal sac disease in cats, which corresponds to the fact that the diagnosis of anal sac disease is based on multiple criteria combined. As discussed in the introduction, most of these criteria mentioned above are valid to use in diagnosing anal sac disease according to current literature. However, consistency and color of feline anal sac contents are not believed to be reliable factors in diagnosing anal sac, whilst these can be highly variable. A study executed on normal feline anal sac secretions reported seven different colors: brown, yellow-brown, tan, gray, white, light yellow, and orange, and four types of consistencies: thick, creamy, watery, and solid portions. Also, the study found a variety in presence or absence of solid material of anal sac contents of normal cats (Frankel et al., 2008). Therefore, color, consistency, and presence of chunks are not reliable factors in diagnosing feline anal sac disease. This is in line with reports of studies executed in dogs (Lake et al., 2004; Pappalardo et al., 2002). According to the authors' knowledge, the amount of anal sac contents is not discussed in available literature.

The option 'microscopic examination' in the questionnaire included: presence of bacteria, amount of bacteria, and presence of polymorphonuclear leukocytes and/or erythrocytes, and was chosen to a lesser extent. Current literature states that cytological and bacteriological examination are not reliable factors in diagnosing anal sac disease in cats. A study with the aim to characterize the cytological and gross characteristics of anal sac contents of clinically healthy cats, concluded that cytological findings in normal cats can show a large variety (Frankel et al., 2008). This study showed a heterogeneity in number of basal epithelial cells, parabasal squamous epithelial cells, corneocytes, neutrophils, mononuclear leukocytes, and yeasts in anal sac contents of healthy cats (Frankel et al., 2008). Furthermore, in dogs, cultured bacteria and yeasts obtained from diseased anal sacs appear to be similar to those obtained from non-diseased anal sacs. These included: staphylococci, streptococci, micrococci, Clostridium species, Bacillus species, Escherichia coli, Proteus species, and Malassezia (Halnan, 1976a; Lake et al., 2004; Pappalardo et al., 2002; Paterson & Steen, 2016; Rutherford & Lee, 2015; Zoran et al., 2012). Consequently, cytological findings and bacteriologic examination appeared not to be reliable indicators for anal sac disease. A study that investigated gross and cytological normal feline anal sac contents in 30 healthy cats, found a mixture of gram-positive cocci, gram-negative cocci, and gram-negative and gram-positive rods. 63% of the samples contained predominantly gram-positive cocci, 30% gram-negative cocci, and the remaining 7% were dominated by rods (gram-negative or

gram-positive) or contained no dominant bacteria. Unfortunately, cultures were not performed in this study, hence the presence of specific bacterial species could not be examined (Frankel et al., 2008). This study of Frankel et al. is, to the authors' knowledge, the only existing study that investigated feline anal sac contents (Frankel et al., 2008). No other research has been performed on neither healthy anal sac contents nor diseased anal sac contents. Whilst cytological examination is not a useful factor for the diagnosis of non-neoplastic anal sac disease, it can be valuable for neoplastic anal sac disease (Jung et al., 2016). One exception is the presence of erythrocytes. Frankel et al. also showed that anal sac contents of healthy cats rarely contain erythrocytes and therefore it is suggested that the presence of erythrocytes in anal sac contents might indicate a disease condition of the anal sacs (Frankel et al., 2008). Thus, regarding bacteria and leukocytes, the results of the present questionnaire correspond to the conclusions of current literature. However, the presence of erythrocytes indicates a diseased state of the anal sacs and can be included in the diagnosing of anal sac disease.

Furthermore, the anal sac's consistency and ease by which the anal sac can be emptied were also criteria the veterinarians indicated to base their diagnosis on. As mentioned before, impacted anal sacs can feel firm and are often more difficult to express than non-diseased anal sacs, whereas abscessed anal sacs cannot be expressed at all. Therefore, these criteria are also valid to include in the diagnosis for anal sac disease.

As Figure 11 shows, no diagnostic imaging methods were used for diagnosing anal sac disease in cats. Currently, no diagnostic imaging methods are available for diagnosing anal sac disease. In a study conducted on 10 healthy dogs and 8 healthy cats the aim was to provide reference features of feline and canine anal sacs using several imaging methods such as ultrasound, low-field MRI, and radiograph contrast (Jung et al., 2016). They found that most anal sacs seemed to be symmetric and, therefore, suggested that modifications such as a difference in shape, size, location, and margin, could indicate a diseased state. With the results of this study the normal references of feline and canine anal sacs are now known and further research can be performed in which the imaging features of cats suffering from anal impaction, inflammation or an abscess can be compared to the features of this research (Jung et al., 2016).

It is of importance to realize that the diagnosis of feline anal sac disease is based on multiple criteria combined. For instance, the presence of clinical symptoms by itself is quite non-specific and no pathognomonic symptoms exist (Jung et al., 2016). However, the presence of clinical symptoms combined with perianal swelling and an enlarged, painful anal sac can predict a more accurate diagnosis. Moreover, it is important to rule out differential diagnoses and to keep in mind that possible underlying diseases could be causing anal sac disease.

Differential diagnoses

The primary differential diagnoses for anal sac disease include: flea allergy (which causes licking and biting), anal or perianal tumors (which cause perianal swelling and ulceration), perianal fistulas, and

pyoderma (which can result in abscessation and draining tracts) (Fossum et al., 2019; Zoran et al., 2012). In dogs, anal furunculosis (also known as peri-anal fistulas) can be the cause of anal sac disease, however, in cats anal furunculosis is rare (Zoran et al., 2012). Also, pyoderma is less common in cats than in dogs (Hill, P. B. et al., 2006). In a study on the prevalence, diagnosis, and treatment of dermatological diseases in dogs and cats in the United Kingdom, 5 out of 1043 cats were diagnosed with pyoderma. Flea infestation was the second most diagnosed dermatological disease among these cats (Hill, P. B. et al., 2006). The owner should be asked about flea management in the cat. Differential diagnoses for anal or perianal irritation include: anal sac disease, endoparasites, dermatitis, perianal fistulas, tumors, or vaginitis. Furthermore, differential diagnoses for perianal swelling include: anal sac disease, perianal neoplasia, perianal gland hyperplasia, anal sac neoplasia, perianal hernia, atresia ani (a congenital embryological anomaly), rectal pythiosis, and vaginal tumors (Ellison & Papazoglou, 2012; Fossum et al., 2019; Zoran et al., 2012). Pythiosis is a tropical and subtropical disease that affects mostly dogs and rarely cats (Cridge, Hughes, Langston, & Mackin, 2020). Also, differential diagnoses for dyschezia (difficult or painful defecation) include: anal sac disease (abscess), rectal foreign body, perianal hernia, perianal fistulas, anal stricture, rectal stricture, anal sac abscess, rectal neoplasia, anal neoplasia, anal trauma, anal dermatitis, rectal pythiosis, and anorectal prolapse (Fossum et al., 2019; Zoran et al., 2012). Lastly, any inflammatory disease within in the perianal region, such as proctitis, perianal fistulas or dermatitis, can cause secondary inflammation of the anal sacs, leading to anal sac inflammation (Zoran et al., 2012).

Differentiating anal sac disease types

The most commonly used criteria for differentiation between anal sac impaction and inflammation by the participants were: pain during palpation of the anal sac, nature of the contents and consistency of the contents. In case of an inflammation the anal sacs are more painful than in the presence of just an impaction with no signs of inflammation. Also, inflammatory characteristics can be noted in the form of a swollen, red, and painful perianal area in case of anal sac inflammation. Additionally, in case of a severe inflammation, anal sac contents can contain blood (Culp, 2013). As stated before, consistency of feline anal sac contents varies even between healthy cats and is therefore not a reliable factor in differentiating anal sac impaction and inflammation (Frankel et al., 2008). One participant indicated not to differentiate between anal sac impaction and anal sac inflammation. However, a differentiation should be made because treatment is different for these two types of feline anal sac disease.

Criteria mostly used for differentiation between anal sac inflammation and an anal sac abscess were: nature of the contents, draining fistulas in the perianal area, and size of the anal sac. Pain during palpation of the anal sac and presence of a wound/burst abscess were chosen to a lesser extent. Draining fistulas in the perianal area and the presence of a wound or burst open abscess are accurate criteria to use when differentiating between an anal sac inflammation and an abscess. When one of these criteria is observed, an abscess is present. In case of an anal sac abscess the sac is enlarged and the skin overlying the anal sacs will get thin, erythematous and edematous (Rutherford & Lee, 2015; Zoran et al., 2012). The anal sac contents can be observed as bloody/purulent in case of an anal sac

abscess, but also in case of severe anal sac inflammation (Culp, 2013). Furthermore, the sacs are extremely painful in case of an anal abscess (Culp, 2013). Again, one participant said not to differentiate between anal sac inflammation and anal sac abscesses.

Criteria mostly used for differentiation between anal sac impaction and anal sac abscesses were: nature of the contents, pain during palpation of the anal sac, and the anal sac contents in general. An abscess often contains blood or puss, whereas an anal sac in case of impaction does not (Culp, 2013). Also, an abscess is often extremely painful and an impaction aches less, therefore pain during palpation could be used to differentiate between these two types (Fossum et al., 2019). Furthermore, the presence of draining fistulas in the perianal area or a wound/burst abscess is typical for an anal sac abscess. One participant did not differentiate between anal sac impaction and anal sac abscesses.

5.4 Treatment

Which type of treatment an anal sac disease patient is given, depends on the stage of anal sac disease that is diagnosed: anal sac impaction, anal sac inflammation, or an anal sac abscess. Therapeutic options include: manual expression, flushing, local antibiotics, systemic antibiotics, and, eventually, surgical removal of the anal sacs. It is important to state that even though the treatment of anal sac disease is described in several articles and textbooks, not much studies have been performed on how effective these above mentioned treatments really are (Culp, 2013; Fossum et al., 2019; Ragni, 2012; Rutherford & Lee, 2015). An important example is manual evacuation of the anal sacs, which has been described as part of the treatment for anal sac impaction and anal sac inflammation (Table 7) (Fossum et al., 2019; Paterson & Steen, 2016; Van Duijkeren, 1995). However, literature is contradictory on how often such evacuation should be executed and on what the effect is. Fossum et al. stated that palpating and expressing the anal sacs routinely, may enhance early detection of anal sac disease (Fossum et al., 2019). Halnan described that repeated manual expression enhances the success of conservative treatment (Halnan, 1976c). Also, Fossum et al. stated that weekly expression is required in more severe cases of anal sac infections (Fossum et al., 2019). However, other literature states that frequent expression of the anal sac could actually enhance recurrence or enhance infection in case of anal sac impaction (Van Duijkeren, 1995). James et al. studied the behavior of 10 healthy dogs and 20 dogs with recurrent anal sac disease. They found that after manual expression, clinical signs (such as scooting) recurred after a median of three weeks for 81% of the anal sac disease dogs. 19% of the dogs only stopped showing clinical sigs for 1-3 days after anal sac expression. Manual expression occurred monthly to every two months for these dogs (James et al., 2011). Further research is necessary to investigate the effect of manual evacuation on anal sac disease.

Even though results of current study did not show a relation between anal sac disease and underlying dermatological or gastrointestinal diseases, existing literature indicates that treatment of underlying dermatological or gastrointestinal diseases, e.g. concurrent dermatoses, cutaneous adverse food reaction (hypoallergenic diet) or diarrhea, facilitates treatment of anal sac disease (Fossum et al., 2019; Rutherford & Lee, 2015). Another important aspect of treating anal sac disease are pain killers and anti-inflammatory drugs. Since anal sac disease can be very painful for the patient, pain killers are important.

In case of inflammation, anti-inflammatory drugs should be prescribed (Rutherford & Lee, 2015). In the present study, NSAIDs were mostly mentioned. However, corticosteroids could also be administered. Furthermore, a high fiber diet has been recommended in literature to enhance the prevention of anal sac disease (Ragni, 2012; Van Duijkeren, 1995; Zoran et al., 2012).

	Treatment
Anal sac impaction	- Manual evacuation - High fiber diet is recommended
Anal sac inflammation	- Manual evacuation - Flushing with antiseptic - Local antibiotics - Systemic antibiotics - High fiber diet is recommended
Anal sac abscess	- Opening and draining of abscess - Flushing abscess - Systemic antibiotics - High fiber diet is recommended

Table 7: Schematic overview of types of treatment that can be applied in case of anal sac impaction, inflammation or an abscess in cats according to existing literature. However, every case is different, therefore deviations may occur regarding individual patients.

Anal sac impaction

Anal sac impaction is treated by manually emptying the anal sacs, which can be performed internally or externally. In dogs, manual evacuation of the anal sacs is often executed by using the internal method. For this method, one finger is inserted in the rectum. This finger applies gentle pressure on the juxtaposed thumb. In this way digital pressure gets expressed through the rectum. In small breed dogs and in cats, it is appropriate to use the external method. With this method digital pressure is performed through the perianal skin, using thumb and forefinger. Both methods should be executed with caution and as a-traumatically as possible. In case of anal sac impaction with no signs of inflammation, antibiotics are not indicated (Fossum et al., 2019; Paterson & Steen, 2016; Van Duijkeren, 1995). Flushing the anal sacs is often not necessary in case of an anal sac impaction. However, if the sac cannot be emptied using manual evacuation, the sacs can be gently flushed with a saline solution (Zoran et al., 2012). The outcome of current survey showed that manually evacuating the anal sacs was by far the number one treatment for anal sac impaction. After that, treating a potential underlying cause was of importance and a smaller percentage also flushed the anal sacs. Altogether, this means that feline anal sac impaction is often treated the correct way by the participants, namely by manually emptying the anal sacs and treating a possible underlying disease. Remarkably, there was one participant that put a local antibiotic (amoxicillin) in the anal sacs in case of an impaction, however, prescribing antibiotics is not indicated, as stated before. Furthermore, two participants said not to initiate a treatment in case of anal sac impaction, however, manually emptying the anal sacs is recommended according to

the literature. Also, it is suggested that a high fiber diet might contribute in reducing the chance of recurrence of impaction (Ragni, 2012; Van Duijkeren, 1995; Zoran et al., 2012).

Anal sac inflammation

In case of an anal sac inflammation the anal sacs should be manually evacuated the same way as described for anal sac impaction, this process is often associated with considerable pain. A major part of participants indicated to manually evacuate the anal sacs in case of an impaction, thus, reacting the right way (44/50 participants). After the sacs are emptied they should be flushed, by inserting a sterile tube or catheter into the anal sac duct (Fossum et al., 2019; Paterson & Steen, 2016; Van Duijkeren, 1995). Only 16/49 participants said they flushed the anal sacs in case of an inflammation. These participants mainly used isotonic saline for flushing. Betadine (povidone-iodine) was also used, and water and chlorhexidine were used to a lesser extent. Current literature suggests that flushing should be performed with an antiseptic solution, such as: saline solutions, chlorhexidine or povidone-iodine solution (Betadine) (Fossum et al., 2019; Van Beusekom et al., 2017; Van Duijkeren, 1995). However, no research has been published on how effective these solutions are for flushing the anal sacs. Water is not antiseptic and therefore less qualified for flushing.

After flushing, an antibiotic should be inserted in the sacs (Van Duijkeren, 1995). According to the ''Formularium Gezelschapsdieren'' composed by the working group of veterinary antibiotic policy, local antibiotics that should be used in case of an anal sac inflammation are: chloramphenicol or chlortetracycline as first choice (both eye ointments) and oxytetracycline + polymyxine as second choice (Table 8) (Van Beusekom et al., 2017). Repeated administration by the veterinarian can be required (Van Beusekom et al., 2017). Most often antibiotics get installed through the anal ducts, however, antibiotics can also be inserted through a lacrimal needle (Van Duijkeren, 1995). Topical antibiotics should only be inserted in anal sacs that are intact (Paterson & Steen, 2016). In the present study only 10/49 participants indicated they applied a local antibiotic in the anal sacs, whereas 21/49 participants said to prescribe a systemic antibiotic. The lower amount of local antibiotics prescribed can be explained by the need for cats to be anesthetized when these local antibiotics get applied. This makes it only possible to apply the antibiotics when the animal is already anesthetized for, for instance, flushing the anal sacs (Halnan, 1976c). Prescribing antibiotics is indicated in case of an anal sac inflammation and was not done by all participants (Van Beusekom et al., 2017).

In the present survey, the most used local antibiotic for feline anal sac inflammation was chloramphenicol ointment (also referred to as 'cafzalf'). Surolan (an ear ointment) was also used and silver sulfadiazine, amoxicillin, and duplocillin also got applied into the anal sacs, but to a lesser extent. Note that the sample size was 11 for flushing in case of inflammation.

In case local treatment does not work, systemic treatment can be considered. According to the ''Formularium Gezelschapsdieren'', first choice systemic antibiotics in case of an anal sac inflammation are spiramycin + metronidazole, second choice is amoxicillin, and a potential third choice antibiotic

should be based on culture and resistancy testing. However, a bacteriologic examination of the anal sac hardly ever delivers a useful outcome, since contamination is very hard to avoid (Van Beusekom et al., 2017). An indication of the period of treatment is 5-10 days (depending on the severity of the inflammation) (Van Beusekom et al., 2017). 14/20 participants used spiramycin-metronidazole in case of an inflammation, which corresponds to the Formulary. 5/20 of participants used metronidazole by itself and 1/20 participant used amoxicillin-clavulanic acid.

	First choice	**Second choice**	**Third choice**
Local	Chloramphenicol[1] Chlortetracycline[1]	Oxytetracycline + polymyxine[2]	-
Systemic	Spiramycin + metronidazole[3]	Amoxicillin[4]	Based on bacterial examination + antibiogram

Table 8: First, second and third choice antibiotics that should be used in case of an anal sac inflammation and an anal sac abscess in the Netherlands according to the ''Formularium Gezelschapsdieren'' (Van Beusekom et al., 2017). 1: Chloramphenicol and chlortetracycline (eye ointments) are not registered for this indication, but are allowed through the cascade regulation. 2: This combination is not registered for this indication, but is allowed though the cascade regulation. 3: Spiramycin is always combined with metronidazole, no veterinary medicines are registered that exclusively contain spiramycin. Also, spiramycin/metronidazole is not effective against E. coli. 4: Amoxicillin is registered for this indication without clavulanic acid.

Anal sac abscess

The most popular treatment choices by the participants were to subscribe a systemic antibiotic (36/50 participants) and manual expression of the anal sacs (35/50 participants). After that, flushing the anal sacs (23/50 participants) and treating a potential underlying cause (20/50 participants) were chosen most. The option ''Other'' was chosen by 14/50 participants, from which six participants indicated to prescribe painkillers (from which five were NSAID's) and four participants indicated that they opened the abscess. This is mostly in line with current literature, which indicates that in case of an anal sac abscess a systemic antibiotic should be used (Table 8). The abscess should be surgically opened, so that the infected material can be cleaned out and the remaining liquid can be drained. Hot packs can be used to make this process easier (Paterson & Steen, 2016; Van Duijkeren, 1995). Most used solutions for flushing an abscessed anal sac in the present study appeared to be isotonic saline. Betadine and chlorhexidine were also sometimes used and water and green Biotex were both mentioned once. Recommended solutions for flushing an anal sac abscess are similar to the ones in case of inflammation. Namely antiseptic solutions, such as: saline solutions, chlorhexidine or povidone-iodine (Fossum et al., 2019; Van Beusekom et al., 2017; Van Duijkeren, 1995). Water is, again, not suitable. Green Biotex contains subtilisin, lipase, amylase, and mannanase and is a detergent that is sometimes used for

disinfection of small skin injuries. However, the use of green Biotex for flushing in anal sacs has not been investigated. Also, note that the sample size was 8 for flushing in case of an anal sac abscess.

In current study, 12/50 participants applied local antibiotics in the anal sacs in case of a feline anal sac abscess. Chloramphenicol ointments appeared to be the mostly used local antibiotic (6/8 participants). The systemic antibiotic that was most often used by the participants was spiramycin-metronidazole (17/32 participants). After that, metronidazole by itself (8/32 participants) and amoxicillin-clavulanic acid (6/32 participants) were used by some participants, and one veterinarian prescribed clindamycin. Hence, most participants followed the formulary when prescribing local and systemic antibiotics to cats with an anal sac abscess. However, systemic antibiotics are definitely indicated in case of an anal sac abscess, therefore, 36/50 participants prescribing a systemic antibiotic may not be enough.

Anal sacculectomy

In current survey, the most important criterion for proceeding to surgical removal of feline anal sacs in practice was reported to be frequent recurrence of anal sac disease. This is in accordance with current literature, which states that performing an anal sacculectomy is advised in case of frequent recurrence of anal sac impaction, inflammation or an abscess, despite appropriate treatment (Charlesworth, 2014; Culp, 2013; Zoran et al., 2012). Furthermore, the results of the present study showed that surgical removal in felines is also performed, to a lesser extent though, in case no improvement is observed when a possible underlying cause has been treated/excluded. A reduced quality of life, severe symptoms, and an untreatable cat appeared to be less frequent reasons to remove the anal sacs of cats in practice. A vast part of participants had never proceeded to surgical removal in cats before, so several of the given answers were hypothetical.

Surgical removal of the anal sacs is hardly ever performed in cats with anal sac disease, whereas in dogs this procedure is more common. In the present study a majority of participants had never executed an anal sacculectomy in a cat (61.7%). To perform an anal sacculectomy, an open or a closed technique can be used. These techniques differ in whether the anal sac lumen is opened or not (Ragni, 2012; Van Duijkeren, 1995). Disadvantages of the open technique are an increased risk of contamination of the surgical field and postoperative infection (Fossum et al., 2019; Hill, L. N. & Smeak, 2002; Ragni, 2012). However, opening the anal sac causes the secretory lining of the anal sac to be visible, which makes it easier to identify the anal sac and enhances its full removal (Scarff, 2010). A disadvantage to the closed method is possible overdistension (e.g. in case of gel as distension material), which can lead to more dissection of the anal sphincter and to thinning of the anal sac wall (Charlesworth, 2014). Also, when a probe is used for distension, the presence of an assistant is necessary to hold the probe in the required position. When too much pressure is put on the probe, the anal sac wall may rupture (Charlesworth, 2014). In the present study, if surgical removal was carried out, the closed method was most often used.

Before surgery, regardless the method, the perianal area should be clipped and aseptically prepared for surgery. Feces should be manually evacuated from the rectum and to reduce fecal contamination, a

purse-string suture should be placed or swabs inserted into the rectum. The anal sacs should be manually emptied and flushed (Fossum et al., 2019; Ragni, 2012; Rutherford & Lee, 2015). The patient should be positioned in ventral recumbency with the tail fixed dorsally over the back, with the pelvic limbs hanging down from a padded table and the pelvis elevated (Fossum et al., 2019; Rutherford & Lee, 2015). In case of anal sac inflammation or an anal sac abscess, the inflammation should be controlled before surgery is performed, using antibiotics (Fossum et al., 2019; Zoran et al., 2012). The presence of inflammation or fibrosis at the time of surgery increases the risk of damaging the anal sphincter (Fossum et al., 2019). The anal sac is tightly attached to the external sphincter muscle and can be distinguished by its grey color as opposed to the red color of the anal muscle fiber (Ragni, 2012; Rutherford & Lee, 2015). However, according to Erik Wouters (DVM, Dipl. ECVS. European Veterinary Specialist in Small Animal Surgery, personal communication, November, 27, 2020), it becomes more and more difficult to distinguish the anal sac from surrounding tissues in case of inflammation the anal sacs. This is why it is advised to remove both anal sacs when an anal sacculectomy is performed, even if only one is diseased (Fossum et al., 2019). Also, surgical removal of an abscessed anal sac is even more difficult than the removal of an inflamed anal sac, which is why the removal of anal sacs in case of anal sac inflammation should not be delayed.

Closed technique

When the closed technique is used, the anal sac gets dissected from surrounding tissues without opening the anal sac lumen. First, a material or tool is inserted into the sac lumen for distension and to help with the identification of the anal sacs. Materials that have been described for this purpose include: gel, melted paraffin, umbilical tape, string, plaster of Paris, Foley catheters, and instruments such as: curved hemostats or grooved directors (Charlesworth, 2014; Fossum et al., 2019; Ragni, 2012; Rutherford & Lee, 2015). However, a study that investigated risk factors for postoperative complications in dogs, found that the use of gel for distension of the anal sacs increased the risk of postoperative complications, compared to the use of a blunt probe (Charlesworth, 2014). Furthermore, in medium and large sized dogs a Foley catheter can be used for distension of the anal sacs. However, this catheter is too big to apply in cats (Ragni, 2012; Van Duijkeren, 1995). In the present study; resin, anal sac paste, a groove director, a Teflon IV catheter, and forceps were mentioned to be used. When an instrument is used, it is placed up to the most ventral and lateral side of the anal sac lumen. Then, a vertical incision is made and with careful sharp and blunt dissection, from the base of the sac towards the orifice, the sac gets separated from the external and internal anal sphincter muscle (Fig. 30) (Ragni, 2012; Van Duijkeren, 1995). To reduce the chance of injuring the anal sphincter or caudal rectal arteries or nerves, dissection should be performed as close to the anal sac surface as possible, while simultaneously sac perforation must be avoided (Ragni, 2012; Rutherford & Lee, 2015; Van Duijkeren, 1995). Fine instruments such as Metzenbaum scissors can be used for this (Fossum et al., 2019; Rutherford & Lee, 2015). The blood vessel that manages the arterial blood supply and is located at the back of the anal sacs should be coagulated (Ragni, 2012) (Erik Wouters). After dissecting the anal sac from surrounding tissues (Fig. 29), the anal duct should be ligated close to the orifice and the incision is closed (Rutherford & Lee, 2015). This ligature can be placed using a 4-0 monofilament absorbable suture (Fossum et al.,

2019). For the apposition of muscle and subcutaneous tissue, 3-0 or 4-0 interrupted, monofilament, absorbable sutures can be used. The skin can be apposed using the same suture material with subdermal sutures (Fossum et al., 2019; Ragni, 2012; Rutherford & Lee, 2015; Zoran et al., 2012).

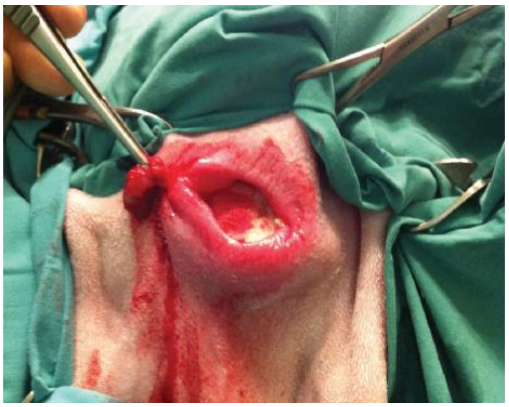


Fig. 29: Anal sacculectomy in a dog using the closed technique. The anal sac is dissected from the surrounding tissues. This figure is obtained from: ''Anal sac disease and its surgical treatment'' (Ragni, 2012).

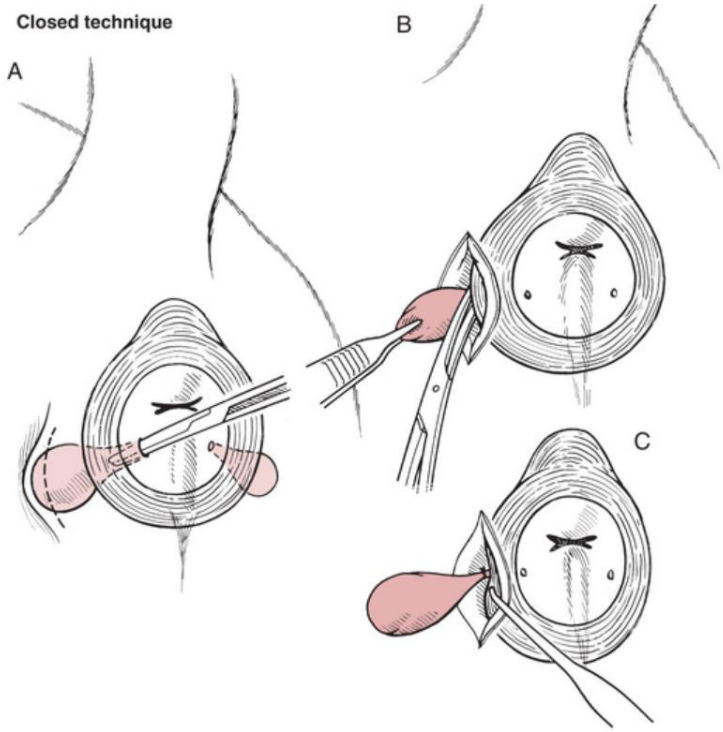


Fig. 30: Schematic demonstration of how to perform an anal sacculectomy using the closed method. A: Insert a small probe or hemostat into the anal sac. The line indicates the location of incision. B: Make the incision and carefully dissect the anal sac from surrounding tissues using sharp and blunt dissection. C: Ligate the anal duct near the orifice and remove the anal sac and anal duct. This figure is obtained from: ''Surgery of the digestive system'' (Fossum et al., 2019).

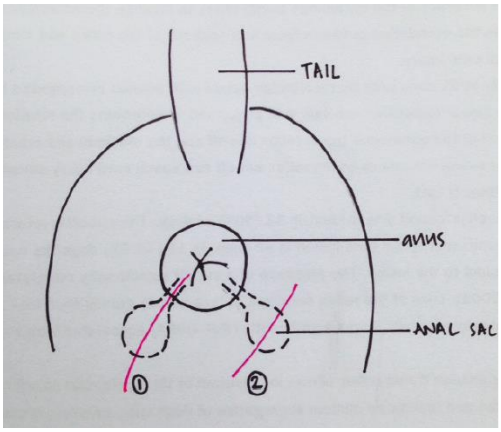


Fig. 31: Schematic display of the surgical incisions required for an open (1) and closed (2) sacculectomy. This figure is obtained from: ''Anal sac disease in dogs'' (Rutherford & Lee, 2015).

Open technique

For the open technique, one blade of a pair of sharp scissors is inserted through the anal duct into the anal sac (Fig. 31). Then, the scissors are closed, cutting the anal sac, anal duct, and overlying layers (external sphincter, subcutaneous tissues, and skin). Alternatively, a blunt-ended probe can be inserted into the anal sac and an incision can be made along the anal duct. Elevate the cut edge of the sac and carefully dissect the anal sac and anal duct free from surrounding connective tissue and external sphincter muscle using sharp or blunt dissection, a Metzenbaum can be used for this (Fig. 32) (Fossum et al., 2019; Ragni, 2012; Rutherford & Lee, 2015; Van Duijkeren, 1995). Again, stay as close to the anal sac wall as possible to reduce additional damage to the anal sphincter. After the majority of the anal sac and duct is dissected free, an incision is made around the duct orifice and the anal sac, anal duct, and duct orifice can then be removed. An alteration is to place ligatures around the anal duct opening and to leave it in situ (Rutherford & Lee, 2015). After taking out the anal sac, full removal should be checked. Closure is similar as for the closed technique (Rutherford & Lee, 2015). A modified open technique has also been described, in which only partial opening of the anal sac is required. For this procedure the incision extends not all the way to the basis of the anal sac, but only until the lining of the sac is identified. From there the anal sac dissection begins and proceeds towards the base of the anal sac (Hill, L. N. & Smeak, 2002; MacPhail, 2008).

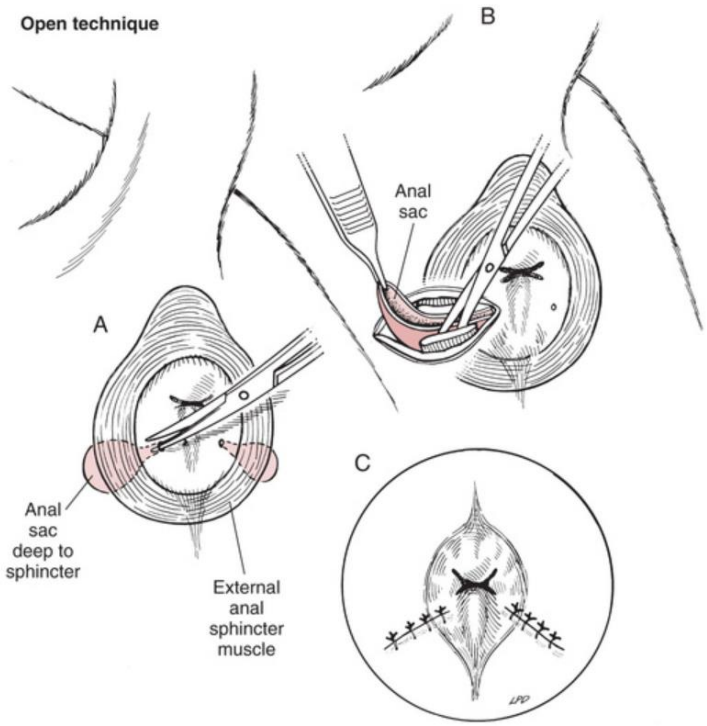


Fig. 32: Schematic demonstration of how to perform an anal sacculectomy using the open technique. A: One blade of a pair of sharp scissors is inserted through the anal duct into the anal sac. Then, the scissors are closed, cutting the anal sac, anal duct, and overlying layers. B: Elevate the cut edge of the anal sac and dissect free from the external anal sphincter. C: Appose the anal sphincter, subcutaneous tissues, and skin. This figure is obtained from: ''Surgery of the digestive system'' (Fossum et al., 2019).

Complications of anal sacculectomy

Short term postoperative complications of anal sacculectomy may include: scooting, inflammation, tenesmus, excessive drainage from the surgical site, and seroma formation. Long-term complications include: stricture formation, fistulation, and fecal incontinence. Fecal incontinence after an anal sacculectomy can be temporary or permanent. It may present itself during the healing process, but usually disappears within several weeks (Charlesworth, 2014; Fossum et al., 2019; Hill, L. N. & Smeak,

2002; Rutherford & Lee, 2015). Other complications include infection, dehiscence, dyschezia, tenesmus, rectal prolapse, and hematochezia (Fossum et al., 2019).

A study that compared open versus closed bilateral sacculectomies for treatment of canine anal sac disease, concluded that using the open technique increased the risk of long term complications compared to using the closed technique. Short term complications appeared to be rare for both techniques. The closed and modified open technique had similar complication rates (Hill, L. N. & Smeak, 2002). Furthermore, a study about risk factors for postoperative complications following bilateral closed anal sacculectomies executed in dogs, found that 32.3% of 62 individuals developed mild, short-term, self-limiting complications, among which 14.5 had short term fecal complications. None of the dogs developed permanent fecal incontinence (Charlesworth, 2014). Also, the use of gel increased the risk of postoperative complications compared to the use of a blunt probe. It has been suggested that this may be due to possible overdistension of the anal sacs, resulting in more dissection of the anal sphincter than otherwise would be needed. Additionally, overdistension of the anal sac could lead to thinning of the anal sac wall, which may result in a higher risk of tearing during surgery (Charlesworth, 2014).

Anal sacculectomy is thought to be a safe and effective treatment for canine anal sac disease, causing a relatively low rate of long-term complications and with a low risk on fecal incontinence (Charlesworth, 2014; Hill, L. N. & Smeak, 2002; Rutherford & Lee, 2015). The closed technique is associated with the lowest risk of long term complications. However, much of the currently available research has been conducted on anal sacculectomies in dogs and not in cats. To learn more about the complications of anal sacculectomies in cats, feline complications should be studied in future research.

5.5 Effect of treatment

Research about the recurrence of anal sac disease after treatment has not been executed so far in cats and neither in dogs. The calculated percentage of recurrence in the present study was highest for anal sac impaction (40.5%), followed by inflammation (30.1%), and, according to the participants, abscesses showed the least recurrence (17.8%). As discussed before, a similar study to the present study has been executed on canine anal sac disease. In this study the recurrence of canine anal sac impaction turned out to be 35.7%, of inflammation 6.3%, and of an abscess 2.9% (Woldring, H., master thesis, "An observational, retrospective, study on the prevalence, predisposing factors, diagnostic tools, treatment options, and recurrence rate of anal sac disease in dogs"). As in the present study, the recurrence of impaction appeared to be highest. Also, the recurrence rate of feline anal sac impaction appeared to be relatively close to the recurrence rate of canine anal sac impaction. However, the recurrence rate of anal sac inflammation and an anal sac abscess was much higher in cats than in dogs, based on these two studies. Note that the ‘’n’’ is relatively low in this part of the present study. Especially for inflammation (n=28) and abscesses (n=26), which could lead to an inaccurate representation of the whole population. According to the participants of the present study, the average period until recurrence was for feline anal sac disease in general 4.2 months, for anal sac impaction 5.4 months, for anal sac inflammation 4.6 months, and for an anal sac abscess 4.9 months. Note that the ‘’n’’ is again very low,

especially for abscesses (n=9), resulting in a valid reason to question whether this sample size is able to represent the whole population.

5.6 Limitations of the study

One of the limitations of the current study was the representation of the study population. Whilst the questionnaire was partly distributed via Facebook, it can be assumed that a relatively young group of veterinarians reacted to the survey (since especially young veterinarians are active on Facebook). This could result in a young population sample, which would not represent the age of the whole population of veterinarians accurately. Ten participants graduated between 1991 and 2000, 18 participants between 2001 and 2010 and 19 participants between 2011 and 2020. Of the rest of the participants the date of graduation is not known. Also, as participants could choose whether to participate in the survey or not, this could lead to self-selection bias. Furthermore, three participants graduated in the year of 2019 or 2020 and were therefore only active as veterinarians for a limited period of time. One could argue that these participants have not yet gained enough experience to make statements and participate in surveys such as current one. Additionally, 35 of the questionnaires were Dutch, whereas eight were from elsewhere in Europe. Whilst only eight questionnaire were originated from other countries than the Netherlands, conclusions based on the present study can only be applied to Dutch veterinarians. No assumptions can be made about other countries while these countries were only represented by one or two samples each. Regarding the questions about possible predisposing factors, sometimes no option with ‘’not applicable’’ was available. Participants could think that they had to fill out something and then fill out their second best answer, and would have filled in ‘’not applicable’’ if possible. Furthermore, since participants could see all possible answers to closed questions before answering, their answers could be suggestive. Also, as stated before, the calculated prevalence of anal sac impaction, anal sac inflammation, and anal sac abscesses in the present study was based on often rough estimates, which means that the prevalence could be higher or lower than calculated in the present study. Lastly, the completion rate of the present study may have been higher when less questions were included. The completion rate was calculated at 0.62. The number of questions per page and total number of pages are important factors in the completion rate. The current survey consisted of nine pages with a maximum of six questions per page, which may cause participants to quit before finishing the survey. Therefore, the completion rate may have been higher if less questions were included in the survey. Lesser participants would have quit the survey before having finished it, resulting in a higher number of completed responses.

6. Conclusion

Whilst published literature lacks information regarding feline anal sac disease, this observational study was conducted to gather information concerning this subject. According to the results, anal sac impaction had the highest prevalence out of anal sac impaction, inflammation, and abscesses. Anal sac impaction also appeared to have the highest rate of recurrence out of the three types of anal sac disease. Out of the investigated predisposing factors, age category was the only one in which the participants chose a different option more than the option 'no difference''. Gender, castration, obesity, type of coat, type of diet, type of season, underlying dermatological and underlying gastrological diseases were not mentioned to be associated with feline anal sac disease by a majority of participants in this survey.

To diagnose anal sac disease (impaction, inflammation, and abscess), the veterinarians used several criteria. The presence of clinical symptoms and size of the anal sac were most often used. Also, nature, consistency, and amount of contents were used relatively frequently, as well as, pain and the color of contents. According to published studies, color and consistency are not suitable factors for diagnosing anal sac disease. The remaining factors were all mentioned in literature. Criteria most used for differentiating between anal sac impaction and inflammation were: pain during palpation of the anal sac, nature of the contents, and consistency of the contents. The most commonly used criteria for differentiation between anal sac inflammation and an anal sac abscess were: nature of the contents, the presence of draining fistulas in the perianal area, and the size of the anal sac. For every differentiation between two types, only one person indicated not to differentiate. Therefore, the three different types were being differentiated in an accurate way by a vast majority of participants.

Furthermore, a difference was found in treatment for the three types of feline anal sac disease. Anal sac impaction was mostly treated by manual evacuation and treating any underlying cause by the participants. A majority of participants indicated they treated an anal sac inflammation by manual evacuation. Also, prescribing systemic antibiotics and treating a potential, underlying cause were mentioned relatively often. Veterinarians also said they flushed the anal sacs in case of an anal sac inflammation, however, more should do so. The treatment of anal sac abscesses was mostly executed by prescribing a systemic antibiotic and by manual evacuation. Also, flushing the anal sacs and treating a potential underlying cause were mentioned, to a lesser extent. Thus, for all three types of feline anal sac disease, manual evacuation and treating a possible underlying cause appeared to be important, according to the participating veterinarians. A large part of participants prescribed a systemic antibiotic for an anal sac abscess, whereas for inflammation not so much, and for impaction zero. Also, flushing appeared not to be executed in case of an impaction, in contrast to inflammation and abscesses in which case it was used more often. All in all, the treatment for the three different types of anal sac disease appeared to contain differences, but also contained some similarities.

7. Practical guidelines

Diagnosis

The prevalence of anal sac disease in cats is extremely low, however, veterinarians do get confronted with such cats once in a while. Diagnosing feline anal sac disease is a complicated process. It is based on a combination of factors, including clinical symptoms and the findings during physical examination (including rectal examination). According to the present study, clinical symptoms that are shown by cats with anal sac disease can vary. However, the most observed clinical symptoms included; frequently licking or biting the anal area, and the presence of perianal discharge. Figure 11 shows the rest of the symptoms that cats with anal sac disease can show. Further criteria that can be included in the diagnosis of feline anal sac disease, include: an enlarged anal sac, pain when palpating the anal sac, nature of the anal sac contents (blood, puss), presence of erythrocytes in the anal sac contents, consistency of the anal sacs, and ease by which the anal sacs can be emptied. Also, a visible or palpable swelling at four or eight o'clock can often be noted. Color, consistency, and cytological examination of the anal sac contents are not reliable criteria (except the presence of erythrocytes) and should therefore not be used in diagnosing feline anal sac disease. On top of that, bacteriological examination should not be included in the diagnosis.

Differentiation should be made between anal sac impaction and anal sac inflammation, while treatment is different for these types of anal sac disease. An inflammation is often more painful than an impaction and in case of severe inflammation, the anal sac contents can contain pus or blood. Furthermore, inflammatory characteristics can be noted in the form of a swollen, red, and painful perianal area. The presence of draining fistulas in the perianal area or presence of a wound/burst abscess is typical for an anal sac abscess. Also, the anal sac is enlarged, often extremely painful and pus or bloody discharge can sometimes be present on the perineum. After some time, the skin overlying the anal sac can become thin, erythematous, and edematous. Also, pyrexia is often present in case of an abscess, but can also be present in case of severe anal sac inflammation. The differentiation of an anal sac abscess is important as well, whilst treatment is different as opposed to an anal sac inflammation (an abscess should be opened and cleaned).

Diseases such as flea allergy, perianal tumors, perianal fistulas, and pyoderma should be taken into account as possible differential diagnoses. For more differential diagnoses see page 32. Also, any inflammatory disease taking place in the perianal region (such as proctitis) can cause secondary inflammation of the anal sacs.

Treatment

There are, to the authors' knowledge, no studies that investigate the effect of applied treatments for anal sac disease in dogs and cats. Therefore, the advice of what treatment to use is based on what is suggested in available literature. Therapeutic options include: manual expression, flushing, local antibiotics, systemic antibiotics, and, eventually, surgical removal of the anal sacs. Underlying dermatological or gastrointestinal diseases such as: cutaneous adverse food reaction, atopic dermatitis,

and diarrhea are suggested to predispose cats for anal sac disease. When anal sac disease is diagnosed these should also be treated if present. Furthermore, a high fiber diet is recommended for prevention of anal sac disease (Ragni, 2012; Van Duijkeren, 1995; Zoran et al., 2012). In case of an anal sac impaction, manual evacuation is indicated. The use of antibiotics is not necessary and neither is flushing in most cases. When a cat suffers from anal sac inflammation, the sacs should be manually evacuated and flushed under sedation with antiseptic solutions, such as: isotonic saline, chlorhexidine or povidone-iodine. Local antibiotics can be applied, however, nearly all cats have to be sedated for this, so the appliance of a local antibiotic can only occur when the cat is already under sedation for e.g. flushing. Consequently, proceeding to systemic antibiotics right away is accepted. In case of an anal sac abscess, the abscess should be surgically opened, drained, and flushed (the same solutions can be used as for inflammation). Also, systemic antibiotics should be administered.

Whilst several factors play a role in deciding which treatment to choose, it is hard to provide one specific advice regarding medicinal treatment of anal sac feline disease. The choice of treatment can be different for every patient. Criteria that should be taken into account include: pharmacodynamics, pharmacokinetics, practical feasibility, medical history of the patient, and legislation. While legislation is different for every country in Europe, the present study only provides an antibiotic treatment advice for veterinarians operating in the Netherlands. When choosing an antibiotic for anal sac inflammation or an anal sac abscess, the ‘’Formularium Gezelschapsdieren’’ should be the leading guideline (Van Beusekom et al., 2017). According to the formulary, local antibiotics that should be used in case of an anal sac inflammation or abscess are: chloramphenicol or chlortetracycline as first choice (both eye ointments) and oxytetracycline + polymyxine as second choice. First choice systemic antibiotics in case of an anal sac inflammation or abscess are: spiramycin + metronidazole, second choice is amoxicillin, and a potential third choice antibiotic is based on bacteriological research and making antibiograms. An indication of the period of treatment is 5-10 days (depending on the severity of the inflammation) (Table 8) (Van Beusekom et al., 2017). However, when these antibiotics are not suitable, other antibiotics can be selected, using the cascade regulation. In the cascade, if an antibiotic is not suitable that has the corresponding indication, as well as the same the target animal, an antibiotic with a different indication and same target animal, or corresponding indication and different target animal, can be selected (Besluit diergeneeskundigen. article 5.1, 2014). It is therefore allowed to deviate from the formulary, as long as it can be properly substantiated.

In currently available literature, local and systemic antibiotic treatments for anal sac disease are described. According to the literature, the local treatment should be started with and if that is not effective or impractical (in case of a poorly manageable cat), the veterinarian should prescribe systemic antibiotics. However, in practice, local antibiotics can only be applied in the anal sacs when a cat is anesthetized. These antibiotics can therefore often only be applied once, for instance, when the anal sacs are being flushed or when the anal sacs are manually evacuated under sedation. It is not realistic to prescribe a regimen of local antibiotics for cats while owners are not able to apply the local antibiotic themselves and the cat should be anesthetized every time. This is why in practice it is acceptable to

proceed to systemic antibiotics right away. Also, when a veterinarian chooses to insert a local antibiotic into the anal sacs of a feline anal sac disease patient, there is also a practical side that has to be taken into account. It appears to be very practical if an antibiotic is already packed with a spout, whilst this makes it easier to apply the antibiotic into the opening of the anal sac duct. This is why eye ointments are often used for anal sacs.

Whilst selecting a suitable antibiotic, pharmacodynamics and pharmacokinetics are of importance. While antibiograms are often not reliable in case of anal sacs, prescribed antibiotics are selected without knowing which bacteria is the cause of infection. This is why it is important to know which bacteria are usually present in the anal sacs of cats. The chosen antibiotic should be effective against these bacteria that are usually present in the anal sacs. However, only one study has investigated the bacteria in feline anal sacs. Unfortunately, no cultures were performed during this study and therefore, no specific bacterial species could be identified (Frankel et al., 2008). However, they did find a mixture of gram-positive cocci, gram-negative cocci, and gram-negative and gram-positive rods. In dogs, staphylococci, streptococci, micrococci, Clostridium species, Bacillus species, Escherichia coli, and Proteus species have been identified in the anal sacs. This would mean a mixture of cocci and rods, gram-positive and gram-negative, and aerobic and anaerobic bacteria are present in the anal sacs of dogs. Pharmacokinetics are also of importance when choosing an effective antibiotic. The antibiotic has to be able to reach the anal sacs. The volume of distribution is an important factor in this. It could be possible that inflamed anal sacs are that well perfused that a high distribution volume is not necessary. However, no research has been done to find out whether a large or smaller distribution volume is necessary in order to reach the anal sacs. Therefore, to be sure, a large volume of distribution if preferred.

Anal sacculectomy

Surgical removal of anal sacs is indicated in case of frequent relapse of anal sac disease despite appropriate treatment (Charlesworth, 2014; Culp, 2013; Zoran et al., 2012). According to Erik Wouters (DVM, Dipl. ECVS. European Veterinary Specialist in Small Animal Surgery, personal communication, November, 27, 2020), it is advised to proceed to surgical removal after the third pharmacological treatment of anal sacculitis. If surgical removal gets delayed, an anal sac abscess can develop, making the execution of an anal sacculectomy way more complicated. When only one anal sac is diseased, removal of both sacs should be discussed with the owner (Fossum et al., 2019). This is because a chance exists that the other anal sac will also develop anal sac disease. When no inflammation is present, the greyish anal sac can be quite easily distinguished from the red anal sphincter fibers, however, in case of an inflamed anal sac the structures will get more difficult to distinguish. This is why it can be useful to remove both anal sacs.

Before starting an anal sacculectomy, anal sac inflammation and an anal sac abscess (with possible fistulas) should be calmed down. The inflammation should be reduced as much as possible, using local and systemic antibiotics several days before surgery (Fossum et al., 2019). According to Erik Wouters, an anal sacculectomy appears to be a surgery that does not have to be performed by a specialist. The

complication rate is low for anal sacculectomies and the development of permanent fecal incontinence is rare. In order to develop permanent fecal incontinence, more than half of the external anal sphincter has to be harmed or the pudendal nerve injured. This can be avoided by staying as close to the anal sac wall as possible during dissection of the anal sacs. However, even though the risk of permanent fecal incontinence is small, owners should still be informed that this minor risk is present. Short term fecal incontinence can occur during the healing process, but often returns within a few weeks (Fossum et al., 2019). A description of how an anal sacculectomy is performed is shown from page 38. Is it up to the surgeon to choose which method to use (open or closed), however, the closed method is associated with a smaller risk of contamination and postoperative complications (Fossum et al., 2019). After surgery, cats should be provided with an Elisabeth collar (or something similar) and painkillers, such as NSAIDs. Also, laxatives may be prescribed for two or three weeks as a stool softener (Fossum et al., 2019). Patients should return for a check-up in 3-5 days and after two weeks (according to Erik Wouters).

8. Prospective trial

Little information is available concerning anal sac disease in cats. Studies that examine the anal sacs or anal sac contents of healthy cats exist, however, to the authors' knowledge, none of these studies investigate anal sac disease. A major part of information available about feline anal sac disease are suggestions and/or is based on research executed in dogs. And even in dogs, there is still a lot to find out. Predisposing factors have been mentioned/suggested, but have not yet been tested in randomized controlled trials yet. According to the results of the present study, in combination with available literature, several predisposing factors would be interesting to investigate in further research. One of them is age category. Age category was the only predisposing factor in which an alternative option was chosen more often than the option ''no difference''. Therefore, this was the only factor that a majority of participants noticed as a possible predisposing factor for feline anal sac disease. Age category has not been mentioned in literature, however, a study found that young cats (<1year) have more watery secretions than older cats, which could contribute to the fact that this majority of participants noticed a higher occurrence of anal sac disease in mature cats (Frankel et al., 2008). Furthermore, obesity should be involved in further research, whilst obesity has been mentioned in available literature and 36.1% of participants in the present study noticed obesity as a predisposing factor for feline anal sac disease. Also, even though type of diet did not come forward as a predisposing factor in the present study (84.9% did not notice type of diet as a predisposing factor in cats), a high fiber diet has been mentioned in literature to have an effect on anal sac disease and would therefore be interesting to further investigate. Additionally, even though cutaneous adverse food reaction was not believed to have a relation with feline anal sac disease by a large part of participants, it was the second most common answer for both questions about concurrent dermatological and gastrointestinal diseases and has been mentioned in the literature as a possible predisposing factor. Therefore cutaneous adverse food reaction as a predisposing factor for feline anal sac disease could be interesting to investigate. Lastly, a large majority of participants did not notice a more frequent presence of anal sac disease in cats with diarrhea. However, diarrhea is mentioned as a predisposing factor in many articles and textbooks and Halnan found that the presence of diarrhea on short term before developing anal sac disease could increase the risk of developing anal sac disease in dogs (Halnan, 1976a). The effect on diarrhea could therefore be studied in further research. Besides information about predisposing factors, the prevalence of feline anal sac disease has also not been reported yet. The present study provides a prevalence by using rough estimates of (mostly Dutch) veterinarians, this means further research might be necessary to test whether this prevalence is accurate.

Furthermore, several aspects regarding treatment of feline anal sac disease could be further investigated (also for canine anal sac disease). For instance, the effect of manual evacuation on the prevention/treatment of anal sac disease, the effect of flushing, whether different flushing solutions have a better efficacy, which bacteria are present in the anal sac of healthy cats, and which antibiotics are effective. Also, short and long term complications after an anal sacculectomy in cats could be investigated, as this has only been executed in dogs. Additionally, it would be interesting to investigate

what percentage of feline anal sac disease (impaction, inflammation or an abscess) patients presented in practices, end up with surgical removal of the anal sacs.

In the present study, more clarity is obtained on how veterinarians currently diagnose anal sac disease in cats. The results are compared to what is advised in available literature. However, more research should be executed on how accurate these different criteria are in diagnosing feline anal sac disease.

Based on the results of the current study, a possible prospective trial that includes recurrence of feline anal sac disease should ideally last 12 months. According to this survey, after 12 months no recurrence of any of the three types of feline anal sac disease takes place anymore. However, with a period of six to eight months the major part of the recurrences has also taken place. Figure 25, 26, and 27 show that the majority of impaction and inflammation recurrences takes place within six months and the majority of abscess recurrences takes place within eight months. Therefore, a period of six to eight months would also be suitable for a prospective trial that investigates feline anal sac disease recurrence. When such a prospective trial would be performed in cats, it may be convenient to include cats that have an increased risk of feline anal sac disease and therefore might have an increased risk on recurrence of feline anal sac disease. According to the present research, such individuals could be mature (3-10 years), obese, European shorthair cats. Even though obesity did not come forward as predisposing factor in the present observational study, this factor has been mentioned in literature and to be sure to include as many increased risk cats as possible this factor could be included when selecting cats.

9. Attachments

Attachment 1: List of comments on questions

1.1 Predisposing factors

Age

- No difference between adult and old cats. - Both young cats and adult cats.

Season

- Summer. - Summer. - Autumn/winter. - Spring and autumn.

1.2 Diagnosis

Symptoms of feline anal sac disease

- Bad mood. - Visible fistula channel perianal. - Owner reports tail pain, keeping the tail low. - Excessive licking of flanks.

Criteria for diagnosing feline anal sac disease

- Visible fistula channel. - Location of the anal sacs, e.g. deeply embedded anal sacs.

Criteria for differentiating feline anal sac impaction and inflammation

- Reaction cat and easiness of emptying the anal sacs. - Consistency of the sac, nature of the content. - Among other things/in particular, nature & color of the anal sac content, overall clinical picture (appetite, temperature, fitness, etc.). - Material, color, consistency, level of pain of the anal gland. - Color and consistency of the content. Inflamed or not. - Contents anal gland. - Presence of inflammation cells in contents and nature of the content. - Thickening of the anal sac wall when inflamed. Nature, consistency, smell, and color of the content. - Pain, redness perianal region, content. - Consistency, nature, color, smell of the anal sac content. In combination with presence of pain and the consistency of the anal sac.

- Consistency anal sac content.
- Yes or no blood/red swelling at the location of the anal sac.
- Aspect of content.
- Painfulness, swelling, and consistency of content.
- Yes or no pain.
- Pain and content
- Remaining swelling after emptying the anal sacs manually.
- Contents of anal glands, pain.
- Impaction: more full than normal. Inflammation: red, possibly bloody or pussy content, swelling, more painful.
- Swelling anal area after emptying, possibly fever.
- The color and consistency of the content.
- Blood or pus in the anal sac content.
- Painfulness, contents, and easiness of emptying.
- Contents of anal sac. Thickness of empty anal sac.
- In particular the color, nature, and consistency of the content. But the rest of the above is also included.
- Consistency
- Pain, thickening of the wall, possibly blood.
- Pus, blood, pain.
- Color content, pain, color anus region.
- Inflammation reminds me more of pain and a more aqueous contents in the anal sac.
- Pus or no pus.
- Inflammatory fluid/pus from the anal sac or not, thickened, and red.
- The consistency and color of the anal sac content.
- The easiness of emptying and whether the anal sac is easy to empty in general. Additionally, the thickness of the wall.
- What comes out and what the anal sac looks like.
- Not applicable.
- Painfulness during emptying, size of the anal sac after emptying.
- Inflammatory mediators: pus yes or no.
- Anal sac contents or pus.
- The nature of the content.
- Color and consistency of content, thickness anal sac, painfulness.
- Painfulness, consistency/contents anal sac.
- Impaction is the retention of secretions without signs of inflammation. Inflammation is the increasing of glandular secretions with the concurrent bacterial flora involved.
- The consistency of the anal sac contents and the presence of pain.
- Difficulty to express contents which is also very hard.
- The easiness of extraction.

- I do not differentiate.
- Nature of the anal sac content.
- Anal sac content, painfulness, general wellbeing of the cat.

Criteria for differentiating feline anal sac inflammation and abscess

- Obvious abscess, so pus, often already burst open.
- Nature of content.
- Not; in particular, I pay attention to whether there is a fistula.
- Presence of fistula in perianal area.
- The presence of an abscess yes or no.
- Pain, redness.
- Size of the anal sac, combined with the thickness of the wall.
- In case of an abscess there is a fistula opening. See last question for inflammation. Format of anal sac often bigger in case of an abscess. In case of an abscess often also swelling and inflammation around anal sac.
- Not applicable.
- Consistency, nature, color, odor of the anal sac content. In combination with the painfulness and consistency of the anal sac.
- Pain, degree of protruding of the anal sacs.
- Yes or no pussy content.
- Degree of swelling.
- Format of the anal sac. In case of an abscess, an accumulation of material in the cavity. And whether the skin of the perianal area at the height of the anal sac is still intact.
- Open or closed to the outside through the skin instead of discharge.
- Size.
- In case of inflammation hard swelling. In case of an abscess soft swelling. Both painful.
- Cracked open/wound.
- When it is already cracked open, is must have been an abscess. In case of an abscess there is a fluctuating or thicker swelling than with just an inflammation.
- Fistula opening, not being able to empty, often far more painful.'
- Palpation / fistula forming.
- Amount of pus and blood, visible swelling in anal area. I usually do not see the cats until the abscess is already open and draining.
- External features, painfulness, content.
- Breakthrough through the skin, pussy contents indicate abscess.
- I do not.
- Size, outward opening, asymmetry of both anal glands.
- Abscess = pus.
- Pus, blood, open/enlarged.

- Wall thickness, purulent material, protruding abscess. Sometimes an opening in the abscess to the outside.
- A fistula or not. An abscess when fistula is present.
- In case of an abscess there is a real enlargement and hardening of the wall, possibly broken through to the outside, only inflammation has a wall that feels normal.
- In case of an abscess a large thickening and it may break open > pus.
- Yes or no opening through the wall.
- The content.
- Not applicable.
- To what extend it can be emptied, nature contents (purulent?), painfulness.
- Whether it is open or not.
- Pus: abscess.
- The external features such as redness of the skin, a clear mass, bursting of the abscess.
- Ease of emptying, anal sac size, anal sac color.
- Contents of anal sac, painfulness, temperature.
- Abscess involves the collection of pus with possible draining fistula or sinus.
- Clinical exam of the cat presenting eventually perianal pain, fever, anorexia, presence of degenerated neutrophils, and inflammation of perianal tissues with possible fistula or collected purulent liquid >> abscess.
- Sero-hemorrhagic or purulent secretion without enlargement of sac.
- Pus.
- More severe pain, presence of pus, anal fistula.
- Anal sac content.
- Not. Only when it has broken through, then I am talking about an abscess. It makes no difference to the owner and neither to the terms of treatment.

Criteria for differentiating feline anal sac impaction and abscess

- Abscess, often burst open.
- Nature of the content.
- Among other things/in particular, nature and color of the anal sac content, general clinical image (appetite, temperature, fitness, etc.).
- Consistency (type of secrete) material
- Contents and swelling.
- Pain, redness.
- Nature of contents and microscopic presence of inflammatory cells in content.
- Thickening of anal sac wall in case of an abscess. Nature, consistency, smell, and color of the content. And fistula opening. Size of anal sac. Swelling of surrounding.
- Not applicable.
- Pain, degree of protruding of the anal sacs.
- Impaction: normal content, can be thin/thick, normal odor, no blood. Abscess: pussy content.

- Swelling, aspect content.
- Format of anal sac. Painfulness.
- Impaction is not necessarily a complaint, but is a finding. Abscess is open, pus, dirty, pain.
- Size, painfulness, consistency
- Blood, pus in case of an abscess. Impaction is not associated with pain, an abscess is.
- Pain, odor/content, yes or no wound or burst open.
- Contents: normal in case of impaction. In case of an abscess pus or blood. Abscess also more painful and swollen.
- Easiness of emptying. Swelling around the area, pus, possibly fistula.
- Color and consistency of the content.
- Presence of pus or blood in secrete.
- Complaints, appearance, content.
- Contents of the anal sac.
- Abscess/inflammation often goes together.
- Pain, size.
- Contents: brown-black or yellow-flaky.
- X
- Idem.
- Presence of fistula.
- Abscess in case of enlargement and hardening of the wall, possibly broken through to the outside. Only impaction when wall feels normal.
- Normal anal fluid after expression.
- Size anal sac + content.
- Thickness of wall and possibly opening to the outside.
- The content.
- Not applicable.
- Painfulness/possibility to empty, nature content, painfulness.
- Not.
- The contents of the anal sac.
- De nature of the content.
- Color anal sac, painfulness during emptying, temperature anal sac, sometimes temperature cat
- Painfulness, content/consistency anal sac, temperature.
- Presence of draining fistula or sinus.
- Augmented consistency of the anal sac contents in case of impaction but absence of fever and collected purulent material.
- Like above with enlargement and/ eruption.
- Extraction easiness.
- More severe pain, presence of pus, anal fistula.
- Anal sac content.
- Abscess breaks through, and there is an inflammation so the treatment is different.

1.3 Treatment

Solutions used for flushing

Impaction	- Isotonic saline. - Isotonic saline. - Isotonic saline. - Isotonic saline. - Isotonic saline. - Chlorhexidine ointment dissolved with isotonic saline. - Isotonic saline.
Inflammation	- Isotonic saline. - Water. - In chronic cases isotonic saline. - Isotonic saline. - Isotonic saline. - Isotonic saline. - Diluted povidone-iodine. - Povidone-iodine solution. - Isotonic saline. - Isotonic saline. - 0.5% povidone-iodine. - Chlorhexidine ointment dissolved with isotonic saline. - Isotonic saline.
Abscess	- Isotonic saline. - Water. - Isotonic saline. - Isotonic saline and betadine solution. - Isotonic saline. - Ringer, leave behind Dermiel. - Chlorhexidine. - Only flush at the location of the abscess with green Biotex. - Povidone-iodine solution. - Isotonic saline. - Sometimes flush with isotonic saline. - Povidone-iodine solution. - Isotonic saline, possibly with chlorhexidine. - Isotonic saline. - Isotonic saline. - Isotonic saline. - 0.5% povidone-iodine solution. - Chlorhexidine diluted 0.05%.

Local antibiotics

Impaction	- Local ab: amoxicillin.
Inflammation	- Silver Sulfadiazine ointment. - Duplocillin locally or chloramphenicol. - Chloramphenicol or Surolan. - Chloramphenicol ointment. - Surolan. - Chloramphenicol. - Chloramphenicol ointment. - Amoxicillin. - Chloramphenicol. - Like above and repeat after 3 d (above = chlorhexidine ointment dissolved with isotonic saline).
Abscess	- Chloramphenicol. - Duplocillin. - Chloramphenicol ointment. - Chloramphenicol. - Chloramphenicol. - Amoxicillin. - Chloramphenicol. - Chloramphenicol.

Systemic antibiotics

Impaction	
Inflammation	- Spiramycin-metronidazole. - Metronidazole. - Amoxicillin-clavulanic acid. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Metronidazole. - Spiramycin-metronidazole when accepted. - Spiramycin-metronidazole. - Spiramycin-metronidazole.

	- Spiramycin-metronidazole. - Spiramycin-metronidazole, NSAIDs. - Metronidazole. - Spiramycin-metronidazole. - Metronidazole.
Abscess	- Spiramycin-metronidazole. - Amoxicillin-clavulanic acid. - Spiramycin-metronidazole. - Metronidazole. - Amoxicillin-clavulanic acid. - Spiramycin-metronidazole. - Metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Preferably spiramycin-metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Metronidazole or amoxicillin-clavulanic acid. - Spiramycin-metronidazole. - Metronidazole. - Amoxicillin-clavulanic acid 12.5 mg/kg. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Metronidazole. - Spiramycin-metronidazole. - Amoxicillin-clavulanic acid. - Spiramycin-metronidazole. - Metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole. - Spiramycin-metronidazole, NSAID. - Metronidazole. - Spiramycin-metronidazole. - Clindamycin. - Spiramycin-metronidazole. - Only if fever. - Amoxicillin-clavulanic acid five days + NSAIDs.

Type of treatment depends on the severity of the condition:	
Impaction	- Flushing depends on this + recurrence/no recurrence. - In case of complaints empty manually. - When the cat can manage it by itself through good stool (e.g. after diarrhea), the cat will be able to empty the sacs by itself. If not, and when the anal sacs are inflamed, then empty the sacs manually if necessary and give antibiotics.
Inflammation	- Sometimes treatment with metronidazole. - Empty the sacs if possible and systemic ab (spiramycin-metronidazole) and NSAIDs. - Antibiotics: spiramycin-metronidazole. - Possibly systemic antibiotics. - How often does it return? - NSAIDs if necessary. - Possibly painkillers. - Painkillers such as meloxicam. - In case of severe inflammation, otherwise only empty the sacs. - NSAIDs.
Absces	- The above depends on severity, recurrence, etc. - If it is possible administer AB locally, this is preferable to oral and NSAID. - Open and flush. If fever then briefly oral antibiotics. - How often it occurs. - If necessary open the abscess, painkiller. - Painkillers such as meloxicam. - NSAIDs.

Type of treatment: ‘’Other’’	
Impaction	- NSAIDs.
Inflammation	- NSAIDs. - NSAIDs. - Check-up in one week. - Surgical removal in case of repeated recurrence. - NSAIDs. - Give NSAIDs.
Absces	- NSAIDs. - Drainage, flushing, and antibiotics only with fever (TMPS). - NSAIDs.

	- NSAIDs. - Painkillers and check-up in one week. - Flushing through the fistula channel, or open wound after opening. - Open the anal sac from the outside, if it can be done. - Surgically open the abscess when it is not fissured. - NSAIDs.

Difference between cat and dog treatment

Impaction	
Inflammation	- Cats get antibiotics right away. - Also flush both anal sacs in dogs. - Chloramphenicol locally and painkillers. - When severe itching or other itching complaints possibly Oclacitinib (Apoquel) and high fiber diet. - Start flushing sooner. - Same but also shower the area.
Absces	- Also flush both anal sacs in dogs. - Painkillers and metronidazole antibiotics. - In dogs I can flush the anal sacs easier without anesthesia. - In dogs, flushing the anal sacs more often. - Same but also shower the area.

Criteria of when to decide to surgically remove feline anal sacs

- Not. - In case of rapid or repeated recurrence. - Not yet executed in cats, but in dogs in case of regular recurrence (on average within every 2-3 months during 1 year) and if underlying causes cannot be traced or resolved. - Rarely. - A lot of recurrence. - We do not do it. - Often recurrence despite looking for underlying cause. - Never chosen to do it. - Never decided to do it. - Chronic problems that do not improve, but we are very reluctant. - In case of recurrent trouble. - Has not yet been the case. - In case of rapid recurrence and no response to different diet such as hypoallergenic diet. - No experience with it. - Never executed that before.

- Never experienced.
- In case of recurrent abscesses.
- Only if the cat has had an abscess/inflammation of the anal glands for 2 of more times in its life (never experienced this in a cat).
- When underlying factors have been tackled and adjusted nutrition has been started and when the complaint continues to recur.
- Has not yet been necessary.
- Has not yet been necessary.
- Never.
- Has not yet been necessary. But I would consider it in case of frequent recurrence.
- Never.
- If the underlying cause had been properly addressed and no difference has occurred.
- When a cat has continuous fistulas.
- Never.
- Has never been necessary.
- If the cats quality of life is impaired.
- In case of frequent recurrence (<2x per month).
- Never executed that before.
- Not applicable.
- Not yet applicable. I expect in case of recurrent serious complaints (very severe inflammation/abscess).
- Haven't had to think about it yet.
- In case of frequent recurrence or severe complaints and/or an untreatable cat.
- Never performed it before, but I think when antibiotics and meloxicam do not have any effect and problems remain after flushing the anal sacs under sedation.
- Never.
- Repeated problems, but try to avoid.
- No response to conservative treatment.
- In case of recurrence of abscess or inflammation and if underlying causes are excluded.
- Repeated problems recurring frequently.
- In case of recurrence of abscess, tumor.

Which surgical method do you use? ''Other'':

- Never executed before.
- Not applicable.
- Do not get operated.
- Not applicable.
- Outsourced.
- Never executed/proposed/needed before.
- Not applicable.

- Never executed before.
- Not applicable.
- Never executed before.
- Never executed.
- Not applicable.
- Never done myself.
- None, refer if necessary.
- Depends on the seriousness of the complaint.
- Not applicable.
- Not applicable.
- Never executed before.
- I would have to study on that, never performed.
- None.
- Leave it to the surgeon.
- I will forward it to the surgeon.

Short description of surgical method

- Empty the anal sac and then fill them with resin. Peel and remove using the closed technique.
- Not applicable.
- First medical treatment until recovered and in case of recurrence remove in consultation.
- Filling up with special anal gland paste and then the surgical closed method.
- A colleague does it.
- No.
- Not applicable.
- Not applicable, I would probably forward to the surgeon.
- No.
- Incision lateral to orifice of anal sac. Prepare the anal sac freely. Ligate duct with monocryl 4-0 and remove the sac. Stitch subcutis and cutis with monocryl 4-0/3-0.
- Not applicable.
- Cut from anal sac opening so that the inside is visible and then carefully dissect the sac. Then stitch in two layers.
- No.
- No, we do not do that here.
- Not applicable.
- Not applicable.
- No.
- Filling up, preparing, and removing of the anal gland.
- Unfortunately not. I would follow the instructions in the surgeon books.
- Anesthesia, fill the anal sac with synthetic resin or filler preparation, incision through the skin at the location of the anal sac, blunt preparation of the anal sac, removal of the gland, close the skin.

- Groove director to identify the sac, incision over the sac, dissection from surrounding tissues, duct ligation, and sac removal.
- The anal sacs are identified inserting a teflon IV catheter, then an incision parallel to the external anal sphincter is made on the sac. The sac is identified and isolated through dissection, then the duct is ligated and cut.
- Sterile preparation of surgical field incl. flushing anal sacs. Tampon in rectum and purse string suture. Inserting instrument in anal sac. Cutting open on top of it. Grasping sac with forceps and preparing it free sharp and stump from surrounding tissues close to the sac. Cutting duct and removing it. Checking for full removal Closure with monofilament resorbable suture muscle, subcutis, and skin intradermally.
- No idea.

Attachment 2: Remaining figures

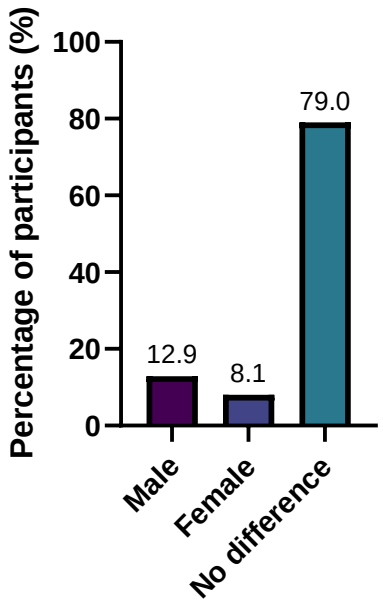


Fig. 33: Gender in which anal sac disease is most often observed (n=62).

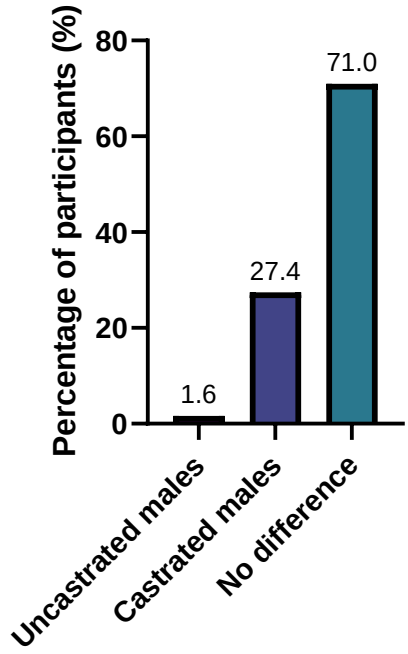


Fig. 34: Castrated versus uncastrated male cats and the occurrence of anal sac disease (n=62).

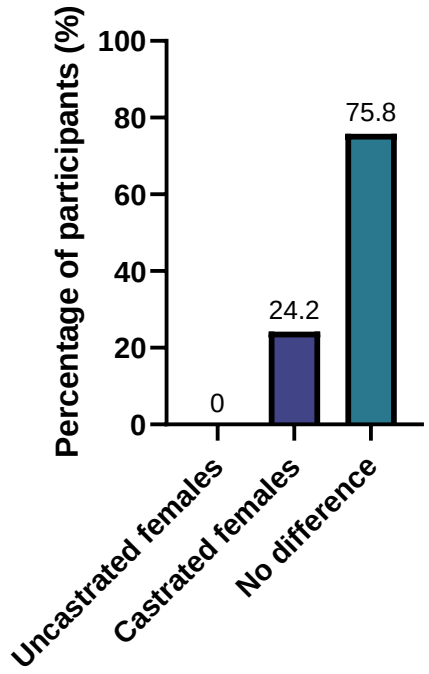


Fig. 35: Castrated versus uncastrated female cats and the occurrence of anal sac disease (n=62).

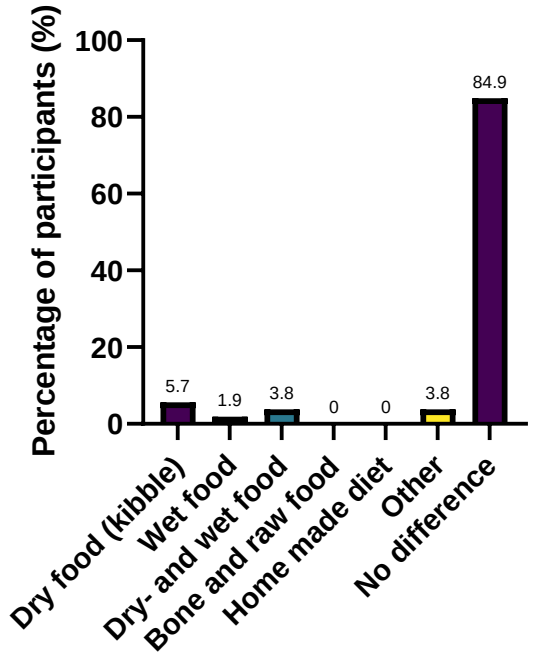


Fig. 36: Anal sac disease in combination with different types of diet in cats (n=53).

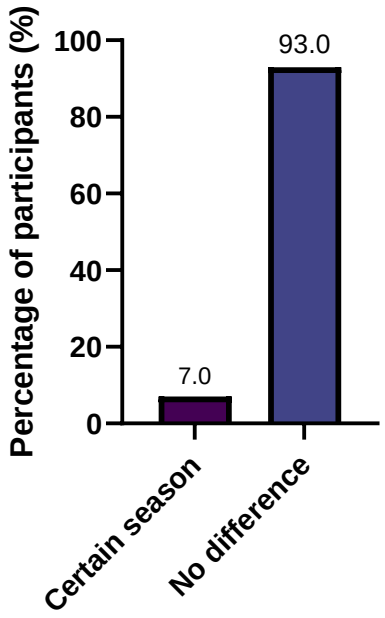


Fig. 37: Relation between anal sac disease and a certain season of the year (n=57).

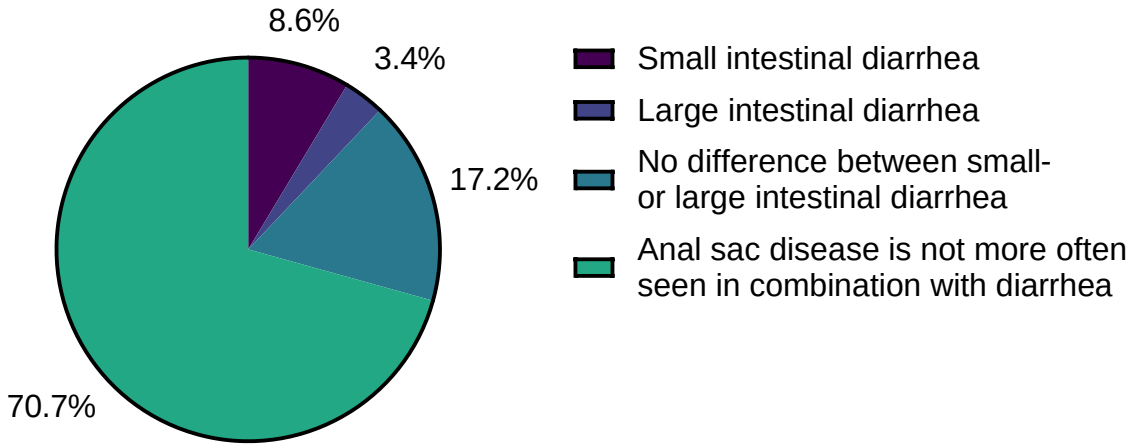


Fig. 38: Relation between anal sac disease and large/small intestinal diarrhea (in percentage of participants) (n=58).

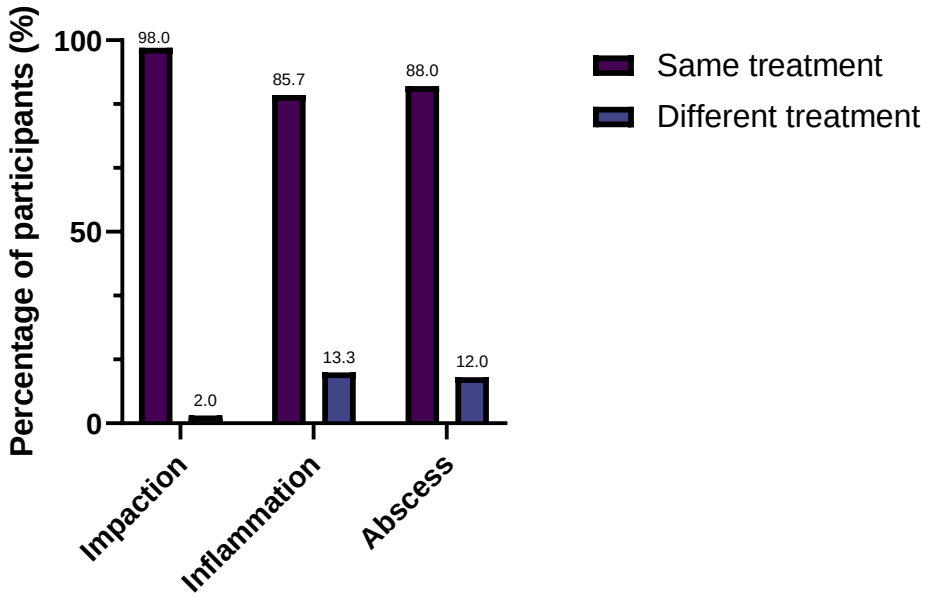


Fig. 39: Comparison of treatment of impaction, inflammation, and an abscess in cats and dogs (n=49).

Attachment 3: Survey concerning feline anal sac disease in Dutch

Deze enquête is gemaakt in het kader van een observationele studie aan de Universiteit Utrecht onder leiding van Dr. R.J. Corbee naar aandoeningen van de anaalzakken bij de kat. De gegevens zullen gebruikt worden om de prevalentie, predisponerende factoren, diagnose en behandeling van aandoeningen van de anaalzakken bij katten in kaart te brengen. Tevens is er momenteel eenzelfde enquête naar aandoeningen van de anaalzakken bij de hond.

Met het invullen van deze enquête helpt u om een beter beeld te krijgen van het voorkomen, de predisponerende factoren, de diagnose en de behandeling van deze aandoeningen bij katten.
De enquête bestaat uit meerkeuze- en open vragen. Elke pagina bevat maximaal 6 vragen. In totaal zijn er 9 pagina's. Tijdens de enquête is er de mogelijkheid om naar de vorige pagina terug te keren en uw antwoord te herzien.

Voor de kwaliteit van de resultaten van deze enquête, is het belangrijk dat u de enquête volledig en slechts éénmalig invult. Er zal zeer zorgvuldig om worden gegaan met uw persoonlijke gegevens en deze zullen na verwerking verwijderd worden. De enquête zal ongeveer tien tot vijftien minuten in beslag nemen.

Bij vragen of onduidelijkheden kunt u contact opnemen met Lianne van den Eijnde (e-mail: l.m.vandeneijnde@students.uu.nl tel: 06-40719016). Bij voorbaat dank voor uw deelname!

Prevalentie van aandoeningen van de anaalzakken bij de kat
In deze sectie worden vragen gesteld over de prevalentie van anaalzakaandoeningen bij de kat. Indien u de cijfers niet precies weet is een schatting ook voldoende.

1. Hoeveel katten heeft u in totaal behandeld in de afgelopen 4 jaar (tussen september 2017 en september 2020)?

2. Bent u werkzaam in een kattenkliniek/cat friendly kliniek?

- Ja
- Nee

3. Bij hoeveel katten heeft u in de afgelopen 4 jaar, tussen september 2017 en september 2020, een aandoening van de anaalzakken (overvulling, ontsteking of een abces) gediagnosticeerd?

4. Bij hoeveel katten heeft u in de afgelopen 4 jaar, tussen september 2017 en september 2020, een anaalzakovervulling gediagnosticeerd?

5. Bij hoeveel katten heeft u in de afgelopen 4 jaar, tussen september 2017 en september 2020, een anaalzakontsteking gediagnosticeerd?

6. Bij hoeveel katten heeft u in de afgelopen 4 jaar, tussen september 2017 en september 2020, een anaalzakabces gediagnosticeerd?

Predisponerende factoren voor aandoeningen van de anaalzakken bij de kat

In deze sectie worden vragen gesteld over predisponerende factoren voor aandoeningen van de anaalzakken bij de kat. Indien de door u ingevulde prevalentie van katten met anaalzakaandoeningen erg laag is, kunt u de vragen beantwoorden naar aanleiding van katten die u bent tegengekomen tijdens uw gehele carrière als dierenarts.

7. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij:

- Katers
- Poezen
- Geen verschil

8. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij:

- Ongecastreerde katers
- Gecastreerde katers
- Geen verschil

9. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij:

- Ongecastreerde poezen
- Gecastreerde poezen
- Geen verschil

10. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij:

- Jonge katten (<3 jaar)
- Volwassen katten (tussen de 3 en 10 jaar)
- Oude katten (>10 jaar)
- Geen verschil
- Anders, namelijk...

11. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij:

- Katten met obesitas (body condition score van: 7 of hoger op een 9 punts schaal / 4 of hoger op een 5 punts schaal)
- Katten zonder obesitas (body condition score van: 6 of lager op een 9 punts schaal / 3 of lager op een 5 punts schaal)
- Geen verschil

12. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij één of meerdere van de volgende rassen:

- [ ] Britse korthaar
- [ ] Europese korthaar
- [ ] Maine Coon
- [ ] Noorse boskat
- [ ] Pers
- [ ] Siamees
- [ ] Sphynx
- [ ] Anders, namelijk

☐ ⊗ Geen verschil

13. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij katten met een bepaald type vacht:

- ○ Korte vacht
- ○ Lange vacht
- ○ Haarloos
- ○ Anders, namelijk...
- ○ Geen verschil

14. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij katten op een dieet van voornamelijk:

- ○ Droogvoer (brokken), namelijk...
- ○ Natvoer, namelijk...
- ○ Een combinatie van droogvoer en natvoer, namelijk...
- ○ Rauwvoer (Bone And Raw Food), namelijk...
- ○ Zelfgekookt dieet
- ○ Anders, namelijk...
- ○ Geen verschil

15. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij katten in een bepaald seizoen:

- ○ Ja, namelijk...
- ○ Geen verschil

16. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij katten met een huidaandoening, zoals:

- ☐ De aanwezigheid van ectoparasieten (vlooien, luizen, mijten, teken)
- ☐ Vlooienbeetovergevoeligheid of vlooienallergie
- ☐ Voedselovergevoeligheid of voedselallergie
- ☐ Contactallergie
- ☐ Overgevoeligheid voor een insectenbeet, namelijk...
- ☐ Atopie
- ☐ Malassezia dermatitis
- ☐ Primaire superficiële pyodermie
- ☐ Anders, namelijk...
- ☐ ⊗ Geen verschil

17. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij katten met een maag- darmaandoening, zoals?

- ☐ Virale of bacteriële enteritis
- ☐ Worminfectie
- ☐ Gastritis

- [ ] Voedselovergevoeligheid
- [ ] Neoplasieën
- [ ] Anders, namelijk...
- [ ] ⊗ Geen verschil

18. U ziet vaker een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij katten met diarree:

- ○ Ja, namelijk bij dunne darm diarree
- ○ Ja, namelijk bij dikke darm diarree
- ○ Ja, maar geen verschil tussen dunne- of dikke darm diarree
- ○ Nee

Diagnose

In deze sectie worden vragen gesteld over de criteria waarop de diagnose van een aandoening van de anaalzakken bij de kat is gebaseerd.

19. De symptomen die u waarneemt bij een kat met een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces), is/zijn:
Meerdere antwoorden mogelijk.

- [ ] Het veelvuldig likken of bijten van de anusregio
- [ ] Het veelvuldig likken of bijten van de staartregio
- [ ] Staartjagen
- [ ] Sleetje rijden
- [ ] Het schuren van de anusregio tegen objecten
- [ ] Discomfort bij het gaan zitten
- [ ] Perianale uitvloeiing
- [ ] Tenesmus
- [ ] Anders, namelijk...

20. Het criterium of de combinatie van criteria waarop uw diagnose van een aandoening van de anaalzakken (zoals overvulling, ontsteking of een abces) bij de kat is gebaseerd, is/zijn:
Meerdere antwoorden mogelijk.

- [ ] De aanwezigheid van één of meerdere van de volgende klinische symptomen: het veelvuldig likken of bijten van de anusregio/staart regio, sleetje rijden, staartjagen, tenesmus, het schuren van de anusregio tegen objecten, discomfort bij het gaan zitten en/of perianale uitvloeiing
- [ ] Het formaat van de anaalzak
- [ ] De consistentie van de anaalzak
- [ ] De vorm van de anaalzak
- [ ] De temperatuur van de anaalzak
- [ ] De kleur van de anale regio
- [ ] Pijn bij palpatie van de anaalzak
- [ ] Het gemak waarmee de anaalzak leeggeknepen kan worden
- [ ] De hoeveelheid anaalzakinhoud

☐ De consistentie van de anaalzakinhoud

☐ De aard van de anaalzakinhoud

☐ De kleur van de anaalzakinhoud

☐ De geur van de anaalzakinhoud

☐ De lichaamstemperatuur

☐ Het reageren op de thermometer

☐ Microscopisch onderzoek van de anaalzakinhoud (onder andere de aanwezigheid van bacteriën, de hoeveelheid bacteriën en de aanwezigheid van polymorfkernige leukocyten en/of erytrocyten)

☐ Anders, namelijk...

21. Het onderscheidt tussen een anaalzakovervulling en een anaalzakontsteking bij de kat, maakt u op basis van:

22. Het onderscheidt tussen een anaalzakontsteking en een anaalzakabces bij de kat, maakt u op basis van:

23. Het onderscheidt tussen een anaalzakovervulling en een anaalzakabces bij de kat, maakt u op basis van:

Behandeling

In deze sectie worden vragen gesteld over de behandeling van een aandoening van de anaalzakken bij de kat.

24. Wat is de behandeling die u instelt bij katten met een anaalzakovervulling?
Meerdere antwoorden mogelijk.

☐ Niets/geen behandeling

☐ Het leegknijpen van beide anaalzakken

☐ Het spoelen van beide anaalzakken, met...

☐ Het achterlaten van een lokaal antibioticum (zalf) in de anaalzakken, namelijk...

☐ Een systemisch antibioticum voorschrijven, namelijk...

☐ Het operatief verwijderen van de anaalzakken

☐ Het behandelen van een eventuele, onderliggende oorzaak

☐ Dit hangt af van de ernst, namelijk...

☐ Anders, namelijk...

25. Wat is de behandeling die u instelt bij katten met een anaalzakontsteking?
Meerdere antwoorden mogelijk.

☐ Niets/geen behandeling

☐ Het leegknijpen van beide anaalzakken

☐ Het spoelen van beide anaalzakken, met...

☐ Het achterlaten van een lokaal antibioticum (zalf) in de anaalzakken, namelijk...

☐ Een systemisch antibioticum voorschrijven, namelijk...

☐ Het operatief verwijderen van de anaalzakken

☐ Het behandelen van een eventuele, onderliggende oorzaak

☐ Dit hangt af van de ernst, namelijk...

☐ Anders, namelijk...

26. Wat is de behandeling die u instelt bij katten met een anaalzakabces?
Meerdere antwoorden mogelijk.

☐ Niets/geen behandeling
☐ Het leegknijpen van beide anaalzakken
☐ Het spoelen van beide anaalzakken, met...
☐ Het achterlaten van een lokaal antibioticum (zalf) in de anaalzakken, namelijk...
☐ Een systemisch antibioticum voorschrijven, namelijk...
☐ Het operatief verwijderen van de anaalzakken
☐ Het behandelen van een eventuele, onderliggende oorzaak
☐ Dit hangt af van de ernst, namelijk...
☐ Anders, namelijk...

27. Wordt dezelfde behandeling toegepast bij een hond met een anaalzakovervulling?

○ Ja
○ Nee, namelijk...

28. Wordt dezelfde behandeling toegepast bij een hond met een anaalzakontsteking?

○ Ja
○ Nee, namelijk...

29. Wordt dezelfde behandeling toegepast bij een hond met een anaalzakabces?

○ Ja
○ Nee, namelijk...

30. Wanneer besluit u tot verwijdering van de anaalzakken bij de kat?

31. Welke methode gebruikt u bij het operatief verwijderen van de anaalzakken bij de kat?

☐ Open methode
☐ Gesloten methode
☐ Anders, namelijk...

32. Kunt u een korte omschrijving geven van hoe u deze methode uitvoert?

Effect van de behandeling

In deze sectie worden vragen gesteld over het effect van de behandeling van een aandoening van de anaalzakken bij de kat.

33. Bij hoeveel katten met een aandoening van de anaalzakken (overvulling, ontsteking of abces) is er een recidief na de behandeling geweest in de afgelopen 4 jaar (tussen september 2017 en september 2020)?

34. Bij hoeveel katten met een anaalzakovervulling is er een recidief na de behandeling geweest in de afgelopen 4 jaar (tussen september 2017 en september 2020)?

35. Bij hoeveel katten met een anaalzakontsteking is er een recidief na de behandeling geweest in de afgelopen 4 jaar (tussen september 2017 en september 2020)?

36. Bij hoeveel katten met een anaalzakabces is er een recidief na de behandeling geweest in de afgelopen 4 jaar (tussen september 2017 en september 2020)?

37. Op welke termijn treedt er gemiddeld een recidief op na behandeling van een aandoening van de anaalzakken (overvulling, ontsteking of abces) bij katten?

38. Op welke termijn treedt er gemiddeld een recidief op na behandeling van een anaalzakovervulling bij katten?

39. Op welke termijn treedt er gemiddeld een recidief op na behandeling van een anaalzakontsteking bij katten?

40. Op welke termijn treedt er gemiddeld een recidief op na behandeling van een anaalzakabces bij katten?

Tot slot

In deze sectie kunt u aangeven of u de eindresultaten van dit onderzoek wilt ontvangen en of u nog opmerkingen of aanvullingen heeft voor deze enquête. Ook vragen we u wanneer u afgestudeerd bent en of u wilt deelnemen aan de enquête over de hond.

41. Heeft u nog opmerkingen, aanvullingen of tips om deze enquête te verbeteren?

42. Wilt u het eindverslag met daarin de resultaten van dit onderzoek ontvangen?

- Ja, mijn e-mailadres is...
- Nee bedankt

43. In welk jaar bent u afgestudeerd?

44. In welk land bent u werkzaam?

Naast dit onderzoek over aandoeningen van de anaalzakken bij de kat, onderzoeken we ook hetzelfde probleem bij de hond. Zou u ook deel willen nemen aan deze enquête? U zou ons er erg mee helpen!

U kunt deze link kopiëren: https://survey.uu.nl/jfe/form/SV_3QVpb7czG47zdwF

Attachment 4: Survey concerning feline anal sac disease in English

This survey is made as part of an observational study on anal sac disease in the cat at the University of Utrecht, supervised by Dr. R.J. Corbee. The data will be used to determine the prevalence and predisposing factors and to clarify how the diagnosis is made and which therapy is used in several types of anal sac disease of the cat. There is also a similar survey concerning anal sac disease in the dog. With completing this survey, you are contributing to a better understanding of the prevalence, predisposing factors, diagnosis and therapy of this disease in cats.

The survey consists of multiple choice questions and descriptive questions. Each page contains a maximum of six questions and the survey has a total of ten pages. During the survey it is possible to return to the previous page to review your answer. For the quality of the survey, it is important that you make sure to answer all of the questions completely and that you fill in the survey only once. Your personal data will be handled with great care and will be deleted after processing the data. The survey will take approximately ten to fifteen minutes.

If you have any questions or if anything is unclear, please contact Lianne van den Eijnde (e-mail: l.m.vandeneijnde@students.uu.nl tel: +31 640719016).

Thank you in advance for your participation!

Section 1. Prevalence of anal sac disease in the cat

In this section, questions will be asked about the prevalence of anal sac disease in the cat. If you do not know the exact numbers, an estimation can be made.

1. How many cats did you treat in the last 4 years (between September 2017 and September 2020)?

2. Do you work in a cat clinic / a cat friendly clinic?

- Yes
- No

3. How many cats did you diagnose with anal sac disease (impaction, inflammation or an abscess) in the last 4 years (between September 2017 and September 2020)?

4. How many cats did you diagnose with an anal sac impaction in the last 4 years (between September 2017 and September 2020)?

5. How many cats did you diagnose with an anal sac inflammation in the last 4 years (between September 2017 and September 2020)?

6. How many cats did you diagnose with an anal sac abscess in the last 4 years (between September 2017 and September 2020)?

Predisposing factors for anal sac disease in the cat

In this section, questions will be asked about predisposing factors for anal sac disease in the cat. In case the prevalence of cats with anal sac disease in the previous section is very low, you can answer the following questions based on all of the cats with anal sac disease that you have encountered during your entire career as a veterinarian.

7. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in:

- Male cats
- Female cats
- No difference

8. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in:

- Uncastrated male cats
- Castrated male cats
- No difference

9. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in:

- Uncastrated female cats
- Castrated female cats
- No difference

10. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in:

- Young cats (<3 year)
- Mature cats (between 3 and 10 years)
- Old cats (>10 years)
- No difference
- Other, please specify: …

11. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in:

- Obese cats (body condition score of: 7 or higher on a 9 point scale / 4 or higher on a 5 point scale)
- Non-obese cats (body condition score of: 6 or lower on a 9 point scale / 3 or lower on a 5 point scale)
- No difference

12. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in certain breeds, such as:

- [ ] British shorthair
- [ ] European shorthair
- [ ] Maine Coon
- [ ] Norwegian forest cat
- [ ] Persian cat
- [ ] Siamese
- [ ] Sphynx

☐ Other, please specify: ...

☐ ⊗ No difference

13. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in cats with a certain type of coat, such as:

○ Short coat

○ Long coat

○ Hairless

○ Other, please specify: ...

○ No difference

14. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in cats on a certain type of diet, such as:

○ Dry food (kibble), namely...

○ Wet food, namely...

○ A combination of dry- and wet food, namely...

○ BARF: bone and raw food, namely...

○ Home made diet

○ Other, please specify: …

○ No difference

15. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in cats in a certain season:

○ Yes, namely...

○ No difference

16. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in cats with a skin condition, such as:

☐ The presence of ectoparasites (flea, lice, mites, ticks)

☐ Flea hypersensitivity or flea allergy dermatitis

☐ Cutaneous adverse food reaction or food allergy

☐ Allergic contact dermatitis

☐ Hypersensitivity induced by insect bites, namely…

☐ Atopic dermatitis

☐ Malassezia dermatitis

☐ Primary superficial pyoderma

☐ Other, please specify: …

☐ ⊗ No difference

17. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in cats with a gastrointestinal condition, such as:

- [ ] Viral or bacterial enteritis
- [ ] Worm infection
- [ ] Gastritis
- [ ] Cutaneous adverse food reaction
- [ ] Neoplasia
- [ ] Other, please specify: …
- [ ] ⊗ No difference

18. Anal sac disease (such as impaction, inflammation or an abscess) is more often seen in cats with diarrhea:

- ○ Yes, namely in small intestinal diarrhea
- ○ Yes, namely in large intestinal diarrhea
- ○ Yes, but no difference in small- or large intestinal diarrhea
- ○ No

Diagnosis

In this section, questions will be asked about the criteria on which the diagnosis of anal sac disease in the cat is based.

19. The symptoms(s) that can be observed in a cat with anal sac disease (such as impaction, inflammation or an abscess), is/are:
Multiple answers possible.

- [ ] Frequently licking or biting the anal region
- [ ] Frequently licking or biting the tail region
- [ ] Tail chasing
- [ ] Scooting
- [ ] Rubbing the anal area against objects
- [ ] Discomfort when sitting down
- [ ] Perianal discharge
- [ ] Tenesmus
- [ ] Other, please specify: ...

20, The criterion or the combination of criteria on which your diagnosis of anal sac disease (such as impaction, inflammation or an abscess) in the cat is based, is/are:
Multiple answers possible.

- [ ] The presence of one or more of the following clinical symptoms: licking or biting the anal area frequently, scooting, tail chasing, tenesmus, rubbing the anal area against objects, discomfort when sitting down and/or perianal discharge
- [ ] The size of the anal sac
- [ ] The consistency of the anal sac

- [ ] The shape of the anal sac
- [ ] The temperature of the anal sac
- [ ] The color of the anal area
- [ ] The presence of pain in palpation of the anal sac
- [ ] The ease by which the anal sac can be emptied
- [ ] The amount of the anal sac contents
- [ ] The consistency of the anal sac contents
- [ ] The nature of the anal sac contents
- [ ] The color of the anal sac contents
- [ ] The smell of the anal sac contents
- [ ] The body temperature
- [ ] The reaction on inserting the thermometer
- [ ] Microscopic examination of the anal sac contents (including the presence of bacteria, the amount of bacteria and the presence of polymorphonuclear leukocytes and/or erytrocytes)
- [ ] Other, please specify...

21. The distinction between anal sac impaction and anal sac inflammation in the cat, is based on:

22. The distinction between anal sac inflammation and an anal sac abscess in the cat, is based on:

23. The distinction between anal sac impaction and an anal sac abscess in the cat, is based on:

Treatment

In this section questions will be asked about the treatment of anal sac disease in the cat.

24. What treatment do you give cats with anal sac impaction?
Multiple answers possible.

- [ ] Nothing/no treatment
- [ ] Emptying the anal sacs by manual evacuation
- [ ] Flushing the anal sacs, using…
- [ ] Putting a local antibiotic (ointment) in the anal sacs, namely...
- [ ] Prescribing a systemic antibiotic, namely…
- [ ] Surgical removal of the anal sacs
- [ ] Treating a potential, underlying cause
- [ ] This depends on the severeness of the condition, namely...
- [ ] Other, please specify: ...

25. What treatment do you give cats with anal sac inflammation?
Multiple answers possible.

- [ ] Nothing/no treatment
- [ ] Emptying the anal sacs by manual evacuation
- [ ] Flushing the anal sacs, using…
- [ ] Putting a local antibiotic (ointment) in the anal sacs, namely...
- [ ] Prescribing a systemic antibiotic, namely…
- [ ] Surgical removal of the anal sacs
- [ ] Treating a potential, underlying cause
- [ ] This depends on the severeness of the condition, namely...
- [ ] Other, please specify: ...

26. What treatment do you give cats with an anal sac abscess?
Multiple answers possible.

- [ ] Nothing/no treatment
- [ ] Emptying the anal sacs by manual evacuation
- [ ] Flushing the anal sacs, using…
- [ ] Putting a local antibiotic (ointment) in the anal sacs, namely...
- [ ] Prescribing a systemic antibiotic, namely…
- [ ] Surgical removal of the anal sacs
- [ ] Treating a potential, underlying cause
- [ ] This depends on the severeness of the condition, namely…
- [ ] Other, please specify: ...

27. Do you apply the same treatment in a dog with anal sac impaction?

- ○ Yes
- ○ No, please specify: ...

28. Do you apply the same treatment in a dog with anal sac inflammation?

- ○ Yes
- ○ No, please specify: ...

29. Do you apply the same treatment in a dog with an anal sac abscess?

- ○ Yes
- ○ No, please specify: ...

30. When do you decide to surgically remove the anal sacs of a cat?

31. What method do you use for the surgical removal of the anal sacs of a cat?

- [ ] Open method
- [ ] Closed method
- [ ] Other, please specify: ...

32. Can you please give a short description on how you perform this method?

Section 5. Effectiveness of the treatment

In this section, questions will be asked about the effectiveness of the treatment of anal sac disease in the cat.

33. How many cats with anal sac disease (such as impaction, inflammation of abscess) have relapsed after treatment in the last 4 years (between September 2017 and September 2020)?

34. How many cats with anal sac impaction have relapsed after treatment in the last 4 years (between September 2017 and September 2020)?

35. How many cats with anal sac inflammation have relapsed after treatment in the last 4 years (between September 2017 and September 2020)?

36. How many cats with an anal sac abscess have relapsed after treatment in the last 4 years (between September 2017 and September 2020)?

37. On average, in what time frame does a relapse occur after the treatment of an anal sac disease (such as impaction, inflammation or abscess) in cats?

38. On average, in what time frame does a relapse occur after the treatment of an anal sac impaction in cats?

39. On average, in what time frame does a relapse occur after the treatment of an anal sac inflammation in cats?

40. On average, in what time frame does a relapse occur after the treatment of an anal sac abscess in cats?

Section 6. In conclusion

In this final section you can specify whether you would like to receive the end results of this research and you can share any comments or recommendations for this survey. Furthermore, we ask you when you graduated, in which country you work and whether you would like to participate in the survey for the dog.

41. Do you have any comments, recommendations or tips to improve this survey?

42. Would you like to receive the final report, including the results of this study?

- Yes, this is my e-mail address: …
- No thanks

43. In which year did you graduate?

44. In which country do you work?

45. In addition to this study on anal sac disease in the cat, there is also a similar study on anal sac disease in the dog. Would you also like to participate in this survey? You would help us out a lot!
You can copy this link: https://survey.uu.nl/jfe/form/SV_7PYNb4lGxRlABmZ

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