Understanding segmental eosinophilic colitis in the Swedish horse population

Clinical presentation, prevalence and survival rate

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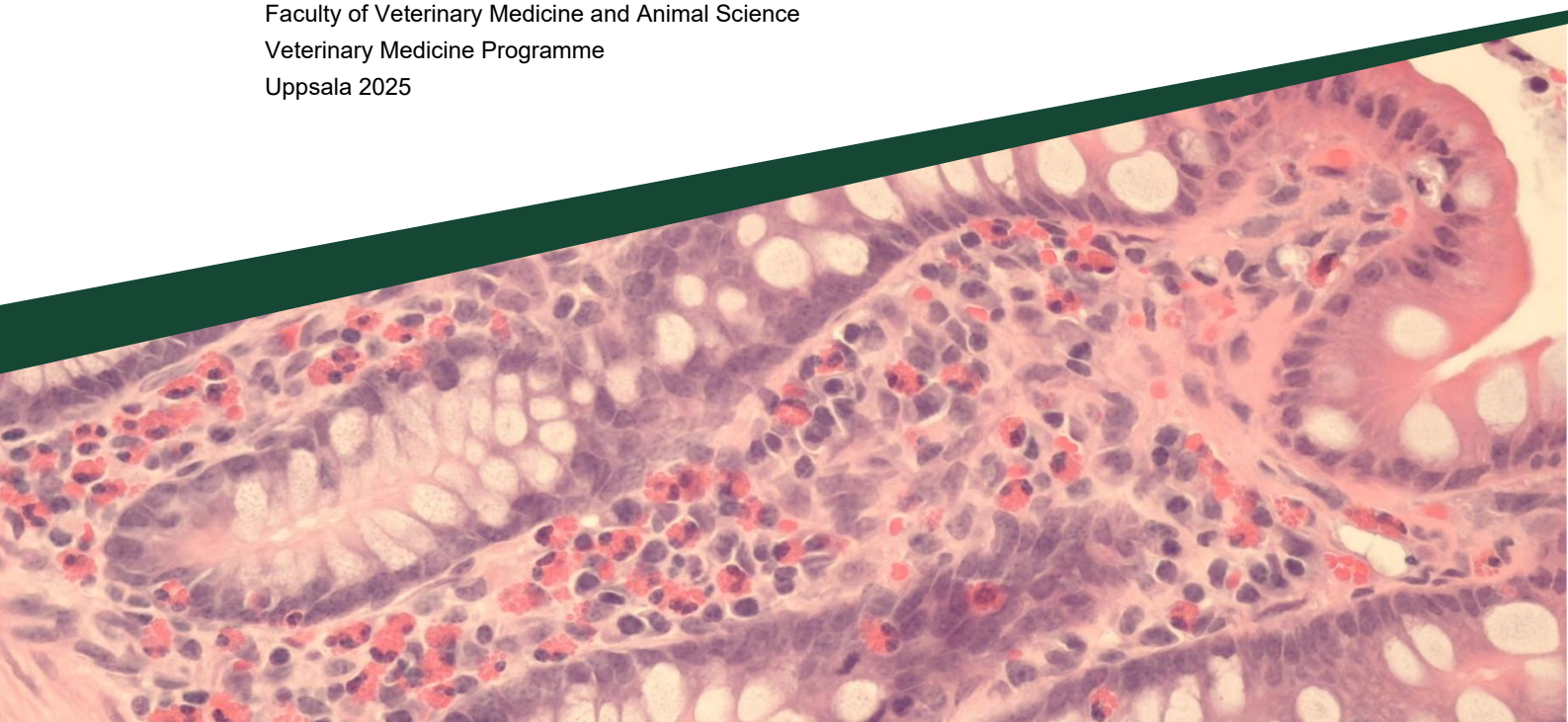

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Understanding segmental eosinophilic colitis in the Swedish horse population - clinical presentation, prevalence and survival rate

Segmentell eosinofil kolit hos svenska hästar - klinisk presentation, prevalens och överlevnad

Matilda Persson

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Keywords:	SEC, colon resection, non-strangulating intestinal infarction, *Strongylus vulgaris*

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Abstract

This study aimed to investigate cases of segmental eosinophilic colitis (SEC) in a Swedish horse population, focusing on clinical parameters and results of diagnostic tests (blood tests, analysis of abdominal fluid, and rectal examination) prior to surgical intervention. Additionally, the prevalence of SEC in a Swedish horse population was estimated and survival rates were projected. Histological findings of SEC were analysed in comparison to other studies of non-strangulating intestinal infarctions (NSII).

Cases of SEC were identified retrospectively using clinical records from three equine clinics in Sweden. Owners of discharged horses were contacted to gather information about their horse long-term survival.

The majority of horses with SEC exhibited moderate colic symptoms, with over half suspected of having intestinal displacement. Abdominal paracentesis revealed peritonitis with a mean white blood cell count (WBC) of 156 × 10^9/L (±SD 158.3) and a mean total protein concentration of 37.7 g/L (±SD 14.5). Intraoperative findings included thickening of the colon wall, primarily in the pelvic flexure or left dorsal colon (LDC), with hyperaemic or necrotic/ulcerated serosa. Histopathology revealed eosinophilic inflammation, extending to the mesentery and regional lymph nodes. Notably, the histological features shared similarities with NSII.

The prevalence of SEC among surgically treated colic cases was estimated at 2.0% (range 0.8–4.3%). Short-term survival rates were 59% from induction to discharge and 72% from recovery to discharge. The long-term survival rate from discharge to one year post-surgery was 87.5%.

In conclusion, no specific pre-surgical indicators could predict SEC, but clinical signs and elevated peritoneal fluid total protein suggest the need for surgery. The short-term survival rates following colon resection due to SEC in this study are comparable to other studies on colon resection in general. Additionally, the long-term survival rates remain comparable to other studies on colon resection. Since NSII and SEC share many similarities, further research is needed to determine whether SEC is a phenotype of *Strongylus vulgaris* migration.

Keywords: SEC, colon resection, non-strangulating intestinal infarction, *Strongylus* v*ulgaris*

Sammanfattning

Denna studie syftade till att undersöka fall av segmentell eosinofil kolit (SEC) hos svenska hästar, med fokus på beskrivning av kliniska parametrar och resultat från diagnostiska tester (blodprov, analys av peritonealvätska samt rektalundersökning) före kirurgisk intervention. Dessutom uppskattades prevalensen överlevnadsdata för SEC i en svensk hästpopulation. Histologiska fynd vid SEC jämfördes med tidigare studier av icke-strangulerande tarminfarkter (NSII).

Fall av SEC studerades retrospektivt via journaler från tre hästkliniker i Sverige. Ägare till utskrivna hästar kontaktades för att samla information om deras hästs överlevnad efter operationen.

Majoriteten av hästarna med SEC uppvisade måttliga koliksymtom, där mer än hälften misstänktes ha någon typ av grovtarmsfelläge. Vid abdominocentes uppvisade ett genomsnittligt antal vita blodkroppar (WBC) på 156 × 10⁹/L (SD 158,3) och en genomsnittlig total proteinkoncentration på 37,7 g/L (SD 14,5). Makroskopiska fynd inkluderade förtjockning av kolonväggen, främst i flexura pelvina eller vänstra dorsala kolon (LDC), med hyperemisk eller nekrotisk/ulcererade serosa. Histopatologi visade eosinofil inflammation, i vissa fall utsträckt till mesenteriet och regionala lymfknutor. Noterbart var att de histologiska egenskaperna liknade NSII.

Prevalensen av SEC bland kirurgiskt behandlade kolikfall uppskattades till 2,0 % (område 0,8–4,3 %). Överlevnaden på kort sikt var 59% från induktion till utskrivning och 72 % från uppvak till utskrivning. Överlevnaden på lång sikt från utskrivning till ett år efter kirurgi var 87,5 %.

Sammanfattningsvis finns det inga specifika förkirurgiska indikatorer som förutsäger SEC, men kliniska tecken och förhöjd total proteinkoncentration i peritonealvätska kan indikera på behovet av kirurgi. Kortsiktig överlevnad efter kolonresektion på grund av SEC i denna studie är jämförbar med andra studier om kolonresektion i allmänhet. Dessutom förblir de långsiktiga överlevnadsgraderna jämförbara med andra studier om kolonresektion. Eftersom NSII och SEC delar många likheter behövs ytterligare forskning för att avgöra om SEC är en fenotyp av *Strongylus vulgaris* migration.

Nyckelord: SEC, kolonresektion, icke-strangulerande tarminfarkt, *Strongylus vulgaris*

Declarations

Ethics approval and consent to participate

All patient and owner data were managed in accordance with relevant guidelines and regulations.

Artificial intelligence

I wish to inform that ChatGPT, an AI-based language service developed by OpenAI, was used in this work for translation and grammar verification. The results have been manually reviewed to ensure accuracy.

Originality

This is entirely my own work, except where otherwise acknowledged.

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Abbreviations

Abbreviation	*Description*
CRT	Capillary refill time
DEE	Diffuse eosinophilic enteritis
DEEC	Diffuse eosinophilic enterocolitis
EDCI	Idiopathic eosinophilic diseases confined to the intestine
EE	Eosinophilic enterocolitis
EGID	Eosinophilic gastrointestinal disorders
EID	Eosinophilic intestinal disease
ELISA	Enzyme-linked immunosorbent assay
ESHS	Evidensia Specialisthästsjukhuset Strömsholm
GE	Granulomatous enterocolitis
HR	Heart rate
IBD	Inflammatory bowel disease
IFEC	Idiopathic focal eosinophilic colitis
IFEE	Focal (or multifocal) eosinophilic enteritis
LDC	Left dorsal colon
LTS	Long-term survival
LVC	Left ventral colon
MEED	Multisystemic, eosinophilic, epitheliotropic disease
MHK	Mälaren Equine Clinic
NSII	Non-strangulating intestinal infarction
OLTS	Overall long-term survival
OR	Operating room
OSTS	Overall short-term survival
PCR	Polymerase chain reaction
PM	Postmortem
RDD	Right dorsal displacement
SD	Standard Deviation
SEC	Segmental eosinophilic colitis
SLU	Swedish University of Agricultural Sciences, Uppsala
STS	Short-term survival
UDS	SLU University Animal Hospital, Uppsala
WBC	White blood cell count

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1. Introduction

Segmental eosinophilic colitis (SEC) is described as a focal inflammation predominant in the wall of the left dorsal colon and the pelvic flexure in horses (Edwards *et al.* 2000). It is characterized by a local lesion with oedema, hyperaemia, serosa petechias and in some cases necrosis. The inflammation often results in a secondary partial obstruction of the pelvic flexure which can be found during rectal examination (Theoret *et al.* 1993; Edwards *et al.* 2000; Someshwar 2016). If not treated the inflammation could be life threatening due to leakage from the lesion, or in worst cases rupture of the colon wall (Sanchez 2018).

Due to the predilection sites of SEC, there are many similarities with non-strangulating intestinal infarctions (NSII) caused by Strongylus vulgaris migration (Pihl *et al.* 2018). Studies suggest that changes in peritoneal fluid, such as a high white blood cell count (WBC) and increased total protein levels, may correlate with SEC, NSII and idiopathic peritonitis (Theoret *et al.* 1993; Edwards *et al.* 2000; Pihl *et al.* 2018; Odelros *et al.* 2019; Hedberg-Alm *et al.* 2022). In Sweden, where idiopathic peritonitis occurs, it can be challenging to differentiate if surgery is needed. Accurate diagnosis is crucial to provide the right conditions for affected horses, as the prognosis with only medical treatment varies between idiopathic peritonitis and SEC or NSII (Edwards *et al.* 2000; Odelros *et al.* 2019; Hedberg-Alm *et al.* 2022).

The aetiology of SEC is unknown, but suggestions include parasitic involvement, allergy, medical treatment (nonsteroidal anti-inflammatory drugs, NSAIDs) or part of a multisystemic disease (Theoret *et al.* 1993; Edwards *et al.* 2000). The strongest suspicion at this point is infection with migrating *Strongylus vulgaris* (Theoret *et al.* 1993; Schumacher & Legere 2018), but no significant evidence has yet been found (Edwards *et al.* 2000; de Bont *et al.* 2013; Someshwar 2016).

Currently there is one case series and two case reports written about SEC (Theoret *et al.* 1993; Edwards *et al*. 2000; Someshwar 2016). The case series describes SEC as a novel finding during colic surgery in 1992 (Edwards *et al.* 2000). Since only case series/reports are specifically written about SEC, more information about this disease could help clinical veterinarians identify these cases earlier and provide horse owners with a more accurate prognosis.

The aim of this study is to describe the clinical presentation and laboratory parameters before surgical intervention in a population of horses with confirmed SEC. Furthermore, the study will identify the prevalence of SEC in a Swedish horse population and the survival rate compared to other studies of SEC and NSII. Lastly, the study will discuss the histological findings related to SEC compared to NSII.

2. Literature review

2.1 Anatomy of the colon

The colon wall is composed of four main layers: the mucosa, the submucosa, the muscularis and the outer lining serosa (Liebich & König 2020). The mucosa consists of three layers: an epithelial lining closest to the lumen, beneath which lies the lamina propria composed of connective tissue, and a third thin layer of muscle cells, the lamina muscularis mucosae (Figure 1). The submucosa consists of connective tissue, blood and lymphatic vessels. The muscularis layer consists of two muscular layers, the inner layer which is orientated in a circular pattern and the outer layer which is orientated longitudinally along the intestine.

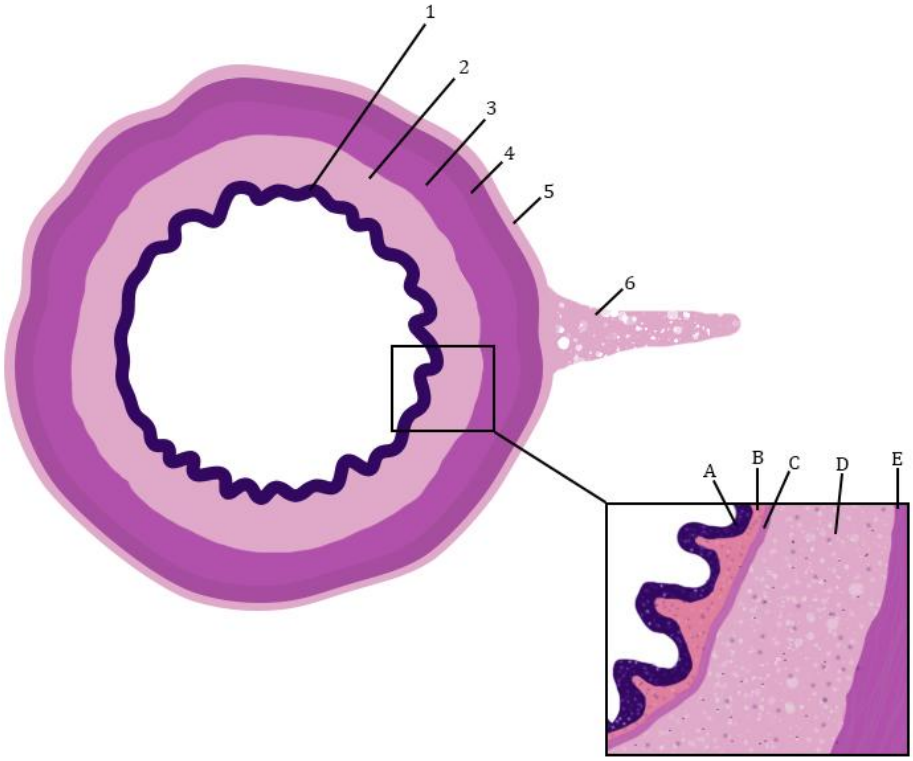

Figure 1. Schematic illustration of the colon of the horse. 1. Mucosa 2. Submucosa 3. Inner circular muscle layer 4. Outer longitudinal muscle layer 5. Serosa 6. Colon mesentery A. Epithelial lining of mucosa B. Lamina propria C. Muscular layer of the mucosa D. Submucosa E. Inner circular muscular layer. Illustration by: Matilda Persson

2.2 Immunology of the intestine

The immune response in the intestine needs to be precisely regulated, keeping a balance between inflammation and barrier repair together with elimination of pathogens and tolerance of the normal microbiota (Perkins 2016; Sanchez 2018). The enteric nervous system plays a partial role in regulating inflammation in the intestine. It involves triggering mast cells and neutrophil migration (Sanchez 2018). If the balance is disturbed it can lead to an overreaction causing cell or tissue damage, ulcer formation, infiltration of inflammatory cells and villous atrophy.

In order to keep potential pathogens located in the intestine from entering the host, the gastrointestinal epithelium consists of an apical cellular membrane with intercellular tight junctions lined with mucus (Sanchez 2018). The mucus layer together with the epithelium activates the immune response. Depending on the type of pathogen triggering the activation different responses occur.

2.2.1 Normal distribution of eosinophils in the intestines

In many animal species, small amounts of eosinophils are located in the gastro-intestinal tract, reproductive tract and thymus (Blanchard & Rothenberg 2009; Brosnahan 2020). However, in horses, it seems that the distribution within the equine intestine differs from other mammals, with increased eosinophilic count in both the mucosa and submucosa (Rooney *et al.* 1966; Meschter *et al.* 1986 see Sanchez 2018). The total distribution of eosinophils varies throughout the horse's gastrointestinal system, with highest numbers in the caecum and ascending colon and lowest numbers in stomach and small intestine (Rocchigiani *et al.* 2022). The uneven distribution of eosinophils may be explained by a larger parasitic load found in the large intestine compared to other parts of the gastrointestinal tract.

2.2.2 Eosinophils in immune response

Eosinophils are granular cells that, upon degranulation, exhibit cytotoxic effects against parasites and allergens (Felippe 2016). Studies also show that eosinophils might play a broader role in immune responses than previously thought (Rötting *et al.* 2008; Blanchard & Rothenberg 2009; Brosnahan 2020). In people and rodents, eosinophils also play an important role in viral infections, especially with RNA viruses as well as in fungal infections where they bind to the fungal wall (Blanchard & Rothenberg 2009).

In a study involving experimentally induced ischemia in the colon, the total number of eosinophils decreased (Rötting *et al.* 2016). When ischemia persisted for one hour, no significant changes in the distribution were observed. In contrast, if ischemia persisted for two hours, a notable transition in eosinophil localization to the luminal side was noted. When the tissue was reperfused, the eosinophil count

did not increase but the shift to the luminal side was more notable. As seen in the experimental cases of ischemia (two hours), the same shift of distribution was observed in cases with naturally occurring volvulus of the colon (Rötting *et al.* 2016).

Eosinophils are generally associated with allergies or parasitic infections (Ross & Pawlina 2016; Mescher 2018). One study has evaluated the eosinophilic response in the intestinal mucosa during infection with *S. vulgaris* and examined it histologically (Rötting *et al.* 2008). Mucosal samples were collected from ponies in a parasite-free environment, as well as from horses experimentally infected with *S. vulgaris*, both before and after deworming. The study showed no significant changes in eosinophilic presentation in the mucosa between helminth-naïve ponies and experimentally infected horses (with L3 larvae). However, in two horses where small strongyles were encysted, a local eosinophilic response was found. One important thing to keep in mind is that its only the mucosa studied in the aforementioned study.

2.3 Eosinophilic intestinal diseases

2.3.1 Classification

There is no definitive consensus on the classification of inflammatory gastrointestinal diseases in horses. Authors have proposed different approaches, classifying these diseases based on clinicopathological (Schumacher & Legere 2018) and histopathological characteristics (Timko 2024).

There are several proposed general terms for inflammatory intestinal diseases. The term inflammatory bowel disease (IBD) is often used as the general term in which eosinophilic gastrointestinal diseases are included, see Figure 2 (Timko 2024). However, Makinen *et al.* (2008) suggests the term eosinophilic gastrointestinal disorders (EGID) as an alternative to IBD, since IBD is specifically used for ulcerative colitis and Crohn's disease in human medicine (Reggiani Bonetti *et al.* 2021). Another systematic classification, proposed by Schumacher and Legere (2018) uses the term eosinophilic intestinal disease (EID) as a more encompassing general term (Figure 3). In none of these studies were non-strangulating intestinal infarctions (NSII) mentioned. This is likely due to it being classified as an acute infarction resulting from vasculitis rather than an inflammatory process which is the case with eosinophilic intestinal diseases.

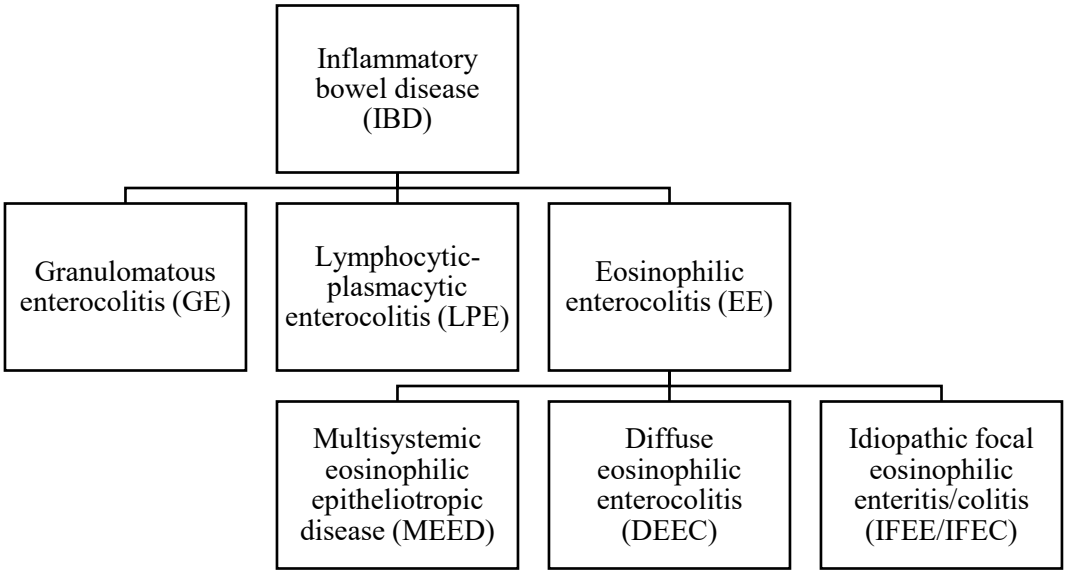

Figure 2. Classification of inflammatory gastrointestinal diseases based on histopathological characteristics. Illustration by Matilda Persson based on Timko (2024).

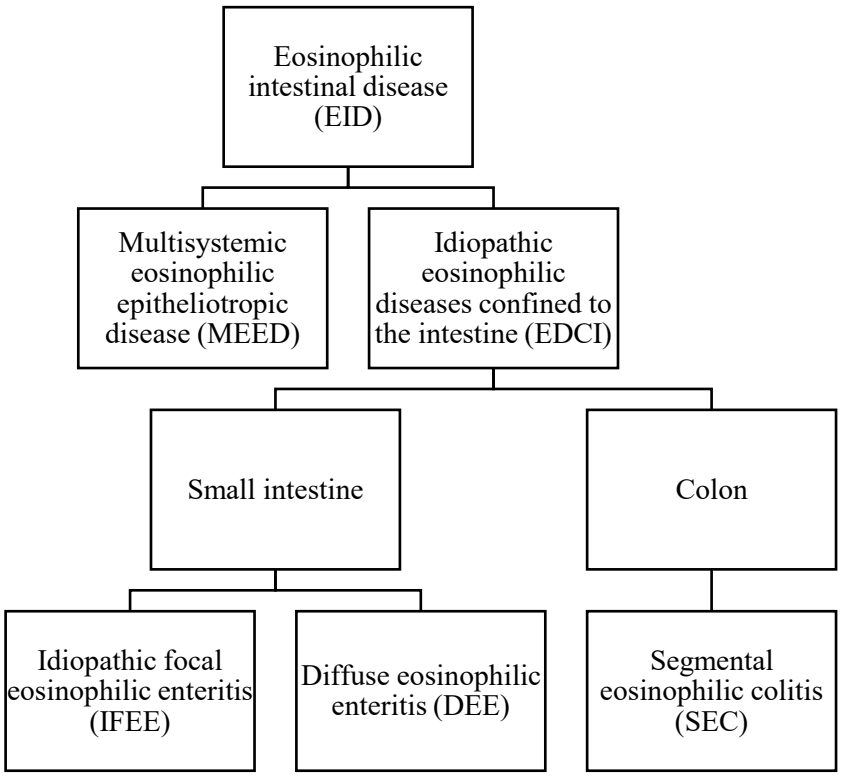

Figure 3. Classification of inflammatory gastrointestinal diseases based on clinicopathological characteristics. Illustration by Matilda Persson based on Schumacher & Legere (2018).

2.3.2 Diagnosis

To definitely diagnose SEC, exploratory laparotomy is necessary to biopsy the affected intestine and perform histological examination (Edwards *et al.* 2000; Makinen *et al.* 2008; Sanchez 2018). To put a horse under general anaesthesia is always a risk (Gozalo-Marcilla *et al.* 2021), therefore other parameters need to be evaluated first to select appropriate candidates. Parameters that can indicate that surgical intervention in a colic patient is necessary include abnormal rectal examination, changes in peritoneal fluid and/or unresponsive abdominal pain (Marshall & Blikslager 2019; Hedberg-Alm *et al.* 2022).

Changes in peritoneal fluid, both the gross appearances as well as its composition and leukocyte count, can provide valuable insights into the functional status of the abdominal organs. Gross appearance of normal peritoneal fluid is often transparent with a hint of yellow to orange (Brownlow *et al.* 1981; Radcliffe *et al.* 2022), in contrast to cloudy, serosanguinous or dark coloured peritoneal fluid that may indicate intestinal pathology (Sanchez 2018; Radcliffe *et al.* 2022). The first sign of intestinal ischemia is increased total protein because of leakage of albumin due to higher endothelial permeability (Sanchez 2018). If the ischemia persists, the endothelial permeability increases, and bigger molecules like fibrinogen starts to leak and can be detected in the peritoneal fluid (Sanchez 2018). Lactate in peritoneal fluid is another molecule that increases when tissue hypoxia persists and can be detected earlier in peritoneal fluid than in serum (Latson *et al.* 2005). Lactate can therefore also be an indicator if strangulating intestinal obstruction occurs (Latson *et al.* 2005).

When it comes to cells in peritoneal fluid, neutrophils and macrophages constitute the majority of cells in normal peritoneal fluid (Mair *et al.* 2002). In the early state of ischemia, red blood cells are the first to leak from the affected vessels (Radcliffe *et al.* 2022). White blood cells on the other hand, especially neutrophils, are recruited later in the inflammatory process when the mucosa degenerates due to ischemia, and bacteria as well as bacterial toxins leak from the intestinal lumen (Radcliffe *et al.* 2022). Neutrophils are primarily responsible for making the peritoneal fluid cloudy (ibid). Eosinophils are either absent or present in low numbers in normal peritoneal fluid (Brownlow *et al.* 1981). Therefore, a differential leukocyte count with increased number of eosinophils could indicate an eosinophilic lesion (Theoret *et al.* 1993).

2.4 Segmental eosinophilic colitis

The earliest article written about SEC, as a separate disease, is a case report from Canada describing a case of a 7-year-old thoroughbred with severe colic where exploratory laparoscopy was performed (Theoret *et al.* 1993). A case series was

then published in 2000, describing the condition in 22 horses. The horses had impactions in the pelvic flexure due to an intramural lesion in the left dorsal colon (Edwards *et al.* 2000). In both articles, these lesions are described as a novel finding.

2.4.1 Clinical findings

Horses with SEC tend to present at the clinic with colic signs rather than diffuse symptoms, such as malabsorption or wasting that is often seen with other inflammatory intestinal diseases (Sanchez 2018; Timko 2024). In the study by Edwards *et al.* (2000), the horses presented with colic and a mean duration of 29.5 hours prior to admission and a range from five to 120 hours. The colic signs were mild to moderate, responded temporarily to analgesia and the horses had tachycardia with a mean heartrate of 52 beats/min. A majority of the cases had normal mucus membranes and normal capillary refill time (CRT).

It has been suggested that rectal examination and paracentesis are the best diagnostic tools to identify these cases prior to surgery (Edwards *et al*. 2000). During rectal examination, the findings usually involve distension of the colon and a soft to moderate impaction in the pelvic flexure and left ventral colon (ibid).

The peritoneal fluid may have elevated protein levels and increased WBC from 10.3 to 250 x 10^9/L where neutrophils represent the largest proportion (Theoret *et al.* 1993; Edwards *et al.* 2000). A WBC count higher than 100 × 10^9/L was observed in six horses, and four of them had a history of colic lasting longer than 48 hours. However, horses presenting with colic for the same duration could exhibit a WBC count of 35 x 10^9/L. The highest cell count was found in a horse with colic lasting for 18 hours. In addition to the elevated total cell count, if a differential WBC count is performed, increased amounts of eosinophils might be detected (Theoret *et al.* 1993). The appearance of the peritoneal fluid varies in turbidity and colour, from yellow to orange (Edwards *et al.* 2000; Timko 2024).

2.4.2 Gross appearance of lesion

The overall gross appearance during surgery includes a segmental lesion with mural oedema and discoloration, particularly in the left dorsal colon near the pelvic flexure (Theoret *et al.* 1993; Edwards *et al.* 2000). The oedema of the intestinal wall in one study was up to 25mm and had a gelatinous consistency (Edwards *et al.* 2000). In the same study serosal changes were found in at least one part of the left dorsal colon in 20 of the 22 cases, varying from petechiation to larger areas of erythema and well-defined area of serosal necrosis. Four horses also had oedema and subserosal haemorrhage in the surrounding mesocolon.

The mural lesion in cases with SEC often partially occludes the lumen of the intestine which results in a mild to moderate impaction oral to the lesion (Edwards *et al*. 2000; Someshwar 2016). The severity of the occlusion caused by the mural lesion was evaluated following enterotomy to resolve the impaction (Edwards *et al*. 2000). In 16 cases partial colon resection of the left dorsal colon was necessary due to the severity of occlusion, where the length of resection varied from 12-65 cm. In the same study, there was one case where colic had persisted for five days resulting a severe necrotic inflammation of the colon wall, leading to severe peritonitis. Consequently, the horse had to be euthanized during surgery.

2.4.3 Histological findings

The histological findings vary between cases, however, an eosinophilic infiltrate, submucosal oedema, lymphatic dilatation, thrombosis and fibrinous exudate were generally observed (Edwards *et al.* 2000). Mucosal necrosis occurred in eight cases, and in the other cases, a range from mucosal erosion to full thickness necrosis with ulceration were observed. The eosinophilic infiltration was located to the submucosa and serosa together with oedema, it was also observed in the muscular layer in more severe cases. External muscle layers of the intestine were, in most cases, intact, with the inflammation primarily affecting the mucosa or serosa. Less common findings included submucosal fibroplasia and granulation tissue, along with fibrinous exudate and muscular necrosis of the external layer. Additional frequent findings were basophilic structures around the submucosal arterioles.

The transition between the macroscopic lesion and normal tissue could also be histologically observed as a sharp border (Edwards *et al.* 2000). However, one case that was euthanized post-surgery due to mild colic was found to have eosinophilic infiltration in the lamina propria and submucosal oedema distant from the anastomosis (Edwards *et al.* 2000). This could indicate a more widespread eosinophilic inflammation in the intestine.

2.4.4 Aetiology

Why these types of intestinal lesions occur in horses is not yet fully understood. There are multiple hypotheses, such as parasitic involvement, medical treatment (NSAIDs) and generalized immune mediated disease (Theoret *et al.* 1993; Edwards *et al*. 2000). Even though there is no established underlying cause, Shumacher and Legre (2018) indicate that idiopathic focal eosinophilic enteritis (IFEE), diffuse eosinophilic enteritis (DEE) and SEC might be different manifestations of the same disease.

Parasites

One hypothesis is that SEC is an atypical presentation caused by a parasitic involvement like *S. vulgaris* (Theoret *et al.* 1993; Edwards *et al.* 2000). This was documented in the case report from 1993, where there was a strongyle found in the lesion together with fragments of nematode during histological examination (Theoret *et al.* 1993). In the study by Edwards *et al.* (2000) there was one case observed with asteroid bodies/Splendore-Hoeppli phenomenon. This phenomenon is a histopathological finding characterized by eosinophilic infiltrates and unorganized material around a foreign body or infectious agent, such as helminths or fungi, forming a starlike structure (Gopinath 2018). These histological findings are suggestive of a parasitic aetiology (Theoret *et al.* 1993; Edwards *et al.* 2000). Given that there is only one case out of twenty-two with clear parasitic findings in the study by Edwards *et al.* (2000), further investigation regarding the aetiology is clearly needed.

Another intestinal lesion with similar predilection site is a non-strangulating infarction (NSII) (White 1981, see Pihl *et al.* 2018) which is the main differential diagnosis to SEC. NSII is caused by migrating *S. vulgaris* larvae and therefore interesting to compare with SEC. In NSII it is described that when strongyle larva migrates along the vessels, inflammation leads to a decreased or obstructed circulation to the intestine (Pihl *et al.* 2018). This presentation of NSII shares similarities with SEC regarding the inflamed vessels where thrombi formation is seen histologically (Edwards *et al.* 2000; Hedberg-Alm *et al.* 2022).

There are different diagnostic tools to diagnose a horse infected with *S. vulgaris*. These include larval cultures, polymerase chain reaction (PCR) analysis of faecal samples and enzyme-linked immunosorbent assay (ELISA) performed on blood for detection of *S. vulgaris* antibodies (Nielsen *et al.* 2008, 2016).

The overarching problem to diagnose horses with *S. vulgaris* is during the phase of larval migration. The larvae causing the inflammation do not reproduce until six months after infection and that means eggs won't be detectable in faeces at the time of disease and therefore faecal samples will not be able to be used as a diagnostic tool (Duncan & Dargie 1975; Theoret *et al.* 1993). Another problem with faecal samples is the risk of low sensitivity when low numbers of eggs are retrieved (Nielsen *et al.* 2008). However, PCR analysis is reported to have higher sensitivity than faecal egg counts and culturing for morphological identification (Nielsen *et al.* 2008). With ELISA, on the other hand, antibodies associated with *S. vulgaris* migration are detected in blood, suggesting alternative possibilities for detecting the presence of *S. vulgaris* (Nielsen *et al.* 2016; Pihl *et al.* 2018). The sensitivity and specificity of ELISA has been determined to be 73% and 81% respectively in horses with migrating *S. vulgaris* (Andersen *et al*. 2013). The high presence of

antibodies in the Swedish horse population (Hedberg-Alm *et al.* 2020), raises the question of possible cross-reaction to Cyathostominae. Another problem with antibody detection is that the antibodies persist up to months after infection (Nielsen *et al*. 2016). Regardless, given how common antibody presence is, the possibility of persisting antibodies, and the rarity of both SEC and NSII, the specificity of the ELISA test for diagnosing these diseases is likely very low.

Medical treatment

Lesions in the colon could be a result of NSAID treatment, a condition called right dorsal colitis. As the name indicates, it is primarily the right dorsal colon that is affected in this disease (Flood *et al*. 2023). The location of the lesions, together with the lack of previous treatment with NSAID in the reported cases of SEC, indicate that right dorsal colitis is unlikely to be the aetiology (Edwards *et al.* 2000; Someshwar 2016).

Generalized disease

Another hypothesis is that SEC could be part of a generalized eosinophilic disease. However, there is today none or little evidence of multisystemic involvement, as the condition appears localised to the intestine, and surgical intervention generally results in a favourable outcome (Theoret *et al.* 1993; Edwards *et al.* 2000).

Allergy

In humans, eosinophilic gastrointestinal conditions might be caused by allergy together with genetic components (Schumacher & Legere 2018). In horses no evidence of allergic aetiology to SEC has been reported, but there are no specific studies on the topic (Theoret *et al.* 1993; Edwards *et al.* 2000).

2.4.5 Treatment

Surgery

The reported treatment for SEC involves laparotomy, with partial colon resection and end-to-end or side-to-side anastomosis, depending on the location and length of the resected segment (Edwards *et al.* 2000). The protocol used by Edwards *et al.* (2000) also involved lavage of the abdomen with warm Hartmann's solution and intraperitoneal antibiotics (penicillin, gentamicin, and metronidazole). In the same study, colon resection was not performed in five cases due to the viability of the intestine, but the author suggests that resection should be routinely performed because of the risk of complications seen in unpublicised cases. Of the five cases where intestinal resection was not performed, four horses survived for more than two years after surgery and one horses was euthanized within a year due to recurrent colic.

Medication management following surgery

Post-operative treatment following colon resection due to SEC consists of broad-spectrum antibiotics (penicillin and gentamicin) and flunixin meglumine (Theoret *et al.* 1993; Edwards *et al.* 2000; Someshwar 2016).

Glucocorticoid s have not been reported for the treatment of SEC (Theoret *et al.* 1993; Edwards *et al.* 2000; Someshwar 2016), although glucocorticoids are used to treat other inflammatory gastrointestinal diseases (Impellizzeri *et al.* 2019). However, in one case of idiopathic focal eosinophilic enteritis (IFEE), dexamethasone was used when complete resection of all lesions was not possible (Archer *et al.* 2006).

Food and water regiment

In two reports water was offered directly to the horses upon their return to the stable, but food was withheld until 24 - 48 hours post-surgery, then increased gradually (Edwards *et al.* 2000; Someshwar 2016). Bertone (1989) on the other hand, suggested that feed can be introduced 12 hours post-surgery. However, the importance of considering the patient's history is emphasised and may indicate a need for a delayed introduction. The recommended feed to start the introduction includes laxatives, such as mash and soaked pellets (Bertone 1989).

2.4.6 Prevalence

There are no studies, to this authors knowledge, which have investigated the prevalence of SEC in an equine population. The fact that SEC has not been thoroughly investigated and that there are few studies on the subject suggests that the disease is likely rare, or that it is not well recognized and is therefore classified as something else.

2.4.7 Survival

An established treatment for irreversible colon injuries is partial large colon resection and anastomosis (Bertone 1989). This treatment is also proposed to be routinely performed in cases of SEC, although five cases have reported successful outcomes without resection (Edwards *et al.* 2000). Since SEC is a relatively recent finding and there are a limited number of studies on the topic, survival rates have not been specifically investigated. Although, compared to other eosinophilic gastrointestinal disorders, SEC is thought to have a better prognosis (Sanchez 2018). Short-term survival rates (recovery to discharge) after large colon resection due to a variety of lesions has been reported as 53-81%, depending on the length of resection; the lower percentage corresponding to a larger amount of intestine resected (Bertone 1989; Ellis *et al.* 2008; Pezzanite & Hackett 2017). The same short-term survival rate was seen in the study by Edwards *et al.* (2000), where 18

out of 22 (81%) horses diagnosed with SEC were discharged from the clinic after surgery. However, resection was not performed in all cases (five were left un resected); of the 16 cases where resection was performed, 13 survived until discharge. Of the four horses euthanized at the clinic, one was euthanized on the operating table due to a poor prognosis, one after surgery at the owner's request, one due to a post-operative fracture in the recovery stall, and one due to persistent abdominal pain unresponsive to treatment 12 days after surgery. Of the 18 horses discharged, all were still alive at least three months post-surgery.

In a Swedish study exploring the outcome of 137 abdominal surgery cases at UDS, six cases involved large intestinal resection, none of which survived until discharge (Förander 2024). Three of these six cases are horses also included in this study since the same clinic and years were studied.

2.5 Non-strangulating intestinal infarctions

Non-strangulating intestinal infarctions (NSII) are a differential diagnosis to SEC. The accepted aetiology of NSII is infection with *S. vulgaris* larvae resulting in segmental infarctions of the pelvic flexure (Pihl *et al.* 2018; Hedberg-Alm *et al.* 2022). The larvae migrate from the intestinal lumen to the intima of intestinal arterioles, triggering an inflammatory response with infiltration of inflammatory cells, haemorrhage and oedema (Sanchez 2018; Hedberg-Alm *et al.* 2022). This inflammation can lead to intestinal ischemia, resulting from either thrombosis or fibrotic constriction of the arterioles (Sanchez 2018).

Most horses with NSII exhibit clinical signs such as colic and fever, although these symptoms are also common signs in cases with idiopathic peritonitis (Hedberg-Alm *et al.* 2022) and SEC (Edwards *et al.* 2000), making differential diagnosis a challenge. During rectal examination, it's sometimes possible to palpate a mass in the colon wall of the pelvic flexure or the mesenteric artery, which may help identify candidates for surgical intervention (Pihl *et al.* 2018; Sanchez 2018; Hedberg-Alm *et al.* 2022). Seasonal factors should also be considered, as NSII cases have been reported to be more prevalent during the winter months (Hedberg-Alm *et al.* 2022; Poulsen *et al.* 2023). Faecal analysis has limited value for diagnosing *S. vulgaris* in early stages due to non-reproductive larvae and ELISA testing for antibodies against migrating larvae has also limited value due to high population prevalence, with low diagnostic specificity for intestinal disease (Theoret *et al.* 1993; Nielsen *et al.* 2016; Sanchez 2018; Tydén *et al.* 2019).

The typical histological findings in cases with NSII consists of a well-defined area of transmural necrosis together with vasculitis and perivasculitis, typically located in the region of the pelvic flexure or a nearby area (Pihl *et al.* 2018; Hedberg-Alm *et al.* 2022). Endarteritis affecting the cranial or caudal mesenteric roots and/or

major mesenteric branches are also typical findings as well as thrombus formation. It is also common with varying degrees of eosinophilic infiltration (Hedberg-Alm *et al.* 2022).

3. Material and methods

A retrospective study of horses with SEC was conducted at three of Sweden's large animal hospitals, SLU University Animal Hospital (UDS) Equine clinic, Evidensia Specialisthästsjukhuset Strömsholm (ESHS) and Mälaren Equine Clinic (MHK) between the years 2008 and 2024.

3.1 Inclusions criteria

3.1.1 SEC diagnosis

The study population included horses in Sweden presented to one of three horse clinics, listed above, with colic signs and that underwent laparotomy during their stay or that after euthanasia were sent for postmortem (PM) examination. Specific inclusion criteria were horses that were diagnosed with a segmental eosinophilic colitis at surgery or at PM, confirmed by histological examination of affected tissue and were older than one year of age at admission. Horses with NSII or a diffuse eosinophilic infiltration of the gastrointestinal tract were excluded.

3.1.2 Prevalence calculations

Case selection for prevalence calculations was based on cases recorded in the surgical logbooks at UDS, ESHS and MHK. Included cases were those involving laparotomy performed for colic, originating from the gastrointestinal tract, including both acute and planned surgeries. Excluded cases were, for example, laparotomy due to abdominal puncture injury, abdominal abscess, uterine torsion and dystocia.

3.2 Case selection

The study years varied between the clinics depending on the ability to find surgical logbooks. At UDS, the years studied were between January 2020 and October 2024, at ESHS, between January 2008 and October 2024 and at MHK, between January 2014 and August 2024. Patient records were collected from the medical record systems as stated below.

At UDS, cases were collected from the medical record system Provet cloud. The diagnosis codes that were used to search in Provet cloud, included the pathological diagnosis codes "DTC04 eosinofil kolit/tyflit" and "DTC06 eosinofil granulomatous" together with pyrimidine diagnosis code "DB.06.01.08.03.03 - eosinofil kolit". Additionally, cases were identified in Provet cloud by searching laboratory referral texts for phrases such as "eosinophilic colitis", "eosinofil kolit" and

”eosinofil”. These cases were later compared to the surgical logbooks between 2021 and 2024.

At MHK, cases were collected by searching in FileMaker for patient records containing the text “eosinophilic” or “eosinofil kolit”, as well as the diagnosis code for “eosinofil kolit”. It was possible to find patient records dating back to 2014 in the system.

At ESHS, cases were selected by going through the surgery logbook to find cases of laparotomy. The cases were further checked in Provet cloud if they matched the inclusion criteria. Due to the change of the medical record system, it was not possible to search using diagnostic codes, which is why all cases were reviewed manually. Cases were selected from 2008 to October 2024.

3.3 Data collection

The data collected from each patient record were age, breed and sex along with clinical and clinicopathological findings (Table 1). Abdominal pain was graded as mild, moderate or severe, based on the response to analgesia (metamizole, flunixin meglumine, butorphanol) combined with the assessment by the receiving veterinarian. If no grading was performed by the clinician and only metamizole or butorphanol was administered and the horse responded to this, the pain was graded as mild. The need for flunixin meglumine or a combination of more than one analgesic agent indicated moderate pain, while severe pain was graded when there was insufficient response to treatment with pain relief or if colic signs re-ocurred too rapidly.

Table 1. Summary of the types of data obtained from the medical records of horses with SEC from three equine hospitals in Sweden.

Parameter	Description
Demographic data	Age, sex, breed
Medical history	Deworming history, abdominal pain (mild, moderate, severe), duration of abdominal pain,
Admission data	Clinic of admission, date of admission, season, heart rate, body temperature, rectal findings,
Laboratory data	Blood: Haematocrit, total protein (TP) Peritoneal fluid: Appearance, white blood cell count (WBC), TP, lactate
Hospital data	Heart rate, body temperature, date of exploratory laparotomy, location of lesion and length, method of anastomosis, short-term complications, surgical outcome, discharge date, pathology and necropsy reports, revisit/communication with owner after discharge

Short-term complications were classified into the following categories: post-operative colic, impaction, incisional complications, peritonitis, post-operative reflux, laminitis, and any other complications occurring from surgery to discharge. Post-operative colic was defined as requiring at least one dose of metamizole and/or being noted in the patient record. Impactions were identified if documented during rectal examination in the patient record. Post-operative reflux was categorized as the drainage of more than four litres of fluid via a nasogastric tube, or more than two litres at repeated intubation (Merritt & Blikslager 2008). Incisional complications included suture dehiscence and infections at the incision site, characterized by discharge persisting for more than 24 hours after surgery.

3.4 Histopathology

The histological examination of the samples was performed by the Swedish Veterinary Agency (SVA), BioVet AB and Department of Animal Biosciences, section of pathology at SLU.

3.5 Statistics

All statistics were calculated with the software R version 4.4.2 (R Core Team 2024). Descriptive statistics, including mean, median and standard deviation, were calculated for several variables to summarize the data distribution. These included age, heart rate, body temperature, blood parameters (haematocrit and total protein), peritoneal fluid parameters (total protein, lactate, and WBC) and the time spent at the clinic (from arrival to the hospital until surgery/discharge).

A generalized linear model (GLM) with logistic regression and a binomial family was applied to evaluate the association between the time (in days) from admission to surgery and the likelihood of survival to discharge. Missing data (NA) were excluded from the calculations, and the analysis was performed using the glm function in R.

Data visualization was performed using the ggplot2 package in R (Wickham 2016). This package was utilized to generate plots and histograms to summarize the data distribution.

3.6 Questionnaire

To assess long-term survival rates, the owners of horses discharged from the clinics were called or e-mailed and asked to answer questions from the questionnaire (Appendix 1 and 2). The questionnaire, written in Swedish, included questions if the horse was still alive or when it passed away, if it returned to its previous function and whether it experienced any subsequent colic episodes post-surgery.

4. Results

In total, 23 cases that underwent laparotomy due to colic or were examined postmortem matched the inclusion criteria between 2008-2024. This represented 9 out of 186 cases at UDS (2021 - oct 2024), 10 out of 427 cases at ESHS (2008 - oct 2024) and 4 out of 505 cases at MHK (2014 – nov 2024).

4.1 Demographic data

Age at the time of arrival ranged from one to 23 years, as shown in Figure 4, with a mean age of 13.7 years and a standard deviation (SD) of 5.2 years. At UDS, the mean age was 12.3 years (± SD 5.96), at ESHS it was 14.8 years (± SD 3.77), and at MHK it was 13.8 years (± SD 7.14). The distribution of sex and breed is presented in Table 2. Three out of 23 horses were of pony breed.

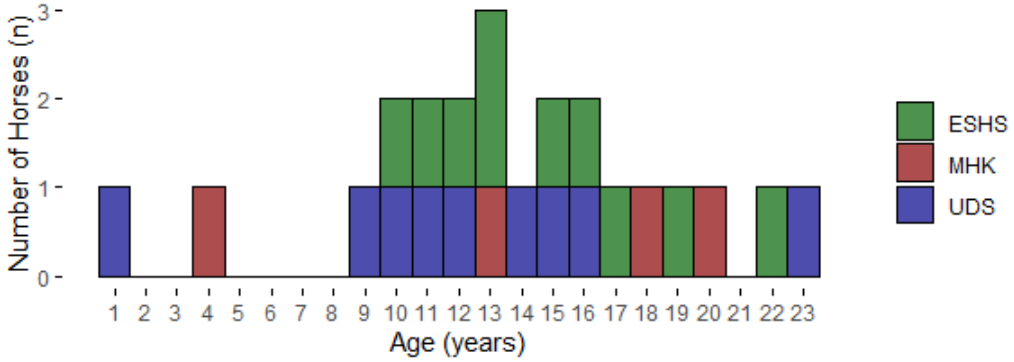

Figure 4. Age distribution of horses diagnosed with SEC from three equine hospitals in Sweden. The height of the bars represents the number of horses at each age, and the colour represents the clinic where the horse was treated. SLU University Animal Hospital (UDS), Evidensia Specialisthästsjukhuset Strömsholm (ESHS) and Mälaren Equine Clinic (MHK).

Table 2. Demographic data of 23 cases of SEC at three equine hospitals in Sweden summarised.

	Number of horses			
	Total	UDS	ESHS	MHK
Sex				
Mare	9	5	3	1
Gelding	13	3	7	3
Stallion	1	1	0	0
Breed				
English Thoroughbred	1		1	
Gotland Pony	2	1	1	
Holstein	1	1		
Icelandic Horse	1		1	
Lusitano	1			1
Northern Swedish Draft Horse	1	1		
PRE (Pura Raza Española)	1	1		
Paint Horse	1			1
SWB (Swedish Warmblood)	12	3	7	2
Standardbred	2	2		

4.2 Medical history, clinical presentation, and laboratory findings

Of the 23 horses admitted to the clinics, 17.4% exhibited mild colic signs, 56.5% showed moderate colic signs, and 21.7% presented with severe colic signs. Additionally, one horse (4.3%) showed no colic signs and only presented with fever at the time of admission. One case of the severe colic cases was euthanized in the ER due to a concurrent small intestinal strangulation. This horse was diagnosed at PM examination with SEC.

The duration of abdominal pain prior to admission was recorded for 21 patients, with the following distribution: 39.1% of cases experienced pain for less than 12 hours, 34.8% for 12 to 24 hours, and 21.7% for more than 24 hours. The mean heart rate (HR) and rectal temperature at admission were 48.0 beats/min (± SD 9.7) and 37.8 °C (± SD 0.9) respectively. Four out of ten horses for which information about rectal temperature at admission was available had a fever (>38.2°C).

The time from admission to surgery was documented in 21 of the 22 surgical cases seen in Table 3. . In the majority of cases, surgery was performed either immediately or the day after arrival at the clinic. The cases that were treated at the clinic for two days or longer prior to the surgery were all initially treated for idiopathic peritonitis with antibiotic. The cases that were treated for seven days or

longer did initially respond to the treatment but the condition aggravated again, necessitating surgical intervention.

Table 3. The number of days from arrival at the clinic until the time of surgical intervention in 21 cases of SEC at three equine hospitals in Sweden.

Days from arrival to surgery	Number of horses
0	8
1	7
2	1
3	1
4	1
5	0
6	0
7	1
8	1
9	1

Parasitic status was documented in the medical records for 10 of 23 horses. Three horses were previously identified as testing positive for the presence of *S. vulgaris* through routine faecal sampling prior to deworming. The point in time at which the horses were diagnosed with *S. vulgaris* was not recorded in the medical records.

Table 4. Blood and peritoneal fluid parameters in 23 horses diagnosed with SEC at three Swedish equine hospitals. Missing values were excluded in the calculations. SLU University Animal Hospital (UDS), Evidensia Specialisthästsjukhuset Strömsholm (ESHS), Mälaren Equine Clinic (MHK), standard deviation (SD), total protein (TP), White blood cell count (WBC)

	Number of	Mean (median)			
Parameter	horses	Overall	UDS	ESHS	MHK
Blood					
Haematocrit (%)	9	31.7 (33.0)	33.8 (33.5)	28.0 (27.0)	38.0 (38.0)
SD		4.9	1.7	4.9	-
TP g/l	9	67.4 (69)	71.0 (71)	63.3 (64)	70.0 (70)
SD		5.7	2.4	6.3	-
Peritoneal fluid					
WBC $\times 10^9$/l	13	156.0 (109.8)	251.3 (246.2)	101.6 (17.6)*	6.0 (6.0)
SD		158.3	88.7	191.7	0.2
TP g/l	15	37.7 (30)	47.8 (50)	32.7 (30)	25.0 (25)
SD		14.5	15.7	9.6	5.7
Lactate mmol/l	9	5.0 (3.0)	9.6 (12.7)	2.7 (3.0)	2.7 (3.0)
SD		4.6	5.9	1.4	0.9

* Four horses, range from 8.7 to 444.53 $\times 10^9$/l.

The mean haematocrit was found to be 31.7%, while the mean total blood protein levels was 67.4 g/l. The appearance of the peritoneal fluid varied, ranging from light yellow and clear to turbid with an orange/brown colour. Of the 20 horses on which abdominal paracentesis was performed, the peritoneal fluid of four horses was assessed as having a normal appearance. In terms of the peritoneal fluid composition, the mean total protein levels and lactate concentration were 37.7 g/l and 5.0 mmol/l, respectively. Additionally, the mean WBC in the peritoneal fluid was approximately 156.0×10^9 cells/l. Further detailed information on these variables is presented in Table 4. Additionally, in six of 14 cases where differential count of the peritoneal fluid was performed, eosinophils were detected.

In eight out of 23 cases findings during rectal examination, as documented in the medical records, suggested the presence of colon impaction upon admission. Additionally, in 14 out of 23 cases, a large colon displacement, such as nephrosplenic entrapment or right dorsal displacement (RDD), was suspected.

4.3 Gross appearance

In Table 5, the gross findings observed during laparotomy were categorized based on distinctive features, including thickened colon wall, hyperaemia/discoloration, necrosis/ulceration, petechiation, and/or the presence of thickened mesentery. Furthermore, lesions were classified as either focal or circumferential whenever possible. In three cases, the only descriptions available in the medical records referred to the lesions as having a typical “focal eosinophilic colitis” appearance, as described in the study by Edwards *et al.* (2000). Due to the lack of detailed descriptions, these cases have been summarized separately.

The most frequently noted finding in the medical records was local thickening of the bowel wall (Table 5), which in six cases was specifically described as focal thickening. Three cases were specifically described as focal lesions to the antimesenteric side, and no cases were reported as circumferential lesions. In nine cases, multiple lesions were observed in the intestine; however, only the largest lesions were sampled or removed. In six cases, thickening and/or oedematous mesentery adjacent to the affected colon was described. Additionally, it was noted that adjacent lymph nodes appeared to be affected.

Table 5. Surgical or postmortem findings described in the medical records of 23 cases of SEC. The number of horses represents how many medical records included either information about location or gross appearance in the description.

Location	Number of horses
Pelvic flexure	10
Left dorsal colon (LDC)	18
left ventral colon (LVC)	5
More than one site	9
Small intestine	4
Small colon	0
Caecum	2
Focal to the antimesenteric side	3
Gross appearance	
Thickened bowel wall	17
Hyperaemic/Discoloured serosa	9
Petechiation/Haematoma	4
Necrosis/Ulceration	8
Thickened/oedematose mesentery	6
No description available	3

4.4 Histopathology

Out of the 23 cases, histology reports or parts of reports from 21 cases were available. The key findings (based on previous histological observations) have been summarized in Table 6 (Edwards *et al.* 2000). While not all histology reports mentioned an increased number of eosinophils in the free text field, the overall conclusion for all cases was eosinophilic colitis. No signs of neoplastic cells or any other evidence of neoplasia were observed in any of the histological reports. In two cases, a nematode residue suspected to be *S. vulgaris* was found and accompanied by massive inflammation in the surrounding tissue.

The inflammation ranged from being predominantly localized to the submucosa, which is illustrated in Figure 5, to involving the entire bowel wall. The locations where increased eosinophils were found are summarized in Table 6. In 13 histology reports, the inflammation was described as transmural involving all bowel wall layers.

In cases with necrotic mucosa both neutrophilic and eosinophilic leukocytes were present in the tissue, and in two cases, the luminal surface was covered with bacterial colonisation. In one case, necrotic/degenerated myocytes were described, while in the other 12 cases, infiltration of eosinophils was observed between the muscle layers (Figure 6). Additionally, in one case, ulcerations were observed

extending through all layers of the intestine leaving only 1.5 mm until complete rupture. This patient had been treated for idiopathic peritonitis eight days prior to surgery.

Thrombosis was documented in five histological reports and vascular recanalization was described in two of these cases. Additionally, eight cases were described as a chronic active lesion with both fibrotic tissue and active inflammation. Eosinophilic granulomas of varying degrees of maturity were also observed in four of the cases (Figure 7).

In 11 of the 23 cases, the histological examination also included samples from the margin, mesentery (Figure 8) or the nearest lymph node. In the macroscopically normal bowel wall, there was still evidence of eosinophilic inflammation, although to a lesser extent. Examination of adjacent lymph nodes exhibited a normal inflammatory appearance, although an increased eosinophilic infiltration was noted.

Table 6. Histological findings in 23 cases of SEC at three equine hospitals in Sweden. One horse could have more than one key finding.

Key findings	Number of horses
Oedematose mucosa/submucosa	12
Ulcerated/necrotic mucosa	9
Ulcerated/necrotic serosa	3
Granulation tissue	7
Fibrinous exudate	2
Thrombosis	5
Eosinophilic granulomas	4
Nematoda residues	2
Dilated lymph vessels	5
Fibrosis/ Indication of chronicity	8

Table 7. Location of increased number of eosinophils specifically described in the histological report. One horse could be represented in more than one location.

Location of eosinophilic inflammation	Number of horses
Mucosa	10
Sub mucosa	17
Muscularis layers	13
Subserosa	12
Serosa	11
Perivascular	8

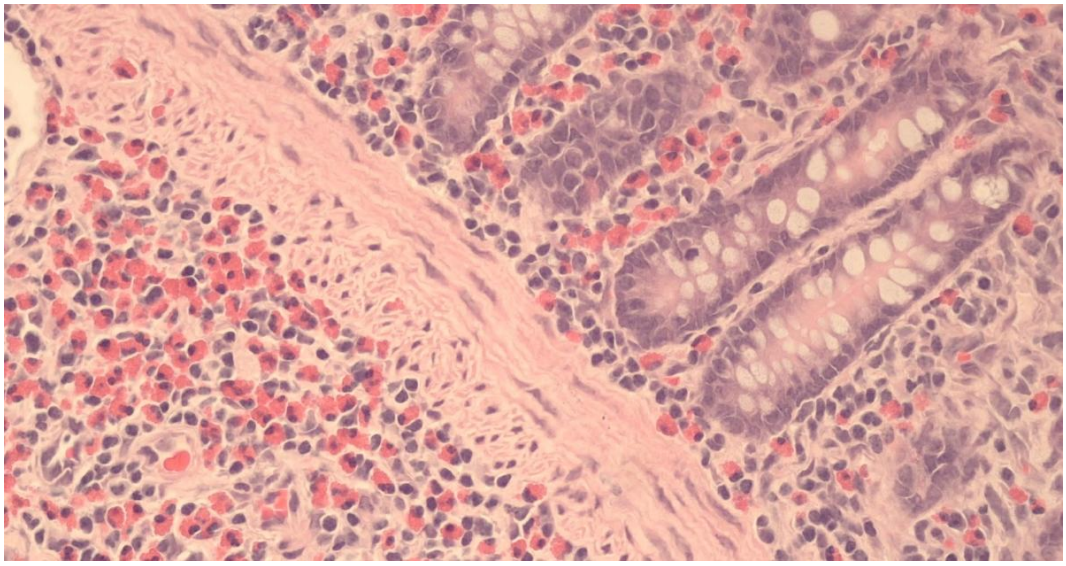

Figure 5. Eosinophilic inflammation located to the lamina propria and submucosa in a sample from left dorsal colon of a horse with SEC. Photo by: Matilda Persson/Lisa Lindström

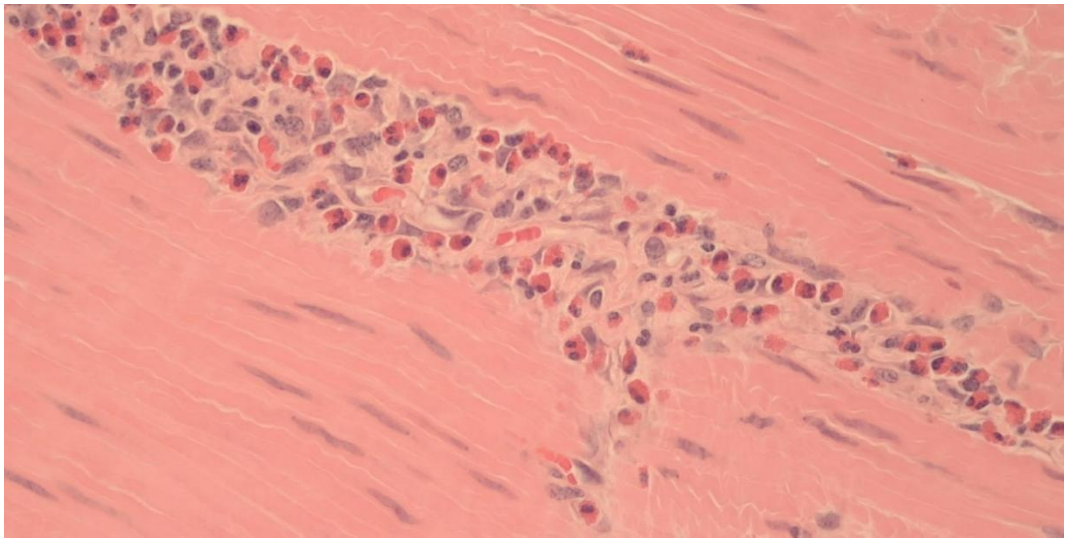

Figure 6. Eosinophils in the muscularis layer of the colon in a case with SEC. Photo by: Matilda Persson/Lisa Lindström

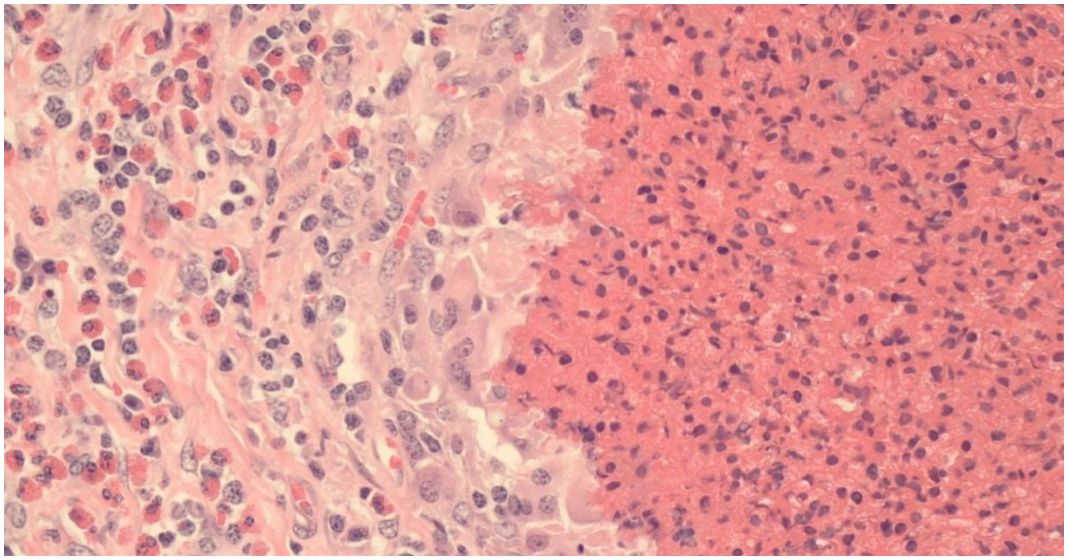

Figure 7. An eosinophilic granuloma: to the right are degenerated eosinophils surrounded by epithelioid macrophages. Photo by: Matilda Persson/Lisa Lindström

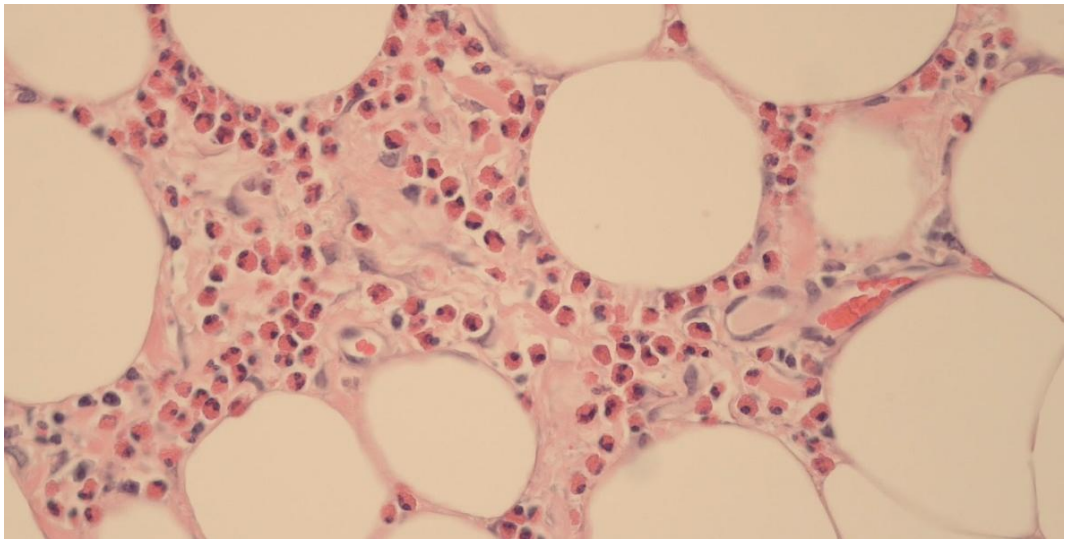

Figure 8. Eosinophils in the mesentery fat from a horse with a SEC lesion. Photo by: Matilda Persson/Lisa Lindström

4.5 Prevalence

The overall prevalence of SEC was 2.0%. At UDS, from January 2021 to October 2024, it was 4.3%; at ESHS, from January 2008 to October 2024, it was 2.1%; and at MHK, from January 2014 to November 2014, it was 0.8% (Table 8). Out of the 23 cases, 18 horses were presented at the clinics during the winter or spring months (Figure 9). The arrival months of SEC cases was compared with those of all colic laparotomies at UDS during the same period in Figure 10.

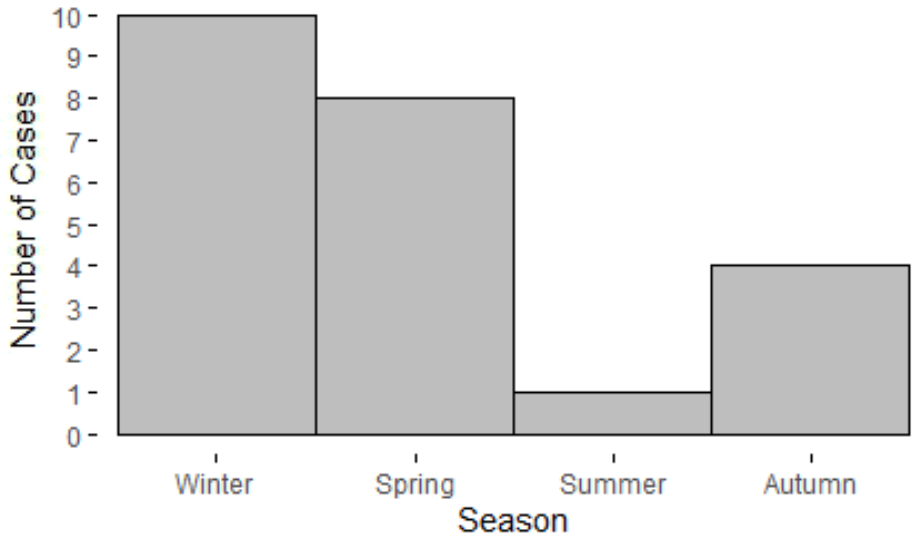

Figure 9. Seasonal variation of 23 cases with segmental eosinophilic colitis (SEC) at three equine hospitals in Sweden.

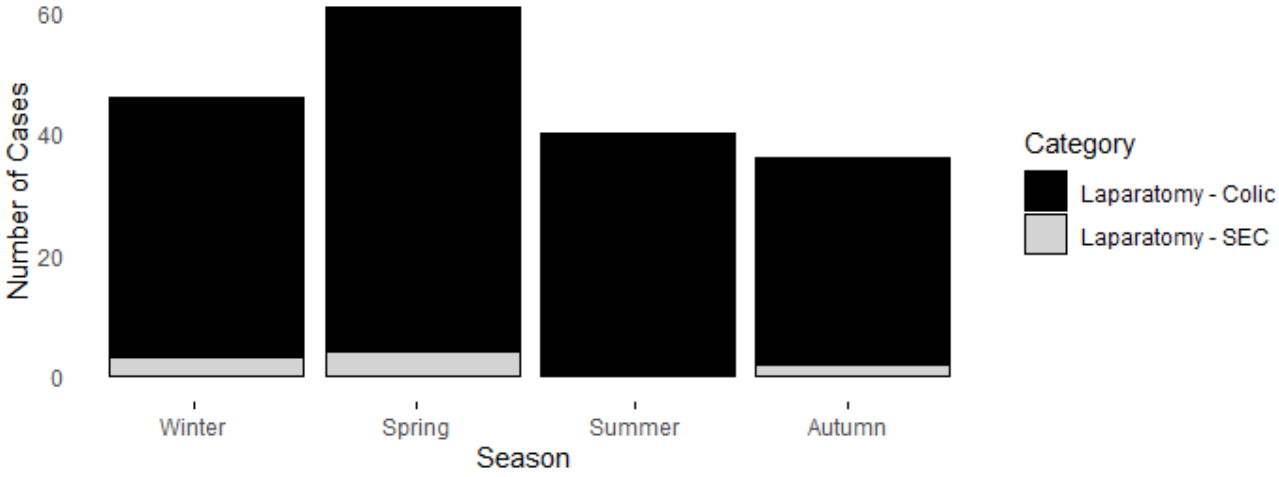

Figure 10. Seasonal variation of diagnosed segmental eosinophilic colitis (SEC) cases compared to all colic laparotomy performed at SLU University Animal Hospital (UDS) during January 2020 to October 2024.

Table 8. Prevalence of segmental eosinophilic colitis (SEC) at SLU University Animal Hospital (UDS), Evidensia Specialisthästsjukhuset Strömsholm (ESHS) and Mälaren Equine Clinic (MHK)separated by year and summarised in total.

Clinic	Year	Cases of SEC found at laparotomy	Total colic laparotomy cases	Proportion of SEC cases %
All clinics	total	22	1118	2.0
UDS	total	8	186	4.3
	2021	2	53	3.8
	2022	1	39	2.6
	2023	2	47	4.3
	2024 oct	3	44	6.8
ESHS	total	9	427	2.1
	2008	1	38	2.6
	2009	0	52	0.0
	2010	2	63	3.2
	2011	1	47	2.1
	2012	1	31	3.2
	2013	2	21	9.5
	2014	0	20	0.0
	2015	0	21	0.0
	2016	0	16	0.0
	2017	0	23	0.0
	2018	1	19	5.3
	2019	0	20	0.0
	2020	1	9	11.1
	2021	0	10	0.0
	2022	0	21	0.0
	2023	1	11	9.1
	2024 oct	0	5	0.0
MHK	total	4	505	0.8
	2014	1	9	11.1
	2015	0	33	0.0
	2016	1	52	1.9
	2017	1	52	1.9
	2018	1	49	2.0
	2019	0	52	0.0
	2020	0	69	0.0
	2021	0	75	0.0
	2022	0	73	0.0
	2023	0	41	0.0
	2024 nov	0	31	0.0

4.6 Post operative treatment

Of the 18 cases that recovered from laparotomy, all were treated with flunixin meglumine and 17 cases with broad-spectrum antibiotics (benzylpenicillin and gentamicin). Three of five cases that were euthanised in the ward after surgery, experienced inadequate therapeutic response, necessitating a broadening of the antibiotic regimen. Besides antibiotics and analgesics, 13 of 18 cases were additionnally treated with glucocorticoids (Table 9). The glucocorticoid treatment varied both in timing and duration. The commencement of treatment ranged from administration during surgery to several days after discharge when the histology report had been received. The duration of glucocorticoid treatment varied between three days to several weeks.

Table 9. Postoperative treatment regarding glucocorticoids in 18 horses diagnosed with segmental eosinophilic colitis at three equine hospitals in Sweden.

Treatment	Number of horses
No steroid treatment	5
Only dexamethasone	5
Only prednisolone	4
Dexamethasone and prednisolone	4

4.7 Survival and complication analysis

Twenty-two cases underwent laparotomy due to colic and had the gross appearance of segmental eosinophilic colitis (Figure 11). Seventeen of these recovered and were treated in the clinic ward. Four cases were euthanised in the operating room (OR), three of which were due to a poor prognosis. The poor prognosis in these cases was caused by a ruptured intestine or a lesion too extensive to be surgically treated.

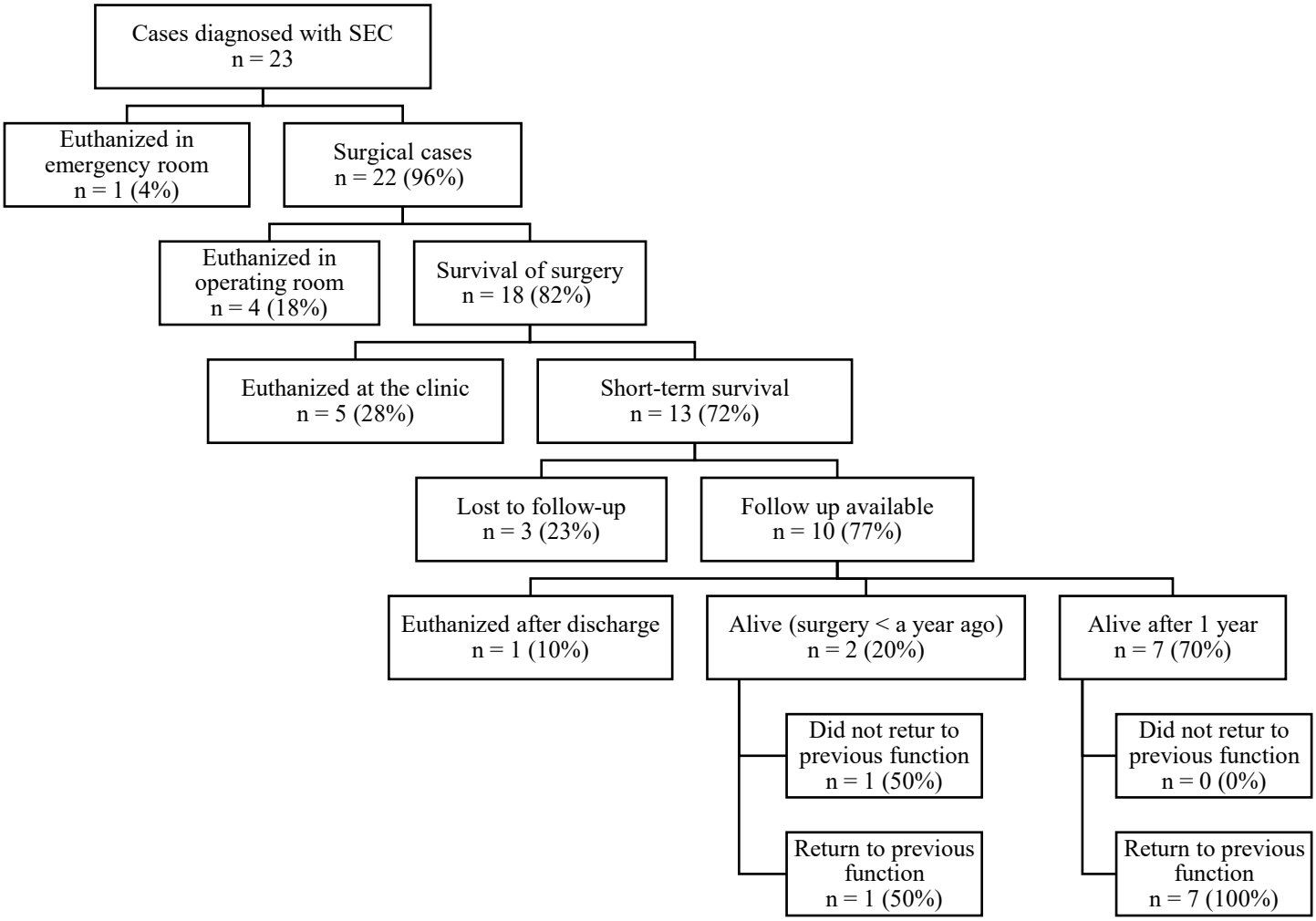

Figure 11. An overview of survival and return to previous function in horses diagnosed with segmental eosinophilic colitis (SEC) at three equine hospitals in Sweden. Short-term survival refers to the period from arrival at the clinic until discharge.

4.7.1 Short-term survival

Among the 18 SEC cases that recovered from surgery, 13 (72%) were successfully discharged from the clinics. Five cases, however, were euthanized in the clinic ward due to complications such as recurrent colic, post-operative reflux, peritonitis, suspectted intestinal rupture, and one case of anaemia secondary to hemoabdomen. This resulted in an overall short-term survival rate of 59% from anaesthesia to discharge.

A logistic regression model was calculated to assess survival probability based on the number of days from arrival to the clinic until surgery, excluding any time the horse might been treated at home (Figure 12). The model included an intercept

estimate of 0.5907 with standard error 0.5529 and p-value = 0.285. The coefficient for days before surgery of -0.1576 with standard error 0.1703 and p-value 0.355. The residual deviance of the model was 27.773 with 19 degrees of freedom, and the null deviance was 28.682 with 20 degrees of freedom. These results did not show statistical significance.

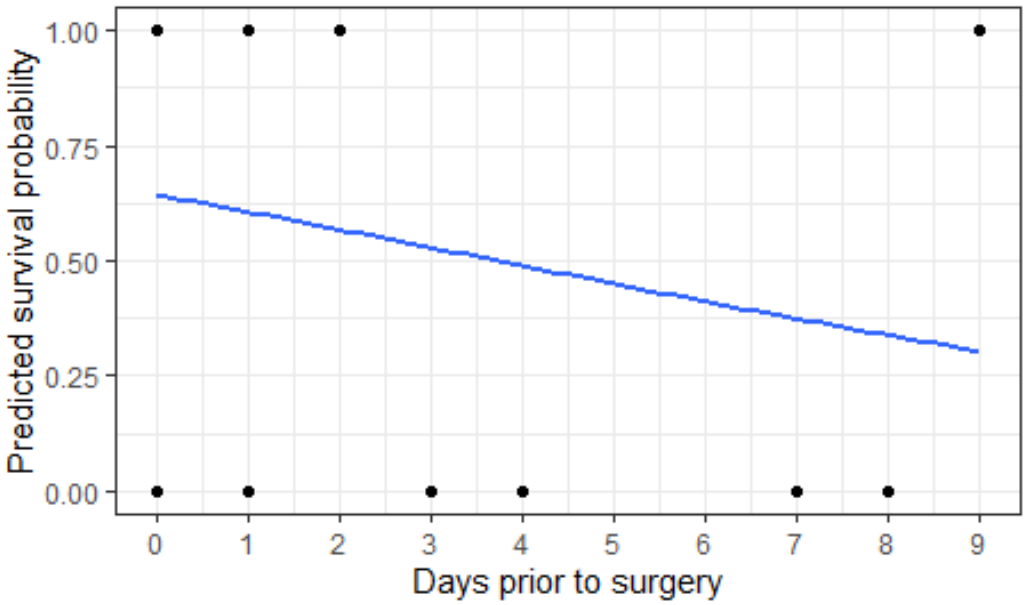

Figure 12. Graph that shows results from logistic regression modelling on survival probability until discharge from the hospital for cases with segmental eosinophilic colitis at three equine hospitals in Sweden. The model is based on the number of days from arrival at the hospital until surgery.

The mean duration of post-surgical treatment (recovery to discharge) at the clinics was 8.4 days (

Table 10). For one of 13 horses, the discharge date could not be determined from the medical record and this case was therefore excluded from the calculations. Additionally, one case was excluded from the calculations of both “arrival to surgery” and from “recovery to discharge” due to missing information regarding the date of surgery. As mentioned above surgery was performed either immediately or the day after arrival at the clinic in most cases. In cases that were initially treated for peritonitis the lack of therapeutic response necessitating surgical intervention (Hedberg-Alm *et al.* 2022).

Table 10. The amount of days horses with segmental eosinophilic cases at three equine hospitals in Sweden spend at the hospital. Categorised from arrival at the hospital until surgery or discharge and from recovery after surgery until discharge.

		Days		
	Number of horses	Range	Mean (Median)	Standard deviation
Arrival to Discharge	12	4 - 19	9.5 (8)	4.3
Arrival to Surgery	21	0 - 9	1.9 (1)	2.8
Recovery to Discharge	11	4 - 18	8.4 (7)	4.2

4.7.2 Long-term survival

Of the 13 cases discharged from the clinics, one horse was euthanized one month after the discharge date due to colic, and therefore the owner was not contacted. Of the remaining twelve owners, eight were followed up by calls or e-mail, four owners did not respond or could not be reached due to loss of contact information. The response rate in the present study was 58.3%. Of the four cases where the owner did not respond, it was possible in two cases to extract information about competition results from Tävlingsdatabasen (a national database of competitions in dressage, show jumping, and eventing – Svenska Ridsportförbundet n.d.). From the information in the competition database, it could be determined whether the horse had survived at least one year after surgery and whether it had returned to its previous competition level, thereby regaining functionality.

The long-term survival (LTS), from discharge to one year after surgery, and the overall long-term survival (OLTS), from anaesthesia to one year after surgery, can be found in Table 11. For horses that had LTS over one year, the mean survival time after surgery was 6.3 years, with a range from 1.7 to 14.2 years.

Table 11. The long-term survival (LTS) of surgical cases with segmental eosinophilic colitis (SEC) at three equine hospitals in Sweden. 13 of 22 surgical cases survived surgery and were discharged from the hospital. Tree horses were lost to follow-up and were excluded from the calculations of LTS and overall long-term survival (OLTS). Two cases that were discharged with follow-up, the surgery was performed less than a year ago; therefore, these as well excluded from the calculations of LTS and OLTS.

	Surgical SEC cases	Discharged - lost to follow-up (%)	Discharged - with follow-up (%)	Horses discharged - <1 year from surgery (%)	LTS – from discharge until 1 year after surgery (%)	OLTS – from anaesthesia until 1 year after surgery (%)
Number of horses	22	3 (13.6)	10 (45.4)	2 (0.9)	7 of 8 (87.5)	7 of 17 (41.2)

4.7.3 Long-term complications

Among the twelve horses that survived longer than one month, one experienced recurring colic years after surgery and was subsequently euthanized for that reason. Two horses developed small hernias as a result of infection, while another developed an infection without herniation. Additionally, two horses, both of pony breeds (Icelandic horse and Gotland pony), developed laminitis after discharge. Both were treated with dexamethasone at the clinic, and one of them was also treated with prednisolone at home. One pony had a history of a previous episode of laminitis and the other pony was later diagnosed with PPID (Menzies-Gow *et al.* 2024). A summary of long-term complications can be found in Table 12; cases could have more than one complication.

Table 12. Surgical long-term complications in 12 horses operated on for segmental eosinophilic colitis (SEC) at three equine hospitals in Sweden. Long-term complications refer to issues that arose after the horse was discharged from the hospital.

	Number of horses
Colic	2
Surgical site infection	3
Abdominal hernia	2
Laminitis	2

4.8 Return to previous function

All but one horse returned to its previous level of function, as reported by the owners or based on competition results from Tävlingsdatabasen (a national database of competitions in dressage, show jumping, and eventing – Svenska Ridsportförbundet n.d.). The reported training levels prior to surgery varied, ranging from high-level competition to recreational riding or driving. The horse that did not return to training underwent surgery in 2024 and is still in the convalescence phase at the time of writing.

4.9 Owner satisfaction

All seven owners that responded reported being satisfied with both the surgery and the aftercare of their horses. Only owners whose horses were discharged from the clinic were surveyed. Owners of horses that were euthanized during surgery, while in the clinic, or shortly after surgery were excluded from the survey. Five owners would recommend surgery to another person in the same situation, one was unsure, and one would not recommend surgery. The owner who would not recommend surgery had a horse that experienced multiple complications post-surgery.

5. Discussion

5.1 Study population

The study population consisted of a small sample size with a range of breeds, predominantly warmblooded horses. This distribution, with a higher number of warmbloods than other breeds, was also observed in the study describing colic surgeries from UDS by Förander (2024) and also reflects the general breed distribution in Sweden based on insurance data from Agria (Orrpars 2024). The normal distribution of breeds at the three clinics was not investigated. If a similar distribution of horses compared to ponies is observed in future studies, it would be interesting to investigate potential reasons for this distribution.

All the clinics from which the cases were collected are referral hospitals located in the "central parts" of Sweden and they all provide 24 hour service for emergency cases. One of these clinics is the northernmost 24/7 operating clinic in Sweden and receives horses referred from the furthest northern areas. Given the geographic coverage of these clinics, which span a wide range of regions, the study population can be considered representative of the broader equine population in Sweden.

A similar age distribution to the present study, with predominantly middle aged horses, has been noted in horses with idiopathic peritonitis and colon infarctions (Hedberg-Alm *et al.* 2022). Additionally, a similar mean age has been reported in previously documented SEC cases, as calculated from data presented (Edwards *et al.* 2000). This age distribution may be attributed to the increased likelihood of older horses encountering factors that trigger intestinal inflammation, such as *S. vulgaris* infection in cases of infarction. Due to the small study populations from each clinic, it was not possible to perform any statistical analyses to determine whether age is a factor influencing the risk of getting SEC.

5.2 Clinical presentation

The majority of horses admitted to the three clinics presented with either mild or moderate colic, which is consistent with previous descriptions of SEC (Edwards *et al.* 2000). One of the horses presenting with severe colic was found to have concurrent small intestinal strangulation, which could account for the severity of the pain response. It was not documented in the medical records whether the horses had exhibited any colic signs prior to this colic episode, which raises the interesting question of whether horses could have subclinical segmental inflammation in the large intestine. Additionally, the question arises if the inflamed large intestine could predispose for colon displacement, that was seen in five of the studied cases.

Most of the horses had shown colic symptoms for up to 24 hours prior to arriving at the clinics. This suggests a more acute onset, which is interpreted as secondary issues resulting from the focal thickening of the colon wall due to severe inflammation. The acute onset, combined with histological findings suggesting a chronic active lesion, strengthens the theory that colic arises secondary to another comorbidity. However, it cannot be stated with certainty as no statistical associations have been calculated. All the horses exhibited some form of comorbidity, such as impaction, large colon displacement or peritonitis. This makes it difficult to determine if the clinical and laboratory parameters are related to the comorbidity or if it is related to the segmental eosinophilic colitis (SEC).

The mean rectal temperature was within the normal range for body temperature. However, four of the 23 cases presented with fever, which is considered to be related to peritonitis. This is likely a result of inflammation and necrosis of the in the intestinal wall and potential bacterial translocation.

Total protein levels in the peritoneal fluid of horses with SEC were higher than normal peritoneal fluid in all cases that had samples taken and analysed prior to surgery. The same trend with a higher TP was also seen in studies of idiopathic peritonitis and NSII (Odelros *et al.* 2019; Hedberg-Alm *et al.* 2022). It in the study by Hedberg-Alm *et al.* (2022) the TP in peritoneal fluid were shown to be significantly higher in NSII cases than cases with idiopathic peritonitis indicating TP to be corresponding to intestinal injury. An elevated total protein in the peritoneal fluid may therefore indicate the need for surgery as previously described (Hedberg-Alm *et al.* 2022). One important finding in the present study is that a macroscopically normal peritoneal fluid had an increased total protein level, which indicates to routinely analyse total protein in the peritoneal fluid from colic cases. In addition, the presence of eosinophils in the peritoneal fluid was seen in six cases with SEC and it would be interesting to investigate if this could be a marker for SEC or if it occurs in cases with NSII or idiopathic peritonitis as well. Eosinophils are not mentioned to be present in peritoneal fluid samples from horses with NSII or idiopathic peritonitis (Nielsen *et al.* 2016; Pihl *et al.* 2018; Odelros *et al.* 2019; Hedberg-Alm *et al.* 2022). However, it has not been specifically examined, which is why no conclusions can be drawn.

Compared to studies of NSII and idiopathic peritonitis there are no clinical parameters or laboratory parameters that stand out in the present study of SEC (Pihl *et al.* 2018; Odelros *et al.* 2019; Hedberg-Alm *et al.* 2022). As mentioned earlier in the paragraph above, significant differences in total protein levels have been observed between cases of NSII compared to idiopathic peritonitis, although there is a large overlap between the cases (Hedberg-Alm *et al.* 2022). Since only cases of SEC have been described in this study, it is not possible to make any comparative

analyses of clinical or laboratory parameters to identify factors specifically associated with SEC compared to NSII or idiopathic peritonitis. For future studies, it would be of interest to conduct a comparative study between SEC, NSII, and idiopathic peritonitis to determine if there are significant differences between these three conditions.

In Sweden, where idiopathic peritonitis occurs and favourable outcomes are achieved with medical treatment (Odelros *et al.* 2019; Hedberg-Alm *et al.* 2022), there is a risk that other underlying causes for the peritonitis, for instance SEC, may be overlooked. To determine which horses are candidates for surgical intervention is still not entirely clear, but a combination based on clinical findings and laboratory results should be indicative. An elevated total protein level in the peritoneal fluid could suggest surgical involvement as it is shown to be significantly higher TP in peritoneal fluid from horses with NSII compared to idiopathic peritonitis (Hedberg-Alm *et al.* 2022), but the exact degree to which this is indicative remains unclear. As previously described by Hedberg-Alm *et al.* (2022), a careful assessment is required when considering peritonitis to be caused by a surgical condition. Further studies are needed to make statistically reliable conclusions.

5.3 Diagnosis

It may be possible that SEC is underdiagnosed, although it appears to be a very rare disease. The diagnostic parameters examined in this study (blood: haematocrit and total protein, Peritoneal fluid: WBC, TP and lactate) are relatively nonspecific and have low sensitivity for identifying SEC prior surgery. It is possible that SEC may initially occur subclinical, as the majority of the horses in this study exhibited some form of comorbidity, likely caused secondarily, such as displacement or colon impaction. The case where SEC was found in a horse with small intestinal strangulation suggests that the disease can be subclinical; however, no other subclinical cases were identified in the review of postmortem reports from the pathology department. It is also possible that in this case, there may have been affected small intestine that predisposed the horse, such as IFEC.

Other factors that could potentially contribute to underdiagnosis include cases where horses are euthanized due to colic and do not undergo necropsy. However, it is likely that more horses experience colic for reasons other than SEC, as only one case of SEC was identified at UDS at postmortem examination. At UDS during the academic term, horse owners are offered postmortem examination at no extra cost for horses that are euthanized. Although not applicable to the other two clinics studied, this further supports that only a small number of cases are likely to be missed due to euthanasia without postmortem examination.

Impactions occur both in horses in this study, in horses with idiopathic peritonitis, and in horses with NSII and can sometimes be palpable by rectal examination (Odelros *et al.* 2019; Hedberg-Alm *et al.* 2022). To differentiate horses with a palpable impaction together with idiopathic peritonitis from horses with peritonitis due to SEC or NSII, it is suggested that rectal ultrasound of the impaction could provide valuable information on whether it is a normal impaction or if there are changes in the bowel wall surrounding the impaction (Hedberg-Alm *et al.* 2022). Rectal ultrasound was not examined in this study, but it would be of interest to evaluate it in future studies, particularly in comparison with cases of NSII, to determine if there are any differences between the cases. Performing a rectal ultrasound could shorten the process from admission to surgery in cases where impaction is palpable at rectal examination and there is no clear indication of surgical distress based on laboratory findings.

5.4 Gross appearance

The general appearance of the large colon affected by SEC demonstrated varying degrees of wall thickening, predominantly in the pelvic flexure or LDC. In most cases, the lesions were characterized by erosions or necrotic changes involving the outer layers of the intestinal wall. This is similar to what was previously described (Edwards *et al.* 2000). Although similar descriptions have been made regarding horses with NSII, the distinguishing factor is that NSII typically presents with a clear ischemia (Pihl *et al.* 2018; Hedberg-Alm *et al*. 2022). In Figure 13, the difference in gross appearance between SEC an NSII is illustrated.

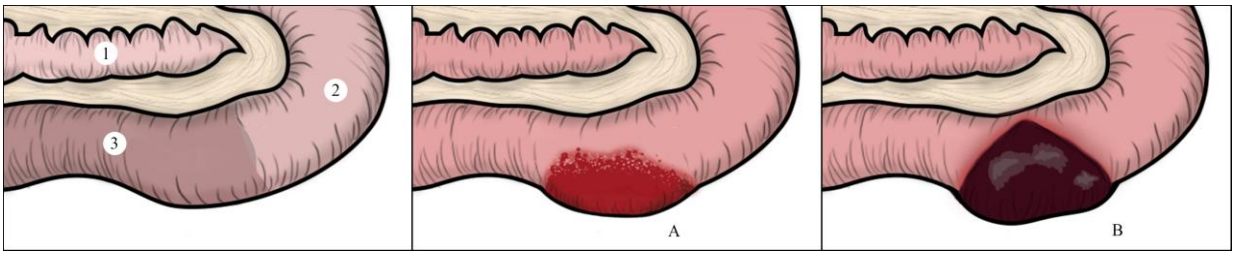

Figure 13. Illustration of the left ventral and dorsal colon, along with the pelvic flexure, showing segmental eosinophilic colitis and non-strangulating intestinal infarction, respectively. 1. Left ventral colon 2. Pelvic flexure 3. Left dorsal colon
A. Segmental eosinophilic colitis B. Non-strangulating intestinal infarction.

Illustration by: Matilda Persson

There were no significant associations observed between a longer time before surgery and the outcome of the surgery. This supports previous studies on SEC (Edwards *et al.* 2000) and NSII (Poulsen *et al.* 2023). Although no significant conclusions can be drawn about the effect of the number of days before surgery on the outcome, the curve's slope Figure 12. Graph that shows results from logistic regression modelling on survival probability until discharge from the hospital for

cases with segmental eosinophilic colitis at three equine hospitals in Sweden. The model is based on the number of days from arrival at the hospital until surgery. in the graph suggest a small advantage of a shorter time before surgery.

In all cases, the lesions were located in the pelvic flexure or the left dorsal colon (LDC). However, in two cases, signs of inflammation were also observed in the cecum, and in four cases, signs of inflammation were seen in the small intestine. This localization, also described for NSII, is thought to be due to these segments being supplied by the cranial mesenteric artery (Pihl *et al*. 2018), which is also the predilection site for *S. vulgar*is L4 larvae (Marchiondo *et al.* 2019). The cranial mesenteric artery also supplies the small intestine, except for the oral part of the duodenum (Liebich & König 2020:373). This could indicate, as previously suggested by Schumacher & Legere (2018), that the lesions observed in idiopathic focal eosinophilic enteritis (IFEE) and DEE are the same as those seen in cases with SEC, but represent different phenotypes, if the inflammatory cause is spread via the blood supply. This would be interesting to investigate further in future research.

5.5 Histopathology

The histological presentation found in the samples are similar to that previously reported, with an eosinophilic inflammation, mucosal necrosis and submucosal oedema (Edwards *et al.* 2000). This presentation is also similar to that found in cases of NSII, with the addition that NSII cases typically show more signs of infarction accompanied by thrombosis (Pihl *et al*. 2018; Hedberg-Alm *et al.* 2022).

Histological examination showed little evidence of parasites in the samples, with two cases having visible nematodes in the histology sample. This finding is consistent with a previous study of a similar sample size (Edwards *et al.* 2000). Given the small number of cases with direct evidence of helminths, it is not possible to draw significant conclusions about the involvement of S. vulgaris migration.

5.6 Aetiology

As previously discussed, the aetiology of SEC remains undetermined. The previously suggested hypothesis of parasite involvement cannot be supported further if the burden of proof requires the presence of nematodes in histological sections. However, histological findings align with those described in cases of parasite migration. Of the horses included in this study, only two were confirmed to have been positive for *S. vulgaris* based on faecal examinations prior to admission but there were medical records where the information about helminth status was missing. Another important aspect, as previously described, is that the worms migrating in the intestines blood vessels do not reproduce and therefore do not shed eggs until six months after infection (Duncan & Dargie 1975; Theoret *et*

al. 1993). This means that negative faecal samples do not provide any information about the presence of migrating *S. vulgaris* larvae.

The possible aetiology behind SEC might be the same for idiopathic focal eosinophilic enteritis (IFEE) and diffuse eosinophilic enteritis (DEE) since the macroscopical appearance and histological presentation are similar (Schumacher & Legere 2018). In addition, there are many similarities in both the predilection sites and the histological presentation to what is observed in NSII due to *S. vulgaris* migration (Hedberg-Alm *et al.* 2022; Poulsen *et al.* 2023). This observation could indicate that the underlying aetiology is the same, but the presentations differ.

Something described in the histology reports is a hypersensitivity reaction to *S. vulgaris* migration. The inflammation is often prominently observed in the sub-mucosa and perivascular regions, which corresponds with the migration of *S. vulgaris* from lumen of the intestine to the arteries (Jacobs *et al.* 2016; Taylor *et al.* 2016). This raises the possibility that SEC, NSII, IFEE and DEE are manifestations of a hypersensitivity reaction to *S. vulgaris* migration, with NSII potentially representing a progression where the inflammation results in complete infarction of an intestinal segment. Future research could focus on grading both the gross appearance and histological findings to determine whether there are significant similarities or differences.

5.7 Prevalence and seasonal variation

The overall prevalence of SEC is low compared to other abdominal surgeries performed during the same period at the three equine clinics. The seasonal variation at UDS aligns with the patterns observed for all types of abdominal surgeries and those previously described for NSII (Hedberg-Alm *et al.* 2022; Poulsen *et al.* 2023). While this seasonal correlation does not allow for far-reaching conclusions, it may suggest some form of connection with the life cycle of *S. vulgaris* larvae. Horses ingest infectious larvae during the spring and summer while grazing, which then migrate and develop in the cranial mesenteric artery for 3-4 months (during summer and autumn), before returning to the intestines to lay eggs in the winter or spring months, depending on the time of infection (Jacobs *et al.* 2016).

5.8 Postoperative treatment

In this population, a majority of the cases were treated with glucocorticoids following intestinal resection, according to the medical records. This differs from previous studies on SEC, where postoperative treatment has only included antibiotics and analgesia (Edwards *et al.* 2000). In this study, glucocorticoid treatment did not appear to have an impact (positive or negative) on the likelihood of discharge.

However, a possible negative aspect of postoperative glucocorticoid treatment was observed in two of the horses that post-surgery developed laminitis, which could been linked to glucocorticoid treatment, one case in combination with undiagnosed PPID (Potter *et al.* 2019; Menzies-Gow *et al.* 2024). These horses were of pony breeds, which are at a higher risk of developing laminitis when treated with glucocorticoid (Potter *et al.* 2019). Other risk factors correlated to development of laminitis when treated with glucocorticoid are obesity and a previous history of laminitis.

The use of glucocorticoids in these cases is likely based on the observation that the inflammation appeared more widespread than being confined solely to the focal thickened area. There were cases where the veterinarian delayed initiating glucocorticoid treatment until the histology report was available, to avoid unnecessary treatment in sensitive individuals.

It cannot be stated with certainty whether glucocorticoid treatment is necessary in these cases. However, one argument in favour of glucocorticoid treatment is that one of the cases included in the study, which was initially not treated with glucocorticoids, experienced colic after discharge. Glucocorticoids were then administered, and the horse had no further episodes of colic thereafter. Whether this is the result of treatment or spontaneous recovery cannot be determined.

5.9 Survival compared to other colic surgeries

In the present study the short-term survival (STS), from recovery to discharge, was at 72% and the overall short-term survival (OSTS), from anaesthesia to discharge, was at 59%. In comparison to other studies where large colon resection where performed the highest OSTS to be reported are 74-81% (Bertone *et al.* 1986; Edwards *et al.* 2000; Ellis *et al.* 2008; Pezzanite & Hackett 2017). One of these studies examined SEC cases with the OSTS of 76% (Edwards *et al.* 2000). The lowest survival rates were reported on non-strangulating intestinal infarction (NSII) cases with an STS of 33-50% and an OSTS of 14-42% (Pihl *et al.* 2018; Hedberg-Alm *et al.* 2022). The great variation in survival rates reported could be due to different intestinal lesions examined in the studies, where it seems to be lower survival correlated NSII than other lesions. Other variables that could influence the survival rate could be duration of medical treatment before surgery or coincidence due to small sample size in all studies.

In this study, the time from admission to surgery did not significantly appear to affect the survival rate. However, the logic regression model is fitted to a small negative correlation between time to surgery and survival outcome. The vague indication of a correlation with a shorter time prior surgery and survival align as earlier mentioned with results from a study on NSII, where a shorter time between

admission and surgery was associated with improved survival rates (Poulsen *et al.* 2023). It is possible that significant pattern could be observed in a larger study population or if duration of colic or treatment prior admission to the clinic was included, making this an interesting area for future research.

The long-term survival rate in this study was high, consistent with findings from another study, although that study included only three cases in follow-up (Pihl *et al.* 2018). The cases discharged from the clinics in this study were likely to survive for one year or longer after surgery.

5.10 Return to previous function and owner satisfaction

In this study, all but one of the horses discharged from the clinic and surviving a month after discharge returned to their previous function. The horse that did not return to its previous function experienced complications related to the surgical incision site and laminitis, possibly caused by glucocorticoid treatment.

The owners who participated were all grateful for the treatment of their horse and the support from the clinicians, with no significant difference based on which clinic they had visited. Even the owners of horses with complications post-surgery were satisfied with the treatment. However, owners of horses that did not survive the surgery were not surveyed, which introduces a potential bias toward positive feedback. This aspect of satisfaction of care was examined in relation to the follow-up on long-term survival, but it would be interesting to explore this further in future studies.

5.11 Study design

Retrospective studies are challenging due to the possibility of incomplete data, as not all values are available or well-documented. It is up to the attending veterinarian to make an assessment, which must be relied on, even though others might have classified the case differently. Missing data occurs in observational studies, and in this study, varying degrees of missing observations or insufficient descriptions were noted. This could be the result of the acute nature of colic making it a lower priority when it comes to record-keeping.

6. Conclusion

Based on the available descriptions, it is possible that SEC is a phenotypic presentation of *S. vulgaris* migration in the colon. Although nematodes could only be found in the histological samples in a minority of cases, the inflammation may persist even after the parasites have passed, making it still a plausible explanation. No specific parameter could be found to be specifically related to horses with SEC, but the overall picture indicates the necessity of surgical intervention. Based on the laboratorial samples, it would be interesting to investigate whether variables such as the degree of elevated total protein levels in the peritoneal fluid could be used to differentiate SEC from idiopathic peritonitis or other types of surgical colic cases.

The present study results indicates that the true prevalence of SEC in Sweden is between 0.8-4.3% of all surgical colic cases, dependent on the surgeon's assessment when classifying cases as SEC or NSII. Another factor that may influence the results is that the time period examined at the different clinics varies both in the number of years and in which specific years were studied. Additionally, horses that are euthanized without PM examination could contribute to an underestimation of the prevalence. However, it is likely that the distribution between horses euthanized before surgery and those that undergo surgery is relatively balanced. Since the study was conducted at three equine clinics providing 24-hour emergency care in Sweden, with one being the northernmost, it is reasonable to conclude that this is close to the true prevalence of SEC in Sweden.

Since all three diseases, SEC, NSII and idiopathic peritonitis, present with some degree of elevated peritoneal WBCs, elevated peritoneal total protein levels, and potentially a colonic impaction, it is difficult to identify a clear indicator for one condition over the other. One suggestion is to perform rectal ultrasound on horses with concurrent peritonitis and colonic impaction, in order to approach a differentiation of idiopathic peritonitis and SEC or NSII. This could result in horses undergoing surgery earlier, rather than waiting until they do not respond to medical treatment, which might be too late.

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Populärvetenskaplig sammanfattning

(Popular science summary in Swedish)

Att särskilja om en häst har bukhinneinflammation av okänd orsak (idiopatisk peritonit) eller om det finns något underliggande orsak är mycket viktigt för att kunna behandla hästen på rätt sätt och kunna ge en tillförlitlig prognos till dess djurägare. Bukhinneinflammation behandlas oftast medicinskt med antibiotika medan andra orsaker kan behöva åtgärdas via bukkirurgi för att hästen ska överleva. En bakomliggande orsak till bukhinneinflammation hos häst kan vara segmentell eosinofil kolit (SEC) eller tarminfarkt till följd av stor blodmask (*Strongylus vulgaris*). I dagsläget finns det få forskningsunderlag specifikt för sjukdomen SEC, som är en lokal tarminflammation i grovtarmen som först beskrevs under 1990–2000-talen. Denna inflammation kan i värsta fall leda till att tarmen spricker, vilket hos hästar får dödlig utgång. I dag krävs det bukkirurgi och vävnadsprov från tarmen för att ställa diagnos. Bukkirurgi på häst är en krävande operation, och det är viktigt för veterinärer att kunna identifiera rätt kandidater och ge en välgrundad prognos baserat på fynden.

Denna studie syftar till att undersöka vilka kliniska symptom som hästar med SEC uppvisar, om det finns laboratorietester som skulle kunna indikera SEC före kirurgi, hur vanligt SEC är i en svensk hästpopulation samt hur dessa fall ser ut på cellnivå i vävnaden (histologisk undersökning) i jämförelse med icke-strangulerande tarminfarkter (NSII), som ofta orsakas av stor blodmask.

För att undersöka detta har 23 fall av SEC undersökts genom att samla data från tre svenska hästsjukhus mellan 2008 och 2024. Information har hämtats från hästarnas journaler samt genom samtal med djurägare till de hästar som skrivits ut från klinikerna.

Vid den kliniska undersökningen av hästarna vid ankomst kunde inga tydliga indikatorer för SEC påvisas. Ett förhöjt proteinvärde i bukvätskan observerades hos alla hästar, men i jämförelse med andra studier som undersökt andra buklidanden, såsom icke-strangulerande tarminfarkter och bukhinneinflammation av okänd orsak, kunde man inte med säkerhet skilja dessa åt. Den variabel som verkar kunna särskilja SEC från NSII är hur tarmen ser ut under bukkirurgi. Tarmens utseende vid SEC uppvisade mer rodnad och irritation, medan NSII kännetecknades av mörkt färgade infarkter.

Prevalensen av SEC bland hästar som opererats för kolik varierade mellan 0,8–4,3 % vid de tre undersökta klinikerna. Korttidsöverlevnaden från uppvak till ut-

skrivning var 72 %, medan den långsiktiga överlevnaden från utskrivning till ett år efter operation var 87,5 %.

Även om inga laboratorietester i nuläget kan förutsäga SEC före kirurgi, kan ett förhöjt totalprotein i bukvätskan indikera ett behov av bukkirurgi. Korttidsöverlevnaden i denna studie ligger ungefär i mitten av procentintervallet jämfört med andra, medan långtidsöverlevnaden ligger på ungefär samma nivå som tidigare studier. Ytterligare forskning om SEC som diagnos behövs för att kunna fastställa dess orsak och undersöka om det finns en koppling till migration av stor blodmask.

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Appendix 1

Questions to owners whose horses have been discharged from the hospital. The questions originally in Swedish, English translation in Appendix 2. The questionnaire are based on the questionnaire in the study by Förander (2024).

Swedish

- Är hästen fortfarande vid liv idag? (Ja/Nej)
    - Om nej
        - Vid vilket datum avled din häst?
        - Varför avlivades hästen? (Kolik, Ålder/Annat)
- Har/hade din häst kolik igen efter operationen? (Ja/Nej)
- Har du sökt veterinärvård för kolik åt din häst efter operationen? (Ja/Nej)
    - Om ja, hur många gånger har din häst behövt veterinärvård för behandling av kolik?
        - Sökt vård 1 gång för kolik
        - Sökt vård 2 gånger för kolik
        - Sökt vård återkommande för kolik (fler än 2 gånger)
- Läkte operationssåret utan komplikationer och utan att behöva söka veterinärvård?
    - Ja, läkte utan komplikationer
    - Uppkom sårinfektion som behövde veterinärvård
    - Uppkom bråck som behövde veterinärvård
    - Annat)
- Vad gjorde din häst för arbete innan sjukdom?
    - Unghäst
    - Promenadridning eller körning
    - Träning för lättare tävling (2-3ggr vecka)
    - Träning för tävling på medelnivå
    - Träning för tävling på hög nivå
- Har din häst återgått till det arbete/funktion som hästen hade innan operationen?
    - Ja-samma
    - Ja-bättre
    - Nej
- Hur lång tid tog det innan din häst kunde återgå till tilltänkt arbete/funktion efter utskrivning?
    - Mindre än 3 månader
    - 3–6 månader
    - 6–9 månader

    - Mer än 9 månader
    - Återgick inte till tilltänkt arbete/funktion
- Vad är ditt övergripande intryck av vården din häst fått i samband med sin sjukhusvistelse? (Gott/Medel/Dåligt)
- Skulle du rekommendera andra hästägare att låta sin häst opereras om deras häst blev sjuk med samma sjukdom som din häst? (Ja/Nej)
- Övrigt du önskar komplettera:
- Är du intresserad av att ta del av studien när den är färdigställd? (Ja/Nej)

Appendix 2

English

- Is the horse still alive today? (Yes/No)
    - If no:
        - On what date did your horse pass away?
        - Why was the horse euthanized? (Colic, Age/Other)
- Has your horse had colic again after surgery? (Yes/No)
    - Have you sought veterinary care for colic in your horse after surgery? (Yes/No)
        - If yes, how many times has your horse needed veterinary care for colic treatment?
            - Sought care 1 time for colic
            - Sought care 2 times for colic
            - Sought care repeatedly for colic (more than 2 times)
- Did the surgical wound heal without complications and without the need for veterinary care?
    - Yes, healed without complications
    - Wound infection occurred, requiring veterinary care
    - Hernia occurred, requiring veterinary care
    - Other
- What work did your horse do before the illness?
    - Young horse
    - Leisure riding or driving
    - Training for light competition (2-3 times a week)
    - Training for mid-level competition
    - Training for high-level competition
- Has your horse returned to the work/function it had before the surgery?
    - Yes, the same
    - Yes, better
    - No
- How long did it take before your horse could return to its intended work/function after discharge?
    - Less than 3 months
    - 3–6 months
    - 6–9 months
    - More than 9 months
    - Did not return to intended work/function

- What is your overall impression of the care your horse received during its hospitalization? (Good/Average/Poor)
- Would you recommend other horse owners allow their horse to undergo surgery if their horse had the same illness as yours? (Yes/No)
- Other thing you want to add:
- Are you interested in receiving the study results when it is completed? (Yes/No)

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