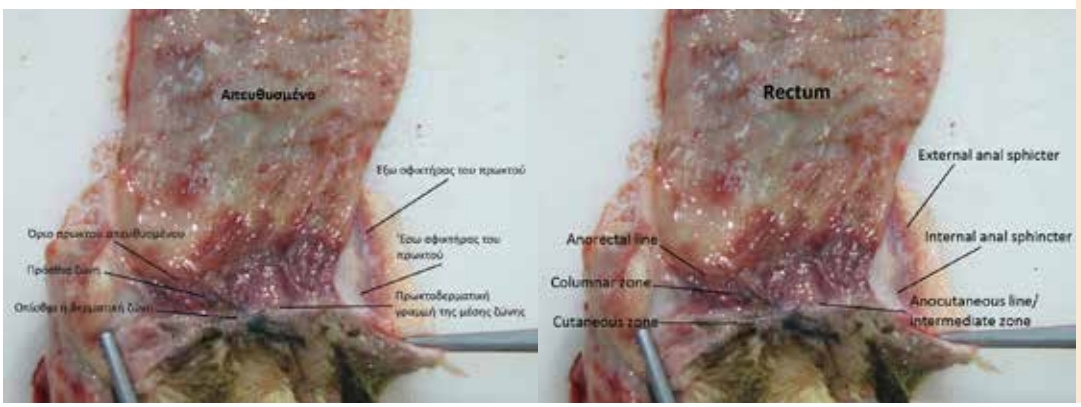
Εικόνα 1. Δοθιήνωση του πρωκτού σε έκταση 360^0 σε ποιμενικό Βελγίου.
Figure 1. Anal furunculosis extending 360^0 circumferentially in a Belgian shepherd.

Εικόνα 2. Δοθιήνωση του πρωκτού σε έκταση 360^0 και στένωση του πρωκτού σε Γερμανικό ποιμενικό.
Figure 2. Anal furunculosis extending 360^0 circumferentially and anal stricture in a German shepherd.

Εικόνα 3. Δοθιήνωση του πρωκτού σε έκταση 180^0 σε Γερμανικό ποιμενικό.
Figure 3. Anal furunculosis extending 180^0 circumferentially in a German shepherd.

Εικόνα 4. Δοθιήνωση του πρωκτού σε έκταση 360^0 σε Γερμανικό ποιμενικό.
Figure 4. Anal furunculosis extending 360^0 circumferentially in a German shepherd.



Εικόνα 5. Ανατομικό παρασκεύασμα του απευθυσμένου και του πρωκτικού σωλήνα μετά από τομή στη μέση ραχιαία γραμμή. Rectum: απευθυσμένο, External anal sphincter: Έξω σφικτήρας του πρωκτού, Internal anal sphincter: Έσω σφικτήρας του πρωκτού, Anorectal line: όριο πρωκτού-απευθυσμένου, Columnar zone: πρόσθια ζώνη, Anocutaneous line of intermediate zone: πρωκτοδερματική γραμμή της μέσης ζώνης, Cutaneous zone: οπίσθια ή δερματική ζώνη. Τα περιπρωκτικά συρίγγια εκτείνονται σε διαφορετικό βάθος που μπορεί να φθάσει μέχρι τη μέση ζώνη και τον έξω σφικτήρα του πρωκτού.
Figure 5. Cadaveric preparation of the rectum and the anal orifice following a dorsal midline incision in a normal dog. Perianal fistulae may extend to various depths that may include the intermediate zone or external anal sphincter.

Εικόνα 6. Πλάγιο ακτινογράφημα κοιλίας του σκύλου της εικόνας 2, όπου απεικονίζεται κοπρόσταση λόγω στένωσης του πρωκτού.
Figure 6. Lateral abdominal radiograph of the dog in figure 2, where obstipation is evident due to anal stenosis.

Εικόνα 8. Καρκίνωμα του πλακώδους επιθηλίου της περιπρωκτικής χώρας, που θα πρέπει να διαφοροποιηθεί από τη δοθιήνωση του πρωκτού.
Figure 8. Squamous cell carcinoma of the perianal region, which should be differentiated from anal furunculosis.

Εικόνα 10. Ο σκύλος της εικόνας 9, 4 εβδομάδες μετά την έναρξη της θεραπείας με κυκλοσπορίνη όπου φαίνεται σημαντική υποχώρηση των αλλοιώσεων.
Figure 10. The dog of figure 9, 4 weeks post initiation of treatment with cyclosporine when marked remission of lesions is evident.

Εικόνα 11. Δοθιήνωση του πρωκτού σε έκταση 360^0 σε Γερμανικό ποιμενικό.
Figure 11. Anal furunculosis extending 360^0 circumferentially in a German shepherd.

Εικόνα 7. Συρίγγιο περιπρωκτικού θυλάκου που διαπιστώνεται με την είσοδο μύλης διαμέσου του εκφορητικού του πόρου.
Figure 7. Anal gland fistula explored by inserting a probe through the corresponding excretory tract.

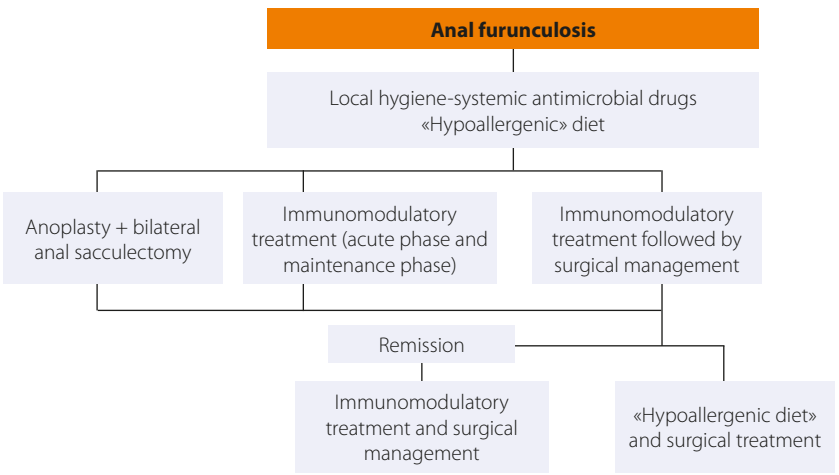
Εικόνα 9. Δοθιήνωση του πρωκτού σε έκταση 180^0 σε Γερμανικό ποιμενικό πριν τη θεραπεία με κυκλοσπορίνη.
Figure 9. Anal furunculosis extending 180^0 circumferentially in a German shepherd prior to treatment with cyclosporine.

Εικόνα 12. Πρωκτοπλαστική 360^0 με συρραφή του απευθυσμένου στο δέρμα στο σκύλο της εικόνας 11.
Figure 12. 360^0 anoplasty by suturing the rectum to the perineal skin in the dog of figure 11.

Εικόνα 13. Δοθιήνωση του πρωκτού σε έκταση 360⁰ και στένωση του πρωκτού σε Γερμανικό ποιμενικό.
Figure 13. Anal furunculosis extending 360⁰ circumferentially and anal stricture in a German shepherd.

Εικόνα 14. Εκτομή όλων των παθολογικών ιστών σε έκταση 360⁰ στο σκύλο της εικόνας 13.
Figure 14. Resection of all of the abnormal tissues in a 360⁰ in the dog of figure 13.

Εικόνα 15. Πρωκτοπλαστική με συρραφή των ιστών και του απευθυσμένου στο δέρμα της περινεϊκής χώρας και τοποθέτηση σωλήνα Penrose στο κατώτερο σημείο της τομής στο σκύλο της εικόνας 13.
Figure 15. The end result of anoplasty following suturing of tissues and rectum to the skin of the perineal region and placement of a Penrose drain in the ventral site of the surgical wound in the dog of figure 13.



Αλγόριθμος 1. Αλγόριθμος της θεραπείας της δοθιήνωσης του πρωκτού στο σκύλο.
Algorithm 1. Management algorithm for canine anal furunculosis.

Canine anal furunculosis: is there a place for surgery?

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> Abstract

Anal furunculosis is a chronic progressive canine inflammatory disorder affecting the anus and the perianal region, resulting in ulcers and blind fistula in the skin and subcutaneous tissues of the perianal region. German shepherds are predisposed to this condition. The origins of the disorder are unknown but it can be immune- mediated. Treatment can be medical or surgical, but complete cure is uncommon. Medical treatment with immunomodulatory drugs, mostly cyclosporine or cyclosporine and ketoconazole usually provides satisfactory results. Surgical treatment is employed in cases with no response to medical management, due to increased cost or prolonged duration of the latter and includes complete anoplasty and simultaneous anal sacculectomy.

> Introduction

Anal furunculosis (AF) or perianal fistulae is a chronic progressive canine inflammatory disorder of dogs affecting the anal orifice and the perianal region. It is characterised by the presence of ulcerative lesions and blind fistulae in the skin and subcutaneous tissues of the perianal and perineal regions.[1] The sinus tracts can be single or multiple and they can extend 360^0 circumferentially in the perianal area (Figures 1,2,3,4).[2] AF affects dogs with a median age of six years and of both genders. German shepherds are predisposed to the disorder even though AF occurs in other middle or large sized breeds as well as mixed breed dogs (Table 1).[1,3-5]

> Pathogenesis

The precise origin of the disorder is not fully known. Recent studies implicated an inflammatory response with presence of T-lymphocytes, other inflammatory cells, cytokines, enzymes, and other intermediaries of the inflammatory cascade and histological similarities between AF and Crohn's disease in people, resulting in the theory of a possible immune-mediated origin.[6-11] This theory is supported by an impressive response following administration of immune-mediated drugs.[2] German shepherd breed predisposition to AF is probably of genetic origin, contributing to the pathogenesis of AF.[12]

Originally, AF manifests as a subtle inflammatory response without the presence of ulcers. At this time, ulcerative lesions and sinus tracts are formed, which are lined by squamous epithelium and they are infiltrated by lymphocytes, plasmacytes, macrophages, neutrophils and eosinophils. The evolution of the inflammatory response is characterised by the presence of T-lymphocytes with extensive formation of granulomatous and fibrous tissue (fibrosis). The normal anatomy of the area is disrupted with the formation of fistulae originating from the anal glands to the anocutaneous junction, as well as lesions in the anal sacs (Figure 5). The contribution of the anal sacs to the inflammatory response is secondary resulting in abscessation and rupture. The formation of fibrous tissue in the area of the outer anal sphincter in dogs with extensive and severe lesions can result in stricture. [3,13]

> Clinical signs

Clinical signs in dogs with AF vary and are usually connected with pain in the perineal area and disorders of defecation (Table 2).[1,14-16] Several dogs already have severe lesions at the time of diagnosis.[14]

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Keywords

- Anal furunculosis
- Anoplasty
- Dog
- Perianal fistulae

Table 1. Canine breeds predisposed to Anal Furunculosis
German shepherd
Irish setter
Collie
Border collie
Labrador retriever
Old english sheepdog
English bulldog
Bouvier des Flandres
Jack Russel terrier
Cocker spaniel

> Diagnosis

Reaching a diagnosis of AF is mostly based on the history and physical examination findings. It is necessary to perform a physical examination, both with the dog in an alert state and under general anaesthesia. In the alert state, other than external examination of the anus and the perianal area, the external anal spincter tone is also tested. Most of the times, however, physical examination in the alert state is difficult or even impossible due to severe pain elicited both by palpation of the area as well as from handling and elevating the tail. Prior to administrating general anaesthesia, it is necessary to obtain a complete blood count, serum biochemistry analysis and urinalysis, as part of the preanaesthetic evaluation, as well as to exclude other conditions with similar clinical signs. Then the perianal region is visually observed to assess whether the diseased areas may in part (0°- 270°) or entirely (360°) affect the region. Rectal digital palpation is necessary in order to locate and evaluate the formation of fibrous tissue and the degree of rectal fibrosis. Stricture formation may lead to constipation and obstipation (Figure 6). Palpation of the anal sacs is also performed by digital rectal palpation and patency of their excretory ducts is determined; any sinus tracts connecting the perianal region with the anal glands are detected and the contribution of the anal glands to the inflammatory process is assessed (Figure 7). The depth of the sinus tracts is determined by using a probe. Colonoscopy and biopsy should be performed in some dogs with clinical signs of colitis, as a strong correlation has been found between chronic inflammatory disease of the large intestine and AF.[17-20]

> Differential diagnosis

AF should be differentiated from abscessation and rupture of the anal glands, anal gland adenocarcinoma, adenoma and adenocarcinoma of the perianal glands, squamous cell carcinoma of the perianal region, chemical burns, trauma and subcutaneous mycosis (Figure 8).[2] In such cases and when in doubt, cytological and histopathological examinations are recommended.

Table 2. Clinical signs of Anal Furunculosis in dogs
Pain in the perineal area
Pustular secretions in the perianal area
Abscess or fistulae of the anal sacs
Licking of the perianal area
Anal stricture
Abnormal tail positioning
Tenesmus
Fecal impaction
Dyschezia
Haematochezia
Diarrhoea
Constipation
Weight loss
Behavioural disorders

> Treatment

Treatment for AF can be medical or surgical, but it is uncommon to lead to complete and permanent cure. Surgical management of AF has been the treatment of choice for several years. A multitude of surgical techniques have been used in the past, such as surgical excision of fistulae, surgical debridement combined with chemical cauterisation, cryosurgery, cauterisation by electrodiathermy, complete tail amputation (given that a wide tail was implicated as a predisposing factor for AF) and excision by ND:YAG laser. The high percentage of relapsing and complications, including faecal incontinence, surgical wound dehiscence and anal stricture, have led to abandonment of surgical treatment as a single management strategy for AF. Moreover, many dogs required several surgical procedures in order to correct any complications.[1,4,14,15,21-26]

> Medical management

Nowadays medical management with immunomodulatory drugs is considered to be the treatment of choice due to highly satisfactory results.[2] Medical treatment aims in suppressing the pain and lesions of the anal orifice and perianal area both in the short and long-term, as relapses of the disease after treatment is withdrawn are not uncommon. Medical management includes the **acute phase**, the **maintenance phase,** a specialised **clinical**

Table 3. Immunomodulatory treatment in the management of canine anal furunculosis [2,5,38]

Acute phase	Cyclosporine: 4-8 mg/kg SID, PO, until elimination of lesions
	Cyclosporine: 0.5 mg/kg BID up to 5 mg/kg SID, PO, with ketoconazole 5-10 mg/kg SID or BID, PO
	Tacrolimus: topical application BID
	Prednisone or prednisolone: 2mg/kg PO, SID or BID, until elimination of lesions
	Azathioprine 2mg/kg SID, PO, until elimination of lesions
Maintenance phase	Cyclosporine: tapering of initial dose by 25% every 4-8 weeks or administration of initial dose every other day. Ketoconazole: SID administration in doses maintaining remission. Discontinuation when deemed appropriate
	Tacrolimus: topical application every 48-72 hours
	Prednisone or prednisolone: 0.5-1 mg/kg every other day. Discontinuation when deemed appropriate
	Azathioprine: 1 mg/kg every 48-72 hours. Discontinuation when deemed appropriate

BID: every 12 hours, PO: per os, SID: every 24 hours

diet and **local perineal hygiene-antimicrobial treatment**. For the acute and maintenance phase cyclosporine has been used as monotherapy or in combination with ketoconazole, glucocorticoids, azathioprine and local application of tacrolimus (Table 3).[2,27-39] This medication can lead to remission and, in some cases, elimination of lesions and clinical cure.[27-37]

Glucocorticoids mostly suppress cellular immunity, are inexpensive but their administration usually results in adverse effects (polyuria, polydipsia, and polyphagia). Initially they had been used combined with a specialised diet in the management of AF. In 27 German shepherds prednisone was administered (2 mg/kg/SID [/24 hours] PO [orally]) for 2 weeks, then 1mg/kg for 4 weeks and then was reduced to at a dose of 1mg/kg/48h for 8-16 weeks. Clinical cure was achieved in 33.3% of dogs, improvement in 33.3% and the rest did not respond to medical treatment.[27]

Azathioprine has been used successfully in the management of AF. Due to the long period of time that is necessary for this drug to be fully effective, it is recommended to combine it with glucocorticoids, at least during the acute phase.[38] In a prospective study with 14 dogs with AF a combination of azathioprine and prednisone was administered. Permanent cure was achieved in 57% of cases, partial improvement in 7% and no response in 36% of dogs.[40]

Cyclosporine is a powerful immunomodulatory agent, which suppresses the production of inflammatory cytokines, which are related to the activation of T-lymphocytes. In particular, cyclosporine suppresses mostly the production of interleukin-2, which is necessary for the differentiation and proliferation of T-lymphocytes.[39] The administration of cyclosporine is considered the most effective treatment of AF with a success rate of 50-85%.[29,30,33,35,36] The mean duration of treatment until the eradication of lesions, according to one study, was 8.8 weeks.[35] However, discontinuation of treatment may result in relapse usually necessitating continuation of life-long treatment at the smallest dose possible.[28] Cyclosporine was initially administered at a dose regimen of 4-8 mg/kg SID PO for 2-4 months, until the eradication of lesions, and then the dose was gradually tapered by 25% every 4-8 weeks or alternatively the initial challenge dose was administered every other day after remission of clinical signs (Figures 9, 10).[2,35,38] Cyclosporine treatment is costly and can be associated with adverse effects including vomiting, diarrhoea, anorexia, lethargy, aggression, hypertrichosis or trichorrhoea.[29,33,35,36]

The high cost of cyclosporine directed many researchers to investigate alternate methods of treatment. The combination of cyclosporine with ketoconazole reduces the cost of treatment with no change in effectiveness, compared to monotherapy with cyclosporine.[41] Ketoconazole, an antifungal agent, affects the metabolism of cyclosporine by inhibiting the effect of cytochrome P450 3A oxidase, resulting in the increase of cyclosporine blood serum levels.[41-43] Cyclosporine was administered at a dose regimen ranging from 0.5 mg/kg BID (/12 hours) up to 5 mg/kg PO SID and ketoconazole in a dose of 5-10 mg/kg PO SID.[2,38,41-43] According to a study in 19 dogs with AF, the combination of cyclosporine and ketokonazole was successful in eradicating lesions when used for a duration of 3-10 weeks in 100% of dogs, whereas relapse was observed in 37% of dogs after a period of 1-6 months after the initial treatment.[41]

Tacrolimus is a topically applied macrolide with a similar immunomodulatory effect to that of cyclosporine, which has been used successfully in the management of AF.[2,31,37] In a study of 10 dogs with AF, the topical application of tacrolimus SID or

BID for 16 weeks resulted in remission of lesions in 90% of dogs, among which 50% were completely cured.[31] In a different recent study of a total duration of two years, in 19 dogs with AF, 0.1% tacrolimus ointment was simultaneously administered with prednisone (2 mg/kg SID over two weeks, 1mg/kg SID for four weeks and 1mg/kg/48h for ten weeks) in combination with "hypoallergenic" diet. Moreover, metronidazole was administered PO at a dose of 10mg/kg BID for two weeks. After the completion of 16 weeks, 79% of dogs were cured and in 21% significant improvement was observed. During the next two years, the maintenance regimen was adhered to with tacrolimus and prednisone, and 86.6% of dogs apparently remained in remission.[37] Tacrolimus is recommended mostly for long-term maintenance, following initial remission of clinical signs with administration of cyclosporine, when applicable, every 24-72 hours aiming at the prevention of relapses.[2,38] This treatment is considered to be costly.[2,37,38]

> Clinical Diet

The combination of AF and colitis prompted several authors to recommend a specialised "hypoallergenic" diet with hydrolysed protein or protein to which the dog has never been exposed previously. Thirty three dogs with AF were fed a diet based on fish and potatoes, for 1-180 days prior to surgery (en bloc resection of lesions and anoplasty) and one year later 87.9% of dogs experienced a complete eradication of lesions, whereas only 20.7% manifested any clinical signs.[16] A specialised "hypoallergenic" diet is therefore recommended during the maintenance phase, especially in cases of lesion recurrence.[2,38]

> Local hygiene and systemic antimicrobial treatment

Local cleansing of the perineal region and hygiene measures such as clipping of the hair coat and lavage with antiseptic solutions along with systemic and topical administration of antibiotics, following culture and sensitivity testing, could aid in reducing the local bacterial flora and managing the secondary bacterial infections that are always present.[2,38]

> Preoperative immunomodulatory treatment

Preoperative immunomodulatory treatment results in remission of lesions allowing for a more conservative approach during surgical resection and reduction of complications to a minimum.[30] Various treatment regimens have been employed, such as the administration of azathioprine (50 mg PO) and metronidazole (400 mg PO) for a duration of 4-6 weeks preoperatively and two weeks postoperatively. A significant clinical improvement was noted during the first two weeks, but after the advent of 4-6 weeks there was minimal further improvement. Dogs that received the above regimen did not relapse in the following 7-10 months.[19] The adverse effects of azathioprine include gastrointestinal disorders, bone marrow suppression, hepatotoxicity, and pancreatitis whereas metronidazole side effects include anorexia, central nervous system toxicity and hepatotoxicity.[2] In a study of 25 dogs with AF, cyclosporine was administered (2.5-5 mg/kg BID PO) as monotherapy, cyclosporine (1-1.5 mg/kg BID PO) in combination with ketoconazole (12.5 mg/kg SID PO), or azathioprine (1-2 mg/kg SID PO) in combination with prednisolone (1 mg/kg BID PO for 2 weeks and then reduced to 0.5 mg/kg BID PO) for less than 12 weeks. Surgical management included resection of all fistulae, cryptectomy of the transitional zone of the rectum up to the anocutaneous line and bilateral anal sacculectomy. None of the dogs relapsed after a follow-up time of 9 months after surgery.[30]

> Surgical management

Indications of surgical management include cases nonresponsive to medical treatment, cases with AF affecting the anal glands, and cases in which the cost of medical treatment is significant and its duration is prolonged. Surgical resection of all of the affected tissues is a prerequisite for successful results.[1,5,16] Good knowledge of anal canal anatomy is necessary in order to prevent severe complications. Surgical resection includes the removal of all perianal fistulae and their sinus tracts, as well as bilateral anal sacculectomy due to anal sac implication in the pathogenesis of the disorder.[5,16] Currently, in cases of extensive lesions in the perianal region, complete 360^0 anoplasty is recommended with simultaneous bilateral sacculectomy.[5,16] Following surgical resection of the skin around the anus, all of the lesions are removed including the subcutaneous tissue, the muscles and fascia as well as the anal orifice. If necessary, partial or complete resection of the external anal sphincter is performed. Dead space is eliminated and the subcutaneous tissue is approximated to the serosa and muscular layer of the rectum by 3/0 polydioxanone simple interrupted sutures. Finally, the mucosal layer and submucosa of the rectum are sutured to the skin by 3/0 nylon sutures (Figures 11,12, 13, 14, 15).[5,16] In cases when surgical wound closure is impossible, due to increased tension, healing by secondary intention is preferred. In a study of 51 dogs with AF which underwent 360^0 anoplasty combined with bilateral anal sacculectomy, after a median follow-up of 18 months, 2% of cases relapsed, 13% manifested anal stenosis and 4% had fecal incontinence.[5]

Treatment of AF is summarised in Figure 1.

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