Fibrotic myopathy of the iliopsoas muscle in a dog

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Introduction

Fibrotic myopathy or muscular contracture is a chronic, progressive disorder of severe muscle contracture and fibrosis (1, 2). The exact cause is usually unknown. The fibrotic myopathy may result from acute trauma, chronic repetitive trauma, autoimmune disease, drugs reactions, infections, neurogenic disorders and vascular abnormalities (2). Ischaemia secondary to indirect trauma may also lead to fibrosis and contracture (1, 2). Histologically, muscle is replaced by dense, collagenous connective tissue (2).

In humans, indirect muscle injuries occur subsequent to rapid acceleration during athletic activities (3). Muscle strains are caused by excessive force or stress on the muscle that induces tearing of muscle fibres or, most often, tearing of the musculotendinous junction (3, 4). The type and severity of injury determines whether the muscle heals predominately by regeneration of functional myofibrils or by scar formation (4, 5). Severe damage to a muscle is followed by fibrosis and contracture, with minimal regeneration. Although fibrous scar tissue provides tensile strength and plays a part in normal muscle healing, excessive scar tissue impedes muscle fibre regeneration and interferes with muscle contraction and relaxation, resulting in varying degrees of mechanical lameness (1, 6–11).

Muscle injuries in dogs may be underestimated because of the failure to establish a definitive diagnosis, poor recognition of muscular damage when accompanied by concurrent, more severe trauma, and problems with the classification of muscular trauma (6–8, 12). Muscle injuries are said to account for only 5% of reported musculoskeletal disease (9, 13). Lameness is usually more intense in the acute phase and improves with time. When injured muscle undergoes fibrous contraction, a mechanical lameness may remain (6, 7, 9, 14). Exercise-induced trauma and intramuscular injections have been associated with the development of fibrotic myopathies in dogs, cats, horses and humans (9, 15–21). Pelvic muscles reported to be affected by fibrotic myopathy are the quadriceps, gracilis, semitendinosus and sartorius muscles in dogs (7, 10, 22, 23).

Ninety-five percent of hind limb muscle strain injuries in 22 dogs involved the hip adductor muscles (15). The iliopsoas was primarily affected in seven dogs (32%), but only three dogs in this study had chronic clinical signs due to iliopsoas muscle injury (15). In this series, the symptoms did not resolve completely with conservative therapy and none of the dogs were treated surgically. Two case reports of chronic clinical signs due to iliopsoas injury in dogs reported excellent function following surgical treatment (tenotomy or tenoectomy) of the muscle lesion (3, 24). In these cases, the diagnoses of the chronic iliopsoas injuries were based on physical examination and did not include confirmation by computed tomography (CT) images or histological examination.

This article reports the clinical findings and successful surgical treatment of fibrotic myopathy of iliopsoas muscle in a dog. Concurrent femoral neuropathy was suspected. To our knowledge, this is the first description of histopathologically confirmed fibrotic myopathy of the iliopsoas muscle in a dog. The appearance of this lesion on CT is also reported for the first time.

Case report

A seven-year-old, 28 kg, female, Korthals Griffon dog was examined by a veterinarian for the complaint of acute onset of left hind limb lameness. The lameness appeared after a period of two days of intense exercise while the dog was hunting. On physical examination, pain was localised to the left coxofemoral joint. The lameness improved with re-
stricted activity and administration of meloxicam\(^a\) (0.1 mg/kg, PO, q 24 hr) for 10 days. However, the lameness recurred each time the activity was progressively increased. After several weeks, the severity of the lameness progressed from mild to non-weight-bearing.

Two months after the initial episode, the dog was referred for a second opinion. Orthopaedic examination revealed pain on simultaneous extension and internal rotation of the left coxofemoral joint and palpation of the left lumbar paraspinal musculature and lesser trochanter. Left quadriceps muscle atrophy was present. On neurological examination, assessment of the postural reactions and some spinal reflexes of the left pelvic limb was not possible due to pain. The left patellar reflex was depressed.

Complete blood count, biochemistry, and urinalysis were unremarkable except for a mildly increased plasma creatinine kinase concentration (536 U/l; reference range 76 to 110 U/l). On survey, ventro-dorsal and lateral radiographs of the lumbar spine and pelvis, a reduction in the quadriceps muscle mass of the left pelvic limb was present.

The dog was anaesthetised, and pre-contrast transverse CT\(^b\) images were acquired with 3 mm thick sections from the caudal end of the third lumbar vertebra to the 2nd coccygeal vertebra. This sequence was repeated following an intravenous infusion of 2 ml/kg contrast medium (iodine\(^c\), 300 mgI/ml) which was delivered by hand injection as a bolus. Computed tomography revealed an asymmetric enlargement of the left iliopsoas muscle belly near the musculotendinous junction, with a small well-defined high density area and non-uniform enhancement after contrast medium injection (Fig. 1A, B).

Surgical biopsy of the left iliopsoas muscle was performed via an approach to the ventral aspect of the left hip joint. The iliopsoas muscle belly was enlarged and did not show macroscopic signs of partial rupture. The dog was confined in a cage with anti-inflammatory therapy pending histopathological results. Histopathological examination revealed variably sized muscle fibres separated by mature fibrous tissue composed of fibroblasts and increased collagen, consistent with moderate to severe endomysial and perimysial fibrosis (Fig. 2A, B). There were low numbers of lymphocytes and plasma cells around blood vessels.

A tenomyectomy of the iliopsoas approximately 0.5 cm from its origin was performed. A 2 cm section was resected. Normal range of motion for the hip was verified.

Following the surgery, cefalexine\(^d\) (22 mg/kg PO, TID) was administered for three days. Analgesia was provided with a fentanyl skin patch\(^e\) (50 \(\mu\)g/kg), and carprofen\(^f\) (2.2 mg/kg PO, bid – for seven days). Minimal exercise and light physiotherapy were instituted for the first five days.

Five days after surgery the dog was intermittently weight bearing on the affected limb. The patient was discharged with instructions to restrict exercise to leash walks for the first

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\(^a\) Metacam\(^®\): Boehringer Ingelheim GmbH, Ingelheim, Germany

\(^b\) CT\(\text{e} ProSpeed 3rd Generation: General Electric Medical Systems, Milwaukee, WI, USA

\(^c\) Telebrix\(^®\): Guerbert laboratory, Roissy, France

\(^d\) Cefaseptin\(^®\): Vetoquinol SA, Lure, France

\(^e\) Durogesic\(^®\): Janssen-Cilag, Issy-Le-Moulineaux, France

\(^f\) Rimadylo\(^®\): Pfizer Santé Animale, Paris, France
three weeks, followed by a controlled progressive increase in activity over the next six weeks.

On re-examination 16 weeks later, the dog did not show signs of lameness. Physical examination revealed a normal range of motion of the left coxofemoral joint. There were not any signs of pain evident on palpation of the operated area nor on manipulation of the joint. Neurological examination was normal with the exception of a slightly depressed left patellar reflex. The dog was then allowed to return to full activity. During telephone follow-up conversation 24 months after surgery, the owners indicated that the dog remained clinically normal without recurrence of lameness.

**Discussion**

To the authors’ knowledge, this is the first report of histopathologically confirmed fibrotic myopathy of the iliopsoas muscle in dogs. The initial injury to the iliopsoas muscle belly that we report could have been caused by indirect trauma or strain similar to previously reported injuries in athletes (3, 4). It is unlikely that traumatic external force would affect the iliopsoas muscle in isolation because of its protected anatomic location. In this case, lameness appeared after intense exercise. Muscle fatigue predisposes to strain by decreasing the elasticity of the muscle fibres from over-stretch and overuse (3, 25). This injury is characterised by initial muscular inflammation and haemorrhage. Sustained elevation of intramuscular pressure could result from increased fluid content or decreased compartment size. This acute compartment syndrome reduces capillary perfusion below a level necessary for tissue viability, and irreversible muscle and nerve damage may occur (4–6, 9).

In this case, as described in previous reports, internal rotation and extension of the affected pelvic limb results in the stretching of the muscle-tendon unit of the iliopsoas muscle and pain. Palpation of the iliopsoas muscle just cranial to its attachment on the lesser trochanter of the femur, or transrectal palpation of the pubic rim and ventromedial aspect of the ilium in small dogs, allows evaluation of various portions of the iliopsoas muscle for pain response. (14, 24, 26). In dogs, several case reports describe ultrasonographic diagnosis of iliopsoas injury (14, 15, 24). Ultrasound imaging is often adequate and appropriate in the evaluation of potential muscular injuries that are anatomically accessible (27, 28). In humans, ultrasonography is described for the diagnosis of muscle and tendon tears, but not muscle strains (3, 12, 29). However, ultrasonography has some limitations, including poorer soft tissue contrast compared to CT and the inability to penetrate osseous structures (12, 29). The sensitivity of diagnostic imaging of soft tissue injuries has been enhanced by CT and magnetic resonance imaging (MRI). The psoas muscles are easily visualised in dogs (27) and humans (12, 29–33) on abdominal and pelvic CT and MRI examinations. Abnormalities of the iliopsoas muscle usually result in asymmetrical enlargement. Inflammation, haemorrhage and neoplasia may involve the entire length of the muscle. In humans, lesions at the level of the muscle-tendon junction are characterised by limited tearing of the fibres and a subsequent inflammatory reaction with increased fibrous or scar tissue at the site of injury (30, 31). A possible sequel of strain injury is the appearance of dystrophic calcification at the injury site (12, 30–32). Computed tomography is superior to MRI in imaging deposition of calcium in muscle (12). This cal-
cification can often be invisible on plain radiographs (12, 32). Garret et al. (30) suggested that indirect hamstring muscle injury is detected acutely on CT examinations as a low-density lesion. This lesion evolves over time, with resolution, or becomes mineralised (12, 30, 31). It is unknown whether athletes with muscle mineralisations are more likely to have chronic or recurrent injuries (3, 12, 30). In this case, CT images showed non-uniform contrast enhancement with a small high-density region of mineralisation within the iliopsoas muscle belly near the musculotendinous junction. Histopathology of the muscle biopsy revealed fibrosis with minimal inflammation. An area of mineralisation was not present but the small high-density region may not have been sampled. Computed tomography in this case revealed lesions located in anatomical areas adjacent to the tendon of insertion of the iliopsoas muscle, which may provide supportive evidence for the presence of a muscular strain.

In humans, conservative treatment of chronic groin pain, including long-term non-steroidal anti-inflammatory drug administration, is often unsuccessful and the rate of re-injury is high. Results of tenomyectomy are reported to be excellent clinically (3, 25, 34). The purpose of tenomyectomy is to remove the painful muscle pull at the tendon of insertion and restore pain-free adductor muscle function (3, 34). Tenomyectomy is simple and has a low complication rate (34). In this case, as previously reported in other dogs, tenomyectomy resulted in the successful treatment of chronic iliopsoas injury (14, 24).

The femoral nerve has motor and cutaneous sensory functions. Its superficial branch (saphenous nerve) is the sensory pathway from the skin on the medial surface of the limb and medial digit. The principal motor nerve function is extension of the stifle and flexion of the hip (35). In humans, extensive lesions located in the psaoses or iliacus muscles, may lead to an iliacus compartment syndrome and cause femoral neuropathy, either by direct compression or local nerve ischaemia (36–40). Clinically, these patients develop subacute pain in the inguinal region and weakness of the leg. Examination reveals weakness and atrophy of the quadriceps muscle and an absent knee jerk reflex. Sensation is usually spared (37, 38). In dogs, femoral neuropathy was reported in two cases of acute traumatic iliopsoas muscle injury (14, 26) and in one case of iliopsoas muscle tumour (haemangiosarcoma) (41). More recently, one case of chronic iliopsoas muscle injury with femoral nerve dysfunction was reported (24). Iliopsoas muscle injury with femoral nerve paralysis is a syndrome that is characterised by severe pain and pelvic limb lameness in dogs (14, 24, 26). A lesion that affects the femoral nerve or its branches is suspected following the identification of the depressed patellar reflex, incomplete pelvic limb withdrawal reflex, and the absence of cutaneous sensation in the medial aspect of the limb (35). In this case, sensory deficits were not observed. Considering the depressed patellar reflex and loss of quadriceps muscle mass on the left limb, a femoral motor lesion could be considered. This muscle atrophy could also have developed secondary to chronic pain and disuse of the pelvic limb. An electromyographic examination could have been useful in order to confirm a potential neurological deficit. On CT images, a lesion consistent with a myelopathy of the L3-L6 spinal cord segments was not visualised. We suspect that some degree of neuropraxia involving the proximal segment of the femoral nerve resulted from compression by the adjacent, enlarged iliopsoas muscle.

In conclusion, history, clinical examination, CT images and histological findings confirmed the presence of fibrotic myopathy of the iliopsoas muscle in this case. Computed tomography appeared to be a valuable tool for the assessment of this injury and it revealed an enlargement of the affected muscle when compared with the unaffected side, as well as variable non-uniform contrast enhancement with a small high-density region. Histopathological examination of the muscle tissue was essential to characterise the type of lesion. This case report also suggests that tenomyectomy should be considered in dogs with pain secondary to fibrosis of iliopsoas muscle that has been refractory to conservative treatment. Finally, when an injury of the iliopsoas muscle is clinically suspected, a careful neurological examination should be performed to exclude secondary femoral nerve injury.

Acknowledgements
The authors wish to acknowledge Doctors Barbara Kirby, Aidan McAlinden, Jerry O’Riordan and Philip Cusack for providing constructive feedback on the report.

References