Case Report

Supracoronal approach for keratoma removal in horses: Two cases

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Summary

Two competitive horses were presented for examination of chronic lameness; one associated with a hoof-wall deformity, the other with a firm mass over the dorsal pastern region. Radiographs revealed moderately radiopaque masses associated with both deformities. The lesions were characterised ultrasonographically as noninvasive, well-circumscribed heterogeneous masses. Computed tomographic examination of the second case revealed a well-defined, partially mineralised, bi-lobed mass with associated bony resorption of the underlying middle phalanx. Both patients were anaesthetised and the keratomas surgically removed via approaches 1–2 cm proximal to the coronary bands. Both horses were stall-sound 2 days after surgery and returned successfully to an equal level of competition by 8 months. A supracoronal approach is a viable alternative to partial or complete hoof wall resection for the removal of nonsolar keratomas from the foot of a horse.

Introduction

Differential diagnoses for soft tissue masses of the distal limb include neoplasia such as fibroma, squamous cell carcinoma (Berry et al. 1991) and malignant melanoma (Kunze et al. 1986). Given the rarity of neoplasia in this area (Lloyd et al. 1988; Chan and Munroe 1997; Valentine et al. 2000), hoof wall keratoma must be considered. Keratomas can present as masses with or without hoof wall deformation (Chan and Munroe 1997; O’Grady and Horne 2001), associated focal lysis of the distal phalanx (P3), or concurrent solar infection and lameness (O’Grady and Horne 2001). They typically originate just distal to the coronary band and extend toward the toe (Chan and Munroe 1997). The masses in this report were located proximal to the coronary band, leaving doubt as to their origin and pathophysiology. Surgical excision is the treatment of choice for each of the differentials and is preferred to conservative management in the case of a keratoma (Bosch et al. 2004).

Case 1

An 18-year-old Thoroughbred gelding used for novice level eventing was referred to the George D. Widener Hospital at the University of Pennsylvania, New Bolton Center in June 2006 with a 2 year history of a mass on the dorsolateral aspect of the right hind foot. The mass had been noticed in early 2004 coincident with moderate right hindlimb lameness. Treatment with rest, nonsteroidal anti-inflammatory drugs and later, a 14 day course of trimethoprim/sulphamethoxazole (25 mg/kg bwt per os q. 12 h), had been unsuccessful. After having received antimicrobial treatment the lameness had dissipated but the mass had remained unchanged. Successive episodes of lameness were increasingly severe.

A 3 x 4 cm mass at the dorsolateral aspect of the right hind coronary band caused deformation of the hoof from the coronet to the tip of the toe. The horse was 3/5 lame in the right hindlimb at a trot in a straight line (Ross and Dyson 2002). Lameness was abated by 80% with perineural analgesia of the plantar digital nerves at the base of the proximal sesamoid bones. Low plantar digital local anaesthesia at the level of the heel bulbs did not change the lameness. Radiographs revealed a well-circumscribed, heterogeneous, radiopaque mass in the soft tissues dorsal to the distal interphalangeal (DIP) joint and lateral to the extensor process of P3 (Fig 1). No deformation, invasion or lysis of P3 was noted, nor was there any evidence of a sclerotic rim of bone adjacent to the mass.

The mass was ultrasonographically characterised as lamellar with heterogeneous echotexture and measured 2.8 cm wide, 3.6 cm long and 1 cm deep. The collateral cartilages, long digital extensor tendon and the collateral ligaments of the DIP joint were ultrasonographically normal. Differential diagnoses included hoof wall

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keratoma, calcified haematoma, fibroma, squamous cell carcinoma and malignant melanoma (Sundberg et al. 1977; Berry et al. 1991; Seahorn et al. 1992; Valentine et al. 2000; O’Grady and Horne 2001).

The horse was placed under general anaesthesia in left lateral recumbency and an Esmarch tourniquet was applied to the proximal third of the metatarsus. The right hindlimb was clipped and prepared pursuant to standard aseptic technique, from the proximal metatarsus to the foot. The foot itself was thoroughly cleaned and then scrubbed with chlorhexidine. An iodine povidone/ isopropyl alcohol solution (DuraPrep)1 was then applied and allowed to dry. Perineural analgesia was performed at the level of the base of the lateral proximal sesamoid bone. The surgical site and hoof were covered with an iodophor impregnated antimicrobial incise sheet (Ioban)1. A proximally convex crescent-shaped skin incision was made over the dorsolateral aspect of the middle phalanx (P2) 2 cm proximal to the coronary band. The body of the mass was isolated with periosteal elevators. A vascular pedicle originating from the sensitive lamina of the hoof wall was double-ligated and transected. The mass was placed in 10% neutral-buffered formalin and submitted for histopathological analysis. The subcutis and skin were closed in 2 layers.

Removal of the mass left a large amount of dead space under the bulging hoof wall defect. To allow distal drainage, a 4 cm long, 3 mm wide full-thickness vertical groove was burned through the apex of hoof wall deformity using a high-speed rotary tool (Dremel High Speed Cutter)2. The cavity was packed with a collagen sponge (Ultrafoam Collagen Sponge)3 soaked in amikacin (1.5 g; Amiglyde-V)4. The disruption of hoof wall integrity and resultant instability was countered by placement of 1.25 mm steel-wire suture across the groove in a shoe-lace pattern (Fig 2) and application of a 2-layer reinforced dorsal hoof wall covering. The sutures were not tightened enough to close the gap or occlude drainage, but were secure enough to decrease shearing forces on the hoof wall. A urethane-soaked (Equi-Thane Adhere)5 linear carbon fibre fabric patch6 was bonded to the hoof wall with its fibres running perpendicular to the defect. A piece of stiff plastic tubing was placed in the distal-most aspect of the gap, to be pulled before the adhesive hardened, in order to maintain a distal opening for drainage. Kevlar/ carbon-fibre meshwork (Cobra Sox)5 saturated with Equithane was placed over the entire repair to provide support in torsion and compression and protection from dorsal impact. The foot was left bare of any type of shoe, supportive device or cast, and was placed in a bandage with a duct tape covering. The limb was then placed in a modified Robert-Jones-style bandage extending from the ground (including the foot) to the tarsus.

The gelding recovered from general anaesthesia without incident. Stall confinement was initiated, phenylbutazone (3 mg/kg bwt per os q 12 h) was administered and daily bandage changes were performed. Although moderately painful in the immediate post operative period, by 48 h the gelding was ambulatory with a greatly improved comfort level as judged by decreased heart rate, increased voluntary motion and weight borne on the affected limb. Bandage changes revealed minimal bleeding and adequate drainage. The gelding was discharged 5 days after surgery with instructions for strict stall rest, a tapering course of oral phenylbutazone and bandage changes every 3 days. One
month later the hoof patch was reset and a glue-on shoe (Sigafloos Series I) was applied. The gelding was sound at this time. Over the next year, the coronary band returned to its normal conformation and the hoof wall defect was pushed down and out of the hoof by healthy new growth. The gelding was gradually returned to work and was competing successfully at the same level 8 months after surgery. There has been no keratoma recurrence.

Case 2

A 12-year-old Hanoverian gelding was referred to the George D. Widener Hospital at the University of Pennsylvania, New Bolton Center with a history of persistent left forelimb lameness. Treatment with corticosteroid injections of the corresponding distal and proximal interphalangeal joints and multiple i.m. injections of polysulphated glycosaminoglycans had failed. The gelding had recently developed a bulge on the dorsal aspect of the left front pastern. Magnetic resonance imaging of the foot and pastern region had been performed at another referral centre 3 weeks prior to presentation. The radiologist’s report had described a mass located just dorsal to P2 and P3 and had diagnosed villonodular synovitis.

At presentation the gelding displayed grade 2/5 left front limb lameness and had a firm, nonpainful mass on the dorsal aspect of the left front pastern. Magnetic resonance imaging of the foot and pastern region had been performed at another referral centre 3 weeks prior to presentation. The radiologist’s report had described a mass located just dorsal to P2 and P3 and had diagnosed villonodular synovitis.

At presentation the gelding displayed grade 2/5 left front limb lameness and had a firm, nonpainful mass on the dorsal aspect of the left front pastern. The owner wanted the mass removed and elected not to have a detailed lameness examination performed. Radiographs showed soft tissue thickening over the dorsal proximal aspect of P2 (Fig 3). Organised mineralisation was visible within the thickened area. There was well-marginated lysis in the dorsolateral portion of the diaphysis of P2 and proximal irregular periosteal reaction. Primary differential diagnoses for the mass included soft tissue neoplasia, resolving haematoma, granuloma and keratoma.

The gelding was placed under general anaesthesia in right lateral recumbency. Computed tomography was performed using an 8 slice mobile CT scanner (EQUS I) at 120 kVp and 1.25 mm slice thickness (Fig 4). A well-defined, partially mineralised bi-lobed mass was seen overlying the dorsolateral aspect of the mid-diaphysis of P2. The mass was deep to the common digital extensor tendon, noninvasive and measured 4.5 cm wide by 2.3 cm deep by 4.5 cm long.

Presurgical preparation of the limb was performed as described in Case 1. An inverted ‘T’ shaped skin incision was made directly over the mass. The vertical incision extended from mid-pastern to 1 cm proximal to the coronary band and the horizontal incision was 7 cm long. The common digital extensor tendon was transected in an inverted ‘V’ just distal to the insertion of the extensor branches of the suspensory ligament and retracted distally. The mass was excised as described in Case 1 and submitted for histopathological analysis. The extensor tendon was reapposed using No.1 polyglactin 910 (Vicryl) in a cruciate pattern. The skin was closed in 2 layers and the distal limb was placed in a fibreglass cast.

The gelding recovered from general anesthesia without incident and was sound at the walk immediately after surgery. Stall confinement was initiated and both phenylbutazone (3 mg/kg bwt per os q. 12 h for 5 days) and procaine penicillin (22,000 iu/kg bwt i.m. q. 12 h for 3 treatments) were administered. The gelding was discharged 5 days later with instructions for stall rest and a
tapering course of oral phenylbutazone. Four weeks later
the cast was removed and the animal was sound at a
walk. Gradual reintroduction to work was commenced
after 2 months of rest. The gelding was sound competing
successfully as an upper-level dressage horse one year
after surgery. There has been no keratoma recurrence.

The masses were grossly characterised as disorganised
with inwardly-folded lamellar structure. They ranged from
tan-yellow on the periphery to dark brown in the centre.
Histopathologically, the masses were composed of large
amounts of lamellar keratin devoid of viable cellularity and
were diagnosed keratomas.

Discussion

Keratoma is a rare condition of the equine hoof (Sundberg
et al. 1977; Lloyd et al. 1988; Reeves et al. 1989; Berry et al.
1991). In a review by Sundberg et al. (1977), keratomas
accounted for 1.3% of 236 neoplasms diagnosed from 1322
biopsies or necropsies over a 5 year period. Keratomas
typically originate from the keratinocyte-producing stratum
basale of the coronary band (Reeves et al. 1989). They are
also reported to arise from both the inner cornified layer of
the hoof wall and rarely from the sole itself (O’Grady and
Horne 2001). They grow between the hoof wall’s inner
stratum and P3 (Lloyd et al. 1988; O’Grady and Horne 2001).
They are usually solitary masses comprised of characteristic
concentric sheets of squamous epithelial cells, abundant
keratin and few viable cells (Lloyd et al. 1988). They can be
oblong or spherical (O’Grady and Horne 2001), appear
tan/yellow to brown on cross-section (Sundberg et al. 1977;
Lloyd et al. 1988; Reeves et al. 1989), and are often
associated with local infection (Lloyd et al. 1988; Boys Smith
et al. 2006). Although their aetiology remains obscure
(O’Grady and Horne 2001), they are thought to arise from
trauma to the hoof wall (Lloyd et al. 1988) or chronic
irritation of the inner laminae (Reeves et al. 1989). Despite
being located predominantly proximal to the foot, both of
the masses described had vascular or filamentous
connections to the sensitive lamellar tissues of the foot and
thus do not necessarily challenge proposed aetiologies.

Keratomas commonly cause lameness when present
(Lloyd et al. 1988; Valentine et al. 2000). Lameness
manifests only when they become large enough to
impinge on the laminar dermis of P3 or are associated with
acute subsolar infection (Seahorn et al. 1992). Although a
keratoma is not typically visible radiographically unless
mineralised, its presence can be suspected with a
radiolucent defect in P3 (Lloyd et al. 1988). The defect
occurs due to pressure necrosis as the mass grows in a finite
space. This radiolucency is distinguished from osteomyelitis
by its distinct margination, lack of sclerotic rim and history of
gradual onset of lameness. Computed tomographic
imaging can show underlying bony reaction but is not
necessary for diagnosis.

The treatment of choice for keratomas is surgical
excision via complete or partial hoof wall resection (Boys
Smith et al. 2006). Bosch et al. (2004) reported a return to
equal or higher level of performance in 83% of patients
managed surgically, as opposed to 42% of those managed
conservatively. A study by Boys Smith et al. (2006)
compared complete and partial hoof wall resection
techniques for keratoma removal, and found fewer surgical
complications and a more rapid return to athletic activity
with the latter technique. Post operative complications of
significance include loss of hoof wall stability, excessive
formation of granulation tissue and recurrence (Bosch et al.
2004; Boys Smith et al. 2006). Partial resection of the hoof
wall is preferred as it limits post operative morbidity,
iatrogenic instability and thus post operative lameness.

The cases reported here are unusual due to the
locations of the keratomas and their atypical radiographic
characteristics. Keratomas commonly manifest as
lameness of the affected foot, and presurgical diagnosis is
often predicated on radiographic presence of the classic
radiolucent halo of bony resorption keratomas can cause.
These conditions are not always pre-existing and were not
noted to be a feature of the disease in the cases reported
here. The masses described in this report had mineralised
density on radiographs and no associated halo of bony
resorption (Case 1). Although keratoma-induced bony
resorption was present in Case 2. It was located on P2,
which, to the authors’ knowledge, has not been reported
previously. Both masses were histopathologically identified
as keratomas, proving that this lesion can be located
above the hoof wall. In addition, keratoma must be a
differential diagnosis for a lameness-causing mass of the
foot or pastern region, even without the presence of
radiographic abnormalities of P3.

The successful resolution of these cases documents
the possibility of an extramural approach to keratoma
excision. It offers the distinct advantage of maximising post
operative hoof wall integrity, minimising the convalescent
period and decreasing the time to return to work. The post
operative morbidity, especially protracted lameness,
classically associated with hoof wall resection is avoided.
Immediate cosmesis is also improved. Although chosen in
these cases because of how far proximal the masses were
located, it is possible that this approach could be used for
any hoof wall keratoma.

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Authors’ declaration of interests

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