

Case Report

Cervical vertebral osteomyelitis in a 4-month-old foal

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Summary

Vertebral body osteomyelitis in the cervical spine secondary to *Rhodococcus equi* has been treated both medically and surgically. This Case Report describes a 4-month-old foal exhibiting severe neurological signs from *R. equi* vertebral body osteomyelitis. Rapid, significant resolution of neurological signs was noted in this case with surgical debridement and use of synthetic bone filler. The outcome suggests that aggressive surgical therapy in conjunction with synthetic allograft may be indicated in treatment of cervical vertebral body osteomyelitis.

Introduction

Vertebral body osteomyelitis can cause mild to severe neurological disease in foals and is usually found secondary to septicaemia or bacteraemia. There have been few reported cases of vertebral osteomyelitis in foals, but common sites include the cervical vertebrae and pelvis (Richardson 1986; Giguère and Lavoie 1994; Olchowy 1994). The primary source may be pneumonia, omphelophebitis or gastrointestinal disease. Most reports of vertebral body osteomyelitis in foals aged >1 month are secondary to *Rhodococcus equi* pneumonia (Desjardins and Vachon 1990; Chaffin 1995; Chaffin *et al.* 2003; Clark-Price *et al.* 2003). However, other bacterial infections have been reported (Richardson 1986; Markel *et al.* 1986). Clinical presentation of foals can include: history of previous septicaemia, pneumonia or omphelophebitis; fever; neutrophilia with left shift; varying degrees of lameness; and neurological disease, dependent on the location of the lesion. Differential diagnoses of ataxia in the foal include trauma or cervical vertebral malformation. Treatment of vertebral body osteomyelitis entails long-term antibiotic therapy, nonsteroidal anti-inflammatories, surgical debridement of vertebral body lesions and appropriate wound care.

Initially, medical management of the primary disease is instituted. If the clinical signs persist or worsen, surgical debridement of the vertebral osteomyelitis is indicated. Descriptions of medical treatment alone have been unsuccessful (Giguère and Lavoie 1994; Olchowy 1994). However, only one case has been described utilising surgical intervention in a pelvic abscess (Clark-Price *et al.* 2003). No cases involving surgical debridement of a cervical vertebral lesion have been reported. The current Case Report describes surgical management of vertebral osteomyelitis in a foal with concurrent use of ultraporous B-tricalcium phosphate (B-TCP) as a packing material post debridement.

Case details

A 4-month-old, 125 kg Trakehner colt presented to San Luis Rey Equine Hospital for neurological evaluation and advanced diagnostics. The referring veterinarian had been treating the foal with anti-inflammatory, antibiotic and sulphamethoxazole-trimethoprim with pyrimethamine therapy for the previous 6 weeks. The foal was admitted with a history of recumbency and inability to stand unassisted for the previous 3 weeks.

Physical examination revealed a recumbent foal with grade 5/5 ataxia. All other physical examination findings were within normal limits. A complete blood count revealed a normal white blood count (11.1×10^9 cells/l) with a left shift and hyperfibrinogenaemia (6.00 g/l). Cervical radiographs revealed a lytic lesion involving both C2 and C3 (**Fig 1**). Radiographs of the pelvis and thoracic spine revealed no significant abnormalities. The foal was catheterised in the left cephalic vein using a 16 gauge catheter; 75 ml DMSO in 1 litre i.v. fluids (Normasol R) and tetanus toxoid vaccination were given. Myelography and computed tomography (CT) were performed consecutively. The foal was anaesthetised using a constant rate infusion of 50 g guaifenesin, 1500 mg ketamine and 500 mg xylazine (GXX) in 1 litre, placed in right lateral recumbency and aseptically prepared for myelogram. Neutral, flexed and extended radiographs of the cervical spine were obtained. Marked dorsal spinal column impingement was noted at the articulations of C2–3

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Fig 1: Initial myelographic results demonstrate bony lysis at C2/C3 and dorsal spinal column narrowing at C2-3 and C4-5.

and C4-5. A large lytic lesion was noted at the cranial end of C3 and marked bony lysis was noted at the C2-3 articulation. CSF analysis revealed no abnormalities. CT images of the cervical spine confirmed a vertebral body abscess and spinal canal compression (**Fig 2**). The foal recovered well from the procedures.

Surgical debridement of the cervical lesions was elected. The foal was treated with 125 mg flunixin meglumine (1 mg/kg bwt) i.v. b.i.d., 550 mg omeprazole (4.4 mg/kg bwt) *per os* and 3 l Normasol R i.v. CBC revealed a marked leucocytosis (19.2×10^9 cells/l) with left shift and hyperfibrinogenaemia (6.06 g/l). The foal was placed under general anaesthesia using isoflurane gas and placed in dorsal recumbency. The ventral midline of the neck was clipped, prepared and aseptically draped. The lesion was located using 16 gauge needles and digital radiography intraoperatively. A 20 cm skin incision was made on the ventral midline of the neck centred over C2-3 using digital radiography. Haemostasis was maintained with haemoclips and haemostats. The overlying connective and muscle tissue layers were bluntly and sharply dissected to the cervical spine. The ventral spine of C2 was palpated and exposed by an incision through the *longus colli* muscle. All attachments to the

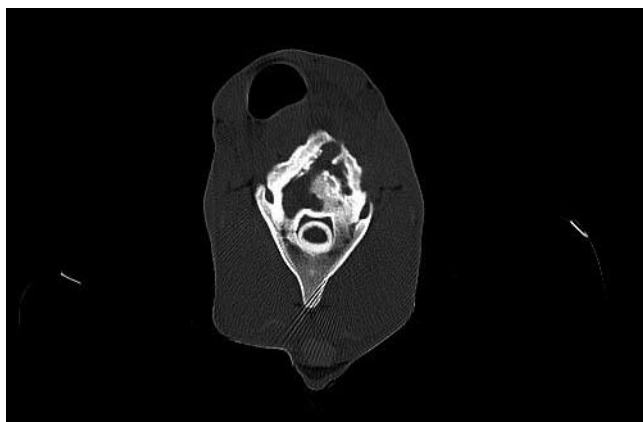


Fig 2: Initial computer tomography images demonstrating bony lysis at C2-3.

spine were removed by blunt dissection. The vertebral abscess was located. Purulent and necrotic tissue from C2-3 was removed and debrided to healthy tissue using bone curettes and ronguers. The purulent debris was gram stained and submitted for culture. Large amounts of Gram-negative bacteria were noted on cytology. Culture results returned no growth. The cavity was thoroughly flushed with sterile saline containing 1 g amikacin. Blood (50 ml) was obtained and combined with the B-TCP bone filler. The mixture was allowed to clot and firmly packed into the debrided cavity. The muscle bellies were apposed in a simple continuous pattern using 2-0 Vicryl. The subcutaneous tissues were closed with 2-0 Vicryl in a simple continuous pattern. The skin was closed with skin staples. The foal recovered well unassisted in the stall.

Post operatively, the foal was treated with 1 l Normasol R i.v. b.i.d., 250 mg ceftiofur (2 mg/kg bwt) i.v. s.i.d., 125 mg flunixin meglumine (1 mg/kg bwt) i.v. b.i.d., 550 mg omeprazole (4.4 mg/kg bwt) *per os* s.i.d. and 2000 iu vitamin E *per os* s.i.d. Antibiotic therapy was changed to 900 mg enrofloxacin (7.5 mg/kg bwt) i.v. s.i.d. for 7 days post operatively due to the Gram-negative bacteria noted on cytology. Antibiotic therapy was discontinued at this time due to a normal CBC and concerns for enrofloxacin-induced cartilage damage. Intensive physical therapy consisted of moving the foal from lateral to sternal recumbency; and encouraging and assisting him to stand every 2 h. The frequency was decreased over time consistent with the foal's strength ability. At 14 days post operatively, the foal was able to stand for over 4 h without assistance. A customised sling facilitated nursing, partial weightbearing and manoeuvring around the stall. A modified Anderson-type sling was fashioned to a hoist in the centre of the stall. This allowed the foal to pivot in circles in the centre of the stall, and the mare to reside comfortably on the perimeter of the stall, as can be seen in a video at <http://www.youtube.com/watch?v=GHy5TRC6zuw&feature=related>. Post operative radiographs revealed no significant change to the debrided vertebrae (**Fig 3**).

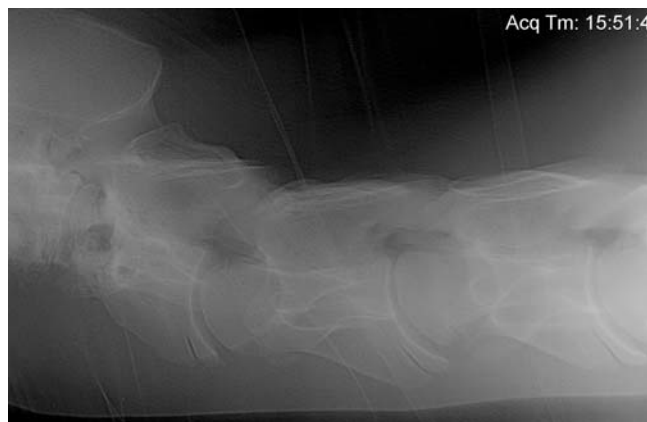


Fig 3: Fourteen days post C2-3 vertebral body surgical debridement with no significant change to debrided surgical site.

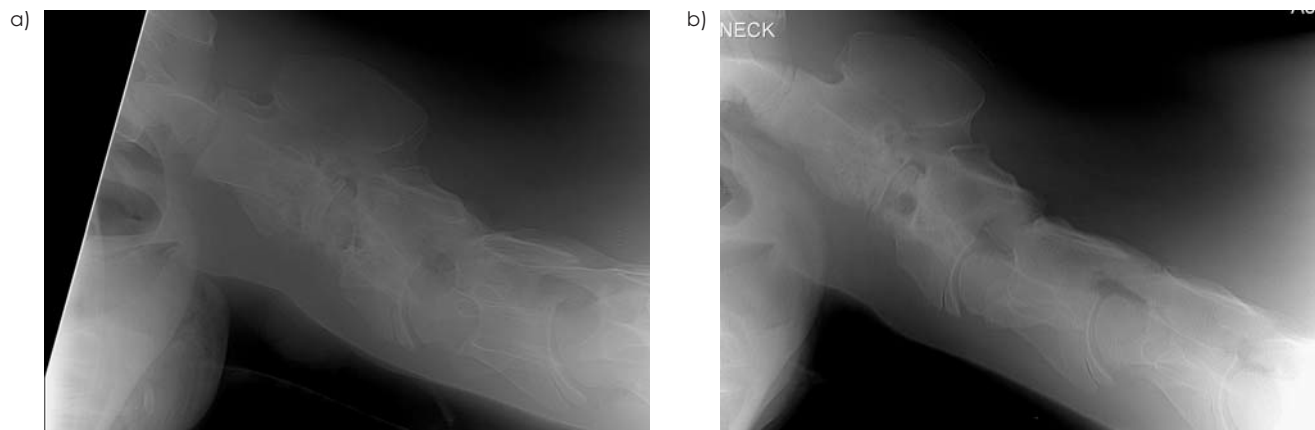


Fig 4: a) Thirty days post operatively, 50% bony fusion of C2–3 noted; b) 45 days post operatively, 100% bony fusion at C2–3.

Fourteen days post operatively, the foal had a fever of 39.8°C. No pain, heat or swelling was associated with the surgical site. A CBC revealed a leucocytosis (12.3×10^9 cells/l) with a left shift and a marked hyperfibrinogenaemia (8.27 g/l). Thoracic radiographs and ultrasound revealed moderate subpleural consolidation caudoventrally, moderate pleural roughening bilaterally. The colt was started on 700 mg ceftiofur i.v. b.i.d. He was continued on 125 mg flunixin meglumine i.v. b.i.d., 2000 iu vitamin E per os s.i.d. and 550 mg omeprazole (4.4 mg/kg bwt) per os s.i.d. for 14 days.

Radiographs were taken at 30 and 45 days post operatively (**Fig 4**). At 30 days, marked active bony remodelling and proliferation was noted in the defect. Bridging and fusion of C2–3 was noted in the ventral 50% of the vertebral body. At 45 days, the bony proliferation and remodelling appeared to have matured radiographically. Vertebral bodies for C2–3 were completely fused.

The neurological status of the foal improved to a grade 4/5. Muscle strength, endurance and coordination also continued improve and minimal assistance was required to encourage the foal to stand on his own. Radiographs taken at 60 days post operatively were consistent with increased bone density in the debrided cavity and fusion at the C2–3 junction (**Fig 5**). The foal was discharged at 60 days post operatively. Discharge instructions included administration of 2000 iu vitamin E per os s.i.d., continued physical therapy and a controlled exercise programme; stall confinement was recommended for the first 2 weeks, with 10–15 min daily exercise increasing 5 min every week for 4–6 weeks increasing paddock size to 3.6 x 6 m turnout over the next 4 weeks.

The foal (400 kg) returned to San Luis Rey Equine Hospital 7 months post operatively for re-evaluation and neurological examination. Physical examination was within normal limits. Neurological examination revealed mild to moderate neurological deficits (grade 2/5). Complete blood count was within normal limits. Standing radiographs of the neck revealed good fusion of C2–3 and apparent narrowing of the spinal canal at C4–5 (**Fig 6a**). The colt was treated with 40 mg dexamethasone

(0.1 mg/kg bwt) i.v., 400 mg flunixin meglumine (1 mg/kg bwt) i.v. preoperatively, anaesthetised with 400 mg xylazine (1 mg/kg bwt), 800 mg ketamine (2 mg/kg bwt), 16 mg valium (0.4 mg/kg bwt) and placed in right lateral recumbency. Anaesthesia was maintained using a constant rate infusion of 50 g guaifenesin, 500 mg xylazine and 1500 mg ketamine in 1 litre.

A myelogram was performed. Neutral, flexed and extended views revealed marked narrowing of the dorsal spinal column at the C4–5 junction (**Fig 6b**). Computer tomography of the cervical spine revealed fusion of the C2–3 vertebral bodies with no intercolumnar narrowing at the site and confirmed C4–5 narrowing. The foal recovered well. The foal was treated with 400 mg (1 mg/kg bwt) flunixin meglumine per os s.i.d. and 2000 iu vitamin E per os. Due to the dorsal spinal column narrowing and the abnormal neurological examination findings, C4–5 cervical fusion was elected.

Surgery was performed a week after admission. A complete blood count was within normal limits. The foal was treated with 21 ml penicillin procaine G (20,000 iu/kg bwt) i.m. b.i.d., 2.1 g (6.6 mg/kg bwt) Gentocin i.v. s.i.d.,



Fig 5: At discharge, 60 days post operatively, radiographs demonstrate an increase in bony density at C2–3.



Fig 6: Cervical (a) and myelographic (b) radiographs taken at second admission demonstrating apparent narrowing of the spinal column at C4–5.

and 400 mg (1 mg/kg bwt) flunixin meglumine i.v. s.i.d. preoperatively. The foal was anaesthetised with xylazine, ketamine, valium as noted previously and anaesthesia was maintained using isoflurane. The foal was placed in dorsal recumbency; the ventral midline of the neck was clipped, shaved and aseptically prepared. The C4–5 articulation was located using needle markers and digital radiography. A cervical interbody fusion was performed at this site using a paediatric partially threaded Seattle Slew implant. The foal recovered well. Post operative radiographs demonstrated good implant placement (**Fig 7**). The foal was continued on antibiotics and flunixin meglumine for 3 days post operatively. No post operative complications were encountered, and the foal was discharged 7 days post operatively. Discharge instructions recommended continued vitamin E supplementation, and strict stall confinement for the first 60 days followed by a gradual increase in paddock size and a control exercise programme of 10–15 min of handwalking daily increased by 5–10 min weekly.

At 90 days post spinal fusion (10 months after the initial surgery), the foal returned to SLREH for neurological



Fig 7: Immediate post operative cervical fusion radiographs using paediatric partially-threaded basket implant.

evaluation. Standing radiographs of the cervical spine demonstrated an intact implant and fusion of the C4 and C5 vertebral bodies (**Fig 8**). Neurological examination revealed *grade 1+/5*, deficits noted in decreased lateral neck flexion and backing exercises. Discharge instructions recommended an increase in exercise and paddock size, but cautioned against total free turnout.

Video clips of the foal's neurological status representing several stages of his recovery, including the use and design of the customised sling, may be viewed at http://youtube.com/profile_videos?user=debora04&p=r. The most recent video at 2 years of age depicts a virtually neurologically sound gelding at free turnout.

Discussion

This Case Report utilised several diagnostic imaging modalities in the investigation of the osteomyelitis lesion of the cervical spine and cervical myelopathy. Traditionally, radiographs alone are required for diagnosis of vertebral osteomyelitis. Plain radiographs and myelography have been utilised for accurate diagnosis of cervical myelopathy in horses (Stewart *et al.* 2004). The initial myelogram and CT were conducted to confirm, localise and characterise the C2–3 osteomyelitis lesion and to



Fig 8: Cervical radiographs 90 days post cervical fusion (10 months post C2/3 vertebral body debridement) demonstrating good position of paediatric implant and good cervical fusion at C4–5.

confirm that spinal cord impingement was associated with this lesion. Both of these modalities were also used in the diagnosis of the C4–5 cervical myelopathy. CT was used to document the healing progress of the resolved C2–3 osteomyelitis lesion and to verify that the current neurological signs were associated with C4–5 stenosis and not C2–3 (Moore *et al.* 1992). In both of these instances, CT supplemented and further localised and characterised the pathological lesions.

Allografts and autografts have been used in veterinary and human medicine for years. Allograft use has been riddled with complications of contamination, storage, expense and host-donor compatibility. Autografts have been a more readily useable source in equine medicine. Common autograft sites include the trochanter of the femur, the sternbrae and the dorsal spinous processes of the vertebrae. Cancellous autografts provide scaffolding, progenitor cells and stimulate healing in large bone defects and infected fractures. Antimicrobial impregnated grafts can deliver high levels of antimicrobial coverage to surgical sites (Baxter 1996). However, harvesting autografts at the time of surgery often requires additional surgery, additional preparation time and a secondary surgical site. Currently, advancements are being made to develop synthetic graft materials that mimic the low complication advantages of autographs and ease of use (Betz 2002; Hinz *et al.* 2002). Common synthetic grafts are composed of demineralised bone matrix, collagen, ceramics and ultraporous B-TCP. Disadvantages to use of demineralised bone matrix and collagen lie in the lack of structural strength. In addition, collagen has potential immunogenicity. Ceramics have been demonstrated to be the most favourable synthetic bone graft material. It is nonimmunogenic and has no risk of disease transmission. However, it also provides poor structural support and lacks high levels of osteogenic properties. Ultraporous B-TCP was developed with a broad range of pore diameter, mimicking natural cancellous bone (Betz 2002). Clinical animal trials using B-TCP have demonstrated ease of use, minimal complications and rapid bone formation and resorption at the surgical site (Betz 2002).

In a case study by Desjardins and Vachon (1990), an osteomyelitis lesion in the cannon bone was surgically debrided and packed with a cancellous bone autograft. The outcome in this particular case was favourable. These authors suggested that autograft placement in a previously infected surgical site helps speed resolution of the osteomyelitis (Desjardins and Vachon 1990). This was also noted in this case by a short course of antibiotic therapy (7 days of enrofloxacin). The second course of antibiotic therapy (14 days of ceftiofur) was noted to be associated with moderate pneumonia and not continued infection at the surgical site. Case reports that did not utilise bone grafts or other defect fillers noted bony filling by approximately 120 days post operatively (Richardson 1986; Chaffin 1995). The authors in this case noted good bony fusion at the C2–3 junction at 30 days post

operatively with use of a synthetic allograft. Rapid resolution of the neurological deficits was also noted.

In this study, a *grade 5/5* recumbent animal was discharged, at 60 days post operatively, with significant improvement in neurological status to *grade 3/5*. Three foals that presented with *grade 5/5* neurological deficits and were treated medically only, either died or were subjected to euthanasia due to poor prognosis (Giguère and Lavoie 1994). Surgical debridement of a severe cervical vertebral osteomyelitis causing *grade 5/5* ataxia proved to be a successful treatment in this case. Aggressive therapy and advanced diagnostics may be the preferred protocol for diagnostics and treatment of this disease processes. The use of B-TCP in the described case proved to have minimal complications and rapid radiographic bone filling at the surgical site. It may be a viable option for use as an allograft in horses.

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