



## Idiopathic haemarthrosis in eight horses

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**Objectives** To review eight horses diagnosed with idiopathic haemarthrosis and to describe the intra-articular use of yttrium-90 (<sup>90</sup>Y) and methylprednisolone acetate (MPA) in recurrent haemarthrosis cases.

**Design** Retrospective case series.

**Method** The medical records, diagnostic images, histopathology and outcome of all horses diagnosed with idiopathic haemarthrosis between 1998 and 2010 were reviewed.

**Results** Four Thoroughbred racehorses with haemarthrosis of the antebrachio-carpal joint had severe acute lameness (median, grade 4) and marked joint effusion after high-speed exercise. Another four horses (2 Thoroughbred racehorses, 1 Standardbred racehorse, 1 Warmblood) had haemarthrosis of the tarsocrural joint and presented with mild, intermittent lameness (median, grade 1) and marked, persistent joint effusion. Six of the eight horses had recurrent haemarthrosis prior to treatment. Radiographic and nuclear scintigraphic examinations did not identify bone pathology. Diagnostic arthroscopy (7 cases) identified grossly hypertrophied yellow/brown discoloured synovium. Synovial histopathology of these cases revealed chronic synovial hyperplasia with severe haemosiderosis and granulomatous inflammatory reaction of varying severity. All horses underwent rest, bandaging and phenylbutazone administration. Two horses had subtotal mechanical synovectomy, four horses had intra-articular administration of <sup>90</sup>Y and MPA, and one horse underwent both treatments. Seven cases returned to their previous use (median time, 7 months). Haemarthrosis recurred in three horses, two of which had received the <sup>90</sup>Y and MPA treatment.

**Conclusion** Idiopathic haemarthrosis should be considered a differential for acute and recurrent joint related lameness and effusion. Recurrence appears not uncommon and the use of intra-articular <sup>90</sup>Y and MPA in conjunction with a conservative management treatment protocol warrants further evaluation.

**Keywords** antebrachio-carpal joint; haemarthrosis; horses; lameness; synovectomy; tarsocrural joint; yttrium-90

**Abbreviations** <sup>90</sup>Y, yttrium-90; MPA, methylprednisolone acetate  
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In horses, haemarthrosis typically occurs with joint trauma and is frequently identified with fractures,<sup>1</sup> tearing of intra-articular ligaments<sup>2–4</sup> and iatrogenically to arthrocentesis<sup>5</sup> and surgery. In humans, haemarthrosis predominantly occurs in patients with a pre-

disposition to haemorrhage such as those treated with anticoagulants<sup>6</sup> and those with haemophilia<sup>7</sup> or pigmented villonodular synovitis.<sup>8</sup> Lameness and haemarthrosis without concurrent injury to articular bone or ligaments is a problem that is only briefly described in the horse<sup>1</sup> and a single case of recurrent haemarthrosis of the antebrachio-carpal joint that was associated with proliferative synovitis was managed successfully with subtotal mechanical synovectomy.<sup>9</sup> Experimentally, haemarthrosis of the metacarpophalangeal joint has been reported to produce temporary reversible lameness with a mild to moderate degree of synovitis.<sup>10</sup>

In humans, hypertrophy of the synovium is a common reactive synovial response to recurrent bleeding and trauma, and typically no obvious causes of bleeding are identified at surgery.<sup>6</sup> Histopathologically, there is hypertrophy and hyperplasia of synoviocytes,<sup>11</sup> hyper-vascularisation of the subintima, which increases the risk of future haemorrhage,<sup>12</sup> fibrosis<sup>12,13</sup> and accumulation of haemosiderin in the synovial tissue, which triggers further synovial inflammation.<sup>14</sup> Treatment of recurrent haemarthrosis is aimed at the inciting cause, with radioisotope synovectomy using yttrium-90 (<sup>90</sup>Y) and methylprednisolone acetate (MPA) considered safe and effective in recurrent, refractory cases where reactive hypertrophic synovium is implicated.<sup>15–20</sup> We hypothesised that idiopathic haemarthrosis in horses shares some similarities with recurrent haemarthrosis in humans and that intra-articular <sup>90</sup>Y and MPA treatment, which to our knowledge has not been reported in the horse, may be warranted.

### Materials and methods

#### Study population

All horses admitted between 1998 and 2010 to Randwick Equine Centre where a diagnosis of idiopathic haemarthrosis was made were identified from the electronic medical database (RxWorks V4.2, RxWorks Pty Ltd, Brisbane, WA 4030). Data were collected for each horse including age, sex, use, duration and nature of clinical signs, exercise history (race starts, if applicable) and previous treatments, including intra-articular medication and rest. Horses in which multiple episodes of haemarthrosis were described were termed recurrent haemarthrosis cases. Cases of haemarthrosis diagnosed in conjunction with osteochondral pathology (i.e. chip fractures and/or intra-articular ligament injury) were excluded.

#### Diagnostic procedures

All horses underwent a clinical examination, lameness examination that included palpation of the limbs, gait evaluation and grading of lameness (American Association of Equine Practitioners lameness scale, grade 0–5),<sup>21</sup> arthrocentesis (including joint drainage and decompression), joint fluid analysis and radiography of the affected joint. In selected cases, intra-articular anaesthesia, immediate and delayed phase nuclear scintigraphy and/or diagnostic arthroscopy was performed.

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### Radiography

Radiographic projections of the antebrachio-carpal joint included, dorsal 55° lateral–palmeromedial oblique, dorsal 70° medial–palmerolateral oblique, dorsopalmar, flexed lateromedial, and flexed dorsoproximal–dorsodistal oblique views of the distal radius, proximal and distal rows of carpal bones. Tarsocrural joint radiography included dorsal 45° lateral–palmeromedial oblique, dorsal 45° medial–palmerolateral oblique, dorsopalmar, lateromedial and flexed lateromedial views.

### Nuclear scintigraphy

Delayed phase scintigraphic images (standing lateral and dorsal, and flexed lateral and dorsal) were obtained 3 h after an intravenous injection of 8 GBq technetium-99m ( $^{99m}\text{Tc}$ ) combined with dihydrophosphate (TechneScan HDP, Mallinckrodt Medical, St Louis, MO, USA) using a gamma camera (400AC, 128 × 128 matrix, 450 × 400 field of view, General Electric Holsom, Denmark or IS2 SR Digital Camera, 128 × 128 matrix, 550 × 400 mm field of view, IS2 Medical Systems, Ottawa, Ontario, Canada) and an integrated nuclear imaging system (Starcam H3300C and H2507AG Video Formatter, General Electric or Mirage Software, IS2 Medical Systems) without the use of motion correction processing. In selected cases, images were also obtained 5 min following  $^{99m}\text{Tc}$  injection.

### Arthroscopy

Routine arthroscopic approaches to the dorsal and palmar/plantar aspects of the antebrachio-carpal and tarsocrural joints were used with the horses anaesthetised in dorsal recumbency following routine pre-medication (22,000 IU procaine penicillin IM, 6.6 mg/kg gentamicin IV, 6 mg/kg phenylbutazone PO, tetanus toxoid IM).<sup>22</sup> Arthroscopic examination was performed to identify the cause of haemarthrosis and to facilitate collection of synovial samples where indicated. Synovial membrane samples were obtained with 4 × 10 mm Ferris-Smith rongeurs from multiple sites within each joint and placed in 10% buffered formalin for histopathological examination using haematoxylin and eosin stain. In three horses (case nos. 2, 4, 8), proliferative synovium was resected using a motorised synovial resector (Stryker TPS Formula 180, Stryker Australia, Artarmon, NSW, Australia) prior to routine joint closure. Bandages were maintained prior to suture removal at 14 days post surgery and phenylbutazone was administered (4 mg/kg PO every 12 h for 2 days, then 2 mg/kg PO every 24 h for 5 days).

### Treatment

All horses underwent a period of rest, pressure bandaging and anti-inflammatory therapy (phenylbutazone, 4 mg/kg PO every 24 h for 2 days, followed by 2 mg/kg PO every 24 h for 5 days). For those horses that did not undergo  $^{90}\text{Y}$  and MPA treatment, rest consisted of 1-month box confinement, 1-month small yard rest and 1-month paddock turn-out, before return to training based on repeat clinical examination findings (i.e. resolution of lameness and effusion) by a veterinarian (JML, CBO or the referring veterinarian).

In addition, for cases of recurrent haemarthrosis the recommended treatment was intra-articular injection of  $^{90}\text{Y}$  and MPA 3–7 weeks after diagnostic arthroscopy using the following protocol: intra-articular injection of 444 MBq  $^{90}\text{Y}$  silicate (CisBio International,

B.P.32 Gis Sur Yvette, France) followed by 80 mg MPA (Depo-Medrol<sup>TM</sup>, Pfizer Australia, West Ryde, NSW, Australia) was performed using an aseptic technique with a 23-g needle under general anaesthesia or standing sedation. Systemic anti-inflammatory therapy (phenylbutazone, 4 mg/kg PO every 24 h for 2 days, followed by 2 mg/kg PO every 24 h for 5 days) was administered. The horses were stall rested for 2 weeks, followed by 6 weeks of paddock turn-out prior to training resumption.

### Outcome

Follow-up information was obtained from clinical examination, evaluation of race records<sup>23</sup> and by telephone contact with the referring veterinarian and/or owner or trainer. Resolution of lameness, effusion, return to previous level of performance and treatments following discharge from hospital (including intra-articular medication) were recorded.

### Results

Eight horses were included in the study (Table 1: 6 Thoroughbred racehorses, 1 Standardbred racehorse, 1 Warmblood used for dressage; 5 geldings, 3 mares). Idiopathic haemarthrosis was identified in the antebrachio-carpal (case nos. 1–4) and tarsocrural (case nos. 5–8) joints. The median age of the horses was 4 years (range 2–5 years).

### History

All horses were in training or full work prior to presentation. At presentation, three horses had a single episode of haemarthrosis (case nos. 1, 6, 8) and five had a history of recurrent lameness and effusion attributed to recurrent haemarthrosis (case nos. 2–5, 7). The median duration of clinical signs was 2 months (range 1 h–5 months), and intra-articular therapies had been administered to two horses (case nos. 2, 5). Racehorses had a median of 17 race starts (range 0–28) prior to presentation.

In all cases of antebrachio-carpal haemarthrosis, the initial episode was associated with an acute, severe forelimb lameness following exercise at high-speed and which tended to resolve in the ensuing 1–2 days. Recurrent episodes of antebrachio-carpal haemarthrosis were also characterised by severe forelimb lameness, yet were sometimes not associated with high-speed exercise and occurred while resting in a stall (case nos. 2, 3) or swimming (case no. 2). In contrast, tarsocrural haemarthrosis was accompanied by a history of severe joint effusion with a mild or intermittent lameness. A traumatic incident was only reported in one tarsocrural haemarthrosis case (case no. 7).

### Clinical findings

At presentation, horses with antebrachio-carpal (3 right, 1 left) and tarsocrural joint (4 left) haemarthrosis displayed a median lameness grade of 4 (range 3–5) and 1 (range 0–2), respectively. Joint effusion was severe, except in one case of antebrachio-carpal haemarthrosis (case no. 1). Joint flexion was resented in all but one cases of tarsocrural haemarthrosis case (case no. 5).

### Radiography, arthrocentesis and nuclear scintigraphy

Radiographs were generally unremarkable, with evidence of mild osteoarthritis present in two cases: horse 3 displayed mild modelling

Table 1. Clinical details of the eight horses

Case no./age	Breed (sex)	Joint (limb)	History <sup>a</sup>	Effusion	Lameness (grade) <sup>b</sup>	Radiographic abnormalities <sup>c</sup>	Arthroscopy	Synovectomy (mechanical/ <sup>d</sup> radioisotope)	RIU (starts)	Time to RIU (months)	Recurrence after discharge (months)
1 3 years old	TB (F)	A <sup>B</sup> C (R)	5 previous race starts Lame following a race (1 h duration) 21 race starts	Moderate	3	No	No	No/No	Yes (2)	5	No
2 4 years old	TB (G)	A <sup>B</sup> C (R)	2-month history of recurrent haemarthrosis, 1st haemarthrosis event after exercise, 2nd 7 days later when resting in a stall Injected with 20 mg sodium hyaluronate and rested for 1 month 3 starts prior to 3rd haemarthrosis event during swimming	Severe	5	No	Yes	Yes/Yes	Yes (28) <sup>^</sup>	5.5	Yes (5) <sup>+</sup>
3 4 years old	TB (G)	A <sup>B</sup> C (R)	17 race starts Referred with a 5-month history of intermittent acute forelimb lameness	Severe	4	Yes*	Yes	No/Yes	Yes (2)	7	No
4 5 years old	TB (G)	A <sup>B</sup> C (L)	28 race starts Referred with a 3-month history of intermittent acute forelimb lameness with recurrent haemarthrosis	Severe	4	No	Yes	Yes/No <sup>o</sup>	Yes (9)	9	Yes (4)
5 2 years old	TB (F)	TC (L)	No race starts Referred with a 2-month history of severe effusion and mild lameness that developed in race training	Severe	0	Yes*	Yes	No/Yes	Yes (29)	12	No
6 2 years old	TB (F)	TC (L)	Injected with 20 mg triamcinolone and 20 mg sodium hyaluronate 6 weeks prior to presentation No race starts Referred with a 1-month history of severe effusion and mild lameness that developed in race training	Severe	2	No	Yes	No/Yes	No <sup>o</sup>	NA	No
7 4 years old	SB (G)	TC (L)	23 race starts Referred with a 3-month history of trauma to hindlimb and recurrent haemarthrosis at a later date	Severe	1	No	Yes	No/Yes	Yes (3)	26	Yes (12)
8 4 years old	WB (G)	TC (L)	Referred with 3-week history of severe effusion	Severe	1	No	Yes	Yes/No	Yes (NA)	6	No

<sup>a</sup> All horses had recurrent haemarthrosis, except in case nos. 1 and 8.

<sup>b</sup> All cases except no. 5 had a response to flexion.

<sup>c</sup> Case nos. 1–3 had scintigraphy imaging performed with no abnormalities detected.

TB, Thoroughbred; SB, Standardbred; WB, Warmblood; R, right; L, left; F, female; G, gelding; A<sup>B</sup>C, antebrachio-carpal joint; TC, tarsocrural joint; NA, not applicable; RIU, return to intended use; \*mild modelling consistent with osteoarthritis; <sup>o</sup>retired to stud because of another injury; <sup>^</sup>still in training; +haemarthrosis was secondary to caudal radial osteochondroma and communication with carpal sheath; <sup>o</sup>communication with extensor carpi radialis tendon sheath.

**Table 2. Arthrocentesis cytology (case nos. 1–8)**

	Median	Range	Reference
Red blood cells ( $\times 10^{12}/L$ )	9.0	4.1–11.1	–
Protein (g/L)	44.0	40–56	<25
Nucleated cells ( $\times 10^9/L$ )	10.0	7.4–16.0	0.1–0.8

of the distal radius and horse 5 had a small osteophyte at the cranial distal intermediate ridge of the tibia. Arthrocentesis was performed following radiographic examination in all cases and revealed sanguinous joint fluid, with haemarthrosis confirmed following cytological examination (Table 2). Intra-articular anaesthesia (6 mL, 10 mg/mL prilocaine, Parnell, Alexandria, NSW, Australia) was performed at the time of arthrocentesis in the antebrachio-carpal cases (case nos. 1–4), resolving the lameness in all cases. Nuclear scintigraphy was performed in three of four antebrachio-carpal cases (case nos. 1–3). With the exception of a mild generalised increase in radionuclide uptake associated with the right antebrachio-carpal joint seen in the immediate phase images of horse 2, nuclear scintigraphy images were unremarkable.

### Arthroscopy

Diagnostic arthroscopy was performed for seven horses (case nos. 2–8), all of which had synovial samples submitted for histopathology. All had sanguinous joint fluid and grossly hypertrophied yellow- to brown-coloured synovium (Figure 1) that varied in appearance among the horses. In horse 2, the palmar pouch synovium was hypertrophied but pale in colour, in contrast to that of the dorsal pouch, which was brown. In horse 6, the synovium beneath the long digital extensor tendon showed evidence of active bleeding and evidence of previous haemorrhage near a pedunculated fibrous structure in the dorsal tarsocrural joint pouch. Three horses had focal partial thickness cartilage erosions (case nos. 3, 4, 8).

**Histopathology.** In all 7 cases there was chronic synovial hyperplasia with severe haemosiderosis. Haemosiderin was seen both as granules within or covering the synovial cells and in stromal macrophages. The severity of the granulomatous inflammatory reaction varied, but in most cases there were some multinucleated macrophages with haemosiderin accumulation as either bi- or tri-nucleated cells (Figure 2). In some cases there was evidence of recent haemorrhage, including fibrin clots.

### Treatment

Conservative management was the sole method of treatment in case no. 1. Two horses underwent subtotal mechanical synovectomy of proliferative synovium (case nos. 4, 8), four had intra-articular administration of  $^{90}Y$  and MPA (case nos. 3, 5–7), and one had both treatments (case no. 2).

### Outcome

The median follow-up in all cases was 60 months (range 13–143). Six of the seven racehorses returned to racing, with a median of six race starts (range 2–29). One racehorse was retired to stud following traumatic bilateral carpal injuries (case no. 6). The Warmblood returned to dressage

at its previous level of exercise (case no. 8). The median time to return to the previous level of performance was 7 months (range 5–26). Three horses had further recurrent haemarthrosis events after discharge from hospital (case nos. 2, 4, 7), and for this reason, it was elected by the owners to pasture rest horse 7 for an additional year.

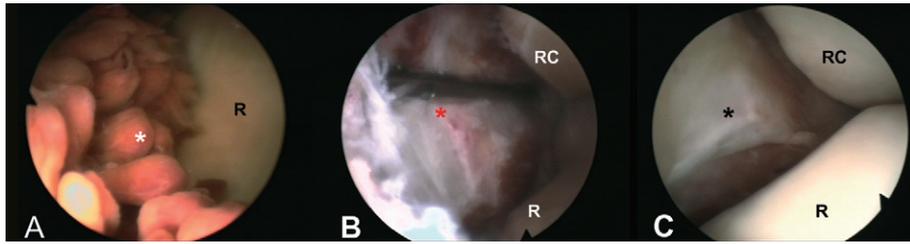
$^{90}Y$  and MPA were administered in five of the six cases of recurrent haemarthrosis. Horse 4 was not treated with  $^{90}Y$  and MPA because it had developed a communication with the the extensor carpi radialis sheath following subtotal mechanical synovectomy. Of the five horses treated with  $^{90}Y$  and MPA, three had complete resolution of effusion and lameness (case nos. 3, 5, 6) and two had recurrence after discharge (case nos. 2, 7). Four of the five horses returned to racing (case nos. 2, 3, 5, 7), with a median time to first start of 9.5 months (range 5.5–26). Two of the four horses that returned to racing experienced at least one episode of recurrent haemarthrosis (case nos. 2, 7), which was characterised by lameness and effusion that initially responded to conservative management (intra-articular administration of 10 mg triamcinolone and 20 mg sodium hyaluronate). Horse 2 completed six races after discharge from hospital, then re-presented 11 months following initial arthroscopy with haemarthrosis of the antebrachio-carpal and carpal sheath (carpal sheath distension was not noted at the initial presentation or arthroscopy). Diagnostic arthroscopy of the dorsal aspect of the antebrachio-carpal joint revealed scarred synovium and grossly normal cartilage (Figure 1c); however, examination of the palmar pouch revealed a communication with the carpal sheath. Carpal sheath tenoscopy revealed a distal caudal radial osteochondroma and associated dorsal deep digital flexor tendon fibrillation. Tenoscopic debridement of the osteochondroma was performed and the horse returned to racing 5 months post surgery, with no reported haemarthrosis recurrence (22 race starts). Four horses have since retired from racing (case nos. 3–6) for reasons unrelated to haemarthrosis and horse 2 is currently racing.

All three horses that did not receive  $^{90}Y$  and MPA (case nos. 1, 4, 8) returned to their previous exercise discipline, with a median time of 6 months (range 5–9). Of these, two underwent arthroscopic subtotal mechanical synovectomy (case nos. 4, 8). However, horse 4 experienced recurrent haemarthrosis and lameness 4 months following arthroscopic surgery and horse 8 has returned to performance with residual moderate tarsocrural joint effusion. Horse 4 underwent multiple administration of intra-articular corticosteroids prior to resumption of racing.

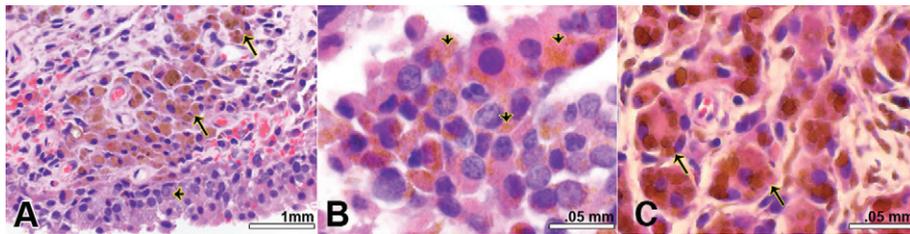
No adverse reactions with  $^{90}Y$  and MPA treatment were reported. However, horse 2 developed dorsal antebrachio-carpal synovial hernias that did not require treatment following subtotal mechanical synovectomy and  $^{90}Y$  and MPA treatment. Horse 4, which had been treated with subtotal mechanical synovectomy but not with  $^{90}Y$  and MPA, developed a communication between the antebrachio-carpal joint and the extensor carpi radialis tendon sheath.

### Discussion

Idiopathic haemarthrosis appears to be a very infrequent cause of lameness, confined to the antebrachio-carpal and tarsocrural joints in 8 horses during the current 13-year study period. These horses were all



**Figure 1.** Arthroscopic images of the dorsal antebrachio-carpal joint (case no. 2) before (A); grossly hypertrophied yellow/brown discoloured synovium), following subtotal mechanical synovectomy (B) and 11 months following initial arthroscopy and subsequent  $^{90}\text{Y}$  and MPA treatment (C). \*Dorsal synovium. R, dorsal distal radius; RC, dorsal proximal radiocarpal bone.  $^{90}\text{Y}$ , yttrium-90; MPA, methylprednisolone acetate.



**Figure 2.** Histological sections (H&E) of synovial biopsies in case no. 4 (A,  $\times 200$ ; B,  $\times 400$ ) and case no. 7 (C,  $\times 400$ ). There is chronic synovial hyperplasia and haemosiderosis with hyperplastic multilayered synovial cells and intracytoplasmic haemosiderin granules (arrowhead), as well as many stromal macrophages laden with haemosiderin (arrow, A) and varying numbers of multinucleated macrophages (arrow, C).

aged 2–5 years, which largely reflects the principle age distribution of horse accessions to Randwick Equine Centre. Haemarthrosis of the antebrachio-carpal joint was characterised by a severe, acute forelimb lameness following high-speed exercise, recurrence was sometimes not associated with high-speed exercise and seemed to occur spontaneously. In contrast, tarsocrural haemarthrosis was associated with severe joint effusion associated with minimal lameness. The reason for both the apparent predisposition of the antebrachio-carpal and tarsocrural joints to haemarthrosis and the difference in the degree of lameness is unknown. In humans, haemarthrosis is known to be a cause of considerable pain,<sup>24–26</sup> thought to be related to rapidity of joint capsule distension.<sup>27</sup> although this theory is consistent with the equine antebrachio-carpal cases, severe lameness was not identified in tarsocrural cases. This difference in clinical expression may be indicative of the limited number of cases, the pathogenesis of haemarthrosis in each joint, damage, joint volume or, alternatively, because of nociception differences between the tarsocrural and antebrachio-carpal joints.

In this case series, a diagnosis of idiopathic haemarthrosis was made when synovial fluid cytology confirmed a current or prior joint haemorrhage, the radiographic and scintigraphic findings ruled out osteochondral pathology (i.e. osteochondral fragments and non-displaced articular fractures) and when diagnostic arthroscopy ( $n = 7$ ) failed to identify intra-articular osteochondral damage or ligament tearing or a specific site of haemorrhage. Histopathology of grossly abnormal proliferative synovium obtained at arthroscopy supported a diagnosis of recurrent haemarthrosis and suggested a synovial etiology or synovial response to recurrent haemorrhage. Although in one antebrachio-carpal case the horse did not undergo arthroscopy, it was included in this case series because there was a common clinical presentation and its inclusion could highlight the potential outcome if rest is instituted following the initial haemarthrosis event. Identification of a definitive site causing haemarthrosis may have been precluded through the haemostatic effect of intra-articular fluid pressure necessary to facilitate diagnostic arthroscopy. Transiently reducing the intra-articular fluid pressure or use of a gas medium may have

increased our ability to identify a specific site(s) of haemorrhage. Similarly, although both dorsal and palmar pouches were examined arthroscopically, visualisation of the entire joint synovial lining is not possible. The use of ultrasonography, magnetic resonance imaging and contrast-enhanced computed tomography may aid in the diagnosis of intra-articular ligament tears or vascular abnormalities that are not visualised with arthroscopy, but none of these techniques were performed in this series.

Synovial histopathology revealed chronic synovial hyperplasia and severe haemosiderosis in both antebrachio-carpal and tarsocrural cases. The differing levels of granulomatous inflammatory reaction varied, but with multinucleated macrophages demonstrated in most cases. It is presumed that these multinucleated macrophages are evidence of chronic synovial inflammation and the response to haemorrhage. Experimental iatrogenic haemarthrosis of the equine metacarpophalangeal joint causes mild to moderate inflammation that resolves within 30 days.<sup>10</sup> In canine studies, blood has been shown to disturb cartilage matrix turnover<sup>28,29</sup> and in human studies untreated haemarthrosis can result in synovitis and osteoarthritis.<sup>30</sup> Irrespective of the initial insult, the chronic inflammatory response and secondary increased propensity to bleed<sup>12</sup> could be responsible for the observed histopathological lesions. Clinical support of this hypothesis is the occurrence of recurrent antebrachio-carpal haemarthrosis events that were not associated with high-speed exercise.

Rest and anti-inflammatory therapy may be the most important components of idiopathic haemarthrosis treatment. Most of the horses presented with a history of multiple haemarthrosis events, yet only short periods or rest and limited intra-articular or systemic anti-inflammatory therapy had been given. Interestingly, the two horses (case nos. 1, 8) that presented soon after the initial haemarthrosis event and were rested for 5–6 months did not have a recurrence. In addition, rest was also used in conjunction with mechanical synovectomy and the  $^{90}\text{Y}$  and MPA treatment. Furthermore, MPA was used with  $^{90}\text{Y}$  for its ability to reduce the inflammatory side effects described in human radiation synovectomy protocols.<sup>15–20</sup> It is pos-

sible that the MPA is responsible for the clinical improvement observed in this study and a similar effect may be seen with other corticosteroids.

In humans, radioisotope synovectomy using  $^{90}\text{Y}$  and MPA is considered a safe and effective treatment for recurrent haemarthrosis refractory to conservative treatment.<sup>15–20</sup> Radioisotope synovectomy is used in combination with surgical synovectomy when synovial debulking is considered necessary.<sup>17</sup> Patients with pigmented villonodular synovitis treated with  $^{90}\text{Y}$  have persistent areas of synovitis, but less prominent and less numerous villi are found.<sup>31</sup> Extensive fibrosis and occlusion of small vessels is believed to prevent haemarthrosis recurrence.<sup>32</sup> Repeat radioisotope synovectomy treatment in cases of continued recurrent haemarthrosis has been reported to have good results.<sup>15,16</sup> The typical dose of  $^{90}\text{Y}$  used in the human knee is 185 MBq.<sup>33</sup> Unfortunately, the effectiveness of the 444 MBq dose of  $^{90}\text{Y}$  that we used has not been assessed for its ability to perform total synovectomy in the horse. Radioisotope synovectomy with holmium-166 and samarium-153 in equine metacarpophalangeal and metatarsophalangeal joints causes multifocal and deep coagulative necrosis of synovium, without providing total synovectomy.<sup>34,35</sup> We used  $^{90}\text{Y}$  because it has higher energy beta-particles ( $\beta_{\text{max}}$  2.3 MeV) with a greater mean effective range of absorbed dose than either holmium-166 or samarium-153 (2.8 mm vs 2.1 mm and 1.0 mm, respectively)<sup>36</sup> and therefore we proposed it may be more effective in achieving synovectomy. Unfortunately, because of the retrospective design and private ownership of horses in this study, we did not obtain data to document the direct effects of  $^{90}\text{Y}$  administration alone (i.e. synovial fluid changes, synovial histopathology, arthroscopic evaluation). Repeat arthroscopic examination was performed in one antebrachio-carpal case after subtotal mechanical synovectomy and administration of  $^{90}\text{Y}$  with MPA and demonstrated apparently grossly normal cartilage and a scarred synovium. Further studies are required to determine the effects of this treatment on equine joints.

We did not observe any serious complications following the  $^{90}\text{Y}$  and MPA protocol used in this study and some horses had extensive racing careers (up to 29 starts) following treatment. In humans, reported complications of radioisotope synovectomy include necrosis of the needle tract and surrounding soft tissue causing skin sloughs, needle tract pigmentation, injection site tenderness, pyrexia and lymphocyte chromosomal abnormalities.<sup>37–39</sup> We used a 23-g needle and performed the technique under general anaesthesia in fractious horses in an attempt to reduce the risk of leakage into the peri-articular tissues. Dorsal synovial hernias and a communication with the carpal sheath developed in one case, but it is unknown whether radioisotope synovectomy and or mechanical synovectomy caused this complication. Another horse in which mechanical synovectomy was performed without  $^{90}\text{Y}$  and MPA administration developed a communication between the antebrachio-carpal joint and extensor carpi radialis sheath. These potential complications should be considered when an aggressive synovectomy technique is used. In addition, the effect of  $^{90}\text{Y}$  on equine cartilage needs to be determined. Radioisotope synovectomy with holmium-166 causes a mild degeneration of adult equine articular cartilage<sup>40</sup> and, in humans, radioisotope synovectomy has a detrimental effect on chondrocytes and proteoglycan content.<sup>33,41,42</sup> Mechanical synovectomy also has a deleterious effect on equine articular cartilage;<sup>43</sup> however, therapy aimed at resolving haemarthrosis-

induced lameness through removal of grossly abnormal synovium may be warranted. The racing results of Standardbred trotters with chronic synovitis improved markedly after partial synovectomy.<sup>44</sup> The return to racing and resolution of effusion and lameness in the horses in the current study suggest that intra-articular injection of  $^{90}\text{Y}$  and MPA may be beneficial as a treatment for horses with recurrent or refractory haemarthrosis. The specific contribution to preventing further haemarthrosis of  $^{90}\text{Y}$  and MPA and their optimal doses warrants further evaluation.

Limitations related to this case series include the small number of cases and problems inherent to a retrospective study (i.e. potential missing information in case records, lack of a standardised protocol and variable follow-up). A further limitation to our study was the use of a range of therapeutics, influenced by clinician preference and economics, which limits the evaluation of the effect of specific therapies for recurrent haemarthrosis.

### Conclusion

A clinical syndrome characterised by idiopathic haemarthrosis should be considered in the differential diagnosis for acute and recurrent joint related lameness and effusion. Based on the results of this study, the antebrachio-carpal and tarsocrural joints appear predisposed to haemarthrosis, but the reason for such specific joint involvement is unknown. Adequate rest and anti-inflammatory therapy appear essential for successful management. Diagnostic arthroscopy enables exclusion of other causes of joint trauma, visual evaluation of the synovium, the collection of synovial samples for histopathological diagnosis and subtotal synovial resection. The use of intra-articular  $^{90}\text{Y}$  and MPA in cases of recurrent haemarthrosis warrants further evaluation.

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## BOOK REVIEW

**Equine clinical medicine, surgery and reproduction.** Edited by GA Munroe and JS Weese. Manson Publishing, London, 2011. 865 pages. Price A\$356.95. ISBN 978 1 8407 6119 1.

Here is a very useful general textbook of equine medicine, surgery and reproduction. It is comprehensive, well organised, up to date, and is easy to navigate.

The book is divided into 15 chapters, the first 12 covering body systems and the final 3 covering wound management, the foal and behavioural problems, respectively. Each chapter is further subdivided in a logical manner, allowing easy location of individual topics. The text is comprehensively written and is supplemented by numerous high-quality photographs, which have been skilfully selected to enhance the textual information.

The information presented in the book more than covers the necessary material for a general equine practitioner or mixed animal practitioner to successfully diagnose and treat most equine cases. The book does suffer from a lack of depth and detail, which is understandable when covering such a wide range of subjects, but

is compounded by the omission of specific references. The 'Further Reading' section at the conclusion of the book provides general references to other books mostly, and sometimes to related journal articles.

However, this book would be a welcome addition to the general equine practitioner's or mixed animal practitioner's library. Easy navigation to specific topics of interest, presentation of clear and concise information, which is frequently supported by appropriate photographs, provides an informative and time-efficient method of learning.

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