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Andy qualified from Cambridge University Veterinary School in 1989 and subsequently trained in surgery at the University of Bristol and then at RosSDales in Newmarket. After working as University Equine Surgeon at the Queen's Veterinary School Hospital, University of Cambridge he returned to RosSDales, where he is now a partner and heads their Equine Diagnostic Centre. His main areas of speciality lie in orthopaedic surgery and lameness, especially related to competition horses. He has always been interested in the application of novel diagnostic and therapeutic techniques to lameness problems and poor performance. He is a Diplomate of the European College of Veterinary Surgeons and holds the Royal College of Veterinary Surgeons (RCVS) Diploma in Equine Orthopaedics. He is recognised by the RCVS as a Specialist in Equine Surgery. He has been team vet to the Japanese and British Three Day Event Teams and the British Pony Showjumping Team, as well as working for numerous private competitors at competitions and championships. He is an official treating vet for the 2012 Olympics in London.

EQUINE REGENERATIVE MEDICINE

By Andy Bathe

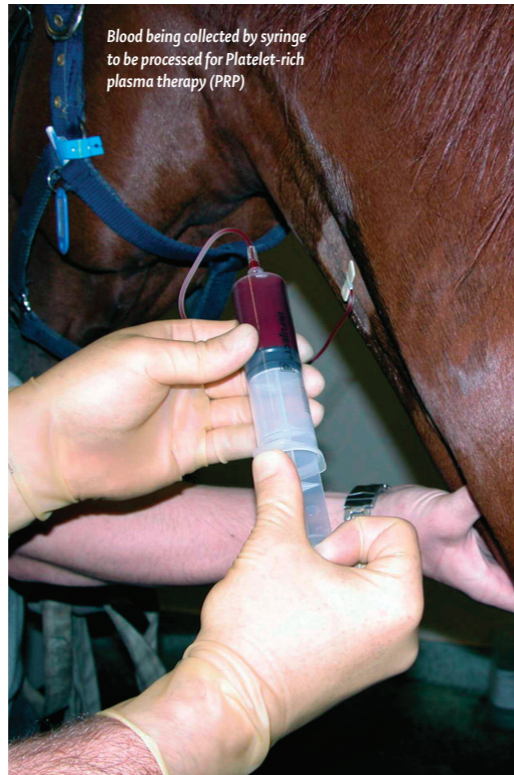
Regenerative medicine is an exciting and emerging field in the treatment of equine orthopaedic injuries. It tries to mimic the processes that occur during embryonic development where tissues are built from scratch. Its aims are healing of the injured tissues back to original quality, ideally without any scar formation and with healing being in an efficient fashion.

Some tissues in the body have excellent powers of repair, such as bone. Others, such as tendons and cartilage have limited abilities to heal fully. Standard therapies revolve around anti-inflammatory therapy, rest and controlled exercise to give the body a chance to heal itself. Whilst regenerative medicine offers hope for a better long term outcome, there is still a huge amount of 'hype' surrounding it and a stronger base of evidence needs to be collected in humans as well as in horses.

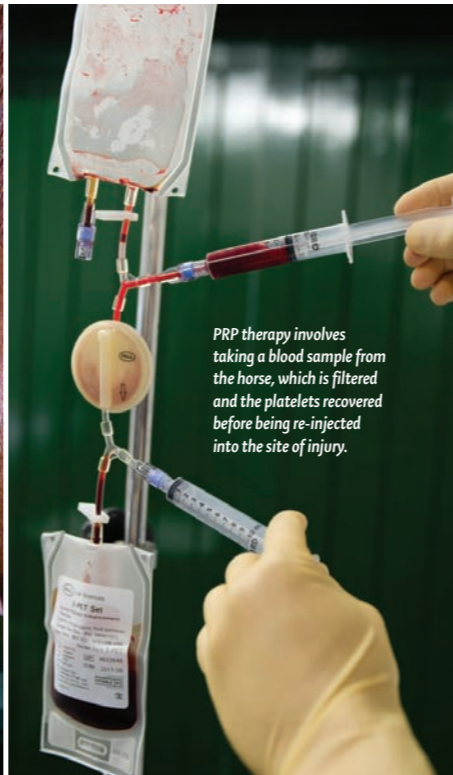
What is regenerative medicine?

The basic principles of any regenerative medicine are to try and provide a scaffold for repair, to provide cells for the healing process and to provide growth factors to stimulate the healing process. The table outlines the list of confusing names and acronyms that are frequently used by veterinary surgeons and others in the veterinary and pharmaceutical industries. Stem cells are the archetypal model for regenerative medicine, with the original thought being that the cells would differentiate into any type of tissue, thus for instance, when injected into a tendon they will produce new tendon cells. Whilst this may be true to a small degree, it is also possible that they just act as a source of growth factors which cause an influx of other cells. Thus other growth factors such as PRP (platelet-rich plasma) can stimulate a healing response by stimulating more cells to migrate to that area.

Of the commonly-used treatments at the current time, stem cells can be used for core lesions in tendon injuries. The normal place for harvesting them is from the sternum, which does carry a risk of severe complications if the heart is accidentally traumatised. The bone marrow is sent away to a laboratory, where the cells are cultured, ready to be injected back into the tendon. The horse still has to undergo a long period of rehabilitation following treatment. A long-term study of National Hunt racehorses showed there does appear to be a decreased risk of re-injury. These horses showed a significantly improved outcome when treated with stem cell therapy compared with rest alone. However, there isn't yet evidence for other types of horse and further research is required in other equestrian disciplines. 'Stem cells' derived from fat are popular in some other countries, but are generally considered inferior to bone marrow-derived cells. PRP is obtained by processing a simple blood sample to concentrate the platelets, which act as a source of growth factors. PRP is also being used in increasing frequency in tendon injuries and is currently the treatment of choice for the majority of ligament injuries. Irap® (an anti-arthritis therapy - see table right) is used successfully in a number



Blood being collected by syringe to be processed for Platelet-rich plasma therapy (PRP)



PRP therapy involves taking a blood sample from the horse, which is filtered and the platelets recovered before being re-injected into the site of injury.

of joint injuries and for injuries such as collateral injuries of the foot where there is soft tissue damage adjacent to the joint. PRP, and occasionally stem cells, are also used to a small degree in joints.

Which treatment?

The choice of which treatment is appropriate for an individual horse depends on a number of factors, such as the severity of the injury, the duration of the injury, the

precise nature of the damage, the future athletic plans for the horse and the economic factors - as some of these treatments can end up being rather expensive. Thus every case needs to be assessed on an individual basis by the owner's vet or by a specialist. It will be interesting to monitor the development of these therapies in the future and hopefully we will get a better idea of which are the most appropriate treatments for some of these severe, career-limiting injuries.

Medical and biological treatments currently used in horses

Name	Origin/Use
ACell®	Powder from pig bladder that aims to provide a scaffold for healing, but little evidence of benefit and can lead to very swollen legs after treatment.
Individual growth factors e.g. IGF or TGFB	IGF (Insulin-like growth factor) and TGFB (Transforming growth factor-beta) are proteins that control a number of functions in cells, generally stimulating growth. Individual growth factors have been rather superseded by the biological 'soups' of growth factors such as PRP.
Platelet-rich plasma (PRP)	Involves taking a blood sample from a horse and processing it to remove the platelets which are concentrated down as a source of growth factors to stimulate healing. This can be done as a same day, horse-side procedure. Mainly used in soft tissues, but also joints.
Bone Marrow	Normally harvested from the horse's sternum. Can be injected straight into tendon or ligament injuries, but somewhat crude.
Bone marrow aspirate concentrate (BMAC)	Processed bone marrow containing a small number of stem cells along with growth factors. Useful as can be injected same day. Has been shown to be beneficial in the healing of cartilage in the equine stifle when added in at the time of surgery.
Autologous conditioned serum (Irap®)	An anti-arthritis therapy that involves taking a blood sample, incubating it overnight in a laboratory, filtering it and then injecting it back into the joint. The blood 'soup' contains growth factors and anti-arthritis agents. Most commonly used in joints but also helps healing of soft tissue injuries.
Stem cells	Generally cultured from bone marrow in the laboratory, taking about 3 weeks to grow. A study in National Hunt racehorses has shown a benefit in decreasing the risk of re-injury in tendons.

A WEEK IN BRIEF

Monday

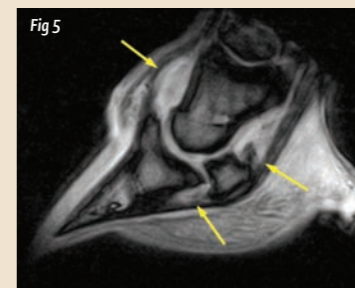
A busy week in prospect, with four new complicated referral cases coming in today, and plenty of horses to recheck too. An 8-year-old ISH is admitted for examination of a 'hopping' gait in front, seen only when ridden. A bone scan has been recommended due to the unusual presentation of lameness. A radioactive substance called Technetium-99 is injected intravenously and taken up into bone in regions of increased activity. Pictures are then acquired with a gamma camera with the horse sedated.

Tuesday

A 10-year-old Anglo-Arab was re-examined at RosSDales Diagnostic Centre today to further assess his hoof wall defect and forelimb lameness. He had sustained an injury to the coronary band 2 months previously leading to abnormal hoof growth and instability of the hoof capsule. The farrier stabilised the hoof with a bar shoe and an acrylic patch (see figs 1 & 2). The bone scan of the ISH which was undertaken yesterday revealed the articular process joints in the lower neck to be the cause of the problem (see fig 3). On X-ray they showed some arthritic change. The neck was medicated with corticosteroid injections into the articular process joints to reduce inflammation and slow the arthritic change. He was discharged for a period of rest before re-examination.

Wednesday

Today is surgery day and spent mainly in theatre operating on horses with a variety of orthopaedic conditions that require surgical treatment. A horse with lameness located to the stifle joint on lameness workup had arthroscopy (keyhole surgery) to remove inflamed and damaged tissue from the joint and fully assess the injury. There was quite a lot of arthritic change already for a young horse, and he is going to be treated with PRP and IRAP during his rehabilitation. Two horses underwent surgical treatment of hindlimb proximal suspensory desmitis. This condition has a poor outlook with conservative management, but has a good prognosis after surgery. An emergency case arrives. An 18-year-old Warmblood was admitted after standing on a rusty wood nail 2 days earlier. The nail had gone down the side of the frog and in at least 2 inches and the lameness was gradually getting worse. He was X-rayed with a probe and contrast in the nail tract, which revealed the nail had gone in deeply towards the heels (see fig 4). Samples were taken from the coffin joint and navicular bursa and showed inflammation but no overt infection currently. These can be life-threatening injuries if the lameness goes undetected for a period of time. The gelding was admitted to the hospital for intravenous (IV) antibiotics and close monitoring.



An MRI scan revealed navicular syndrome in this mare. Top left arrow: coffin joint distension. Bottom arrow: impar ligament inflammation. Right arrow: navicular bursa distension

structures within the foot (see fig 5). A further period of rest, corrective farriery and medication of the coffin joint and navicular bursa were recommended. We re-checked an IDX which had been treated with IRAP for a collateral ligament injury of the coffin joint 7 months earlier. He was up to trotting exercise and was still nice and sound. He is going to start canter work and fingers crossed he continues to do well.

Saturday

The gelding with the nail penetration is still doing well and more antibiotics are injected into the foot. It is explained to the owners that he will require another two months' box rest because of the tendon damage evident on MRI, but hopefully he will make a full recovery. I then go and watch some of my patients competing at a local one day event. They all seem sound, but I can't help them with their dressage marks!

Sunday

A hard day of training on my bike for a charity ride I have been coerced into doing. It's all in a good cause www.dallagliflintonoff2012.com/ I have to look at some urgent vetting X-rays on a Grand prix showjumper - all look good, so the sale should go through.



Fig 1 A coronary band injury has resulted in abnormal hoof growth and instability of the hoof capsule



Fig 2 The same hoof after being fitted with a bar shoe and an acrylic patch

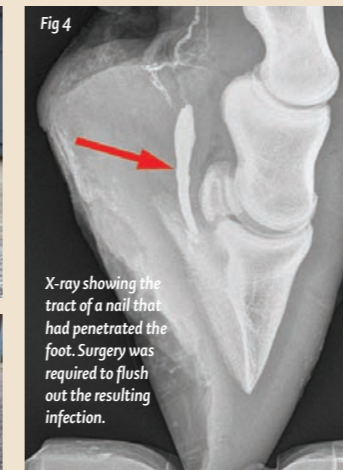


Fig 4 X-ray showing the tract of a nail that had penetrated the foot. Surgery was required to flush out the resulting infection.

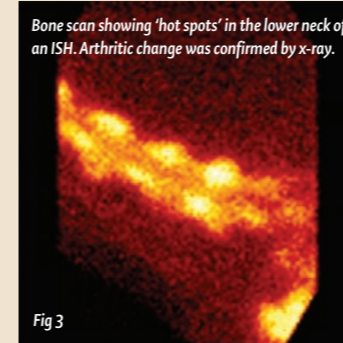


Fig 3 Bone scan showing 'hot spots' in the lower neck of an ISH. Arthritic change was confirmed by x-ray.

Thursday

The gelding with the nail penetration to the foot was very uncomfortable at walk and on re-sampling of the navicular bursa, it was found that infection had tracked into this synovial structure. Surgery was carried out under general anaesthesia to flush out the infection. For the next few days, as well as IV antibiotics, a regional perfusion of antibiotics into the veins in the limb will be carried out to hit the infection hard.

Friday

Another day spent mostly in theatre operating. The gelding with the foot penetration is very comfortable indicating that the infection was successfully treated by the surgery. A 13-year-old mare came in for an MRI scan of her LF foot. The scan revealed navicular syndrome involving several soft tissue



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