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Issue 14

FUTURITY ROUNDUP

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TAKE A LOOK AT Lymphatics

BRITISH STALLION EVENT PROGRAMME 2014



A Light-hearted look at Lymphatics



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What is the lymphatic system?

The lymphatic system is a complex system of vessels and nodes that plays a crucial role in maintaining the fluid balance, cell health and immune response of the body. If you looked at a picture of the lymphatic system, it looks very similar to the network of veins and arteries running through the body – from big ducts through to tiny microscopic vessels.

We tend to think of the cells of the body just sitting there next to each other, but they are actually surrounded by a gel-like substance called the interstitial fluid. Whether these cells are muscle cells, liver cells, skin or other cells, they are all surrounded by interstitial fluid. It is filled up by the oxygen-rich blood being pumped out of tiny arteries into the tissue spaces and it used to be thought that the excess fluid was taken up by the veins. However, we know that the lymphatic system actually removes more than the veins in some instances. This incredible fluid does many things – it allows oxygen and nutrients from the blood to dissolve across it, so that the cells are able to get adequate energy and nourishment to grow, build and repair. It also allows the cells to dump all their waste materials into the interstitial fluid, where the lymphatic system can pick them up and start to dispose of them or filter them. The interstitial fluid also contains temperature regulators, enzymes, acids, salts, sugars, hormones and other things to help transport all the necessary building blocks of life to the relevant cells and parts of the body. So, in effect the health of the cells is very dependent on the health of the interstitial fluid.

The lymphatic system is responsible for picking up lots of particles out of the interstitium – proteins, dead bacteria and cell waste being the most important. It can collect interstitial fluid two ways – firstly from the skin (called the superficial drainage system) and from the bones, organs, tendons, nerves, joints and muscles (called the deep drainage system). Many people

ask why the skin seems to have a drainage system of its own, so to speak. The skin can be considered our largest organ, so good lymph drainage is essential, but also we are more likely to damage our skin and get infections through our skin, so there is a good concentration of lymph vessels in the skin layers.

The best way to imagine the drainage of the skin (superficial system) is to imagine a multi-layered sponge cake with someone sticking their fingers up from the base through the layers. If you imagine that there are little swinging flaps on your fingertips that can open and close and suck in interstitial fluid, that is what the smallest skin collectors look like. Each 'finger' would drain fluid down towards the

wrist, and the fingers and thumb from the right hand would drain in a little group to the right wrist, as opposed to the left hand. We would describe the area covered by the left hand one lymphatic territory, and the right hand would be a separate lymphatic territory. Interestingly, once the interstitial fluid is contained within the 'fingertip' it is technically inside the lymphatic system and is now called lymph.

The deep system, as mentioned, drains everything contained within the body under the skin. Little vessels run internally like tiny straws, collecting fluid from the interstitium. These tiny straws are only about the size of two hairs on your head, with the largest one being about the size of four or five hairs twisted together.

Although small, these vessels can take many litres of lymph in a 24 hour period. These larger vessels look like one-way beaded necklaces, with lymph pumping from one 'bead' to another – which is how lymphatic therapists know where the vessels are and in which direction they are pumping.

So where does the lymph go, when it's collected either from the interstitial fluid in the skin or deeper in the body? If you look at Figure 1, this shows seven coloured areas on a horse's body, which are the territories. Each of these territories has one main set of lymph nodes that receive the lymph from that area. If you look at Section III on the diagram, you will see that the whole neck, shoulders and forelegs

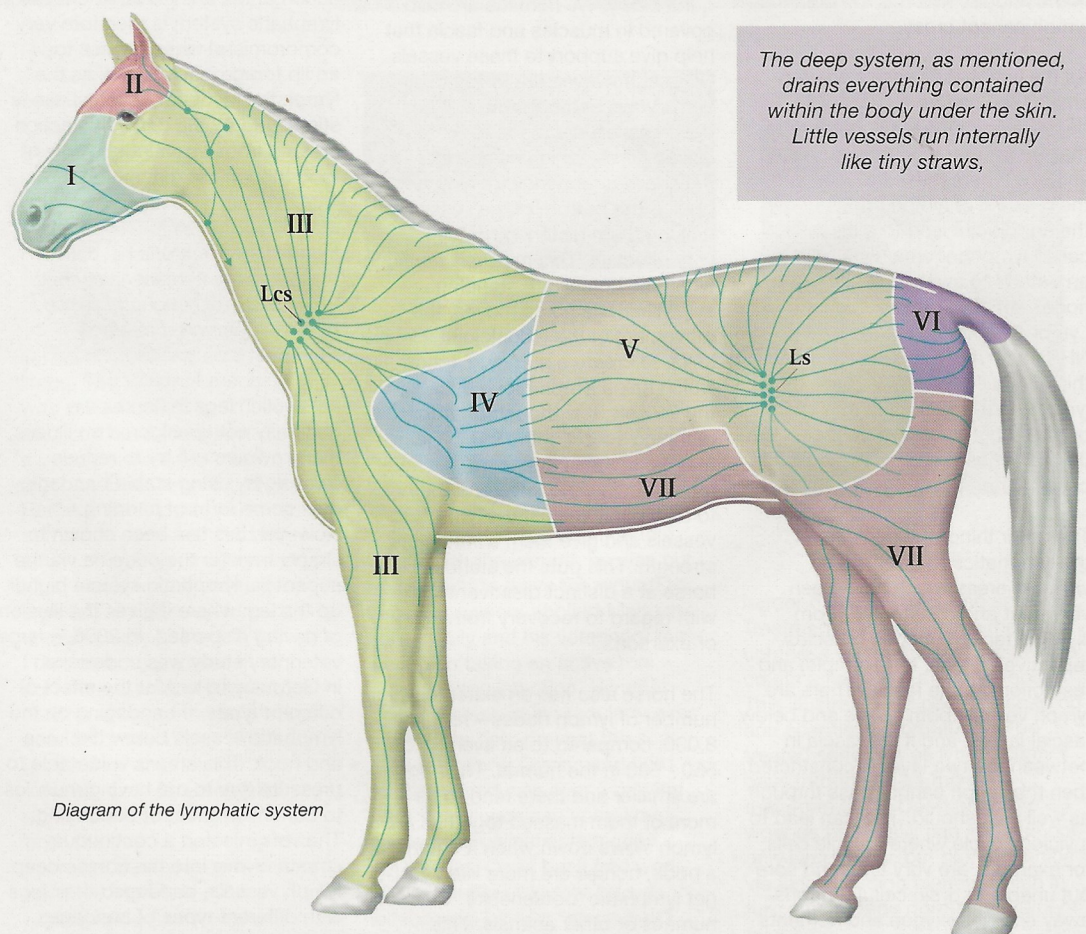


Diagram of the lymphatic system

The deep system, as mentioned, drains everything contained within the body under the skin. Little vessels run internally like tiny straws,

are included in this territory. All the skin in that territory can drain to a set of nodes (shown as "Lcs" on the diagram), and all the bones, muscles, organs, etc will also drain to those same nodes. In between the nodes, there are big vessels that help move large quantities of lymph from one node group to another. All the lymph in the whole body eventually drains to a set of nodes called the superficial cervical nodes, which lie next to the jugular vein. The lymph, which has been cleaned and filtered on its journey, filters back into this large vein, where it is taken to the lungs for re-oxygenation and then to the heart to be pumped back out into the interstitial fluid.

Staying on the diagram, it is possible to push lymph from one territory to another. There are clever devices which I tend to imagine being like emergency bridges crossing ditches. When one territory is overloaded, these emergency bridges can be deployed and excess fluid can be taken up by its neighbours. There are two areas where this cannot happen, as there are no bridges at all. One runs from the centre of the nose, between the ears and all the way along the spine to the tail, and the other along the underneath of the abdomen. This is why when you see swelling on the abdomen, it will appear either on one side only, or there will be swelling on both sides with a non-swollen line in the middle, which is the area that lymph cannot cross.

As the lymphatic vessels are very small, they can be subjected to damage or injury. Many readers may be familiar with breast cancer surgery, where mastectomies and the removal of lymph nodes under the armpit can lead to a disease called lymphoedema, where the arm starts to swell as there are no nodes left able to drain the arm. Lymphoedema therapists on the NHS specialise in the treatment of this condition to help support the lymphatic system. As lymph cannot pass through a scar more than 4mm thick, injuries and scar tissue can cause lymphatic restrictions.

The other thing that can cause the lymphatics to not work so well, are areas which have been very tight and constricted (from ill fitting tack, damaged muscles, repetitive sprains, for example) and restrictions in the fascia. There are lymph vessels both above and below fascial layers, and if the fascia in between the two layers is constricted, then the lymph cannot pass through as well as it should. This can lead to a vicious cycle where muscle cells, for example, are very tight and sore but unable to drain cellular debris away and get oxygen and nutrients in to help the muscle heal.

The body is very clever, and when an injury occurs, the lymphatic vessels will try to grow new pathways around an obstacle, or they will try to grow towards another lymph vessel or a vein and try to graft themselves onto them. However, we know that even though this does occur, the new pathways are never as effective as the original ones.

The lymphatic system does not have a pump (like the heart) to help push the lymph round the body. It is rather like a hitchhiker, grabbing any part of the body that moves and trying to hitch a ride on it. It does have a bit of an ability to pump in the larger vessels, but it also hitches a ride on muscular movement, which is why gentle exercise benefits lymphatic flow. It also hitches on the pumping action of the arteries, the peristaltic action of the intestines as they pump food through the small and large intestine, and it can also use the diaphragm breathing to help bring lymph back up the thoracic duct which is situated along the spine.

Horses vs Human Lymphatics

One of the main differences in the horse's lymphatic system is that human vessels are made up of a lot of smooth muscle cells. This means they are more rigid and firmer so lymph travels through these vessels quite nicely. We humans are also covered in muscles and fascia that help give support to these vessels. Horses, however, are fortunate in some ways and not others. Their deep vessels are made of more elastic fibres, which means that they have a tendency for lymph to pool at the bottom of the vessels, making them distend and not be very effective. This happens mainly when the horses are standing still. When the horse moves, the movement of the fetlock joint helps to create a pumping action which helps lymph move back up the vessels. It is thought that this pumping action of the fetlock joint may be there as the horse has no muscle below the knee and the hock to help push against the lymphatic vessels and give them a little more strength. This puts the standing horse at a distinct disadvantage with regard to recovery from injury or exertion.

The horse also has an extremely high number of lymph nodes – roughly 8,000, compared to an average of 550 - 600 in the human. Their nodes are smaller and there tend to be more of them massed together. As lymph slows down when it enters a node, horses are more likely to get lymphatic 'bottlenecks' than humans or other animals. This means in times of infection, where

Management, treatment and therapy

Treatment focuses on reducing the size of the oedema, minimising infection, skin care, lymph drainage sessions and wearing suitable compression garments if needed. In the horse, it is highly likely that we are missing the early signs of compromised lymphatics by simply dismissing them as 'swollen legs' without realising the full implications of what this actually means for the long term future and performance ability of the horse.

Treating the lymphatic system using equine manual lymph drainage (EMLD) has been effectively applied on the continent for a wide range of equine conditions from wound healing, tendonitis, rhabdomyolosis and filled legs, as well as reducing limb volume after bouts of lymphangitis. EMLD is a highly specific medical technique that works by stretching the skin in the direction of lymphatic flow in a specific manner in order to increase the rate of interstitial fluid being drawn into lymphatic system. Treatment can be augmented by Kinesio Taping and the Deep Oscillation (Hivamat) machine. This can help tremendously with the healing of wounds by radically improving scar tissue. Horses are very receptive to the therapy as it is gentle enough to work around painful wounds or incision sites.

huge amounts of lymph need to be transported to nodes to be filtered and lymphocytes manufactured to fight bacteria or viruses, horses legs can swell extremely quickly. This is seen a lot in a skin infection called lymphangitis.

Half of the horse's lymph nodes (4,000 out of the 8,000) are situated in the ascending colon. The lymph vessels around the colon depend upon hitchhiking on the peristaltic action of the intestines. The horse's lymphatic system is therefore very compromised when access to ad lib forage is restricted, as the lymph flow around the intestines is stimulated by the peristaltic action created from a continuous flow of food through the gut.

Horses' tendons have been shown to contain a very high density of lymphatic vessels compared to blood.

As swollen legs in horses are generally not considered an illness, many owners will try to reduce swelling by using stable bandages over some form of padding. However, this has been shown to simply transfer the oedema via the superficial lymphatic system higher up the leg, where it gives the illusion of having dispersed. In 2006, a large veterinary study was undertaken in Germany to look at the effect of different types of bandaging on the lymphatic vessels below the knee and hock. This area is vulnerable to pressure due to not having muscles to buffer the effect of bandaging. The vets injected a continuous stream of dye into the horses deep lymph vessels, bandaged their legs with different types of bandages, and x-rayed the effects. Horses

bandaged with the elasticated stable bandages were found to have significantly restricted lymph flow, cutting out a lot of the drainage through the deep vessels. Horses' tendons have been shown to contain a very high density of lymphatic vessels compared to blood vessels. This highlights the need for further awareness of the clinical effects of bandaging on lymphatic performance.

When the lymphatics are compromised (either by lack of movement, genetic predisposition, injury, surgery or post infection, such as in cases of lymphangitis), they cannot remove the excess interstitial fluid and this will show up as a swelling somewhere in the body. This usually starts in the legs, as the lymph has further to travel. The swelling (called oedema) usually starts off quite soft and a fingertip pressed into the swollen area will leave a small 'pitting' mark, or indentation, that gradually refills in a few seconds. Over time, this oedema becomes harder and more fibrotic, as the protein left behind by the lymphatic system changes molecular structure and gradually become more hardened and fibrotic.

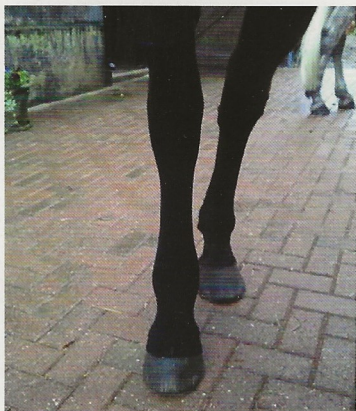
In horses, hind limbs will generally be more affected than front limbs due to the distance that the lymphatic fluid has to. Studies from Germany have shown that horses suffering from recurrent mud fever are likely to be showing signs of an already compromised lymphatic system, whereby small wounds fail to heal quickly due to accumulation of protein rich oedema. This subsequently puts them at greater risk of contracting lymphangitis, which can cause further damage to the superficial lymphatic system as well as compromise hoof health.



Mare suffering from oedema after lymphangitis infection

Case Study 1:

This mare had suffered from mud fever and repeat bouts of lymphangitis, leading to chronic oedema of the off hind. Treatment consisted of EMLD, Hivamat treatment and lymphatic compression bandaging, followed by the wearing of special compression garments that stopped the limb refilling. The owner maintained the limb brilliantly, even keeping the volume lower than the good leg, and the mare returned to full work. This case illustrates the need to diagnose lymphatic problems early on, before they deteriorate to the point where repeat infections cause a downhill spiral of infection and re-infection. There is a need in heavily filled legs, to address the biomechanics and the fascia, as each litre of fluid weighs about a kilo, so tight areas and fascial restrictions are common.



After EMLD and compression bandaging



Brinca

Case Study 2:

This elderly gray mare developed oedema to the lower off hind after being cast. It had been assumed that this was the start of lymphatic failure due to old age, but the mare had previously had an ovarian cyst removed, which had left a great deal of fibrotic scar tissue over the site of the iliac lymph nodes. These are important as they receive the lymphatic fluid from the hind limbs. The Hivamat machine was used in order to soften the fibrotic scar tissue and myofascial treatment was given by Sue Connolly, EMRT. Rather miraculously, this combined approach had the effect of draining the leg – so what was originally considered a palliative case was turned unexpectedly around. Although I do not expect to see this sort of turn around regularly, it illustrates to good effect how scar contraction can affect lymph flow and how treating wounds early on using MLD ensures the ongoing health of both the fascial and lymphatic systems, as well as preventing possible biomechanical problems as well.



Patrick before

Case Study 3:

This advanced eventer underwent surgery to clean out a wound to just below his patella and unfortunately blew his stitches when he arrived back home. Having been unable to re-stitch the wound, he was put on box rest to leave the wound to heal. His owners applied Manuka honey daily and his veterinary team were also taking an active role in preventing infection. Hivamat treatment was given regularly over a month to help prevent the scar from becoming fibrotic and hard. As the wound was over a moving joint, scar tissue can sometimes cause mechanical constriction if not treated. Once back into work, his owner reported that he was exhibiting a bit of a "string-halt" type action when asked to work



Patrick after

harder over big oxers and spreads. Treatment helped release the tightness within the scar tissue and create a flexible but strong repair. This illustrates the need for scarring and scar tissue formation to be treated seriously, as lymph cannot pass through scars more than 4mm thick. Deep puncture wounds especially can impinge not only lymph flow, but biomechanically via fascial gliding planes, which in turn can impede normal movement over time.