The importance of the lymphatic system

Rebecca Blenntoft trained in manual lymphatic drainage for humans at the Vodder Akademie in Austria and at the Veterinary University at Hannover, Germany. She explains the function of the lymphatic system and how it impacts on wellbeing and performance.

The health of the equine lymphatic system is often not taken into account in any great detail when management of the performance horse is being considered, even though any sub-optimal functioning of this system is likely to have a detrimental effect on overall health and recovery from injury. As a result of this low awareness there are some areas in traditional regimens and treatments, which run counter to lymphatic health.

The function of the lymphatic system

The lymphatic system is an extensive system of vessels and nodes that plays a crucial role in maintaining fluid balance and cellular health within the body. It does this by collecting and returning interstitial fluid to the venous system of the blood. Interstitial fluid fills the spaces between muscles, organs and other cellular structures and allows substances such as dissolved oxygen and nutrients to travel through it to reach the cells. The lymphatics also filter and return waste material, such as cell debris, bacteria, dead blood cells, pathogens, toxins and protein molecules back to the venous system. This waste material passes through lymph nodes, which act as biological filters, analysing potential pathogens and triggering any required immune response through the manufacture of lymphocytes. Lymphatic fluid slows and becomes more concentrated when it enters a lymph node for that reason. The cleaned and filtered lymph then re-enters the blood supply via the external jugular veins.

The lymph drainage of the skin begins in the dermis, where tiny, blind-ended ‘initial lymphatic vessels’ (ILV’s) are joined by anchoring filaments to the collagen fibres of the connective tissue. These ILV’s look rather like the fingers of a glove, and are comprised of single epithelial cells. When the pressure on the anchoring filaments increases, they cause the epithelial cells to open like a swinging flap, and interstitial fluid is drawn into the ILV. From that moment, the fluid is referred to as lymph, or lymphatic fluid due to it being enclosed within the lymphatic system.

The lymph travels in a single direction—firstly to simple ‘pre-collectors’ and then to the larger ‘collector vessels’. The collector vessels can be viewed as looking a little like a beaded necklace, where each bead or ‘angion’, fills up with lymph until the internal pressure stimulates muscle cells in the angion to push it through a bicuspid valve into the next angion. These valves are designed to prevent lymphatic backflow into the previous angion and therefore they dictate the direction of lymph flow.

The lymphatic system does not have an organ to act as a pump to help with the circulation of the lymph, like the heart does for the cardiovascular system. It relies upon factors such as muscular contraction, arterial pulsation, the peristaltic action of the intestinal system and increased thoracic pressure during deep respiration to stimulate lymphatic flow. The muscle fibres of the collector vessels can also contract and help lymph flow, and the
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ILV's can also increase the speed in which they can refill and empty interstitial fluid to a certain degree.

Areas of ILV's, pre-collectors and collectors work together in designated skin territories, delineated by lymphatic 'watersheds'. Each of these skin territories drains lymphatic fluid to a specific group of lymph nodes. Lymph from one skin territory will generally not travel across these watersheds into other skin territories unless the neighboring territory becomes very congested. In these instances, the lymphatic system can use 'anastomoses'—small connecting vessels—to enable lymph to cross the watersheds and enable lymph to pass.

Even though the lymphatic system is part of a continuous, one-way network, it is usually referred to as either 'superficial' or 'deep', dependent upon which vessels are being utilised and what is being drained. The superficial lymphatic system drains the sub cutis and the skin, and is delineated by watersheds as described above. The deep lymphatic system refers to the drainage of the mucosa, nerves, tendons, tendon sheaths, joints and muscles. Each internal organ also has its own specific deep drainage pathway. In humans, these tend to be inaccessible due to being under layers of subcutaneous fat, bone and the deeper musculature, but it is important to remember that they are both draining in specific directions to specific groups of nodes and then back to the venous return via the external jugular veins.

**Deep lymphatic collector vessels of the hind legs**

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**The equine lymphatic system**

Although there are similarities between human and equine lymphatic systems, there are some profound differences between them, the misunderstanding of which can lead to the health of the horse being compromised. It is important to remember that the horse has evolved from a small flight animal designed to be in almost constant motion, to the animals we utilise today. Although there have been great changes in the external appearance of the horse, its physiology remains largely similar to that of its earlier ancestors and it is unlikely that its lymphatic system has been able to adapt to suit many of our current management methods.

One of the main differences in the equine lymphatic system is the significantly lower number of smooth muscle cells that make up the walls of the collector vessels.

Research has revealed that equine collectors within the cutis are comprised of 40% elastic fibres, markedly more so than in humans, and the cutis represents the horse's own 'compressive bandage'. This means that the horse requires far more physical movement in order to activate its lymphatic retraction apparatus and maintain the transport of lymphatic fluid. The elastic fibres are assisted by a 'pump mechanism' in the hoof and the fetlock joint, which assist lymph travel up the collector vessels. This high proportion of elastic fibres may have developed because there are no muscles in the lower limbs of the horse to aid with the contraction of the vessels.

**Management and exercise**

Our current modern methods of keeping horses stabled, with concentrated physical training sessions and limited time for free exercise, create a very different pattern of movement.

When a horse is standing still, the transport capacity of the lymphatic system decreases significantly as the lymphatic retraction mechanism is compromised. Both the velocity of flow and the total volume of lymph being moved will be reduced. 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 8000, compared to an average of 600 in the human. It is important to remember that lymphatic fluid slows down and concentrates upon
entering each lymph node, equines therefore, have a greater propensity for lymphatic 'bottlenecks' than other mammals.

The horse also evolved to be a trickle feeder, taking in small amounts of forage during long grazing sessions. Notably, half of the horse's lymph nodes (i.e., 4000 out of the 8000) are situated in the ascending colon. The lymph vessels around the colon depend upon being aided by the peristaltic action of the intestines. The horse's lymphatic system is therefore significantly 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.

When we consider the performance horse, for example, it is by no means unusual to see them in their stables almost permanently during the competitive season. A ration of hay or haylage given in the evening can be eaten up within a few hours, leaving the horse standing without food for up to 12 hours. The horse is then taken out for training exercise, whereby its lymphatic system is being asked to increase lymph flow from a compromised position very rapidly into a highly active state. Often horses are then returned to their stable still warm, and although the lymphatic system still has work to do in clearing cellular debris plus dealing with the consequential increase of arterial blood flow into the interstitium, it is not able to do so because the horse is stood still. This has implications not only in the horse's home environment, but also in the travelling performance horse, when asked to reach top form very quickly after standing for many hours in lorries and tied up in show grounds. It is therefore, not surprising that many performance horses will develop swollen or filled legs as a result of lymphatic compromise.

**Swollen limbs**

As swollen legs in horses are generally not considered an illness, many owners will try to reduce swelling by using elasticated stable bandages or 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 ascertain the effect of different types of bandaging on the lymphatic vessels. This involved injecting a continuous stream of contrast medium (dye) into the lymphatic vessels of horses under sedation and x-raying the effects. Horses bandaged with the elasticated stable bandages were found to have significantly impeded lymph flow when compared to those bandaged with specially designed lymphatic compression bandages.

Horses' tendons have been shown to contain a very high density of lymphatic vessels to blood vessels. This highlights the need for further increased awareness of the clinical effects of bandaging on lymphatic performance. The authors of the study recommended that in the future, the materials and construction of both veterinary and equine sports bandages be seriously reconsidered.

**Nutrients**

When one considers that every cell in the body relies upon receiving dissolved oxygen and nutrients from the interstitium to carry out its metabolic function properly, and that the lymphatic system collects cellular debris from the interstitium in order to filter and return it to the bloodstream, any disruption of the smooth functioning of the lymphatics will compromise cellular health. When the lymphatics are compromised (either by lack of movement, genetic predisposition, injury, surgery or post infection, such as in cases of lymphangitis), excess fluid within the interstitium will generally lead to oedema forming ventrally to the abdomen,
mammary glands or sheath, or distally to the limbs. The 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 travel back along the thoracic duct to the superficial cervical lymph nodes and external jugular veins. 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 or cellulitis infections, which can cause further damage to the superficial lymphatic system as well as compromise hoof health.

**Treatment and therapy**

In human lymphology, lymphatic oedema is treated on the NHS as a chronic condition that can compromise overall health, put patients at risk of skin infection and make them susceptible to poor wound healing, as well as certain cancers. In the equine patient, 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.

As there are no drug therapies or surgical procedures available for the repair of the lymphatic system, Equine Manual Lymph Drainage (EMLD) is the only treatment available once the lymphatics are compromised to the point of chronically occurring oedema. As a prophylactic, changing stable management routines to enable horses to move more freely for longer periods of time, supporting the movement of the lymphatics of the intestines through more natural feeding systems and avoiding the use of elasticated bandaging to the lower limbs would greatly alleviate many of the problems and challenges faced by the stabled horse.

Treating the lymphatic system using EMLD has been effectively applied on the continent for a wide range of equine conditions from wound healing, tendonitis, rhabdomyolysis 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 biphasic manner in order to increase the rate of interstitial fluid being drawn into the ILV’s. Treatment can be augmented by Kinesio Taping and Deep Oscillation (HIVamat) treatment to address protein fibrosis. Horses are very receptive to the therapy as it is gentle enough to work around painful wounds or incision sites. It has no adverse side effects and does not contravene any anti-doping legislation, so it allows horses in competitive sport to be treated at any time.

Therapists must first train in Human Manual Lymph Drainage to the highest level, which allows them to treat human lymphatic patients on the NHS. It is important to realise that the terms ‘EMLD’ and ‘MLD’ are not protected as pertaining to a certain standard of training in the UK. Correctly trained therapists can be found at www.mlduk.co.uk.

**Reading sources**


Initial lymphatic vessels (ILVs) with anchoring filaments in (left) closed position and (right) open, allowing interstitial fluid to enter the ILV.