

## Getting it Out of Your (Portal) System: Vascular Dynamics of the Liver and Associated Organs

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### Objectives:

- Attendees will listen to a review of the anatomical structures, especially the major blood vessels in the Portal System with an osteopathic approach.
- Introduction of the use of neuro-vascular reflexes from the heart and liver to support the liver and associated portal system.

### Introduction:

The osteopathic model of vascular/fluid dynamics that we discussed in previous lectures has also proven to be very effective in treatment of vascular flow problems in the liver and its associated portal system. In review, when an **acute traction** and/or **compression injury** or a **chronic irritation (chemical, nutritional and/or radiation)** occurs to an area of the body (e.g., an organ), the vasculature of that area will go in a semi-permanent or permanent state of vasoconstriction in order to protect the organ from more damage. We call these vascular restrictions **vascular wall dysfunctions**. These dysfunctions cause a **three-dimensional** impact to the affected organ and the tissues surrounding it. In the case of the liver, for example, vascular wall dysfunctions affect the vascular and neurological components of the liver leading to soft tissue restrictions in the fascia of the damaged area. The tissues will seem to be stiffer and less mobile when checked for mobility and motility. In a damaged liver, there will be **three-dimensional vascular stagnation**, or hemostasis, in the affected arteries, capillaries and veins. The fluid, or pressure dynamics in that area will be altered, and tension of the surrounding tissues will increase. The rhythms of the involved tissues will be altered as well, and the body will start to compensate and break down from the altered pressures and restricted flow of fluids.

The *greatest* stagnation is usually in the **venous** flow; the “venous blue print of the body” will be altered by the injury. If there is stagnation of venous flow, there may also be an indirect reduction of the arterial flow in that area; as a consequence, the tissue healing of the organ will be slowed down in that area of the body. Also there will be an impact on the tensegrity (the balance between compression and tensile forces) of the involved restricted tissues, as well as the **mobility** and **motility** of tissues of the different liver lobes.

### Anatomy:

Let's review the anatomy of the liver and the portal system, using mostly Miller's Anatomy of the Dog. Knowledge of the liver anatomy will help us to understand the use of the neurovascular reflexes later on in the lecture.

### Liver Parenchyma:

The liver (hepar) is the largest gland in the body, and is situated right behind the most important muscle, the diaphragm. The *diaphragmatic surface* is convex in all directions, and faces more bilaterally and dorsally than cranially and ventrally. There are several ways to divide the liver into different parts for study.

Looking at the *diaphragmatic surface* of the liver, Miller's Anatomy of the Dog subdivides the liver into **right, left, cranial, dorsal** and **ventral parts**. The right part is the largest of these parts. The *visceral surface* of the liver is irregularly concave and mainly faces to the left and the rear of the dog. It contacts the stomach, duodenum, pancreas and right kidney.

Clinically, however, most veterinarians think of dividing the liver into its various **lobes**. The liver is divided by deep fissures in the hepatic tissue into four main lobes, along with four sub-lobes and two processes, by deeply running fissures in the liver parenchyma.

The portion of the liver that lies pretty much to the **left side** of the median plane consists of the ***left lateral hepatic lobe, left medial hepatic lobe, the quadrate lobe, and the papillary process of the caudate lobe***. The left lateral lobe of the liver forms nearly 1/3 to 1/2 of the total liver mass.

The portion of the liver that lies mostly to the **right side** of the median plane consists of the ***right medial lobe, the right lateral lobe, and the caudate lobe with its papillary process***.

Several important structures, such as the *aorta*, the *esophagus* and the *caudal vena cava* cross the diaphragm adjacent to the liver. The caudal vena cava lies to the right of the esophagus as they travel across the liver.

#### **Porta:**

The **porta** of the liver is the hilus of the organ. The hepatic vessels and nerves, and the bile duct communicate with the gland via the porta. The nerves and arteries enter the porta dorsally, the bile duct leaves ventrally, and the portal vein enters between the two.

#### **Fascia:**

The liver is almost completely enveloped by peritoneum, which forms its **serous coat** (tunica serosa). This coat is fused to the underlying **fibrous capsule** (fascia), a thin, strong layer made primarily of collagenous tissue, which closely adheres to the surfaces of the liver. At the porta, the fibrous coat becomes thicker and continues into the interior of the liver in association with the vascular and nervous structures that supply the liver. The coronary ligament, with its associated folds of connective tissue called the triangular ligaments and falciform ligaments of the liver, partially attach the liver to the diaphragm.

#### **Blood and Lymph vessels:**

The “**EFFERENT**” **VENOUS system** of the liver is formed by single ***central veins*** in the centers of the lobules, which then they join to form ***interlobular veins***. The interlobular veins then fuse to form ***hepatic veins***, which drain into the caudal vena cava. The hepatic veins convey to the caudal vena cava all the blood that the liver receives via the portal vein and the hepatic arteries.

The “**AFFERENT**” **VENOUS system** of the liver is the hepatic **portal vein**, which brings blood from the pancreas, spleen, and the entire gastrointestinal tract except for the anal canal. The portal vein is not a true vein, in that it conveys blood to the capillary beds in the liver parenchyma, rather than directly back to the heart. The portal vein supplies about 80% of the blood that enters the liver. The portal vein arises from the

capillaries of the viscera listed above and ends in the liver.

The hepatic portal vein is formed by the confluence of the cranial and caudal mesenteric veins, and the splenic vein. The gastro-duodenal and cystic veins join the portal vein more cranially. In treating the venous system, we always start clearing restrictions from that part of the venous system closest to the heart, so we need to examine the approximate locations, *cranially* to *caudally*, at which the veins enter (or form) the portal vein. There may be some anatomical variation between individual animals.

According to Miller's Anatomy of the Dog, the order of drainage of the various veins into the portal vein, from closest to the heart to furthest, is as follows:

1. Cystic vein (from the gall bladder)
2. Gastro-duodenal vein (blood from the stomach, pancreas and duodenum)
3. Splenic and left gastric veins (blood from the spleen, stomach and pancreas)
4. Cranial mesenteric root (blood from the jejunum and ileum, along with some from the pancreas and duodenum)
5. Caudal mesenteric root (blood from the rectum, colon, and ileum)

### **Liver venous vascular stagnation**

The liver seems to act like a muscle, impelling the blood through the hepatic vein and caudal vena cava to the heart. The hepatic veins (the venous supply from the liver) are on the diaphragmatic surface of the liver. Liver venous vascular stagnation includes the hepatic veins of the liver itself, as well as the portal system coming into the liver. Any restrictions in this hepatic vein pathway should be released and flow restored first, before we will use the liver reflex to open up restrictions in the portal system. So, we divide the liver into **four** major areas, all of which need to be checked for venous stagnation:

- Diaphragm, including the foramen of the caudal vena cava
- Hepatic veins
- Liver lobes blood flow (capillary and arterial)
- Hepatic portal system

If we find tightness in the diaphragm and/or the foramen caudal vena cava, you can use a *Functional Indirect* unwinding technique (FIT) to resolve this problem. Restrictions in the drainage of the hepatic veins may be resolved using the *Heart Roll* Reflex described below. The optimal treatment order is based upon releasing the restriction that is closest to the heart first. The hepatic veins drain directly into the caudal vena cava at the cranial aspect (diaphragmatic aspect) of the liver in the following order, from *closest* to the heart to *farthest* from the heart: the most cranial hepatic vein is from the right lateral lobe; the next lobe to drain is the right medial, then the quadrate, then the left medial, and finally farthest from the heart, the left lateral lobe.

### **Heart reflex:**

#### **• *Position of the heart:***

The heart is located ventral to T2 or T3 to T6 or T7, deep in the ventral thorax, just above the sternbrae 4 to 8, depending on the breed. Positioning is oblique: the base of the heart

faces cranial/ventral and the apex faces caudal/dorsal at an angle of about 45 degrees. At the base of the heart, the aorta is located to the left of midline at the cranio-dorsal aspect of the heart, and the cranial and caudal vena cava are to the right of midline.

- ***Movement of the Heart:***

Because of the oblique orientation of the heart fibers, it makes a roll upwards (dorso-cranially) when it contracts/empties, and rolls backwards (ventro-caudally) when it fills. The blood moves symmetrically in and out of the heart, creating a corresponding rhythm that is about 8 times slower than the actual heart rate. This creates an ENERGETIC HEART REFLEX of emptying and filling that you can follow with your hand on the ribcage over the heart. (The farther away from the heart you are, the slower the rhythm.) The heart reflex follows the “figure of eight” emptying and filling phases of the heart.

When you use the heart reflex, you can follow the blood vessels for the arterial and venous cycles throughout the body. If you are following the vasculature with one hand, and have your other hand drawn into (connected to) the heart rhythm, and the heart roll suddenly stops, that means that there is a vascular restriction at that place in the vasculature. Depending upon which phase the stop occurs (heart emptying or filling), you know if it is an arterial or a venous restriction.

**Treatment Using the Heart Reflex:**

Draw into the heart roll reflex with one hand, preferable on the left side of the animal’s chest. Use the other hand on the restricted area to draw in and put the restricted blood vessel tissue at slight *tension* (we call this neurovascular stimulation) away from (arterial restriction) or towards (venous restriction) the heart.

**VENOUS:** When it is a *venous* problem, you put a slight energetic **pull to** the heart and emphasize the heart roll every time the heart is in the **filling** phase. Most of the time, the restricted blood vessel will open up at the fourth stroke of the heart roll.

**ARTERIAL:** When it is an *arterial* problem, you put a slight energetic **pull away** from the heart and emphasize the **emptying** phase of the heart roll. Most of the time, the restricted blood vessel will open up at the fourth stroke of the heart roll.

**RULES:**

- If both venous and arterial restrictions are present at the same area, start with the VENOUS restriction first, then emphasize the arterial restriction to bring in new blood. You can’t add any more blood if it is still FULL with a venous drainage problem.
- Start treating vessels closest to the HEART first, then work your way away from the heart to more peripheral vessels; this allows blood from the periphery to flow unrestricted back to the heart in venous restrictions. Remove one restriction at a time to clear the pathway for blood flow towards or away from the heart.

**Liver Reflex:**

The liver reflex that we tune into is that of the portal inflow of blood into the liver

(the venous supply to the liver, on the visceral surface), as the blood first goes clockwise (looking from the tail to the head) to the right lateral lobe (the blood has the strongest “oomph” there, coming right off the full portal vein), then the right medial lobe, then the quadrate lobe, then the left medial lobe, and finally the left lateral lobe. The portal system flows through the liver and is then collected into the hepatic veins.

So the *hepatic reflex* that we use starts under the right hand dorsally (the right lateral lobe, which is the first to receive portal blood but the last to drain hepatic venous blood, as its vein is closest to the heart) and goes around clockwise over the hepatic venous system progressively farther from the heart, to the left lateral lobe, which receives the portal blood last and is the first to drain blood into the caudal vena cava as it is closest to the heart.

If the *liver reflex itself is dysfunctional*, then you must use the heart roll reflex to strengthen and restore the liver reflex. To do this, use the heart roll reflex, connecting the heart first to the left lateral lobe (closest to heart); then to the left medial lobe; then to the right medial lobe; and last to the right lateral lobe, to restore the working of the liver reflex. Once the vascular flow within the liver is restored, the reflex will move strongly clockwise, and can be used for checking and treating the portal system.

### **Checking and Treating the Portal System:**

Standing behind the dog or cat, the right hand of the practitioner is on the right dorsal aspect of the trunk over the right lateral lobe, while the left hand checks the following organs by energetically connecting to (drawing into) the following:

1. Cystic (gall bladder) vein
2. Gastro-duodenal and pancreas veins
3. Splenic and left gastric veins
4. Cranial mesenteric root
5. Caudal mesenteric root

If the liver reflex stops going around strongly clockwise, you have a vascular restriction in the organ you are checking. Leave your hands in place and wait; your hands are energetically form a “jumper cable” between the liver reflex and the dysfunctional organ. Within 1 to 2 minutes, the reflex will slowly start up again, as the vascular flow is restored. Check the entire portal system for sufficient blood flow, and treat any dysfunctional areas. These neurovascular reflexes in our practice enhance the vascular flow, connective tissue manipulation, and the circulation of Qi through the liver and the hepatic portal system.

### **References**

- Evans, Howard E: Miller’s Anatomy of the Dog, Third Edition, 1993. W. B. Saunders Company
- Budras et al: Anatomy of the Dog, Fifth, revised edition, 2007. Schlutersche Verlagsgesellschaft mbH &Co.