Original Research Paper

Ultrasonography of Chronic Venous Disease by Doppler Ultrasound and Consecutive Treatment Using Medicinal Leeches (Hirudo Medicinalis)

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Abstract: Chronic venous disease refers to chronic diseases of veins with specific subjective symptoms. In our study, we used a Doppler ultrasound exam of the leg to examine the venous system of patients and make a diagnosis. Venous disease is one of the best-established traditional indications for leech therapy. Patients were diagnosed with the following venous diseases: chronic venous insufficiency, phlebothrombosis, post-thrombotic syndrome and combinations thereof. After consulting with an angiologist and considering the health status of the patients, medicinal leech therapy (hirudotherapy) was offered when appropriate. Hirudotherapy is a biotherapeutic method that uses medicinal leeches for the treatment of a wide spectrum of diseases. We used two species of certified leeches, Hirudo medicinalis (Hirudo medicinalis medicinalis, Hirudo medicinalis officinalis and Hirudo medicinalis orientalis) and Hirudo verbana. Ultrasonography of the venous system showed clinical improvement in 15 patients after treatment with medicinal leeches. Hirudotherapy appears to be a successful alternative treatment for CVD.

Keywords: CVO, Ultrasonography, Doppler, Hirudotherapy, Hirudo medicinalis

INTRODUCTION

Chronic venous disease (CVD) of the lower limbs includes all chronic diseases and anomalies of the venous system. CVD is characterized by many symptoms, including the feeling of heavy legs, pins and needles, cramps and highly specific objective signs (varices, edema, venous eczema, dermatitis, and hyperpigmentation of the skin of the ankle) (Fig. 1). CVD can be classified according to a descriptive clinical, etiological, anatomical, and pathophysiological (CEAP) classification, providing a stable basis for lower limb venous system status assessment ¹, ², ¹⁰, ¹¹. Chronic venous diseases are one of the best-established traditional indications for hirudotherapy – medicinal leech therapy. There is a plethora of case reports and empirical studies on the subject, including clinical investigations of the efficacy of leaching for postoperative prevention of thrombosis before the advent of heparin, which is now the standard prophylactic agent. The postoperative use of leeches for prevention of thrombosis was proposed by the French surgeon Termier. His recommendation was first adopted in France and was later implemented successfully in numerous hospitals around the world. Medicinal leeches have many beneficial substances in their salivary glands that have a positive effect on the patient’s general condition. These substances have fibrinolytic, bactericidal and spasmyloptic activity, which in turn has a beneficial effect on viscosity-enhancing effects in the blood and thereby contributes to the improvement of subjective as well as objective difficulties CVD⁷. In venous disease,
medicinal leech therapy can be recommended for treatment of acute superficial phlebitis (thrombophlebitis), deep vein thrombosis (phlebothrombosis) and chronic venous insufficiency (CVI) associated with varicose veins and post-thrombosis symptom complex 7.

Phlebothrombosis is intravital intravascular blood clotting, which affects the deep venous system of the lower limbs. Thrombosis is the primary process of phlebothrombosis of deep veins, while inflammation of the vein wall is a secondary process. Thrombosis occurs when abnormal amounts of fibrin and thrombocytes accumulate in the veins. The ratio of the two components in a blood clot is dependent on whether the thrombotic process is progressing in a vein or artery. Consequences of phlebothrombosis can be fatal pulmonary embolism, later resulting in CVI and post-thrombotic syndrome 8. The post-thrombotic syndrome is prevalent following deep vein thrombosis and is caused by inflammatory damage and the subsequent dysfunction of venous valves. Typical features of PTS include chronic limb pain, edema, muscle cramps, swelling, heaviness and skin changes in the affected limb. Varicose veins are a secondary feature 5, 6.

Leech therapy is particularly useful for the symptomatic treatment of varicose veins. Although it cannot eliminate the venous dilatation and vascular insufficiency of varicosis, leeching is valued as a tool for quickly alleviating the symptoms associated with the disease 7. Chronic venous insufficiency (CVI I–VI) is a chronic venous disease associated with hypertension in the superficial venous system. The most common symptoms of chronic venous insufficiency are diluted blood vessels, such as telangiectasia, reticular veins and varicose veins, and subjective symptoms such as pain, swelling, skin changes and ulceration. In most cases, the symptoms of swelling, pain and perceived heaviness in the region of varicose veins or perivenous tissues improve significantly after leech application 3, 7. Anamnesis and clinical examination (finding weakened or disappearing pulsation on artery femoralis, artery poplitea, artery dorsalis pedis and artery tibialis posterior, vascular murmur or trophic skin changes) are sometimes sufficient for the diagnosis of CVD.

Venous ultrasonography of the lower extremities has become the most widely used diagnostic modality, either invasive or noninvasive, for the diagnosis and exclusion of acute DVT. There are several types of venous ultrasonography. These include compression ultrasound (B-mode imaging only), duplex ultrasound (B-mode imaging and Doppler waveform analysis), and color Doppler imaging alone. Although these types of venous ultrasonography are sometimes used interchangeably, their sensitivities and specificities for detecting acute DVT vary. Different lower extremity veins are best evaluated using different techniques. Compression Doppler ultrasound is typically performed on the proximal deep veins, specifically the common femoral, femoral, and popliteal veins, whereas a combination of duplex ultrasound and color Doppler imaging is more often used to interrogate the calf and iliac vein 13.

Hirudotherapy is an alternative medical, therapeutic method that uses leeches for the treatment of various diseases. There has been much success in the treatment of various CVD and their manifestations, including swelling, pain and spasms of the legs, varicose veins, and the most severe symptoms of chronic venous insufficiency, venous leg ulcers. The aim of hirudotherapy in these patients is decongestion of the affected extremity and rehabilitation of the cutaneous microcirculation due to the action of local anti-hemostatics, and vasodilatory and anti-inflammatory active substances from the saliva of leeches 9, 12. For therapeutic purposes, only the following types of leech are acceptable: Hirudo medicinalis (three phenotypes Hirudo medicinalis medicinalis, Hirudo medicinalis orientalis, Hirudo medicinalis officinalis) and Hirudo verbena 7.

MATERIALS AND METHODS

Diagnosis of Chronic Venous Disease

Examination of the patients is performed by an angiologist and then a hematologist and includes a clinical examination based on case history and subsequent ultrasound using a Doppler device to diagnose or exclude deep vein thrombosis (Fig. 2). Various CVD were diagnosed in our study. Most patients had phlebothrombosis in connection with post-thrombotic syndrome and other patients had some CVI (stage II–VI).

The criteria for treatment with medicinal leeches were as follows

a) the presence of CVD;
b) recommendation by physician;
c) patient informed consent;
d) lack of contraindications (histamine allergy, anemia, hemophilia, severe forms of diabetes, malignancies, etc.).

Treatment of Chronic Venous Disease

The baseline method for the treatment of CVD in our institution is hirudotherapy using Hirudo medicinalis medicinalis and Hirudo medicinalis officinalis (certified leeches) combined with conventional pharmacological treatment in collaboration with an angiologist. A patient can undergo hirudotherapy after discussion with their physician and following their consent. Therapy consists of 6–8 applications at 3–7-day intervals. This therapy is combined with conventional pharmacological treatment. The patient takes an appropriate drug and follows the physician’s recommendations throughout therapy using medicinal leeches.

In the current study, we placed one to four leeches on the desired area of the lower extremities for each procedure. We placed leeches on the lower limbs: inner, outer and front of thigh and calf. The leeches sucked blood for 30–50 minutes and were then removed using an alcohol tampon, before being stored in a container. At the close of therapy (6–8 applications), each patient had a 2–3-month rest period and then continued with their second course of therapy.
Patients with phlebothrombosis and post-thrombotic syndrome

We placed two leeches on the desired area of the lower extremities to achieve the strong pharmacological anticoagulant effect required by the angiologist and hematologist. We wanted to prevent massive bleeding from the wound, which usually occurs immediately after the removal of medicinal leeches from the skin due to the effect of anticoagulant substances, which the leeches release into the patient’s body while sucking blood. To prevent problems with wound healing, medicinal leeches must not be applied directly to areas with dermatitis and venous ulcers, which are most the most common symptoms of the disease.

Patients with CVI

We placed two to four leeches, and sometimes more, on these patients, according to the extent of the dilated veins (telangiectasias – reticular veins, varicose veins). We always placed the leeches on peripheral veins, and never on affected veins, because this could result in massive bleeding. Similarly, we had to avoid placement of leeches on areas with damaged or weakened skin (edema, hyperpigmentation, eczema, lipodermatosclerosis, venous ulcers).

Procedure of Leech Therapy

We disinfected the required number of leeches in a solution of water and blue vitriol or in chlorine water for 2–10 minutes (Fig. 3B). The number of leeches per procedure for each patient was selected according to the extent of the defect and CVD. During the disinfection of leeches, we disinfected the area to be exposed to leeches using alcohol wipes, then waited for 2 minutes before placing the sterilized leeches on the desired area (Fig. 3C). The leeches were allowed to suck blood for 30–50 minutes and were then removed using an alcohol tampon, before being stored in a container (Fig. 3 D, E). Leeches were only used once. After removing the leeches, the wounds would bleed, so they were disinfected with antiseptic solution and then covered with compresses and absorbent material (Fig. 3F). Wounds may bleed for up to 24 hours and then create scabs and scars. During the healing process, there may be inflammation, redness, swelling or itching around the wound. After therapy, the patients must rest and should not physically exert themselves 4.

The study was approved by the Ethical Committee of the University Hospital of the Merciful Brothers in Bratislava (Reference number 116/2015-2).

RESULTS

We studied 15 patients with various types of CVD. All patients met the criteria for treatment with medicinal leeches. These patients were specially examined by ultrasound before and after treatment. We recorded the subjective conditions of CVD, which patients reported continuously during therapy (Table 1). Ultrasound examinations after therapy confirmed the objective improvement in the deep venous system of the lower extremities (Table 1, Fig. 5, 6 and 7). Bioactive substances in the salivary glands of medicinal leeches improve the blood circulation and have a beneficial effect on the vascular system and on the entire human body.

CONCLUSION

Ultrasound Doppler is a non-invasive examination that is the simplest but also the most reliable vascular examination for demonstrating the presence of thrombosis. On the basis of such examinations, we divided the patients into groups according to disease and considered the need for treatment using medicinal leeches. Hirudotherapy has a positive effect on the treatment of CVD in most cases. Patients often see a noticeable improvement of symptoms immediately after treatment with medicinal leeches. Strong anti-inflammatory, anticoagulant, and antibacterial effects of substances in the salivary glands of leeches attenuate the first signs of the disease (swelling and pain) and patients report that their “legs feel light”.

We placed a large number of leeches on the affected area in the case of acute inflammation of the vein (phlebothrombosis) to speed up the healing effect. On the other hand, in the treatment of CVI, we used a smaller number of leeches for multiple applications, as per the study of Michalsen et al.7. Hirudotherapy is an effective alternative method for treatment of different CVD. We recorded a subjective improvement of health state in all 15 patients in our study. All patients visited the angiologist after therapy and Doppler ultrasound recorded the objective improvement of CVD. Improvements were visible in patients with post-thrombotic syndrome and phlebothrombosis. The deep vein system was recanalized by 30% to 100% in these patients (Fig. 5, 6 and 7). In patients with CVI II–V, we observed only a subjective improvement, but in stage VI of the disease the leg ulcers were healed and the skin hyperpigmentation alleviated.

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ABBREVIATIONS

CVI – Chronic venous insufficiency
CVD – Chronic venous disease
VFS - Superficial femoral vein (Superficial thigh vein)
VP - Vena poplitea (Popliteal vein)
VTP - Vena tibialis posterior (Posterior tibial vein)
<table>
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<tr>
<th>Diagnosis</th>
<th>Objective condition</th>
<th>Subjective condition</th>
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<tbody>
<tr>
<td>Phlebothrombosis</td>
<td>• Complete recanalization in area of VP (Fig. 7C, 7D)</td>
<td>• Improvement of symptoms, without swelling, pain or discomfort of lower limb.</td>
</tr>
<tr>
<td></td>
<td>• Recanalization of VP to 50% on the right lower limb (Fig. 7A, 7B)</td>
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<tr>
<td></td>
<td>• Recanalization to 80% on the right lower limb</td>
<td></td>
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<td></td>
<td>• VFS, VP and VTP I.dx. recanalized</td>
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<td></td>
<td>• 30% recanalization of popliteal vein and 50–100% recanalization of VTP (Fig. 5, 7)</td>
<td></td>
</tr>
<tr>
<td>Phlebothrombosis + Post-thrombotic syndrome</td>
<td>• Recanalization of popliteal vein to 80%</td>
<td>• Reduction of pins and needles</td>
</tr>
<tr>
<td></td>
<td>• Complete recanalization in area of popliteal vein I. dx.</td>
<td>• Improvement of subjective complications and swelling of lower extremities</td>
</tr>
<tr>
<td>CVI st. CEAP</td>
<td>CVI II No objective condition</td>
<td>Improvement of subjective complaints of CVI and constriction of varicose veins on the lower extremities</td>
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<tr>
<td></td>
<td>CVI III No objective condition</td>
<td>Improvement of swelling on the lower extremities, without claudication and inflammation on the lower extremities</td>
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<td>CVI IV No objective condition</td>
<td>Improvement of subjective complaints such as swelling, pain and symptoms of CVI on the lower extremities</td>
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<td>CVI V • Healing of ulcer cruris • Reduction of hyperpigmentation on skin of ankle • DVT on left lower limb is stabilized</td>
<td>• General improvement of clinical subjective complaints of CVI without swelling on the lower extremities</td>
</tr>
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Figure 1: Chronic venous diseases (A, B, C – CVI II – V st. CEAP classification, D, E, F – phlebothrombosis with post-thrombotic syndrome)

Figure 2: Thrombosis of distal popliteal vein. A more distal section of the popliteal artery and vein in the slot at the knee joint showing thrombosis of the popliteal vein (blue arrow) and popliteal artery (red arrow). A) A cross-section. B) Longitudinal section. Left – popliteal vein completely filled with subacute, homogeneous hypoechoic thrombus = gently dilated. Right – popliteal vein in compression = no flow.

Figure 4: A) Thrombosis of distal popliteal vein without signs of recanalization. Popliteal artery and vein under Hunter’s channel, over the blood clot is normal artery and vein (black). Compressive movement: left – without compression, right – with compression. The vein is compressible = without thrombosis. B) Cross-section of thrombosis of popliteal vein during augmentation movement. Blood flow in popliteal artery (red), popliteal vein without blood flow (grey color right of the artery) – without color = thrombosis.

Figure 5: The distal popliteal vein after combining pharmacological treatment with one cycle of hirudotherapy. A) Partial 30% recanalization of the popliteal vein. Blood flow in central portion in 1/3 of the vein during the augmentation movement (red). The thrombus fill approximately 2/3 of the lumen of the vein (grey lines above and below vein). B) A more distal section of the popliteal vein. Turbulent flow in irregular lumen and recanalization in 1/3 of lumen. C) A short section of popliteal vein with almost complete recanalization.
Figure 6: Thrombosis of medial branch of calf vein (VTP) without recanalization. A) The conflux of medial deep calf veins in the top 1/3 of the calf – thrombosis of the vein (grey, blue arrow). B) Two branches of VTP in the top 1/3 of the calf – VTP is coupled (VTP are thrombosed – without blood flow). C) A more caudal section of VTP in the middle 1/3 of the calf – doubled VTP – thrombosed.

Figure 7: A) Medial branch of calf vein in the top 1/3 of the calf (blue color to the left of the red artery) – 50% recanalization. B) VTP just before the join to the VP in the top 1/3 of the calf. Two branches (red) are complete recanalized; the branch in the middle is 50% recanalized (blue). C) Calf vein in the middle 1/3 of the calf (red) – completely recanalized, without thrombosis. D) Peripheral deep calf veins in the lower 1/3 of the calf (red) – completely recanalized, without thrombosis.

REFERENCES