Circulatory disorders

Magnetic therapy of the highest class

Peripheral arterial disease

background

A circulatory disorder or in the technical term "peripheral arterial occlusive disease (PAOD)" is one of the most neglected in the diagnosis of precautionary disease, as it initially develops completely painless and insidious. It is a common side effect in diabetes mellitus and often points to tobacco use, high blood pressure, high blood lipid levels, but also a lack of exercise. According to a nationwide study (6,880 patients / 65 years and older), one in five people already suffer from a beginning or even advanced lower limb circulatory disorder without having already noticed it [1] .

In an earlier study, 11.7% of older people showed major blood vessel involvement and 16.0% had serious changes in the small

blood vessels [2] . The most common cause is arteriosclerosis, which often begins with a narrowing or occlusion of the pelvic leg arteries. There are even estimates that the incidence of PAOD is about five times higher than described in the literature [3] .

Only when the blood circulation is so limited that the muscles receive too little oxygen, it comes to some violent, spasmodic pain in the calf, but this can also play in the foot, thigh or buttocks. One speaks here also of the so-called. "Schaufenstiesterheit", because affected are forced already after relatively short Gehstrecken, to take a break. To conceal this, they often stay at shop windows, as far as they are available. The PAD is always a harbinger of a heart attack or stroke or reduces the life expectancy by about 10 years.

Background of venous leg ulcers (ulcus cruris)

Circulatory disorders are not only caused by narrowing of the afferent arteries, but are also caused by drainage disorders of the

venous system ("chronic venous insufficiency"). If, for example, the blood in the veins is stowed in varicose veins, water accumulates in the surrounding tissue, which over time leads to hardening of the connective tissue. The result is nutritional disorders of the tissue, so that even small injuries ("scratching") can cause badly healing wounds and ulcers (ulcus cruris). Often, venous insufficiency is further complicated by arterial micro or macroangiopathies ("arterial inflow disorders").

Microcirculation for the purpose of maintaining health

The actual blood circulation effects do not take place in the main trunk vessels, but only in the periphery of the blood vessel system. This increase in capillary blood flow, also referred to as microcirculation, is the actual target area for circulation-enhancing measures. The more the capillary blood circulation increases, the more the peripheral resistance is reduced, ie a high blood pressure begins to decrease.

Circulatory disorders are a ubiquitous problem in modern industrial society. An adequate, ie on the respective physiological conditions matched circulation does not take place per se, but is autonomously controlled by the autonomic nervous system. It is immensely susceptible to stress because the archaic escape-fight reflex regulated by the symphatic ("activation") and parasympathetic system ("relaxation") carries the risk of a restricted blood supply to entire tissue regions without the affected person noticing anything of it. Not for nothing did the American Institute of Stress say 30 years ago that a majority of all chronic diseases are directly or indirectly related to misdirected stress management [4] .

therapeutic strategies

Standard PAD treatments include, for example, drug or surgical removal of a thrombus or blood clot, vasodilation, stents, or bypass surgery. In the case of ulcus cruris, in turn, a compression therapy is in the foreground, followed by a challenging wound treatment. Both in PAOD and in advanced

leg ulcers (eg foot) necessary amputations (78 000 cases / year) are not excluded.

In order to minimize the increased risk for the development of a circulatory disorder, it is, for example, in a sedentary job to provide both the diet and a lot of sports or at least regular exercise for a healthy balance. This is true even if there are already first indications of atherosclerotic changes, or especially in a diagnosed diabetes, as this leads to damage to the blood vessels. Unfortunately, due to lack of time, illness, bed-rest, age reasons, or simply lack of motivation, many sufferers are prevented from actively taking care of their health, ie, physical effort. So it makes sense to use the special circulation-enhancing and other cellular stimulation effects of a PEMF [5] .

PEMF in the prophylaxis and treatment of circulatory disorders

It is still far too little known that the physical process of electromagnetic cell stimulation (PEMF) produces effects that are relatively close to natural motion. Thus, there is the one

hand, evidence that the cell type to respond to certain electromagnetic pulses and this even "receive antennas" (receptors) exist, the stimulation of the formation of neurotransmitters result [6] , [7] , .

First of all , second messengers ("second messengers") such as cAMP or Ca ++ , which are responsible for almost cell auctions, are mentioned here. The mammalian naturally occurring cryptochromes [8] , [9] , which react to a PEMF, synchronize the activity of the genes (adapted to the respective metabolic situation) and control via mRNA the growth, the cell division and the so important apoptosis that the Serve cell renewal.

On the other hand, PEMF act directly on the vascular system, which has been shown to increase capillary blood flow. This is due to a PEMF-related formation of nitrogen monoxide (NO) in the small blood vessels, which also has to do with the fact that NO naturally determines the blood flow regulation [10] . For example, it can be observed that PEMF (NO) dilates the arterioles (ie the smallest arteries upstream of the

microscopically thin capillaries) and that the resulting increased blood flow is maintained at least 3 hours after application [11] , [12] .

scrutiny

In this context, it must be questioned whether an increase in blood flow caused by a pulsating magnetic field is actually connected with a frequently expressed increase in the so-called vasomotion observed in the study [13] .

Vasomotion refers to the changes over time in blood flow and vascular resistance, which is caused by oscillating contractions of the smooth vascular muscle cells of arterioles, but also in small arteries [14] , [15] : a distinction must be made between two arteriolar sections [16] , In the distal arterioles (that is, where they pass into capillaries), vasomotion occurs at a rate of 10 to 25 cycles per minute.

The slow vasomotion is only 1 - 3 / minute in the proximal arterioles (ie where the arterioles begin). The purpose of these

oscillations is to increase both the resistance and the blood flow in the arterioles and thus the arterial pressure - of course always assuming that the capillaries are willing to allow this bleeding perfusion. The frequency independence is astonishing, ie the amplitude of the oscillation appears to be crucial [17].

For example, contrary to the prevailing opinion on the vasomotion frequencies of 10 to 25 cycles / min (distal) and 1 to 3 cycles / min (proximal), for example, a study related to a particular magnetic field manufacturer has the dubious claim that it is known be that in the physiological range vasomotion frequencies of 1-5 oscillations per minute (mean 3 / min) can be found [18] . And, as a result, vasomotor activity increases by 7.58% after 30 days of treatment. However, in which part of the arteriolar section has been examined, unfortunately, as well as the indication, which oscillation cycle was used as the initial value is missing.

The enlargement of the arteriolar diameter gives rise to another important aspect: it not only increases the flow rate of the blood,

but also initiates angiogenesis, that is, the formation of new blood vessels [19] , [20] as far as this does not remain a solitary event . This may be due to the increasing shear forces in the blood vessels [21] . In a cell culture study with rat myocardial cells, it was possible to demonstrate, for example, that a 1.5-fold increase in VEGF (Vascular Endothelial Growth Factor) develops under a PEMF (15 Hz / 1.8 mT) and a 2-fold increase of FGF-2 (fibroblast growth factor-2) [22], In another cell culture study, for example, a PEMF insert enhanced angiogenesis via FGF-2 [23] .

explanation

VEGF is a signaling molecule that plays an important role in angiogenesis by mediating endothelium (vascular endothelium). For example, VEGF-C and VEGF-D are involved in the synthesis of lymphatic vessels. VEGF can also cause its own vasodilation via nitric oxide. Proof of this is that VEGF increases extremely in wound healing.

FGF (fibroblast growth factor) is also an important growth hormone formed in cell and tissue injury. It is therefore essential for wound healing.

PEMF study location

In animal experiments [24] , 108 rats who were microsurgically implanted with an artery in the sense of an "arterial circulatory model" received PEMF treatment (10 μT and 200 μT) immediately after surgery and 4, 8 and 12 weeks later. Compared to control rats, both groups showed significant neovascularization.

In another animal study [25] , the cremaster anesthetized rat muscle was treated with either PEMF or a placebo for either 2 or 60 minutes. Compared to the control group, the arteriolar diameter of the muscle increased by 9% after 2 minutes and by 8.7% after one hour. According to the Hagen-Poiseuille law, this corresponds to an increase in the flow rate of approximately

40% [26] . Systemic arterial blood pressure and heart rate were unaffected in this study.

Similar PEMF effects were found in a study of possible microcirculation enhancement in anesthetized mice (50 Hz, 1 mT, 10 minutes / fluorescence microscopy), which demonstrated a significant increase in capillary blood velocity over placebo [27] . Interestingly, with a static magnetic field of 10 times the field strength, a comparable result was achieved.

In a study of possible circulation-promoting effects, a one-time magnetic field treatment (4 Hz, 5 µTm, magnetic field mat) was performed in a placebo-controlled experiment with PAOD patients (stages IIb-IV). As a result (measurement by laser Doppler fluxometry), an increase in circulation of more than 50% and an increase in transcutaneous oxygen partial pressure ($tcpO_2$) at the instep of 17% occurred after one hour of application . The higher the values, the higher the lower the initial values were [28] . The diagnostically used laser Doppler

serves to measure the vasomotion and the flow of muscular microcirculation.

In a study (prospective, double-blinded, multicentric) on the treatment of venous therapy-resistant leg ulcers (additively to classical wound treatment / 3 hours daily), the following results were observed: After 8 weeks, the wound area in the PEMF group increased by 47, 7% - while in the placebo group it even increased by 42.7%. Likewise, wound depth and pain intensity were significantly reduced compared to placebo [29] .

For a PEMF effect on non-healing foot ulcers in diabetics, a double-blind, placebo-controlled study (12 Hz, 1.2 mT, 16 treatments of 60 minutes each) was performed. After three weeks, the wound size had decreased by 18%. In the control group it was only 10%. PEMF also showed an increase of 28% in the capillary blood velocity in the wound area and an increase of the capillary diameter of 14% - which was not observed in the placebo group [30] .

The wound healing effect of PEMF has already been confirmed by a previous animal study. Thus, in the skin of diabetic mice prevented tissue necrosis, which also led to an increase (3-fold) of the growth factor FGF-2. The authors conclude that PEMF can prevent the development of non-healing ulcers, tissue necrosis, and amputation in diabetic patients [31].

In order to determine vascular state (elasticity), degree of oxygenation, autonomic influences or microvascular perfusion, NIRP (near infrared redness reflectance plethysmography) is a particularly suitable method [32] . Thus, for example, a QRS treatment (1-60 μT) revealed a clear vasodilatation with an increase in microcirculation [33] .

Conclusion

A PEMF application extends the arterioles, improving blood flow and microcirculation in the capillary area. It is doubtful that the underlying mechanism of action is related to an increase in

vasomotion. Rather, activation of the nitric oxide system seems to be responsible for this.

An increased increase in microcirculation also stimulates angiogenesis, ie neovascularization, whereby the vascular growth factors VEGF and FGF-2 obviously play a crucial role. This is of considerable importance for the treatment of refractory ulcers and wounds (eg in diabetics / in chronic venous insufficiency), since, for example, the risk of tissue necrosis is reduced and the wound healing process always depends on a functioning microcirculation.

sources

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