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Effect of Ablation of Superficial Vein Incompetence in Patient with Symptomatic Chronic Peripheral Arterial Disease - Case Report

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Abstract

BACKGROUND: The importance and relation of superficial vein incompetence (SVI) in patients with peripheral arterial disease (PAD) were all surgical and PTA interventions are used for saving extremities. In order to protect patients from amputation we have provide a case where with ablation of the SVI we provide better peripheral arterial circulation with forming a completely new arterial collateral network for revascularization of the lower extremities.

CASE REPORT: This case is about a patient diagnosed with PAD with previous PTA/stent interventions and all stents are occluded now it’s in critical limb ischemia. It was made of a medical Consilium with vascular surgeon and interventionalist and there was no other option of treatment of arterial system of lower limb. We have done Doppler ultrasound of arterial and vein system of lower limbs and CT scan angiography.

CONCLUSION: In our patient with PAD and Buerger’s disease with SVI, with ablation of SVI we provide better arterial revascularization of the arterial system of lower limb and new arterial collaterals were formed sufficient to provide enough arterial blood supply to the lower limb. After ablation of SVI we had a much better objective and subjective symptoms.

Introduction

Peripheral arterial disease (PAD) is a relatively common condition with 220 million people affected globally and an increasing prevalence worldwide. The prevalence of PAD has increased in low- and middle-income nations, accounting for the majority of the 25% increase in the global burden of the disease over the previous ten years. Over 200 million people worldwide are currently affected by PAD, which accounts for roughly 12% to 14% of the general population. In patients over 50, the prevalence of PAD rises to almost 30%. According to a comprehensive analysis, 236 million people worldwide, or almost 6% of the population over 25, had PAD in 2015.

The chronic atherosclerotic disease known as PAD affects the peripheral vasculature and can cause gangrene, intermittent claudication, ischemic rest discomfort, ischemic ulcers, and functional impairment. Amputation-requiring sequelae had a ≤50% death rate after a year [1]. Even though issues with the limbs can be fatal, PAD frequently signals obstructive atherosclerotic disease in other areas of the body, such as the coronary and cerebral vasculature. It is true that ischemic stroke, myocardial infarction (MI), and cardiovascular mortality are more common in patients with PAD [2], [3], [4].

In addition, the risk of cardiovascular death is significantly higher for people with PAD than for those with coronary artery disease (CAD) alone [5], [6]. Crucially, PAD significantly impairs patients' quality of life and financial security [7]. Changes in lifestyle, medication, endovascular treatment, or surgery may be used to treat this disease. Peripheral vasodilators, blood pressure control, exercise therapy, antiplatelet therapy, anticoagulation, cholesterol lowering, and quitting smoking are all part of the multimodal medical approach to peripheral artery disease. Following this treatment plan can lower the risk of atherosclerosis-related systemic consequences like stroke and myocardial infarction, as well as limb-related complications including critical limb ischemia and amputation. Peripheral artery disease receives less treatment than coronary artery disease.

From the other side there is a thin border line between the peripheral artery system and the peripheral superficial venous system. That's why we should consider these two systems as one connected system, especially if we have insufficiency in the superficial vein system.

The main problem in the peripheral vein system is the superficial vein. The primary constituents of the leg's superficial veins are the great saphenous vein (GSV) and small saphenous vein (SSV). Most varicose veins are caused by the GSV, which extends from the ankle to the saphenous-femoral junction in the groin. To counteract the pulls of gravity, positional variations, and pressure fluctuations inside the thorax and belly, the normal venous system depends on a complicated mechanism that includes muscle pumps, valves, and pressure changes. Retrograde flow—also referred to as venous incompetence—occurs when the deep or superficial venous systems are unable to operate normally. There are several theories as to how venous incompetence happens. The ascending valvular incompetence theory explains venous pooling, venous hypertension, and valve failure as well as the loss of ante grade flow (from the ankle to the heart) of blood from the high-pressure venous system [9], [10], [11]. Other related processes, like increased ankle vein pressure, inflammation, and blood component leakage into the surrounding tissue, are also involved. As inflammation causes additional venous disruption and venous mechanism failure, these comprise the vicious cycle of venous disease [12], [13], [14], [15].

For chronic venous illness, the Clinical, Etiological, Anatomical, and Pathophysiological (CEAP) categorization is employed to standardize reporting. Table 1 displays the clinical classes according to the CEAP classification. Clinical classification is the focus of the technique, which has been verified in clinical practice [16].

Table 1: Clinical, Etiological, Anatomical, and Pathophysiological (CEAP) categorization

C0	No visible signs of venous disease
C1	Spider veins, telangiectases or reticular veins (diameter < 3 mm)
C2	Varicose veins (with a diameter > 3 mm)
C3	Varicose veins with oedema
C4	Varicose veins with trophic skin lesions secondary to chronic venous insufficiency
C4a	Pigmentation, purpura, eczema
C4b	Lipodermatosclerosis, atrophie blanche
C5	Healed venous ulcer
C6	Active venous ulcer

The most prevalent sign of superficial venous incompetence (SVI) is varicose veins, which are visible, dilated, tortuous vessels. According to NICE 2013b [17], saphenous-femoral, or GSV, valvular incompetence accounts for 60–70% of long-term incompetence, also known as chronic venous insufficiency (CVI), which affects one-third of adults [18]. Age and risk factors such as trauma, a history of deep vein thrombosis (DVT), multiple pregnancies, obesity, and jobs requiring extended standing are associated with an increased prevalence of CVI. Individuals may complain of minor symptoms including soreness, aching, and unattractive appearance, or they may be asymptomatic. According to Rabe (2010) [19], throughout the 6.6-year follow-up period in the Bonn Vein Study II, 31.8% of patients with GSV reflux and C2 illness had more severe disease.

The treatment of vein insufficiency are divided into two categories, surgical and endo-venous-vascular treatments:

1. Open surgery is the conventional method of treating GSV incompetence [20]. In order to accomplish flush ligation of the saphenous-femoral junction (SFJ) and ligation of any tributaries, a tiny incision in the groin must be made. Then, using a wire or flexible PIN-stripper, the GSV is eliminated by a procedure known as "stripping." In an operating room, SFJ ligation and stripping (HL/S) is often carried out as a day case procedure while under general anesthesia. Recovery and return to work following surgery typically take two to three weeks, although in certain situations, this might take up to six weeks [21], [22], [22], [23], [24], [25], [26]. According to some reports, the overall rate of complications after SFJ ligation and stripping ranges from 17% to 20% [27].

2. Endo-venous treatments are divided into thermal tumescent and non-thermal tumescent treatments.

- Thermal tumescent treatments: Using heat to seal a vein is known as endo-venous thermal ablation. The available devices are steam ablation (EVSA), radiofrequency ablation (RFA), and endo-venous laser ablation (EVLA). Each of these categories has a variety of manufacturers, designs, and variations. Tumescent anesthesia, which involves injecting a local anesthetic along the vein's length under ultrasound guidance, is used for EVLA, RFA, and EVSA procedures. This strategy has four advantages: (1) analgesia (pain relief): given both during and after the procedure; (2) compression: because of the increased hydrostatic pressure in the saphenous sheath, the previous diluted anesthetic solution compresses the vein wall onto the endo-venous catheter; (3) hydro-dissection: nervous structures are simultaneously moved away from heat within the vein by hydro-dissection, protecting adjacent structures like nerves; and (4) heat sink: because the fluid is usually cool, it acts as a heat sink, lowering the risk of burns and neurological sequelae [28].

- Non-thermal treatment:

a) Ultrasound-guided foam sclerotherapy (UGFS) was the first non-thermal therapeutic method for GSV incompetence. According to NICE guidelines, UGFS is the second-line procedure that is advised for the treatment of varicose veins in the United Kingdom (UK) [29]. The vein is cannulated and a foam sclerosant is injected under ultrasound guidance, resulting in fibrosis and venous obliteration by inflaming the wall's endothelium and subendothelial layers. There are several kinds of foam available. Nevertheless, it has been noted that initial success rates are modest and that repeated treatments are sometimes necessary [30], [31]. Poor post-procedural cosmetics may result from the procedure; skin discoloration and "lumpiness" have been described.

More recently, there has been increasing use of other non-thermal treatments for GSV insufficiency. These also do not require the use of tumescence (which can be painful and itself cause complications). Additionally, they do not subject individuals to the risk of thermal injury and are therefore known as non-tumescent non-thermal (NTNT) techniques [32], [33].

b) The NTNT approach known as mechano-chemical ablation (MOCA) uses a rotating catheter tip to obliterate the venous lumen, resulting in vasospasm and mechanical damage to endothelial cells. Concurrent injection of a liquid sclerosant causes further chemical damage [32], [34].

c) Cyanoacrylate embolization involves using a hand-held delivery pistol to inject cyanoacrylate glue into the vein. A catheter is placed 5 cm below the SFJ and the incompetent GSV is cannulated distally under ultrasound guidance. After that, cyanoacrylate is injected along the vein's length at intervals of a few minutes using compression and pullback. By chemically joining the opposing vein walls, cyanoacrylate produces instant occlusion [35]. Through an inflammatory vein wall reaction and granulomatous foreign body, the glue leads to fibrotic vein deterioration [31]. Manufacturers claim that there is no need for patients to wear compression stockings after an intervention, and tumescent anesthesia is not necessary. Damage to the nerve structures is less likely because the technique is intraluminal.

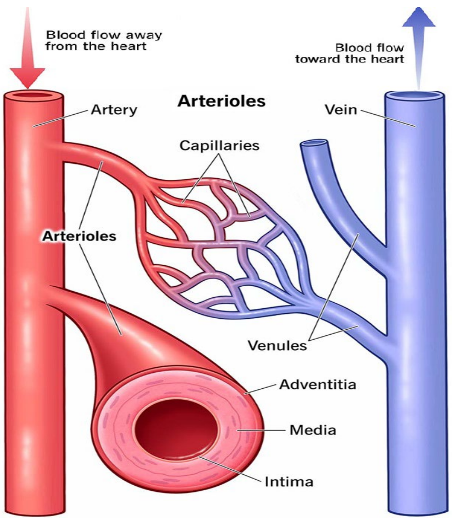

Figure 1: Arterial and vein circulation connected with arterial vein capillary system

In healthy patients the arterial blood circulate to the distal part of the extremities and then through the arterial-venous capillary system (AVCS) goes to the superficial vein system than goes to deep vein system and then trough the vena cava inferior goes to the right heart, from where goes to the pulmonary circulation for oxygenation and realizing the carbon dioxide and as a oxygenate arterial blood goes from the left heart again to the arterial circulation, Figure 1.

But in patient with SVI, when the arterial blood comes to the AVCS there is a higher pressure that comes from the SVI because of its insufficiency and retrograde makes the higher pressure that transfer to the arteries especially of below the knee, which makes a “wall stress” of intima media of the arteries and provoke the atherosclerosis that ends with total occlusion of the arteries.

Case report

In our case we did a vein Doppler where we have shown that our patient has PAD and SVI. Our case started 3 years ago, when the patient, male 24 years old, non-smoker, came with acute occlusion of superficial femoral artery (SFA) and we did a ballooning and after 1 month the patient came again with the same occlusion and we did PTA/stent of SFA in middle portion. After 7 months the patient came again with another occlusion but in the proximal portion of SFA and we did PTA/stent SFA in proximal portion. The patient was recommended to do genetics for his situation, but he refuses. After 8 months the patient came again with another occlusion of common femoral artery (CFA) and we did another PTA/stent CFA. After 9 months’ patient came again with occlusion of the CFA and a necrotic wound on the medial side of the joint (figure 2) and it was refer to vascular surgeon, but the patient refuses to go.

Figure 2: Necrotic wound of right leg

He returns after 2 months with cold foot, pain in the leg and no sensation or motorial activities of the foot and an open wound on the medial part of the joint (Figure 3) that was treated by surgeon. He did a genetic test where Buerger's disease was diagnosed.

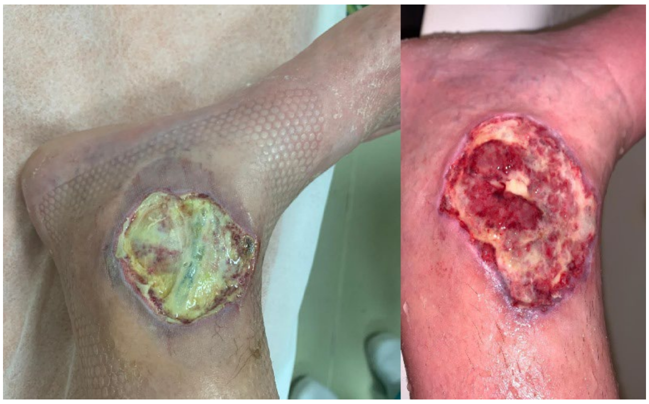

Figure 3: Wound of right leg after surgical treatment, 2 months after appearing

We did an arterial and venous Doppler: We found an occlusion of all arterial systems starting from CFA, SFA, popliteal artery and tibiae anterior and posterior artery with tiny and insufficient collateral system that was not enough for providing arterial blood to the lower extremities. We did venous Doppler and we found SVI with high reflux and diameter of GSV at femoral region over 8 mm and in crural region GSV over 7 mm with sign of high reflux and SSV with diameter over 7mm with sign of high reflux.

We did a CT scan (Figure 4):

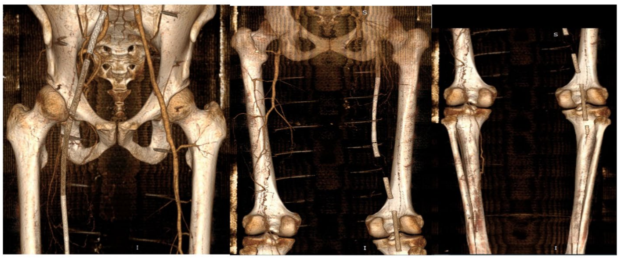

Figure 4: CT angiography with occluding stents of CFA; SFA, with low system of collaterals with absent od circulation of below the knee (BTK) arterial system of right leg

Consilium with vascular surgeon and endovascular interventionalist was done and the conclusion was that there is no other procedure that can be done to save the leg and hill the wound. It suggested a hyperbaric chamber and treatment for Burger's disease and if necessary, an early amputation of the bellow the knee.

We decided to start with the ablation of the SVI as no other option for this patient to save the leg and we did it on both legs according to the CT scan with bilateral PAD.

The procedure that we chose was a cyanoacrylate ablation for ablation of SVI because of its safe style and no need of wearing compression socks after the procedure [36], [37], [38]. The cyanoacrylate ablation procedure it starting with making two puncture points, one at the anterior part of the joint and second above the knee for GSV and for the second procedure for SSV a puncture point of the posterior part of the joint, where we put 5F introducers.

Figure 5: Catheter system with red light on the top for applying the cyanoacrylate, with pistol-like system for administration on which its attached 2 ml syringe

Through this introducer we apply a special catheter 5F with a tip that has a red light (Figure 5) on it for better visualization through the skin and we placed this tip 3 -5 cm from the femoral-saphenous junction (Figure 6) and on second event on popliteal junction. When we confirm the position by doppler probe we make a pressure on the femoral-saphenous and on second event on popliteal junction and start to advance the ablation fluid through 2 ml syringe that it's attached with luer lock to the catheter and we are applying the ablation fluid 2 cm per second through all the length of GSV and after in SSV vein. After applying the ablation fluid we made a pressure of all length of GSV and SSV for 60 seconds and after that the procedure is finished and the patient went to recovery room on his feet.

Figure 6: From left to right, first picture its anatomical situation of femoro- saphein junction; second picture its GSF and the third picture its GSF with the catheter inside

After 2 hours of the treatment the patient felt warm foot so sensation and motorial function of the foot were restored and felt much better. After 1 month the patient had increased walking distance, starting from 50 meters before IVS ablation and 500 meters 1 month after.

We did a new CT scan of the arteries on lower extremities and we found a situation with occluded native vessels but formed newly and large arterial collaterals that are providing blood to the lower extremities. These are the following pictures (Figures 7, 8, 9,10):

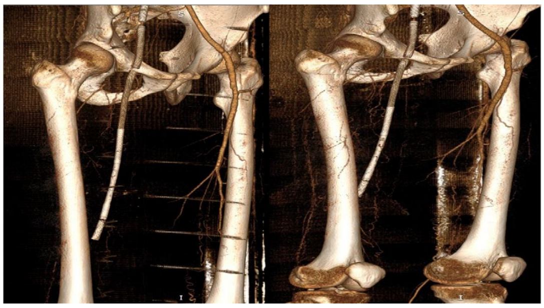

Figure 7: CT scan- left picture it's anterior-oblique view of the femoral part before ablation, where we can appreciate occluded stents with almost none collateral system on right and left leg; right picture its compared after 1 month after ablation, where we can appreciate newly formed large number of collaterals on medial and lateral femoral side starting from the pelvis down to the knee on both legs

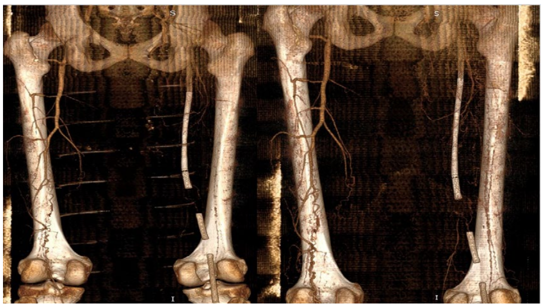

Figure 8: CT scan – left picture it's a posterior view of femoral part before ablation, where we can appreciate almost none collateral system on right leg and some collateral system from deep femoral artery on the left leg; right picture its compared 1 month after ablation, where we appreciate a huge and large developed collateral system on posterior femoral side on both legs

On every picture we can see that after 1 month of the ablation of GSV and SSV there are developed a huge collateral arterial network of both parts of the leg, femoral and crural part. The sensation of the leg, especially of the foot was completely recovered and the motorial function of the foot especially of the fingers was recovered completely.

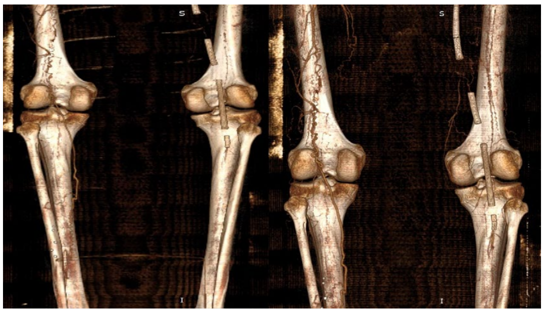

Figure 9: CT scan- left picture its posterior view of distal femoral and proximal crural part before ablation, where we can appreciate tiny collateral system that doesn't supply enough the BTK on the right leg and some collateral system on the left leg; right picture its compared 1 month after ablation, where we appreciate a huge and large developed collateral system on posterior distal femoral and crural side on both legs

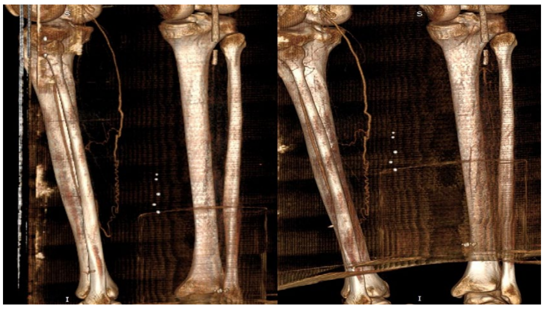

Figure 10: CT Scan – left picture it's an anterior oblique view of BTK before ablation, where we can appreciate some collateral system on the left BTK and none of right BTK; right picture its compared 1 month after ablation, where we appreciate a huge and large developed collateral system on both BTK

For follow up we did a new CT scan 1 year after the ablation and we made a comparison pictures of the CT scan on the same projections and the situation was much better than the situation after 1 month from the ablation of GSV and SSV as its shown much larger and bigger arterial collaterals are formed and we can appreciate a better arterial flow to the foot although ATA and ATP are chronically occluded the collaterals are providing blood to the arterial circles of the foot (Figures 11):

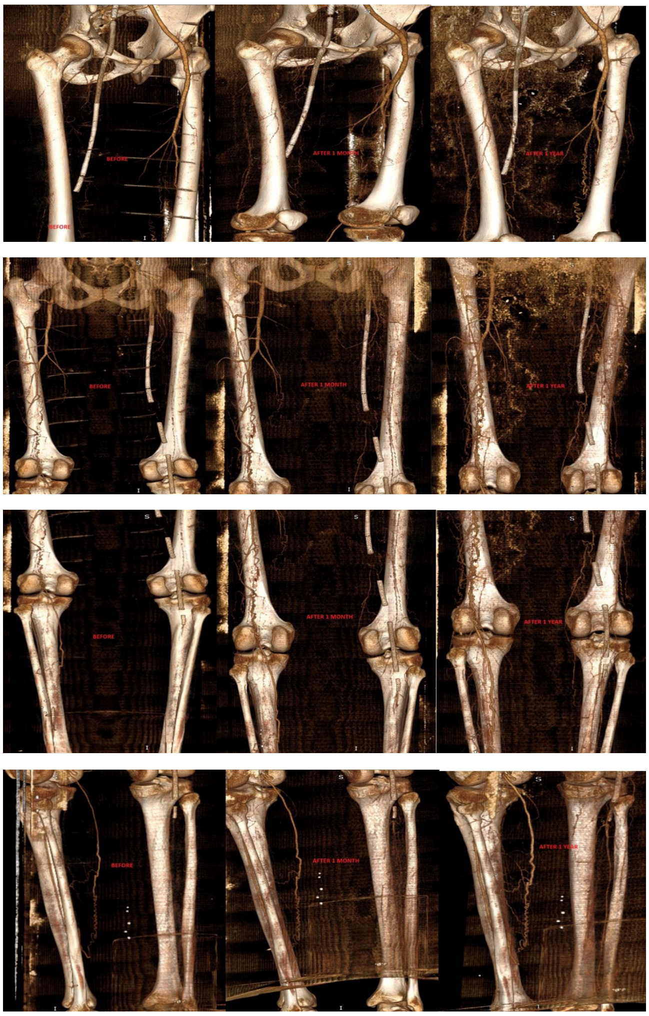

Figure 11: From left to right: before ablation, after 1 month and after 1 year

The wound started to heal and almost closed after 7 months from ablation (Figure 12).

Figure 12: From left to right: before ablation, one month after ablation, 4 months after ablation, 7 months after ablation

The patient now doesn't have any claudication and has a walking distance of 1 km, with warm foot, with normal sensation and motorial function of both legs and feet and almost healed wound of right leg.

Conclusion

In patients with PAD besides doing arterial Doppler its beneficial to do and venous Doppler to provide significant evidence of SVI, because in patient with PAD and SVI after ablating the SVI we provide:

- much better outflow of below the knee (BTK) arterial system

- relieved symptoms (pain, cold feet, sensation and motorial function)

- increased flow of collateral system and active native arterial system

- increased walking distance

- increased rate of healing wound of the extremities

By having all this points, we give a chance to the organism to provide and formed newly and better collateral network that will completely exchange the native arterial system of lower extremities and saving the extremities and providing better quality of life for the PAD patients.

Treating the SVI can be crucial for future treatments of PAD patients where we have already used and performed all surgical and PTA interventions and treating SVI can provide much better and long-term outcome of surgical and PTA procedures with patients with PAD.

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