Case Resolution

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Diagnosis

Plantar vein thrombosis.

Discussion

Plantar vein thrombosis (SVT) is a scarcely frequent entity characterized by the presence of intraluminal thrombus within the plantar veins. It preferably affects middle-aged females (58 years old on average). The lateral plantar vein is the most frequently affected, followed by the medial plantar vein. In some cases, there can be simultaneous participation of more than one venous segment.

Suspected causal factors are diverse—traumatisms, extenuating physical activity, paraneoplastic syndrome, postoperative stage, thrombophilia (anticardiolipin antibody syndrome, mutation of the G20210A prothrombine gen, activated protein C resistance) use of oral contraceptives, immobilization, and infection by the human immunodeficiency virus. However, most cases are classified as idiopathic.

With respect to patients' symptoms, —from moderate to severe—foot pain is usually the main one in venous thrombosis. This makes diagnosis difficult, because pain in itself is an unspecific finding which is usually present in virtually the whole range of differential diagnoses that are usually considered in a patient that consults for plantar pain: plantar fasciitis, plantar fibroma, intermetatarsal bursitis, Morton neuroma, sesamoiditis, tendon pathology, tarsal tunnel syndrome, ganglion cysts and stress fractures.

Therefore, most times patients are referred to imaging studies with no suspicion of SVT, sometimes due to the aforementioned diagnostic difficulties and, some other times, due to the lack of awareness of this entity, even among orthopedists and other specialists.

With that said, imaging tools play a key role in diagnosis. If clinical suspicion were to be high, Doppler US could rapidly resolve the diagnostic dilemma. Diagnosis is straightforward for the expert, and Doppler US signs for diagnosis are:

- Vein ectasia
- Hypo echoic venous contents
- Loss of vascular compressibility
- Lack of Doppler US flow

Conflict of interests: The authors have reported none.

However, in routine protocols in deep venous thrombosis screening, not every US specialist includes the examination of the plantar veins; therefore, initial diagnosis rates are low in such diagnostic methodology. On our part and also in several publications that we consulted, examination started by MRI and only later, with the suspicion of SVT, confirmation was obtained by US and Doppler US.

MRI findings consist of:

- Peri-vascular edema: It is depicted by the increase in signal in peri-vascular tissues in fluid-sensitive assessment modalities (fat-suppression DP/ T2, STIR). The signal increase in the peri-vascular area probably represents edema or an inflammatory reaction. Other hypothesis is that this signal increase may have to do with nervous or metabolic disorders due to the circulatory deficit caused by thrombophlebitis.
- Muscle edema: Increase in signal in the same sequences in the muscle compartment, in the area of the affected vessels.
- Intraluminal signal: Intraluminal intermediate signal in T1 and T2. In some cases, there can be high signal in T1.
- Vein ectasia: Usually there is an increase in diameter in the veins involved.
- Colateral veins: Although this is not a frequent finding, it can show in chronic cases.
- Peri-vascular enhance: According to the publications, there is invariable peri-vascular enhance after administering i.v. gadolinium contrast. On our part, we conducted MRI without such.
- Intraluminal filling defect.

With these signs, MRI diagnosis also feels straightforward. However, in many cases SVT can still go unseen because it was not being looked for. Therefore, it is essential to be acquainted with both SVT and the anatomy of the plantar veins to make a diagnosis that more often than not may not be detected.

The foot venous system is quite complex and it is made up of a deep venous tree, which is the spitting image of the arterial system, and a superficial venous tree that can be seen and palpated. Venous drainage is accounted for in 90% by the deep venous tree and in 10% by the superficial venous tree. What follows is a schematic description of such vascular tress for the sake of revision:

Superficial dorsal venous tree

The superficial dorsal venous tree is made up of great diameter veins, which are not many but are highly interconnected so as to form at the level of the forefoot the foot dorsal venous arch, which receives from distant areas the dorsal veins of the toes, highly connected between one another, and the dorsal interdigital veins, which drain into the anterior superficial plantar venous tree (Figure 9). The dorsal venous arch gives:

- From its medial side the medial marginal vein and then the greater or medial saphenous vein in the tibial premalleolar region.
- From its lateral side the lateral marginal vein and then the lesser or lateral saphenous vein, which goes behind the fibular malleolus. The lateral marginal vein is not constant , as opposite to the lateral melleolar venous plexus, which is another possible origin for the lateral saphenous vein trunk.

Superficial plantar venous tree

This tree, finely weaved, it is made up of many small-diameter, inframillimetric venules. Its front part drains from the superficial plantar venous arch at the root of the toes, where also the plantar venous tree of the toes ends.

Deep plantar venous tree

It is the intermuscular tree made up of two great collectors (the medial one, and especially the lateral collector), which truly represent storage for the plantar pump (Figure 10).

- The lateral plantar venous collector, or lateral plantar veins, is long—it can be up to 12 cm-long, and bulky, with 4-5 mm-diameter veins. It is usually double, although it can be isolated in part of its pathway, but it shows fusiform, plexiform dilations (plantar sinus), what explains its storage role.
- The medial plantar venous collector, or medial plantar veins, is short and it is located somehow behind; it is about 5 cm-long. It is usually made up of two narrower veins (2.5-3 mm) which, sometimes, show plexiform layout.

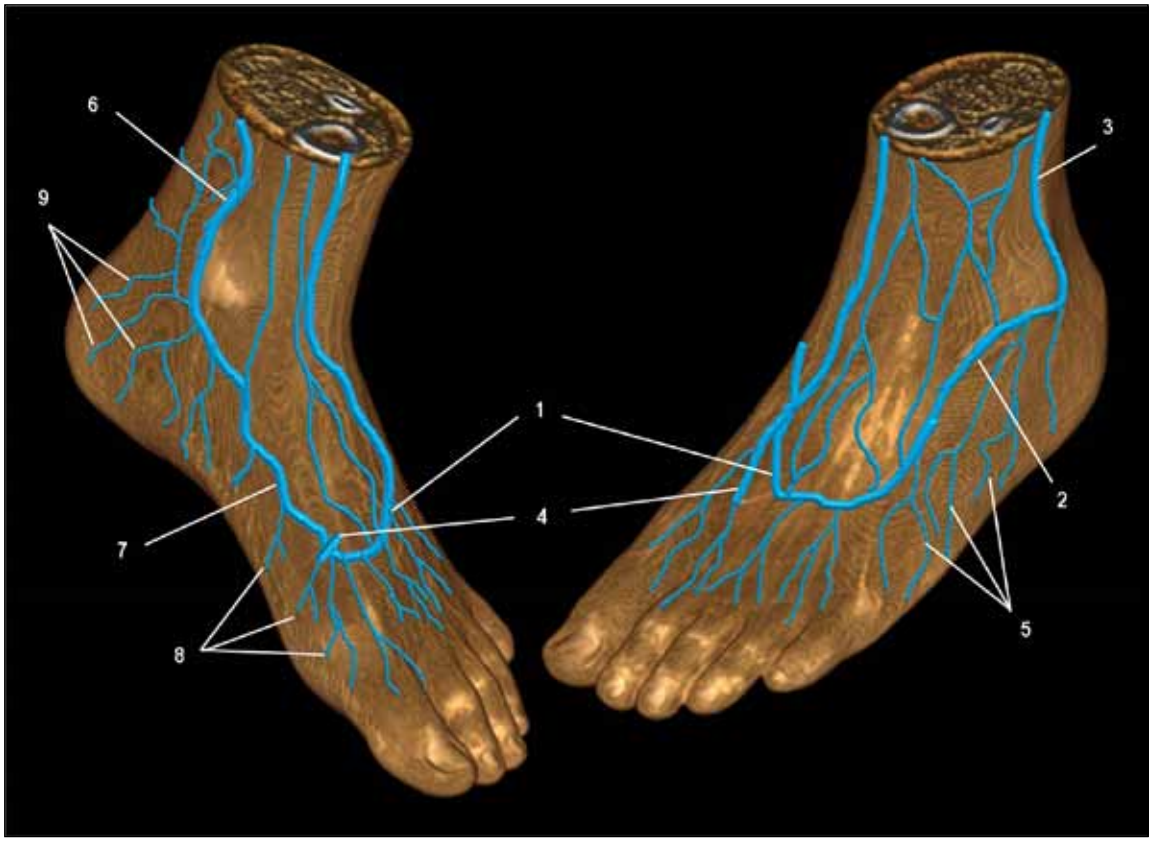

Figure 9. Superficial dorsal venous tree
1, dorsal venous arch;
2, lateral marginal vein;
3, lesser saphenous vein;
4, perforating vein of the first space;
5, lateral collector veins;
6, greater saphenous vein;
7, medial marginal vein;
8, medial collector veins;
9, dorsal collector veins.

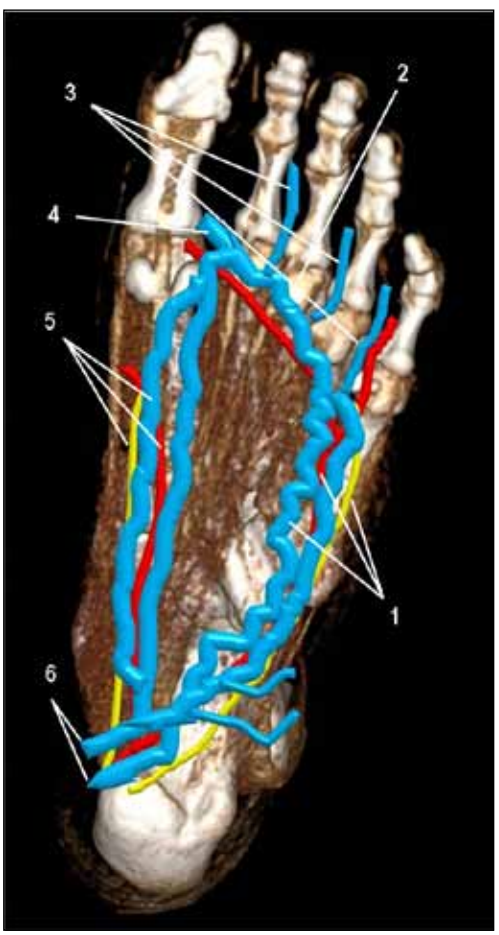

Figure 10. Deep venous tree
1, lateral plantar veins, with artery and nerve;
2, deep plantar venous arch;
3, plantar metatarsal veins;
4, perforating vein of the first space;
5, medial plantar veins, with artery and vein;
6, dorsal tibial veins.

In the plantar venous tree there are few valves, although the number varies depending on the individual's personal features and age (three on average).

The two collector systems at their front part make up the deep plantar venous arch. Such veins get together within the tarsal tunnel, making up the calcaneal venous confluence, which originates the dorsal tibial veins.

Deep dorsal venous tree

It is the group of the foot dorsal veins which then become the anterior tibial veins.

Anastomotic systems

There are numerous veins that link the dorsal trees to the plantar ones—deep and superficial. The ones that link the superficial system to the deep one are usually called perforating veins because they go through the aponeurosis, whereas the ones that link the superficial venous trees are called collector and communicating veins.

The medial anastomotic tree prevails over the lateral tree, and both are supplemented by inter-metatarsal perforating veins and by a fine tree of adipose plantar perforating veins.

The most significant complications associated with SVT include the spread of thrombosis to the deep veins of the leg, and the onset of lung embolism.

In the case we present, by means of Doppler US we verified the proximal spread of thrombosis, which reached the soleus muscle venous sinus.

There is no agreement on the treatment for SVT, and potential therapeutic strategies include the use of anticoagulant drugs, NSAIDs, elastic socks and rest. Plantar veins are part of the distal deep venous system and, therefore, they should be treated as such.

Conclusions

Taking into account the wide range of differential diagnoses in plantar pain, imaging diagnosis methods represent useful tools for an appropriate characterization of the entity that causes plantar pain. SVT should be considered as an infrequent cause of plantar pain, and it requires high suspicion rates.

Since SVT symptoms overlap with those in many other plantar pain conditions, the main advantage of MRI is its usefulness for diagnosing this condition while ruling out all the other differential diagnoses which are associated with similar symptoms.

US and Doppler US are potentially the first diagnostic tools due to their wide availability, high speed and low costs. However, they are not the initial studying methods in forefoot pain. Moreover, plantar veins are not assessed routinely in current US protocols screening deep venous thrombosis.

In view of our current knowledge about distal venous thromboembolism, SVT implies a very low risk of (symptomatic) lung embolism and post-thrombotic syndrome. However, if detected, we should take therapeutic measures as soon as possible to avoid thrombosis spread and minimize its onset.