What is a deep competitive reflux and why we should study it

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Abstract Reflux of the GSV is considered the absolute criterion for its incompetence. However, there are 3 specific conditions in which, despite being dilated with all its valves incompetent (destroyed and/or coaptation defect due to excessive dilation of the vein), the GSV does not reflux during diastole of the valvo-muscular pump of the calf. The first of these conditions is what I have called deep competitive reflux, the second is occlusion of the reentry perforators, and the third is dilation due to a compensatory flow by-passing of a deep venous occlusion.

Keywords Perthes test, Calf muscle pump, Paraná test, Deep venous reflux, GSV reflux

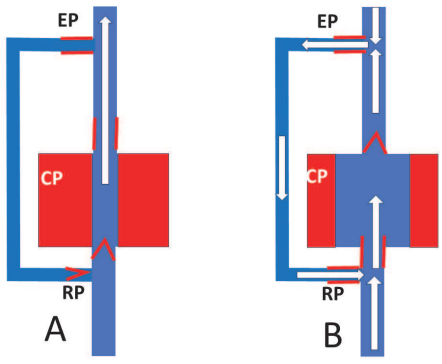

Figure 1 - Incompetent GSV: active closed shunt with competent deep veins, CP: Calf pump, EP: Escape Point RP: Reentry point. A: Systole: No reflux, B: Diastole: GSV reflux.

More than a century ago, Perthes hypothesized a defect in the deep venous system when an effective tourniquet applied at the root of the thigh did not cause the varicose Great Saphenous Vein to collapse when walking. Limited by the diagnostic means of his time, he did not describe the precise causes of this defect.

With the advent of echodoppler, these causes can now be explained.

In these Perthes-test positive cases, calf compression-relaxation or, more physiologically, the Paranà Maneuver (isometric reflex proprioceptive contraction of the calf)[1, 2] do not show Doppler diastolic reflux in the GSV, which is too dilated to contain valves that are still competent.

There are 3 possible causes:

First cause: When the pump is healthy, its diastolic aspirative depression causes physiological micro-reflux or partial or segmental reflux in the deep veins, particularly the popliteal vein, depending on whether the valve leakage is minor (perforation or incomplete coaptation) or the overlying valves are competent. At the same time, the incompetent GSV shows a typical closed shunt reflux (diastolic reflux that is wider and longer than the anterograde systolic flow due to the diastolic overflows fed by the deep veins)[3, 4], causing all or part of the blood previously ejected into the femoral vein to return to the calf pump. (Fig 1)

Failure of the valvular-muscular calf pump due to major deep valve incompetence results in total reflux (diastolic reflux symmetrical with systolic anterograde flow: reflux without resistance of all the ejected volume) which I call competitive deep reflux when it prevents

diastolic reflux from a large saphenous vein that is clearly incompetent, although not refluxing. In these conditions, the pump's diastole cannot produce aspirative depression, because the pump's diastolic volume increase has no aspirative depressive effect if there is no resistance to the flow that fills it and gravitational hydrostatic column height doesn't change.

Indeed, the pump's diastole cannot produce aspirative depression because the pump's diastolic dilation (diastole) has no upstream aspirative depressive effect due to total incompentence up and downstream the pump "chamber" made of the ensemble of the deep calf veins. At the same time, the gravitational hydrostatic column height is not dynamically fractioned which keeps the deep upstream venous pressure upstream the pump at least equal or superior to the GSV at the other side of the perforator, so preventing reentry flow

(Fig 2) Due to deep and superficial incompetence, Valsalva systole causes reflux and the same increase in pressure in both GSVs, so that there is little or no exchange of flow between them. This deep-superficial pressure equilibrium explains why these GSVs do not, or only slightly, reflux during the Valsalva maneuver.

The second cause may be occlusion by thrombosis or endovenous procedure of the reentry perforator of a closed GSV shunt, which prevents any reentry reflux into the healthy or incompetent calf pump. (Fig 3)

The third cause may be a GSV dilated by high Doppler flow, which may be termed compensatory anterograde systolic reflux of a femoro-popliteal occlusion, constituting a vicarious open shunt overloaded by deep venous blood due to deep venous obstacles. Re-entry may occur higher up, via the saphenofemoral junction, or via the pelvic and abdominal branches. (Fig 4)

It should be noted that all these phenomena concern the pathophysiology of the upright, walking subject.

Clearly, diagnosis of these 3 conditions of non-reflux in dilated GSV is essential to avoid treatment that is too often iatrogenic (reentry perforators closure), and to choose the most rational and safe treatment.

The first case of GSV non-reflux due to competitive deep reflux is primarily a matter of compression. Initial treatment of major deep incompetence (valvuloplasty, deep CHIVA[5]) can be considered a success if it creates the conditions for reflux of the great saphenous vein (pump efficacy restored), which thus becomes a closed shunt treatable by the superficial CHIVA strategy. Initial removal of the GSV would worsen Transmural Pressure, and thus the defect in superficial venous drainage. Initial superficial CHIVA treatment is pointless if deep venous insufficiency cannot be corrected. In this case, compression alone remains a significant treatment option.

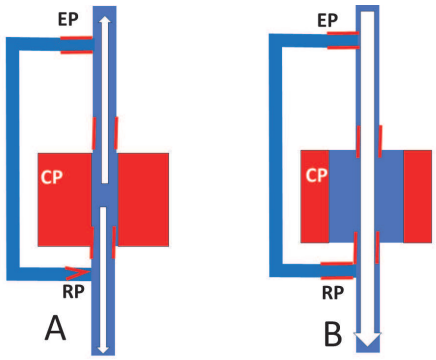

Figure 2 - Incompetent GSV: active closed shunt with incompetent deep veins, CP: Calf pump, EP: Escape Point RP: Reentry point. A: Systole: No reflux, B: Diastole: No possible GSV reflux for Deep venous Competitive reflux.

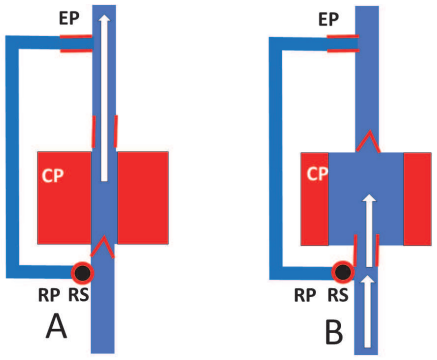

Figure 3 - Incompetent GSV: Closed shunt reflux blocked by RS reentry point stop, CP: Calf pump, EP: Escape Point RP: Reentry point. A: Systole: No reflux, B: Diastole: GSV Reflux hampered by reentry point stop as thrombosis, ligation or endovenous procedure.

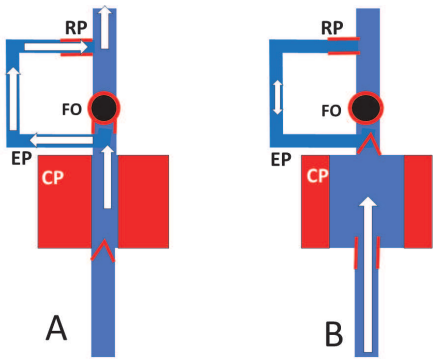

Figure 4 - Femoral vein occlusion: FO. CP: Calf pump, EP: Escape Point RP: Reentry point A. Systole: GSV High systolic antegrade «reflux» from deviated deep veins flow. B. Diastole: No GSV retrograde reflux if competent. Reflux if incompetent.

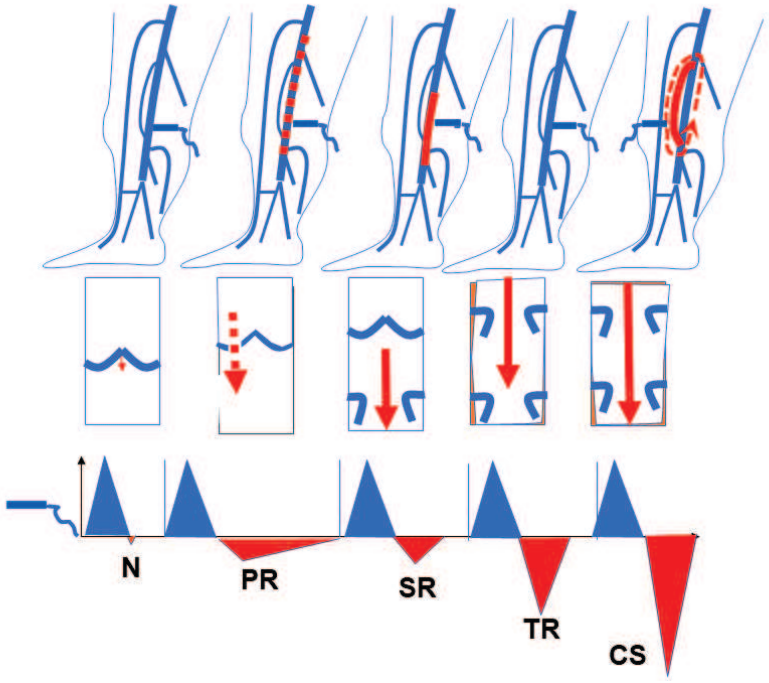

Figure 5 - Doppler Reflux Grade Classification. Dynamic Reflux Index DRI. Dynamic Reflux Index : DRI = (VmR² x tR)/ (VmS² x tS). VmR =Reflux Velociy mean, tR = Reflux time, VmS = Systole Velociy Mean, tS= Systole time. N : Normal = 0,125, PR: Partial Reflux = 05, SR: Segmental Reflux = 1, TR: Total Reflux = 1, CS: Closed Shunt = 4.

The second cause calls for two responses: Firstly, to avoid occluding the reentry perforators, whatever the technique, since their hemodynamic irrationality is due to a misunderstanding of their role, hidden by the removal of the GSV. Then, wait for effective re-entry to develop before proposing a CHIVA cure.

The third case shows how the GSV can constitute a welcome natural OVS bypass for deep vein occlusions, which must be preserved absolutely. It is also a further argument in favor of conservative treatment of GSV as a natural bypass for potential deep vein occlusions.

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