Hemodynamic Principles of Varicose Vein Therapy

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To the Editor:

Primary varicose veins (PVV) affect 10–15% of our population. In addition to pain, edema, and superficial phlebitis, etc., they can cause chronic venous insufficiency (CVI). Indeed, in one series, PVV represented the sole etiological factor in 42 (53%) of 79 ulcerated limbs. Therefore, proper treatment, based on sound hemodynamic principles, is imperative if the problem is to be permanently eradicated.

Primary varicose veins are hemodynamically characterized by the existence of a retrograde circuit. This was first described by Trendelenburg over 100 years ago. Tibbs, using continuous wave Doppler ultrasound, and Hach, using ascending press phlebography, further expanded our understanding of the hemodynamic pathophysiology of PVV.

The retrograde circuit (RC) consists of a proximal start-reflux (escape) point, usually located at the level of an incompetent junction, through which blood from the deep system is shunted into the superficial saphenous veins. This terminates at the end-reflux point where the incompetence of the saphenous trunk(s) ends. The segment of vein trunk between these two points represents the axial reflux. Based on the anatomical location of the end-reflux point, Hach classified long saphenous vein (LSV) into four, and short saphenous vein (SSV) varicosities, into three different grades. Rarely did the end-reflux point reach the level of the ankle (LSV grade IV and SSV grade III). In most cases reflux terminated higher (goni-grade I; mid-thigh-grade II; and upper calf-grade III), confining the axial reflux to a much shorter segment of the main long saphenous trunk. Only long axial reflux varicosities (LSV grade III and IV and SSV grade III), causing volume overload decompensation and secondary incompetence of the deep system, can lead to CVI changes. The last constituent of the RC is the reentry point(s), an inwardly flowing perforator(s) that drains the retrograde saphenous flow back into the deep veins.

Bjordal’s concomitant invasive flow and pressure measurements demonstrated that, in PVV, during the diastolic phase of the walking cycle, blood streams downward (average 300 ml/min) and the ambulatory venous pressure (AVP) in the distal saphenous system, perforators included, remains elevated. Only occlusion of the proximal escape point will normalize the elevated AVP by abolishing the regurgitant flow. In other words, in PVV the increased AVP is caused by the reversed saphenous flow and not by incompetent perforator(s) causing outward flow from the deep to the superficial veins.

Theoretically, with incompetence and reflux confined to the superficial venous system, varicose veins should be easy to treat. For long-term efficacy any therapeutic procedure must achieve hemodynamic optimization by abolishing the offending regurgitant flow (reflux) responsible for the elevated AVP. Since venous competence cannot be restored, the varicosities must be either permanently obliterated by sclerotherapy or ligated and removed by surgery.

Injection sclerotherapy (IST) is an appealing therapeutic modality since it shifts treatment away from costly hospital care. Unfortunately, it is associated with unacceptably high failure rates. Prospective randomized clinical studies of Hobbs in 1974, Jakobsen in 1979, and Einarsen et al. in 1993 have reported 5-year failure rates of 63–74% compared with only 10–20% for traditional stripping. Studies of Jakobsen in 1979, Neglen et al. in 1986, Goren in 1991, and Rutgers and Kitislaar in 1994 reported similar unacceptably high failure rates of 40–50% even when surgical ligation of refluxing junctions was combined with tributary sclerotherapy.

The most conclusive damaging data came with publication of three recent studies that used duplex imaging to assess the therapeutic outcome of IST rather than rely on the traditional subjective visual assessment and finger palpation that invariably produced "excellent" results. The studies of Bishop et al. and Gongolo et al. in 1991 reported reestablishment of reflux after only 2 years of follow-up in 80% and 63% of cases, respectively. In 1994 Biegeleisen, using selective angiographic, rather than percutaneous delivery of the sclerosing agent, reported a 100% failure rate of IST in controlling long saphenous axial reflux. Thus IST fails, even when the injection has been selectively delivered to the source of offending incompetence and reflux. Based on these data the likely efficacy of duplex-guided IST, an expensive and unproven form of IST (echosclerotherapy), is more than doubtful. The failure of IST is not delivery dependent but rather caused by the temporary thrombogenic and phlebitogenic properties of all sclerosing agents following endothelial injury. After lysis of the clot ("transient thrombotherapy") reflux is usually reestablished and varicosities will "blossom" again. It is our belief that with failure rates of 63–100%, IST cannot be considered a viable ethical therapeutic option for PVV, at least not in the hands of a responsible practitioner.

A recent elaborate review article on the diagnosis and treatment modalities of PVV printed in a prestigious dermatologic journal and authored by well-known practitioners omitted referencing most of the above enumerated scientific evidence disproving efficacy of IST although they were published in highly visible professional journals. The authors failed, however, to mention this accurate statement in a previous writing summed up the fate of IST with an accurate statement that needs no further comment: "It is anticipated that pure sclerotherapy in the treatment of varicosities to the exclusion of other modalities will not gain acceptance in institutions where critical review of results is practiced. The authors failed, however, to mention this accurate statement when writing about the therapeutic options of PVV in their otherwise excellent comprehensive review article.

Surgery remains, therefore, the only current effective method of choice in the treatment of PVV. Although performance of the classical Babcock/Myers ankle to groin stripping confers excellent long term results the oversized acorn-
shaped intraluminal stripper head causes major soft tissue trauma and is responsible for the postoperative morbidity and prolonged convalescence. In addition, it is also a cause of injury to the saphenous or sural nerves. Concurrent removal of the varicose tributaries via generous skin incisions adds to the trauma and may result in undesirable scarring as well. Performed under general anesthesia and in a hospital setting this traditional approach is costly.

Based on the already cited hemodynamic evidence,\textsuperscript{3–6,9–13} in most cases of PVV, following junctional ligations a stripping limited to the length of the axial reflux of the long\textsuperscript{9,39,41} and short\textsuperscript{41} saphenous trunks will be sufficient. The classical blind ankle to groin stripping is unnecessary “overkill.” The reintroduction of stripping by invagination via a nylon filament by van der Stricht\textsuperscript{39} drastically reduced operative trauma and nerve injury.\textsuperscript{39} PIN stripping, the recently reported invagination technique of Oesch,\textsuperscript{39} further eliminated the need to expose the distal saphenous trunk and visualize the far end of the stripper. The introduction of stab avulsion for the varicose tributaries additionally reduced the operative trauma and improved cosmesis. Whereas Rivlin\textsuperscript{40} ("multiple cosmetic varicectomies") avulsed the varicosities with small, makeshift, instrumentation, it was Muller\textsuperscript{47} ("phlebectomie ambulatoire") who first introduced the phlebectroductor hooks. Complete protocols for this minimally invasive and cost-effective surgery performed under local-regional anesthesia and in an office setting have been published by us.\textsuperscript{38–41}

In 1929 Homans\textsuperscript{42} stated that the surgical "profession has taken a lazy man's attitude towards the varix of the leg." Moreover, once performed, "the operation was relegated to the end of the operating list and delegated to the surgical tyro."\textsuperscript{43} Unfortunately, this cavalier attitude still persists. It comes as no surprise, therefore, that disciplines other than surgical specialties are eager to treat the condition. We read, therefore, with interest the article on ambulatory phlebectomy using tumescent local anesthesia that was recently published in this journal by a group of osteopathic dermatologists.\textsuperscript{44}

Tumescent anesthesia\textsuperscript{45} is an excellent method for large, potentially bleeding, surfaces encountered in liposuction, dermalabrasion, or laparotomy. Its use in varicose vein surgery is perhaps questionable. In our hands the indurated subcutaneous tissues represent an obstacle to effective hook phlebectomy. For long saphenous varicosities we prefer the femoral block anesthesia\textsuperscript{46} successfully used by others as well.\textsuperscript{47} For the short saphenous vein surgery we use simple infiltrative anesthesia although sciatic block is an excellent and simple alternative.\textsuperscript{48}

Our major criticism, however, relates to the misleading overly simple message a patient or a practitioner gets after reading the article, which was also publicized in lay publications countrywide. The authors accept the failure of sclerotherapy and offer ambulatory phlebectomy as the simple alternative for all forms of PVV. They suggest that all one needs is an unassuming office, local anesthesia, and a few phlebectroductor hooks. This simple protocol omits, however, several key hemodynamic issues.

A hemodynamically correct treatment protocol implies control of the escape point by surgical ligation and control of existing axial reflux by some form of stripping (reflux control surgery), before attempting to remove the varicose tributaries by the hook phlebectomy (ambulatory phlebectomy) technique.

In over 850 cases of PVV operated in the last 5 years, Doppler ultrasound examination localized the escape point in the groin at the sapheno-femoral junction (SFJ) in 74% representing 10% more than what we previously reported on 230 limbs.\textsuperscript{49} The incidence of sapheno-popliteal junction (SPJ) remained at 8%. Dimakakes et al\textsuperscript{49} in a series of 25000 limbs with PVV reported an almost identical distribution of incompetence 71.75% for SFJ and 8.3% for SPJ. Ferrin,\textsuperscript{51} in a series of 317 varicose legs, reported an incidence of incompetent SFJ in 68.7% and SPJ in 18.5%. Therefore, the suggested ambulatory phlebectomy is hemodynamically appropriate in less than 20% of patients with PVV. The remaining 80% of patients with varicose veins harbor delicate and vital structures such as the femoral artery, femoral vein, popliteal vein, tibial nerve, etc. Therefore, junctional ligations require technical skills that only general or vascular surgeons acquire during their residency and/or fellowship. Muller, himself a dermatologist, stated in his first publication in 1966, that all varicosities displaying sapheno-femoral junctional incompetence are left for the surgeon "pour une crossectomie suivie d'un stripping externe selon Mayo..." or, "for a junctional ligation followed by external stripping of Mayo..." the method of stripping he probably preferred at the time.\textsuperscript{47} Attempts to practice hook phlebectomy of incompetent saphenous trunks after junctional ligation have been described.\textsuperscript{50} This procedure can be technically challenging, as thighs come in different sizes. The long saphenous vein trunk, always localized beneath the membranous fascia, can often be inaccessible to hook extraction. The short saphenous trunk, completely subfascial at its termination, cannot be hooked in the proximal calf unless the fascia is opened as well. The unorthodox avulsion of the SFJ (1) was also suggested by nonsurgeons to the readers of this journal in the recent past.\textsuperscript{52} This invites unnecessary complications.

Based on the principles of the regurgitant circuit, varicose veins mimic a waterfall. The escape point is equivalent to the top of the hill proximal source of downpour, and the varicose tributaries are equivalent to the bottom of the hill, creating pool(s), that all waterfalls have. By analogy, siphoning the water from the pools at the bottom of the hill, without capping the flow at the top of the hill, will result in rapidly refilled pools. Transposed to PVV, removing the varicose tributaries by hook phlebectomy (ambulatory phlebectomy) and leaving the proximal escape points "dripping," as proposed in the article, represents a hemodynamic compromise which will lead to early recurrences.

A technically faulty reflux procedure during "high ligation" is reported in 70–80% of all cases of recurrent varicose veins. Excellent results are dependent on the training, skill, and experience of the surgeon. Similarly, the above reported high failure rate of injection sclerotherapy is due to the inability of the method to provide long term control of the offending proximal reflux, regardless of its delivery method.

Varicose veins are not just a simple subcuticular structures
that will respond to a minimal and incomplete manipulations performed under local anesthesia. Knowledge of hemodynamics, of noninvasive diagnostic modalities (for mapping the source and course of the axial reflux, and tedious acquired technical skills are essential for a successful and long lasting therapeutic outcome. Ambulatory phlebectomy without proper reflux control surgery will fail as ISIS does. Cost efficiency is important, but not at the expense of the patient.

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References

47. Creton D. Study of the limits of local anaesthesia in one-day
48. Levebvre-Vilardebo M. Personal communication.