The Incidence, Clinical Importance and Management of Incompetent Gastrocnemius Vein

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Purpose: To report the incidence, clinical importance and management of the incompetent gastrocnemius vein.

Methods: The incompetency was examined by duplex and pulse-Doppler ultrasound at the popliteal fossa in a standing position between July 2006 and August 2014.

Results: Among 1805 legs surveyed, 14 legs showed primary incompetent gastrocnemius vein (0.78%). The incompetency was in medial gastrocnemius vein in 13 legs (93%). Clinical manifestation was varicose vein in the small saphenous territory in nine, varicose vein in great saphenous territory in one, congestive dermatitis in two, calf clamp in one and no symptom in one. The nine cases with varicose vein in the small saphenous territory received surgical management. These included three cases with residual varicose veins after saphenopopliteal disconnection and stripping small saphenous vein. The root of the gastrocnemius vein was divided leaving no complication. In cases without varicose vein in small saphenous territory, an elastic compression socks was useful in some degree.

Conclusions: Incompetency of gastrocnemius vein was not so rare. When a case is accompanied by small saphenous varicose veins, division of the root of gastrocnemius vein along with small saphenous vein stripping is recommended in order to reduce residual varicose vein.

Keywords: incompetent gastrocnemius vein, small saphenous vein, varicose vein

Introduction

Observation of a dilated gastrocnemius vein (GCV) in living humans was reported by May and Niğl, who used venography in the 1960s. Dodd et al. reported a method which examined the refluxing flow of the GCV. They used direct needle puncture into the root of the vein during open surgery. After the introduction of duplex ultrasound examination in the late 1980s, Hobbs et al. noted that the incompetency of the GCV could be confirmed non-invasively. So far, an ‘incompetent GCV’ has been described in some reports which surveyed the venous status of the legs after varicose vein surgery or of legs having chronic venous disease. However, the incidence, clinical importance and management of an incompetent GCV have rarely been discussed.

The aim of this study was to survey and to report the incidence, clinical importance and management of an incompetent GCV.

Patients and Methods

Included were all patients who were able to undergo venous survey with duplex ultrasound at the popliteal fossa (performed with the patient in a standing position) between July 2006 and August 2014. The workup of deep veins at the popliteal fossa was carefully performed when a patient first visited with venous symptoms. The symptoms included varicose veins, inflammation with or without ulcers, edema, cramps or heaviness in the leg. The competency was examined by duplex and pulse-Doppler ultrasound with compression-decompression maneuvering of the calf in a standing position. An incompetency was defined to exist when refluxing flow lasted over 0.5 s (Fig. 1). This incompetency could be due not only to a functional abnormality of the valve, but also to a deficiency or positional abnormality of the valve. The examination was performed with a GE LOGIQ P5 device using an 8–12 MHz linear probe.

Results

We evaluated 1805 legs in 906 patients. Both legs were examined in 899 patients and the leg on only one side in seven. The unaffected leg was also screened unless the patient refused. Although the conditions of the affected legs varied from clinical class C0–6 in the Clinical Etiologic Anatomic Pathophysiologic (CEAP) classification, up to 88% of them were equivalent to C0–3. This indicated that many of the patients complained of mild symptoms reflecting the fact that Kanoiwa Hospital is a local primary hospital.
An incompetent GCV was observed in 19 legs from 17 patients (1.05%). Among these, five legs from four patients had a previous history of deep vein thrombosis. These were determined by history taking or by observing the presence of an organized thrombus in the popliteal vein or in the GCV by duplex scanning. The deep vein incompetency at the popliteal vein was restricted in four legs from three patients, all of whom had a history of deep vein thrombosis. In other words, 14 legs from 13 patients showed a primary incompetent GCV without a previous history of deep vein thrombosis or an incompetent popliteal vein (0.78%). These 14 legs were surveyed further. The incompetency was in the medial GCV in all nine cases with varicose veins in the small saphenous territory. Three were early cases that had previously undergone saphenopopliteal disconnection and small saphenous vein (SSV) stripping (Fig. 2). Refluxing flows into residual varicose veins were supplied from the incompetent GCV via perforating veins that connected the tributaries of the GCV to the residual varicose veins (Fig. 3). Among the other six cases, the root of the GCV was common with the small saphenous vein in four cases, and the roots were separated in the other two cases. In particular, one case showed a SSV which had no connection with the popliteal vein and continued to the Giacomini vein. Preoperative duplex ultrasonography made it possible to clearly observe the form of the junction of the GCV with the popliteal vein. This junction was sometimes situated on the transverse side of the popliteal vein. Moreover, there was one case in which the GCV had two connections with the popliteal vein.

In all nine of these cases, GCV tributaries were connected with the SSV trunk or its tributaries (Fig. 4: 4-2). The connection was through the incompetent perforating veins which penetrated the gastrocnemius muscle fascia. The persistence of varicose veins after saphenopopliteal disconnection, as mentioned above, was due to refluxing flow via this course. Especially in the first case, which showed residual varicose veins in spite of saphenopopliteal disconnection and SSV stripping, the incompetent perforating veins which

Patients with an incompetent GCV with varicose veins in the small saphenous territory (nine legs in nine patients)

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connected the incompetent GCV with the residual varicose veins had been cut under the muscular fascia several times under local anesthesia. However, another perforating vein had become incompetent within a few years. The decision was reached that the incompetent GCV itself should be divided as the origin of refluxing flow, and this was successfully performed.

These nine cases received surgical management. The three cases with residual varicose veins in spite of saphenopopliteal disconnection and SSV stripping underwent the division of the GCV root at 19 months, 7 years and 8 years after the original procedures. The patient was laid in the prone position, with the popliteal fossa extended. Then under lumbar anesthesia, a ∼4 cm skin incision and a small incision of the fascia were made at the mid portion between the root of the SSV and the root of the GCV. The root of the GCV was exposed with the help of the root of SSV as a landmark. In cases in which the SSV had been stripped from its root, the root of the GCV was exposed using only the preoperative skin markings made during preoperative duplex ultrasound. The root of the GCV was divided after suture ligation, taking care not to injure the accompanying gastrocnemius artery and branches of the tibial nerve.

After division of the root of the GCV, the trunk and tributaries of the GCV were left as they were. The SSV was managed by division of the saphenopopliteal junction, followed by an inverted stripping maneuver from its root to the level where the refluxing flow was detected. There are often peripheral direct connections between the GCV trunk and SSV trunk (Fig. 4: 4-2 left). These connections were divided by additional small skin incisions before the

Fig. 3 (Left): The small saphenous vein and medial gastrocnemius vein were both incompetent. The tributaries of the small saphenous vein were varicose, and some of them had communications with the gastrocnemius vein via perforating veins which penetrated the fascia of the gastrocnemius muscle. These were 'indirect perforators' which originated from the intra muscular vein (gastrocnemius vein), and were different from 'direct perforators' which originate from the intermuscular vein (e.g. the posterior tibial vein). (Right): The postoperative status after stripping the small saphenous vein. Note that the residual varicose vein remains dilated by the refluxing flow via the perforating veins which communicate with the persistent varicose veins and the tributaries of the gastrocnemius vein. PopV: popliteal vein; M.GCV: medial gastrocnemius vein; L.GCV: lateral gastrocnemius vein; GCM: gastrocnemius muscle; SSV: small saphenous vein
SSV stripping to prevent redundant bleeding. The tributaries of the SSV were left as they were, and the connections between the GCV and SSV tributaries were also left as they were (Fig. 4: 4-2 right).

After dividing the root of the GCV (all were medial GCV), a thrombus was observed by an ultrasound examination of the residual trunk of the GCV and its tributaries in the muscle (Fig. 5). However, the thrombus did not extend into other deep veins, including the popliteal vein, or into other muscular veins, such as the soleus veins. There were no complaints of distention or tenderness at the calf. The other remaining GCV (lateral GCV) seemed to work as the drainage vein (Fig. 5). The varicose veins occasionally had thrombus continuing to the tributaries of the GCV via the perforators. The residual varicose veins without thrombus also showed regression within six months in all the nine cases, including the early three cases that showed residual varicose veins after saphenopopliteal disconnection and SSV stripping. There have been no complaints of varicose vein recurrence after a maximum follow-up of 6 years (range, 6 months to 6 years; mean, 34 months).

**Patients with an incompetent GCV without varicose veins in the small saphenous territory (five legs in four cases)**

One patient had a great saphenous varicose vein. In this case, the GCV was not managed surgically, but was instead managed only with the use of elastic knee-high compression socks after selective stripping of the great saphenous vein. The varicose veins that were supplied by the GCV via
perforating veins have persisted for 21 months. The other three patients with four affected legs showed solitary GCV incompetence, and were managed with elastic knee-high compression socks without surgical intervention. The manifestation of congestive dermatitis in both legs in one patient showed a slight regression after two years of continually wearing the elastic compression socks. The calf cramps in one case showed slight regression. The one patient with no symptoms has not developed any symptoms.

Discussion

In this study, each patient experienced several symptoms, so the frequency of the incompetence of GCV based on individual symptoms could not be calculated. However, the overall frequency of GCV incompetence was around 1% in this study. The patients who underwent ultrasound screening were not ordinary subjects because they consisted of some regular patients who complained of some abnormality in their legs, at least unilaterally. However, because Kanoiwa Hospital is a small local hospital where local residents visit with relatively minor symptoms, the 1% frequency of this newly noticed disorder is considered to be surprisingly high. Therefore, it is important to make efforts to examine all patients for incompetence of the GCV when they complain of symptoms in their lower legs. The incompetence of the GCV can be a cause of varicose veins, congestive dermatitis, cramping and other symptoms. In this study, the association between the severity of symptoms and duration of the refluxing flow of GCV was...
not examined and remains unknown. The association between the extent of incompetency of GCV and its dimension was also not examined and remains unknown.

Although it has been suggested that femoral and popliteal venous incompetence regresses after the management of saphenous incompetency, the fate of an incompetent GCV is unknown. In the early three cases and the great saphenous vein case, the incompetency of the GCV did not improve after saphenous vein surgery. Indeed in cases with varicose veins in the small saphenous territory, unmanaged incompetency of the GCV can be a cause of residual varicose veins, as in our three early cases. A previous study showed that incompetency of the GCV was observed in over 30% of the recurrent cases during a long-term follow-up study after SSV surgery.

The incompetency of the GCV should be examined before SSV varicose vein surgery, and if an incompetent GCV is observed, it should be treated simultaneously. In the three early cases that underwent division of the GCV root after having previously undergone saphenopopliteal disconnection and SSV stripping, the detection of the GCV root was challenging because it was difficult to determine that a limited exposed vein, which was buried in fat and surrounded by an artery, a nerve and fibrous tissue, was truly the GCV itself. The subsequent six cases received division of the GCV root at the same time as saphenopopliteal disconnection and SSV stripping. These operations were relatively easy, because the preoperative ultrasound studies had clarified the positional relationship between the root of the GCV and the root of the SSV, which was used as a landmark. Before SSV stripping, the peripheral direct connection between the SSV trunk and the GCV trunk should be divided in order to prevent redundant bleeding. The preoperative duplex examination must not overlook these connections.

All of the surgically-treated cases were suffering from incompetency of the medial GCV. No incompetency in the lateral GCV was experienced in any of our surgical cases. The ligation and thrombosis of the medial GCV did not cause any serious complications in our cases. We believe that this was because the other remaining GCV (lateral GCV) could work as a drainage vein. However, the potential drainage vein needs to be confirmed during the preoperative duplex ultrasound study, because there are many variations of the venous anatomy at the popliteal fossa.

The incompetency of the GCV can also cause residual varicose veins after surgery for a great saphenous varicose vein, as was observed in our case. A solitary incompetent GCV can cause congestive dermatitis, as experienced by our case. In these cases, surgical division at the root of the GCV can be performed, as well as management using elastic knee-high compression socks. When the operation is performed, the normal SSV may be useful as a landmark to find the root of the GCV.

With regard to the strategy used for surgical management, dividing the incompetent perforating veins instead of GCV root division is one choice. However, there are many perforating veins which penetrate the muscular fascia and connect the tributaries of the GCV to the superficial veins (indirect perforators). These are different from the perforating veins which connect deep veins, like the anterior or posterior tibial veins, to the superficial veins directly (direct perforators). The incompetency of the indirect perforators is therefore not due to such perforators themselves, but instead this phenomenon is thought to be due to the incompetency of the GCV root. Performing procedures which only divide the incompetent indirect perforating veins will inevitably lead to the development of another indirect perforating vein. This will therefore only delay the successful resolution of the patient’s varicose veins, as observed in the first case. Another choice for the treatment is foam sclerotherapy. However, it will lead to recurrent varicose veins via newly-formed incompetent perforating veins due to the patent incompetent GCV when foam sclerotherapy is performed for only superficial varicose veins and perforating veins. This will therefore only delay the successful resolution of the patient’s varicose veins. On the other hand, effective foam sclerotherapy requires thrombotic occlusion of the incompetent GCV in order to prevent new formation of incompetent perforating veins. However, such thrombosis may be followed by proximal venous thrombosis or pulmonary thromboembolization if the root of the GCV is not ligated. Although foam sclerotherapy is an easy procedure to perform, application of it onto varicose veins due to incompetent GCV may lead to either potentially fatal complications or immediate recurrences. The varicose vein due to GCV incompetency is a special situation and no previous studies have focused on management with foam sclerotherapy against this type of varicose vein, and there also appears to be no evidence regarding foam sclerotherapy for this situation. Studies will reveal the actual safety of the therapy. Concerning endovenous thermal (laser or radiofrequency) ablation, this treatment modality appears to be of little use. The tributaries of the GCV are situated in the gastrocnemius muscle and are closely surrounded by muscle fibers, and the trunk of the GCV outside of the gastrocnemius muscle is closely attached to the gastrocnemius artery and branches of the tibial nerve. The incompetent perforators derived from an incompetent GCV usually only connect tributaries of the GCV with varicose veins and are too short to be managed by endovenous thermal ablation (Fig. 4: 4-2). Even if endovenous thermal ablation is technically applicable in the treatment of such perforators or the tributaries of the GCV, the incompetent GCV root will remain as the more central source of venous insufficiency. Recommendations to use endovenous thermal ablation...
for such cases should be treated with care until a thorough study has been reported.

**Conclusions**

In cases with an incompetent GCV with varicose veins in the small saphenous territory, the root of the GCV should be divided, along with saphenopopliteal disconnection and SSV stripping, in order to prevent residual varicose veins. The management of the root of the GCV is relatively easy when the SSV is used as a landmark. A staged operation in which the GCV is managed another day after the management of the SSV is not recommended, because it is difficult to find the root of the GCV when there is no SSV to use as a landmark.

In cases with an incompetent GCV without varicose veins in the small saphenous territory, elastic knee-high compression socks may be useful. However, especially in cases with varicose veins in the great saphenous territory or with congestive dermatitis, surgical management might be necessary.

**Foot Notes**

The essential points of this article were read at a plenary session of the 115th Annual Congress of the Japan Surgical Society.

**Disclosure Statement**

Mitsuuyuki Nakayama has no conflict of interest.

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