

## The Role of Phlebotomy in the Prevention of Pedicled Sural Artery Flap Venous Congestion

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### ABSTRACT:

#### BACKGROUND:

The lower extremities defects considered one of the most challenging, lack of tissue, exposure of vital structure (bones, tendons, blood vessels, and nerves) make flap coverage is a must. Venous congestion is one of the common consequences in lower extremities flaps. Phlebotomy is one of the methods to reduce venous congestion.

#### OBJECTIVE:

To discuss the role of intravenous catheterization as a method of decreasing venous congestion in reverse flow Sural artery flap used for the reconstruction of lower limb defects.

#### METHOD:

Eight patients were treated at Alshadeed Ghazi Alharirie hospital for variable defects in lower limb during the period from January 2018 to April 2019 all treated with reverse Sural flap, the venous drainage of these flaps was enhanced by the addition of phlebotomy tube that was removed after the blood flow through it stops.

#### RESULTS:

A total of eight patients were included in this study with ages ranging from 30-62 years (7 males – 1 female) cause of defects was trauma (5 cases), diabetic foot ulcer (2 cases), and post burn contracture release in one patient.

The site of the defect was heel (3 cases), ankle (2 cases), lower leg (2 cases) and lateral malleolus (1 case). The size of the defect was ranging from 7\*8 cm to 10\*9 cm. All the flaps survived with no reported case of complete or partial flap necrosis, only one patient had mild skin necrosis of about 1 cm in width of distal margin of the flap which was held with secondary intention.

#### CONCLUSION:

Intravenous catheterization of lesser saphenous is a simple and safe method for prevention of venous congestion of distally based Sural artery flap, intensive nursing care is needed and it is associated with less complications.

**KEYWORDS:** Sural flap, intra venous catheterization, venous congestion, lower limb defects.

### INTRODUCTION:

Lower extremity reconstruction represents one of the major challenging problems for the plastic surgeon because of paucity of adequate local soft tissues coverage together with poor blood supply. There are many options for defect reconstruction in lower leg, ankle and heel. The flaps used for such area should have pliable and thin characteristics with acceptable tissue match. In spite of recent advances in using of free flaps for lower leg reconstruction, reverse sural flap remain the main used flap for reconstruction of heel and foot and the lower leg.<sup>(1,2,3)</sup>

Masquelet et al were the first to describe the distally based sural flap in 1992. Distally based sural flap is a fasciocutaneous flap based

on the septocutaneous perforator of the peroneal artery and its main vascular axis the median superficial sural artery which accompanies sural nerve. There are many anastomosis presents between the peroneal artery and its vascular axis.<sup>(4,5,6)</sup>

In spite of its versatility, still distally based sural artery flap associated with high failure rates that occur mainly due to venous congestion which occurs in around 4.5% and in one series it had shown to occur in 21.5% of cases. Banmeister et al had described very high complications with using of distally based sural flap reaching up to 36%. Rate of total flap necrosis can reach up to 19%. The cause of flap is mainly due to venous congestion rather than arterial supply since distally based sural flaps have a constant and robust arterial supply.<sup>(7,8,9,10,11)</sup>

There are many suggested methods that reported to be used to improve venous out flow including

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the use of leechs , extending the pedicle ,temporary intermittent short saphenous vein drainage ,and finally anastomosis of the lesser saphenous vein to nearby vein in the defect site or in the foot ( super charging the flap) .<sup>(12)</sup>

In this study we evaluate the use of harvesting 5cm extra length of short saphenous vein with distally based sural flap and using it as phlebotomy to decrease the incidence of venous congestion of distally based sural artery flap.

### PATIENTS AND METHOD:

Distally based Sural flaps were used in eight patients for reconstruction of soft tissue defects in lower leg , ankle, and heel .

From January 2018 to April 2019 in Al-Shaheed Ghazzi hospital at medical city teaching complex , the soft tissue defect was due to trauma , post burn ankle contracture , and diabetic wound . patient data are shown in table - 1- below

Table 1:Patients' data.

Patient	Age	Gender	Site of defect	Cause of defect	Defect dimension ( cm )
1	30		Lower leg	Trauma	7 * 11
2	52		Heel	Trauma	8 * 11
3	44		Lower leg	Trauma	9 * 8
4	48		Ankle	Trauma	10 * 8
5	37		Ankle	Post-burn contracture	7 * 8
6	55		Lateral malleolus	Trauma	7 * 11
7	57		Heel	Diabetic foot	8 * 10
8	65		heel	Diabetic foot	10 * 9

We included those cases who had a soft-tissue defect of the lower leg, ankle and heel of moderate size with exposed bone and tendon. For case No. 5 (post burn contracture) reverse sural flap was used to cover exposed tendon and bone after contracture release of her ankle joint.

We exclude those patients with peripheral vascular disease, varicose vein of lower leg. Patient whom had wound or scar at pedicle sites were also excluded.

Preoperative detailed history was taken from all patients regarding their age , cause of soft tissue defect , duration and any associated comorbidity like smoking, diabetic, and peripheral vascular diseases .

Thorough examination was done for all patients with documentation site, size, exposed tendon or bone. Doppler study was done to exclude the perforator of the distally based sural flap which located approximately 5 cm above the lateral malleolus , routine preoperative investigations were sent for all of the patients and informed consent was obtained from all patients preoperatively informing them about the procedure , possible complication and donor site morbidity

#### **Operative method;**

All operations were done under general anesthesia with patients in supine position with knee flexion , in all cases tornequite were used . after draping and sterilization , the operation begin with debriding and excision of the wound

(for the case with post burn contracture of ankle , the operation began with releasing of the contracture ) after finishing and preparation of the wound, flap marking was done, we marked a line extending at midpoint Achilles tendon and lateral malleolus to junction of the proximal and middle third of lower leg at midline the pivot point of reverse sural flap is about 5 cm above the lateral malleolus , the defect is measured and template design according to the defect size this template then transferred to the donor site of the flap at the junction of the middle and proximal third of leg and size of the flap marked according to the template size in a round or tear-drop shape. the flap then incised along its proximal border in a sub facial plane with identification of short saphenous vein and sural neurovascular bundle which usually included within the flap at least 5cm segment of lesser saphenous vein is taken with flap and exteriorized at venous pedicle .This short segment of lesser saphenous vein is temporary occluded using micro vascular clamp and then the lesser saphenous vein is divided with ligation of proximal segment of the lesser saphenous vein with 3/0 polyglactine suture , while the flap and at least 3cm width of its pedicle then raised down to the pivot point. The flap then transposed to the defect without tunneling in order to avoid compression with incising any intervening skin between the defect and the pivot point. Donor site was closed using split thickness skin graft ,

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the flap with its 5cm of short saphenous vein is fixed to its receiving site under tension using 3/0 interrupted silk suture, corrugate drain inserted inside it 18 Fr nasogastric tube and the tube is fixed to the vein by using 3/0 silk which wrap around the vein. the tube is fixed to the skin to avoid its slipping during patient transfer and kept it open, both donor site and recipient site were dressed when patient is transferred to the ward the leg elevated and the tube is hang freely from the flap and the blood is collected in a collecting bag.

the collected blood is measured daily. When the blood flow from the tube is occluded by clot we infused the vein with heparinized saline to flush it. The tube usually kept at least 48 hours after the operation and removed after blood flow completely stop. the segment of short saphenous vein usually fall spontaneously. all patients kept on injectable broad spectrum antibiotics for at least three days postoperatively and patients were kept on follow up for at least six weeks



(a)



(b)



(c)



(d)



(e)



(f)



(g)

**Figure 1: Reverse flow Sural artery flap ,(a) heel defect, (b) flap marking and perforator location, (c) flap elevation, (d) flap setting to the heel defect, ( e) NG tube venotomy , (f) NG tube with flap sutured in-situ (g) flap survival post op .**

### RESULTS:

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the site of the defect was heel (3 cases ) , ankle ( 2 cases ) , lower leg ( 2 cases ) and lateral malleolus ( 1 case ) . the size of the defect was ranging between 7\*8 cm to 10\*9 cm .

all the flaps survived with no reported case of complete or partial flap necrosis , only one patient had mild skin necrosis of about 1 cm in width of distal margin of the flap which was held with secondary intention . flap venous congestion was noticed in 3 cases of flap intra operatively . no case of flap venous congestion was noticed postoperatively in all of our cases , nor other complication like hematoma , wound infection , seroma or wound dehiscence was noticed . the average blood loss from short saphenous vein 80cc . in all of our patient no further blood from the lesser saphenous vein was noticed after 48 hours , no blood transfusion were needed in all of our patients . in three of our patients blood flow was stop after 12 hours from operation due to clot formation and the short saphenous vein was flushed with heparinized saline and regain its blood flow .

no probing of the nasogastric tube was needed and all patients whom had blood flow obstruction was relieved by using heparinized saline the flap provided bulky ,pliable coverage of the defect site . all of our patients had satisfied with postoperative results and they were able to wear shoes and became ambulated after healing of their wound . two of our patients had concerns about the bulk of the flap . no donor site morbidity , apart from sensory loss along the lateral border of the foot which was tolerable and

have no effects on the patient . no painful neuroma was reported as the Sural nerve was routinely buried in muscles mass.

### DISCUSSION:

Because of its constant septocutaneous perforator and it's easy to plan and execution , reverse sural flap can provide a durable coverage for a soft tissue defect of lower leg ,ankle and heel from different causes and in any age group .

Many complication had associated with reversed sural flap namely partial or complete flap necrosis which can reach up to 50% .

Many risk factors associated with flap necrosis these include peripheral arterial disease , venous insufficiency , tobacco use , chronic alcoholism and patient age more than 40 years,

Venous congestion is one reason of partial or complete flap failure which occur due to insufficient venous drainage ,<sup>(12,13,14)</sup>

The reverse sural flap had dual venous drainage these include the lesser saphenous and the vena comitant that accompany the Peroneal perforator . In lesser saphenous vein the blood flow is in reverse direction while in vena comitant the blood flow is ante grade .

The lesser saphenous vein provided the main drainage to the most area of the flap . however, its reverse blood flow direction present adequate outflow . this reverse flow occur due to valvular incompetence that occur due to denervation of the vein during flap elevation . the vena comitant drain the blood eventually from lesser saphenous vein into Peroneal system , these vena comitants connected to the lesser saphenous vein by mean of oscillating veins which are devoid of valve , in order to maintain outflow between lesser saphenous vein and vena comitant, these oscillating vein must be multiple and hypertrophied .

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According to the work of Taylor et al, they observed that these a valvular oscillating veins get hypertrophy and multiply after flap elevation in response to increase flow.

So that during the time which needed to these oscillating vein to get hypertrophy and multiply , a temporary measure should be done to relief venous congestion transiently and this was done by using phlebotomy through externalized segment of lesser saphenous vein as was done in our study<sup>(4,15,16)</sup>.

In this study, reverse sural artery flap had been used for the treatment of lower extremity defect of lower leg , ankle and heel of different causes.

Short segment of lesser saphenous vein up to 5cm had been externalized and harvested with the flap , this segment was cannulated using a nasogastric tube and keep it for at least 48 hours post operatively in order to provide temporary venous drainage of the reverse sural flap while awaiting for adequate and effective neovascularization of the venous system to provide alternative drainage pathway. The recommended duration of phlebotomy in literature ranging from less than 24 hours to 9 days

De Chalain reported in his extensive study of using leech therapy in the treatment of venous congestion is that the mean duration phlebotomy or exanguination to be 2.4 days. In our study which based on Wong et al study<sup>(16)</sup> , a duration of 24 - 48 hours was enough period to establish adequate deep venous system that effectively drain the flap . our results with using this technique with reverse sural flap showed to be effective in prevention of venous congestion, were all of our flap had completely survived with no reported case of venous congestion .

In this study broad pedicle had been harvested ( at least 3 cm ) , according to Hollier et al they stress of crating wide pedicle that not including just lesser saphenous vein but also containing vena comitant that accompany the artery thus provide extensive communicating network vessels . In our study, the 3cm wide pedicle was not of excessive bulkiness and was fair enough to include the small veins in addition to the lesser saphenous vein<sup>(5,17)</sup> . No subcutaneous tunnel was used in order to avoid compression of the pedicle.

Intermittent phlebotomy of short saphenous vein with reverse sural artery flap had being used by Wong et al<sup>(16)</sup> were in 34 patients they noticed intraoperative venous congestion of 14 flap (41%) after 30 minutes of flap in setting to the recipient site . In 2 of these congested flaps they employed venous supercharging with micro

vascular anastomosis of the short saphenous vein to the nearby vein in the recipient area. In another 12 congested flaps , where is no suitable vein for anastomosis , they employed phlebotomy technique to relief congestion. In their study they didn't use intravenous catheter as we did to relief congestion , instead they used micro vascular clamp that occlude the vein which should be released as needed . In our study we kept the vein open by intravenous catheter and maintaining venous draining rather than doing intermittent draining as Wong et al , is that they used intermittent phlebotomy for only the flap that developed intraoperative congestion , while in our study we kept continuous phlebotomy of lesser saphenous vein by adding intravenous nasogastric tube till 48 hours for all the flaps .In other words , Wong et al used intermittent phlebotomy as management of intraoperative venous congestion , while in our work we used continuous phlebotomy of lesser saphenous vein as a prophylaxis against venous congestion of reverse sural flap . We thought that during the next 48 hours the deep venous system will be established to perform adequate draining system for the flap and during that time we created a temporary draining system by using intravenous catheter of short saphenous vein. Wong et al reported improvement of the venous congestion in those congested 12 flaps and complete flap survival without any sequels.

Using of intravenous catheter for venous drainage of sural flap had shown to be effective method to prevent venous congestion. It need no intensive care and no case of infection was reported. The main only concerning is about blood loss, However, the blood loss was minimum (80 cc/day) and non on our patients had anemia. This low blood loss is attributed to receiving of the low arterial flow from peroneal perforators which far less than axial flap like anterior tibial of radial forearm flap. Also the blood loss is decrease gradually as deep venous system is become gradually effective to drain the flap<sup>(16)</sup>

It been shown that venous ischemia is far more damaging to the tissues when compared with ischemia due to poor blood supply of same duration in any venous obstruction more than 8 hours will result in flap necrosis .

Furthermore venous congestion leads to increased back pressure which eventually affects arterial blood flow. There are many suggestive techniques to prevent venous congestion<sup>(8,16)</sup>.

Foran et al suggested in order to improve blood supply and decrease venous congestion of the reverse sural flap is to delayed for 48-72 hours .however , this method added extra procedure and increase the cost and morbidity of operation<sup>(18)</sup>

Micro vascular supercharging technique have been suggested to reduce venous congestion of reverse sural flap which involve micro anastomosis of lesser saphenous vein to nearby vein in the recipient area . however , this procedure require experience in micro surgery in addition that it is not always easy to find a vein in vicinity of the defect because of the trauma<sup>(16)</sup> Leeches had been used for treatment of venous congestion of the flap , it secret Hirudin which is a natural thrombin inhibitor . however , leeches had been associated with increased incidence of infection ,require nursing care and associated with blood loss . in addition to that , in a study it showed that flap treated with leeches had poor re-perfusion than that of flap which is not treated by leeches . in a study that was done by Mozafan et al comparing of using leeches and venous catheterization for treatment of venous congestions in sural flap they had shown using of venous catheter is much more superior to the use of leech or it was more effective , safe and easy with less complication rates when compared to leeches<sup>(19)</sup>.

### **CONCLUSIONS AND RECOMMENDATIONS:**

Intra venous catheterization of lesser saphenous vein showed to be simple and safe method for prevention of venous congestion of distally based Sural artery flap . it required no intensive nursing care and it is associated with less complications like excessive blood loss or infection .

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