Published online: 2019-10-07

Ideas and Innovations

Short-term augmentation of venous drainage with extra-corporeal shunt and simultaneous auto-transfusion, for salvaging a congested free flap

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ABSTRACT

Adequate drainage of venous blood is the most critical part of successful free tissue transfer. We report a case of anterolateral thigh flap used for covering open communited tibial fracture. The flap was salvaged with short term augmentation of venous drainage with external shunt. The drainage was continued for six days. It was confirmed that there is no more congestion after blocking the catheter and then the drainage was discontinued on seventh day. The flap was successfully salvaged. This method has potential applications in multiple situations for successful salvage of free tissue transfer.

KEY WORDS

Extracorporeal drainage; external shunt; salvage of congested flaps; venous obstruction in free flap

INTRODUCTION

Reliability of micro-vascular tissue transfer has improved in recent years owing to the advances in the instrumentation, improved surgical training and growing experience.[1,2] Failures though less common, still occur and venous problems are the most common of them.[3]

Essential factors for a reliable micro-vascular anastomosis are: Disease-free vessels with good flow, no tension on the pedicle and technically perfect anastomosis.[4,5] Additionally, in post trauma situations, especially in the lower extremities, the extent of injury and duration after the injury (inflammation/stasis) may influence the availability of vessels for free flap anastomosis.[5,6] Systemic factors (i.e. age of the patient and atherosclerotic disease) can also contribute to the prognosis, leaving only the technical part under surgeon's control.

We report a case of successful salvage of a vastus lateralis myocutaneous flap where short-term augmentation of the venous drainage with extracorporeal bypass helped us overcome the non-availability of recipient vein.

Access this article online	
Quick Response Code:	Website: www.ijps.org
	DOI: 10.4103/0970-0358.122024

CASE REPORT

A 48-years-old male presented with history of road traffic accident. He had sustained head injury, fracture of right femur and Gustillo type IIIc fracture of both bones right leg. He had anterior tibial artery injury and extensive crushing of anterior compartment muscles along with a soft tissue defect spanning across upper and middle thirds of leg and extending into the upper part of lower third of leg [Figure 1a-d]. Associated head injury and

patient's hemodynamic instability did not allow early surgical intervention. As the management of wound was difficult due to multiple unstable fractures, after 48 hours of injury he was taken up for a short procedure of fracture fixation. His fractures were stabilised with external fixator, spanning across the knee. Soft tissue cover was not possible at this stage because of his general condition.

After getting clearance from neurosurgery and the intensive care specialists, he was taken up for elective micro-vascular free tissue transfer on the fourth post injury day. On exploration of the wound, posterior tibial artery was found intact but both accompanying deep veins of both anterior and posterior tibial vessels were found thrombosed. The short saphenous vein was injured; the great saphenous vein (GSV) was patent and uninjured. Gentle irrigation with heparin saline into the vein (GSV) was possible without much resistance and the intima appeared healthy under microscope, hence it was selected as recipient vein for anastomosis.

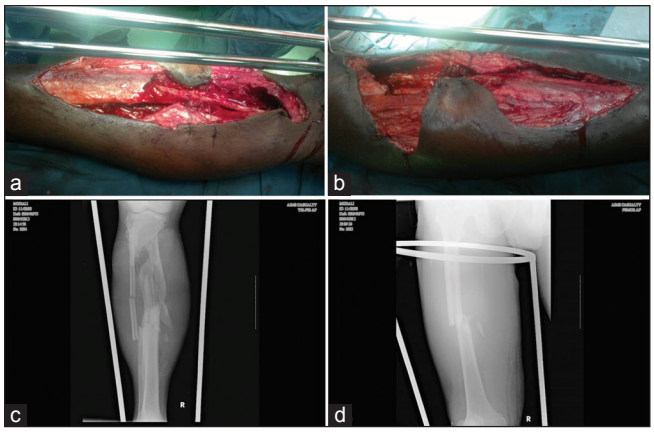

Figure 1: (a) Type IIIC fracture both bones right leg with extensive soft tissue defect extending from upper third into the lower third of right leg shown from medial aspect; (b) The same defect shown from the lateral side; (c and d) Comminuted fracture of both bones right leg and fracture shaft femur in the same extremity. Patient also had unstable knee joint

After confirming the recipient vessels, Vastus lateralis myo-cuteneous flap of dimensions 30 × 15 cm was harvested from the left thigh and was transferred to recipient site for coverage of the fracture site. After partial insetting, anastomosis was performed. The artery was anastomosed to the posterior tibial artery in an end to side fashion with 9/0 nylon. One of the flap veins was anastomosed to the great sephanous vein in an end to end manner. Due to non-availability of recipient veins in the vicinity, the second flap vein was clipped at the end of the procedure after confirming good flow. In setting was completed and good bleeding was observed from the flap at the end of the surgery. The patient was shifted to postoperative ward.

An hour after the surgery, the flap became congested. Clinically, it was evident by brisk and congested bleeding on scratching the flap with needle. The flap was explored immediately suspecting some compromise in the venous flow. On exploration, after exposing the anastomotic site, the vein anastomosis was found patent. Both the anastomosed flap vein and the GSV were distended and tense. The ligated second vein was also found to be tense and distended [Figure 2a]. The clip at the end of the second vein was released to let out some blood, in order to decongest the flap. This manoeuvre improved the flap colour and bleeding after some time. The flap drainage through a single vein was probably inadequate, so nearby areas were re-explored for another recipient vein. We could not find a suitable vessel for the second anastomosis.

As there was no possibility of getting a second vein for anastomosis, it was decided to let the blood out

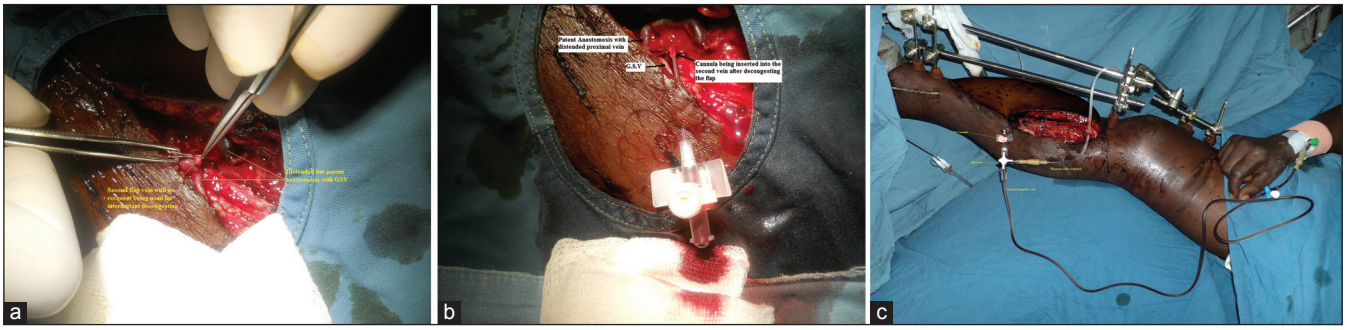

Figure 2: (a) Postoperative photograph of congested flap during re-exploration showing engorged tense vein proximal to the site of anastomosis. The anastomosis although was patent. The second vein (held with clamp was used to decongest the flap intermittently; (b) Cannula (I.V. catheter) being placed in the vein for external drainage. The same was stabilised with a suture over the vein and on the skin for additional security. Blood can be seen flowing through the cannula; (c) The whole assembly of shunt system. The cannula has been connected to a three way system and on one side heparinised saline is being infused to keep the shunt patent. The shunt can be seen draining blood and simultaneously transfusing it to the patient through another I.V. catheter over his forearm.

periodically to decongest the flap. The blood flow through the second vein was checked and was found to be very high (22 ml/min); letting out so much blood in a patient with multisystem injury was not a suitable option. Collecting the blood and then transfusing it was another option but had risk of contamination and sepsis. After carefully considering all the options and weighing the risks, it was decided to drain the blood through an IV catheter and auto-transfuse it to the patient simultaneously. The idea was to create a closed system with lesser risk of contamination. One IV cannula was inserted over patients forearm and the other one in the second vein of the flap through the edge of the flap. In the leg the flap vein was ligated over the cannula under appropriate pressure with 7/0 polypropylene, also the position of cannula was secured over the skin so as to prevent it from accidently getting dislodged. The cannulas were connected with an extension tubing (100 cm) as shown in Figure 2b. A three way system was attached at the proximal end of the extension tube through which heparin (5000U in 500 ml of normal saline) infusion was started at a rate of 20 micro-drops per minute to keep the extension tube patent [Figure 2c].

The drainage of the flap vein through the external shunt was checked every 2 hours as shown in the accompanying video [Video 1]. The patient was also quite comfortable with this position and was even able to take his hand to the mouth. Considering the fact that cannulating the flap vein and transfusion of blood from the site of injury directly into systemic circulation might lead to sepsis, stringent wound hygiene was maintained. As a precautionary measure the venous cannula draining the flap vein was changed once, after 3 days of drainage. By seventh day the flap developed enough collateral venous drainage and there was no congestion on blocking the venous cannula. At this time the drainage was stopped and the second vein was ligated.

The flap survived, except a small area of necrosis at the distal edge [Figure 3a]. The final insetting was completed after 2 weeks. The distal necrotic portion was debrided and the residual raw area was managed with VAC and was covered with skin graft at a later date. Complete wound healing was achieved in 4 weeks [Figure 3b].

DISCUSSION

The success rate of flap following the re-exploration depends upon the duration of occlusion of blood flow to the flap and the effects of hyper or hypo-perfusion of the flap due to venous or arterial problem respectively. The flap salvage rates after re-exploration have been reported to be between 44% and 80%.[7,8]

Timely re-exploration and correction of the underlying problem is the most effective way to manage these problems.[5] After diagnosing vascular thrombosis the treatment is thrombectomy and revision of the anastomosis. Even after early diagnosis and treatment, sometimes it may be difficult to re-vascularise the flap due to extension of the clot into the recipient or the donor vessels.[5]

In the lower extremity this is especially more common if the vessels are affected by the trauma, inflammation and stasis.[5] In multilevel injury also vascular patency is greatly reduced because of possible intimal damage that cannot be ruled out pre-operatively and there is high risk of vessel thrombosis. The ideal way to deal with this is to use vein grafts and take the anastomosis out of the zone of trauma. A cross leg free flap procedure is another possible option but needs complicated positioning, stress, pain and the possibility of tension over the anastomotic site.[9,10] Also one loses the option of future pedicle cross leg flap.

In the patient being discussed the deep recipient veins were thrombosed. Additionally there was wound over the medial aspect of thigh that might have compromised the great saphenous vein and its drainage. As the venous anastomosis was patent on re-exploration, the vein might have been draining through some other collaterals, but it was certainly not adequate.

In cases where larger flaps are harvested because of the need of additional soft tissues, there may be possibility of compromised drainage of flap and second vein anastomosis has been recommended in these cases (large bulky flaps) by few authors.[11] In the presented case also the large flap may be the reason for inadequate drainage,

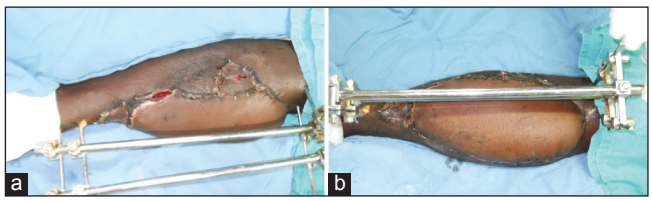

Figure 3: (a) Well-settled flap with small bits of skin grafts over the lost flap site. Picture of the same leg from the lateral side; (b) Well-settled flap from the medial side

but with one working vein and adjuvant technique of auto transfusion, it settled over a period of time.

In case of non-availability of suitable vessels, the above-mentioned technique could be very useful for short-term augmentation of venous drainage, the necessary pre-requisites are that the patient should be haemodynamically stable and the flap vessels are patent (a working artery and possibly a working vein draining the flap). The intravenous infusion set extension which is cheap and readily available could be used as a shunt. The tubing can be changed periodically along with the intravenous cannula. The extension tube was irrigated continuously with heparin solution containing 5000 U heparin in 500 ml normal saline at the rate of 20 micro-drops/minute. Patient's coagulation parameters were monitored. There was a slight increase in the APPT and PT after 24 hours and it remained stable for rest of the (heparin) treatment period. The patient required 2 units of blood transfusion during this period. The renal function, liver functions were normal throughout the treatment period; along with these the patient was also closely watched for any signs of sepsis which was a real possibility.

In a previous report claiming similar drainage, the authors have used Teflon shunt with urokinase and heparin saline irrigation to keep it patent. They have reported that the shunt remained patent for 3 weeks. In a patient with multisystem injury including head injury, giving urokinase could have been harmful. In this patient particularly, because of multisystem injury, such an option could have been dangerous because of increased risk of internal haemorrhage. Heparin, even at higher concentrations would be a safer alternative in these cases.[10] The shunt used in this case was very cheap and could be changed periodically. The second flap vein was kept very close to the skin and with good available length there was no problem during the shunt changing.

There is another article by Jones *et al*. demonstrating the utility of venocutaneous fistula for salvaging of a compromised flap.[12] In our flap, the venous drainage through the second vein was very high (22 ml/minute). Due to the risk of excessive blood loss, this option was not viable.

For pedicled skin flaps, it is generally agreed that the circulation gets stabilised after 3 weeks. Multiple delay techniques have been proposed and isolated reports have claimed to decrease this period to as early as 5 days.[13] Because of higher capillary concentration and rapid neovascularisation, circulation in the muscle flaps gets stabilised much earlier and successful salvage of free muscle flaps after delayed vascular occlusion has been reported.[14]

With one functioning vein and the vastus lateralis muscle in the flap, the transferred tissue in this case, probably regenerated/developed adequate draining channels. The flap drainage through the anastomosed vein was periodically monitored by blocking the second vein. On the seventh day the flap remained congestion free and the external drainage was stopped.

This technique could have applications in some very selective situations in reconstructive microsurgery. It can be used as a temporary drainage in distally based flaps with inadequate drainage. It could be useful when there are no suitable veins available for anastomosis and doing the vein grafts is not a possibility. In such situations it should be considered as a last resort (but potentially useful one) as a tool for salvaging the congested free flap.

CONCLUSION

In selective cases this technique of augmenting venous drainage of flap with extracorporeal shunt can be very useful.

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How to cite this article: Patil RK, Jayaprasad K, Sharma S, Sharma M, Mathew J. Short-term augmentation of venous drainage with extra-corporeal shunt and simultaneous auto-transfusion, for salvaging a congested free flap. Indian J Plast Surg 2013;46:572-6.

Source of Support: Nil, **Conflict of Interest:** None declared.