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Venous Flap for Dorsum of Foot Soft Tissue Defect: An Apt Alternative for Small Defects with Adjunct Modalities

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case study

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ABSTRACT

The utilization of venous flaps for small defects lesser than 4cm has its advantage of preserving the artery in the donor site and providing an adequate soft tissue without much of dissection needed for arterial flaps. In this case series, we discuss the utilization of saphenous venous flap in closure of the dorsal soft tissue defect of the foot. We utilized hyperbaric oxygen therapy as an adjunct to prevent venous congestion and to provide adequate neo-vascularization for the survival of the flap.

Keywords: Venous flap; hyperbaric oxygen therapy; saphenous vein; Osteomyelitis; tarso-metatarsal joint.

1. INTRODUCTION

Soft tissue defects of small in size (less than 4cm) particularly in the dorsum of foot are challenging to the reconstructive surgeon. When the arterial flaps are planned, it may result in significant bulky flaps which may compromise the vascularity of already traumatized limb. The

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patients often find difficulty in the adapting to the bulkiness of the flap by altering their foot wear. However, a thin flap matching the dorsal skin is always desirable when particularly the defects are small in size. Venous flaps have a risk of venous congestion or partial flap loss if there is no effective flap perfusion. To enhance the vascularity of the flap and to increase the plasma imbibition, neovascularization, we utilized hyperbaric oxygen therapy as an adjunct to the venous flap surgery. In this case report, we discuss on effective utilization of hyperbaric oxygen therapy along with venous flap reconstruction to prevent complication related to the procedure.

2. CASE PRESENTATION

2.1 Case 1

A 39 year old male presented in Plastic surgery outpatient department with a chronic sinus at the second tarso-metatarsal joint in the right foot. X-ray of the foot was normal. He had a history of trauma to the foot before 9 years following which reverse sural artery flap and skin grafting done. But he developed sinus formation at the level of second metatarsal joint level which was recurrent even after multiple curettage. The patient was evaluated and a surgical decision of wide excision of the tract communicating the joint was decided. Patient had psoriatic patches in the limb particularly in the distal third leg for which the patient was undergoing long term treatment. Patient was admitted and after preoperative evaluation, the surgery was done under spinal anesthesia with a tourniquet control. On excision of the tract with surrounding tissue, a defect measuring about 3.5cm x 3cm x 2cm exposing the tarsal and metatarsal bone was present [Fig. 1]. A venous flap based on saphenous vein was planned to cover the defect [Fig. 2]. Planning in reverse done. Flap elevation done carefully by including saphenous vein and adjacent tissue [Fig. 3]. Flap inset completed and donor area covered with split thickness skin grafting [Fig. 4 & Fig. 5]. In the post operative period, the leg was immobilized by splint for a period of 10 days and the flap settled well [Fig. 6 & Fig. 7]. Patient was started on third generation cephalosporins as antibiotics during the intra-operative and post-operative period with adequate analgesics for post operative pain relief. Six sessions of hyperbaric oxygen therapy was administered in the post operative period. Hyperbaric oxygen therapy was started on post operative day 1 and administered for 6 days consecutively. Each session for a duration of 90 minutes a day. Patient was discharged after 10 days following surgery without any complication.

2.2 Case 2

A 27 yr male presented with a soft tissue defect measuring about 3.5cm x 3cm x 2cm exposing the Extensor hallucis longus tendon and base of first metatarsal bone of the left foot due to trauma [Fig. 8]. Patient was admitted under plastic surgery department and after preoperative evaluation, the surgery was done under spinal anesthesia with a tourniquet control. A venous flap based on saphenous vein was planned to cover the defect [Fig. 9]. Planning in reverse done. Flap elevation done carefully by including saphenous vein and adjacent tissue [Fig. 10]. Flap inset completed and donor area covered with split thickness skin grafting [Fig. 11]. In the post operative period, the leg was immobilized by splint for a period of 10 days and the flap settled well [Fig. 12]. Patient was started on third generation cephalosporins as antibiotics during the intraoperative and postoperative period with adequate analgesics for post operative pain relief. Six sessions of hyperbaric oxygen therapy was administered in the post operative period. Hyperbaric oxygen therapy was started on post operative day 1 and administered for 6 days consecutively. Each session for a duration of 90 minutes a day. Patient was discharged after 10 days following surgery without any complication.

Fig. 1. Post surgical soft tissue defect right foot dorsum

Fig. 2. Saphenous venous flap planning

Fig. 3. Saphenous venous flap elevation

Fig. 4. Flap inset completed in the recipient area

Fig. 5. Donor area skin grafted

Fig. 6. Two weeks following surgery with healthy flap

Fig. 7. Late postoperative picture

Fig. 8. Soft tissue defect left foot dorsum exposing the extensor hallucis tendon

Fig. 9. Saphenousveinflapplanned

Fig. 10. Flap Elevation done

Fig. 11. Flap inset completed to cover the tendon

Fig. 12. Postoperative picture Day 5 following surgery – Flap healthy

3. DISCUSSION

Venous flaps survive through the venous network located within them [1]. Advantages of utilizing the venous flaps are relatively thin flaps and there is no need to sacrifice the arterial supply of the already compromised limb. The extensive classification of venous flaps was dealt by Chen et al. and Thatte et al. [2,3]. Kamei et al. depicted the use of large de-epithelized flaps based on saphenous vein for lower extremity defect with some superficial skin necrosis in one flap [4].

Nakayama utilized venous flaps to close composite defects of tendon, nerve, bone and nail [5]. Moderate to small defects of the foot are challenging to reconstructive surgeons as an ideal tissue transfer is often difficult to obtain. In case of arterial flaps, it may result in significant bulky flaps which may compromise the vascularity of already traumatized limb. In our particular case scenario, patient had a small defect with previously traumatized and operated limb. The initial planning was a flap cover based on lateral supra-malleolar flap however post excision the defect was smaller and extensive dissection in the lower third leg territory may jeopardize the vascularity of the already compromised limb [6]. The patient had psoriatic lesion in the lower third leg region which also a factor for hesitancy in transferring flaps from regional tissue. However, with venous flap as a soft tissue cover, a thin flap matching the recipient area was possible. The patientsdifficulty in the adapting to the bulkiness of the flap and repeated surgical procedures for thinning of flap in case of arterialized flap could also be avoided.

The saphenous flap is elevated basically as a fasciocutaneous flap with saphenous vein and nerve incorporated within the flap generally used for covering the soft tissue defects of the the lower limb below keen level. Saphenous venous flap can be described as equivalent to axial pattern flap and could be harvested in more length than a conventional transposition flap which is a random pattern flap with restriction of 1:1 ratio of the length: breadth. Venous flaps have a chance of venous congestion or partial flap loss if there is no effective flap perfusion. Jackson et al. demonstrated that the survival of venous flaps were enhanced when the pervious tissue is preserved [7]. In this particular case, we did meticulous dissection to preserve peri-venous tissue for the survival of the flap. Furthermore, when a greater area is perfused, the survival rate of the venous flaps are also increased [8]. Some studies showed the unphysiological blood flow channels in a venous flap are replaced gradually by physiological arterial over a period of 6 weeks, till then the oscillating slow flow through the venous network is sufficient for flap survival [9]. Pittet et al. proved the significance of neovascularization in the recipient area for graft and flap survival [10]. One of the studies based on dynamic analysis of carbohydrate oxidation in venous flaps, the flaps may require an external source of nourishment within 72 hrs of flap transfer for flap survival as the venous flaps are susceptible to ischaemia-reperfusion injury [11]. This leads us to the usage of hyperbaric oxygen therapy in venous flaps. Venous flap are primarily nourished by oscillating veins, diffused oxygen present in the plasmatic fluid present in the interstitial space in the recipient bed and within the flap. Plasmatic imbibition is a short mechanism which salvages the flap till the neovascularisation from the recipient bed grows into the flap. Hyperbaric oxygen therapy prevent ischaemia- repercussion injury, provides 100% oxygen to the tissue by diffusion which supports imbibition and promotes neovascularisation at the earliest. All factors indicates the necessity of hyperbaric oxygen therapy in venous flaps. Korambayil et al, emphasized the usage of hyperbaric oxygen therapy in reducing the delay time for the extended reverse sural flaps, where in the delay period could be reduced from 45 days to 7 days [12,13].

The principle of applying hyperbaric oxygen therapy in flap delay could be wellutilized for increasing the survival of venous flaps survival. Our treatment algorithm includes surgical debridement and initiation of hyperbaric oxygen therapy. Combination of the adjunct modalities for venous flaps allows preservation of marginal tissue, prevention of extension of ischemia, reduction of tissue edema and congestion, and maximum preservation of the transferred flap. There were no complications due to hyperbaric oxygen administration. However, additional studies are required to determine any additional indications, as well as the optimal timing and dosage of HBO therapy for venous flaps. Optimal usage of HBO therapy will enhance flap survival and reduce the complications in venous flaps. Hyperbaric Oxygen Therapy dramatically increases amounts of physically dissolved oxygen in the blood for delivery to the tissues. Therapeutic mechanisms of action for hyperbaric oxygen therapy are based on elevation of both the partial pressure of inspired oxygen and of the

hydrostatic pressure. This last mechanism contributes to a compression of all gas-filled spaces in the body (Boyles Law) and hyperbaric Oxygen Therapy increases the distance which oxygen diffuses from functional capillaries into hypo-perfused wounds and flaps.

4. CONCLUSION

Utilization of venous flap for the closure of the dorsal soft tissue defect of the foot with hyperbaric oxygen therapy as an adjunct is a reasonable option for reconstruction.

CONSENT AND ETHICAL APPROVAL

As per university standard guideline, participant consent and ethical approval have been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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