

Patent Blue Dye in Lymphaticovenular Anastomosis

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Abstract

Introduction: Lymphaticovenular anastomosis (LVA) has been described as a treatment of chronic lymphoedema. This microsurgical technique is new and technically difficult. The small caliber and thin wall lymphatic vessels are difficult to identify and easily destroyed during the dissection. **Materials and Methods:** We describe a technique of performing lymphaticovenular anastomosis with patent blue dye enhancement. Our patient is a 50-year-old lady who suffers from chronic lymphoedema of the upper limb after mastectomy and axillary clearance for breast cancer 8 years ago. **Results:** Patent blue dye is injected subdermally and is taken up readily by the draining lymphatic channels. This allows for easy identification of their course. The visualisation of the lumen of the lymphatic vessel facilitates microsurgical anastomosis. The patency of the anastomosis is also demonstrated by the dynamic pumping action of the lymphatic within the vessels. **Conclusion:** Patent blue dye staining during lymphaticovenular anastomosis is a simple, effective and safe method for mapping suitable subdermal lymphatics, allowing for speedier dissection of the lymphatic vessels intraoperatively. This technique also helps in the confirmation of the success of the lymphaticovenular anastomosis.

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Introduction

In the field of plastic surgery, a novel technique of supermicrosurgery has radically changed many concepts of microsurgery. Lymphaticovenular anastomosis (LVA) has been described as a treatment for primary and secondary lymphoedema in the extremities.¹ However, a lymphatic vessel of 0.5 to 0.8 mm diameter is always difficult to identify with precision. As such, multiple lymphatic channels may be accidentally destroyed during the dissection phase and the time for identifying the subdermal lymphatics can be unduly long. We describe a technique of using patent blue dye for lymphatic enhancement during LVA.

Materials and Methods

LVA with patent blue dye enhancement was performed in a 50-year-old lady, 8 years after she had a mastectomy and axillary clearance for breast cancer. She complained of worsening ipsilateral upper limb lymphoedema that was not responding to conservative treatment. LVA was advised for treatment.

Three sites were selected for the anastomosis; 1 cm distal to the wrist crease on the volar aspect of the forearm, 1 cm proximal to the elbow crease on the volar aspect of the forearm and 1 cm proximal to the axilla on the medial aspect of the arm. The subdermal venules can usually be located adjacent to the lymphatics at these locations. Patent Blue dye (0.2 mL; 2.5% Bleu Patenté V® by Guerbet Laboratory, France) was injected subdermally 2 cm distal to the 1st incision site using a 0.5 mL syringe and 27G needle (TERUMO®, Singapore). The skin was massaged for 2 minutes. Stained dermal lymphatic vessels appeared within 1 minute and continued proximally, assisting in accurate identification of incision sites directly over prominent subdermal lymphatic vessels. The incision was then made under magnification (20-30x) and the subdermal lymphatics/venules of 0.5 mm to 0.8 mm were easily detected. In a fair skinned individual, the course of the lymphatics and the lymphatic sacs can be visualised with ease on the skin (Fig.1).

The lymphatics were strongly stained by the blue dye (Fig.

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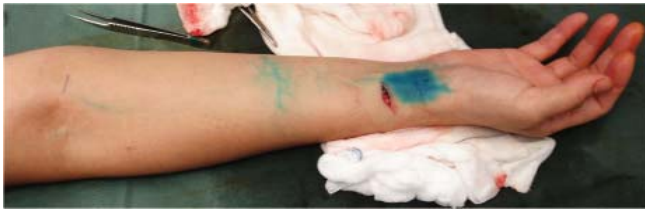


Fig. 1. The figure shows the course of lymphatic vessels stained by patent blue dye.



Fig. 2. The figure shows patent blue stained lymphatic vessels.

2) and the lumen easily visualised once it was transected. After anastomosis with 11/0 nylon sutures, the flow of lymphatic fluid could be seen between the lymphatics and the vein. The pumping action of the lymphatics was also easily discernable.

Discussion

In the field of plastic surgery, the novel technique of supermicrosurgery (anastomosis of vessels or lymphatics with diameters of 0.5 to 0.8mm) has radically changed many concepts of microsurgery. Lymphaticovenular anastomosis (LVA) has been described as a treatment for primary and secondary lymphoedema in the extremities.¹ It is also effective for secondary lesions of lymphoedema, including acquired lymphangioma circumscriptum and elephantiasis nostras verrucosa.² Secondary lymphoedema is a troublesome adverse effect following radical resection of various cancers.³ Conventional therapies for lymphoedema such as skin care, massage and compression therapy are not always satisfactory. In such cases, surgery may be attempted. A long-term follow-up study after lymphaticovenular anastomosis for lymphoedema propose LVA as a new

clinical standard for the treatment of lymphoedema in the near future.^{4,5}

It has always been difficult to identify with precision a lymphatic vessel of 0.5 to 0.8 mm in diameter. As such, multiple lymphatic channels have been accidentally destroyed during dissection and the time for identifying the subdermal lymphatics can be unduly long. Multiple incisions are also necessary to find suitable functional lymph vessels.

Various staining methods are then introduced to enhance visualisation of the lymphatic vessels intraoperatively. Dyes such as indigo carmine dye and indocyanine green dye have been used. However, they have not been found to be good indicators for identifying lymphatics.^{6,7} The affected lymphatics are often dilated and sclerotic and are weakly stained or unstained by these dyes.

We describe a method of using patent blue dye enhancement intraoperatively during LVA to enable better identification of lymphatic vessels. Only a small amount (several millilitres) injected distally is needed to demonstrate the dermal lymphatics.⁸ The lymphatic channels take up the dye rapidly and appear within a minute.

The advantages of using patent blue dye in intraoperative lymphatic enhancement are as follows: it is a simple technique requiring only injection subdermally, it enables the identification of the subdermal lymphatic systems prior to skin incision and hence assists in the planning of incisions. The stained lymphatics also allow speedy dissection of the lymphatic vessels intraoperatively. Patent blue dye is readily available and easy to handle. To the patient, it is non-toxic and readily excreted. During the microsurgical anastomosis, the lumen of the lymphatic vessels is more visible with staining. Real time visualisation of dynamic lymph flow aids in the selection of functional lymph vessels intraoperatively. The success of the lymphaticovenular anastomosis can also be confirmed by direct vision by the pumping action of the stained lymphatic fluid.

Patent blue dye is a sodium or calcium salt of diethylammonium hydroxide inner salt. It is a Food and Drug Administration-approved substance that has been used for lymphatic mapping in humans. It is selectively absorbed into the lymphatics, bound to albumin, and excreted into the urine and bile.

It has been used for demonstrating sequential lymphatic dissemination of melanoma into sentinel nodes by Morton et al in 1992.⁹ It has also been established in the identification of sentinel nodes in breast cancer and in lymphatic mapping of the lower limbs. It has, however, not been used intraoperatively to identify lymphatics for the purposes of LVA. Patent blue dye is non-toxic to lymph nodes.¹⁰ There is presently no data to suggest

toxicity to endothelial cells. It may have a toxic effect on retinal function when used topically in eye surgery.¹¹ Rare adverse reactions ranging from rash to anaphylaxis to the dye are documented.¹² Incidence of anaphylactic reactions to patent blue dye ranges from 0.2% to 2.7% with a mean of 1.8%.^{13,14} The usual symptoms of anaphylactic reaction are mild, such as pruritus, urticaria and mucocutaneous odema. Cardiovascular collapse and death have been reported.¹⁵ Surgeons using patent blue dye for procedures should be aware of this rare but possible life threatening adverse effect.

The patient may notice a transient blue or green discolouration of the urine, serum or skin discolouration. This usually disappears in 24 hours. Intraoperatively, it may create a modest artifactual desaturation effect via pulse oximetry but this is not clinically significant.¹⁶ The anesthetist may also notice blue staining of the endotracheal tube.¹⁷ An unusual presentation of blue angiodema and blue urticaria has also been reported.¹⁸

We feel that it is not routinely necessary for preoperative skin prick testing as the incidence of adverse reaction is low and a negative test does not exclude allergy in some patients.¹⁹ A detailed allergy history, especially to dyes, should be taken and patients should be informed of potential life threatening allergic reactions.

Conclusion

Patent blue dye staining during lymphaticovenular anastomosis is a simple, effective and safe method for mapping suitable subdermal lymphatics, allowing for speedier dissection of the lymphatic vessels intraoperatively. This technique also helps in the confirmation of the success of the lymphaticovenular anastomosis.

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