

Historical Review of Lymphatic Studies in the Hand

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Abstract

Review Article

As a part of vascular systems, the lymphatic system was discovered later than the others. Initially lymphatic vessels were observed in the viscera of mammals. Lymphatic vessels of the human limbs were not found until the mercury injection technique was introduced, which were largely referred by later literature. However the knowledge sometimes does not match or explain some of the unexpected clinical findings. Although, the superficial lymphatic distribution of the upper limb has been updated during the last decade, but the deep lymphatic pathways of the hand were still remained in uncertainty till a recent article was reported. This review the current investigative approaches through the historical perspective for clinical management and scientific researches in this region.

Key words: Lymphatic system; hand; history; superficial lymphatic vessel; deep lymphatic vessel.

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INTRODUCTION

In daily life, the hand is the most important part of the body and involved in a variety of disorders, ranging from trauma, inflammation, tumour, congenital dysplasia and secondary lymphedema, etc (Beasley, 2003; Maschke, 2005). Clinical management requires detailed and accurate anatomical understanding. Although, the superficial lymphatic anatomy of the upper limb has been updated within the last decade (Pan, 2015; Pan, 2017), while the deep lymphatic pathways of the hand were still remained in uncertainty till a recent article was reported (Ma *et al.* 2018). This reviews the current investigative approaches through the historical perspective for clinical management and scientific researches in this region.

This review aims to increase awareness of the lymphatic anatomy of the hand. Improved understanding should assist in clinical management and further scientific research.

BACKGROUND

Although the earliest reference to the lymphatic system came from ancient times (Haagensen *et al.* 1972), but lymphatic vessels were not identified until early 17th century (Aselli 1622). Aselli discovered lacteal vessels in the mesentery of a well-fed dog. It was recognised that these vessels were related to meals after repeated dissections in both well-fed and unfed dogs. Afterwards it was found that these vessels drained to the cisterna chyli and thoracic duct that ended in the jugular venous angle (Pecquet 1651).

It was not until Nuck (1692) introduced the mercury injection technique that was possible to delineate the lymphatics although early anatomists tried to inject water, ink, various coloured liquids, and wax into all types of vessels. Thereafter, this technique became the major method for investigating the lymphatic system in the next two centuries.

Using the technique to identify lymphatic vessels, Cruikshank (1786) made a composite drawing of the lymphatic vessels and nodes of the whole body (*Figure 1*). But the drawing did not show details in the hand, especially the deep lymphatic vessels.

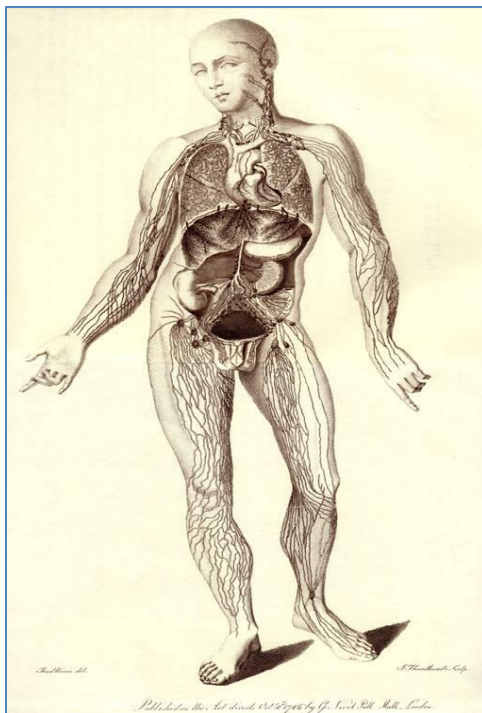


Fig-1: William Cruikshank’s drawing of the lymphatics in man (1786).

Mascagni (1787) used the same method to illustrate human lymphatics. Although his result advanced the work of Cruikshank but failed to reveal details of lymphatics in the hand.

In 1874, Sappey (1874) published a book and demonstrated an extensive series of lymphatic studies and presented the lymphatic network, distribution of the whole body including organs with structures of the lymph vessels and nodes. Using a fine glass cannula,

Sappey injected mercury into the cutaneous lymphatic vessels of the superficial layer of putrefied cadavers. His detailed description of the anatomy, physiology and pathology of the human lymphatic system have been accepted and applied for more than a hundred years. However, his drawings were based on multiple cadaver dissections and are composite images. On the hand section, only a couple of deep lymph vessels could be observed (*Figure 2*).

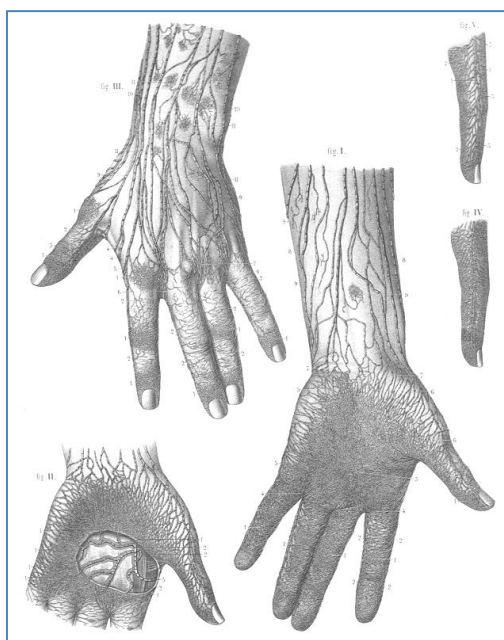


Fig-2: Drawings of the lymphatic anatomy of the hand by P.C. Sappey 1874.

From: <http://web2.bium.univ-paris5.fr/livanc/?cote=01562&do=chapitre>.

Beyond the mercury injection technique

In 1896, Gerota (1896) reported an improved, safer method for the injection and visualisation of the collecting lymph vessels. He suspended Prussian blue dye in turpentine with ether and injected it into fresh cadaver tissue through a fine glass needle with a small syringe. The Prussian blue dye highlighted the lymphatic vessels that could then be observed in the tissue surrounding the injection point. This technique was dubbed “Gerota’s method”.

In 1909, Bartels (1909) utilized Gerota’s method to assess the lymphatics in cadavers of young children and foetuses, and published an anatomical book of the lymphatic system (*Figure 3*). Also primarily using Gerota’s methods, Rouvière conducted an exhaustive study of human lymphatic vessels, nodes, and their territories. He conducted a review of the works of others and published his classic book, *Anatomy of the Human Lymphatic System*, in French in 1932. It was translated into English by Tobias in 1938.

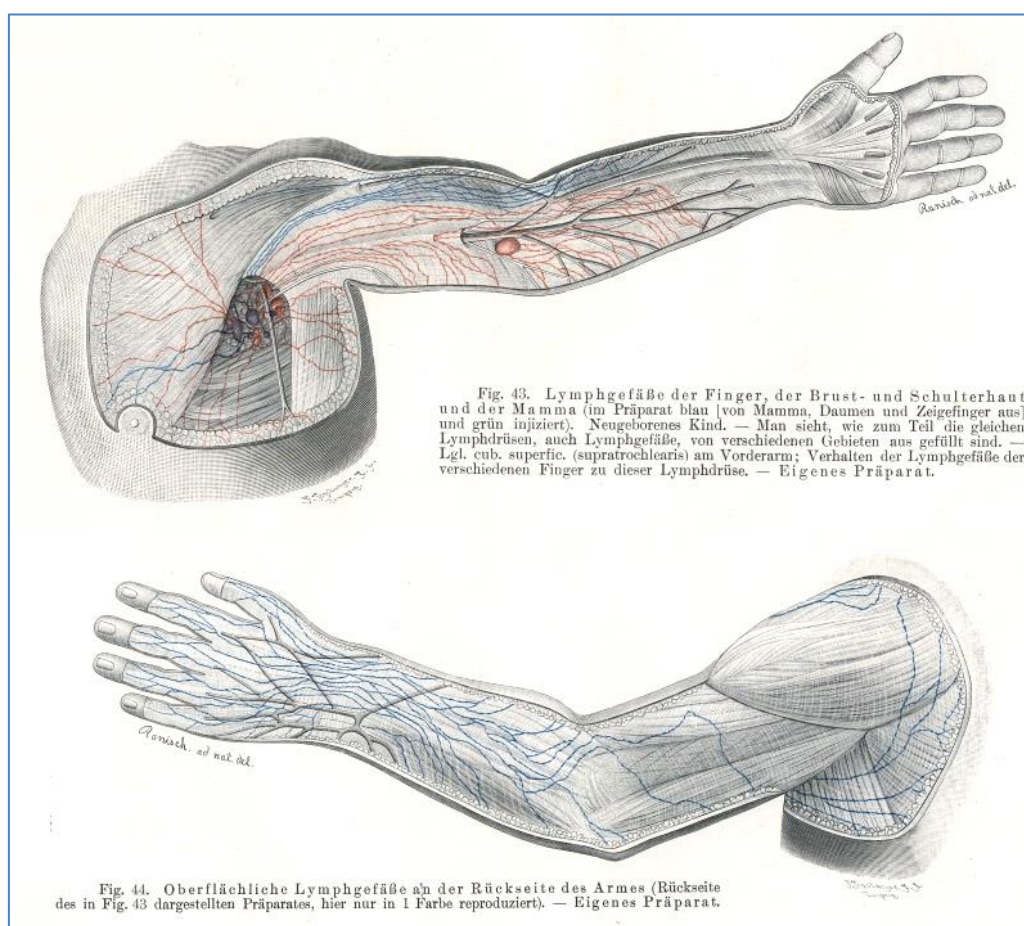


Fig-3: The results of the study of the lymphatics of the hand by Bartel in 1909.

Knowledge of the lymphatic system of the hand is largely based on early anatomical studies (Mascagni, 1787; Sappy, 1874; Bartels, 1909; Gerota, 1932). Although, the superficial lymphatic distribution of the hand has been presented, but the deep lymphatic pathways of the hand were still remained in uncertainty. A re-appraisal of lymphatic drainage is required to assist surgeons in anticipating lymphatic drainage pathways, and thereby reduce the incidence of false-negative investigations.

Current studies

In 2005, a new method of lymphatic assessment was established by Suami *et al.* (2005). The technique used hydrogen peroxide for the lymphatic vessels and micro-vascular injection with a lead-oxide mixture for demonstrating these vessels.

Using this technique, the superficial lymph vessels have been found in the subcutaneous of the dorsal hand (Pan 2015, 2017). Originating beneath the dermis, 1 or 2 lymph vessels on both side of each finger ascended tortuously in the subcutaneous along the mid-axial lines paralleling with digital arteries, veins and nerves (*Figure 4*). Generally lymph vessels of neighbouring fingers merged in the web spaces on the dorsal hand except those on the medial side of the little finger and the lateral side of the thumb, which ran radially to merge with lymphatic vessels on the dorsum of the hand. The pattern of the lymphatic drainage of the dorsal hand differ from person to person and are even asymmetrical on sides of the same body (*Figure 5*).

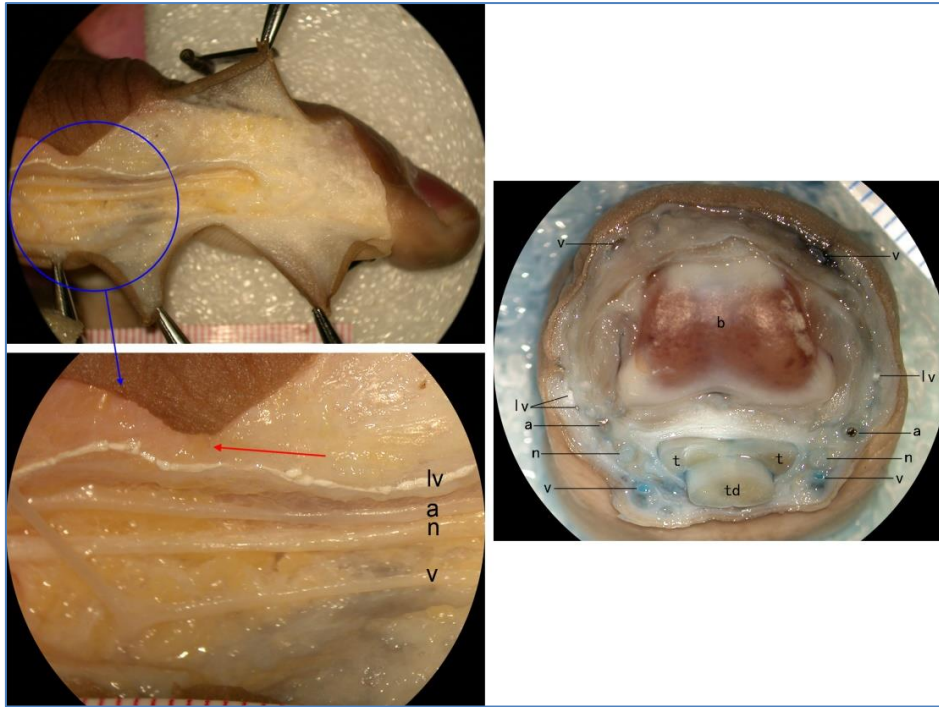


Fig-4: (Left) A digital lymph vessel (lv) (injected by a barium sulphate mixture) travels next to the digital artery (a), vein (v) and nerve (n) of the right index finger. Red arrow indicates the direction of the lymph flow

(Right) Photograph of the transversal section at the level of the proximal joint of the right middle finger. a = Digital arteries (inserted by metal wires); v = Digital veins; n = Digital nerves; b = Head of proximal

phalanx of the middle finger; lv = Digital lymphatic vessels (injected by a barium sulfate mixture); t = Flexor digitorum superficialis tendon; td = Flexor digitorum profundus tendon.

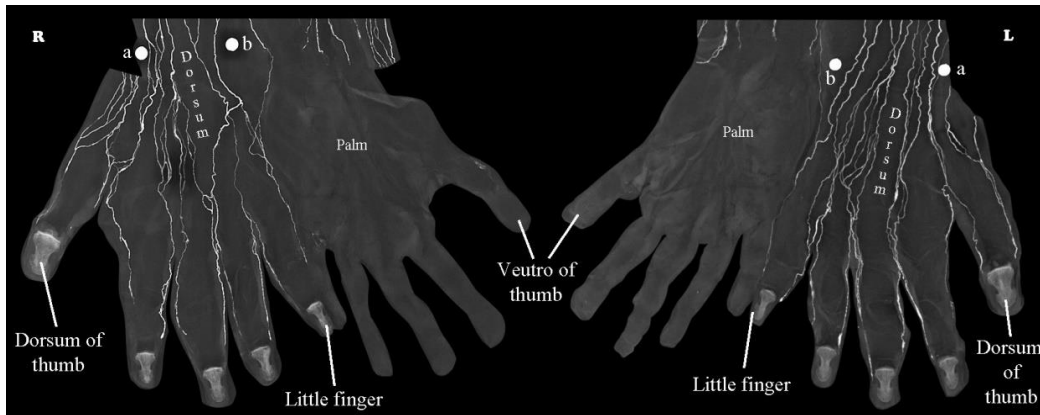


Fig-5: Radiographs show the lymphatic distribution in the integument of bilateral hands of the same body. a = Styloid process of the radius; b = Styloid process of the ulna

It was not until Ma *et al.*'s article was published (2018) that details of the deep lymphatic distribution of the hand were well explained (Figure 6). Five groups of the deep lymph vessel of the hand have been presented. The characteristics of the drainage pattern were described; 1) The deep lymphatic of the hand arose from the different layers and areas of the palm; 2) Each group of lymph vessels travelled firstly in different directions and turned to the dorsum of the hand, and then ran towards the wrist in different layers; 3) The superficial palmar arch lymph vessel (SPALV)

and the hypothenar lymph vessel (HTLV) travelled in the subcutaneous of the dorsal hand after turning in the fingerwebs; 4) The deep palmar arch lymph vessel (DPALV), after passing through the interosseous membrane between the 1st and 2nd metacarpal bones, ran with either the dorsoradial deep palmar artery/vein (deep layer) or the tributary of the cephalic vein (superficial layer); 5) Occasionally a communicating lymph vessel (CLV) was presented between the SPALV and DPALV. It travelled from the DPALV to SPALV (Figure 7).

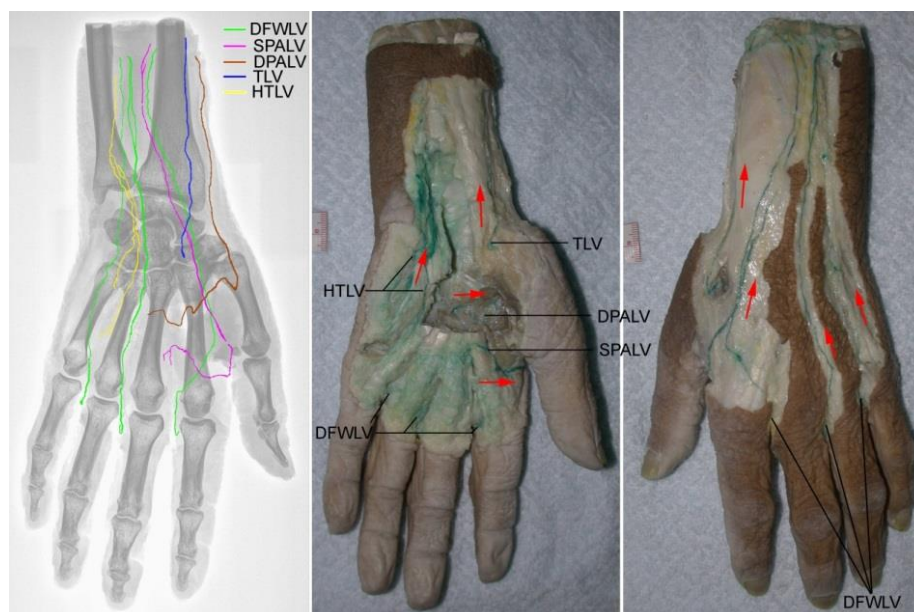


Fig-6: Radiographs (left) and photographs (center and right) of the left hand. Five groups of the deep lymphatic vessel of the hand are highlighted in colors (left). Groups of SPALV and DFWLV turn their courses in the fingerwebs, from the palm to the dorsum of the hand and then run in the subcutaneous (right). Red arrows indicate the travelling direction of lymphatic vessels.

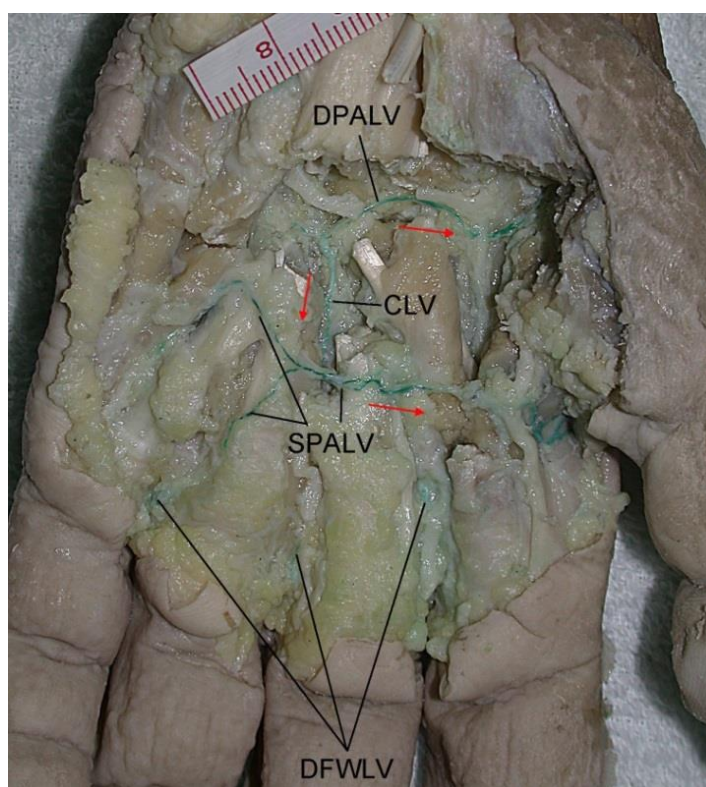


Fig-7: In different layers (left), SPALV and DPALV are connected by CLV. Red arrows indicate the travelling direction of lymphatic vessels. DFWLV= Deep fingerweb lymph vessel.

CONCLUSION

The knowledge of the lymphatic anatomy in the hand has been advanced by using the new technique. It will help with clinical management and for scientific research.

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