*mary Jurisdiction in Default of Payment of Fines and other Sums of Money* (July, 1934), an opinion was expressed that in some instances men, although able to pay, preferred to go to prison rather than pay for the upkeep of a child which they believed was not theirs; one case is cited (p. 57) in which:

"the defendant, who denied not only that he was the father of the child but that he had ever had intercourse with the complainant, had been committed to prison for non-payment no fewer than fifteen times in about two years, although he was well able to pay. He finally collected evidence upon which the mother of the child was convicted of perjury in the original proceedings. As a result the Court of Summary Jurisdiction refused to enforce the order for weekly payments. The adjudication of paternity, however, still remains."

The hearing of these cases often takes up much of the time of our courts, and the patience shown by the justices in their attempts to arrive at the truth is well known. In some instances they would be spared all the hearing of the case if blood group tests were employed, for an immediate decision could be taken after the hearing of the scientific evidence and without recourse to any other evidence. The saving in time and money which the tests would ensure is quite sufficient to counterbalance their cost or the cost of maintaining centres where they could be carried out. It is needless to compare the thoroughly proven reliability of the evidence of scientific blood tests with the notoriously unreliable "evidence" often advanced—for example, resemblance between the accused man and the child.

It would therefore seem desirable from every point of view that the fullest encouragement should be given to the use of blood group tests, and that, if necessary, consideration should be given to the question of providing statutory powers to enable the tests to be made in every case where the question of paternity is at issue.

It is a pleasure to express our thanks to Mr. D. H. Kitchin, barrister-at-law, for his valuable assistance with the legal aspects of this paper.

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The following medical promotions in, and appointments to the Venerable Order of the Hospital of St. John of Jerusalem were announced in the *London Gazette* of January 1: as Knights, Sir Louis Knuthsen, K.C.V.O., O.B.E., Mr. G. M. Huggins, Lieut.-Colonel A. R. Falconer, C.B.E., V.D., Dr. S. L. Dawkins, Major-General R. M. Downes, C.M.G.; as Commanders, Dr. W. D. Kirkwood, Lieut.-Colonel H. W. Webber, Dr. L. E. Ellis, Colonel J. A. H. Sherwin, V.D., Surgeon Vice-Admiral Sir Robert Hall, K.C.B., O.B.E., K.H.P., Dr. J. N. Morris; as Associate Commander, Lieut.-Colonel Sir Hassan Suhrawardy, O.B.E.,; as Officers, Dr. G. Holroyde, *M.C.*, Dr. E. Jones, Captain H. F. J. Norrie, Dr. R. V. Clayton, Lieut.-Colonel L. H. Leeson, Lieut.-Colonel W. Vickers, D.S.O., V.D., Colonel H. H. E. Russell, O.B.E., Dr. H. Smith, Captain R. Marshall, Dr. C. G. Moore, C.V.O., Dr. A. G. J. MacIlwaine, C.I.E., Dr. I. W. MacGregor, Dr. R. W. M. Strain, Lieut.-Colonel J. S. Matheson, Dr. W. W. White, Dr. G. R. Johnson, Lieut.-Colonel D. A. Whitton, O.B.E., Colonel S. R. Burston, C.B.E., D.S.O., V.D., Colonel W. W. S. Johnston, D.S.O., *M.C.*, Colonel H. C. Disher, Dr. F. E. McAree, Lieut.-Colonel J. R. Donaldson, Dr. Margaret E. Douglass; as Associate Officer, Dr. Ardaviraf Dinshawji Edal-Behram; as Serving Brothers, Dr. R. Y. Stones, *M.C.*, Dr. J. P. Mitchell, O.B.E., Dr. R. D. Brinton, Dr. J. B. Aitken, Dr. W. Verner, Dr. C. E. L. Burman, Dr. A. E. Pinniger, Captain W. A. Rees, Dr. S. E. Dunkin, Captain R. I. Poston, Dr. D. Malloch, *M.C.*, Mr. A. Croll, Dr. E. A. H. Russell, O.B.E., V.D., Dr. G. Simpson, Dr. J. J. Hurley, Dr. C. W. Gale, Dr. J. E. Piper, Dr. F. M. Read, Dr. J. S. Davies; as Serving Sister, Dr. Mary A. S. Ham.

# SOME CLINICAL ASPECTS OF THE LYMPHATIC SYSTEM

BY

**H. A. HARRIS, M.A., M.D., D.Sc.**

*Professor of Anatomy, University of Cambridge*

The repeated discussions during the last few years as to the respective merits of surgical operation and radium therapy in carcinoma of various organs call for a brief analysis of our topographical knowledge of the lymphatic system. The need is all the greater now that various schemes are under discussion for the establishment of accurate registers of the occurrence, spread, and degree of lymphatic involvement in cases of cancer. The questionaries which have been circulated from time to time are almost valueless as regards the sections dealing with the involvement of the lymphatic glands. Most of the illustrations of the lymphatic vessels and lymphatic glands in the standard textbooks of anatomy are variants of the beautiful plates in Mascagni's famous atlas, which was published in 1787. Successive anatomists and artists, often with more imagination than accuracy, continue to depict in green various lymphatic vessels and glands in relation to veins coloured blue. A careful reading of William Hewson's researches in the Windmill Street School from 1768 to 1774, together with a study of Mascagni's plates, will convince the reader of the conservatism which exists in this field. It is not surprising, therefore, that the collective reports of lymphatic involvement both at operation and at necropsy defy analysis.

Certain important contributions have been made to the history of the development of the lymphatic vessels by Sabin (1901), Huntington and McClure (1910), and Kampmeier (1928). Lymphatic vessels are now regarded as modified veins lined by an endothelium which is derived from and is continuous with that of the veins. In early life lymph vessels invade the embryonic tissues in the same way as the arteries and the veins. The lymphatic invasion is incomplete since the lymph vessels never reach the spleen, the epithelium proper, the sclerotic of the eyeball, uncalcified cartilage, the depths of the central nervous system, the bone marrow, and the foetal part of the placenta. Whereas most lymphatic vessels eventually lead to the thoracic duct or the small right thoracic duct, there are several organs in the body, notably the thyroid gland, in which the lymphatics open directly into the neighbouring veins. The classical discussion whether all the lymphatic vessels arise centrifugally from the jugular lymphatic sinuses or whether some of them arise in the mesoderm and develop centrifugally from tissue spaces to the jugular lymph sacs is immaterial. Kampmeier (1928) has shown that the thoracic duct and the main conduits of the lymphatic system acquire a system of valves at an early date in the life of the embryo. The human embryo aged 3½ months already presents forty-two valves in the thoracic duct, but most of the valves in the venous system are formed after this date.

### Histological Structure and Disposition

The fundamental facts about lymphatic vessels are indicated by their histological structure and disposition. Lymphatic vessels are rich in yellow elastic tissue and in valves but poor in muscle. They are situated near the main arteries of the area so that the pulsation of the artery, transmitted to the neighbouring lymphatic vessel, is mainly responsible for the propagation of the lymph in the direction determined by the valves. For this reason the thoracic duct in its ascent from the cisterna chyli in the abdomen to the thorax lies in proximity to the

abdominal and thoracic aorta. It crosses from right to left in its attempt to hug the left-sided aortic arch, and so reaches the region of the subclavian artery and vein on the one hand and the left common carotid and internal jugular vein on the other. The right lymphatic duct bears a corresponding relation to the innominate artery on the right.

In the early embryo the lymph drainage consists of paired lymph trunks on either side of the aorta with numerous anastomoses across the middle line—a pattern which also holds for the veins of the area. The suppression of the right aortic arch and the persistence of the left result in the formation of the adult duct from the distal portion of the right and the proximal portion of the left embryonic ducts, the cross anastomosis being situated at about the fifth dorsal vertebra in common with one or more anastomoses of the azygos venous system.

### Lymphatics of the Upper Limb

If the upper limb is placed in the embryonic position with the thumb directed cranially and the little finger caudally, the preaxial border of the limb is delineated by the cephalic vein and the postaxial border by the basilic vein. In the embryo there is a well-marked arterial anastomosis along both borders. The postaxial persists as the axillary, brachial, and ulnar arteries; the persisting parts of the preaxial anastomosis are found in the distal two-thirds of the radial artery and in the humeral branch of the thoraco-acromial artery in the groove between the biceps and the deltoid.

The change in arterial pattern of the limb has led to corresponding changes in the lymphatic drainage. The main lymphatic drainage in the adult is now concentrated along the postaxial border of the limb with a few lymphatic glands near the medial condyle of the elbow and numerous glands in the axilla. The lymphatic drainage along the preaxial border of the limb has been considerably reduced, and the only lymphatic gland or group of glands is that found in the delto-pectoral triangle below the clavicle where the costo-coracoid membrane is pierced by the branches of the thoraco-acromial artery and by the cephalic vein. Thus the frequency of involvement of the axillary glands, as compared with the delto-pectoral glands, results from the change in pattern of the lymphatic drainage due to the change in the arterial pattern. In short, the lymphatic vessels tend to hug the pulsating arteries of the postaxial border.

### Lymphatics of the Lower Limb

In the lower limb the preaxial border is delineated by the great saphenous vein from the great toe to the groin—the postaxial border in its distal part by the short saphenous vein, and in its proximal part by a line from the head of the fibula across the outer side and back of the thigh to the coccyx. In the early embryo there is a well-marked arterial anastomosis along the preaxial border of the limb. This persists in practically all mammals, including all the primates except man, as the arteria saphena which accompanies the saphenous vein in the whole of its extent and the saphenous nerve in its distal half. Along the postaxial border of the limb of the embryo there is an arterial anastomosis which has disappeared in adult man except for the proximal portion represented by the anastomosis of branches of the inferior gluteal artery with posterior sacral branches of the lateral sacral arteries, and distally by the anastomosis of the peroneal artery in relation to the external malleolus.

In most of the lower animals the short saphenous vein does not enter the popliteal vein at the back of the knee, but ascends to a higher level along a path which is marked out by the posterior cutaneous (small sciatic) nerve of the thigh. In man the short saphenous vein frequently makes but a small communication with the popliteal vein, and continues its course along the back of the thigh in company with the posterior cutaneous nerve to a point about three to four inches below the fold of the nates; it then runs medially across the inner aspect of the thigh to join the great saphenous vein. Thus the lower limb in the adult presents a lymphatic drainage which is concentrated almost entirely along the preaxial border to reach the glands of the groin.

Textbooks indicate a rich lymphatic drainage along the postaxial border of the limb. This is virtually non-existent, since infections of the third, fourth, and fifth toes or the interdigital clefts, as in epidermophytosis, result in painful enlargement of the glands of the groin. The popliteal glands are small, and are never involved except in the case of an infection of the skin at the back of the heel. All the rest of the limb drains into the groin.

The lower limb is thus burdened with a system of lymphatic vessels which are no longer related to actively pulsating arteries of any considerable size. The arterial anastomoses along the postaxial border are almost negligible and, subsequent to the loss of the great saphenous artery, the preaxial border maintains only the anastomoses around the internal malleolus of the ankle, the diminutive saphenous branch of the anastomotica magna, or arteria genu suprema, at the knee, and the large superficial femoral artery in the groin.

The lymphatic drainage differs more from the primitive arterial pattern in the lower limb than in the upper limb. In the lower limb it is always on the verge of breaking down. Moreover, the lymphatic glands of the lower limb occur mainly in the superficial fascia in proximity to cutaneous nerves, whereas those of the upper limb lie mainly in the deep fascia. This explains the pain and urgency of infections of glands in the groin as compared with glands in the axilla.

### The Lymphatics of the Female Generative Organs

The various derivatives of the intermediate cell mass (Wolffian body) of the embryo are supplied by a series of arteries which arise in turn from the abdominal aorta, the common iliacs, the umbilical arteries, the external iliacs, and the sacral arteries. In the early embryo the blood supply to the germinal ridge extends from the neighbourhood of the suprarenal gland to the position of the future internal abdominal ring at the midpoint of the groin. The ovary, proximally, maintains its supply by a direct branch from the abdominal aorta; the round ligament, distally, at the groin, like the spermatic cord in the male, maintains a supply from the deep epigastric branch of the external iliac artery. The uterus and vagina are supplied by the uterine and the vaginal arteries, which are branches of the internal iliac artery. The vaginal artery corresponds to the inferior vesical in the male, and both of these often arise in common with the middle haemorrhoidal artery. In short, these branches of the internal iliac artery supply the derivatives of the cloaca of the embryo.

The inferior haemorrhoidal and the various other branches of the internal pudendal artery to the perineum and the external genitalia are the derivatives of the embryonic artery to the proctodeum. In addition, branches of the lateral sacral arteries run with branches of the second, third, and fourth sacral nerves, the nervi erigentes, to form a number of neuro-vascular bundles

supplying the rectum, cervix, and the base of the bladder. In all the mammals with a bicornuate uterus the broad ligaments contain an anastomosis not only of the ovarian, uterine, vaginal, and lateral sacral arteries, but also of the branches of the external iliac artery in the neighbourhood of the internal abdominal ring. The latter branches, in the pregnant rabbit, cat, or dog, are as large as the uterine and ovarian arteries. In the woman these uterine branches of the external iliac arteries have been almost entirely suppressed. They persist as small branches to the round ligament of the groin, but they are significant. In the human genus also the ventral extension of the genital

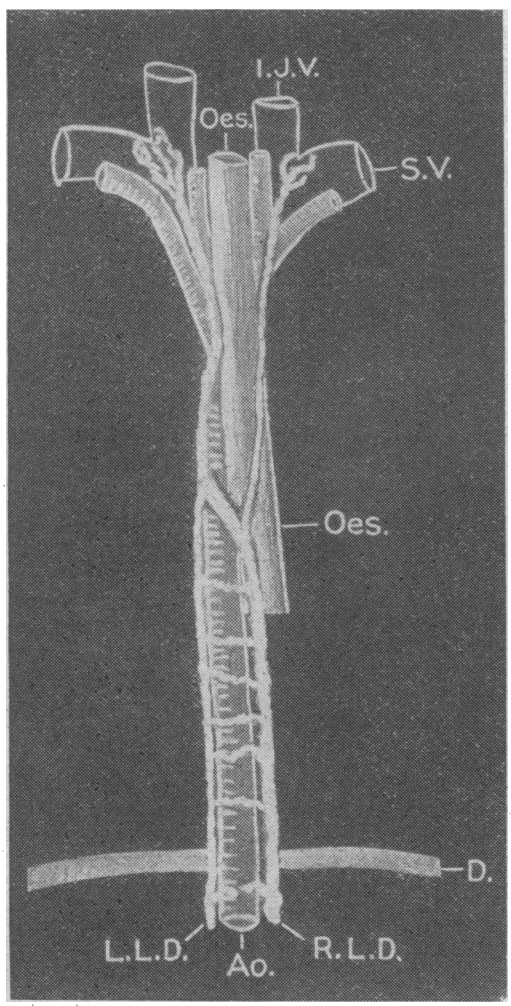


Diagram of the posterior aspect of the paired right and left lymphatic ducts in the human embryo of the third month to show the manner in which the adult thoracic duct is formed from the right duct inferiorly, one of the numerous transverse anastomoses, and the left duct superiorly in accord with the left-sided aortic arch. The superior portion of the right side persists as the right lymphatic duct of the adult. Abbreviations: Oes. = Oesophagus. I.J.V. = Internal jugular vein. S.V. = Subclavian vein. D. = Diaphragm. Ao. = Aorta. L.L.D. = Left lymphatic duct. R.L.D. = Right lymphatic duct.

cleft accounts for the relatively large supply to the pudendum from the superficial and deep external pudendal branches of the femoral artery.

As in the case of the upper and the lower limbs, the lymphatic drainage of the female genital tract is clearly portrayed by this brief history of the mammalian arterial pattern. The glands involved in carcinoma of the cervix are essentially internal iliac, common iliac, aortic by reason of the uterine artery; aortic direct by reason of the anastomosis between the uterine and ovarian arteries; superficial and deep inguinal glands by reason of the round ligament and the large ancestral uterine branches of the external iliac arteries; internal iliac, common iliac, and aortic by reason of the internal pudendal arteries; presacral glands by reason of the lateral and middle sacral arteries; and superficial inguinal by reason of the superficial and deep external pudendal arteries from the femoral.

It is probable that an attempt at a block dissection of any of these groups of glands is doomed to failure, whether it be for carcinoma of the cervix, the ovary, or the vulva. Primary healing of the skin of the groin after a block dissection of the inguinal glands is rarely, if ever, seen. This has its counterpart in the chronic infection of the inguinal area in the male affected by buboes. The skin of the groin will stand nothing more than a linear incision if healing by primary intention is to be guaranteed.

### Age Changes in the Lymphatic System

The precocious development of the lymphatic ducts and valves in the early embryo is purchased at a price. The senile degenerations of the lymphatic vessels probably precede those of the arterial and venous systems, so that the effective extent of the lymphatic vessels undergoes considerable shrinkage with age. It is not without significance that age changes in the way of degenerations, with or without calcification of the matrix, constitute a phenomenon commonly witnessed in the ligaments, arteries and meninges of the brain and spinal cord in the aged dissecting-room cadaver. The slow rate of lymphatic involvement in post-menopausal cancer of the breast or female genital tract may be a consequence of the senile shrinkage of the lymphatic vessels draining the areas.

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J. P. Bose and U. N. De (*Indian J. med. Research*, October, 1936, p. 489) have estimated by the method of Myers and Wardell the total plasma cholesterol content in one hundred normal and eighty diabetic Indians, together with the blood sugar in the diabetics. The normal plasma cholesterol values ranged from 102 to 178 mg. per 100 c.cm., 91 per cent. lying between 120 and 160, which was taken as the normal range; the mean value was 147 mg. per 100 c.cm. There was no difference between males and females. In the diabetics the plasma cholesterol ranged from 100 to 410 mg. per 100 c.cm., and bore no relation to the degree of hyperglycaemia. The cases were grouped according to their plasma cholesterol contents and observed for ten days, with treatment appropriate to their clinical needs. Twenty-four cases had a normal plasma cholesterol content, showed few complications, and responded satisfactorily to treatment. In the other groups with hypercholesterolaemia, as the range of plasma cholesterol content rose, the frequency of complications, especially arteriosclerosis, rose, and the response to treatment was less and less satisfactory. The authors conclude that the degree of cholesterolaemia in diabetes is a more satisfactory index of the severity of the disease than is any other factor, including hyperglycaemia. They discuss the relation of hypercholesterolaemia to arteriosclerosis in diabetics.