

strated in our lymphogram are surprisingly regular and symmetrical the stick-pin-sized, multiple lakes of contrast medium in the course of the tortuous vessels, the loop formation and the dilatation of some vessel sections indicate the pathological changes in the lymphatic system here.

Bilateral lymphography of the back of the foot revealed normal lymphatic drainage without a block so that a retroperitoneal dysplasia of the lymph vessels can be excluded. Therefore this case presents a circumscribed isolated congenital malformation of the lymph vessels of the scrotum and of the skin of the penis.

Summary

The lymphographic demonstration of the subepidermal lymph plexus of the skin of the scrotum and of the penis was successfully performed in a case of lymphangioma circumscriptum cysticum. The problems arising in the evaluation of this picture, as well as the degree of pathology are discussed.

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Lymphangiographic Appearances in the Rat

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Standard texts on the anatomy of the rat deal very perfunctorily with the appearances of the lymphatic system (1, 2) and no description of the normal radiological findings could be located in the literature. In a previous communication (3) the method of performing this examination in rats was described. The present paper is based upon the results of 24 lymphangiographies and is presented as there are certain fundamental differences from those occurring in humans. Any investigator using this technique must therefore be aware of these aspects.

Material and Methods

Lymphangiography was carried out on 21 animals using the method previously described, by injecting contrast medium directly into an ilio-lumbar lymph node. As certain variations in appearances could conceivably have been affected by the position of the animal during the procedure, seven animals were kept in the supine position, seven on their right and seven on their left sides during the examination. In addition there were three examinations carried out by injecting contrast medium into a knee node.

The lymphangiograms were analysed with special reference to presence and degree of retrograde flow into mesenteric lymph channels, the visualisation of the presacral lymph plexus, the lymph nodes in the abdomen, the number of abdominal lymph channels and the size of the thoracic duct.

General Appearance of Knee Lymph Node Injections (Fig. 1)

From the popliteal fossa the contrast medium passed towards the region of the femoral condyles and in the supine position crossed the middle third of the femur, running round and into a small femoral lymph node. From this lymph node the contrast ran on in two different pathways. The medial pathway crossed the iliac bone and entered the ilio-lumbar lymph node and thence ran cranially along the lateral margin of the spine to the cisterna chyli. The lateral pathway ran into lymph nodes on the lower abdominal wall and thence cephalically in a subcutaneous lymphatic to the ipsilateral axilla.

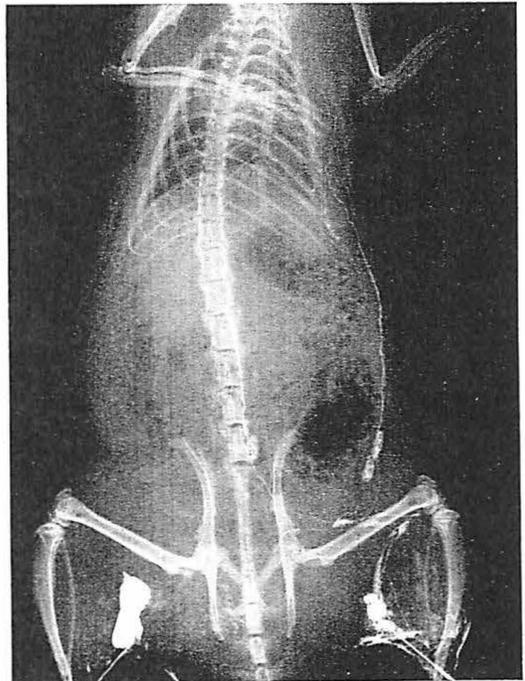


Fig. 1

The contrast medium on the left side has been injected into the lymph node, whereas on the right there has been extravasation around the lymph node. On the left side the lymph channels drain into the femoral node and then by two separate pathways, one medially and the other laterally. The medial pathway drains into the cisterna chyli whereas the lateral pathway shows two lateral abdominal wall lymph nodes and then runs subcutaneously to the left axilla.

General Appearance of Ilio-lumbar Lymph Node Injection

The contrast medium passed cephalically by one, two or three parallel lymph vessels lying in front of or just lateral to the lumbar spine from the level of L 6 to the level of L 2. At this level a large lymph node on the right side was shown (the intestinal node) and smaller nodes to the left (cisternal group of nodes) (1). Thereafter the cisterna chyli filled lying on the anterior surface of the vertebral bodies of L 1 and L 2 (Fig. 2). The contrast medium then ran into the thoracic duct which was found to take a cephalic course somewhat on the right side of the spine to the level of D 6 and then towards the left side up to the level of the lower cervical vertebrae (Fig. 3).

On the lateral view the lymph channels were separated from the anterior surface of the spine by a gap of from 6–8 mm but above the cisterna chyli the thoracic duct lay close to the anterior aspect of the spine with only a narrow gap of 1–2 mm in its lower part and no discernable gap in its upper part (Fig. 4).



Fig. 2



Fig. 3

Fig. 2 Injection into the right ilio-femoral node has produced some peritoneal spill. Lymph channels are visible in front of and to the right of the lumbar spine with a left-sided lymph node at L3 and a right node at L2. The cisterna chyli is well filled and a further lymph node is shown to the left of it overlying L1.

Fig. 3 Antero-posterior view of the thoracic duct which is shown to lie to the right of the midline in its lower part and to the left in its upper part, crossing the midline at the level of D6.

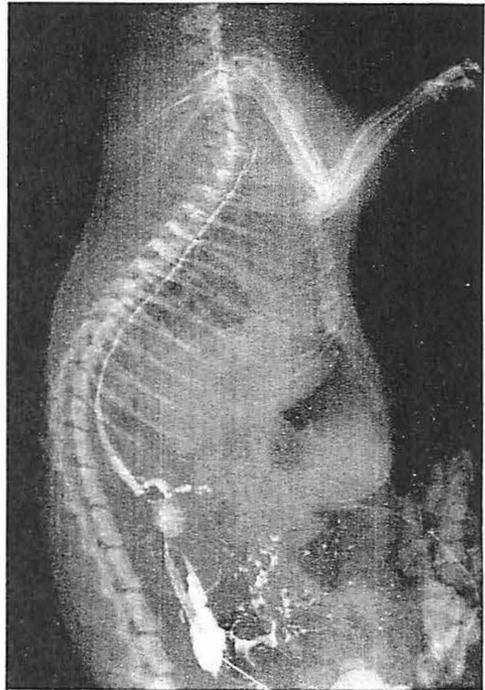


Fig. 4
Lateral view of the thoracic duct. The upper abdominal lymph node drains into the cisterna chyli with a gap between it and the spine. In the upper thoracic region the thoracic duct lies very close to the anterior aspect of the vertebral bodies.

Position and Number of Abdominal Lymph Nodes Demonstrated

In all cases there was at least one lymph node in the region of L 6 on the side injected. In one animal there were two lymph nodes and in one three lymph nodes lying one above the other in this position. In nine rats there was only one further lymph node demonstrated at the level of L 2 but in the remainder there were two or more. In most of these there was a lymph node to the right at the level of L 3 (intestinal lymph node) and another to the left at L 2. In four animals there were at least two lymph nodes in the region of the left side of L 2 (cisternal nodes). In one instance an extra lymph node was present at the level of L 5 and in another at the level of L 4.

Backflow of Contrast into the Mesenteric Lymph Channel (Figs. 5 and 6)

In seven animals there was moderate to marked backflow along the mesenteric lymphatic vessels, that is the mesenteric vessel measured more than 2 mm and up to 2.5 cm. In only nine rats was there no evidence at all mesenteric backflow. It was found that of the seven animals lying on the left side, only two had backflow of approximately 1 mm and five showed no backflow, while of those examined on their right side, five had backflow of greater than 2 mm and only one had no backflow. Of those animals examined in the supine position, two had marked backflow, two slight and three none.



Fig. 5

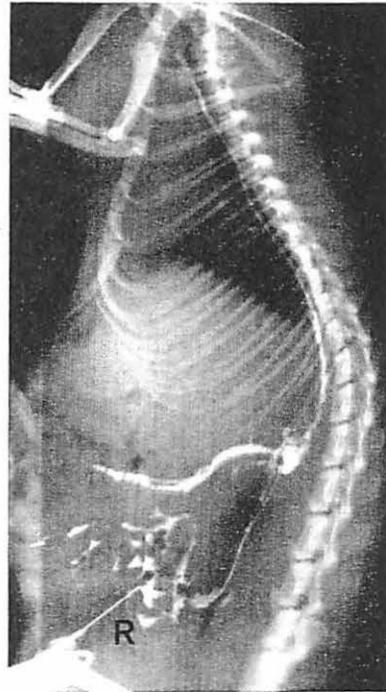


Fig. 6

Fig. 5 Lymphangiogram carried out with animal lying on its right side showing moderate backflow into the superior mesenteric lymph channel.

Fig. 6 Marked backflow into the superior mesenteric lymphatic channel with the examination carried out in the right lateral position.

Presacral Backflow (Fig. 7)

This occurred in two animals both examined in the supine position. In the one it was associated with leak of contrast medium into the peritoneal cavity but in the other there was no spill whatsoever.

Number of Abdominal Lymph Channels

In eleven animals only one channel filled; in two of these a small loop was formed by a vessel dividing off and then rejoining the main stream. In six the one channel formed a division into two and in two animals two channels came off the lymph node immediately. In one the channel formed three separate channels and in one both right and left nodes were injected so that two channels were shown.

The width of the Cisterna Chyli and Thoracic Duct

In all animals examined, the width of the thoracic duct was less than 1 mm while the width of the cisterna chyli was 2 mm or less in all the animals examined.

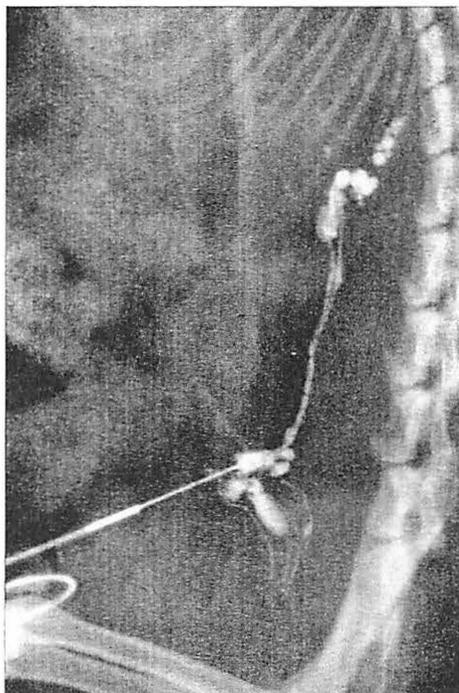


Fig. 7
Retrograde filling of presacral lymph nodes and channels after injection of the usual iliolumbar lymph node.

Discussion

Unlike normal human lymphangiography, injection in the leg fills both the intra-abdominal lymphatics and subcutaneous abdominal wall channels in the rat. The filling of the abdominal wall lymphatic deviates contrast medium from the thoracic duct making it more difficult to fill the thoracic duct by this route.

The presacral lymphatic plexus is shown in humans only in the presence of more proximal lymph stasis, but in two rats this occurred with no evidence of more proximal obstruction or stasis. Even more surprisingly, retrograde flow of contrast medium commonly occurred into the mesenteric channels. This appeared to be related to the position of the animal at the time of the examination. If the rat was kept on the right side it was commonly seen and could be quite marked, while in those animals kept on the left side it was uncommon and then only of slight degree. This may of course be purely fortuitous, but if not, no anatomical or physiological reason for this is at present available.

Some variation in the position of lymph nodes and the number of lymph channels was encountered, but on the whole there is a lymph node on either side of the body of L 6, to the right of L 3 and to the left of L 2, although nodes may also be present at the level of L 4 or L 5 and multiple nodes to the left of L 2 may be demonstrated. One to three abdominal lymph channels may also be shown with occasional loops on these channels.

Summary

The appearances of lymphangiography in the normal rat have been presented. The main anatomical features and their variations as shown radiographically have been described and illus-

trated. Particular attention has been drawn to variations in these features and to those aspects that differ from those found in humans. In particular, retrograde mesenteric lymphatic backflow is common when these animals are examined lying on their right side.

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Influence of Neonatal Thymectomy on the Development of Primary Rous Sarcomas in two Inbred Strains of Rats *

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In a number of experimental systems it has been shown, that neonatal thymectomy renders the animals more susceptible to the action of oncogenic viruses – polyoma virus in mice (7) and rats (10), SV 40 virus in rats (2), Rous sarcoma virus in chickens (8).

Tumour specific transplantation antigens have been demonstrated in mice (5) and in rats (4) carrying sarcomas induced by Rous sarcoma virus of the *Schmidt-Ruppin* strain (RSV-SR). It was the aim of the present investigation to study the role of the immunologic impairment following neonatal thymectomy for the course of development of primary sarcomas induced by RSV-SR in two inbred strains of rats.

In the search for suitable experimental animals five strains of rats were studied in advance for the effect of neonatal thymectomy upon their lymphoid tissue and their immunological capacity (3); neonatally thymectomized and sham-operated rats were immunized with sheep red blood cells when adult, and their haemolysin titers measured; also the cell content of particular lymph nodes was determined. A significant reduction in haemolysin titers and of cell counts of lymph nodes in the groups of neonatally thymectomized animals as compared with their sham-operated litter mates was observed in the inbred Wistar/Fu (W/Fu) and Black/Norway (B/N) strains of rats. Therefore these two strains were selected for the present long term experiment.

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