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# Xeroradiography of the Lymphatics

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### *Summary*

Lymphograms of 40 patients were made on xeroradiographic plates and conventional X-ray films. Both imaging procedures are compared in regard to their spatial and contrast resolution. Although xeroradiography offers little advantage in retroperitoneal lymphography, it essentially improves imaging of brachial lymphatic vessels and lymph nodes.

### *Introduction*

Although xeroradiography has been widely used in X-ray examinations of breast (1-4) and bone (5-8), studies of the lymphatics by xeroradiography have not yet been reported on.

Salient features of xeroradiography in comparison to conventional X-ray film examination are

1) Large contrast range permitting to represent both bone and soft tissue structures at the same time

Table 1

| Position | Xeroradiography Range of exposure | Xeroradiography mean exposure | Conventional X-ray film mean exposure parameters |
|---|---|---|---|
| Thorax 1. oblique projection for ductus thoracicus | 120 kV 50 . . . . . 75 mAs | 120 kV 65 mAs (0,16 sec) | 65 kV* 250 mAs (0,5 sec) |
| upper abdomen | 120 kV 65 . . . . . 110 mAs | 120 kV 75 mAs (0,2 sec) | 65 kV 600 mAs (1,6 sec) |
| lower abdomen | 120 kV 75 . . . . . 130 mAs | 120 kV 90 mAs (0,25 sec) | 65 kV 500 mAs (1,3 sec) |
| lumbar spine lateral projection | 120 kV 110 . . . . . 180 mAs | 120 kV 110 mAs (0,32 sec) | 68 kV 700 mAs (2,5 sec) |
| oblique projection of pelvis and spine | 120 kV 68 . . . . . 150 mAs | 120 kV 110 mAs (0,32 sec) | 68 kV 600 mAs (2,0 sec) |
| forearm ventro-dorsal | 120 kV 14 . . . . . 35 mAs | 120 kV 14 mAs (0,06 sec) | 45 kV* 20 mAs (0,04 sec) without blend |
| upper thoracic aperture with elevated arm | 120 kV 35 . . . . . 60 mAs | 120 kV 45 mAs (0,25 sec) | 60 kV 100 mAs (0,32 sec) |
| Axial shoulder and humerus | 120 kV 22 . . . . . 35 mAs | 120 kV 30 mAs (0,16 sec) | 50 kV 40 mAs (0,08 sec) |

Range of exposure refers to parameter used with slender and obese patients. Focus detector distance was always 110 cm

* For the sake of comparison the shortest possible exposure times were used with six-puls-generator DA 1000 (Müller) and a rotalix tube (30 kV, focus diameter 1,2 mm).

2) Contrast magnification of object borders (edge effect)

3) Increasing kilovoltage, which will diminish contrast on conventional X-ray films, only slightly effects xerographic picture quality.

From a theoretical point of view these described characteristics seem useful for lymphography, which for optimal interpretation needs good contrast resolution as well as large contrast range. In order to assess the method's clinical value, we have compared conventional X-ray films and xeroradiograms in patients undergoing lymphography.

### *Method*

In 40 patients lymphography was performed using 4-7 ml Lipiodol® for legs and 3 ml for the lymphatic vessels of arms. For several patients suffering from melanoma radioactive Phosphorus was added to Lipiodol (Endolymphatic Radiotherapy) which does not alter lymphographic imaging. Lymphangiograms (2 hours after application) and lymphadenograms (24 hours after application) were made using the position and exposure parameters indicated on table 1. Conventional X-ray films were used with universal intensifying screen and xeroradiograms were produced as negatives, since pilot experiments had shown no advantage of positive imaging. Lymphograms displayed by xeroradiograms and conventional X-ray films were evaluated by several physicians independently, who compared spatial and contrast resolution in lymphatic vessel contours and intranodal structures. Thus the diagnostic potential of the two imaging procedures, especially the ability to depict structure details, was assessed.

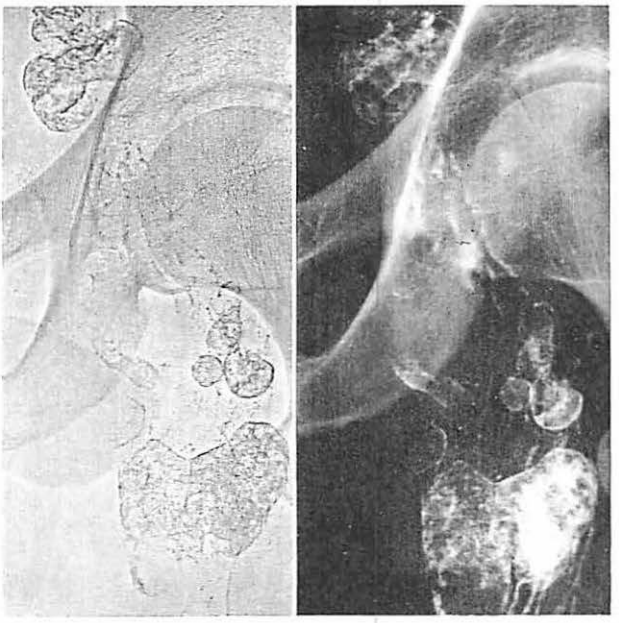


Fig. 1 Enlarged inguinal and iliac lymph nodes with bubblelike structure in a case of Hodgkin's disease. In xeroradiogram sharp reproduction of sinus marginalis (section of picture).

*Results and Discussion*

The imaging of *retroperitoneal lymphatics* by xeroradiography provides little or no advantage compared to conventional X-ray films. Due to the large tissue volume, the high kilovoltage (120 kV) used in xeroradiography induces a considerable radiation scatter and deteriorates the picture, especially when paraaortic lymph nodes are taken in the lateral or oblique projection in obese patients. Also, commercially available xeroradiographic plates are too small to cover the whole abdomen and more than one sectional picture is required. On the other hand, in slender patients recognition of structure details is satisfactory which is mainly due to the good small area contrast (edge effect) found in xeroradiography (Fig. 1). Likewise, thoracic duct and

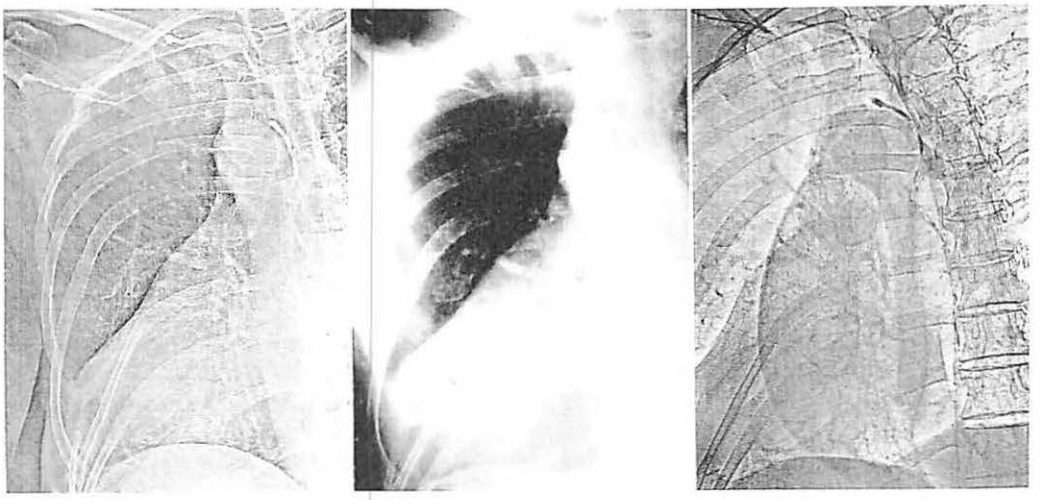


Fig. 2 Xeroradiography of thoracic duct. Left picture: negative procedure; right picture: positive procedure.

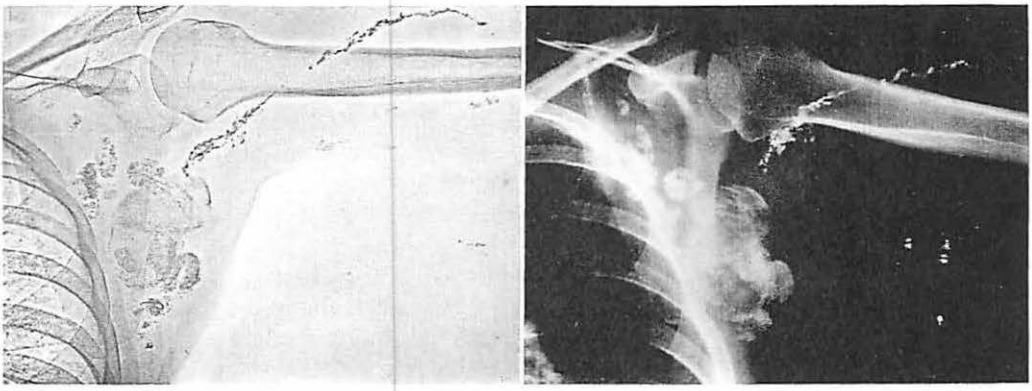
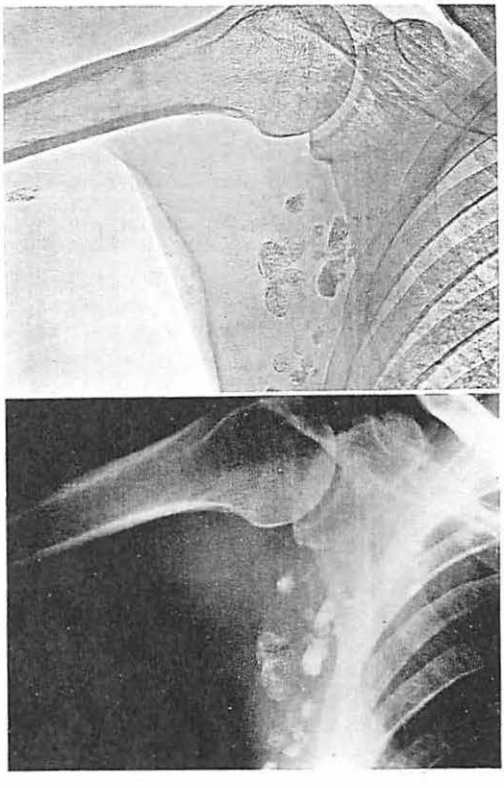


Fig. 3 Metastasis of a malignant melanoma. Infraclavicular lymph node with defect. Enlarged lymph nodes in axillary region. Sharp reproduction of details in xeroradiography. Better recognition of lymph nodes superimposed on the scapula.

Fig. 4 Enlarged lymph nodes with irregularities in the structure and some defects. Sharp delineation of defects in xeroradiography (upper picture: positive procedure). Resolution and delineation of defects is worse (below) in negative procedure.



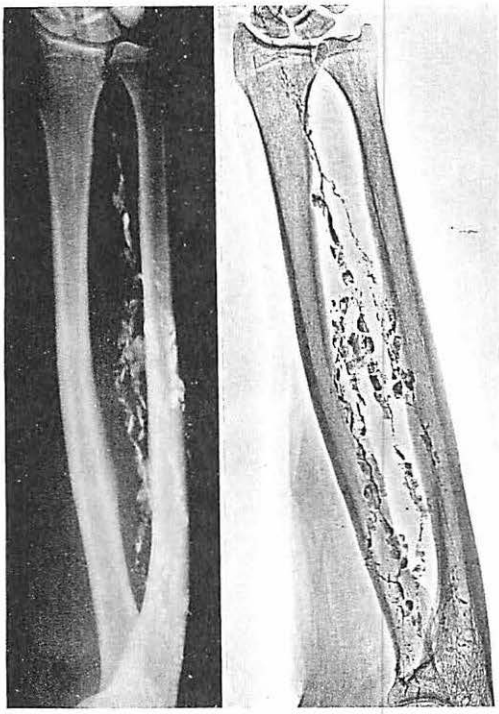


Fig. 5 Infiltration of soft tissue in the left arm with contrast medium, which can be very well differentiated from the skeleton.

its structures were generally well delineated (Fig. 2). The slightly higher radiation dose of xeroradiography is negligible in view of the better resolution and sharp delineation of defects. Thus xeroradiography of retroperitoneal lymphatics can only be recommended in a few cases.

Far better results were obtained in *brachial lymphography*. Relatively low tissue volume reduces radiation scatter and optimizes the major qualities of xeroradiography. The edge effect promotes the recognition of small lymphatic vessels. Excellent results were found in lymphangiopathies (Fig. 3, 5), and sometimes Lipiodol was seen in small lymph vessels which were not detectable by conventional X-ray films (Fig. 6).

Although large area contrast is higher in conventional X-ray films, defects of lymph nodes as metastases could well be delineated by their enhanced bounderies which compensated for poor large area contrast. The wide contrast range found in xeroradiography improved recognition of lymphatic structures superimposed on the skeletal bone. Therefore we have to conclude that xeroradiography is useful procedure for the study of brachial lymphatics including especially lymphangiopathies and can be highly recommended.

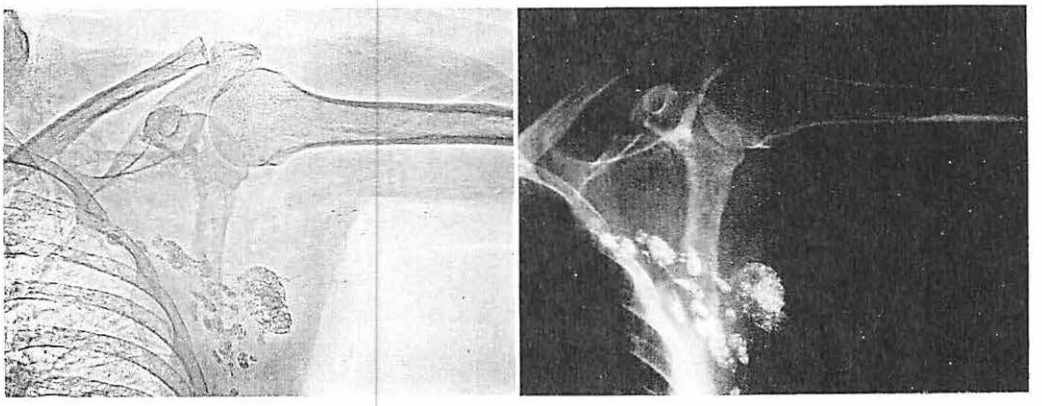


Fig. 6 Metastasis of malignant melanoma. Good differentiation of lymph vessels and of two enlarged lymph nodes in xeroradiography of axillary lymph system.

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# Lack of Genetic Control of the Lymphatic Pathway. Studies on Rats

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*Summary*

The lymphatic route from the testis to the cisterna chyli is studied in two inbred and one random bred strain of rats. The pathway varied similarly in all three groups with no indication of genetic control.

*Introduction*

It has previously been reported that the lymphatics from the right testis of rats sometimes bypass all lymph nodes and drain directly to the cisterna chyli (4). There are some old observations which indicate that this direct pathway to the blood stream can be found in endocrine glands in animals (2) and it has been observed in the thyroid gland in man (5).

In experiments on rats, Engeset (4) observed that lymphatics from the testis went directly to the cisterna chyli in about 1/3 of the animals. One of the rat strains primarily studied (Hooded strain A, reference 4) has since been inbred. In the present study testis lymphography has been performed in this strain in order to see if this direct lymphatic communication is genetically controlled.

*Material*

This study has been performed on 39 animals in 3 groups.

*Group I:* 24 rats from the inbred Hooded strain A. This strain has been bred as a closed popu-