

4. Giant cells with several nuclei occur in tonsils more often than in lymph nodes, especially in young patients.

The lymphoreticular tissue in the tonsils is more exposed to external antigen stimuli than that in the lymph nodes. This fact may explain the higher blast transformation rate in tonsils. The presumed antigenic response in young subjects is stronger than in the adult.

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Lymphatic Dynamics in Filarial Chyluria and Prechyluric State — Lymphographic Analysis of 52 Cases

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Chyluria is an abnormal urinary condition in which intestinal chyle appears in the urine as the result of fistulous communications between the lymphatic pathways (transmitting chyle) and the urinary tract at, or beyond the level of the renal tubules either within the kidney, the renal pelvis or the urinary bladder.

Lymphatics of the kidney (Fig. 1) fall into three groups — (1) inter-tubular lymphatics — within the substance of the kidney; (2) sub-capsular lymphatics, and (3) perinephric

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lymphatics. Groups (2) and (3) communicate with each other and join the renal pelvic lymphatics (4) to drain into the superior mesenteric nodes (5). The intertubular lymphatics, coursing along and around the renal vascular pedicle and through the upper para-aortic nodes (*viz.*), superior mesenteric and coeliac nodes (6), terminate finally into the cisterna chyli (7). Many of the right renal lymphatics and a few from the left drain directly into the cisterna chyli (Fig. 9). Corresponding vessels from the left kidney drain mainly into the descending intercostal trunk (8) which joins the cisterna chyli. The pelvic and para-aortic lymphatics traverse the upper para-aortic nodes before draining into the cisterna chyli as right and left lumbar trunks (9). The intestinal lymphatics

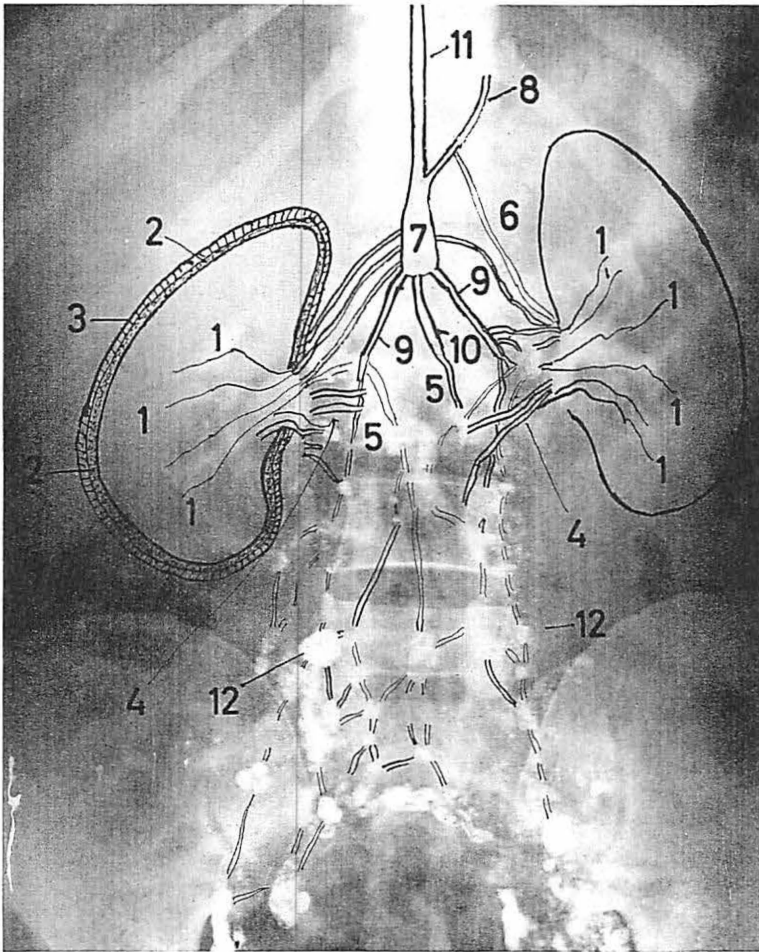


Fig. 1 Anatomical basis of chyluria illustrated on the 48 hour lymphogram (of case No. 5) combined with excretory urogram: (1) Intertubular lymphatics (2) Subcapsular lymphatics (3) Perinephric lymphatics (4) Renal pelvic lymphatics (5) Superior mesenteric nodes (6) Coeliac nodes (7) Cisterna chyli (8) Descending intercostal trunk (9) Right and left lumbar trunks (10) Gastro-intestinal trunk (11) Thoracic duct (12) Right and left para-aortic nodes.

carrying chyle also course through these nodes to terminate in cisterna chyli as gastro-intestinal trunk (10). It may thus be noted that the three tributaries of the cisterna chyli (viz.) the right and left lumbar trunks and the gastro-intestinal trunk course through the upper para-aortic nodes prior to their termination into cisterna chyli and these nodes also act as intermediary stations for the renal and renal pelvic lymphatics. Whenever there is an obstruction to the flow of chyle at the level of the upper para-aortic nodes – (as happens in filarial chyluria due to fibrotic changes in the lymph nodes) –, the intestinal chyle being unable to course through these nodes takes a deviated retrograde course along the renal and renal pelvic lymphatics which become engorged with chyle and in due course the hydrostatic pressure in them increases to sufficient magnitude as to cause rupture into the renal tubules or into the renal pelvis with resultant escape of intestinal chyle into the urinary tract and its appearance in the urine.

Material and Methods

We have made 62 lymphographic studies on 52 filarial chylurics by unilateral injection of 5 to 7 ml of Myodil or Lipiodol Ultra-Fluid. Ten cases were studied by Kinmonth's technique of intra-lymphatic injection and 42 cases were studied by open direct inguinal lymphadenography (Fig. 2) a new simple technique. There is no scientific reason to choose one or the other side for injection since lymphography done on the opposite side at a later date demonstrated the same findings in 6 cases. Our lymphographic series usually consisted of A.P. skiagrams of the kidney ureter bladder area under study and the chest taken 15, 30 minutes, 1½, 3, 6 and 9 hours after completion of injection. The timings were determined by the rate of flow of contrast as assessed by preliminary fluoroscopy and by the first or second set of lymphograms. Each skiagram is studied for the appearance of the contrast in the bladder before the patient is asked to empty the bladder; and he is instructed not to void urine until he is x-rayed next. If the contrast is demonstrated in the bladder the patient is x-rayed also the next day. Thereafter daily lymphograms are obtained. We have combined lymphography with excretory urography and tomography in a few cases. Follow through excretory urography in 14 cases 24 to 48 hours after lymphography has helped to assess renal function, to study the calyceal pattern, to delineate the lymphatico-urinary fistulae in relationship with the calyces and renal pelvis, and to demonstrate pyelo-lymphatic reflux which is evidenced by reopacification of lymphographic contrast by excretory urography contrast in the renal lymphatic and adjacent para-aortic lymphatics and nodes.

Results and Discussion

Lymphographic Findings:

Three of our cases with clinically fairly severe degree of chyluria did not demonstrate any lymphatic abnormality, even though lymphography was performed on both sides at different sittings. At present, we are not able to offer any explanation for this. All other cases demonstrated significant lymphatic abnormalities (Fig. 2 to 9) such as a definite partial block at the level of superior mesenteric and coeliac nodes with resultant saccular dilatation, tortuosity and increase in the number of the ilio-pelvic-abdomino

aortic lymphatic channels up to the level of the block, cross flow of contrast along pre- and retro-aortic vessels and retrograde filling of contralateral para-aortic and pelvic lymphatics up to the inguinal regions (and even further down to the popliteal and ankle regions in a few cases referred to later); stasis of contrast in these dilated sacs for three weeks and even more; and reflux of contrast towards intertubular and renal pelvic lymphatics with subsequent delineation of pelvi-calyceal system (Fig. 1, 3 and 7) and appearance of contrast in the ureter and/or the bladder thereby establishing the lymphatico-urinary fistulous communication. Lymphographic contrast (in 19 cases) appear-

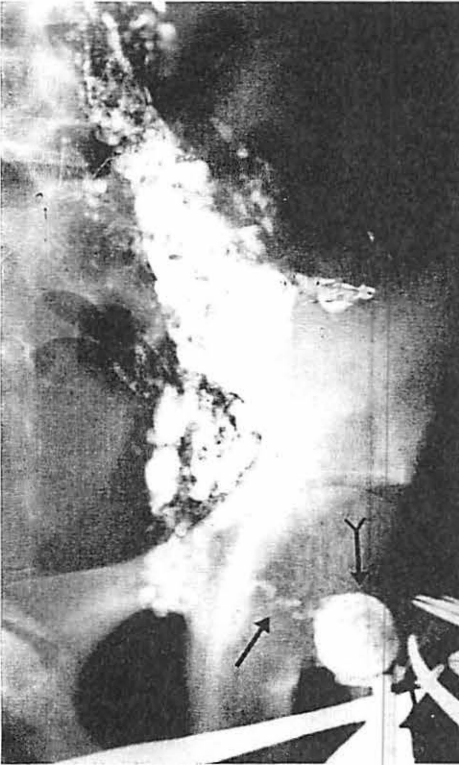


Fig. 2

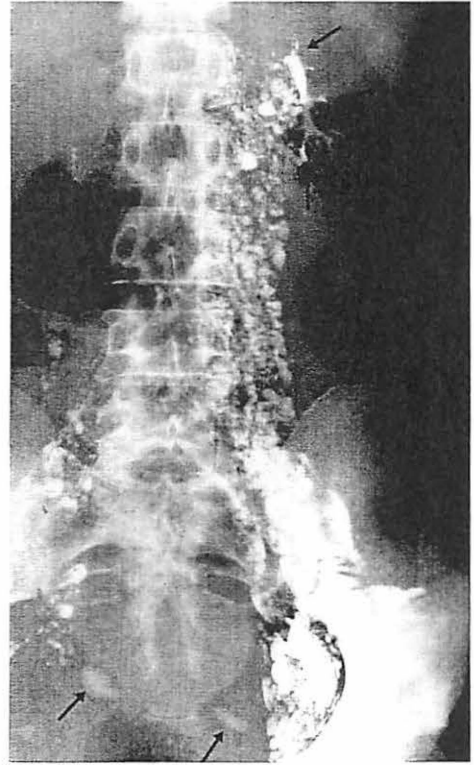


Fig. 3

Case 1 (female, age 35, Fig. 2-5)

Fig. 2 Filarial chyluria of two months' duration. Bed x-ray demonstrating the simple technique of open direct inguinal lymphadenography. Here an inguinal node is exposed under local anaesthesia by a 4 cm, skin incision and 5 to 10 ml of lipiodol ultra fluid injected (manually) directly into the lymph node taking 3 to 5 minutes per ml. The inguinal node (↓) with the needle in situ, the contrast flowing along the efferent vessel (↗) and one of the afferents (↑) clamped to prevent the leak of contrast are seen.

Fig. 3 1½ hour lymphogram shows saccular dilatation of pelvic, para-aortic and renal pelvic lymphatics with delineation of the pelvi-calyceal system (↑↔) consequential to lymphatico-urinary fistulization.

ed in the bladder 15 minutes to 8 hours after the completion of injection. When the flow of contrast along the para-aortic vessels was slower, its demonstration in the bladder was only a "chance catch". Ureteric opacification by lipiodol has been obtained in 7 cases.

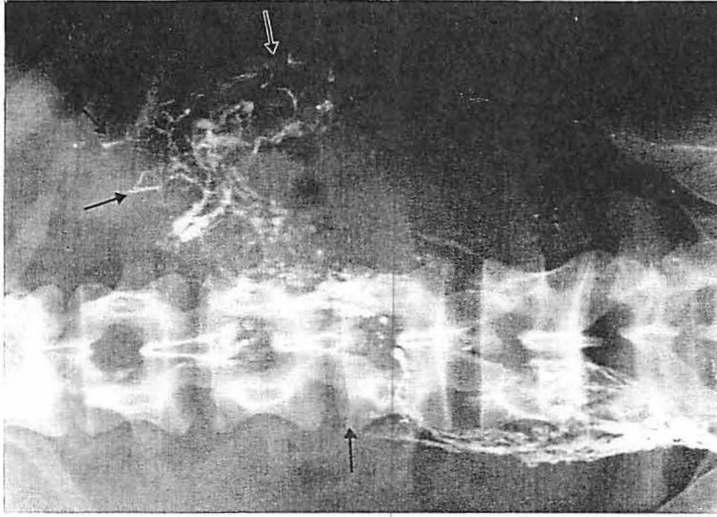
Bilateral lymphatico-urinary fistulae were found in 15 cases and unilateral fistulae in 34 cases. There were 56 instances of intertubular lymphatic rupture (32 on the rt. and 24 on the lt.) and 22 instances of renal pelvic lymphatic rupture (12 on the rt. and 10 on the lt.). The increased incidence of right sided lymphatic-urinary fistulization is



Fig. 4 The upright spot film showing fluid levels (\rightleftharpoons) in the dilated sacs and layering of the lipiodol at the inferior part of the bladder ($\uparrow\uparrow$). Bloating over thick chylous urine.

explained by differences in mode of drainage of renal lymphatics (Fig. 1 and 9). Since many of the right renal lymphatics drain directly into the cisterna chyli, reflux along these vessels occurs more easily. On the left side most lymphatics drain into the descending intercostal trunk. Reflux from the cisterna chyli is more prominent along this vessel either to join the thoracic duct at a higher level or to flow along the intercostal lymphatics towards the axilla. Therefore lymphatic hypertension in the left renal lymphatics does not rise as high as on the right side.

Neither in our experience nor in the literature there was any proof of lymphatico-vesical fistulae in cases with filarial chyluria (Fig. 1). Though varicosities of peri-ureteral



Case 2 (male, age 18)
 Fig. 6 Chyluria of 4 months' duration. 20 minutes' lymphogram demonstrates obstructed right upper para-aortic nodes (→) with cross-flow of the contrast to the left delineating coiled net work of dilated tortuous left intertubular lymphatics (↔). The 2½ hour lymphogram showed major and minor calyces of the left kidney with retrograde flow of contrast from L₁ along the testicular lymphatics into the scrotum. (Patient remains achyluric after the study - 4 months.)

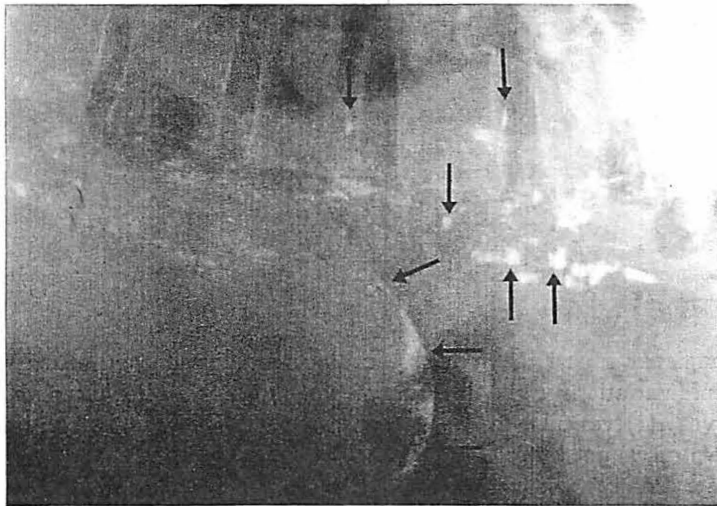
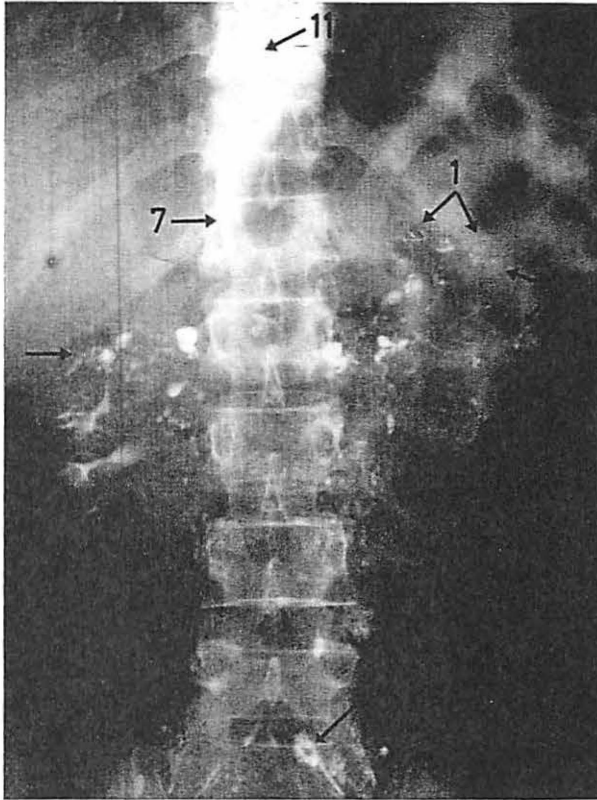


Fig. 5 The lymphogram obtained 11 days later demonstrated stasis of contrast in the lymph vessels (↔), absence of nodal opacification and retrograde flow along the gastro-epiploic lymphatics (→). The latter evidenced obstructed coeliac nodes. Barium study of the stomach confirmed the position of these lymphatics along the gastric greater curvature. (Chyluria cleared following lymphography and the patient remains well to date [one year].)

lymphatics has been noted, rupture into the renal tubules or pelvis occurs first. We could not demonstrate any uretero-lymphatic fistula; also engorgement of vesical lymphatics by extension from peri-ureteral lymphatics was absent. The iliac and para-aortic nodes were either poorly opacified or not visualised at all. There was a total absence of nodal visualisation in six cases; a few pelvic nodes were seen but no para-aortic nodes in three cases.



Case 3 (male, 45 years, Fig. 7-8)

Fig. 7 Chyluria of 15 years - 45 minutes - lymphogram demonstrates intertubular lymphatics ($\overleftarrow{\text{v}}$) (1) with minor and major calyceal systems (\rightarrow) with lipiodol in dilated cisterna chyli and thoracic duct. (The numbers are as in Fig. 1.)

Apart from lymphangiectasia, stasis, lymphatico-urinary fistulization and sparsity of lymph nodes, multiple variations in the direction of flow along the following pathways have been observed: (1) vesical lymphatics (two cases); (2) visceral lymphatics such as perinephric (two cases), mesenteric (two cases) and gastro-epiploic lymphatics (one case); (3) psoas lymphatics (eight cases); (4) perivascular lymphatics around the iliac vessels (five cases); (5) internal iliac lymphatics coursing towards the hollow of the sacrum (two cases); (6) lymphatics coursing along the under surface of the right dome of diaphragm (one case); (7) left intercostal lymphatics reaching the axillary

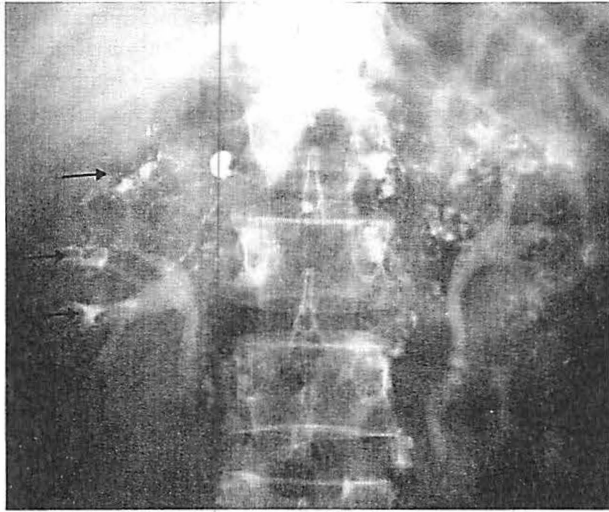
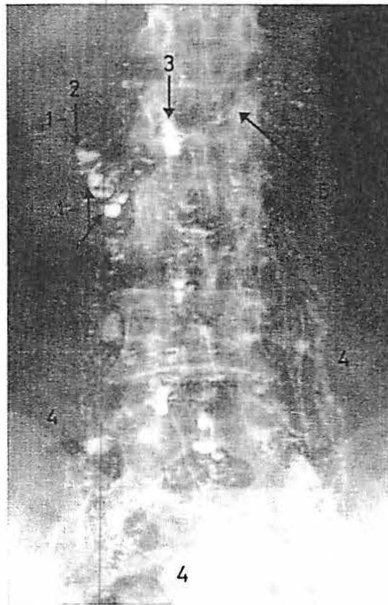


Fig. 8 Same case combined with excretory urogram shows the differential contrast delineation of the calyceal system both by lipidol and by excretory urographic contrast. Patient awaiting surgery.

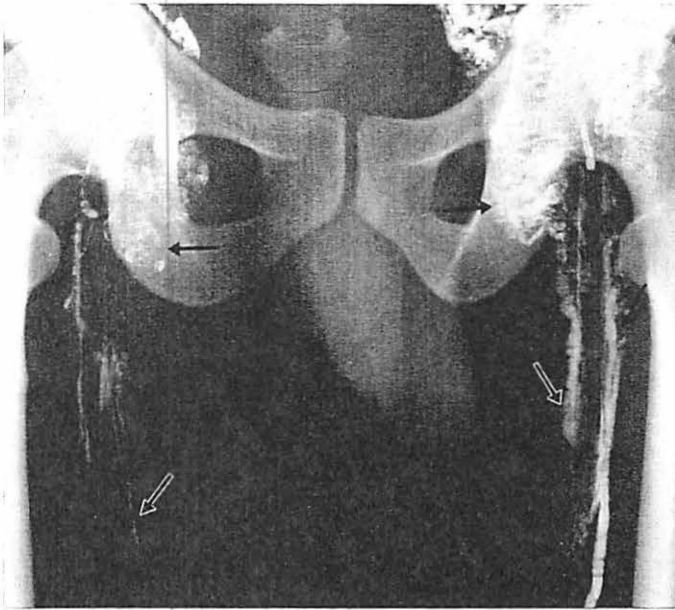


Case 4 (female, age 40)

Fig. 9 Chyluria of 6 months' duration. In this case left lymphography (done on 3. 9. 68) and right lymphography (done on 11. 9. 68) demonstrated similar findings. One hour lymphogram (standing erect view) demonstrates many of the right renal and renal pelvic lymphatics (1 & 2) draining directly into the cisterna chyli (3). (On the left side only a few [5] directly drain into the cisterna chyli.) This anatomical variation explains the increased incidence of right sided lymphatico-urinary fistulization (see text). Notice the extent of intercommunications between the para-aortic, pre-aortic and retro-aortic lymphatics at various levels (4). Chyluria cleared after the second study – patient remaining well to date (one year).

nodes (two cases); (8) retrograde flow of contrast from the injected inguinal node along the dilated, tortuous, valveless deep lymphatics of the thigh (four cases) (Fig. 10). In these cases reflux of chyle from lumbar to the inguinal and then to the popliteal regions has been demonstrated (in one of these cases there was reflux of contrast down to the ankles on both sides though the right inguinal node only was injected); (9) chylous reflux from the para-aortic region to the scrotal skin (two cases) (Fig. 11); and (10) along the testicular lymphatics into the scrotum (two cases) has been demonstrated.

The thoracic duct visualised in 39 cases, was normal in 30 and dilated in 9 cases. Opacification of the thoracic duct was intermittent and irregular. Though the entire thoracic duct was occasionally seen, usually only 2 to 10 cm of the terminal segment



Case 5 (male, age 25)

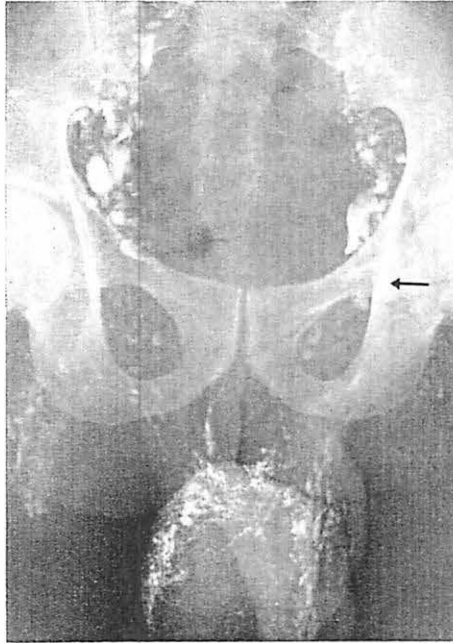
Fig. 10 Chyluria – six months; no oedema of the limb, right lymphography (←) done on 6. 11. 67 demonstrated involvement of the left intertubular lymphatics and chyle reflux along the dilated tortuous deep lymphatics of the thigh to the popliteal nodes. Left lymphography (→) done on 21. 11. 67 demonstrated similar findings in the abdomen and chyle reflux along the deep lymphatics of the left thigh (↘↙). There is stasis in the right thigh vessels even after 15 days. Since popliteal nodes receive lymphatics from the synovial membrane of the knee joint, escape of chyle into the joint by rupture of these engorged lymphatics will lead to chylous arthritis. (Patient remains free from chyluria to date.)

were opacified, $\frac{1}{2}$ to 3 hours after injection. Once the thoracic duct was visualised another chest skiagram taken 15 to 20 minutes later showed its disappearance. This was considered to be a sign of normal function of the thoracic duct. In our experience, thoracic duct abnormalities resulting from filarial infestation have no aetiological bearing on the causation of chyluria. There was no correlation between the degree of chyluric state and the incidence and extent of thoracic duct abnormalities. Early vis-

ualisation of the thoracic duct was due to the accelerated flow of contrast during the injection. In our experience with 107 lymphographic investigations pulmonary oil embolization occurred in only one case who also exhibited lymphatico-venous communications at the level of the external iliac nodes (Fig. 12).

Severity of Chyluric State:

The time course and the extent of opacification of retroperitoneal lymph nodes may give an idea about the stasis within the lymphatic channels and hence about the severity of the chyluric state. Early and adequate opacification was associated with mild chyluria, whereas late and poor contrast filling was typical of severe chyluria. Of course



Case 6 (male, age 50)

Fig. 11 Having chyluria and chylous oedema of the scrotal skin (which was studded with vesicles oozing with chyle when pricked). Left lymphography (←) demonstrated lymphato-urinary fistula in the right kidney and chyle reflux downwards from the lumbar towards pelvic and inguinal regions and into the scrotal skin. Stasis of contrast in the scrotal vesicles was noticed even after ten days. (Patient is free from chyluria – 20 months.)

the chyluric state must also be defined by the extent, nature and localisation of the fistulous communications. The rate of clearance of the contrast medium from the lymphatics gives additional information. One of our cases with clinically a severe degree of chyluria and lack of dilatation of lymphatics showed clearance of most of the contrast medium within 24 hours. At 72 hours only a few poorly opacified left iliac nodes could be seen. A hyperdynamic lymph flow together with bilateral fistulae explained the severity of the chyluric state in this case.

The Concept of Pre-chyluric State:

The prechyluric state is a condition – where the patient is achyluric prior to lymphography but exhibits typical lymphatic abnormalities, including lymphatico-urinary fistulae on the lymphogram pointing to the potential of the development of chyluria.

This conclusion was reached after the study of two cases. Both had verified filaria and suffered attacks of severe abdominal pain associated with fever, rigor, vomiting and inflamed inguinal and iliac nodes due to retroperitoneal lymphangitis. Lympho-



Case 7 (female, age 65)

Fig. 12 Right lymphography (20 minutes after injection) demonstrated lymphatico-venous communication at the right external iliac node level resulting in pulmonary lipiodol embolization evidenced by absence of opacification of external iliac chain beyond this node and opacification of pulmonary arterioles and capillaries. One hour later submiliary mottling due to lipiodol micro-emboli was seen in the lung fields. Patient was asymptomatic and the lipiodol disappeared in a week. Left lymphography however, was successful in this case. (Patient is free from chyluria - 13 months.)

graphy was performed one week after the subsidence of the acute attacks. The first case showed bilateral stasis in the markedly dilated renal pelvic lymphatics lasting 10 days. Obstruction of the lower thoracic duct deviated lymph flow through the descending intercostal trunk to reach the thoracic duct at the level of T8 and T9. The second case showed markedly dilated intertubular and renal pelvic lymphatics on the left side with eventual opacification of the abdominal part of the left ureter. Both patients had no evidence of chyluria prior to or at the time of lymphography. Only after the examination urinalysis revealed proteinuria of 0.6 and 0.7 g per 100 ml and a trace of

fat. On the basis of lymphographic findings, urinalyses and clinical data it was postulated in the first case that rupture of one of the lymphatic varices into the renal pelvis would result in chyluria. In the second case, a definite fistulous communication had been demonstrated, but its magnitude apparently was insufficient to produce clinical chyluria, but could be assumed to result in increasing degrees of chyluria in the future. Both patients were kept under observation and were subsequently shown to develop chyluria, confirming the reality of the concept of the pre-chyluric state.

The criteria for the diagnosis of a prechyluric state are:

1. The patient must be proved to be free from chyluria both clinically and chemically; (urine must be free from proteins and fat);
2. He should not have had chyluria any time before;
3. Lymphatic abnormalities described above must be demonstrated;
4. Subsequent to lymphography and prior to the development of clinical chyluria, development of chyluric state should be proved by demonstration of fat and proteins by chemical tests (thereby proving their lymphatic origin).

Chyluria disappeared in 27 (i.e. 52%) cases subsequent to lymphography (usually within 24 to 96 hours). The reason for this is not definitely known though others have attributed it to beneficial effects of iodine in the contrast medium. These 27 patients have remained achyluric during a follow up period of 6 months to 3 years. Though chyluria is a disease characterised by spontaneous remissions, the natural history alone is unlikely to explain the improvement following lymphography, since it is difficult to conceive that spontaneous remission should occur so often one or two days after lymphography. Hence it has to be postulated that injection of lipiodol possesses a therapeutic action. Further investigation is required in order to evaluate the therapeutic potential of lymphography.

In our series, four cases were treated by stripping of the renal vascular pedicle. All patients recovered and are now remaining achyluric. This was further substantiated after 2 months by scout films of the abdomen showing disappearance of the previous lymphographic contrast and by repeat-lymphography revealing absence of reflux towards the renal region. Excretory urography in three cases showed a normal urinary tract. All patients remained well for 3, 14, 18 and 24 months respectively.

New Surgical Technique:

Choi (5); *Kanetkar et al.* (8); *Kishimoto* (9); *Okamoto* (17); and *Torres* (25) reported their experiences with stripping of the renal vascular pedicle combined in some cases with renal decapsulation. *Cockette* and *Goodwin* (6) reported a case of chyluria in whom the flow of chyle was deviated from the lymphatic vessels to the spermatic vein near the hilum of the left kidney. The lymphatic vessels were doubly ligated with the exception of one large trunk which was isolated and cannulated. This was anastomosed to the proximal segment of the previously divided left spermatic vein. The patient had no chyluria for two years. Thereafter the left kidney became non-functioning but the reason could not be explained by the authors.

On the basis of our lymphographic findings, an alternate method of surgical treatment can be suggested. An anastomosis should be established between one of the large

lymphatic trunks and the proximal portion of the previously sectioned and mobilised subcostal vein draining the lymph via subcostal and azygos or inferior hemiazygos vein. Such a lymphatico-venous anastomosis is not associated with the risk of functional impairment of the kidney. The efficacy of the treatment is under study and will be reported later.

Summary

1. Since filarial infestation inflicts the lympho-vascular system primarily and principally and since in filarial chyluria, lymphatico-urinary fistulization is the chief anatomical lesion, lymphography is the ideal diagnostic aid for the *in vivo* demonstration of the various lymphatic abnormalities in these cases. It is particularly helpful: (a) to determine the site of obstruction to the flow of lymph; (b) to detect the site of fistulous connections; (c) to assess the severity of the chyluric state; to demonstrate various collateral pathways in these cases; (d) in the planning of treatment when surgery is contemplated; and (e) to assess the efficacy of surgical treatment by repeated examination during follow up; (f) lymphography in chyluria possesses not only a diagnostic and prognostic value but also a therapeutic potential (chyluria cleared in 27 out of 52 cases studied).

2. Equally good results have been obtained by intra-lymphatic injection at the foot (Dr. *Kinmonth's* technique) and by open direct inguinal lymphadenography – a new and simple technique.

3. The anatomical basis and the pathogenesis of lymphatico-urinary fistulae explain their increased incidence on the right side.

4. Abnormalities of the thoracic duct caused by filarial infestation do not produce chyluria.

5. A prechyluric state has been demonstrated in two cases of filarial abdomen.

6. Based on lymphographic findings, dilated lymphatics should be anastomosed to the subcostal vein.

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Lymphographic Visualization of Lymphaticovenous Communications and their Significance in Malignant Hemolymphopathies

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The presence of lymphaticovenous communications (l.v.c.) besides the junction between the thoracic duct and the left subclavian vein is no longer doubted today. Experimental studies (2, 3) as well as the anatomical dissection studies (10, 14) have proved the existence of such communications at all levels. Lymphography has made them visible in vivo. Their visualization is always related to an obstruction of the lymphatic flow, due either to node metastases (1, 7, 8, 9, 16, 17) or to sclerosis subsequent to x-ray therapy (5), as well as to surgical interruption of lymphatic circulation after removal of lymph nodes (1, 12). Only few papers mention l.v.c. in malignant hemolymphopathies (5, 6, 11, 13).

It appears that in humans l.v.c. begin to function only in pathologic conditions i.e. in case of deficiency of the lymphatic chains which become inadequate to prevent the