

# The role of radionuclide lymphoscintigraphy in chyluria

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## Abstract

The objective of this study was to study the characteristics of chyluria on radionuclide lymphoscintigraphy and evaluate the diagnostic value of radionuclide lymphoscintigraphy in chyluria. In this report radionuclide lymphoscintigraphy was performed in 41 cases of chyluria patients and the imaging results were retrospectively analyzed. Among 41 cases, 30 of them were caused by filariasis, 4 cases were secondary chyluria from abdomen surgery and 7 cases were caused by lymphangitis. Sixteen cases were proved as bilateral chyluria and 25 cases as unilateral chyluria by cystoscopy. The most common pattern of chyluria in radionuclide lymphoscintigraphy is that kidney or pelvis was imaged in the early phase of dynamic acquisition. In conclusion, radionuclide lymphoscintigraphy is a useful noninvasive method for detecting the origin site of chyluria, and for providing reliable information to perform safe operation.

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## Introduction

Filariasis has worldwide distribution, but it is mainly prevalent in tropical countries [1]. In China, according to the data of 2003, 840 thousand people were suffering from filariasis. Chyluria occurs in up to 10% of patients with filariasis and it is a major chronic health problem.

Chyluria, the presence of chyle in the urine, is a disease of a long history and was diagnosed in humans since 1741. It is rare in western countries, but it is or was not uncommon in Asia countries [2-4]. It is believed to occur as a result of communication between the lymphatics and the renal collecting system.

The conventional diagnostic approach involves confirmation of chyle in the urine and the demonstration of lymphatico-urinary fistulae by lymphangiography [5]. Radionuclide lymphoscintigraphy (RL), since its first introduced in 1953 [6] has been recognized as a simple, noninvasive and gold standard functional test for assessing the lymphatic system. We have reported before the clinical role of RL in a case of extremity lymphedema [7]. In this study we report the result of lymphoscintigraphy findings by using technetium-99m sulfur colloid (<sup>99m</sup>Tc-SC) in 41 patients with chyluria.

## Subjects and methods

### Study population

Between January 2000 and June 2006, totally 41 patients (33 males and 8 females; mean 41.7 years, range 16-65 years) mainly complained of milky white urine were reviewed. All were diagnosed to have chyluria with Sudan III stain. Radionuclide lymphoscintigraphy and cystoscopy were performed in all cases.

### Radionuclide evaluation

The radiopharmaceutical used in this study was <sup>99m</sup>Tc-SC (Syncor, Shanghai). Patients were asked to lie on the scanning bed in supine position. The tracer was injected subcutaneously in the webs between the first, second and third toes, two sits per limb, of 37MBq per site. Lymphoscintigraphy was performed using a large-field-of-view gamma camera (GE, Millenium VG, Hawkeye) fitted with a low-energy, general purpose collimator. Dynamic imaging with a matrix of 128×128 totally 30 frames, 2 minutes per frame were acquired soon after the injection. The field of view covered the kidneys, bladder, groin and iliac lymph nodes. A whole body scan or static scintigraphy was last performed when needed. During the dynamic imaging the injection sites had to be massaged to help spread the radiotracer. Images were reviewed by two nuclear medicine physicians together, Dr Q Luo and Dr LB Chen.

### Interpretation criteria

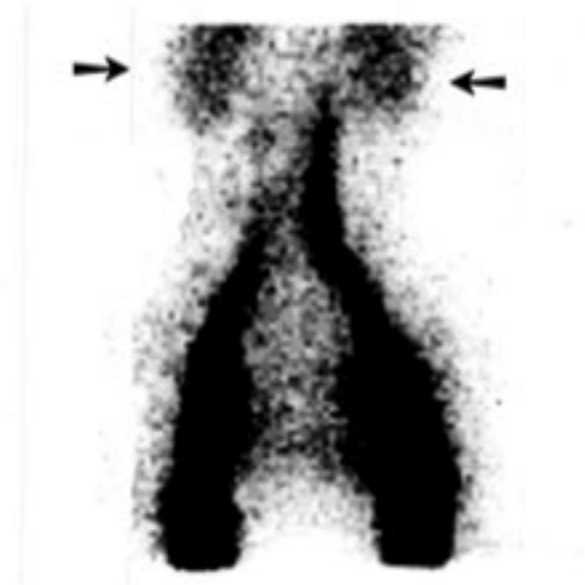


Normally the injected radiotracer will be transported from the injection site through lower extremity lymphatics, cisterna chyli and finally by ductus thoracicus into blood circulation system [8]. Therefore, the kidney should be imaged in the late phase of the scintigraphy. If the kidney or pelvis were imaged before radioactivity appeared in the bladder, it could be concluded that a connection between the lymphatic and renal system existed. In our study this finding was used as the main diagnostic point of RL for chyluria. Other imaging characteristics, like enlarged lymphatics, ductus thoracicus and abnormal lymph nodes could be used as reference diagnostic information.

## Results

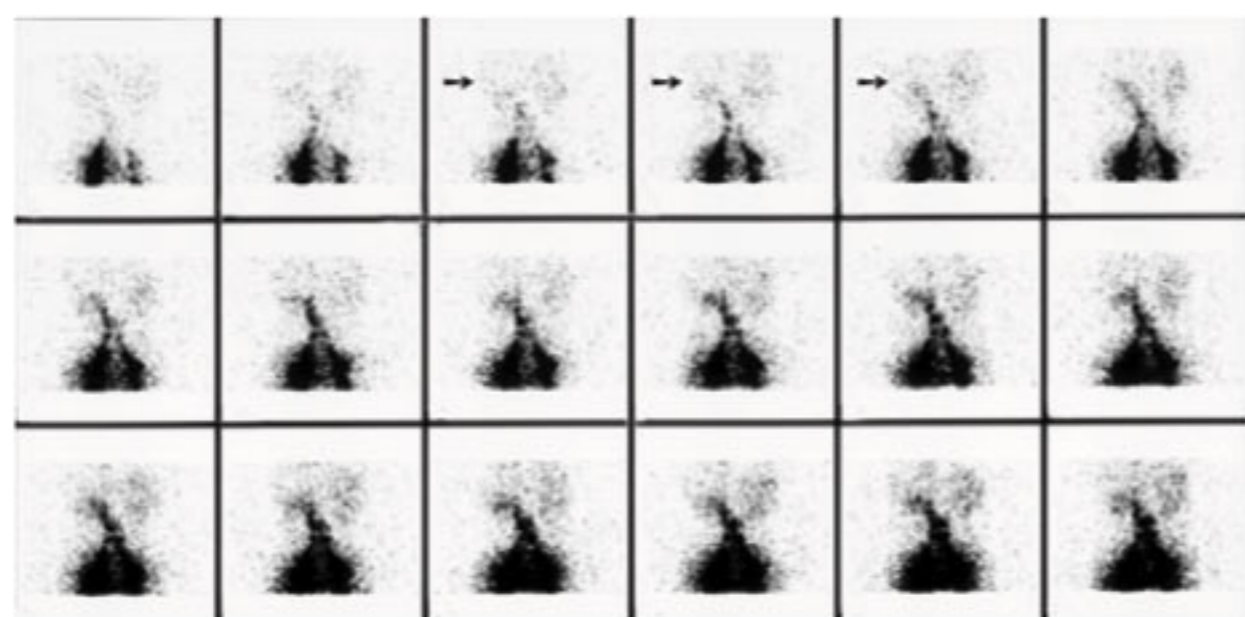
Finally 30 of the 41 cases were diagnosed as filariasis, 4 cases were secondary after abdomen surgery and 7 cases were caused by lymphangiitis.

Sixteen cases were proved as bilateral chyluria by cystoscopy. Ten cases showed both kidneys imaged in the early phase (Fig. 1). In 4 cases, the kidney on one side and the pelvis on the other side were early imaged. For the remaining 2 cases, only one kidney was early imaged.



**Figure 1.** Female, 52 years with bilateral chyluria. Dynamic scintigraphy showed radioactivity in both kidneys.

Twenty-five cases of unilateral chyluria showed positive results both in cystoscopy and in RL. There were 3 typical patterns of RL in unilateral chyluria: one side kidney, early imaged (14 cases, Fig. 2), one side pelvis, early imaged (7 cases, Fig. 3) and iliac lymphatics enlarged (4 cases, Fig. 4).

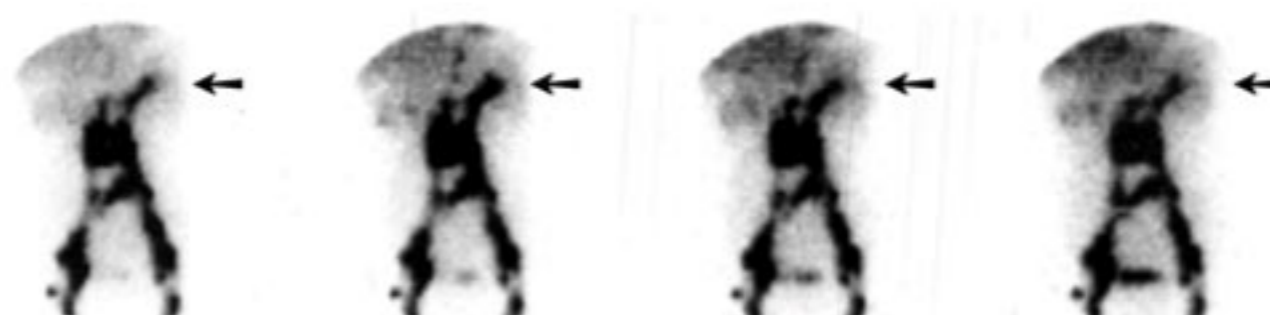


**Figure 2.** Male, 31 years. The right pelvis could be recognized from the 19-20min phase (first image) and later the kidney was faintly imaged.

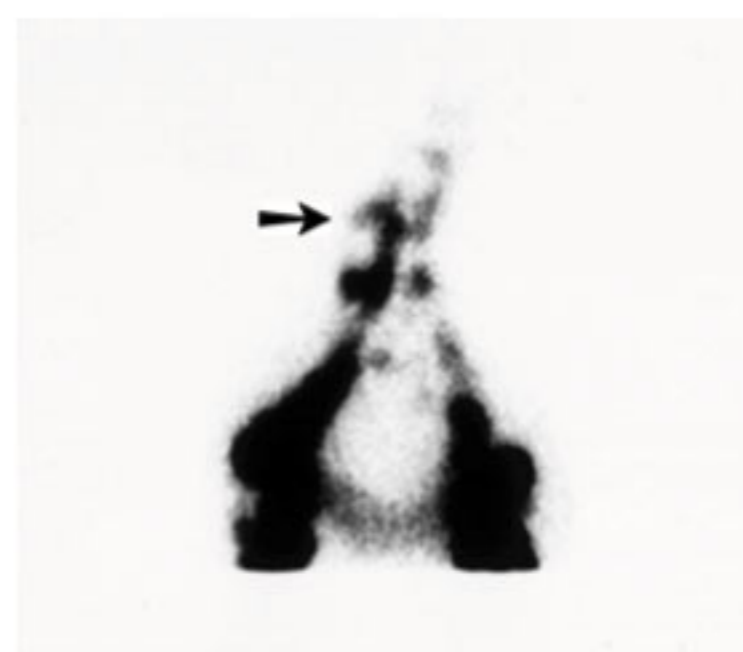
## Discussion

Lymphangiography has been the main imaging modality in investigating chyluria, chyloperitoneum and chylotho-

rax [9]. Although it was once used as the main and gold diagnostic method in lymphatic disease, this method has been almost abandoned as a diagnostic tool in clinical trial due to its invasive character, difficult techniques and potential side effects. Cystoscopy has always been an important main method for localized diagnosis of chyluria but it is nevertheless, an invasive method and injury, pain, bleeding and infection are somewhat unavoidable. When the disease is not in the period of onset or the disease is in mild situation, due to the opacity urine, it becomes more difficult to diagnosis the disease by nude eye under cystoscopy [10]. This is the main limitation of cystoscopy.



**Figure 3.** Male, 37 years. Dynamic scintigraphy showed that left iliac lymphatics was gradually imaged from the 5min (first arrow) and left pelvis could also be seen. The right side iliac lymphatics were not seen.



**Figure 4.** Male, 31 years, chyluria caused by filariasis. A delayed scintigraphy clearly showed left iliac lymphatics enlarged.

Radionuclide lymphoscintigraphy was first introduced in 1953 using aurum-198-colloid. Because of its high absorbed radiation at the injection site, the radiotracer has been replaced by <sup>99m</sup>Tc-SC, human serum albumin (HSA) and recently dextran. Radionuclide lymphoscintigraphy allows functional assessment of lymphatic transport and depiction of regional lymph nodes. After the interstitially administered tracer is taken up by the lymphatics, clearance and trapping of the colloid in lymph nodes is dependent on the particle size of the colloid and functional status of the reticuloendothelial system [8]. Radionuclide lymphoscintigraphy is useful in the evaluation of primary and secondary lymphadema, lymphangioma with lymphatic leakage, lymphangectasia, chylous ascites and chylothorax.

The protocol for RL is not standardized and differs in various diagnostic centers. Differences include the choice of radiotracers, the type and site of injection and the type of acquisition mode. Many technetium-99m labeled radiopharmaceuticals could be used for RL including HAS (human serum albumin), antimony sulphide colloid, HIG (human Immunoglobulin) and dextran [7]. As the diagnostic point of RL in chyluria is to catch the abnormal radioactivity in kidney before the radiotracer entering blood pool, high radiochemistry purity and sole uptake mechanism are the most important demand of the tracer used [8]. In China, <sup>99m</sup>Tc-dextran is



the most commonly used radiotracer for RL. It is adequate for detecting lymphedema, but due to its dual uptake mechanism, with resorption into capillaries, its lower radiochemistry purity and slower transportation from the injection site, we used  $^{99m}\text{Tc}$ -SC as imaging agent in this study. The technique of injection in RL is an intractable problem [7]. Most authors use whole body scan and static acquisition for RL [11-13]. From our experience, these techniques may miss the very diagnostic scintigraphy phase, in which abnormal radioactivity appeared. Early imaging, usually within the first 10 minutes after radiotracer injection, may not catch the diagnostic point of chyluria, radiotracer appeared in kidney or pelvis. In delayed imaging, when radioactivity appears in the bladder, any abnormal phenomenon may lose its diagnostic specificity. It is very difficult to visualize the suitable diagnostic imaging phase by whole body scan or static acquisition. In our study we used a dynamic acquisition protocol for the scintigraphy and we found that this modality can avoid the diagnostic embarrassment.

Lymphatic duct obstruction produces an increase in intralymphatic pressure, lymphangiectasia, subsequent development of valvular incompetency and abnormal retrograde flow of chyle, resulting in lymphatico-urinary shunt at the level of the kidney, bladder or ureter. The kidney is a favorable site of exit for chyle from ruptured lymphatic vessels because of its fragility and susceptibility to rupture, associated with inadequate collateral vessels [14]. Kidney or pelvis images have different meaning in clinical practice. If kidney was directly imaged, the lymph fluid leakage was greater than that of the image of the pelvis. In the case of bilateral chyluria, when the lymphatic fluid leakage of two kidney was different, usually the side with more leakage was imaged during the dynamic imaging. This is the reason why 2 cases of bilateral chyluria only showed the characteristics of unilateral chyluria on RL.

Many case reports demonstrate the usefulness of RL in chyluria [15-17] but fewer papers systematically discussed the clinical value of RL in assessing chyluria. Sun et al (2002) used RL to examine 34 patients with chyluria and the results of RL were compared with those of cystoscopy and lymphangiography. In 85.3% of these patients the diagnosis by RL of unilateral localization was coincident with that by cystoscopy. The positive rate of the diagnosis of bilateral localization of RL was higher than that by cystoscopy [12]. Others retrospectively analyzed the results of 21 whole-body RL using  $^{99m}\text{Tc}$ -antimony sulfide colloid or dextran in 18 patients with chyluria, chyloperitoneum and/or chylothorax [11]. The images were reviewed to assess the rate of tracer transport and number, size and distribution of lymph vessels and nodes as well as the presence of collateral, fistula or lymph reflux. The imaging characters of these

diseases in RL were discussed in detail. In our study, we thoroughly studied the 41 cases and concluded that the early imaged kidney and pelvis was the most important and common diagnostic point of chyluria in RL. Furthermore, enlarged lymphatics, ductus thoracicus and abnormal lymph nodes could be used as reference diagnostic information. Also we found false negative findings might result in the bilateral chyluria.

*In conclusion*, RL is a useful noninvasive method for detecting the origin site of chyluria. It could be considered as the first choice among the available examination methods.

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