Clinics in Oncology

Research Article
Published: 31 Oct, 2017

Magnetic Resonance Lymphangiography: Clinical and Radiological Correlation

Savaş Tepe, Ali Ertan Çapar and Ali Rıza Ercocen*

Bayindir Hospital, İstanbul, İçerenköy, Turkey

Abstract

Aim of this study is to search the correlation between the clinical and pre and post operative findings and three dimensional Magnetic Resonance Lymphangiography (MRL) images of the lower extremities. Total of 10 patients with primary and secondary lymphedema of the lower legs (2 males, 8 females, range 15-80, mean age of 36) were retrospectively evaluated, challenges and technique of MRL were reviewed in patients with lower extremity lymphedema. Demonstration of lymphatics, venules, lymph nodes and surgical lymphaticovenular anastomosis is a lately utilized radiological method which diagnoses presence, extent, intensity of lymphedema; maps and identifies lymphatic vessels; and guides for surgical planning. MRL maintains volumetric datasets that are high in resolution to determine the existence and intensity of lymphedema; illustrates superficial lymphatic vessels; provides anatomic and morphologic information. All our patients were referred by the Aesthetic & Reconstructive Surgery Department. In close relationship we have discussed the results of pre and post operative versions of MRL with them and finally prepared an MRL report that would fulfil their needs. Value of the radiology report for the surgeon in an MRL examination is also emphasized.

Introduction

Purposes of this study are demonstration of lymphatics using Magnetic Resonance Imaging (MRI) as a guide, seeing the correlation of clinical findings and helping surgeon select appropriate microsurgical techniques and treatment for lymphedema.

Stages of lymphedema are latent (subclinical), mild, moderate and severe. Latent and mild stages could respond to conservative approach such as limb elevation and gradient compression garments. In our study MRL was performed for the patients with severe stages of lymphedema.

Identification or visualization of the lymphatics has a long and remarkable historical challenge. Lymphedema is a debilitating disease caused by abnormal lymphatic flow and generally associated with malignancy and also its treatment. Lymphedema is basically described with the following; inflammation, abnormally gathered protein rich fluid, interstitial space fibrosis, and hypertrophy of the adipose tissue [1]. Lymphedema is categorized as primary (congenital) or secondary. Congenital lymphedema is less common compared to secondary which might arise from blockage of lymph vessels due to operation, trauma, infection or radiation. Breast cancer and gynecological malignancies and related surgeries are the most frequent malignancies causing secondary lymphedema [2,3].

Patients with lymphedema secondary to connective tissue diseases, infection and recurrent cellulitis are not included in this study.

Newer imaging technique with high resolution dynamic three dimensional (3D) MRL, demonstration of lymphatics, venules, lymph nodes and surgical lymphaticovenular anastomosis is a lately utilized radiological method which diagnoses presence, extent, intensity of lymphedema, maps and identifies lymphatic vessels, and guides for surgical planning. MRL maintains volumetric datasets that are high in resolution to determine the existence and intensity of lymphedema; illustrates superficial lymphatic vessels; provides anatomic and morphologic information which may differ chronic phase of the disease.

Materials and Methods

From January 2013 to August 2017 ten patients were evaluated with MRL. Informed consent was obtained from all individual participants included in the study. The research was performed

OPEN ACCESS

Correspondence:
Savaş Tepe, Bayindir Hospital, Department of Radiology Bayindir Hospital, Bayindir Hastanesi Ali Nihat Tarlan Cd. Ertas Sk. No:17 Icerenköy, Atasehir, Istanbul, Turkey, Tel: 5307803893; 216 5752666 (3956), E-mail: mstepe@bayindirhastanesi.com.tr

Received Date: *22 Sep 2017*
Accepted Date: *30 Oct 2017*
Published Date: *31 Oct 2017*

Citation:
Tepe S, Çapar AE, Ercocen AR. Magnetic Resonance Lymphangiography: Clinical and Radiological Correlation. Clin Oncol. 2017; 2: 1362.

Table: Table of the patients with lower extremity lymphedema.

Age	Sex	Lymphedema type	Side	Etiology
36	M	secondary	R	LG dissection
72	F	Secondary	L	Gynecological malignancy
80	F	Secondary	R&L	Gynecological malignancy
60	M	Secondary	R	Malignant melanoma LG dissection
15	F	primary	L	Unknown
19	F	Primary	L	Unknown
40	F	Primary	L	Unknown
58	F	Primary	R&L	Unknown
40	F	Primary	R&L	Unknown
52	F	Primary	L	Unknown

LG: Lymph Ganglion

according to the Declaration of Helsinki principles. MRL was applied on a 1.5 Tesla MR imaging magnet (Siemens, Magnetom Avanto, Erlangen, Germany) employing phased array surface coils. Imaging protocol used for the MRL, image post processing and interpretation of the images in our institution are as revealed. Upon clinical request MRI of the lower extremities was applied bilaterally. In the MRI magnet patients are laid feet first and lying on their backs, having the face upward. Surface coils are placed from mid foot to hip. Head coils are positioned to ankle region. First, high T2 weighted 3D sequence was used for defining the intensity and scope of lymphedema. Then intracutaneous contrast medium injected through both feet interphalangeal area 4 sites each to detect lymph vessels using 3D gradient echo (GRE) sequence images.

Imaging parameters are as follows;

Pre contrast T2W Fat suppressed coronal plan, repetition time (TR) 2000 msn, echo time (TE) 693 msn, Flip Angle (FA) 150, field of view (FOV) 450 mm, section thickness 1 mm, matrix 259 x 320, scan time 6.5 minutes.

Post contrast T1 spoiled gradient echo (SPGR) fat saturated coronal plan, TR 4.66, TE 2.38, FA 25, FOV 450, section thickness 1.5 mm, matrix 448 x 448, scan time 2.4 minutes.

First EMLA (Astrazeneca, France) anesthetic cream is put on the foot distal intermetatarseal- interphalengeal area prior to injection. The contrast material is prepared while pre contrast scan acquisition is taken. During intracutaneous contrast administration, patients felt mild pain. There were no other discomfort or complications related to study. If there is a case of patient expressing pain and distention, we recommend dealing with discontent similar to contrast extravasation which may be seen after intravenous contrast injections (get vitals, evaluate for compartment syndrome tissue necrosis, raise extremity, make cold compress, monitor, advise the patient with instructions to follow additional medical care if symptoms worsen, consult surgery, report to the patient's physician, note down in the medical record).

Combination of the subcutaneous injection of 2% citanest (Zenica Medical, Paris, France) 5 cc, 0.1 mmol/kg body weight gadolinium (multihance, gadobenate dimeglubine, Guerbet, France) injected to the each interdigital web space between the metatarsals approximately 2 cc each interdigital web space with a 24 G needle. The injected sites were massaged for a minute. Acquisition was done at 5, 15, 30, 45, 60 minutes, 2 hours, 4 hours, 8 and 24 hours. Following contrast administration venous enhancement always occurs. Lymphatics enhancement usually augments and slowly advances with time, whereas enhancement of the veins lessens with time, therefore kinetic of the enhancement of lymphatics versus veins are helpful to differentiate.

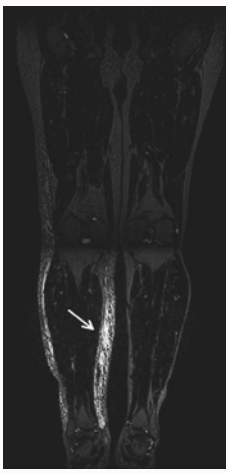

Figure 1: Pre contrast coronal T2W MR image characteristically demonstrates muscle sparing epifascial distribution of lymphedema (arrow).

Enhanced lymphatic channels may not be detected in standard extremities with MRL which is assumed to be related with quicker lymphatic transport in a normal extremity.

Results and Discussion

Patients

Table: Table of the patients with lower extremity lymphedema.

Before administration of the contrast agent, first pre contrast T2W magnetic resonance images are evaluated. This will provide the knowledge of distribution of lymphedema (Figure 1). Following this sequence mapping of lymphatics are in order. Starting at 5 minutes, followed by 15, 30, 45, 60 minutes, 2 hours, 4 hours, 8 and 24 hours post contrast magnetic resonance lymphangiography sequences are performed (Figure 2 and 3).

Dermal back flow is an area of progressive interstitial dispersion of the contrast medium in soft tissue due to proximal obstruction of lymph drainage or in another term poor lymphatic drainage, reflects proximal lymphatic obstruction (Figure 4).

Lymphatico venular anastomosis is performed when finding a

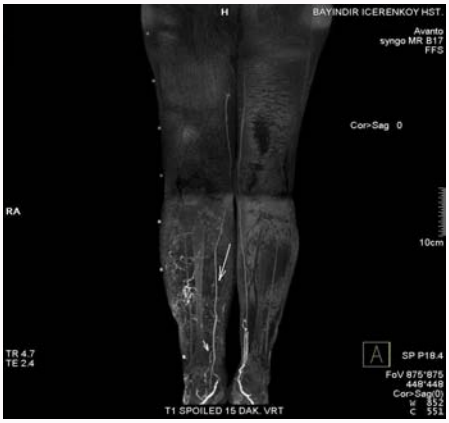

Figure 2: Early visualization of lymphatics at 15 minutes showing lymphatic networks, discontinuous, tortuous, beaded lymphatic vessels, whereas veins are smooth and uniform in caliber, linear and continuous (short arrow lymphatic vessels, long arrow veins).

Figure 3: Same patient at 60 minutes (short arrow lymphatic vessels, long arrow veins).

Figure 4: MRL at 2 hours, showing sites of dermal back flow (an area of progressive interstitial dispersion of the contrast medium in soft tissue due to proximal obstruction of lymph drainage or in another term poor lymphatic drainage, reflects proximal lymphatic obstruction), patchy, non regular high signal intensities on contrast enhanced image (arrow).

vein in suprafascial area without venous insufficiency, neighboring lymphatics near and well mapped (Figure 5).

Lymphaticovenous anastomosis redirects a lymphatic obstruction by conducting distal lymph flow into neighboring veins therefore is

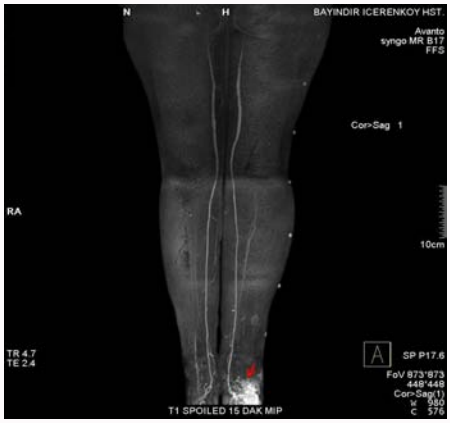

Figure 5: A region of blush (arrow) represents a site of LVA.

Figure 6: MRL image at 1 hour showing transferred lymph node. (arrow).

generally performed to treat lymphedema. For the regimen and to appropriately treat lymphedema, visualization of the lymphatic channels prior to surgery is important. New dedicated MR imaging sequences are able to demonstrate lymphatic channels with MRL and thus help the surgeon plan adequate microsurgery, currently lymphaticovenular anastomosis and lymph node relocation to nurture lymphangiogenesis, improve lymphatic drainage, reduce limb diameter, and avoid dermal sclerosis (Figure 6).

It is also possible to compare this method with other visualization techniques and methods. Available alternative imaging techniques for evaluation of lymphedema are bioelectric impedance spectroscopy, nuclear medicine lymphoscintigraphy and indocyanine green lymphography. Bioelectric impedance spectroscopy applies electrical impedance to weight the magnitude of extracellular water in an extremity. Nuclear Medicine Lymphoscintigraphy (NML) is frequently used method providing affirmation of unorthodox lymphatic flow to analyze lymphedema. Lymphatic dysfunction is identified as slowed asymmetric or non visualization of regional lymph nodes, unsymmetrical lymphatic channels or dermal back flow. NML may not portray individual lymphatic channels since it suffers from poor spatial and temporal resolution [4]. Fluorescent indocyanine green is infused intracutaneously into the extremities for indocyanine green lymphography (ICGL) technique, and a photoelectric apparatus is utilized to detect the indocyanine green fluorescence within the superficial lymphatic routes and at places of dermal back flow. ICGL has a limited penetration depth of approximately 2 cm which is short in depth. The patient is not regarded suitable for reconstruction

with LVA and becomes a possible nominee for excisional surgery or cosmetic reduction if non functioning superficial lymphatic channels are detected with MRL.

Conclusion

In our MRL method we had acquisitions performed at 5, 15, 30, 45, 60 minutes, 2 hours, 4 hours, 8 and 24 hours, in order to evaluate if there are improvements or benefits examining the patients at those late intervals. However, this method is demanding and time consuming. Our findings reveal no great benefit performing the scanning after 4 hours. Even it is possible to get the most of necessary information in the first two hours scanning of MRL therefore it will not add too much extra information in the extended hours despite the efforts and time spent. If time limitation is an issue, MRL examination even only the calf lymphatic vessels may be informative. Hence Lu [3] and colleagues mention that there was insignificant variance when normal and affected thighs are compared but there was a meaningful variance in transverse width and numbers of lymphatic channels between healthy and abnormal calf. They also imply that lymphatic neoperfusion or neovascularization appears more often in the abnormal calf than the abnormal thigh. This observation interestingly is about secondary LEL. On the other hand people with congenital or praecox types of primary lymphedema types are described as having hypoplastic lymph routes in the thigh and calf.

We performed MRI sequences in coronal plan for both legs at the same time. Some centers perform scan orientation in sagittal plan then transform the images at workstations to Maximum intensity projections to coronal plan. This may provide better visualization, however it is not possible to perform MRL for both legs at the same time and MRL should be performed separately unilaterally for each leg if MRL would be performed bilaterally in sagittal plan. The patient should be centered to the magnet, and the legs should be placed as nearly as possible to the scanner isocenter. This helps promote shimming and homogeneity of fatty tissue elimination.

Some limitations of the MRL must be mentioned and these are long duration of the MR examination, and infrequent difficulty in characterizing the affected lymphatic vessels when an underlying venous contamination is present. Pelvic and above knee region were insufficient to image for lymphatics due to low volume of contrast material remained in this vascular system. Therefore our study region remained mainly below the knee. White et al. [5] reported intradermal injection of rather than a subcutaneous injection for the optimal visualization of lymphatics. However Mazzei et al. [6] did not find significant differences between intradermal and subcutaneous injection approach. Mazzei logically advices the precaution adopted before the contrast medium injection to withdraw the syringe plunger in order to avoid a small vein cannulation.

What is important for the surgeon in a MRL radiology report?

As a preoperative imaging technique and in order to plan best strategy for lymph vessel reconstruction, our microsurgeons expect that a radiology MR imaging report detect and mention the intensity and magnitude of the lymphedema, depict and define the region and course of specific lymphatic vessels, distance between affected lymphatic vessel and the vein chosen for the LVA, detection and localization of lymph nodes, presence of venous contamination. When dynamic post contrast sequences are examined lymphatics present as dotted, zigzag course, interrupted contrast enhancing vessels that gradually enhance in time. If there is any dermal back flow, its existence, region and magnitude of any sites should also be indicated. Venous contamination almost always occurs. Morphologic changes and the evaluation of enhancement are applied to characterize lymph vessels versus superficial veins since amplitude of enhancement alters in time on both vessel systems. This report will guide the surgeon's appropriate surgical repair.

References

1. Kerchner K, Fleischer A, Yosipovitch G. Lower extremity lymphedema update: pathophysiology, diagnosis and treatment guidelines. J Am Acad Dermatol. 2008; 59: 324-331.
2. Mitsumori LM, McDonald ES, Wilson GJ, Neligan PC, Minoshima S, Maki JH. MR lymphangiography: How do I do it? J Magn Reson Imaging. 2015; 42: 1465-1477.
3. Lu Q, Delproposto Z, Hu A, Tran C, Liu N, Li Y, et al. MRLymphangiography of lymphatic vessels in lower extremity with gynecological oncology related lymphedema. Plos One. 2012; 7(11): e50319.
4. Kamble RB, Shetty R, Divakar N, Madhusudan G. Technical note: MRL lymphangiography of the lower limb in secondary lymphedema. Indian J Radiol Imaging. 2011; 21(1): 15–17.
5. White RD, Weir-Mccall JR, Budak MJ, Waugh SA, Munnoch DA, Sudarshan TAP, et al. Contrast enhanced MRL in the assessment of lower limb lymphedema. Clinical Radiology. 2014; 69(11): e435-44.
6. Mazzei FG, Gentili F, Guerrini S, Squitieri NC, Guerrieri D, Gennarop P, et al. MR Lymphangiography. A practical guide to perform it and a brief review of the literature from a technical point of view. BioMed Research İnternational. 2017; 2017(2017), Article ID 2598358, 8.