The Egyptian Journal of Radiology and Nuclear Medicine xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

The Egyptian Journal of Radiology and Nuclear Medicine

journal homepage: www.elsevier.com/locate/ejrnm

Original Article

Role of contrast enhanced MRI lymphangiography in evaluation of lower extremity lymphatic vessels for patients with primary lymphedema

Ahmed A. Baz[a,*], Talaat A. Hassan[a], A.T. Atta[b], Mohamed S. El kholy[c]

[a] Radiology Department, Faculty of Medicine, Cairo University, Egypt
[b] General and Plastic Surgery Department, Faculty of Medicine, Cairo University, Egypt
[c] General and Plastic Surgery Department, El Sheikh Zayed Al Nahyan Hospital, Ministry of Health, Egypt

ARTICLE INFO

Keywords:
Primary lymphedema
MRI lympahngiography

ABSTRACT

Objective: Evaluating the role of MRI lymphangiography with the intracutaneous injection of gadolinium in the assessment of the lower extremity lymphatic vessels in primary lymphedema.
Patients and methods: The study was conducted on 20 patients (had 26 affected extremities) with primary lymphedema. All were evaluated by MRI lymphangiography with the intracutaneous injection of gadolinium in the digital web spaces of the feet.
Results: The patterns of the lymphatic pathways in the affected lower limbs were classified in this study into five patterns. Pattern (I) was seen in 53.84% (n = 14), pattern (II) was seen in 26.92% (n = 7), pattern (III) was seen in7.69% (n = 2), pattern (IV) was seen in 3.84% (n = 1) and pattern (V) was seen in 7.69% (n = 2) of the affected extremities.
Conclusions: MRI lymphangiography with the intracutaneous injection of gadolinium had the potentiality for being the main diagnostic modality in primary lymphedema patients especially those who are candidates for microsurgical reconstruction through providing better visualization of the precise lymphatic anatomy by a feasible, minimally invasive and safe technique.

1. Introduction

Lymphedema is a chronic disorder characterized by a progressive and excessive accumulation of lymphatic fluid in the interstitium resulting from impaired lymphatic drainage. It can be congenital or acquired. The acquired form usually results from injury of the lymphatic vessels by infection, trauma, or tumors but it may also be iatrogenic following surgical interventions or radiotherapies [1–3].

Despite being a common problem, it is vulnerable to misdiagnosis and has been badly reputed as an incurable disease [4].

Recently, microsurgical treatment aiming to reconstitute natural outflow of the lymph fluid through diversion into the venous system bypassing the obstructed segment of the lymphatic pathway .this is known as lymphovenous anastomosis (LVA), currently, this strategy has been the preferred surgical intervention in lymphedema cases [5].

Owing to its high spatial and temporal resolution, MRI lymphangiography has the potentiality for being the main imaging modality that can give functional and anatomical data in planning the microvascular surgery for lymphedema cases, moreover, it is safe, minimally invasive and a quick examination that can assess the severity of lymphedema, lymphatic vessels, lymph nodes, venous structures as well as the drainage pattern [6–8].

Aim of the work: The purpose of this study is to evaluate the role of MRI lymphangiography with the intracutaneous injection of gadolinium in the assessment of extremity lymphatic vessels in cases with primary lymphedema.

2. Patients and methods

The study was conducted on 20 patients (with 40 extremities from which there are only 26 extremities are affected by the disease) from June 2014 till March 2017 including all cases of primary lower limb lymphedema with either unilateral or bilateral affection. The patients were referred to our department from the surgery department after their clinical assessment.

The patients' ages ranged from 13 to 54 years with a mean age (25.05 ± 14.31 years). There were 6 females (30% of cases) and 14 males (70% of cases).

Inclusion criteria: were lymphedema of one or both lower extremities and a willingness to participate in the study.

Peer review under responsibility of The Egyptian Society of Radiology and Nuclear Medicine.
* Corresponding author.
E-mail address: ahmedbaz2012@yahoo.com (A.A. Baz).

https://doi.org/10.1016/j.ejrnm.2018.06.005
Received 15 March 2018; Accepted 8 June 2018

Table 1
demonstrating lymphatic pathway patterns that seen in patients with primary lymphedema.

Patterns	Description
Pattern (I)	Multiple tiny cutaneous lymphatic vessels with blushes of progressive dispersion of the contrast material into the surrounding peri-lymphatic soft tissues known as **dermal backflow** seen in the distal leg, in addition to scanty dilated lymphatic collectors that were depicted in the proximal leg
Pattern (II)	Enhanced lymphatic vessels in a radiating fashion seen in the distal leg, they clustered at the inner (medial) aspect of the knee and then ascended to the thigh
Pattern (III)	Barely enhanced & dilated lymphatic vessels but with interrupted course along the inner (medial) aspect of the entire lower extremity
Pattern (IV)	Aggregates of ecstatic and obviously enhanced lymphatic vessels that were seen more in the inner (medial) than in the outer (lateral) aspects of the thigh
Pattern (V)	Dilated& opacified lymphatic vessels that were directed from the distal leg to the inguinal nodes with few branches along their courses

Table 2
Demographic distribution for lymphedema patients.

Sex			Count	%
		Males	14 patients	70%
		Females	6 patients	30%
Side	Unilateral affection	Rt. lower extremity	4 patients	20%
		Lt. lower extremity	10 patients	50%
	Bilateral affection	Bilateral (Rt. side more than Lt. side)	4 patients	20%
		Bilateral (Lt. side more than Rt. side)	1 patient	5%
		Bilateral with an equal affection of both sides	1 patient	5%

Exclusion criteria: Patients were excluded when they had contraindications for MRI (e.g. pacemakers), renal impairment, or a known hypersensitivity to a gadolinium contrast agent.

The local ethics committee approved the study and all participants gave their informed consent before being included.

All patients were subjected to through history taking.

3. Contrast material injection

Injection technique: The skin was disinfected with betadine at the injection sites. A thin needle (24 gauge) was used.

Contrast material: Dimeglumine gadopentetate is an available, extracellular, water-soluble paramagnetic contrast agent.

A 9 ml of Dimeglumine gadopentetate and 1 ml of lidocaine hydrochloride 2% (for local anesthesia) was subdivided into 10 portions. Four portions were injected intracutaneously into the dorsal aspect of each foot in the region of the four interdigital webs; one portion was injected medial to both first proximal phalanges.

Post-injection precautions: Directly after administration of the contrast material, the injection sites of each foot were massaged for approximately 1–2 min. The message was repeated during data acquisition. All patients were asked to tell if there was a pain at the time of Dimeglumine gadopentetate application and the examiner inspected carefully if there were signs of extravasations or swellings.

After the examination, the patients were monitored closely for possible complications such as swelling or infection.

3.1. MRI examination

MRI was performed with a 1.5-T scanner (Philips Intera) equipped with high-performance gradients. The examined extremity was divided into three stations: the first one (**feet region**) includes the distal leg and the foot region; the second one (**calf region**) includes the proximal leg, knee, and lower thigh region; and third one (**thigh and pelvic region**) includes the pelvic region and the proximal-most thighs. For imaging of all these three stations, the machine body coil was used and no peripheral surface coils were used during the examination. Before HR MR lymphangiography, the extent and the distribution of the lymphedema were evaluated using T2-weighted turbo spin-echo sequence (TR/TE, 4889/100; flip angle, 90; matrix, 248 × 297; bandwidth, 192.7; field of view, 460 mm; slices, 44; voxel size, 1.2 × 1.54 mm; acquisition time, 3 min 45 s). For HR MR lymphangiography TI High Resolution Isotropic Volume Excitation (THRIVE) with the following parameters was used: TR/TE, 4.9/2.4; flip angle, 10; matrix, 244 × 243; bandwidth, 327.9; field of view, 415 mm; slices, 160; voxel size, 1.7 × 1.72 × 1.7 mm; acquisition time 3 min , 44 s). The examination was done without contrast for the three stations then repeated 15, 25, 35, 45, and 55 min after intracutaneous injection of the contrast material. To emphasize

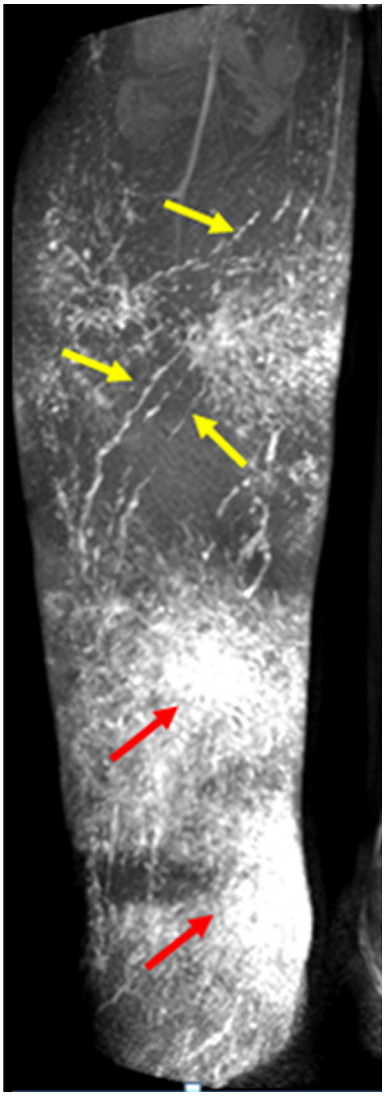

Fig. 1. 3D contrast-enhanced magnetic resonance lymphangiography showing pattern I of lymphatic drainage pathway showing multiple tiny cutaneous lymphatic vessels with blushes of progressive dispersion of the contrast material into the surrounding peri-lymphatic soft tissues known as dermal backflow seen in the distal leg (red arrows), in addition to scanty dilated lymphatic collectors that were depicted in the proximal leg (yellow arrows). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)