

Ultrasonographic Diagnosis of Limb Lymphedema

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Abstract Objective To explore the ultrasonographic diagnosis for the unknown edema of limb. **Method** 20 cases normal lower limbs, 160 cases with deep venous thrombosis in lower limbs and 56 cases lower limbs with lymphedema were examined by color doppler ultrasound device. **Results** in 20 cases normal lower limbs, the ultrasound image of epidermis, dermis and hypodermis are clear with distinct texture, the deep fascia presents a clear and shining band with high echo; in 160 cases with deep venous thrombosis, the ultrasound images of skin are less clear than normal and the skin depth close to or thicker than normal skin slightly; in 56 cases with lymphedema in lower limbs, the ultrasound images of skin are unclear, the hypodermis become thicker obviously (5–10 times than normal), in severe case, the hypodermis space become wider to form irregular cleaves, which contain low echo and liquid echo, the blood signal can not be detected. **Conclusion** The ultrasound images of lower limb with lymphedema have characteristics differ from those of lower limb with deep venous thrombosis, and the ultrasound technique provide a simple and practical method for the unknown edema of lower limb.

Key words Ultrasound image; lymphedema; lower limb

Swelling of limb is a common clinical situation of peripheral vascular diseases, lymphedema is one of the common cause. The clinical diagnosis of the lymphedema is generally made by elimination method depend upon the medical history, symptom and sign, but the atypical case is easy to be given a misdiagnosis. Up to now, the gold standard of lymphedema is also lymphangiography, but the technique is hard, so the rate of its usage is decreasing. As ultrasound becoming popular, it is not a problem to diagnose the deep venous thrombosis and deep venous valve incompetence by the ultrasound image, but the diagnosis of lymphedema is not easy. Up to now, there is no report about such issue.

From Jan. 2000 to Jan. 2002, we applied Doppler ultrasound to examine the normal people and the patients with limb edema who had a specific clinical diagnosis, the results of detection and comparison are reported as follows.

MATERIAL AND METHOD

Objects: 20 normal legs (no edema and signs of venous disease), 160 limbs of deep venous thrombosis that has had a specific clinical diagnosis, 56 legs of limb edema result from the recurrent erysipelas and groin lymph node resection.

Instrument: Medison company Soaoace-6000C

color Doppler ultrasound device, linear array probe, frequency of 7.5MHz~10MHz.

Examine method of ultrasound: Make the examined limb uncover, supine or prostrate, scan the vein of lower extremity along the sequence of femoral–profunda femoral–popliteal–posterior tibial veins, to exclude the venous disease of limb, then scan the edema part of leg repeatedly, mainly observe the changes of skin structure and the depth from the epidermis to the deepest layer of skin that next to the deep fascia.

RESULTS

Skin of 20 normal legs contain three layers: epidermis, dermis and hypodermis. The display of ultrasound shows that structure of every layer is clear with distinct texture, the skin depth is about 0.2~0.5cm, the deep fascia is a clear and shining band of high echo beneath which is the muscle fibrous tissue with slope striation (Fig 1).

In the 160 legs with edema caused by deep venous thrombosis, the ultrasound has a little difficult to pass through the skin and the hypodermis, the structure of every layer are less clearer than the normal tissue, 80 per cent (128/166) of their skin depth is close to normal, 20 per cent (32/160) are 0.2~0.3 cm thicker than normal. If there are some outstretched superficial veins, the color blood flow

signal can be detected (Fig 2).

In the 56 legs with lymph edema, the three layers become unclear, hypodermis becomes thicker significantly, the skin depth is generally 1.0~2.0cm (5~10 times thicker than normal), the severe case may be more than 3.0cm, the band of deep fascia also becomes 2~3 times thicker than normal. Because it is difficult for ultrasound to pass through the thicker skin, the muscle fiber tissue below the deep fascia is not clear, their striation disappear. In the case with long course, we can find the hypodermic space between the hypodermis become wider, which form several irregular crevice that

contain low echo and liquid echo; The more severe case form a reticular crevice and contain more liquid; generally the blood flow signal cannot be detected (Fig 3). All limbs with lymphedema have typical manifestation. Depending on the severity of disease, we divide them into three stage(table 1).

DISCUSSION

The lymph circulation system derives from the interspace among the epidermis cells and the dermis collagen fibers, the nutrition of epidermis cells re-

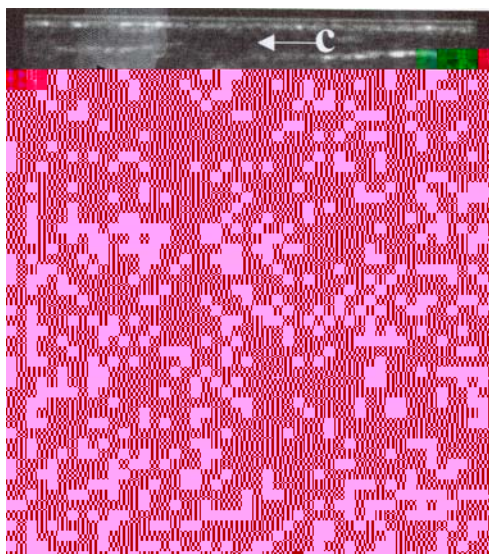


Fig.1 The gray scale ultrasonogram of normal tissue of lower extremity

- a: Deep fascia;
- b: The muscle fibers under the deep fascia is clear, the arrange of the muscle fibers is in order;
- c: The depth of hypodermis is normal,less than 0.5 cm;
- d: The echolucet of muscle and sarcolemma is good, the muscle fibers and their arrangement is clear, the varicose vein can not be detected.

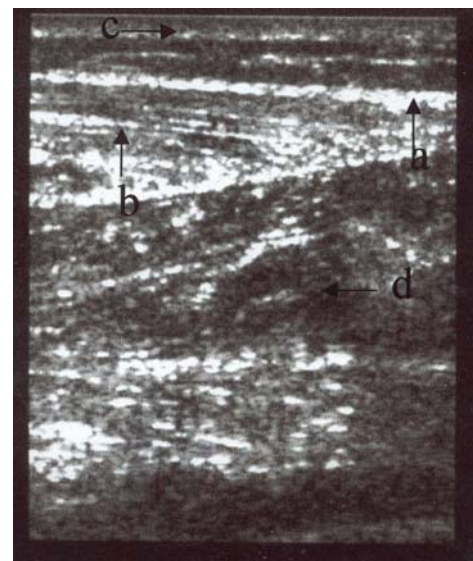


Fig.2 The gray scale ultrasonogram of legs edema result from venous disease

- a: Deep fascia;
- b: The muscle fibers under the deep fascia is clear;
- c: The depth of hypodermis is normal or a few thicker, about 0.6cm~1.0cm;
- d: The echolucet of muscle and sarcolemma is good, the arrange of the muscle fibers is in disorder, the varicose vein can be detected.

Table 1 The relationship between the course, clinical signs and the ultrasound characteristics among the 56 legs with lymphedema

stage	course(year)	numbers of legs(n)	clinical signs	ultrasound characteristics	
				skin depth(cm)	reticular crevice liquid in hypodermis
I	<1	8	slight edema, slight thicker skin	1.0~1.2	small, striation, local
II	1~5	32	obvious edema	1.3~2.0	large region, connected to mass, more liquid
III	>5~10	16	Severe edema like elephantiasis, skin cracked like old bark and exudation	>2.1~3.0	more crevices and expanding to effusion region

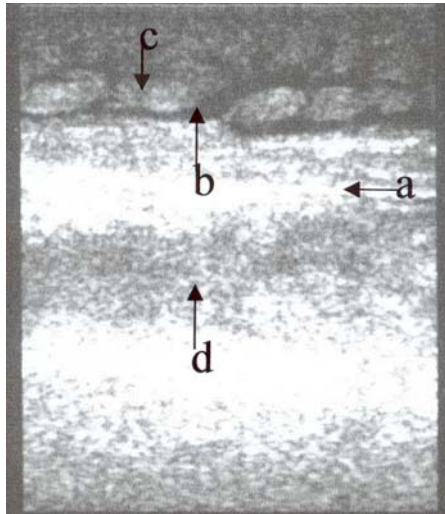


Fig. 3 The gray scale ultrasonogram of legs lymphedema
 a: Deep fascia;
 b: Low liquid echo in the hypodermis crevices;
 c: The depth of thicker hypodermis is about 2 cm;
 d: The echolucent of muscle is bad, the structure of muscle fibers is vague, the sarcolemma is expanded high echo band.

lied on the lymph fluid among the cells. After entrancing the lymphatic capillaries in the dermal papilla, the lymph fluid collect into the lymph vessel network below the dermal papilla, and the lymph vessel in hypodermis, go into the large lymphatic vessel through lymph nodes. Although the cause of lymphedema is different, its pathological change is the same, which is resulted from the obstruction of lymphatic vessels. At the first stage, As the lymph fluid that deposited in the tissue contains protein richly, which is suitable for fibroblast to proliferate and for bacteria to infect, the hypodermis become fibrosis gradually, result in the lymph fluid to deposit in the hypodermis, so that the skin and hypodermis become thicker and thicker, the lipid tissue degenerated and the fibrous connective tissue proliferated. At last, a typical elephantiasis are formed. However, the edema of lower extremity caused by the deep venous thrombosis is mostly in the interspaces among the muscle cells, so the clinical situation is whole limb extensive edema, not a simple thicker skin.

Based on the physical and pathological characteristics above, the ultrasound image characteristics of limb with lymphedema are different from other edema. It can be concluded as follow:

1. The structure stratification is not clear, deep fascia become thicker, the muscle tissue fibers below the fascia is vague.

2. The hypodermis tissue becomes thicker significantly, generally 4~5 times more than normal.

3. The hypodermis tissue exits reticular crevices that contain deposited fluid. With the course prolonging and the condition becoming severer, the deposited liquid is increasing, the crevices becoming larger and wider, result in a small region liquid echo eventually.

4. Generally, there is no blood flow signal in the thicker hypodermis region.

It can be seen from Table 1 that the depth of skin, the amount of crevices among the hypodermis tissue are directly proportional to the degree of deposited liquid, the length of course, the degree of the lymphatic vessel obstructed. Although the ultrasound technique cannot directly observe the condition of the intra-lymphatic vessels, but it can provide a few obvious different characteristics in ultrasound image, it is a simple and practical method to diagnose the unknown edema of lower extremity. Sometimes the deep venous thrombosis can be combined with lymphedema, so the finding of lymphedema characteristic in ultrasound can not deny the venous disease. Only examine the venous system synchronous and analyze them synthetically, the missed diagnosis and misdiagnosis can be avoided.

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