Sonographic Appearance of Soft Tissue Lipomas

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Background: *To describe the sonographic appearance of soft tissue lipomas with pathological correlation.*
Material and Method: *Patients presenting with clinically palpable soft tissue masses who underwent ultrasound examination and excision with documentary pathological diagnosis of lipomas were collected for this retrospective study. Institutional review board approval was obtained and informed consent was waived. All sonographic images were reviewed by musculoskeletal radiologist and resident in consensus. The sonographic findings were recorded and analyzed. The available pathologic slices were reviewed by pathologist.*
Results: *Fifty-two pathologically documented lipomas were available. Four patterns of sonographic appearance of the soft-tissue lipomas were categorized. The most common pattern was well-organized, heterogeneous echogenicity with multiple clearly defined long smooth continuous internal echogenic lines parallel to the long axis of the lesions. The second pattern was disorganized heterogeneous mixed hypo- and hyper-echogenicity with some irregular, interrupted, internal echogenic lines. The third pattern showed disorganized heterogeneous hyper-echoic mass with some irregular, interrupted internal echogenic lines. The last pattern was rather homogeneous echogenic mass with short interrupted, irregular internal echogenic lines.*

There were available pathological slices for review in 29 lesions, which were distributed among all four sonographic categories. These lipomas showed variable fibrous and vascular components without atypical cell or myxoid component. There are no distinct histological features in any of the four groups.
Conclusion: *The soft tissue lipomas contain some internal echogenic lines parallel to the long axis of the masses. The sonographic appearances of the lipomas are variable and no distinct histological correlation is identified.*

Keyword: *Soft tissue lipoma, ultrasound*

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Lipomas are the most common benign mesenchymal soft tissue tumors made up of mature adipose tissue. They can develop in any fat-containing regions of the body. These tumors can occur at any age, but are most common in the fifth or sixth decade of life, and are multiple in 5% of patients[1].

Soft tissue lipomas are classified by location into superficial and deep lesions[2]. Superficial lipomas occur in the subcutaneous tissue, while deep lipomas occur deep to the investing fascia (i.e. subfascial, intramuscular). Superficial lipomas are commonly found in the posterior trunk, neck, and proximal extremities[1]. Superficial soft tissue lipomas are commonly present at a clinical examination as soft, painless, well-delineated, mobile masses[3], while deep-seated lipomas could be difficult to differentiate from other masses by clinical examination and imaging investigation may be required for further characterization.

Soft tissue lipomas can be easily diagnosed by MR imaging with typical signal intensity similar to the subcutaneous fat on all pulse sequences[4]. However, patients with palpable mass are usually sent for evaluation initially with ultrasound because of its availability, low cost, lack of radiation hazard and providing clue to the nature of the palpable abnormality whether it is pseudo-mass or true mass, any cystic or solid component in the mass including vascularity of the lesion. The sonographic appearances of lipomas, in particular their echogenicity, have been shown to be variable[1,3-7]. Our purpose is to analyze the sonographic appearance of these tumors retrospectively in our institute.

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Material and Method

Retrospective data collection and analysis were approved by the Thammasat Institution Reviewer Board and the requirement of informed consent was waived.

From August 2008 to August 2013, we found 52 lipomas in 51 patients who have undergone ultrasound and surgical excision with official pathological report.

All ultrasound studies were obtained with the Philips iU22 machine and performed by musculoskeletal radiologist (KV). We recorded demographic data of our patients (age and sex at the time of ultrasound), the sonographic features regarding site (trunk or extremities), location (superficial or deep), size, shape (round, oval or fusiform), margin (well-defined or ill-defined), echogenicity relative to the adjacent muscle (hypo-echoic, hyper-echoic, iso-echoic, or mixed echogenicity), homogeneity (homogeneous or heterogeneous), acoustic shadow or enhancement, and color Doppler if available (as absent, mildly increased, or profoundly increased).

We analyzed and classified all the lipomas into four groups according to their sonographic appearances.

The pathological slides were available in 29 lipomas and were reviewed by bone and soft tissue pathologist (JK) without clinical data, sonographic findings, and the previous pathological report. The pathologist documented presence or absence of atypical cells and myxoid component, amount of vascular component (less than 50% or more than 50%), and fibrous component (no, thin, thick or mixed). The relationship of the sonographic appearance and pathological findings of the lipomas was analyzed.

Results

Our study included 51patients; 24were men (47.1%) and 27were woman (52.9%). The patients' age ranged from 29 years to 79 years with mean age 50.6 years.

A total of 52 lipomas were obtained. The lipomas were distributed throughout the body, which were classified as trunk (occiput, scalp, neck, posterior auricular area, shoulder, peri-scapular area, anterior chest wall, anterior abdominal wall, back, flank, and buttock) and extremities (hand, wrist, forearm, elbow, thigh, knee, ankle, and foot). The lipomas were distributed at trunk for 42 lesions (80.8%) and at extremities for 10 lesions (19.2%).

Among these 52 lipomas, 22 lesions (42.3%) were superficial lipomas (in subcutaneous layer) and 30 lesions (57.7%) were deep-seated lipomas (22 lesions in interfascial plane and 3 lesions in muscle).

The greatest dimension of these soft tissue lipomas ranged from 1.8-10.4 cm with a mean value of 4.7 cm.

All the soft tissue lipomas were elongated with the longest dimension parallel to the skin. The shape of the superficial lipomas was found to be oval in 23 lesions (44.2%) and fusiform in 29 lesions (55.7%). All the lipomas had a well-defined margin.

The echogenicity of the lipomas (in relative to the normal muscle) were hyper-echoic in 19 lesions (36.5%), iso-echoic in 3 lesions (5.8%), hypo-echoic in 13 lesions (25.0%), and mixed echogenicity in 17 lesions (32.7%). The lipomas were heterogeneous echo in 48 lesions (92.3%) and rather homogeneous echo in 4 lesions (7.7%). All lipomas contained some internal echogenic lines parallel to the long axis of the masses.

All lipomas showed absence of acoustic shadow or enhancement.

The color Doppler was available in 48 lesions. No vascular flow in 32 lesions (66.7%) and mildly increased vascularity in 16 lesions (33.3%).

We analyzed and classified the lipomas into four groups according to their sonographic appearances as follow:

Group 1: Well-organized, heterogeneous echogenicity with multiple clearly defined long smooth continuous internal echogenic lines parallel to the long axis of the lesions (Fig. 1).

Group 2: Disorganized, heterogeneous mixed hypo- and hyper-echogenicity with some irregular, interrupted, internal echogenic lines (Fig. 2).

Group 3: Disorganized heterogeneous hyper-echoic mass with some irregular, interrupted internal echogenic lines (Fig. 3).

Group 4: Rather homogeneous echogenic mass with short interrupted, irregular internal echogenic lines (Fig. 4).

The numbers of lesions distributed among each group were summarized in the Table 1 and the

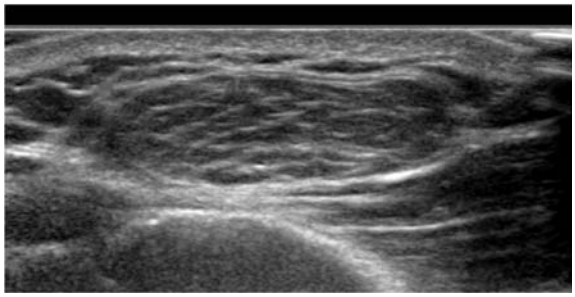

Fig. 1 Group 1 lipoma shows well-organized, heterogeneous echogenicity with multiple clearly defined long smooth continuous internal echogenic lines parallel to the long axis of the lesion.

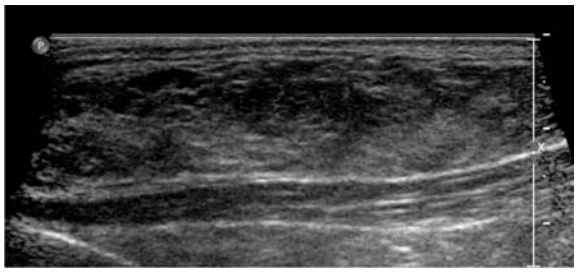

Fig. 2 Group 2 lipoma shows disorganized, heterogeneous mixed hypo- and hyper-echogenicity with some irregular, interrupted, internal echogenic lines.

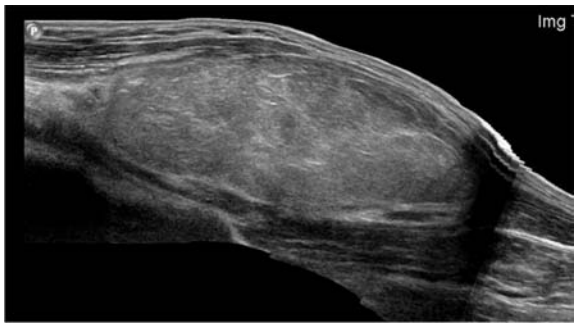

Fig. 3 Group 3 lipoma shows disorganized heterogeneous hyper-echoic mass with some irregular, interrupted internal echogenic lines.

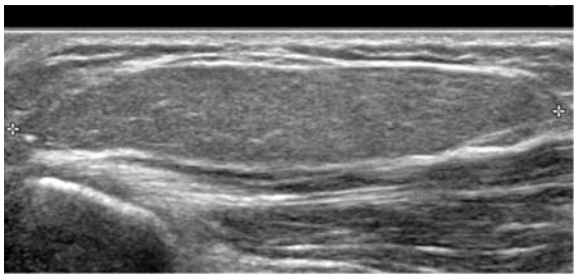

Fig. 4 Group 4 lipoma show rather homogeneous echogenic mass with short interrupted, irregular internal echogenic lines.

locations of the lipomas in each group were summarized in the Table 2.

The pathological slides were available in 29 lesions. All lipomas showed absence of atypical cells and myxoid component. The vascular component of the lipomas had both capillary-size and large vessels that present less than 50% area of the mass. The fibrous band components were varied from no fibrous band in 2 lesions (6.9%), thin fibrous bands in13 lesions (44.8%) (Fig. 5), thick fibrous bands in 7 lesions (24.1%) (Fig. 6), and mixed thin and thick fibrous bands in 7 lesions (24.1%).

Table 1. Number of the lipomas in each group according to sonographic categories

Group	Numbers (lesions, %)
1	23 (44.2)
2	17 (32.7)
3	8 (15.4)
4	4 (7.7)
Total	52 (100)

Table 2. Location of the lipomas in each group according to sonographic categories

Group	Superficial (%)	Deep (%)
1	9 (39.1)	14 (60.8)
2	9 (52.9)	8 (47.1)
3	3 (37.5)	5 (62.5)
4	1 (25.0)	3 (75.0)

The features of fibrous component in these 29 lipomas according to sonographic categories were summarized in Table 3.

Discussion

Lipoma is a benign tumor composed of mature white adipocytes which may or may not contain fibrous tissue. It is one of the most common benign mesenchymal tumor[2]. Patients with lipoma usually present with painless palpable mass. Superficial lipomas are best diagnosed on the basis of clinical history and the palpation of a well-delineated, mobile, and soft superficial mass. When palpation of a soft tissue mass is inconclusive, ultrasound is usually the first-line investigation used for evaluation. Unfortunately, the reported sonographic appearance of soft-tissue lipomas was highly variable. Regarding the intrinsic echogenicity, there was vast variability among reports and discrepancy between different readers in the same paper. Fornage et al[4] reported 35 lipomas, of which 12 were pathologically proved, 29% were hyper-echoic, 22% were iso-echoic, 29% were hypo-echoic, and 20% were of mixed echogenicity. In another study by Ahuja et al[5] of 25 lipomas occurring in the head and neck region, of which 16 were histologically diagnosed, 76% were hyper-echoic, 16% were hypo-echoic, and 8% were

iso-echoic.

The study of 64 deep-seated lipomas, all of which were pathologically proved, by Paunipagar et al[1] who reported 22% were hypo-echoic, 21% were iso-echoic, and 57% were hyper-echoic. Inampudi et al[3] reported 25 lipomas analyzed by two different radiologists, classified 20% as hyper-echoic, 60% as iso-echoic, and 20% as hypo-echoic by reader 1, classified 52% as hyper-echoic, 28% as iso-echoic, and 20% as hypo-echoic by reader 2. Concordance between readers for the masses categorized by echogenicity was 10. Our study presented the same variable echogenicity of soft tissue lipomas which were classified 36.5% as hyper-echoic, 25.0% as hypo-echoic, 5.8% as iso-echoic, and 32.7% as mixed echogenicity. These findings indicated that the diagnosis of the lipomas cannot be made based on the sonographic echogenicity. However; Lin et al[6] reported high accuracy of ultrasound (82%) in diagnosis of subcutaneous lipomas based on diagnostic criteria of well-demarcated, avascular, subcutaneous masses with internal echogenic lines parallel long axis to the superficial skin. Paunipagar et al[1] showed that the feature of deep-seated lipomas are more variable than those reported for subcutaneous lipomas, but the majority of lesions showed fine internal echoes parallel to the ling axis of the tumor. Our series included both superficial and deep soft tissue lipomas with variable internal echogenicities but do have some internal echogenic lines parallel to the long axis of the tumors.

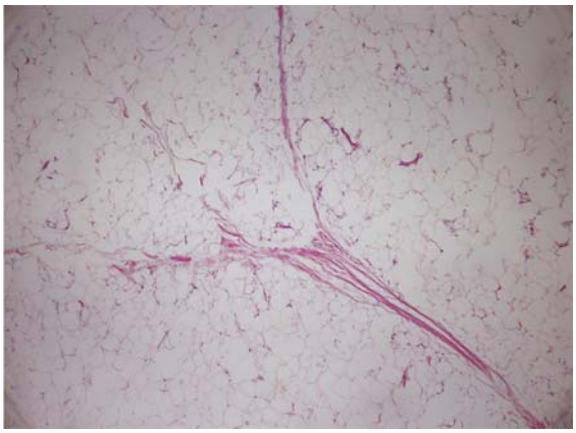

Fig. 5 Pathological picture of the lipoma with thin fibrous band.

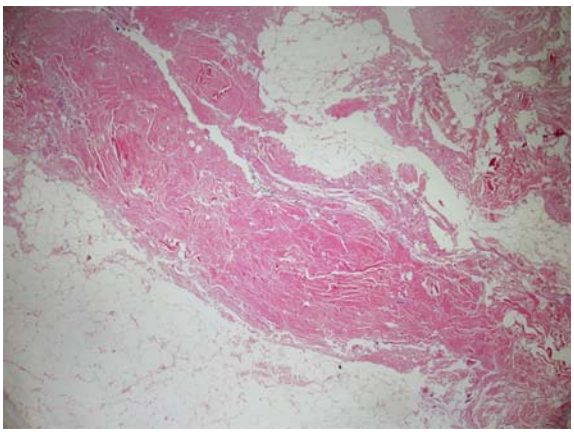

Fig. 6 Pathological picture of the lipoma with thick fibrous band.

After analysis of the sonographic appearances of these lipomas, we proposed four major patterns. The most common and readily recognized pattern is well-organized, heterogeneous echogenicity with multiple clearly defined long smooth continuous internal echogenic lines parallel to the long axis of the lesions. This may have diagnostic value for soft tissue lipomas. However, further prospective study is needed for validation. The second and third patterns have disorganized heterogeneous echogenicities with some irregular interrupted internal echogenic lines, while the last pattern is rather homogeneous with short interrupted, irregular internal echogenic lines. The pathological analysis showed no distinctive feature for each group of the sonographic appearances. Opposed to MR imaging, the diagnosis of soft tissue

Table 3. Fibrous band component in each group of lipoma according to sonographic categories

Group	Thin fibrous	Thick fibrous	Thin and thick fibrous	No fibrous	Total
1	6 (42.9)	3 (21.4)	4 (28.6)	1 (7.1)	14
2	6 (60.0)	3 (30.0)	1 (10.0)	0 (0)	10
3	1 (33.3)	0 (0)	2 (66.7)	0 (0)	3
4	0 (0)	1 (50.0)	0 (0)	1 (50.0)	2

lipomas cannot be made based solely on the echoic appearance as lack of any specific sonographic features. It is postulated that the echogenicity of the lipomas may be related mainly to the number of internal interfaces between fat and other intermingled connective elements[8].

Other sonographic parameters including location, size, shape, margin and acoustic shadow or enhancement show no any implication for specific diagnosis of soft-tissue lipomas.

We acknowledge limitations in this study. First, we were able to review only static images according to retrospective study with no real time assessment. Second, our study included only patients who had both ultrasound and surgery with pathological report. This could be selection bias because there were many patients that had ultrasound without surgery, surgery without ultrasound, or even never come to see the doctor that we could not include in our study. Third, color Doppler was not available in all lesions. And lastly, pathological slides were not available for review in all lesions.

Conclusion

The soft tissue lipomas contained some internal echogenic lines parallel to the long axis of the masses. The sonographic appearances of the lipomas were variable and no distinct histological correlation was identified. We proposed that pattern of well organized, heterogeneous echogenicity with multiple clearly defined long smooth continuous internal echogenic lines parallel to the long axis of the lesions may have diagnostic value to suggest lipoma. Further validation by prospective study is required.

What is already known on this topic?

Soft tissue lipomas are common tumors and not always precisely diagnosed based on clinical exam. Imaging study particularly MRI has high accuracy for pre-operative diagnosis but it is high cost, has limited access and time consuming. Ultrasound is more available, lower cost and takes less exam time but it is known that the soft tissue lipomas have variable sonographic appearance.

What this study adds?

This retrospective study analyses the sonographic appearance of the pathologically proved soft tissue lipomas. Although it is concordance with other papers that soft tissue lipomas have variable appearance, we classify the findings into four major patterns which have common finding that they contain some internal echogenic lines parallel to their long axis. The most common pattern may have diagnostic value for soft tissue lipomas. However, further prospective study is needed for validation.

Potential conflicts of interest

None.

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ลักษณะภาพอัลตร้าซาวนด์ของก้อนทูมไขมันชั้นใต้ผิวหนัง

ก่อเกียรติ วิวิธมงคลไชย, เดียรดา หวังเจริญรุ่ง, จุฑาทิพย์ ดินทรักษ์

วัตถุประสงค์: ศึกษาลักษณะภาพอัลตร้าซาวนด์ของก้อนทูมไขมันในชั้นใต้ผิวหนังและความสัมพันธ์กับลักษณะทางพยาธิวิทยา

วัสดุและวิธีการ: รวบรวมข้อมูลและศึกษาวิเคราะห์ลักษณะภาพอัลตร้าซาวนด์ของผู้ป่วยก้อนทูมไขมัน ในชั้นใต้ผิวหนังที่ได้รับการผ่าตัด และมีรายงานผลชิ้นเนื้อทางพยาธิวิทยาโดยรังสีแพทย์ด้านระบบกระดูกและกล้ามเนื้อ และศึกษาลักษณะทางพยาธิวิทยาโดยพยาธิแพทย์ด้านระบบกระดูกและกล้ามเนื้อ

ผลการศึกษา: จากการศึกษาลักษณะภาพอัลตร้าซาวนด์ของก้อนไขมันในชั้นใต้ผิวหนังทั้งสิ้น 52 ตัวอย่าง พบว่าลักษณะภาพอัลตร้าซาวนด์สามารถแบ่งได้เป็น 4 กลุ่ม โดยกลุ่มที่พบมากที่สุดมีลักษณะเป็นก้อนชัดเจน มีการสะท้อนคลื่นเสียงไม่สม่ำเสมอ (heterogeneous echogenicity) และภายในมีเส้นเรียบยาวจำนวนมาก (multiple clearly defined long smooth continuous internal echogenic lines) วางตัวในแนวขนานกับตัวก้อนไขมัน มีจำนวนตัวอย่างชิ้นเนื้อก้อนไขมันชั้นใต้ผิวหนังสำหรับศึกษาวิเคราะห์ทางพยาธิวิทยาทั้งสิ้น 29 ตัวอย่าง ซึ่งครอบคลุมลักษณะภาพอัลตร้าซาวนด์ทั้ง 4 แบบ จากการศึกษาไม่พบความสัมพันธ์ระหว่างลักษณะภาพอัลตร้าซาวนด์และลักษณะทางพยาธิวิทยา

สรุป: ก้อนไขมันในชั้นใต้ผิวหนังพบมีเส้นภายในจำนวนมาก (internal echogenic lines) วางตัวในแนวขนานกับตัวก้อน ส่วนลักษณะภาพอัลตร้าซาวนด์อื่น ๆ ไม่จำเพาะและไม่พบความสัมพันธ์กับลักษณะทางพยาธิวิทยา