Value of ultrasonography in neurilemmoma diagnosis: the role of round shape morphology

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Abstract

Objective: To evaluate the contribution of ultrasonography in the diagnosis of neurilemmoma and to establish if a round or round-like shape adds useful information for ultrasonographic diagnosis. Methods: Archives of ultrasound findings in 203 patients (127 males and 76 females, aged 14 - 72 years old, mean 32.1 ± 25.8) with limb mass were reviewed. The maximal and minimal diameter of the lesions was 78 mm and 11 mm, respectively (mean 34.7±15.6 mm). Lesions’ morphology, size, capsule, and relationship with the adjacent nerve were analyzed, round-like or round shaped was focused, ratio of longitudinal maximal diameter and short maximal diameter (L/S) was calculated. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of ultrasonographic diagnosis were determined. Results: In 37 patients with ultrasonographic suspicion of neurilemmomas, the neurilemmomas were confirmed in 31 cases. From 166 patients with tumors presumed as being non-neurilemmoma lesions, 18 cases in the final diagnosis were neurilemmomas. Ultrasound had 63.3% sensitivity, 86.0% specificity, 56.4% positive predictive value, 89.2% negative predictive value, and 80.9% accuracy for the diagnosis of neurilemmoma. Round-like or round shaped and L/S diameters ratio were not specific for neurilemmomas ultrasonographic appearance (P > 0.05). Conclusion: Ultrasound can diagnose neurilemmomas with high accuracy, but the round or round-like shaped and L/S diameters ratio have little value in ultrasonographic identification of neurilemmomas of the limbs. Keywords: neurilemmoma, limbs, ultrasound, round shaped

Introduction

Neurilemmoma may occur in the limbs, some are visible and palpable, but the pathology remains undetermined, and some cases entail imaging study and biopsy [1-6]. Preoperative diagnosis is important for the majority of the cases, being associated with appropriate management and prognosis. If the preoperative diagnosis of neurilemmoma is not correct and intraoperative procedure is not appropriate, postoperative sequelae of neurological deficit may ensue [5,6]. Ultrasonography (US) is commonly used for the limbs’ neurilemmoma evaluation. In US if a soft tissue lesion is an ovoid or lobulated shaped encapsulated hypoechoic mass, oriented longitudinally in the nerve distribution, with tapered ends of nerve at two sides, and variable vascularization, the diagnosis of neurilemmoma is ready to be established [2,3,7,8]. However, some neurilemmomas do not have typical characteristics, eg. the relationship to the nerve is invisible and the capsule is not conspicuous; while other sonographic manifestations such as the shape, internal echogenicity, margin and vascularization are not unique, which affect the definitive diagnosis [3,9,10]. In our experience the round-like or round shaped appears more frequently in neurilemmomas of limbs than in other entities of the limbs, and so we assumed that this may be a useful characteristic for identification of the neurilemmoma of limbs. The aim of this study was to evaluate the value of US in the diagnosis of neurilemmoma and whether round or round-like shaped adds useful information for the diagnosis.
Patients and Methods

Patients and ultrasound examination: A retrospective study was conducted based on database from January 2004 through February 2011 for neurilemmoma of the limbs, and the samples were selected consecutively from the picture and archiving communication systems (PACS) of our hospital. In the study 203 patients were enrolled with masses of limbs that undergone histopathological analysis. The patients consisted of 127 males and 76 females, aged 14 years -72 years old, (mean 32.1 ± 25.8). The maximal and minimal diameter of all the lesions was 78 mm and 11 mm respectively, (mean 34.7 ± 15.6 mm). Ultrasound examination of the patients was performed by four sonologists with 9-22 years of experience with the Logiq 9 (GE Healthcare, Waukesha, WI), Voluson expert 730 (GE Healthcare, Piscataway, NJ), HDI1XE (HP Medical systems, China), and Sonos 5500 (HP Medical systems, Netherlands) machines ( 7 MHz-12 MHz linear probes). The preset was adjusted to small parts MSK (muscle and skeleton) model before examination; the color Doppler flow imaging (CDFI) and power Doppler imaging (PDI) were used to detect the vascularization of the lesions.

Institutional review board had approved the study and patients’ informed consent was waived.

Imaging interpretation: The US imagines were simultaneously analyzed in consensus by two sonologists with 11-16 years of experience who were blind to the final diagnosis. The US diagnostic criteria of neurilemmoma met the previous published characteristics [2,3,7,8]: ovoid or lobulated shaped encapsulated hypoechoic mass oriented longitudinally in the nerve distribution, eccentrically, with tapered ends of nerve at two sides and variable vascularization. Key characteristics relating to neurilemmoma were analyzed with the focus on the shapes of the lesions. In this study, a round shaped is when the ratio of the longitudinal maximal diameter and the short maximal diameter (L/S) measuring in the middle section of the entity equals 1.0, and the round-like shaped refers to the ratio ≤ 1.2.

Statistical analysis: Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of US in neurilemmoma diagnosis were determined. Distribution of different characteristics in the neurilemmoma and other lesions of the limbs was analyzed using the χ2 test; comparison of the diameter of neurilemmoma and other tumoral entities was tested using an independent sample t-test. P < 0.05 was considered statistically significant. The statistic software used was SPSS (Version 11.5, SPSS, Inc., an IBM Company, Chicago, IL).

Results

Of the 203 patients, 37 patients undergoing ultrasound were diagnosed neurilemmoma. In these 37 patients with US suspicion of neurilemmomas, the neurilemmoma was histologically confirmed in 31 cases (the other 6 cases were neurofibroma: 2 cases, malignant neurilemmoma: 1 case, intramuscular hemangioma: 1 case, fibroma: 1 case, and lipofibroma: 1 case); 18 out of 166 patients undergoing US presumed diagnosed with non-neurilemmoma were histologically interpretated as neurilemmoma (the 18 neurilemmomas were misdiagnosed as fibroma: 6 cases, neurofibroma: 4 cases, lipofibroma: 4 cases, cavernous hemangioma: 1 case, intramuscular hemangioma: 1 case, granuloma: 1 case, and hematoma: 1 case). The maximal diameter was 78 mm, the minimal diameter 11 mm, and mean 34.7 ± 15.6 mm. Comparison of characteristics of neurilemmoma and non-neurilemmoma lesions are summarized in table I. There were no significant differences between neurilemmoma and other lesions for shape (all P > 0.05). The ratio of L/S was [2.6–1.1, 1.60 ± 0.34] for neurilemmomas and [2.7–1.1, 1.64 ± 0.31] for other enti-

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Neurilemmoma (n =49)</th>
<th>Non-neurilemmoma lesions (n =154)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td>Round-like, round*</td>
<td>9 (18.4 %)</td>
<td>15 (9.7 %)</td>
</tr>
<tr>
<td></td>
<td>Oval, fusiform</td>
<td>39 (79.6 %)</td>
<td>131 (85.1 %)</td>
</tr>
<tr>
<td></td>
<td>Lobulated</td>
<td>1 (2.0 %)</td>
<td>8 (5.2 %)</td>
</tr>
<tr>
<td>Capsule</td>
<td>Conspicuous</td>
<td>19 (38.8 %)</td>
<td>19 (12.3 %)</td>
</tr>
<tr>
<td></td>
<td>No; invisible</td>
<td>30 (61.2 %)</td>
<td>135 (87.7 %)</td>
</tr>
<tr>
<td>Relationship to the nerve</td>
<td>Detectable</td>
<td>27 (55.1 %)</td>
<td>1 (0.6 %)</td>
</tr>
<tr>
<td></td>
<td>Undetectable</td>
<td>22 (44.9 %)</td>
<td>153 (99.4 %)</td>
</tr>
</tbody>
</table>

*Round-like or round shaped refers to the ratio between maximal longitudinal diameter / maximal transversal diameter ≤1.2.
ties, with no significant difference ($P > 0.05$). Ultrasound had 63.3% sensitivity, 86.0% specificity, 56.4% positive predictive value, 89.2% negative predictive value, and 80.9% accuracy for the diagnosis of neurilemmoma. Figures 1–4 show the US findings of neurilemmomas.

**Discussion**

Identification of neurilemmoma by US depends predominantly on the detection of traceable ends of the nerve and the capsule [2,3,7,8]. In this study, only 55.1% (27/49) neurilemmomas had detectable relationship to the nerve, and detectable conspicuous capsule accounts for 38.8% (19/49), which affects directly the diagnosis. Also, 6 out of 37 cases of neurilemmomas were misdiagnosed as non-neurilemmomas and 18 cases of neurilemmomas were misdiagnosed as non-neurilemmomas which show that US diagnosis of neurilemmoma still remains a challenge. With regard to morphology characteristics of neurilemmoma, previous literature [4,7,8] documented that neurilemmomas are oval and lobulated. However, in our previous experience we found that round-like and round shaped seemed associated more closely with neurilemmomas than other entities, and we decided to evaluate this finding. In this study, round-like and round shaped neurilemmomas account for 18.4% (9/49), and oval and fusiform shaped neurilemmomas account for 81.6% (40/49); round-like and round shaped non-neurilemmoma lesions account for 9.7% (15/154), oval and fusiform shaped non-neurilemmoma lesions
account for 90.3% (139/154), but the differences of percentage of shapes between neurilemmomas and non-neurilemmoma lesions have no statistically significance. The results show that although neurilemmoma presents round-like and round shaped more often than non-neurilemmoma lesions do, this finding provides little useful information for the identification of neurilemmoma, having little value in diagnosis.

Differentiation of neurilemmoma involves several entities but the most important is the differentiation from neurofibroma. Neurofibroma has traceable ends of the nerve but no obvious capsule, being eccentric to the nerve, while neurilemmoma is on the center of the nerve [7,11-13]. A study by Tsai et al [11] found the differentiation between neurilemmoma from neurofibroma difficult. Other studies [12,13] found that neurofibroma is less misdiagnosed, the reason being that this tumor often presents as plexiform neurofibroma or diffuse neurofibroma, easier to be recognized. In this study, 2 neurofibromas were misdiagnosed as neurilemmomas, and 4 neurilemmomas were misdiagnosed as neurofibromas. Though neurilemmoma and neurofibroma are all of neurogenic origin, the relationship with the nerve was not clearly visualized in neurofibromas encountered in this study, so whether the neurofibroma was growing centrically or not, is hard to determine; on the other hand, the majority of the neurilemmomas were found growing eccentrically. Neurofibromas in this study appear fusiform and elliptic shaped, and none appear round or round-like shaped. Fibrous tumor and fibrolipoma, common tumors in limbs, have US characteristics similar to atypical neurilemmoma, though fibrolipomas present more hyperechoic, which offers a challenge for the diagnosis. Hemangiomas have various US findings, depending on the histopathological type [14]: capillary, cavernous, arteriovenous, venous, and mixed variations. Bradley et al [15] concluded that the US characteristics of cavernous hemangiomas were variable and of little value except in anatomical localization. In this study, 3 neurilemmomas were misdiagnosed as intramuscular or cavernous hemangioma.

The potential limitations of this study are the retrospective design of the study, the lack of postoperative observation, and the measurement of morphology and size of all the lesions. We enrolled patients only from one district and center, and some special cases were not individually discussed. Also, the small numbers of lesions did not permit a comprehensive analysis.

In conclusion, ultrasound can correctly diagnose the majority of neurilemmomas, but misdiagnosis happens now and then; round-like or round shaped is not a characteristic manifestation of neurilemmoma compared with other tumors in the limbs, and this finding does not add useful information for the identification of neurilemmoma in the limbs.

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Conflict of interest: none

References

