

Percutaneous computed tomography-guided core needle biopsy of soft tissue tumors: results and correlation with surgical specimen analysis*

Biópsia percutânea por agulha grossa de tumores de partes moles guiada por tomografia computadorizada: resultados e correlação com análise da peça cirúrgica

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Abstract Objective: To evaluate the efficacy of percutaneous computed tomography (CT)-guided core needle biopsy of soft-tissue tumors in obtaining appropriate samples for histological analysis, and compare its diagnosis with the results of the surgical pathology as available. **Materials and Methods:** The authors reviewed medical records, imaging and histological reports of 262 patients with soft-tissue tumors submitted to CT-guided core needle biopsy in an oncologic reference center between 2003 and 2009. **Results:** Appropriate samples were obtained in 215 (82.1%) out of the 262 patients. The most prevalent tumors were sarcomas (38.6%), metastatic carcinomas (28.8%), benign mesenchymal tumors (20.5%) and lymphomas (9.3%). Histological grading was feasible in 92.8% of sarcoma patients, with the majority of them (77.9%) being classified as high grade tumors. Out of the total sample, 116 patients (44.3%) underwent surgical excision and diagnosis confirmation. Core biopsy demonstrated 94.6% accuracy in the identification of sarcomas, with 96.4% sensitivity and 89.5% specificity. A significant intermethod agreement about histological grading was observed between core biopsy and surgical resection ($p < 0.001$; kappa = 0.75). **Conclusion:** CT-guided core needle biopsy demonstrated a high diagnostic accuracy in the evaluation of soft tissue tumors as well as in the histological grading of sarcomas, allowing an appropriate therapeutic planning.

Keywords: Sarcoma; Needle biopsy; Computed tomography.

Resumo Objetivo: Avaliar a eficácia da biópsia percutânea por agulha grossa (BPAG) de tumores de partes moles guiada por tomografia computadorizada (TC), em relação ao sucesso na obtenção de amostra para análise, e comparar o diagnóstico da BPAG com o resultado anatomopatológico da peça cirúrgica, quando disponível. **Materiais e Métodos:** Foram revisados os prontuários e laudos diagnósticos de 262 pacientes com tumores de partes moles submetidos a BPAG guiada por TC em um centro de referência oncológico entre 2003 e 2009. **Resultados:** Das 262 biópsias realizadas, foi possível a obtenção de amostra adequada em 215 (82,1%). Os tumores mais prevalentes foram os sarcomas (38,6%), carcinomas metastáticos (28,8%), tumores mesenquimais benignos (20,5%) e linfomas (9,3%). Foi possível realizar graduação histológica em 92,8% dos pacientes com sarcoma, sendo a maioria (77,9%) classificada como alto grau. Do total de pacientes, 116 (44,3%) realizaram cirurgia para exérese e confirmação diagnóstica. A BPAG mostrou acurácia de 94,6% na identificação de sarcomas, com sensibilidade de 96,4% e especificidade de 89,5%. A graduação histológica teve concordância significativa entre a BPAG e a peça cirúrgica ($p < 0,001$; kappa = 0,75). **Conclusão:** A BPAG guiada por TC demonstrou elevada acurácia diagnóstica na avaliação de tumores de partes moles e na graduação histológica dos sarcomas, permitindo um adequado planejamento terapêutico.

Unitermos: Sarcoma; Biópsia por agulha; Tomografia computadorizada.

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INTRODUCTION

Soft tissue tumors comprise a great number of neoplasms, among them, mesenchymal tumors (the benign ones and sarcomas) and other tumors such as lymphomas, melanomas and metastatic carcinomas⁽¹⁾. Malignant mesenchymal tumors,

called sarcomas, are characterized for being solid, with considerable heterogeneity in their anatomy, histological subtypes and degree of biological aggressiveness. The approach to be adopted is significantly influenced by the location and staging of the tumor⁽²⁾.

Anatomopathological analysis allows the identification of tumor type, so it is essential for the therapeutic planning. The preoperative determination of grading and histological type of the sarcomas is critical to identify those patients at higher risk for metastasis, influencing the decision making on the the need for neoadjuvant treatment and surgery extent^(3,4). The current parameters most utilized by pathologists for grading soft tissue sarcomas are the following: cellular differentiation, cellularity, amount of necrosis and number of mitoses⁽⁵⁾.

There are several techniques for obtaining soft tissue tumors specimens for histological analysis. Open surgical biopsy allows direct access to the tumor and generally the collection of larger amounts of material than in percutaneous biopsies, which tends to favor a correct diagnosis, increasing the capability of differentiating benign from malignant tissues. However, its main disadvantages are the high cost and morbidity, as it is the case in any open surgical procedure⁽⁶⁾. For such reasons, percutaneous core needle biopsy (CNB) is many

times utilized as a diagnostic method providing tissue fragments for histological analysis, with a low rate of complications. Percutaneous biopsies are usually guided by imaging methods such as ultrasonography (US) or computed tomography (CT), particularly in cases of deeply located tumors^(7,8) (Figure 1). However, percutaneous biopsy results may underestimated tumor aggressiveness estimate, as only a small part of the tumor is analyzed⁽⁹⁾.

The main objectives of the present study were to evaluate the effectiveness of CT-guided CNB of soft tissue tumors with respect to success in obtaining specimens for analysis, and comparing the diagnosis obtained by means of CNB with the anatomopathological result of the surgical specimen, when available.

MATERIALS AND METHODS

The present retrospective study reviewed records and diagnostic reports from patients with soft tissue tumors submitted to CT-guided CNB in a reference oncology center, in the period from April 22, 2003 to June 30, 2009. The present study was approved by the Committee for Ethics in Research of the institution before the commencement of data collection.

A standardized data form was retrospectively filled in for each patient included in the study. The collected information com-

prised epidemiological data, clinical data, imaging findings, CNB results, information on the surgery and respective anatomopathological report. For histological grading of the sarcomas, the World Health Organization (WHO) criteria based on a two-level reference classification ("low grade" versus "high grade") were utilized. Whenever the utilized grading system was different, the conversion of such grading into the two-level system was performed, as recommended⁽¹⁰⁾.

All the data were stored in a databank for statistical analysis by means of the SPSS software for Windows, version 17.0 (SPSS Inc.; Chicago, IL, USA). The descriptive analysis comprised the calculation of simple and relative frequencies of the studied variables. Sensitivity, specificity, predictive values and CNB accuracy were calculated for the differentiation between benign and malignant mesenchymal tumors. For the analysis of agreement between data regarding CNB results and surgical specimens analysis, the kappa test was utilized, with *p*-value ranging between 0 and 1, indicating higher agreement as closer to 1.

RESULTS

The present study included 262 patients, with a mean age of 51 years (ranging from 1 to 93 years), 132 (50.4%) men. Table 1

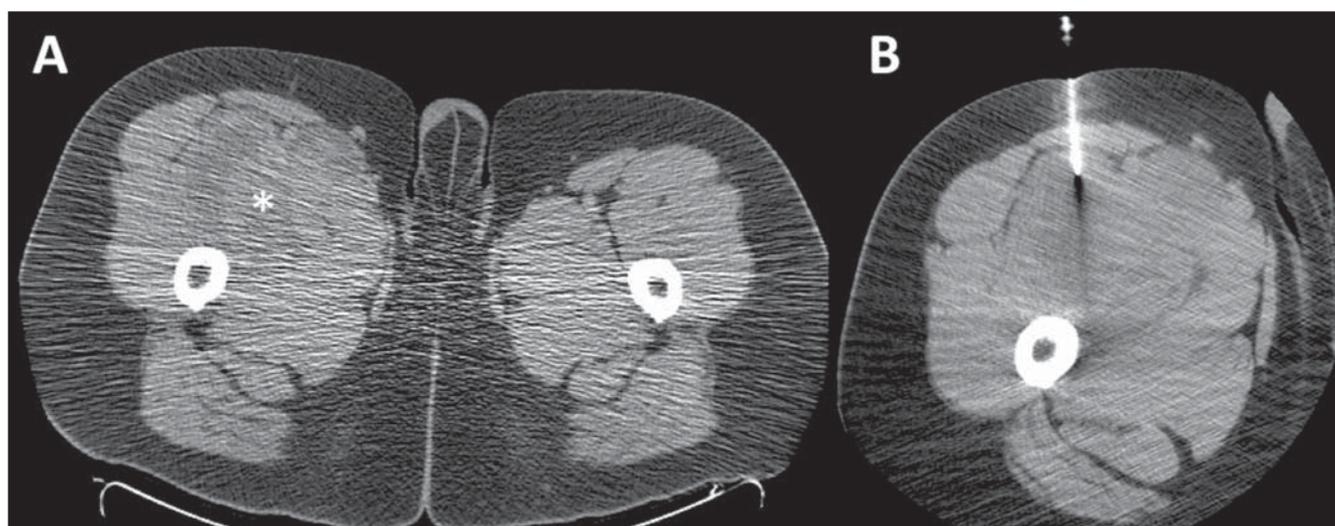


Figure 1. Percutaneous biopsy of an expansile mass in the thigh. **A:** Axial computed tomography section demonstrating the presence of heterogeneous ill-defined mass in the anteromedial aspect of right thigh (asterisk). **B:** Percutaneous computed tomography-guided core needle biopsy directed to the most solid portion of the lesion. Anatomopathological results of biopsy demonstrated malignant fusocellular neoplasm, with morphological and immunohistochemical profile suggestive of synovial sarcoma with a high malignancy degree.

presents the age distribution of patients submitted to CNB. Most of the tumors were located in the trunk ($n = 127$; 48.5%), followed by extremities ($n = 78$; 29.8%), retroperitoneum ($n = 55$; 21.0%) and head & neck ($n = 2$; 0.8%).

Out of the 262 biopsies, appropriate specimens could be obtained in 215 cases (82.1%). Out of the 47 (18%) cases where the specimens were considered as being inappropriate, the histological result was absence of tumor in 33 cases (70%) followed by extensive necrosis in 8 cases (17%); collection artifacts in 3 cases (6%); inflammatory process in 2 cases (4%) and cellular debris intermingled with hemosiderin and red blood cells in one case (2%). The diagnoses of 23 of such patients was later obtained by tumor excision in 19 (83%) cases, open biopsy in 3 (13%) cases and additional CNB in 1 (4%) case. For the remaining 24 cases, no follow-up data was available.

Table 2 presents the quantitative and percentage distribution of the histological results obtained by CNB.

Among the 44 benign mesenchymal neoplasms, it was possible to define the histological subtype by means of CNB in 34 cases (77.3%), with lipoma being the

Table 1 Age distribution of 262 patients with soft tissue tumors submitted to computed tomography-guided core needle biopsy.

Age (years)	<i>n</i>	%
0–20	24	9.2%
21–40	45	17.2%
41–60	103	39.3%
61–80	70	26.7%
> 80	20	7.6%

Table 2 Histological diagnoses obtained with percutaneous computed tomography-guided core needle biopsy in 215 patients with soft tissue tumors.

Histological diagnosis	<i>n</i>	%
Mesenchymal tumors	130	60.5%
Malignant	83	38.6%
Benign	44	20.5%
Benign/malignant	3	1.4%
Metastatic carcinomas	62	28.8%
Lymphomas	20	9.3%
Melanoma	3	1.4%

Table 3 Distribution of histological sub-types of sarcomas diagnosed by computed tomography-guided core needle biopsy in 83 patients.

Malignant tumors	<i>n</i>	%
Pleomorphic sarcoma	12	17.1%
Fusocellular sarcoma	8	11.4%
Synovial sarcoma	8	11.4%
Leiomyosarcoma	7	10.0%
Liposarcoma	5	7.1%
Ewing's sarcoma/Primitive neuroectodermal tumor	5	7.1%
Chondrosarcoma	4	5.7%
Gastrointestinal stromal tumor	4	5.7%
Neuroblastoma	4	5.7%
Chordoma	4	5.7%
Rhabdomyosarcoma	3	4.3%
Myxoid sarcoma	3	4.3%
Osteosarcoma	2	2.9%
Malignant peripheral nerve sheath tumor	2	2.9%
Angiosarcoma	1	1.4%
Ganglioneuroblastoma	1	1.4%
Kaposi's sarcoma	1	1.4%

most frequent type ($n = 17$; 50%). As regards sarcomas, the histological sub-type was defined in 74 of the 83 cases (89.2%), with such cases being described on Table 3. Histological grading could be performed in 77 (92.8%) of the 83 patients with sarcomas, 60 (77.9%) of them being classified as high grade and 17 (22.1%) being classified as low grade.

Out of the 215 patients with tumors diagnosed by CNB, 116 (44.3%) underwent surgery for tumor excision and diagnosis confirmation. Among these cases, 74 had been classified as mesenchymal tumors at CNB – 19 benign and 55 malignant. Among the 19 tumors classified as benign at CNB, 17 were confirmed by the surgical specimens analysis and two results were discordant – one liposarcoma in a lesion classified as lipoma at CNB, and one synovial sarcoma in a lesion previously diagnosed as leiomyoma. Out of the 55 tumors classified as malignant by CNB, 2 (3.6%) presented discordant results in the surgical specimen analysis – one seminoma and one synovial cyst in two lesions classified as undifferentiated sarcomas at CNB.

Thus, CNB demonstrated 94.6% accuracy in the identification of sarcomas among the mesenchymal tumors, with sensitivity and positive predictive value of 96.4% and specificity and negative predictive value of 89.5%.

Out of the 77 patients with sarcomas whose histological grade could be determined by CNB, 49 were submitted to surgery, and only 4 (8.2%) of them presented difference in grading between CNB and surgical specimen analysis. All of such cases were classified as low grade at CNB and reclassified as high grade at the surgical specimen analysis. There was a significant agreement between CNB and surgical specimen analysis in the determination of the histological grade (high and low grade) ($p < 0.001$; kappa = 0.75; CI 95%: 0.48–1.00).

DISCUSSION

Soft tissue sarcomas are rarely found and the clinical/radiological differentiation between benign tumors and sarcomas is sometimes impossible. Furthermore, sarcomas may not be preoperatively suspected, with the diagnosis being confirmed only after the lesion resection. Enucleation (excisional biopsy) is acceptable in cases of benign lesions, but it is not appropriate for sarcomas, as the surgeon misses the opportunity to perform a more effective treatment, with better local management of the disease. Also, incisional biopsy is not routinely indicated for sarcomas because of the high rate of wound complications, which may compromise the local treat-

ment⁽¹¹⁾. For this reason, CNB is the method of choice for preoperative investigation in patients with suspected soft tissue tumors⁽¹²⁾. Fine needle aspiration biopsy is not recommended as a first-line diagnostic modality, however it can be utilized in selected cases, as in the suspicion of recurrence⁽¹²⁾.

Imaging-guided CNB provides additional advantage for being capable of evaluating, at the collection moment, the best site for fragment collection, avoiding, for example, areas of necrosis and/or fibrosis. Narvani et al. have demonstrated that imaging-guided procedures improve the accuracy of CNB in 78% to 95%, specially in cases of small and deeply located lesions⁽¹³⁾. Such procedure must be performed in a reference center, with specialized radiologists and pathologists, and the case must always be previously discussed with the surgeon for a better planning^(12,14,15). During the procedure, the biopsy pathway must be planned in such a way that it can be resected at the moment of the definitive surgery, and several fragments from different areas should be collected for appropriate sampling of the tumor. According to Wu et al., at least four fragments must be collected in soft tissue tumors CNB in order to allow an appropriate histological diagnosis⁽¹⁶⁾.

CT and US have been utilized to guide percutaneous biopsy of soft tissue tumors, with good results being reported in the literature⁽¹⁷⁻¹⁹⁾. No study was found suggesting the superiority of either of the methods. One should select the method in which the lesion is best characterized and the one in which the radiologist is more experienced. In general, US is preferred for superficial lesions, while CT is utilized for deeper lesions.

In the present study, CNB provided appropriate specimens for analysis in 82% of the cases, allowing the differentiation between benign and malignant lesions, identification of the histological type of the tumors, and the histological grading in most of the cases. Such results confirm the accuracy of the method reported in literature, demonstrating that the sub-type and

grading of the tumors can be determined in 80% to 95% of the CNBs⁽²⁰⁾. In the present study, sarcomas were the most prevalent soft tissue tumors, followed by metastatic carcinomas, benign mesenchymal tumors and lymphomas.

In the present casuistry, the diagnostic accuracy of CNB in the identification of sarcomas was high, with significant agreement in relation to the histological grading of the tumor by biopsy and by surgical specimen analysis. Such results were similar to those from other studies published in the literature. Ray-Coquard et al. have demonstrated 95% accuracy of CNB in the diagnosis of soft tissue sarcomas⁽²¹⁾. Strauss et al. have evaluated 530 patients with soft tissue tumors submitted to CNB, reporting 426 mesenchymal tumors (225 malignant and 201 benign), and found 97.6% accuracy in the differentiation between malignancy and benignity, and 86.3% accuracy in the differentiation between high and low histological grade tumors⁽²²⁾.

Woon et al. have evaluated 94 patients submitted to surgery for soft tissue tumors and demonstrated that 95% of the patients preoperatively submitted to preoperative CNB had definitive one-stage surgery, as compared with 45% of those patients who were not submitted to biopsy⁽²⁰⁾.

CONCLUSION

CT-guided CNB demonstrated to be an effective diagnostic method in the evaluation of soft tissue tumors and in the histological grading of sarcomas, allowing for appropriate therapeutic planning.

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