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Initial CT-guided needle biopsy of extremity skeletal lesions: Diagnostic performance and experience of a tertiary musculoskeletal center

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ABSTRACT

Introduction: Appendicular long bones are the target for a wide spectrum of bony lesions with variable clinical presentations. Biopsy procedures are needed for subsequent proper patient's management. Most of the available literature globally assessed musculoskeletal biopsies with inclusion of repeat biopsy results.

We thought to retrospectively assess the diagnostic performance of initial CT-guided percutaneous core needle biopsy (PCNB) of extremity long bone lesions in a tertiary musculoskeletal referral center.

Patients and methods: We retrospectively analyzed the outcome of initial CT-guided PCNB of 49 patients who presented with extremity long bone lesions which were biopsied in our hospital during a 36 months' time period. The diagnostic performance was assessed in terms of diagnostic yield and accuracy.

Results: There were 34 males and 15 females with a mean age of 33.69 years (range from 4 to 77 years). The overall diagnostic yield of initial biopsies was 87.75% with a diagnostic accuracy of 82.85% derived from the surgically proven cases. The higher diagnostic yield was recorded with malignancy, presence of extra-osseous soft-tissue component as well as mixed and sclerotic lesions. The pathologies of the non-diagnostic biopsies included large-cell lymphoma, giant-cell tumor, langerhans cell histiocytosis, osteoid osteoma and a non-ossifying fibroma.

Conclusion: Initial CT-guided PCNB in extremities' long bones lesions showed high diagnostic performance in malignant, mixed and/or sclerotic lesions as well as lesions with extra-osseous exophytic tissue growth. Lack of extra-osseous components, benign and lytic lesions all had worse diagnostic performance.

1. Introduction

Appendicular long bones are the target for a wide spectrum of bony lesions encompassing benign and malignant bone tumors as well as osteomyelitis, reactive focal abnormalities and tumor-like lesions of developmental and/or metabolic origin [1,2]. Pain, swelling and/or pathologic fractures are variable clinical presentations that usually precede the incidental discovery of such lesions on routine radiography, the mainstay of their pick up [1,2].

In spite of recent advances in diagnostic imaging tools and applications for musculoskeletal lesion characterization [3], these lesions remain a daily diagnostic challenge for the radiologist. Hence, biopsy procedures are needed to ascertain the histopathologic nature of these lesions for proper patient's management [4–7].

Recent work [8] assessed the results of imaging-guided percutaneous core needle biopsy (PCNB) in pathologic fracture of the appendicular skeleton. Other common clinical presentations of bone lesions needing biopsy include the following: a swollen painful limb in a child or young adolescent, incidental discovery of a bony lesion in patients presenting with non-specific extremity pain, or patients treated for non-skeletal neoplasia with recently evolving extremity pain [1,2]. Moreover, most of the available literature was non-selective including study results for both initial and repeat biopsies as well as both bony and soft-tissue lesions [6,7,9–11]. To our knowledge, no description of diagnostic performance of first time image-guided PCNB of extremity long bone lesions is available in the English literature.

Thus, we thought to assess the diagnostic performance of the initial CT-guided PCNB of extremity long bone lesions through a retrospective audit at our tertiary musculoskeletal referral center.

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2. Patients and methods

2.1. Study design and research ethics

We retrospectively analyzed the outcome of initial CT-guided core-needle biopsies of patients who presented with extremity long bone lesions performed in our hospital, the tertiary musculoskeletal referral center in the country, during the period from January 2010 to December 2012.

In our hospital, the decision to biopsy a patient is usually discussed between the referring orthopedic surgeons and the musculoskeletal radiologists in view of clinical data, imaging findings, suspected diagnosis and treatment options. We believe that the interdisciplinary approach will provide optimization of patient management. Hence, the preferred approach, biopsy instrumentation and sampling site is individually chosen for each patient. The biopsy procedure indications, benefits and risks are discussed with the patients and/or their guardians and an informed written consent is obtained from all patients before commencing biopsy procedures.

Institutional ethics committee approval was not required for this study as data used did not breach patient confidentiality or disclose their identifying data.

2.2. Study population inclusion and exclusion criteria

Patients presented with (a) pathologic fractures (b) incidentally discovered bony lesions suspected to be sarcomatous or (c) metastatic in nature; either from a known extra-osseous primary or not, were *included* in our retrospective audit.

Meanwhile, we *excluded* patients with (a) lesions completely confined to the extremities' soft-tissues (b) a final diagnosis that has been reached through repeated image-guided biopsies (c) lesions having typical imaging and demographic features consistent with "leave me alone lesions"; where a biopsy would not provide additional information or change patient management.

2.3. Patients' demographics and clinic-pathologic data

Medical records and pathologic reports were reviewed to record patients' demographics, relevant clinical history, management strategies used as well as image-guided and/or surgical histopathologic biopsy results

2.4. Lesions' topography and suggested matrix characteristics

The patient's imaging workup, including radiography, CT and MRI, was used to characterize the lesion to be biopsied categorizing them according to: (a) location of the host bone, (b) presence or absence of extra-osseous soft-tissue component (mainly defined by MR), and (c) imaging nature of lesion's matrix (mainly defined by CT) that was described as: (1) lytic (more lysis than normal medullary bone), (2) sclerotic (more dense than normal medullary bone), and (3) mixed lytic and sclerotic (lesions with both dense and lucent components) (Fig. 1).

2.5. Biopsy guidance and procedures

All biopsies were performed; under CT guidance; by one of the authors with several years of experience in musculoskeletal imaging and procedures.

Prior to the procedure, bleeding parameters as well as other laboratory markers were done. An anesthesiologist electively checked the patient and attended the procedure to monitor the patients' vital signs throughout the procedure.

The majority of patients were in a state of conscious sedation so that they could lie down comfortably and as pain-free as possible during the procedure. Only children and apprehensive patients required general anesthesia.

On procedure start, the patient was usually positioned on CT table in a practical way to access the lesion to be biopsied and maximize comfort for both the patient and operator.

Following an initial CT scan through the lesion, the lesion biopsy trajectory was chosen as per the prior interdisciplinary conference discussion. This is to ensure that uninvolved compartments would not be violated during the biopsy procedure and biopsy tract excision can be performed during definitive surgery if appropriate. Furthermore, we considered the previously described guidelines governing image-guided core needle biopsies of extremity long bone lesions when appropriate [12,13].

A strictly aseptic technique is followed as in any invasive procedure. Local anesthetic infiltration; with 1% lidocaine; was delivered along the recommended biopsy needle trajectory to ensure better post-procedure tolerance by the patient. The biopsy procedures were performed using standard coaxial technique to allow multiple passes through a single skin puncture, and a single track.

A 12–14 gauge bone biopsy needle (TrueGuid® disposable coaxial needle/AngioMed/Bard, Karlsruhe, Germany) was advanced through the planned biopsy trajectory to the targeted site. After that the sharp introducer was removed leaving the needle in place to act as a monorail for further biopsy instruments passage.

A 16- or 18-gauge automated biopsy gun system (Monopty biopsy system, Bard, Temp, AZ, USA) is sufficient in obtaining biopsies of lesions without intact cortex and lesions with exophytic growth into the surrounding soft tissues.

Lesions with intact bony cortex were accessed by the drilling action of a 12–15 gauge Ostycut (OstycutTM/AngioMed/Bard, Karlsruhe, Germany) biopsy needle with sharp introducer. Sometimes, gentle tapping with an orthopedic hammer over the Ostycut was needed for more sclerotic lesions.

If a lesion was predominately lytic in nature, after passing through the cortex, aspiration samples were gathered for cytology, biochemistry and bacteriology evaluation. After that, a 16–18 biopsy needle or an Ostycut bone needle was passed through the sheath to curette the wall of the lesion and obtain tissue samples.

In general, our standard practice was to gather three to six core-biopsy specimens per procedure except in small lesions and osseous lesions at risk for fracture with excess manipulation which was left for the judgment of the interventionalist. A subjective assessment of sample adequacy was made by visual inspection at the time of biopsy. Biopsied tissue fragments were placed in 10% buffered formaldehyde solution and sent to histopathology accompanied by a pathology request form providing relevant clinical information including age, sex, involved bone, number of lesions, presence of a pre-existing lesion and provisional imaging differential diagnosis concluded in pre-procedure discussions.

Post-procedural CT scans were acquired to ensure absence of collections or vascular injuries. The patient was then kept under observation for a median of 2 h before discharge, for any potential complications.

2.6. Biopsy results terminologies/evaluation

The initial CT biopsy sample was considered *diagnostic* when complied with one of the following criteria:

(a) Concordant with the results of a post-surgical resection specimen; or
(b) Pathologic examination resulted in a distinctive pathologic diagnosis revealing unchanged imaging features and clinical status on a 12–24 months follow-up.