Bone marrow biopsy needle vs bone biopsy needle in CT guided core biopsies of osseous lesions

Poster No.: C-1650
Congress: ECR 2014
Type: Scientific Exhibit
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Keywords: Interventional non-vascular, Bones, Musculoskeletal bone, CT, Biopsy
DOI: 10.1594/ecr2014/C-1650

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Aims and objectives

INTRODUCTION:

Percutaneous needle biopsy is a safe, cost-effective procedure most widely used for diagnosing osseous lesions\(^1\)\(^2\). Core needle biopsy (CNB) is a cornerstone in evaluation of osseous lesions especially in differentiation between infective, benign and malignant etiologies. Grading of tumors on histology basis as low, intermediate or high grade in nature is also governed by its accuracy. Its accuracy, safety, and cost-effectiveness are therefore highly emphasized. However, open or excisional biopsy remains the reference standard but it is heavily burdened by its complications more than percutaneous biopsies, cost, hospitalization and large incisions made\(^3\)\(^-\)\(^5\).

First and foremost important factor for a biopsy, however, remains its diagnostic yield to make it successful, as it directly affects the future management of the disease process based on tissue diagnosis made. Precision in coming to one conclusive diagnosis out of differentials is also important as it is one of the major advantages of the radiological guided tissue sampling over radiological imaging alone. Failure to produce diagnosis by this technique will lead to resampling, more ionizing dose, cost and pain to the patient and sometimes leads further to open excision biopsies\(^3\)\(^4\)\(^5\).

Selection of needle type is one of the important factors which may directly affect the volume and length of core obtained and thus has a direct impact on the diagnostic yield\(^1\). Nature of the lesion to be biopsied; its type (sclerotic or lytic) and depth (deep or superficial), is also important in making a choice. However, preference of the operator\(^6\)\(^-\)\(^11\) is one of the key factors in a choice of needle. Biopsy is tailored accordingly keeping all these factors in mind.

Gauge of needles ranges from 22 G for fine needle aspiration sets to 11 G for trephine biopsy. In one of the studies, there was no difference in diagnostic yield on the basis of needle gauge or imaging guidance modality\(^12\)\(^,\)\(^13\). To our knowledge, one study did emphasize in improvement in diagnostic yield with decreasing gauge of the needle\(^1\).

OBJECTIVE:

We present our data comparing 11 G bone marrow biopsy needles and 16 G bone biopsy needles. The objective of this study is to compare them in terms of size of core of sample, diagnostic yield of the sample and cost of the needle.

Methods and materials
Total of 68 patients underwent core needle biopsy at department of interventional radiology at Shifa International Hospital, Islamabad, Pakistan. After the approval of study by institutional review board and ethical committee, analysis was done for data collected from May 2008 to July 2013, for 50 CT guided core needle biopsies (CNB), who have complete records in all respect including their histopathology and imaging reports available on computerized hospital information data base. 18 patients out of 68 were excluded due to incomplete data.

Two types of biopsy needles used in our department of interventional radiology, BBN 16 G x 12.5 cm and BMBN 11 G x 10 cm were compared. The collected data included type of needle used, needle cost, biopsy related technical data, radiological features and histological reports. This data was then analyzed regarding the diagnostic yield, length of specimen in each biopsy and cost of both biopsy needles.

All procedures were performed by interventional radiologist with more than 7 years of experience or by a fellow interventional radiologist undergoing fellow-ship training under supervision.

BIOPSY TECHNIQUE: Interventional radiologists performed the biopsies by using standard techniques under computed tomography (CT) guidance. Two standard needle sizes (Fig 1), BBN 16-G x 12.5 cm and BMBN 11G x 10 cm were used for biopsy of bone lesions. Since the bone biopsy needle (BBN) 16-G was commercially expensive, we switched to bone marrow biopsy needle (BMBN) 11G for biopsy of bone lesions, which provided single core of larger sample size and allowed easy operator handling as well (Fig 2 and 3).

Site of biopsies was determined according to standard protocols of the department under CT guidance using metallic markers. All cases were done under local anesthesia. Under CT guidance biopsy needle was slowly advanced till the core of the lesion has been reached with subsequent confirmation on the limited CT scan (Fig 4). Both needles obtained single core by employing non-coaxial technique during each biopsy.

Specimens obtained were put in an individual yellow capped formalin filled container (Fig 5). Each specimen were processed and interpreted in the same container. Labeling of each specimen was done. Requisition form was filled according to the test required. Samples were sent to the pathology lab immediately.

DETERMINANTS:

Diagnostic versus Non-diagnostic:

On the basis of pathologic and clinical follow up data, biopsies were classified as diagnostic or non-diagnostic.
Biopsy was considered diagnostic if a definitive pathologic diagnosis could be determined or if the result proved clinically useful and no subsequent confirmatory tissue sampling was required.

Diagnostic yield was calculated for each needle in percentage by dividing the total number of diagnostic biopsies divided by the total number of biopsies by that needle multiplied by 100.

Biopsy related Factors:

Length of specimen was documented by a consultant pathologist. They were further subcategorized on the basis of a specimen rating system. Longest length of specimens is included in the study for each biopsy if more than 1 core was obtained.

- Small measured less than 1 cm in length.
- Medium specimen measured equal or longer than 1 cm and smaller than 2 cm in length.
- Large specimen measured equal or longer than 2 cm.

Cost of Needles:

Prices of both the needles were compared which were commercially available and average prices were considered in US dollars.

STATISTICAL ANALYSIS:

Data was entered and analyzed using SPSS Version 10. Descriptive statistics were calculated for both qualitative and quantitative variables. Fischer Exact test was applied to determine the difference in length of core and diagnosis among two core needle biopsy groups, keeping p-value <0.05. A t-test was applied to determine the difference in lengths of specimen with BMBN and BBN.

Images for this section:
**Fig. 1:** Bone biopsy needle (16 G) and bone marrow biopsy needle (11 G)
Fig. 2: Performing a spinal biopsy.
Fig. 3: The handle of the bone marrow biopsy needle provides a firm grip while traversing the needle through the osseous structure.

Fig. 4: CT guided core needle biopsy of thoracic spine.
Fig. 5: Specimen preserved in the formalin filled bottle.
Results

A total of 50 CNBs were analyzed.

AGE/SEX

Total 12 males and 4 females underwent biopsy with BBN and 18 males and 16 females had biopsy with BMBN. The mean patient age was 55.13 ± 1.38 years.

BIOPSY RELATED FACTORS

1. NEEDLE TYPE, GAUGE AND DIAGNOSTIC YIELD

Two patients underwent biopsy for two different sites, and one patient underwent biopsy for three different sites. BBN was used in 16 out of 50 biopsies. BMBN was used in 34 out of 50 biopsies.

All biopsies included in the study were performed under CT guidance.

The overall diagnostic yield was 82 % (41 of 50 biopsies). There was an increase in the diagnostic yield from 85 % for BMBN versus 75% for BBN respectively. 12 BBN and 29 BMBN biopsies were diagnostic (Table 1).

2. COST OF NEEDLES

Cost of commercially available BBN is approximately 4 times more than the BMBN needle in our institution (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Core Biopsy</th>
<th>Needle</th>
<th>BBN</th>
<th>BMBN</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>16</td>
<td>34</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>12</td>
<td>29</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>Diagnostic Yield</td>
<td>75%</td>
<td>85%</td>
<td></td>
<td>82%</td>
</tr>
<tr>
<td>Price</td>
<td>$30</td>
<td>$7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. LENGTH OF CORE SAMPLE
In a subset of 50 biopsies for both needles the specimen length was documented on the basis of a specimen rating system (Table 2). Of the 50 specimens, 14 were small specimens, 25 were medium specimens, and 11 were large specimens. Small specimens were obtained equally by both needles i.e. 7 by each needle. Medium specimens were yielded more frequent with BMBN as compared to BBN, 7 versus 18 respectively. Longer specimen was more frequently obtained with BMBN (9) as compared to BBN (2).

<table>
<thead>
<tr>
<th>Size of Core Sample</th>
<th>BBN</th>
<th>BMBN</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (&lt;1 cm)</td>
<td>7</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Medium (1 cm to &lt; 2 cm)</td>
<td>7</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Large (&gt;2 cm)</td>
<td>2</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

TISSUE RELATED FACTORS

Most frequent histological proven pathology was malignancy in our study (n=13). Out of these 10 were metastatic deposits; 2 were from squamous cell CA of lungs, 3 from adenocarcinoma, 1 was poorly differentiated, 1 case each from HCC and ovarian CA and 1 from an unknown primary. Primary malignancy included 2 cases of plasma cell tumor and 1 case of multiple myeloma.

Most common benign pathology was caries spine (n=10). Pyogenic osteomyelitis was found in 4 cases. On the basis of biopsy 14 cases showed benign findings excluding malignancy and tuberculosis.

The 9 cases were non diagnostic with sample tissue either being non representative of the disease or showed clinically non useful findings.

Most of the biopsies were taken from lumbar spine n= 25 (L1=5, L2=5, L3=6, L4=4 and L5=5) followed by thoracic spine n=12 (T5=1, T7=1, T10=2, T9=4, T11=1, T12=3). Other locations included; sacrum=4, ilium=2, pubic ramus=1, rib=1, chest wall=1, femur=1 and tibia=1. 1 biopsy each was performed from L4-5 and L5-S1 disk space respectively, with simultaneous osseous biopsy from adjacent vertebrae.

STATISTICAL ANALYSIS:
Cross-tabulation was applied between type of needle versus diagnostic biopsies, type of needles versus length in categories (BMBN and BBN) and diagnostic biopsies versus length of specimens. Fisher Exact test was applied; p-value was not significant.

A t-test was applied to determine the difference in length of specimen with BMBN and BBN, result was not statistically significant (p >0.05)

Conclusion

DISCUSSION

At our institution, bone biopsy is routinely performed. Since the bone biopsy needle (BBN) 16-G x 12.5 cm was commercially expensive, we switched to bone marrow biopsy needle (BMBN) 11G x 10 cm for bone lesions which provided larger sample size and allowed easy operator handling as well.

Reported rates of biopsy diagnostic yield in the literature ranged from 69% to 88%\textsuperscript{14}. Our study showed similar rates, with a diagnostic yield of 75% with BBN and a higher yield of 85% with BMBN.

In a study of 117 patients Jean et al\textsuperscript{15} experienced significantly higher positive rate for wider gauge of 12.5 G than the narrow gauge of 16 G needle and attributed the higher rate to the needle caliber and the needle design. This is also established that sampling errors may occur due to the small amount of material obtained\textsuperscript{16-17}. In our study using BMBN longer cores of samples (equal and greater than 2 cm) were obtained as compared to BBN, however any significant relation between sample size and diagnostic yield could not be established.

One of the important aspects of our study, we believe, is its diagnostic yield in the spine biopsies. In previous studies there is an evidence that biopsy rates are lower in the spine with diagnostic yield inferior to accuracy\textsuperscript{15 18 19}. In our study majority of our biopsies using both needles were taken from the spine (approximately 86 % of all cases), and out of 34 biopsies performed by BMBN 28 were obtained from spine out of which only 2 spinal biopsies were non-diagnostic.

Lastly, both needles employ non-coaxial technique in which only a single pass could be made in contrast to a co-axial technique in which numbers of passes could be made and multiple samples can be taken. In our experience using these needles the non-coaxial technique proved to be as good as co-axial technique. The basic advantage of coaxial technique is the retrieval of intact sample with adequate size by taking two or
more samples taken in a single biopsy from the same site. By using BMBN we have experienced that BMBN has a high rate of obtaining an intact samples of large sizes. Obtaining a single sample also reduces the biopsy time and risk of injury.

Our study was limited by its retrospective nature. There was also relatively smaller sample size of bone lesions in each group, limiting evaluation of statistically significant difference in diagnostic yield and effect of wider gauge as determinants of success. Nevertheless, we feel that our study provides useful data and comparative data for future studies.

CONCLUSION

CT guided core needle biopsies are accurate as a diagnostic tool and helps in future management of the patient. Bone marrow biopsy needle is a safe with equal diagnostic yield to dedicated bone biopsy needles marketed for use with imaging guidance and has an important advantage of being much cheaper as compared to bone biopsy needle. Also non-coaxial biopsy using these needles can be a safe choice by making a single pass reducing the biopsy time and risk of injury.

Personal information

References