ROLE OF NON COAXIAL BONE MARROW BIOPSY NEEDLE AND BONE BIOPSY NEEDLE IN CT GUIDED CORE NEEDLE BIOPSIES

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ABSTRACT

Objective: To compare bone marrow biopsy needle (BMBN) with bone biopsy needle (BBN) in CT guided core biopsies considering size of core, diagnostic yield and cost of needles.

Methodology: Retrospective study was done on 50 out of 68 patients referred to Interventional Radiology department for CT guided bone biopsy from 2008 till 2013.

Grading of specimen length was done as small, medium and large. Diagnostic yield was determined on basis of clinical, imaging and histopathology data. Local cost of both needle types was determined. Comparison was made and statistical analysis was performed.

Results: Biopsy was performed by BBN in 16 patients and by BMBN in 34 patients. Overall diagnostic yield of bone biopsies was 82 % (41 of 50 biopsies). Diagnostic yield with BMBN was 85 % and with BBN was 75 %. Overall longer specimen length was obtained using BMBN. Statistically, there was no significant difference between them in diagnostic yield and specimen length; however, BMBN costs almost one half than BBN.

Conclusion: Diagnostic yield and sample length using bone marrow biopsy needle proved to be equivalent to bone biopsy needle. Bone marrow biopsy needle has an added benefit of being low in cost. Despite being a non-coaxial technique these needles can achieve diagnostic yield comparable to that of coaxial techniques as reported in past literature.

Key Words: Diagnostic yield, Non-coaxial, Bone biopsy

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INTRODUCTION

Percutaneous core needle biopsy is safe, cost-effective procedure most widely used for diagnosing osseous lesions[1-2]. Core needle biopsy (CNB) is a corner stone in evaluation of osseous lesions especially in differentiation between infective, benign and malignant etiologies. 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 effects the future management of the disease process according to the tissue diagnosis made. 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[3-5].

Two other important factors which directly affect the diagnostic yield are the technique i.e. coaxial or non coaxial technique and type of needle used. In general, a coaxial technique is preferred as it has an advantage of taking multiple cores in one session through a single bone window with reduced radiation to the patient.

Out of large variety of needles available in the market selection will depend mainly on operator's personal preference and experience[6-12]. Another important factor that should be a strong consideration is the length of core or amount of tissue to be acquired for accurate pathologic diagnosis. The bore size of a biopsy nee-

dle is inversely related to gauge; thus, a smaller-gauge needle will yield a larger specimen for analysis. Therefore, a balance should be achieved between optimal sample sizes to be acquired for accurate diagnosis and increase in risk of local complications in case of larger bore (smaller gauge) needles to be used. There are mixed reviews in the literature regarding the effect of needle type on diagnostic yield. In one of the studies, there was no difference in diagnostic yield on the basis of needle gauge[7,13,14], while one study did emphasize in improvement in diagnostic yield with decreasing gauge of the needle[1].

Hence, radiologist should be aware of various techniques and needle types that can be used for the CT guided core needle biopsies. We present our experience with most frequently used biopsy needles in our institute, including large bore small gauge 11 G bone marrow biopsy needles (BMBN) and small bore large gauge 16 G bone biopsy needles (BBN). As in our part of the world one of the major limiting factors in the management of the patient is the cost burden and 11 G bone marrow biopsy needle has an added advantage of being cheap as compared to 16 G bone biopsy needles, that is why we switched to 11 G bone marrow biopsy needles in our department of interventional radiology for biopsies. Both are non-coaxial technique needles and yet in our experience they achieved the comparable diagnostic yield to each other as well as to that of co-axial techniques mentioned in the literature.

METHODOLOGY

Total of 68 patients underwent core needle biopsy in department of interventional radiology at Shifa international hospital. 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). Two types of biopsy needles used in our department of interventional radiology, BBN 16-G x 12.5 cm (Angiotech ostycut) and BMBN 11G x 10 cm (Tsunami Medical) were assessed. 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 6 years of experience or by a fellow interventional radiologist undergoing fellow-ship training.

Among the total 68 core needle biopsy patients record of 18 patients were not included in the study due to incomplete data such as histo-pathology or imaging reports, and were labeled as invalid. Total of 50 patients selected in the study had complete records in all respect including their histopathology and imaging reports available on computerized hospital information data base.

Biopsy technique: Specified interventional radiologists performed the biopsies by using standard technique under computed tomography (CT) guidance. Needle approach was discussed and decided by the head of interventional team. Two standard needle sizes, BBN 16-G x 12.5 cm (Angiotech ostycut) and BMBN 11G x 10 cm (Tsunami Medical) are used for biopsy of bone lesions (Fig.1).

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. Patient was positioned in the CT machine according to the site of biopsy. 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 2).

Specimens obtained were put in an individual yellow capped formalin filled container. Each specimen were processed and interpreted in the same container. Labeling of each specimen included: patient's name, hospital medical record number (M.R number), brief clinical data, sample site and anatomical side (Right or Left). Requisition form was filled according to the test required. Reporting of the procedure included above mentioned features and some additional information; consent taken, sterile technique used, anesthesia used, type and gauge of the needle used, any complication during the procedure, patient's stability while leaving the department and requirement of extra monitoring if applicable. Samples were sent to the pathology lab immediately.

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 is calculated as the number of diagnostic biopsies divided by the total number of biopsies.

Length of specimen received was documented by a pathologist in histopathology report. We further sub-categorized the sample sizes 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 specimen 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 is equal or longer than 2 cm.

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

SPSS Version10 was used. Frequency was calculated for sex, needle's type, length of sample, diagnostic and non-diagnostic biopsies. Mean +/- SD was calculated for age and cost. Cross tabs 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. A t-test was applied between lengths of specimen with BMBN versus with BBN.

RESULTS

A total of 50 CNBs were analyzed. Total 12 males and 4 females underwent biopsy with BBN and 20 males and 14 females had biopsy with BMBN. The mean patient age was 55.84 +/- 1.50 SD (range, 18-82 years).

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). Total of 12 BBN and 29 BMBN biopsies were diagnostic. There was an increase in the diagnostic yield using BMBN in which diagnostic yield was 85 % while with BBN the diagnostic yield was 75 % (Table.1).

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, 28% (n=14) were small specimens, 50% (n=25) were medium specimens, and 22% (n=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 as compared to BBN i.e. 9 versus 2.

In addition, the longest specimen obtained with BMBN was 3.0 cm whereas with BBN it was 2.2 cm. The smallest specimen was obtained with BBN 0.3 cm as compared to BMBN 0.4 cm.

No major complication was observed using either of the biopsy needles.

Cost of commercially available BBN is approximately 2 times more than the BMBN needle in our institution (Table 1).

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.

There was no major complication in any of the biopsies. Few patients complained of pain and were managed conservatively.

There was no statistically significant difference between any of these BMBN versus with BBN groups.

DISCUSSION

At our institution, bone biopsy is routinely performed. Since the bone biopsy needle (BBN) 16-G x 12.5 cm (Angiotech ostycut) was commercially expensive, we switched to bone marrow biopsy needle (BMBN) 11G x 10 cm (Tsunami Medical) for bone lesions which provid-

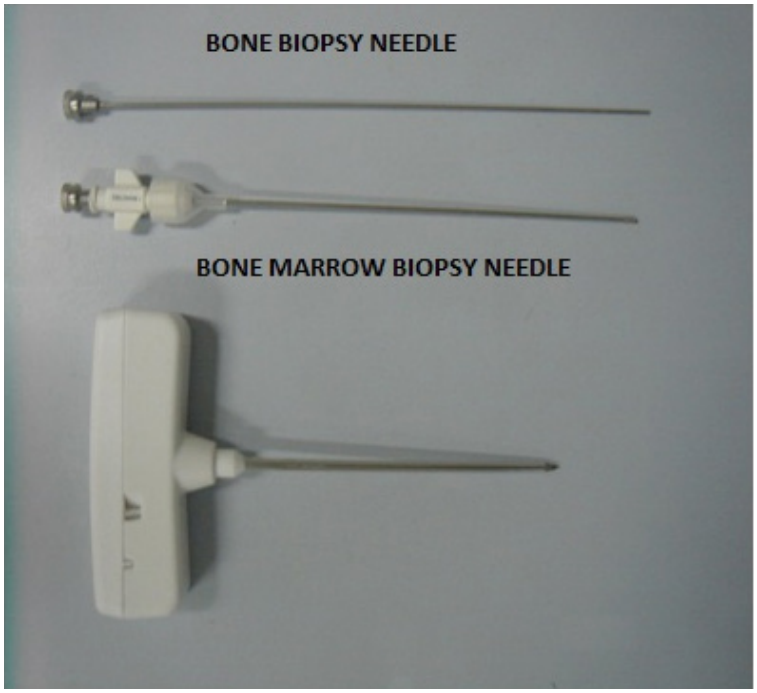
Table 1: Summary of results

VALID DATA	BBN	BMBN	TOTAL
TOTAL	16	34	50
DIAGNOSTIC	12	29	41
DIAGNOSTIC YIELD	75%	85%	82%
PRICE	$35/-	$17/-	
	Rs 3500/-	Rs 1700/-	

Table 2: Specimen rating system

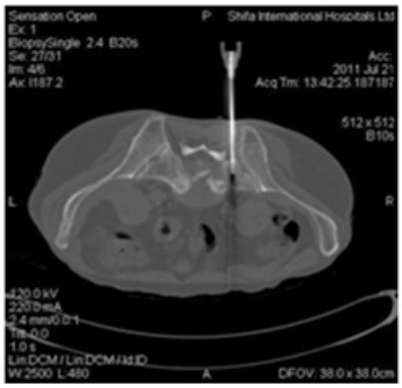
	BBN	BMBN	TOTAL
SMALL (<1 cm)	7	7	14
MEDIUM (1 cm to <2 cm)	7	18	25
LARGE (>2 cm)	2	9	11
LONGEST	2.2 cm	3.0 cm	
SMALLEST	0.3 cm	0.4 cm	

Figure 1: Bone biopsy needle and bone marrow biopsy needle

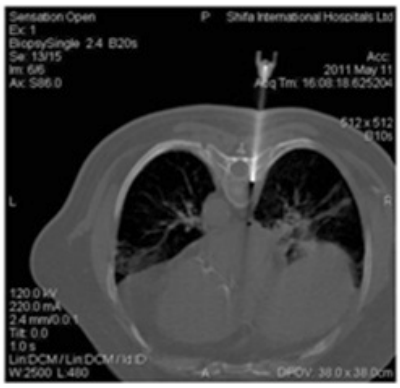


Bone biopsy needle (BBN) 16G x 12.5 cm (Angiotech ostycut)
Bone marrow biopsy needle (BMBN) 11G x 10 cm (Tsunami Medical)

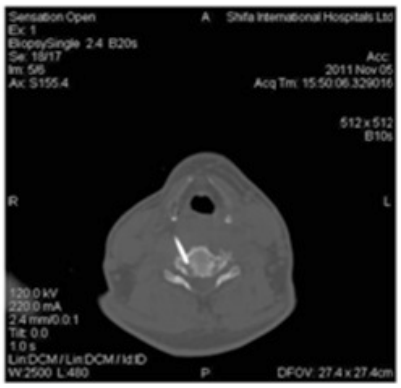
Figure 2: CT guided core needle biopsy



A. Sacral Lesion



B. Thoracic lesion



C. Cervical lesion

ed larger sample size and allowed easy operator handling as well.

Reported rates of diagnostic yield and accuracy of CT guided core needle biopsies in the literature range from 69% to 96%[15]. Our study showed similar diagnostic rates, with a diagnostic yield of 75% with BBN and a higher yield of 88% with BMBN; however there was no statistically significant difference between both the needles. In a study of 117 patients Laredo et al[16] experienced significantly higher positive rate for smaller gauge of 12.5 G than the larger gauge of 16 G needle and attributed the higher rate to the needle caliber and the needle design. We were not able to achieve this significant difference perhaps because of smaller sample size.

This was also established that sampling errors may occur due to the small amount of material obtained in past studies[17,18]. In our study using BMBN larger cores (equal and greater than 2 cm) were obtained more frequently as compared to BBN. No complication was observed in all the biopsies performed with either of the needles, though larger bores may result in local complications.

Robert et al[12] highlighted some important points while comparing various types of needles. They found out that in ease of use, quality of length, post fixation length, post fixation decrease in length, width and in post fixation quality of core, Bard Ostycut 16 G was much inferior as compared to MD tech 11 G with and without trap lock. In contradiction to this Omura et al[15] study emphasized that many variables have no statistically significant difference, one of them being biopsy equipment type.

The basic advantages of coaxial technique are the retrieval of intact sample with adequate size by taking two or more samples taken in a single biopsy from the same site[19]. The needles that we used employed non-coaxial technique in which only single pass was made. In our experience non-coaxial technique using these needles had couple of advantages over co-axial technique. We have observed that BMBN had a high rate of obtaining an intact sample of large size. We frequently divided the larger core into at least two pieces where histology and bacteriology was to be performed as done by Espinosa and colleagues[20]. This large core of intact sample had lower rates of crushed samples as well which some authors found problematic in biopsies particularly in the spine[19]. We also experienced that single long core obtained by BMBN of abnormal tissue was enough for accurate tissue diagnosis rather than taking multiple cores as done in co-axial techniques. Espinosa and colleagues reported the same experience with 11 G needles[20]. Obtaining a single sample also reduced the biopsy time and risk of injury. Espinosa and colleagues reported that larger bore 11-G needle system was not as effective as coaxial needles for sclerotic lesions[20], whereas in our experience that was not the case as according to our interventional radiologists the wide handle of BMBN provided a firm grip for better rotatory motion and penetration in hard sclerotic lesions.

Another important aspect of our study, we believe, is the diagnostic yield of these non co-axial biopsy needles in the spine biopsies. In previous studies there is evidence that biopsy rates are lower in the spine with diagnostic yield inferior to accuracy[16,21,22]. In our study, except for seven out of fifty biopsies, all other biopsies were taken from the spine (approximately 86 % of all cases). Spinal biopsies were performed by BBN in 15 out of 16 cases and performed by BMBN in 28 out of 36 cases, out of which 11 cases (73%) using BBN were diagnostic and 25 cases (89%) using BMBN were diagnostic. We think that higher diagnostic yield in spine was because of the histological and tissue factors affecting the diagnostic yield of percutaneous CT guided biopsies. The commonest pathologies in our study were metastasis and tuberculosis which are more common in the axial skeleton like spine as compared to the appendicular skeleton such as long bones. Metastasis frequently involves red marrow which is more abundant in axial skeleton such as spine. Metastatic deposits have more tissue and stroma increasing the chances of better core and diagnostic yield[19]. In cases of suspected tuberculosis we always divided the core into two for separate histology and bacteriology samples, which also improves the diagnostic yield. Tuberculosis overall in our study was more common in lumbar spine followed by lower thoracic spine as was reported in past literature[23].

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

Non-coaxial CT guided core needle biopsies are safe and accurate as a diagnostic tool particularly in spinal lesions. Bone marrow biopsy needle despite being a wide bore needle, keeps a good balance between adequacy of sample for accurate tissue diagnosis and safety margin. Bone marrow biopsy needles have comparable diagnostic yield to dedicated bone biopsy needles, marketed for use with imaging guidance, with an important advantage of being much cheaper as compared to bone biopsy needle.

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CONTRIBUTORS

HS conceived the idea, planned the study, and drafted the manuscript. AIR and SN helped acquisition of data and did statistical analysis. EMK and MMR drafted and critically revised the manuscript. MYC acquisition of data. All authors contributed significantly to the submitted manuscript.