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Prospective and Retrospective Study of Ct Guided Bone Biopsy

KEYWORDS: Percutaneous,bone biopsy

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ABSTRACT *Aims :*

1. To establish definitive diagnosis of bone pathology by means of CT- guided core needle bone biopsy.

2. Comparison of pre-biopsy radiological diagnosis with post biopsy HPE confirmation

Methods and materials :

50 patients used in the study.

Conducted at Department of Radio diagnosis,

Kasturba Medical College and other affiliated hospitals, Manipal University , Mangalore

Grid method of CT marking in Bright speed / Light speed GE CT equipment.

12gaugeguide with 14 gauge core biopsy Ackermann needle

Results : Our study shows Percutaneous CT guided bone biopsy has higher accuracy rate

1. Diagnostic accuracy varies between 70-93%.

2. For high grade malignant lesions, accuracy rate of definitive diagnosis was more than 90 %.

3. For benign neoplastic lesions, accuracy rate was 80 %

4. For infectious processes, accuracy rate was lower 50%

Conclusions:

Percutaneous CT guided bone biopsy is considered nowadays procedure of choice in musculoskeletal lesions in our institution.

Introduction:

Bone biopsy is removal of piece of pathological bone fragment with the use of biopsy needle , under local anesthesia and CT guidance to distinguish between malignant tumors , inflammatory / infectious conditions and benign bone disease for laboratory examination and analysis.

The radiological study of spinal lesions either infective , tumoral or of different nature has been significantly improved by contribution of CT and MRI imaging. This improvement is essentially morphological and offers an excellent imaging of the anatomical extension as well identification of active parts of the lesion after contrast medium injection**.** The low specificity of these studies however hardly allows a etiological diagnosis based on radio graphical studies alone . For most spinal tumors and psudotumorous lesions a histological study I therefore required in order to make a definitive diagnosis**.**

Accurate diagnosis is essential for work up of any neoplastic lesion and even if modern radiological imaging techniques have a good predictive value in differential diagnosis , histological examination is usually necessary to plan further treatment.[6]

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Open biopsy is a major surgical procedure associated with morbidity and complications . Percutaneous biopsy under CT guidance is safe almost painless.[7]

Percutaneous , image – guided musculoskeletal biopsies provide an accurate , rapid and cost effective method for helping clinicians diagnose benign and malignant musculoskeletal lesions. The reported accuracy of CT guided bone biopsy is 67-97% and the complication rate ranges from 0-26%.

The diagnostic accuracy varies according to the site biopsied , type of disease and operator`s experience . The success rate is higher in malignant lesions , primary and secondary and lower in inflammatory lesions , especially chronic ones . Overall , the false negative rates are low and can be further reduced by careful pre biopsy studying of radiological lesions . Our results are consistent with the data in the international literature.

Objectives of the study :

1. To establish definitive diagnosis of bone pathology by means of Computed Tomography (CT)guided core needle bone biopsy and histopathological examination (HPE)

2. Comparison of prebiopsy radiological diagnoses with post biopsy HPE confirmation.

Subjects :

Prospective and retrospective study of CT guided bone biopsy was conducted at Kasturba Medical College and other affiliated hospitals , Manipal University , Mangalore 50 patients used in the study .

All patients with a suspicious / established radiological diagnosis were included in this study .

Patients with traumatic fractures and bleeding diasthesis were excluded from the study.

Routine investigations were based on the age of the patient , nature and duration of symptoms and clinical impression .

Special investigations like prostate specific antigen , thyroid function tests , andominal ultrasound etc were taken up to rule out any underlying primary pathology or to further confirm the clinical and radiographical diagnosis

Investigations to rule out any bleeding diasthesis like partial thromboplastin time and activated thromboplastin time were done.

The patients , then , after taking prior written consent were subjected to percutaneous CT guided bone biopsy for suspicious osseous lesions.

Materials and methods :

All procedures were done using Bright speed 16 slice / Hi speed single slice GE CT equipment.

Materials :

- Sterile drapes .
- Scalpel , 1% iodine
- Surgical hammer.
- Biopsy needle

For bone biopsies :

- Ackerman bone biopsy needle was used and penetration was carried with surgical hammer . A 12- gauge needle guide with 14 gauge core was used at the .

For soft tissue biopsies :

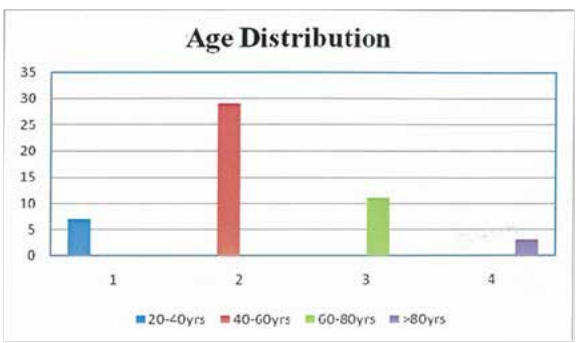
- True cut18gauge needle were used.

Methods :

A single /multi slice axial CT image depicting the lesion was selected . It was performed with the patient in prone/ supine position . The best biopsy approach was determined , traced back to the skin by using cursor on the CT console. The depth of the lesion and cutaneous point entry were determined using skin lead markings . Overlying skin and soft tissues were anaesthetized with local anesthetic usually consisting of 1% lignocaine. The needle was introduced a few centimeters lateral to midline , using an oblique /straight angle (Fig- 4) to avoid vital structures.

Observations and analysis:

- **Age distribution :**



Age (in years)	Number of cases
20-40	07
40-60	29
60-80	11
>80	03

The youngest patient in this series was aged 23 years and oldest was 84 years. . Most of the patients were in 4th of 5th decade of life , with 58% comprising the group. 22 % made up the sixth or seventh decade

- **Sex distribution :**

Males	24
Females	26

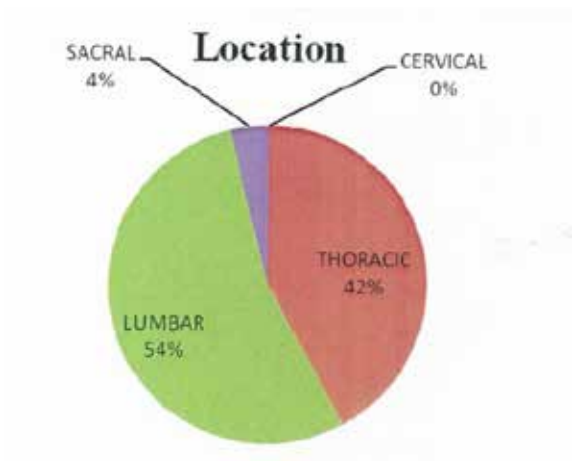


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- **Anatomical distribution of bony lesions :**

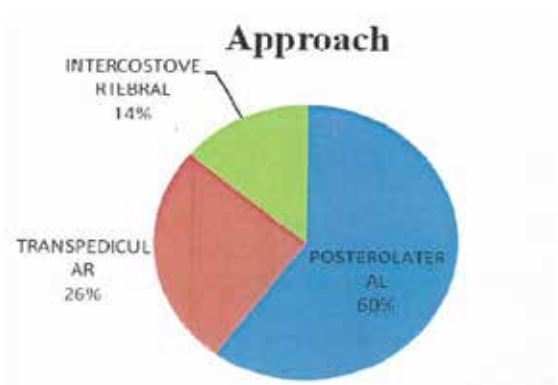
Majority of the lesions were located in thoracolumbar region . Most of the lesions located in T12 and L1 vertebrae were tuberculous in aetiology while most of the lesions in other lumbar vertebrae were due to metastasis or myeloma. 2 patients had osseous lesions in sacrum.

LOCATION	NUMBER
Cervical	0
Thoracic	21
Lumbar	27
Sacral	02



- **Approach used for spinal biopsies :**

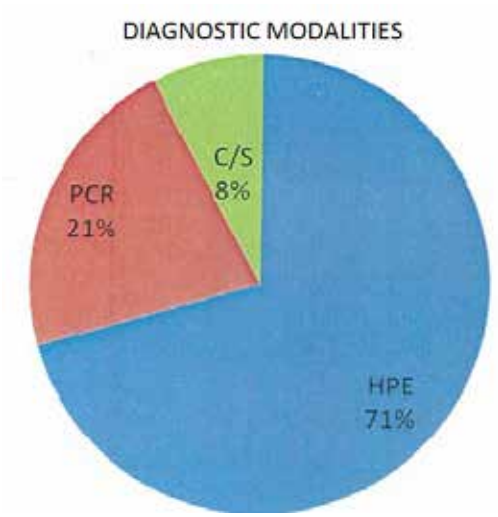
APPROACH	NUMBER OF CASES
Posterolateral	30
Transpedicular	13
Intercostovertebral	07



- **Diagnostic modalities :**

With reference to tuberculosis , the polymerase chain reaction (PCR) is more rapid and reliable method of diagnoses. Tumors can be picked up on histopathological examination provided sufficient material is got during biopsy. Lytic lesions are clearly picked up as compared to sclerotic lesions. A minimum of 2mm aspirate of bone during biopsy is required to aid in proper histopathological diagnoses . In case of Aneurysmal bone cyst , thois method is not applicable .

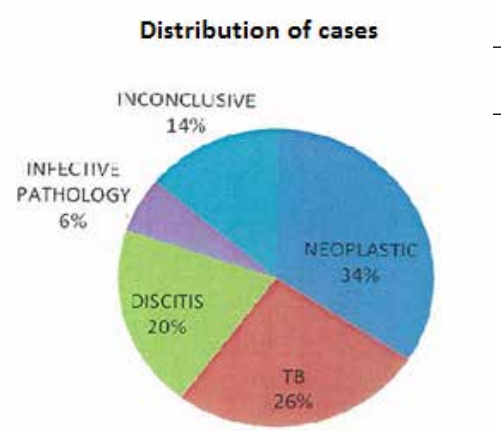
MODALITY	CASES
HPE	36
PCR	11
C/S	04



- **Distribution of cases :**

Among the non neoplasticaetiology , majority of them were tuberculous in aetiology and another group coming under discitis category .

Distribution of cases	Number of cases
Malignant lesions	27

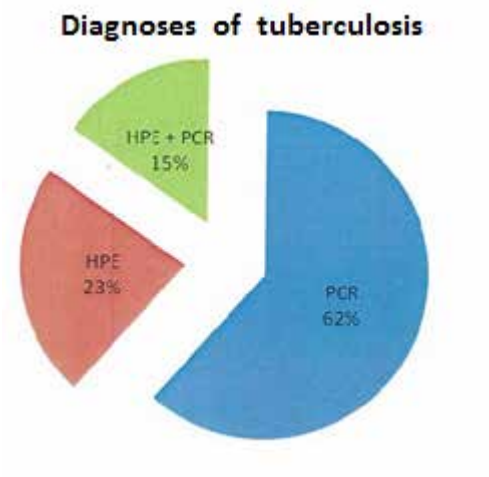


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- **Diagnoses of tuberculosis :**

With special reference to tuberculosis which comprise 26% of the study , 47 % of cases initially came negative fro tuberculosis by histopathological examination came positive in PCR for the same cases.

PCR	08
HPE	03
HPE +	02

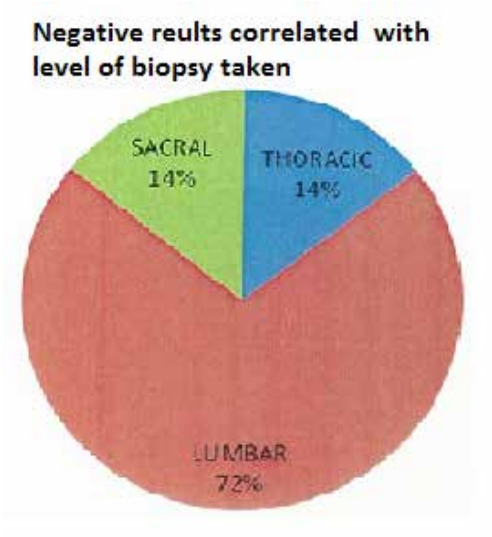


PCR	08
HPE	03
HPE + PCR	02

- **Negative results correlated with the level of biopsy done :**

In our study , 7 results came as negative and majority was from biopsies taken from lumbar spine . In all these cases , biopsies were obtained using posterolateral approach .

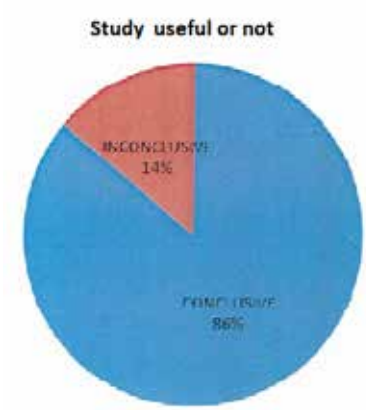
LEVEL	CASES
Thoracic	01
Lumbar	05
Sacral	01



- **Study useful or not :**

Inconclusive results were got when the aspirate was too scanty or insufficient to obtain histopathological diagnoses or when the aspirate showed scanty non specific necrotic material on examination . This percentage of accuracy was found to be well within the range determined by similar studies undertaken elsewhere.

Conclusive	43
Inconclusive	07

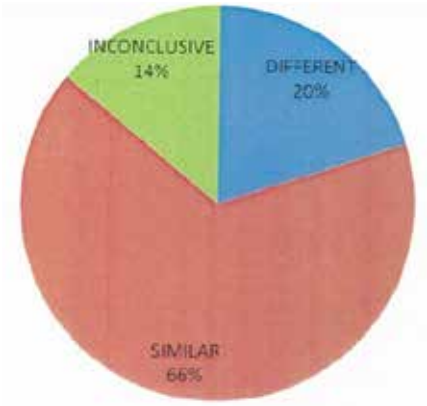


- **Number of cases where the procedure changed the initial clinical and radiological diagnoses :**

Majority of inconspicuous lesions which were thought to be of tuberculous etiology , turned out to be non specific-discitis with histopathological and PCR report being negative for tuberculosis.

Different	10
Similar	33
Inconclusive	07

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- **Complications :**

Hematoma	03
Persistent Pain	09

Discussion:

In any work up of suspected neoplastic bone lesion , even tough advancements in field of radiology which help in narrowing the differential diagnosis , histopathological diagnosis becomes important and necessary to plan the course of further treatment.For obtaining a tissue sample for biopsy , open surgical method and percutaneous needle bone biopsy are the two commonly preferred options. Percutaneous needle bone biopsy is minimally invasive approach for obtaining a sample of tissue for exact histopathological diagnosis especially where in imaging findings are inconclusive. It is safe and accurate method with complication rate of ~1.1% as compared to open biopsy with complication rate of 16% [1,2].

Lesions which are deep seated, especially in the regions of pelvis and vertebral bodies , use of CT guidance for percutaneous tissue sampling has increased the accuracy , reduced the complication rate and nowadays is considered the procedure of choice for percutaneous biopsy in such regions.[3]

This study describes the diagnostic results of the 50 percutaneous CT guided core needle biopsies that were performed on bony lesions in our institution .The major indication was an indeterminate osseous lesion in the bone. .Some interesting findings can be drawn from this series .

- We prefer CT to fluoroscopy because many lesions are difficult to identify on fluoroscopy.
- CT allows better documentation of the placement of biopsy needle within the lesion, especially when cytologic or histologic findings are negative.
- For lesions in which definitive resection would eventually be performed , including resection of the biopsy tract , CT better documents the path of the biopsy needle and skin entry point for the surgeon.

In our study , among the 43 histopathologically positive cases , 27 cases (63%) were neoplastic lesions which included metastatic (18) and primary bone tumours(9) . The rest of the 16 cases (37%)was constituted by tuberculosis(10 cases – 62.5%) and other infective aetiology(6 cases -37.5%). This correlates with the previous literature which have stated that metastatic lesions have higher diagnostic accuracy compared to primary bone tumours / inflammatory conditions[4] . In infectious lesions , there is possibility of negative culture results and non specific histological features . This can lead to false negative diagnosis, especially when patients are on antibiotic or if it is a chronic stage of infection[5].

There are reports stating the diagnostic accuracy of the CT guided bone biopsy depending on the location of the lesion. . Kornblum MB et al reported that CT guided biopsies had lower accuracy rates[6]. Also ,prebiopsy imaging study is very much necessary in order to get high yield of pathological tissue to get conclusive histological diagnosis [5].In our study , highest negative biopsy samples were from lumbar spine (n=5).

Possible explanations for the negative results in our series :

- Immunohistochemistry was negative in some of our needle biopsy , might be due to a technical error during needle biopsy resulting in insufficient amount of sample tissue or non diagnostic tissue.
- Prolonged decalcification during the histologic preparation of the obtained material could have resulted in negative immunohistochemistry.
- When infection is chronic or patient is extensively treated with antibiotics .

Three approaches were used for vertebral biopsies in our study namely posterolateral ,transpedicular and intercostovertebral approach. The posterolateral approach was used more in favour of lesions of the lumbar and lower thoracic vertebrae . The intercostovertebral approach was used in lesions in upper thoracic vertebrae. Posterolateral approach was used among the 5 negative biopsy samples from lumbar region and 1 negative sample from sacral region. Transpedicularapproach was used in 1 negative sample from thoracic region.The accuracy of vertebral biopsy using the posterolateral approach has been estimated at 50% to 91%[7-9]. In our study , it was 88 % accurate in getting adequate tissue sample. The accuracy of percutaneous biopsies using the transpedicular compares favourably with that of biopsies obtained via the posterolateral approach[10]. In our study , out of 13 cases of Transpedicular approach , 1 biopsy specimen inadequate for histological diagnosis.

The expected complications included transient paresis , hematoma pulmonary complications like pneumothorax , inadvertent injury to major neurovascular structures .Hematoma (n=3)which resolved spontaneously in couple of days time and persistent pain (n=9) for 2 days after the procedure were the only complications encountered in our study .

Overall , our results show that percutaneous CT guided core needle biopsy has high accuracy rates . A correct diagnoses was obtained with the procedure in 43 out of 50 cases .7 cases in which CT guided bone biopsy was inconclusive for definitive diagnosis , open surgical biopsy was performed. Sensitivity of CT guided bone biopsy in our study is 86 %.

Our results are consistent with international literature . Diagnostic accuracy varies between 70 – 93 %[3,5,11,12] . For high grade malignant bone tumors and metastasis , Ct

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guided bone biopsy has accuracy of more than 90 % and for low grade malignant and benign tumors around 80 % . Infections have lower accuracy rate around 50 %.

According to our experience , the accuracy rate is influenced by the nature of the lesion more than the site or radiologist`s experience . If the diagnosis after the percutaneous biopsy is negative or the result is not consistent with the clinical suspect and / or radiological imaging , it is mandatory to repeat the needle biopsy or to carry out an open biopsy.No more than three percutaneous biopsies from the same lesion should be performed. Accuracy is further increased by strict collaboration and communication among orthopaedic surgeon , radiologist and pathologist as well.

Conclusion :

CT guided core needle biopsy is a fast , economic and safe procedure .The diagnostic accuracy varies according to the site biopsied , type of disease and operator`s experience . However , if the histological diagnosis after the percutaneous biopsy is still doubtful or the result is not consistent with the clinical suspect and / or radiological imaging , percutaneous needle biopsy should be repeated .

In our institution , percutaneous core needle bone biopsy is considered procedure of choice in musculoskeletal lesions.

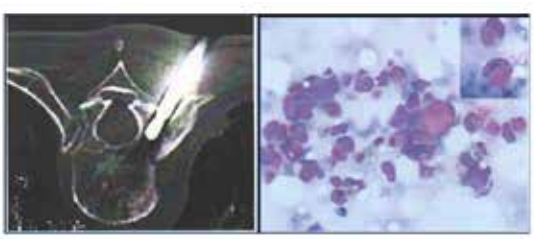


Figure 1 .(a)CT guided biopsy image with delineation bone biopsy needle path.(b)Bone marrow aspirate showing clusters and single scattered cells from gastric carcinoma metastasis.

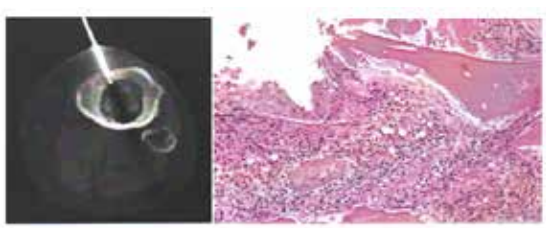


Figure 2.Osteomyelitis of tibia at the level of proximal metaphysis in a 45 years old women. (a)CT guided biopsy obtained using core needle biopsy illustrates the recommended anteromedial approach.(b)Pathological examination found chronic inflammatory cells and bone remodeling which is consistant with chronic osteomyelitis

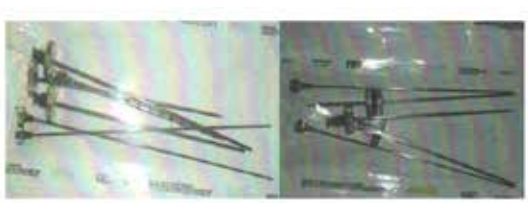


Figure 3.Photograph showing biopsy needles used in our department

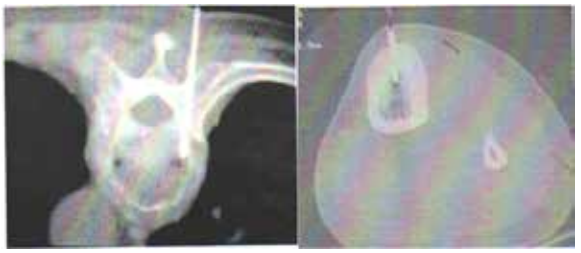
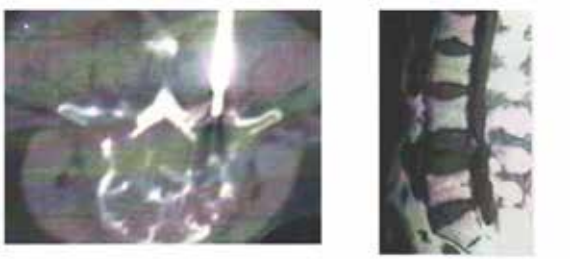


Figure 4.Biopsy of T8 vertebra using transpedicular approach in a 73 years old man with metastasis.(a) CT image taken with a patient lying prone shows the tip of the biopsy needle within the right side of the T8 vertebral body.(b) CT guided biopsy from the aneurysmal bone cyst from the cortex of proximal tibia.



ure 5. Severe L4 compression in a 77 year old women. (a)Axial CT images with patient lying on prone shows biopsy needle inserted into right side of the L4 vertebral body via trans pedicular route(b) sagittal SE T1-weighted MR image showing severe compression of L4 vetrebral body.

Post biopsy diagnosis is tuberculosis of spine.

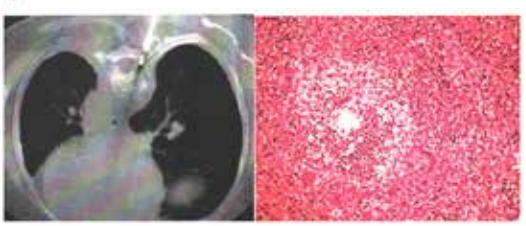


Figure 6.A 58 year old women with history of back and abdominal pain . (a) CT abdomen showed lytic lesion in T7 vertebra .Pre biopsy diagnosis- multiple myeloma /metastasis.(b)Histopathological findings showed tuberculosis.

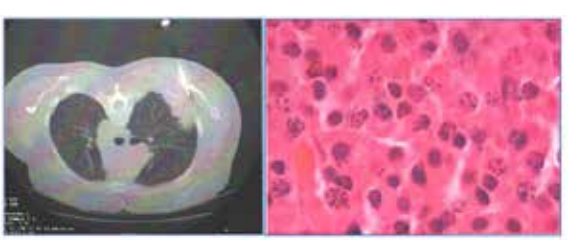


Figure 7.A 45year old female with backpain and tenderness at T5 posterior rib.Prebiopsy diagnosis was osteomyelitis .(a)CT guided biopsy from the lesion performed from supine position.(b)Histopathology showing malignant plasma cells with occational Mott cell, a plasmacell with intracytoplasmicRussel body.

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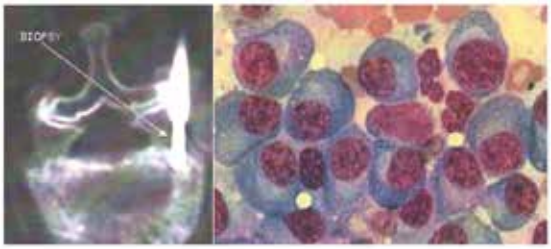


Figure 8.A 68 year old lady with low back pain. CT scan revealed lytic lesions in the L4 and L5 vetrebralbody. Prebiopsy diagnosis was metastasis. (a)CT guided biopsy of L5 vertebra.(b) Histopathological findings showing plasmacells . Note the blue cytoplasm with eccentric nucleus and perinheral pale zone(or Halo)

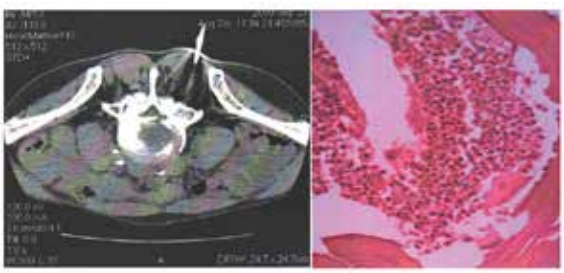


Figure 9.A 55year old male patient with CT scan of lumbosacral spine showing lytic lesion at L5 vertebrae. Pre biopsy diagnosis was metastatic lesion. (a) Bone biopsy done in prone position with posterior approach using 14g biopsy needle.(b) Histopatology findings were consistent with chronic osteomyelitis.

REFERENCE 1 .Welker JA, Henshaw RM, Jelinek J, Shmookler BM, Malawer MM. The percutaneous needle biopsy is safe and recommended in the diagnosis of musculoskeletal masses.Cancer. 2000 Dec 15; 89(12):2677-86. | 2. Mankin HJ, Mankin CJ, Simon MA .The hazards of the biopsy, revisited. Members of the Musculoskeletal Tumor Society.J Bone Joint Surg Am. 1996 May; 78(5):656-63. | | 3. Puri A, Shingade VU, Agarwal MG, Anchan C, Juvekar S, Desai S, Jambhekar NA.CT-guided percutaneous core needle biopsy in deep seated musculoskeletal lesions: a prospective study of 128 cases.Skeletal Radiol. 2006 Mar; 35(3):138-43 | | 4.Kattapuram SV, Rosenthal DI.Percutaneous needle biopsy of the spine. In: Sundarsen N, Schidek HH, Schliller AL, Rosenthal DI, editors. Tumor of the spine: diagnosis and clinical management. Philadelphia: WB Saunders; 1990. pp. 45–61 | 5. Rimondi E, Staals EL, ErraniC ,Bianchi G, Casadei R, AlberghiniM,et al. Percutaneous CT-guided biopsy of the spine: results of 430 biopsies. European Spine Journal. 2008;17(7):975–981. | 6. Kornblum MB, Wesolowski DP, Fischgrund JS, HerkowitzHN.Computed tomography-guided biopsy of the spine.A review of 103 patients.Spine (Phila Pa 1976). 1998 Jan 1; 23(1):81-5. | 7. Stoker DJ, Kissin CM. Percutaneous vertebral biopsy: a review of 135 cases. ClinRadiol 1985;36:569-577 | 8. Bender CE, Berquist TH, Wold LE. Imaging-assisted percutaneous biopsy of the thoracic spine. Mayo ClinProc 1986;61:942-950 | 9. Renfrew DL, Whitten CG, Wiese JA, El-Khoury GY, Harris KG. CT-guided percutaneous transpedicular biopsy of the spine. Radiology1991;180:574-576 | 10. Laurent Pierota and Anne Boulina.Percutaneous Biopsy of the Thoracic and Lumbar Spine: Transpedicular Approach under Fluoroscopic GuidanceAJNR 1999 20: 23-25 | | 11. Madhavan VP, Smile SR, Chandra SS, Ratnakar C .Value of core needle biopsy in the diagnosis of soft tissue tumours.Indian J PatholMicrobiol. 2002 Apr; 45(2):165-8. | | 12. Monti C, Rimondi E, Rollo G, Bettini N, Picci P, Marchi M . Percutaneous computed tomography-guided biopsy in spinal diseases.Radiol Med. 1994 Mar; 87(3):299-304