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Outcomes of Fluoroscopic Guided Percutaneous Transpedicular Vertebral Biopsy

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Abstract: ***Objective: To quantify the results and outcomes of fluoroscopic guided percutaneous transpedicular biopsy of vertebral lesions in our centre. Methods: Retrospective analysis of data collected from consecutive cases of transpedicular biopsy performed in our centre spanning a period of 13 months. Results: We identified 30 patients with complete data who underwent the procedure. We obtained a positive diagnosis in 90% of our patients. Conclusions: Fluroscopic guided transpedicular vertebral biopsy remains a safe and reliable first line method of obtaining a tissue sample in achieving a diagnosis for vertebral lesions.***

Keywords: Transpedicular biopsy, Vertebral lesions, Fluoroscopic guided, Spinal lesions

1. Introduction

We find ourselves encountering an ever increasing number of patients presenting with thoracic and lumbosacral region back pain with a corresponding vertebral lesions on MRI. Reasons for these increasing numbers are: improved general awareness of spine related pathologies and better access to MRI facilities in our region. However, despite performing a through systemic examination with supporting blood investigations and imaging, often these patients have no identifiable systemic problems to indicate the originating pathology. For these patients, a percutaneous transpedicular biopsy is the final step in the diagnosis of their spinal vertebral lesions. Even in patients with known primary tumors, a biopsy of the associated vertebral lesion in these patients are indicated as there are a small percentage of spinal lesions with double pathologies (eg: breast and thyroid cancer metastasis or spinal metastasis and spinal infections).

In our region, where tuberculosis has seen a resurgence, vertebral lesions with disc sparing features on MRI often present the diagnostic conundrum in differentiating between spinal metastasis and spinal tuberculosis. A diagnostic problem also exists in patients with MRI findings of end plate changes which are difficult to differentiate between early spondylodiscitis and degenerative spine Modic 1 changes [5]. These are some examples where despite the thorough history, physical examination, blood investigations and imaging studies, we are still unable to confidently diagnose the vertebral lesion. The ability to obtain a tissue sample of the vertebral lesion for pathological examinations in these cases have become a crucial step in achieving the final diagnosis.

Obtaining a positive result from a percutaneous transpedicular vertebral biopsy can vary from 89-100% [1,2,3,4]. Positive result refers to: positive bone C&S with the organism identified, positive tissue results for tuberculosis (identification of an acid fast bacilli or Langhans giant cells, positive tuberculosis PCR, positive tuberculosis culture or positive for tuberculosis Genexpert testing), significant histopathological examination findings to identify an infective process or identification of malignant cells indicating metastasis.

Open biopsy of vertebral lesions is the traditional method which allows us to obtain tissue samples from the corresponding levels identified on MRI but this method requires the patient to be under general anasthesia and results in a significantly larger incision compared to a percutaneous biopsy which can be done with local anaesthesia utilising only a stab incision. The disadvantage of the percutaneous biopsy method is the amount of tissue sample that can be obtained is generally much smaller and thus may not be representative of the vertebral lesion. Advantages of the percutaneous biopsy in metastatic lesions is the lower chance of metastatic seeding in the biopsy tract compared to the open biopsy method. At our centre, if two attempts at percutaneous biopsy fails to yield a diagnosis, the patient would be counselled for an open biopsy.

2. Method

We collected retrospective data from our centre (from June 2022 until June 2023) and were able to identify 31 consecutive patients who underwent percutaneous transpedicular biopsy of vertebral lesions. The procedure is performed in the general operating rooms. Patients who are ambulatory are admitted from home under the ambulatory daycare centre and if no complications arise post procedure are allowed home the same day. In the operating rooms, the patients are guided to a comfortable prone position on the operating table. During the procedure, the patient's pulse, blood pressure and pulse oximetry are continuously monitored. Imaging during the procedure is using a biplanar C-arm operated by a radiographer. Fluoroscopic imaging is used to identify and mark the pedicles of the vertebral levels intended for biopsy and local anasthesia is given using 1% lidocaine to infiltrate the skin and the biopsy tract. The biopsy instrument used is a 3mm Jamshidi needle. The bone or tissue samples obtained were routinely sent for: histopathological examination (HPE), bacterial culture, TB PCR, tuberculosis culture and TB Genexpert. Once the Jamshidi needle tip is in place at halfway to two thirds of the AP diameter of the vertebral body, a 10cc empty syringe is used to aspirate for any fluid collection. Occasionally, blood

is aspirated and it may yield some tissue sample among the blood clots. These tissue samples are thus sent for pathological examination, often prioritising the histopathological examination as these more vascular lesions are likely to represent blood related malignancies or hypervascular metastases.

3. Result

We identified 31 patients who underwent the procedure during the stated period of time. One patient's had insufficient data and thus was excluded. Of the 30 patients, the demographic breakdown is as follows: 17 (56.7%) male and 13 (43.3%) female, age range was 18-75 years (mean age: 58.1 years, median age: 60.5 years). The vertebral levels biopsied ranged from T6 to S1. Five patients had two levels (adjacent vertebras) where trans-pedicular biopsy was performed during the same setting. The most common levels biopsied was L2 (7/35 = 20%) and L5 (6/35 = 17.1%). Final diagnosis via biopsy results were obtained in 27 patients (90%), the remaining 3 patients had inconclusive results after the transpedicular biopsy examinations.

Two patients had known malignancies (breast ca and chronic lymphoid leukaemia) and both had corresponding metastatic vertebral lesions from the biopsy HPE. Nine patients had new malignancies diagnosed from the biopsy result: 1 hepatocellular carcinoma, 1 plasmacytoma, 1 prostate ca, 2 lung cancer, 2 metastatic adenocarcinomas (undetermined primary location) and 2 metastatic carcinoma (undetermined primary location). Four were diagnosed with pyogenic spondylodiscitis, where two patients had positive blood cultures for *Staph aureus* and the other two showed neutrophilic infiltrates on the HPE and correlating MRI findings for pyogenic spondylodiscitis. Six patients were diagnosed with tuberculosis infection of the spine, where either the HPE showed the pathognomonic Langhans giant cells, or the TB PCR or TB Genexpert was positive for the tissue biopsied. Two patient was diagnosed as as having an old vertebral fracture and four patients were found to have normal bone on HPE. These patients with normal bone on HPE findings were all biopsies taken from lumbar vertebras and were thus concluded to have degenerative lumbar spine. Three patients had inconclusive result from the transpedicular biopsy. In the patients with inconclusive results, the levels biopsied ranged from T12-L5 levels, with two patients having two vertebral levels biopsied. The inconclusive results were reached when the bone HPE showed necrotic bone tissue however, cultures and TB examinations were negative.

We report no complications from this series of patients. The patient who was eventually diagnosed with metastatic hepatocellular carcinoma developed profuse bleeding during the procedure but no hematoma developed after compression was applied. We associated the bleeding to the hypervascular nature of HCC skeletal metastasis [6].

Table 1: List of patients who underwent the percutaneous transpedicular biopsy procedure and the details

	Age / gender	Level of biopsy	Final result
1	69/M	L5	Hepatocellular ca metastasis
2	54/M	L5	Normal bone
3	62/F	L3	Pyogenic spondylodiscitis (Blood: *Staph aureus*)
4	66/M	L2	Pyogenic spondylodiscitis
5	40/M	L3	Spinal tuberculosis (Langhans giant cells seen)
6	46/F	L2	Normal bone
7	64/F	T8	Metastatic carcinoma
8	57/M	L4	Normal bone
9	49/M	L2	Metastatic adenocarcinoma
10	52/F	S1	Spinal tuberculosis (TB PCR positive)
11	18/F	L3	Inconclusive result
12	68/F	L2	Plasmacytoma
13	59/M	T6	Spinal tuberculosis (Langhans giant cells seen)
14	53/M	L4	Pyogenic spondylodiscitis
15	70/M	L5	Lymphoma (known CLL)
16	75/M	L2	Pyogenic spondylodiscitis (Blood: *Staph aureus*)
17	40/M	L5	Normal bone
18	70/M	L2	Old fracture
19	70/F	T9	Metastatic adenocarcinoma
20	47/F	L4	Metastatic carcinoma
21	43/F	L5	Breast ca metastasis (known breast ca)
22	63/M	L2, L5	Inconclusive result
23	48/F	T12, L1	Inconclusive result
24	59/F	L3	Lung adenocarcinoma metastasis
25	67/F	T10, T11	Spinal tuberculosis (TB PCR positive)
26	66/M	T11	Old fracture
27	72/M	T11, T12	Spinal tuberculosis (Langhans giant cells seen)
28	46/M	T11, T12	Spinal tuberculosis (Langhans giant cells seen and TB PCR positive)
29	72/M	T12	Prostate ca metastasis
30	55/F	T12	Lung ca metastasis

4. Discussion

Traditional open biopsy method has evolved into the percutaneous trans-pedicular, fluoroscopic guided biopsy that is ubiquitous in our spine practice today. The biggest advantage with the shift from open to percutaneous transpedicular vertebral biopsies is avoiding general anaesthesia. Some studies show a higher percentage of positive diagnosis in the open biopsies (87.5%) versus percutaneous biopsies (76.5%) [7]. These results are comparable enough that percutaneous biopsy has become the first option for obtaining tissue samples for diagnosis. In events when the percutaneous biopsies results in an inconclusive diagnosis, open biopsy becomes an option to obtain tissue samples. When compared to CT guided biopsies, fluoroscopic guided biopsies have advantage of lower radiation exposure for the patient and the surgeon. In addition, with fluoroscopic guided biopsies, the procedure can be performed in a sterile operating room.

From our data, the lumbar levels showed a higher incidence of inconclusive results compared to thoracic levels in percutaneous biopsies which seems to contradict Yacini's results [7]. Factors that contribute to these results are: very sclerotic or vey lytic types of bone lesion which are difficult to retain in the Jamshidi needle, tissue sample obtained is insufficient and the tissue sample is unrepresentative of the

lesion due to the difficulty in accessing the lesion location on percutaneous method.

In our patients with known malignancies, the HPE of the vertebral lesions corresponds to the primary tumours. In contrast, the patients with unknown primary tumours but are found to have malignant cells on HPE, identifying the primary lesions based on the HPE is more challenging. Often, further examinations, investigations and imaging are needed to locate the primary lesion. Despite these efforts, in 15-20% of spinal metastatic lesions, the primary tumor is unidentifiable or unknown [8].

We found that our patients with "normal bone" results on HPE were all involving the lumbar vertebras and were useful to distinguish between pyogenic spondylodiscitis and degenerative changes. This is especially true in the older patients with co-morbidites such as diabetes and renal impairment. Caution is to be taken to closely monitor these patients in the clinic for worsening symptoms, increasing analgesic requirements and levels of inflammatory markers (we use white cell count, erythrocyte sedimentation rate and c-reactive protein to monitor at our centre).

Transpedicular biopsy to access vertebral body lesion is a safe and easy method to perform. By using a 3mm diameter Jamshidi biopsy needle, and being guided by fluoroscopy, we can stay safely within the cortical walls of the pedicles even at the thoracic levels. A major factor leading to failure to achieve diagnosis from this method of biopsy is the inadequate or unrepresentative bone / tissue sample that is possible to extract. In instances where there is very sclerotic or very lytic bone, the tissue sample may not be retained in the trocar, these tissue samples often get left behind as the trocar is pulled out (despite aspirating using an empty syringe in attempt to create a suction effect) [2,3]. An option to be considered in these difficult to retain lesion is using a larger diameter trocar to allow passage of a small pituitary ronguer to grasp at the lesions which commonly slip out with the Jamshidi needle [4]. In cases where the patients are indicated for spinal surgery, we can also obtain the tissue samples from the vertebra directly via open biopsy.

5. Conclusion

Our data showed a 90% positive biopsy result on performing fluoroscopic guided trans-pedicular biopsy for vertebral lesions. These results are on par with the other studies quoted. This method remains a very important tool in our armada for diagnosing vertebral lesions and has proven to be safe and easy to learn. With an ever increasing population and better awareness of spinal pathologies as well as access to MRI, we expect the number of patients which require vertebral biopsies in their diagnosis process to increase as well. While the majority of our patients have a final diagnosis and thus further relevant treatment, the minority of patients with inconclusive results will require further investigations and detailed clinic follow up.

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Appendix

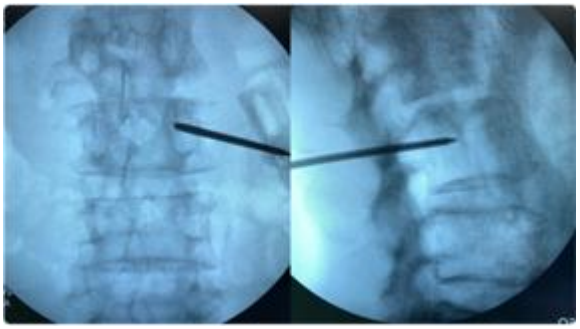

Figure 3: AP and lateral fluoroscopic views with trocar tip at medial border of pedicle in the AP view