The Role of CT-guided Biopsy in the Management of Spinal Lesions

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Abstract

Background: Spinal lesions vary from one case to another and the challenge is still which type of management would be applied and to what extent the reliability of the diagnostic procedure should be. Spinal metastasis is considered the most common spinal lesion and histopathological diagnosis is essential for better management planning. Tissue sample for histopathology could be obtained through open surgery or percutaneous approach. CT guided biopsy became more popular to obtain tissue sample needed for histopathological examination in spinal lesions. In this article we assess the feasibility and accuracy of CT guided biopsy in various spinal lesions and we express the preliminary experience of the neurosurgeon in obtaining CT-guided spinal biopsy.

Material and methods: Under local anesthesia 72 CT guided biopsies had been obtained from spinal lesions in 70 patients. All cases were performed using tru-cut needles, Jamshidi needles and/or spinal needles. 3-5 sample were obtained from each targeted lesion and samples were sent for histopathological diagnosis. All patients have been observed for possible postoperative complication. The histopathological diagnosis was undetermined primarily in six patients and the procedure was repeated in two cases by percutaneous biopsy while open biopsy was done in another two cases.

Results: 72 procedures carried out for the 70 patients, the obtained tissue biopsy was positive for specific pathological diagnosis in 68 patients and the sensitivity was 94.4% with positive predictive value 97% while the specificity was 50% with negative predictive value 66%. Spinal metastasis was the most common lesion among different spinal lesions represented 45/70 (64%) while inflammatory lesions represented 20 % and there are no procedures related complications.

Conclusions: Spinal CT guided biopsy is safe, feasible and accurate modality for proper diagnosis of different spinal lesions that can be performed by spine surgeon with high rate of precision.

INTRODUCTION

Spinal column is the most common site for bony metastasis and became more common finding during the neurosurgical, orthopedic spinal practice. The nature and number of the spinal lesions varies from one case to another and the challenge is still present which type of management would be applied and to what extent the reliability of the diagnostic procedure will be as not all cases are amenable to surgical intervention. Spinal metastases are considered the most common spinal lesions but other pathologies as infections and osteoporotic fracture cannot be excluded without histological diagnosis especially if the patient has a cancer history [1, 2]. Management of spinal metastases may be surgical, radiotherapy, chemotherapy or combined management and the type of surgery is dependent on the type of metastases, general condition of the patient, neurological function and spinal stability, so accurate diagnosis is mandatory for successful management plane but a precise diagnosis usually needs histopathological confirmation of the metastasis and exclusion of other pathology as infection or primary spinal lesions. Biopsy can be obtained as an open surgical procedure which could be major surgery that needs hospitalization, general anesthesia and at the mean time not all patients are amenable for surgical intervention.

Percutaneous biopsy was described for the first time by Robertson and Ball in 1935 when they inserted a needle to the tumor blindly without guidance [3] but with advancement of medical technology, percutaneous biopsy became more popular and could be performed under

fluoroscopic guidance, ultrasonic guidance, CT guidance or MRI guidance [4,5].

For long time percutaneous spinal biopsy was taken under fluoroscopic guidance [6,7], but the popularity of computed tomography guided biopsy is progressively increasing [3,8] as the CT guided biopsy became the modality of choice because it can delineate the lesion and differentiate the bony element and calcifications. Moreover, with the CT guidance we can measure the angles of entry and trajectory of the biopsy needle to avoid injury of the nerves and vessels which is not feasible with fluoroscopic guided biopsy [3,9,10,11,12]. Image–guided percutaneous biopsy gained increasing acceptance as a safe procedure to obtain tissue for diagnosis, with reported accuracy ranging between 68 % to 97 % [8, 9].

The aim of this study is to assess the feasibility and accuracy of CT guided biopsy in various spinal lesions and to express the preliminary experience of the neurosurgeon in obtaining CT-guided spinal biopsy.

MATERIALS AND METHODS

Seventy-two CT guided spinal biopsies were obtained from 70 patients 48 males and 22 females and their age ranged from 18 to70 years with mean age 55.9±10.7. All patients in this study had CT and/or MRI confirmed spinal lesions and the biopsy was planned for histopathological confirmation of the diagnosis.

All patients were exposed to basic laboratory investigations which included complete blood count with differential cell count, coagulation profile, liver and renal function. The procedure was explained to the patients for cooperation during the procedure. All patients were consented for the aim of the procedure and expected possible complications. Whatever the level of the lesion (cervical, dorsal, lumber or sacral) the same steps were carried out. The procedures were done under intermittent CT guidance where preliminary axial CT scanning at the pre-selected levels from previous imaging, contrast generally was not required, and then the most appropriate slice was selected to plan the most suitable entry route for directing the needle into the lesion. In multiple lesions, the largest and the most superficial one was selected while major blood vessels, pleura, peritoneal cavities and spinal canal have been planned to be avoided. All procedures were completed under local anesthesia (xylocain 0.2; infiltrated to the skin and reach the periosteum), ± narcotic analgesic in selected cases for more cooperation. Out of 72 procedures, the prone position was used 69 times (95.8%). The lateral position was used in two cases due to ascites which made the prone position intolerable for the patient. One patient with cervical lesion the procedure was carried out in the supine position in which anterior cervical approach was performed.

Direct posterior or postero-latelal access were used for most of the cases (67/72) and anterior approach was used in one cervical lesion while trans-pedicular approach was used in 4 cases

Tru-cut needles ± spinal needles were used for all cases in the posterior and poster lateral approach while the Jamshidi needle was used in the transpedicular approach and spinal needle only used for the anterior cervical approach case. In this series spinal needles 18-22 G and Tru-cut biopsy needles (autovac & manual) 14-20 G and Jamshidi needles 18 G were used.

Three to five samples were obtained from each targeted lesion. All specimens were fixed in formalin 4% and were sent for histopathological diagnosis. All patients were observed for 60-90 minutes after the procedure to rule out the possibility of early bleeding and any neurological deterioration.

RESULTS

Out of the 72 CT guided biopsy procedures, tissue biopsies were obtained from the cervical spine in 6 procedures (8.3%), thoracic spine in 20 procedures (27.7%), lumber spine in 44 procedures (61.1%) while from the sacrum only in 2 procedures (2.7%). The mean time of the procedure was 70.8±12.7 minutes ranging between 45-90 minutes including the pre-biopsy CT scan and no procedure related complications were encountered.

Metastasis was the most common lesions represented 45/70 (64%) while inflammatory lesions represented 20 %(14/70) (table 1).

Out of the 72 procedures the biopsy was positive for specific diagnostic cells in 68 patients but two of them showed wrong histopathological diagnosis with sensitivity of 94.4% and positive predictive value of 97% while the specificity was 50% with negative predictive value of 66%.There was 6 cases with undetermined or wrong primary diagnosis (table 2).

Table 1

Histopathological diagnosis of the spinal lesions

Pathology	Soft tissue lesions	Mixed lesions	Bony lesion	Total
Metastasis	**9**	**33**	**3**	**45**
Undiff. Carcinoma	-	5	2	7
Hepatoma	-	13	-	13
Adenocarcinoma	3	3	1	7
Squamous cell carcinoma	-	4	-	4
Prostatic adenocarcinoma	4	-	-	4
Thyroid follicular carcinoma	2	4	-	6
Round cell tumour	-	4	-	4
Lymphoma	-	**1**	-	**1**
Multiple Myeloma	-	**3**	**1**	**4**
Neurofibroma	**1**	-	-	**1**
Paraganglioma	**1**	-	-	**1**
Inflammatory	-	**14**	-	**14**
Specific (T.B)	-	2	-	2
Nonspecific	-	12	-	12
Hemangioma	-	-	**1**	**1**
Osteoblastoma	**1**	-	-	**1**
Undetermined pathology	-	**2**	**0**	**2**
Total	**11**	**50**	**9**	**70**

Table 2

Cases with undetermined or incorrect diagnosis

Case No.	Gender	Age	1st biopsy CT-guided	Second biopsy (open)	2nd biopsy CT-guided
1	F	50	Ch. Non-specific inflammation	T.B	-
2	M	23	-ve	Benign osteoblastoma	-
3	F	18	-ve	-	-
4	F	52	-ve	-	***Adenocarcinoma***
5	F	55	Ch. Non specific inflammation	-	Round cell tumour
6	M	46	-ve	-	-

DISCUSSION:

The spinal column is considered the most common site for bony metastases [1]. A precise diagnosis is mandatory for the management plane and usually it needs histopathological confirmation of the metastasis with exclusion of other pathologies as infection or primary spinal lesions.

A biopsy can be obtained as an open surgical procedure or percutaneous with image guidance [9] but the open biopsy is associated with relatively higher rate of morbidity and procedure related complications while the popularity of image–guided percutaneous biopsy was progressively increasing with wide acceptance as a safe, fast procedure for obtaining tissue for histopathological diagnosis, with reported accuracy ranges from 68 % to 97 % [3, 6-9] and at lower cost as well. In percutaneous CT guided biopsy there is no need for hospitalization and can be performed as an one day procedure, mostly under local anesthesia. In addition to the previous merits it has no effect on the hemodynamic stability which occasionally occurs after open biopsy. It also has a significantly lower rate of procedure related infection [3,6-9,13].

For a long time percutaneous spinal biopsies were obtained under fluoroscopic guidance [6, 7], but the popularity of computed tomography guided biopsy has progressively increased [3, 8] and is now the procedure of choice for all spinal lesions whether they contain bony or soft tissue lesions.

Meticulous planning for the target and trajectory of the biopsy needle is mandatory to avoid complications and to increase the accuracy. Hence, the CT guided biopsy became the modality of choice as it can delineate the lesion and differentiate the bony elements and calcifications. Moreover, with CT guidance one can measure the angles of entry and trajectory of the biopsy needle to avoid injury of the nerves and vessels which is not feasible with a mere fluoroscopic guidance [3,9-12] and the ultrasound guiding biopsy for spinal lesions is limited to soft tissue lesions in the posterior column only in thin patients [14].

The spinal lesions may be bony lesions, soft tissue lesions or combined and in this series a soft tissue biopsy was obtained from 11 cases and biopsies from the bone only were obtained in 9 procedures while samples from both soft and bony lesion were obtained in 52 procedures.

It was found that the accuracy of percutaneous image-guided biopsy from bony lesions ranges between 68% to 97% [6-7, 10-14] and in our series there was high rate of accuracy as only we had 6 cases with undetermined or wrong primary diagnosis. The sensitivity was 94.4% with a positive predictive value of 0.97 while the specificity was 50% with a negative predictive value of 0.66. This rate of accuracy could be attributed not only to the advantage of the CT in the lesion detection and its ability to differentiate between bony and soft tissue lesions but also to the previous experience of the operator in the field of open spinal surgery which improved the anatomical orientation in target planning and entry root for the biopsy needle. This translated into a relatively higher diagnostic accuracy.

Most of the spinal lesions can be approached from posterior by the paravertebral approach [15, 16] or trans-pedicular technique [17] but also the lateral approach can be used in the lesions of the lumbar spine [18]. In the current series, most of the cases were performed while the patients were in the prone position using the posterior approach whether a direct posterior or poster lateral one. The trans-pedicular

approach was used only in only 4 cases as it is usually limited to absolute vertebral lesions [19-20] without soft tissue or paravertebral components. It also it possesses a relatively higher risk of inappropriate direction during the procedure because it necessitates a precise working angle and narrow tract through which the needle must be inserted [18]. In spite of the fact that the lateral approach may provide a wider field for the biopsy and can be used for lesions in the vertebral bodies or the paravertebral lesions or the intervertebral disc itself [18], in this series it was not used and even in cases when lateral position was needed, a posterior approach was carried out successfully. This could be explained by the familiarity of the operator with the spinal anatomy from the back owing to the previous experience from the open spine surgical procedures.

During the CT guided biopsy procedures, the operator has to obtain at least three specimens and to achieve this target the operator should be oriented by radiological anatomy of the spine and the needle length should be enough to reach the lesion. There is broad spectrum of needles can be used for biopsies which could be classified into aspiration needles (spinal or Chiba), cutting or tru-cut needles (Quick-core or Temno), and trephine (Ostycut, Craig or Ackerman) needles. In this series, the types of needles used included spinal needles 18-22 G as aspiration needle. Tru-cut needles used were (autovac & manual) 14-20 G and Jamshidi needles 18G. The most important complications in radiological guided biopsy are nerve root injury and vascular injury [19], while other complications as bleeding, needle breakage, infection, formation of a draining sinus, pneumothorax and tumor seeding along the needle tract also have been reported.

In spite of the reported complications in CT guided biopsies being less than in open biopsy, their reported incidence rates of complications are between 0 to 10% while serious complication rates are less than 1% [9,21,22]. In this series, no procedure related complication was encountered and this is could be related to the precise preoperative planning regarding the target and trajectory and good anatomical orientation of the spine.

CONCLUSION

Spinal CT guided biopsy is safe, feasible, and an accurate technique for proper diagnosis of different spinal lesions and it can be performed by a spine surgeon with a high rate of precision.

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