The Results of Comparisons between CT-Guided and Fluoroscopic-Guided Spinal Biopsy

Somchai Cherdchukiatsakul MD*

** Department of Orthopaedic Surgery, Rajavithi Hospital, College of Medicine, Rangsit University, Bangkok, Thailand*

Background: *Various methods have been described for biopsy of spinal lesions. In the past, fluoroscopes were used to guide the performance of biopsy of spinal lesions while computed tomography (CT) is now available in many hospitals. The purpose of the present study was to determine the rate of successful diagnosis of spinal biopsy by the CT-guided technique compared to the fluoroscopic-guided technique.*

Objective: *To compare the success rate in diagnosis of vertebral disease and ensuing complications when using CT-guided and fluoroscopy-guided biopsy.*

Material and Method: *Two study groups were compared in order to establish their respective diagnostic success rates and complications. The CT-guided spinal biopsy group consisted of 10 patients (4 males, 6 females), and the fluoroscopic-guided spinal biopsy group was composed of 16 patients (6 males, 10 females).*

Results: *CT-guided spinal biopsy showed a diagnostic rate of 80.0% compared to a rate of 81.3% achieved by the fluoroscopic-guided technique (p = 1.000). For thoracic vertebrae, the diagnostic rates were 100% and 62.5% respectively. The figures were not statistically significant (p = 0.491), but the CT group showed a tendency towards a higher rate of success. No complication was noted in any of the patients.*

Conclusion: *CT-guided spinal biopsy in thoracic vertebrae had a higher success rate in the diagnosis of spinal lesion than the fluoroscopic-guided maneuver, but the results were not statistically significant. In addition, the CT-guided technique was safer for the patient.*

Keywords: *Needle biopsy, Fluoroscopy, Computed tomography, Spinal diseases, Thoracic vertebrae*

J Med Assoc Thai 2013; 96 (Suppl. 3): S59-S63
Full text. e-Journal: *http://jmat.mat.or.th*

There are various causes of vertebral lesion. Occasionally, these are problematic for surgeons because it is difficult to establish an accurate diagnosis. In general, the diagnosis of vertebral diseases can be put into two categories: infection (bacteria, mycobacteria) and tumor (primary bone tumor, metastasis). Therefore, spinal biopsy is a crucial tool for helping surgeons to determine diagnosis via histopathology[1-5].

In 1956, Hadjipavlou et al[6] proposed a back spinal biopsy maneuver using a paravertebral approach which became a very well-known technique. However, there were some complications, such as bleeding, spinal cord injuries and pneumothorax. Subsequently, a technique was developed using a fluoroscope for spinal biopsy[7]. Although this technique was still a back-entry technique, the transpedicular approach decreased the incidence of pneumothorax and great vessel injuries. Jelinek et al[8] reported a success rate of diagnosis for this technique of 81.3%.

Currently, computed tomography (CT) has attained widespread use because it employs 3D and series cross-sectional images. This technique can identify both depth and direction[9,10], and CT for spinal biopsy was first used in 1986. In his 1988 study, Kornblum et al[11] reported that there was a 71% success rate in the diagnosis of vertebral disease using CT-guided biopsy in 103 patients which was the largest sample size used in any study up to that time.

The objective of this research was to compare the success rates in the diagnosis of vertebral disease and any complications of using CT-guided and fluoroscopy-guided biopsy.

Material and Method

The protocol of this research was reviewed and approved by the ethics committee of Rajavithi Hospital. All patients who had vertebral lesions in Rajavithi Hospital in the period from December 2006-January 2009 were reviewed. The inclusion criteria were patients with vertebral lesion who had undergone

Correspondence to:
Cherdchukiatsakul S, Department of Orthopaedic Surgery, Rajavithi Hospital, College of Medicine, Rangsit University, 2 Phyathai Road, Ratchathewi, Bangkok 10400, Thailand.
Phone: 0-2354-8108 ext. 2242
E-mail: somchai_cherd@hotmail.com

spinal biopsy (transpedicular approach) either by fluoroscopic-guided or CT-guided spinal biopsy. The exclusion criteria were patients who had undergone spinal biopsy by an open technique, patients who could not tolerate biopsy, and patients who had coagulopathy.

CT-guided group

CT-guided spinal biopsy was done step by step. The patient was prepared in the prone position on the CT scanner, and then the direction marker was applied on the back near the biopsy site. The patient was first scanned to scout plain film, and the biopsy landmark was identified. The vertical landmark was set under the CT image and the horizontal landmark was set under the direction marker. Next, the patient was infiltrated with xylocaine and an incision of about 0.50 cm was made at the intersection of the vertical and horizontal landmarks. Then, Craig needle biopsy was inserted, and rescanning was done to confirm the direction, depth and landmark of the Craig needle biopsy. The biopsy was then performed and the appropriate depth was determined from CT scanning.

Fluoroscopic-guided

In the fluoroscopic-guided group, biopsy was performed using the fluoroscopic-guided technique, entering from the back direction using the transpedicular approach. Demographic data such as age, gender, lesion sites and complications were recorded after the biopsy.

The author defined two terms of results as shown below:

1. Success: the biopsy had adequate tissue for evaluation by pathologists according to the institute standards and had specific diagnosis of the pathological tumors or infection.

2. Failure: the biopsy had inadequate tissue for evaluation by pathologists; there was histopathology demonstrating non-specific inflammation; there was suspicion of the presence of any other definite connective tissue disease; or there was no bacterial growth in cultures.

Statistical analysis

Descriptive results of continuous variables were expressed as mean, minimum, maximum and standard deviation (SD) and categorical variables were expressed as numbers and percentages. Statistical analysis was performed using Chi-square or Fisher's Exact tests to compare the success rate of diagnosis from CT-guided and fluoroscopic-guided spinal biopsy. A p-value of less than 0.05 was set for statistical significance.

Results

Ten cases in the CT-guided group and 16 cases in the fluoroscopic-guided group were evaluated. In the CT-guided group (Table 1), the mean age was 54.4 years (SD = 13.78, range 31-70). All levels of spinal lesion biopsy including thoracic, lumbar, and sacrum

Table 1. General characteristics of sample group

Data	CT-guided (n = 10)		Flu-guided (n = 16)		Total (n = 26)	
	n	%	n	%	n	%
Sex						
Male	4	40.0	6	37.5	10	38.5
Female	6	60.0	10	62.5	16	61.5
Age(years)						
Mean $\pm$ SD	54.40 $\pm$ 13.78		60.44 $\pm$ 14.44		58.12 $\pm$ 14.23	
Min-Max	31-70		25-82		25-82	
Biopsy level						
Thoracic	4	40.0	8	50.0	12	46.2
Lumbar	5	50.0	7	43.8	12	46.2
Sacrum	1	10.0	1	6.3	2	7.7
Provisional Diagnosis						
Neoplasm	8	80.0	10	62.5	18	69.2
Infection	2	20.0	6	37.5	8	30.8

*CT = computed tomography, Flu = fluoroscopic

are shown in Table 2. Indications for spinal biopsy were diagnosis of metastatic cancer (8 cases) and diagnosis of infection (2 cases). In this group, 2 out of 10 cases were defined as failures (Table 4). In one case, the specimen demonstrated non-specified tissue. Subsequently, the patient underwent gastroscopy and biopsy and was diagnosed with adenocarcinoma. In the other case, the clinical diagnosis was spondylo-discitis and the histopathological results demonstrated non-specified inflammation (Table 3). The culture result was negative. In conclusion, the success rate of diagnosis was 80.0% (Table 4).

The mean age of the fluoroscopic-guided group was 64.4 years old (SD = 14.44, range 25-82) (Table 1). Three 3 of the 16 cases were defined as failures. In conclusion, the success rate of diagnosis was 81.3% (Table 4).

No patients had any complications (i.e. neurological system, vascular system and wound complications).

Discussion

Spinal biopsy has been performed for more than 60 years by both posterolateral approach and

Table 2. Spinal biopsy level

Site	CT guided (n = 10)		Flu guided (n = 16)		Total (n = 26)	
	n	%	n	%	n	%
Thoracic 2	0	0.0	1	6.3	1	3.8
Thoracic 3	0	0.0	1	6.3	1	3.8
Thoracic 10	2	20.0	1	6.3	3	11.5
Thoracic 11	1	10.0	2	12.5	3	11.5
Thoracic 12	1	10.0	3	18.8	4	15.4
Lumbar 1	2	20.0	1	6.3	3	11.5
Lumbar 2	1	10.0	1	6.3	2	7.7
Lumbar 3	0	0.0	1	6.3	1	3.8
Lumbar 4	2	20.0	1	6.3	3	11.5
Lumbar 5	0	0.0	3	18.8	3	11.5
Sacrum	1	10.0	1	6.3	2	7.7

CT = computed tomography, Flu = fluoroscopic

Table 3. Diagnosis of disease

Diagnosis	CT guided (n = 10)		Flu guided (n = 16)		Total (n = 26)	
	n	%	n	%	n	%
CA nasopharynx	1	10.0	0	0.0	1	3.8
CA stomach	1	10.0	0	0.0	1	3.8
Hemangioma	0	0.0	1	6.3	1	3.8
Lymphoma	1	10.0	0	0.0	1	3.8
Metastatic adeno CA	2	20.0	3	18.8	5	19.2
Multiple myeloma	2	20.0	1	6.3	3	11.5
Plasmacytoma	1	10.0	0	0.0	1	3.8
Renal cell Ca	0	0.0	1	6.3	1	3.8
Undifferentiated CA	0	0.0	3	18.8	3	11.5
TB spine	0	0.0	4	25.0	4	15.4
Spondylo discitis	1	10.0	0	0.0	1	3.8
Suspected TB spine	1	10.0	2	12.6	3	11.5
Suspected metastasis	0	0.0	1	6.3	1	3.8

CT=computed tomography, Flu = fluoroscopic

Table 4. Success rate

Data	CT guided	Flu guided	Total	p-value
All data (n_{CT}: n_{Flu} = 10:16)	8 (80.0)	13 (81.3)	21 (80.8)	1.000[a]
Tumor case(n_{CT}: n_{Flu} = 8:10)	7 (87.5)	9 (90.0)	16 (88.9)	1.000[a]
Thoracic vertebral lesion (n_{CT}: n_{Flu} = 4:8)	4 (100.0)	5 (62.5)	9 (75.0)	0.491[b]
Lumbar vertebral lesion (n_{CT}: n_{Flu} = 5:7)	3 (60.0)	7 (100.0)	10 (83.3)	0.152[b]
Sacrum vertebral lesion (n_{CT}: n_{Flu} = 1:1)	1 (100.0)	1 (100.0)	2 (100.0	-

Value were represented as n (%). [a] = p-value from Chi-square test, [b] = p-value from Fisher's Exact test

transpedicle approach. The biopsy procedure can be done in both vertebral body and intervertebral disc.

To avoid complications, a fluoroscope has been developed for biopsy[12]. Currently, CT scanning is widely used in order to increase diagnostic accuracy and reduce the incidence of complications[1,6,13,14]. In the present study, it was found that using CT-guided spinal biopsy had a successful diagnosis rate of 80.0%, while the fluoroscopic-guided spinal biopsy produced an 81.3% successful diagnosis rate. There was no statistically significant difference between the results of the two groups (p = 1.000) (Table 4). In the analysis of tumor patients, the success rates of diagnosis were 87.5% and 90.0% (p = 1.000) (Table 4). On the other hand, in the thoracic vertebra area, the success diagnosis rates were 100.0% and 62.5.0% respectively (p = 0.491) (Table 4).

This is the first study comparing CT-guided spinal biopsy and fluoroscopic guided spinal biopsy which revealed no complications in either method.

A limitation of the present study was its small sample size. The author is in the process of collecting further data and a final report will be published in the future.

In conclusion, CT-guided spinal biopsy in the thoracic vertebra had a higher rate of successful diagnosis than the fluoroscopic guided maneuver, but the results were not statistically significant. There was no difference in complications between the two methods. CT-guided spinal biopsy is a technique which is easy to learn and safe for the patient. Thus, this procedure can be performed by a general surgeon.

Potential conflicts of interest

None.

References

1. Mick CA, Zinreich J. Percutaneous trephine bone biopsy of the thoracic spine. Spine (Phila Pa 1976) 1985; 10: 737-40.
2. Rieneck K, Hansen SE, Karle A, Gutschik E. Microbiologically verified diagnosis of infectious spondylitis using CT-guided fine needle biopsy. APMIS 1996; 104: 755-62.
3. Vialle R, Mary P, Tassin JL, Parker F, Guillaumat M. Charcot's disease of the spine: diagnosis and treatment. Spine (Phila Pa 1976) 2005; 30: E315-22.
4. Boriani S, Weinstein JN, Biagini R. Primary bone tumors of the spine. Terminology and surgical staging. Spine (Phila Pa 1976) 1997; 22: 1036-44.
5. Monti C, Rimondi E, Rollo G, Bettini N, Picci P, Marchi M. Percutaneous computed tomography-guided biopsy in spinal diseases. Radiol Med 1994; 87: 299-304.
6. Hadjipavlou AG, Kontakis GM, Gaitanis JN, Katonis PG, Lander P, Crow WN. Effectiveness and pitfalls of percutaneous transpedicle biopsy of the spine. Clin Orthop Relat Res 2003; 54-60.
7. Dave BR, Nanda A, Anandjiwala JV. Transpedicular percutaneous biopsy of vertebral body lesions: a series of 71 cases. Spinal Cord 2009; 47: 384-9.
8. Jelinek JS, Kransdorf MJ, Gray R, Aboulafia AJ, Malawer MM. Percutaneous transpedicular biopsy of vertebral body lesions. Spine (Phila Pa 1976) 1996; 21: 2035-40.
9. Brenac F, Huet H. Diagnostic accuracy of the percutaneous spinal biopsy. Optimization of the technique. J Neuroradiol 2001; 28: 7-16.
10. Kang M, Gupta S, Khandelwal N, Shankar S, Gulati M, Suri S. CT-guided fine-needle aspiration biopsy of spinal lesions. Acta Radiol 1999; 40: 474-8.
11. Kornblum MB, Wesolowski DP, Fischgrund JS, Herkowitz HN. Computed tomography-guided biopsy of the spine. A review of 103 patients. Spine (Phila Pa 1976) 1998; 23: 81-5.
12. Minart D, Vallee JN, Cormier E, Chiras J. Percutaneous coaxial transpedicular biopsy of vertebral body lesions during vertebroplasty. Neuroradiology 2001; 43: 409-12.
13. Hoffer FA, Strand RD, Gebhardt MC. Percutaneous

biopsy of pyogenic infection of the spine in children. J Pediatr Orthop 1988; 8: 442-4.

14. Peh W. CT-guided percutaneous biopsy of spinal lesions. Biomed Imaging Interv J 2006; 2: e25.

การศึกษาเปรียบเทียบผลการตัดชิ้นเนื้อจากกระดูกสันหลังระหว่างการใช้ computed tomography และ fluoroscopy

สมชาย เชิดชูเกียรติสกุล

ภูมิหลัง: *การตัดชิ้นเนื้อจากกระดูกสันหลังสามารถทำได้หลายวิธีด้วยกัน ก่อนหน้านี้ได้มีการใช้ fluoroscopy เป็นเครื่องมือช่วยในการตัดชิ้นเนื้อ แต่ในปัจจุบันนี้มีการพัฒนานำเครื่อง computed tomography (CT) มาใช้อย่างแพร่หลายในโรงพยาบาลต่างๆ*

วัตถุประสงค์: *เพื่อประเมินอัตราความสำเร็จในการวินิจฉัยโรค โดยใช้เครื่องมือช่วยในการตัดชิ้นเนื้อจากกระดูกสันหลังด้วยการใช้ CT เปรียบเทียบกับการใช้ fluoroscopy*

วัสดุและวิธีการ: *ศึกษาในกลุ่มผู้ป่วยที่ได้รับการการตัดชิ้นเนื้อจากกระดูกสันหลังด้วยการใช้ CT จำนวน 10 ราย (เพศชาย 4 ราย, เพศหญิง 6 ราย) และในกลุ่มผู้ป่วยที่ใช้ fluoroscopy จำนวน 16 ราย (เพศชาย 6 ราย, เพศหญิง 10 ราย) วัดผลโดยการบันทึกอัตราความสำเร็จในการวินิจฉัยและภาวะแทรกซ้อนของทั้งสองกลุ่ม*

ผลการศึกษา: *กลุ่มผู้ป่วยที่ได้รับการการตัดชิ้นเนื้อจากกระดูกสันหลังโดย CT มีอัตราความสำเร็จของการวินิจฉัยเท่ากับ 80.0% ในกลุ่มที่ใช้ fluoroscopy พบมีอัตราความสำเร็จของการวินิจฉัยเท่ากับ 81.3% ซึ่งไม่มีความแตกต่างกันทางสถิติ (p = 1.000) ในขณะที่ในรอยโรคที่กระดูกสันหลังระดับอก (thoracic vertebra) พบว่าอัตราความสำเร็จในการวินิจฉัย CT เท่ากับ 100% มีแนวโน้มที่สูงกว่าในกลุ่มที่ใช้ fluoroscopy ซึ่งมีอัตราความสำเร็จเพียง 62.5% แต่อย่างไรก็ตามความแตกต่างดังกล่าวไม่มีนัยสำคัญทางสถิติ (p = 0.491) จากการศึกษาพบว่าไม่มีภาวะแทรกซ้อนในผู้ป่วยทั้งหมดที่ได้รับการผ่าตัดทั้ง 2 วิธี*

สรุป: *การตัดเอาชิ้นเนื้อจากกระดูกสันหลังโดย CT มีแนวโน้มว่าอัตราความสำเร็จของการวินิจฉัยโรคสูงกว่าวิธีทำโดย fluoroscopy ที่ระดับ thoracic vertebra แต่ความแตกต่างดังกล่าวยังไม่มีนัยสำคัญทางสถิติ นอกจากนี้ยังพบว่าการตัดเอาชิ้นเนื้อจากกระดูกสันหลังโดย CT ถือเป็นการผ่าตัดวิธีหนึ่งที่มีความปลอดภัยสูงโดยไม่พบว่ามีภาวะแทรกซ้อนเกิดขึ้นในผู้ป่วย*