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Fluoroscopic versus Conventional Computed Tomography-Guided Biopsy

Background/Objective: To determine the success rate of computed tomographic (CT) fluoroscopic CT (FCT) and conventional CT (CCT) for needle navigation in biopsies from mediastinum, bone, abdomen, liver and pelvis.

Patients and Methods: Data from 122 consecutive percutaneous interventional biopsies performed with use of FCT guidance (mean age of 50.5; range: 1-79 years) and 84 consecutive biopsies with CCT guidance (mean age: 50.7; range, 12-83 years) were gathered from the interventional radiologist and general practitioner.

Results: The success rate of procedure was increased in the FCT group as compared with that of CCT group in some organs such as bone, abdomen, liver and pelvis. A statistically significant difference was noted when we compared FCT group with CCT in liver biopsies ($P=0.019$). The mean procedure time was lower in FCT group. The overall mean (\pm SD) FCT time was 200 ± 90 (range: 20-400) sec; in CCT group, it was 420 ± 260 (range: 605-800) second.

Conclusion: FCT facilitates CT-guided biopsy procedures and reduces the procedure time by allowing visualization of the needle tip from skin entrance to the target point.

Keywords: tomography, x-ray computed, fluoroscopy, radiology, interventional

Introduction

The safety and accuracy of imaging-guided percutaneous needle biopsy have been well documented.¹⁻⁴ Because percutaneous intervention is less invasive and more cost-effective than surgery, the number of radiologic procedures is continually increasing.

Computed tomography (CT) has been used to guide interventional procedures from 1976.⁵ This modality is the modality of choice for guidance in many interventional procedures because of its ability to provide images from areas such as bone, retroperitoneum and lungs, not well seen by ultrasonography (US).^{5,6}

A limitation of conventional CT (CCT) is lack of real-time images during the procedure.⁷

More recently, fluoroscopic CT (FCT) has been developed, which provides real-time reconstruction. This modality allows faster image reconstruction, near-continuous image update, and convenient in-room table control and image viewing during CT-guided procedures.

The objective of this study was to determine the success rate of CCT and FCT in taking biopsies from mediastinum, bone, abdomen, liver and pelvis.

Patients and Methods

Our study population consisted of patients with abdominal, pelvic, mediastinal, bone and liver masses for whom biopsy was taken using either FCT or CCT

guidance (Figs. 1 and 2). All procedures were performed by one radiologist. Medical records of 122 patients who underwent percutaneous interventional biopsy using FCT guidance (Somatom Plus 4, Siemens, Germany) during June 2004 to July 2005 were studied. The data gathered were compared with those obtained from 84 patients who underwent biopsies during the same period using conventional spiral CT scan (X Vision, Toshiba Medical Systems, Japan). Informed consents were obtained from all patients enrolled in this study. All biopsy samples were studied by an expert pathologist who was blinded for the type of biopsy. Success of the procedure was defined as obtaining sufficient tissue to allow the pathologist to make an accurate diagnosis. The procedure was considered unsuccessful when the pathologist's report was either "tumor is not seen," or "re-biopsy is needed."

The procedure time for each biopsy was defined as the interval the radiologist was in the CT room. These times were recorded in a standardized data sheet. The same stopwatch was used for each patient.

Statistical analyses were performed by SPSS ver. 11.5. A p value less than 0.05 was considered statistically significant.

Results

Baseline demographic data are presented in Table 1. Number of procedures and mean ages stratified according to the organ biopsied are shown in Table 2.

Fig. 1. CT fluoroscopy-guided biopsy of a sclerotic lesion in L₁ vertebra.

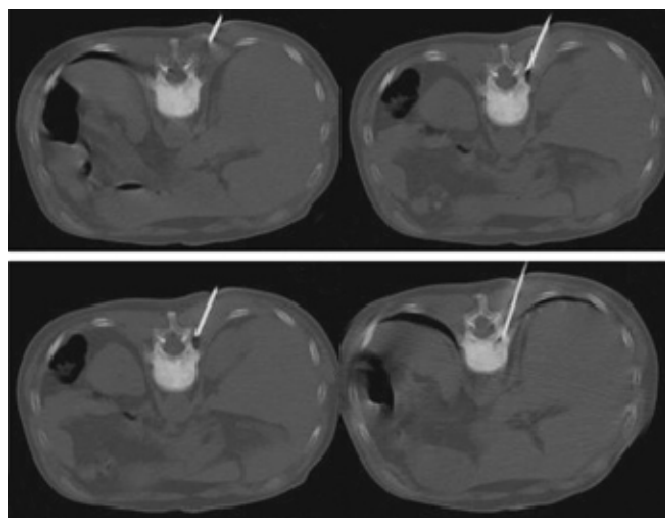


Table 1. Baseline Data of Patients

CT Scanner	Female n (%)	Male n (%)	Mean age (range)
Fluoroscopy	50 (41)	72 (59)	50.5 (1-79)
Conventional	41 (49)	43 (51)	50.7 (12-83)
Total	91 (44)	115 (56)	50.6 (12-83)

The highest number of biopsies was that of mediastinal masses followed by liver and bone masses (Table 2). Success rates for biopsies stratified according to anatomic location of biopsies in FCT and CCT groups are presented in Table 3. No difference was observed between the success rate obtained by FCT or CCT in biopsies of mediastinal, bone, abdominal and pelvic masses. The success rate of FCT (92%) however, was significantly ($p=0.019$) higher than CCT (65%) in taking biopsy of liver masses (Table 3). The mean (\pm SD) procedure time for FCT group was 200 ± 80 (range: 20-400) sec and for CCT group was 420 ± 260 (range: 605-800) sec ($p=0.001$).

Discussion

CCT has been widely used and has been proven to be effective and safe in percutaneous interventions.⁸⁻¹¹ This procedure however, has limitations due to lack of real-time capability. In using CCT in interventions, following each needle or catheter advancement, it is necessary to obtain multiple CT cuts which increases the likelihood of occurrence of needle-tip artifact.^{12,13}

Contrary to fluoroscopy, CT-guided procedures are difficult in uncooperative patients and in organs that are prone to respiratory motion—such as aorta, liver and lung.¹²⁻¹⁴

FCT is a valuable technique for imaging guidance in the majority of percutaneous interventions,¹⁵ which was first described for clinical use by Katada, *et al*, in 1994.¹¹

This technique combines the advantages of CCT with the speed and accuracy of real-time ultrasound or conventional fluoroscopic guidance.¹² FCT images allow sufficient visualization of the region of interest (needle tip and lesion), so that the needle tip may be visualized continuously during needle advancement. FCT significantly decreases the procedure time when compared with CCT-guided techniques. Time saving predominantly is a result of the increased speed of

Table 2. Number of Procedures and Mean Ages Stratified according to the Organ Biopsied

Site	Total Number	Mean Age (range)	Number of FCT	Number of CCT
Mediastinal Mass	81	49.7(1-83)	43	38
Bone Mass	40	48.3 (14-77)	26	14
Abdominal Mass	15	59.5 (38-75)	7	8
Liver Mass	55	53.7 (11-75)	38	17
Pelvic Mass	15	41.5 (12-70)	8	7

Table 3. Success Rate for Biopsies Stratified according to Anatomic Location of Biopsies

Site	Biopsy Type	Negative Number	Success Rate (%)	P value
Mediastinum	FCT	9	79	0.35
	CCT	5	87	
Bone	FCT	3	89	0.21
	CCT	4	71	
Abdomen	FCT	1	86	0.56
	CCT	3	63	
Liver	FCT	3	92	0.019
	CCT	6	65	
Pelvis	FCT	1	88	0.56
	CCT	2	71	

needle localization provided by FCT.^{16,17}

It is even possible to further shorten the procedure time with gaining more experience in placement of the needle.¹³

Although FCT is a useful targeting technique, significant radiation exposures may hamper its use. Therefore, radiologists need to be aware of different methods of FCT guidance and the factors contributing to radiation exposure.¹³

Although the differences were not all significant, except for mediastinal masses, we found higher success rates of biopsy taken by FCT than those taken by CCT guidance. One probable reason may be the difficulty of the patients who were referred for FCT-guided biopsies; another contributing factor may be the fact that in biopsy of mediastinal masses we did not have any dominant movements, as we have in organs near the aorta or respiratory system, which

reduces the difference in success rates between these two methods.

Compared with results obtained with CCT, our results showed the successful use of FCT to guide liver biopsy procedures.

One limitation of our study was that we did not measure the radiation dose the patient received. Another limitation was that we performed fluoroscopic biopsy for more difficult cases which may be the probable reason for worse results in mediastinal masses. Despite this limitation, fluoroscopic results were better than the conventional type and if we randomize our patients to these two modalities, fluoroscopic results may be better than what we observed in this study. The most important limitation of our study was that we did not mention dosimetry of these procedures which has an important role in choosing one of these methods.

Fig. 2. CT fluoroscopy-guided biopsy of a para-aortic lymph node.

In conclusion, careful use of FCT is helpful for interventional radiologists by allowing them to visualize the needle tip from its entrance site to the target point; no doubt, it will reduce complication rates as a result of preventing biopsy repetition.

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