



ORIGINAL ARTICLE

**Assessing the Site of Skin Entry in CT Guided Biopsies by an Additional CT Scan with Local Anesthesia Needle in situ**

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**Abstract**

**Background and Aims:** A guidance system, when integrated into CT-guided procedures, may improve the safety and outcome of the procedure. This study aimed to evaluate the error rate concerning the site of needle entry after planning with the help of an additional scan with the local anaesthetic needle in situ. **Settings and Design:** Consecutive cases booked for CT-guided biopsies were included in the study prospectively from 01 November 2018 to 21 November 2018. An additional CT scan was performed in the region of local anaesthetic infiltration, with needle left in situ. The location of skin entry was compared between the planning CT and the CT after placement of the local anaesthetic needle. This can be easily learned and reproduced in a different centre on different CT machinery. Any mismatch identified was corrected by inserting a local anaesthesia needle into the newly marked site and CT-guided procedure was completed. **Results:** There were 3/71 CT-guided biopsies in which a change in the site of skin entry was detected, out of which one was on the wrong side of the body and two were errors in Z-axis. There were 3 cases of pneumothorax noted post biopsy. There was adequate histopathological yield and radiation dose was within safe limits. **Conclusions:** This novel technique of checking the local needle placement prior to proceeding with the CT-guided procedure with larger needle helps to identify errors in the placement of the needle. This would further help in selecting the correct site of biopsy, improving the yield, and reducing complications.

**Keywords:** CT guided procedures, Local anaesthesia needle, Yield, Complications

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## Graphical Abstract

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#### Background

A guidance system, when integrated into CT-guided procedures, may improve the safety and outcome of the procedure. This study aimed to evaluate the error rate concerning the site of needle entry after planning with the help of an additional scan with the local anaesthetic needle in situ.

#### Setting and Design

Consecutive cases booked for CT-guided biopsies were included in the study prospectively from 01 November 2018 to 21 November 2018. An additional CT scan was performed in the region of local anaesthetic infiltration, with needle left in situ. The location of skin entry was compared between the planning CT and the CT after placement of the local anaesthetic needle. This can be easily learned and reproduced in a different centre on different CT machinery. Any mismatch identified was corrected by inserting a local anaesthesia needle into the newly marked site and CT-guided procedure was completed.

#### Planning CT includes measurements, point of skin entry



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**Conclusions** This novel technique of checking the local needle placement prior to proceeding with the CT-guided procedure with larger needle helps to identify errors in the placement of the needle. This would further help in selecting the correct site of biopsy, improving the yield, and reducing complications.

## Introduction

Histopathological diagnosis of various lesions can be made using CT-guided biopsy. In addition, clinically inaccessible lesions can undergo biopsy using this technique. Early diagnosis with this modality can reduce morbidity and mortality. For example, for lesions in lung [1] and vertebral bodies, CT-guided biopsy is preferred and largely replaces an open biopsy.

We use a novel approach to guidance by introducing an additional check scan using the local anesthesia needle. This is done after administering local anesthesia at the region of planned skin entry. A check scan is done to confirm the site of planned skin entry and the entry site is adjusted if there is a change in the same.

## Methods

### Patient Population

All patients undergoing CT-guided procedures with an additional check scan with a local anesthesia needle were recruited for this study. The patients who did not consent were excluded from the study. The study was carried out from 01 November 2018 to 21 November 2018 in a tertiary care center in south India.

### Procedure

The study was performed in Philips brilliance CT equipment (402, 4th Floor, Worldmark, Sector 65, Gurugram, Haryana 122018). Hematological parameters like PT/APTT, platelets, and hemoglobin are reviewed and discussed with the hematologist about the need for blood products which is required during and after the procedure. Blood-borne virus screening is done and necessary precautions and segregation of the procedure items which came in contact with the patient's blood are

done by the procedure team. All the procedures are done on an in-patient basis.

CT-guided biopsy can be performed on a routine CT machine. Various guidance systems including laser guidance system [2] and robotic arm are used to improve the success rates. However, guidance systems come with the costs of installing additional equipment and training. We used 2% lignocaine as a local anaesthetic, subcutaneous injection, maximum of 10 ml was injected. Artificial intelligence was not used in this study.

### Steps of Procedure

1. Positioning of patient on table:

The position of the patient is decided based on the location of the lesion and in view of avoiding vital structures.

2. Planning CT with a linear marker on the patient's body:

The marker is a linear piece of an angiographic catheter, wrapped on adhesive tape and placed on the patient's body before the planning CT. The linear radio-opaque line on the CT is used as a reference point to plan the point of entry of the needle.

3. Planning of the track of biopsy needle:

The point of skin entry, depth of needle to be inserted, and angle of entry are determined on planning CT (Figure 1). These are done in the console and a separate monitor is available in the procedure room to review the planning CT during the procedure.

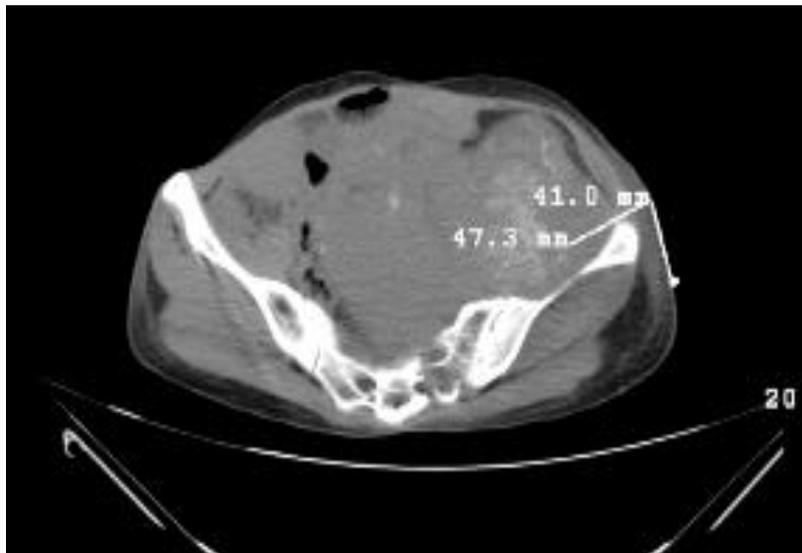


Figure 1. Planning CT includes measurements, point of skin entry, and angle of entry of the needle.

4. Marking on the skin:  
The marking is done on the planned site of needle entry after verbal consent.

The marking is usually a cross or in form of a T (Figure 2).



Figure 2. Skin marking on where the point of entry is planned as per the planning CT.

5. Local anesthesia:

The local anesthesia needle is placed at the skin marking. This is a crucial step in this study. The local anesthesia needle is placed according to the angle and at the site of the marking done on

the skin as pre-planned in the planning CT (Figure 3). After the local anesthesia is administered, the needle is left in place and at the same orientation as the planned track of biopsy needle.



Figure 3. Local anesthesia needle left in place at the same site of planned skin entry with same angulation.

6. Limited CT with local anesthesia needle in situ:

A check CT is done after the local anesthesia needle is left in place (Figure 4). This additional step is done to confirm the planned track is being followed by the local anesthesia needle and as a reference for the biopsy needle to follow the same orientation. This orientation of the local anesthesia

needle is closely studied by the radiologist. The radiologist tries to replicate this while placing the biopsy needle. This helps to home in on the target with accuracy. This improves the yield and avoids complications. This may not add significantly to the procedure time or have additional patient discomfort.



Figure 4. Check CT with the local anesthesia needle.

7. Biopsy needle placement:

The biopsy needle placement is done at the site marked and according to the

angle of the planning CT and the orientation of the local anesthesia needle (Figure 5).



Figure 5. Biopsy needle insertion at the same site and angulation of the local anesthesia needle.

8. Check CT:

This step is essential to confirm the position of the biopsy needle tip inside the lesion of interest (Figure 6), to

calculate the excursion distance of the biopsy needle and to take the tissue sample.

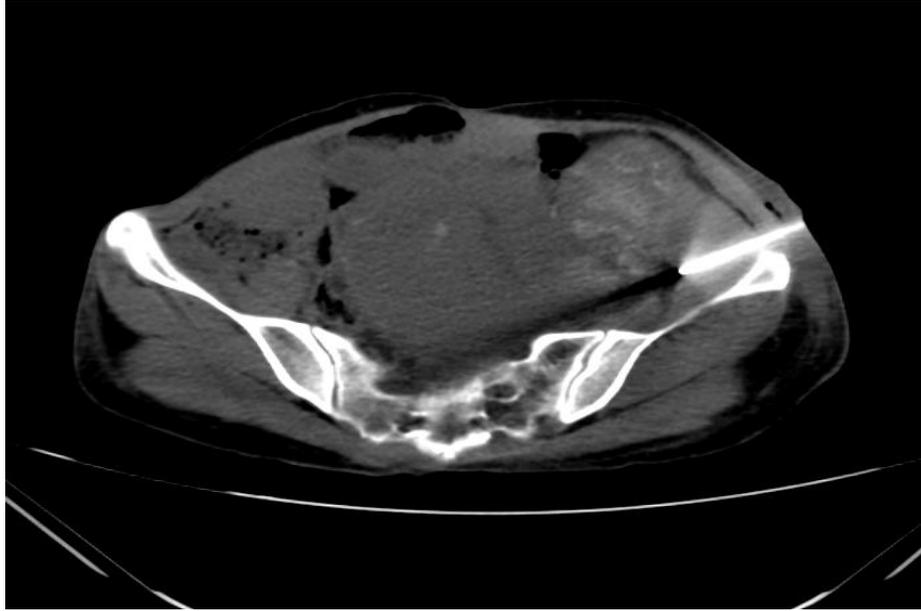


Figure 6. CT check scan with biopsy needle in place

9. Biopsy:

Biopsy is done by the radiologist using the biopsy gun (Figure 7) and the

sample is grossly checked for adequate quantity, if there is pus then an aspiration/drainage can be planned.



Figure 7. Biopsy is being performed with a biopsy gun.

10. Check CT:

This is done to check for complications like pneumothorax, intra-abdominal bleed, to look for the path of the biopsy needle, and to confirm the sample has been taken from the area of interest within the lesion.

Total radiation dose during the procedure (calculated in terms of dose length product) of all the patients from the dose report was sent to PACS at the end of the study. The total radiation doses were presented as mean radiation doses.

**Statistical Analyses**

The outcome of 71 patients who underwent the procedure using laser guidance was recorded and analyzed. The analyses were in terms of percentage, mean, median, and range.

The difference in the site of skin entry, anatomical location of the lesion, complications, and yield were calculated in terms of percentage. If the change in position of local needle is more than 0.5 cm from the planned CT trajectory, we assume that it is more likely that the biopsy needle may not follow the planned trajectory.

Complications were noted at the time of the procedure from the console and images of the same were sent to the PACS server. The data on the adequacy of the sample (yield) was obtained from the clinical workstation.

**Results**

There were 71 CT-guided procedures during the study period. There were 35 males and 36 females. The mean age of patients was 46 years, with a range varying between 12-77 years. The number of cases in which changes in the site skin entry of the biopsy site were found on the check scan done with the local anesthesia needle in situ. Change in site of entry was taken only in cases where there was more than 0.5 cm difference between the planned site of skin entry and the actual site of biopsy. 3 such cases were found (Table 1). Out of the three cases found to have a change in skin entry site, one was change in the side of the biopsy in a paravertebral soft tissue biopsy and two were due to change in Z-axis in a cases of biopsy of lung lesions (Table 2). Repositioning of the needles was done in these cases and procedures were carried out successfully.

Table 1. Frequency of significant differences (>0.5 cm) between planned and actual skin entry sites detected on check scan with local anesthesia needle in situ.

<b>Significant difference more than 0.5 cm in site of skin entry</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	68	95.8	95.8	95.8
	Yes	3	4.2	4.2	100.0
	Total	71	100.0	100.0	

Table 2. Distribution of needle position changes detected on check scan, categorized by change of side or change in Z-axis.

Needle position	Frequency	Percent	Valid Percent	Cumulative Percent
no change	68	95.8	95.8	95.8
change of side	1	1.4	1.4	97.2
change in z axis	2	2.8	2.8	100.0
Total	71	100.0	100.0	

Out of the 71 cases, the most common procedure was biopsy of lung lesions (22, 30.9%), followed by vertebral and para-vertebral lesions (18, 25.3%) (Table 3). The yield was calculated based on the histopathology and culture reports retrieved from the hospital clinical workstation. There

were no inadequate samples reported from the pathology department (Table 4). The mean radiation dose was 535 mGy-cm (Table 5) with a standard deviation of 272 mGy-cm. There were 3 cases (13.6%) of pneumothorax found (Table 6) during the procedures and they were all managed conservatively.

Table 3. Distribution of biopsy sites among study participants.

Site of procedure	Frequency	Percent	Valid Percent	Cumulative Percent
Lung lesion	22	30.9	30.9	30.9
Vertebral and para-vertebral	18	25.3	25.3	25.3
Mediastinum	5	7.04	7.04	7.04
Renal abscess drainage	4	5.6	5.6	5.6
Others	22	30.9	30.9	30.9
Total	71	100.0	100.0	100.0

Table 4. Adequacy of biopsy yield based on histopathology and culture reports

Yield		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	adequate	62	87.3	87.3	87.3
	not applicable	9	12.7	12.7	100.0
	Total	71	100.0	100.0	

Table 5. Summary statistics (mean, median, range) of radiation dose length product during CT-guided procedures.

<b>Radiation_dose_mGycm</b>		
N	Valid	51
	Missing	20
Mean		535.55
Median		493.00
Std. Deviation		272.651
Minimum		133
Maximum		1646
Percentiles	25	361.00
	50	493.00
	75	674.00

Table 6. Frequency and type of complications observed during CT-guided procedures.

<b>Complications</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	68	95.8	95.8	95.8
	Pneumothorax	3	4.2	4.2	4.2
	Total	71	100.0	100.0	100.0

## Discussion

CT-guided procedures have become an inevitable aspect of clinical practice which provides much required histopathological diagnosis. This modality has a high diagnostic accuracy and safety profile [3]. CT-guided procedures are especially useful in intra-thoracic and intra-abdominal lesions [4,5]. Usually, CT-guided procedures are carried out on a normal CT gantry with an additional guidance system. Many guidance systems are studied or used in various centers around the world. Few of them are laser, real-time 3D navigation systems, and smartphone-guided systems [6,7]. However,

these guidance systems come with additional costs and software/hardware inclusions to the existing CT machine and console. These procedures can alternatively be carried out by a novel technique by using the local anesthesia needle as a guidance system. This method not only has the advantage of guiding the radiologist to the target lesion but can also find the discrepancy in the site of planned skin entry, thus avoiding inadvertent larger biopsy needle entry. This may prevent complications such as large vessel, ureteric injury, and increase the yield. This technique can be easily adopted and reproduced across different centers and CT platforms.

Further new residents may feel confident when given an additional check scan prior to the actual biopsy.

Our results showed that there were three instances where there was change in the site of skin entry (>0.5 cm) which was detected by this method. There were 3 (13.6%) instances of pneumothorax out of the 22 biopsies performed for lung lesions. A meta-analysis published by Ya Ruth Huo et al showed a pooled rate of pneumothorax after CT-guided lung biopsies to be 25.9% [8]. The p value when compared to a large study of CT guided lung biopsies, was less than 0.5 [10]. Another study in Indian population showed a complication rate of 13.9% [11]. There were no other complications in biopsies involving other organ systems. There was a 100% yield. The mean radiation dose was 535 mGy-cm, with a standard deviation of 276, which is comparable with a study published by Shuai Leng, in which the median dose length product of CT-guided procedures were 657 to 2351 mGy-cm [9]. When compared to laser guided system, our technique showed better results in terms of complications and yield [2].

This technique can be practiced on a routine CT machine. This may improve the safety, yield, reduce the radiation dose and complications. There are no additional consumables required.

The drawback of this study includes a short additional time required for the extra scan with local anesthesia in situ also warn that the length or placement of the needle used for the local anesthesia should be such that it should not reach the pleural space. In cases where a wrong location was identified

with the help of local needle, we relocated the correct site, and the procedure was continued. Hence, we do not have a comparison arm to test the complication rate if a coaxial biopsy needle would have been inserted in the wrong location.

### **Conclusion**

Assessing the site of skin entry in patients undergoing CT-guided biopsies by an additional CT scan with local anesthesia needle in situ is a simple technique. In this short series, we identified errors in longitudinal (Z) and transverse (XY) planes. While performing CT-guided procedures, this technique can be easily adapted with no additional consumables in low resource settings. Studies with larger numbers and multicentric trials may be necessary to further assess the yield and reduce the complications.

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### **Conflict of Interest**

No conflicts of interest were declared by the authors.

### **Ethical Approval**

Ethics committee approval for this prospective study was obtained.

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