The use of computed tomography (CT) for patient biopsies was first performed in 1975 [1]. A year later, CT was widely regarded as the most limited CT fluoroscopy to guide needle placement.

To our knowledge, the utility of a dedicated planning CT for bone marrow biopsies has not been described. The purpose of this study is to evaluate the impact of eliminating the dedicated planning CT on various technical aspects of the procedure including total dose, use of CT fluoroscopy, procedure time, and biopsy quality.

Radiologists should endeavor to reduce unnecessary radiation exposure while performing CT guided procedures. Previous research with respect to CT-guided procedures has focused on methods to reduce radiation exposure during the planning and post-procedural scans. According to Sarti et al., more than 90% of the patient’s absorbed dose is administered during the planning CT [5]. If a planning CT is deemed necessary by the radiologist, methods to limit radiation exposure include reducing the cranio-caudal scan length (z-axis), increasing the pitch, decreasing the photon fluence (mA), and/or decreasing the beam energy (kVp) [4].

Figure 1. Single axial CT fluoroscopic acquisition in bone window demonstrating the calculation of skin to bone distance of a patient undergoing bone marrow biopsy in prone position.

Table 1. Characteristics of Bone Marrow Biopsy Patients

Patient Characteristics Mean ± SD / Frequency (%) p-value

| Age (years) | 67.55 ± 14.83 | 71.15 ± 17.89 | 69.1 ± 13.18 | 0.1 |
| Gender | Female | 17 (42.5%) | 8 (61.5%) | 9 (23.3%) | 0.41 |
|BMI (kg/m²) | 31.3 ± 10.21 | 34.13 ± 13.74 | 29.94 ± 7.95 | 0.75 |
|Skin to Bone Distance (cm) | 3.68 ± 2.24 | 4.78 ± 4.3 | 3.14 ± 1.87 | 0.06 |

DLP Patl 168.93 ± 209.04 381.99 ± 249.15 61.93 ± 24.59 <0.0001

Total number of DLP fluoroscopic acquisitions 9.38 ± 6.61 8.85 ± 6.55 9.63 ± 3.99 0.64

Number of CT fluoroscopic acquisitions to localization 2.55 ± 1.69 1.08 ± 0.28 3.26 ± 1.63 <0.0001

Procedure time (min) 10.08 ± 0.76 22.54 ± 7.89 18.15 ± 5.77 0.12

Conclusions

1. There were no complications in either group and all obtained samples yielded diagnostic results, suggesting that changing efficiency of the safety were not compromised by forgoing the planning CT. There was significantly more CT fluoroscopy used to localize the target site in Group 2 when compared to patients that did not receive a planning CT. Since each CT fluoroscopy acquisition on our CT unit exposed the patient to a relatively small dose of 6.37 mGy/cm, total radiation dose to the patient was still markedly lower in Group 2 despite additional fluoroscopy acquisitions.

2. Our study has several limitations. First, all procedures were performed by a single MBM radiologist at a single community hospital, which may limit the generalizability. Second, all of the patients were in the prone position, and our findings may not apply to CT guided marrow biopsies performed with aliphasial or different patient positioning. Third, we did not use a CT topographer to aid identification of the target site for Group 2; use of a planning CT could potentially reduce the amount of CT fluoroscopy acquisitions needed to identify an ideal target site even when not performing a dedicated planning CT. Finally, in this study DLP was used as a surrogate for radiation dose, which presents several limitations. DLP is a measurement of radiation output from the scanner (analogous to CT dose index) and is not an accurate measure of the effective dose, which varies based on the specific CT procedure and length, which is often a subjective assessment by the technologist. DLP does not account for patient size, although in our sample there were no statistically significant differences between the groups, suggesting the CT equipment used for the biopsies was similar. Therefore, no surrogate scan parameters were used to compare the subject groups since the relative difference in exposure was the factor of interest.

3. Elimination of a planning CT scan prior to bone marrow biopsy significantly reduces the patient radiation dose by about 84% when compared to the time of the final CT fluoroscopy acquisition. This is consistent with the patient radiation protection principles of justification and limitation of doses and thus, in the appropriate patient population, the radiologist should consider performing bone marrow biopsies without a planning CT. Further studies should be conducted to evaluate the practicality of performing CT guided bone marrow biopsies without a planning CT.

References