Diagnostic Accuracy of Intramedullary Reamings Compared to Traditional Biopsy in Long-Bone Metastases

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INTRODUCTION: Bone is the third most common site of metastasis in cancer patients, with up to 70% of patients having bone involvement found at the time of autopsy. Approximately 15% of patients with suspected bony metastases have no known primary cancer. In these cases, a complete workup including labs, imaging, and biopsy should be completed prior to definitive surgical intervention. This preoperative workup helps differentiate metastases from other lesions such as a primary bone sarcoma or infection, which require different surgical treatments. Additionally, for patients with a history of multiple primary cancers or no known prior metastases, biopsy is essential to identify or confirm the primary cancer site, guide adjuvant treatment, and determine prognosis. Tissue diagnosis can also impact surgical optimization and planning; for example, hypervascular metastases benefit from preoperative embolization to reduce blood loss and prevent the need for transfusion intraoperatively.

In cases of impending fracture, this standard workup can often be completed, and the diagnosis confirmed prior to surgical intervention. However, after pathologic fracture has occurred, any delays in surgical fixation can lead to increased morbidity and mortality for the patient so timely diagnosis is critical. This has prompted some surgeons to forego the traditional staged biopsy, as they seek to diagnose the lesion and stabilize the bone with a single procedure. Despite historical literature showing that reamings are diagnostic only 51-60% of the time, orthopedic surgeons have continued to send reamings to pathology when stabilizing pathologic long-bone lesions.

The primary aim of this study was to determine the diagnostic accuracy of intramedullary reamings compared to traditional biopsy in the identification of metastatic long bone lesions. We secondarily sought to determine if the accuracy of reaming samples was influenced by primary tumor type.

METHODS:

A retrospective review was conducted of patients treated within the Banner hospital system from 2015-2022. Patients were identified using the ICD-10 diagnosis code for pathologic fracture in neoplastic disease (M84.5). Exclusion criteria were patients with non-metastatic neoplastic bone lesions (i.e. primary bone sarcomas or benign bone tumors) and patients who received nonoperative treatment. Only lesions involving long-bones (femur, tibia, or humerus) were included. Patients with both impending fractures and completed fractures were included for analysis. Statistical analysis was performed using the Chi-squared test with statistical significance set at a p-value of 0.05.

RESULTS:

423 patients were initially identified and 249 met inclusion criteria. The mean age was 66 years (range 39-93). The most commonly affected bone was the femur (n=201 patients). The most common surgical fixation methods were intramedullary nail (n=199 patients, 67%) and arthroplasty (n=97, 33%). The most common primary cancer types were lung, breast, and multiple myeloma/hematologic malignancy. 238 patients had traditional biopsy while 97 patients had intramedullary reamings. 43 patients had both traditional biopsy and intramedullary reaming samples sent for pathologic analysis. Traditional biopsy was significantly more accurate than intramedullary reamings in establishing/confirming the primary cancer type (93% vs 74%, $p < 0.001$). Combining both biopsy and reamings increased the accuracy to 98%. When stratified by primary cancer type, the accuracy of reamings varied (Figure 1).

DISCUSSION AND CONCLUSION:

While the ease of obtaining reaming samples has led some surgeons to prefer them over traditional biopsy, the diagnostic value of reamings has never been proven. The cellular changes caused by the reaming process raise concerns about the reliability as an alternative to biopsy. Additionally, reamings are collected from the entire length of the bone rather than isolated to the area of the pathologic lesion which may make the tissue less useful for diagnosis. Hassan et al reported on 90 cases of suspected pathologic fracture and found that intramedullary reamings were non-diagnostic in 60% of cases. In the only published comparative study of 25 patients with reamings and 21 patients with biopsies, Ononuju found that 52% of reamings were positive as compared to 92% of biopsies.

Our study is the largest to report a comparison between reamings and biopsy. We found that reamings were diagnostic in 74% of cases, which is slightly higher than previous *literature* but still significantly less accurate than traditional biopsy, which was diagnostic in 93% of cases. For patients whom both samples were sent, an accurate diagnosis was established for 98% of cases.

We also looked at primary tumor type and found that reamings are more accurate in cases of renal, breast, and lung carcinoma whereas prostate cancer and hematologic cancer reamings are less likely to be diagnostic. In the case of prostate cancer metastases, which are usually osteoblastic, the reaming process can be more difficult and therefore may be more likely to cause heat necrosis which damages the tissue samples.

While many surgeons routinely send intramedullary reamings for histologic analysis in the case of suspected metastatic long-bone fractures, reamings are often unreliable and are significantly less accurate than traditional biopsy. If a surgeon wishes to send reamings for pathologic evaluation, they should be used as a supplement to traditional biopsy, not a substitute. In cases where a primary tumor type is not confirmed preoperatively but there is suspicion of prostate cancer or hematologic cancer, reamings may be even less reliable and should be avoided.

Figure 1: Accuracy of Reamings By Primary Cancer Type