Intramedullary Nailing With and Without the Use of Bone Cement for Impending and Pathologic Fractures of the Humerus in Multiple Myeloma and Metastatic Disease

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INTRODUCTION: Although intramedullary nailing (IMN) is considered the standard of care for the surgical management of most femur metastatic diseases, the optimal treatment of humeral humeral impending and/or pathologic fractures is still debatable. The treatment is influenced by multiple factors, including lesion location and severity, bone quality, presence of complete fracture, and overall patient health. Use of bone cement with IMN has been shown to promote fixation, provide greater construct stability, reduce local tumor mass, reduce early adventitious treatment, and slow disease progression. However, some consider cement unnecessary due to increased complications, operative time, adequate stability with the nail alone, possible neurovascular damage secondary to the cement’s thermogenic effect and soft-tissue extrusion, and slower bony healing. Nevertheless, the use of cemented humeral nails has not been well studied, and only a few small series have compared their results with uncemented nails. Moreover, most studies have not distinguished if the bone cement was used just to fill the tumor cavity or the entire intramedullary canal (cemented IMN as defined in our study). Thus, the purpose of this study was to analyze the (1) survivorship, (2) functional outcomes, and (3) perioperative complications in patients receiving humerus IMN for impending or complete pathologic fractures resulting from metastatic disease or multiple myeloma, and to compare these outcomes in cemented versus uncemented groups.

METHODS: We retrospectively reviewed a single-surgeon database in an urban academic setting from August 2011 to July 2022, and analyzed 100 humeral IMNs in 82 adult patients with impending or complete pathologic fractures, of which 53 were cemented and 47 were uncemented. The use of cement predominantly depended on the extent of tumor involvement, bone quality, amount of bone loss, periarticular lesions, extensive and skip lesions, and fixation stability. Extracted variables included patient demographics, primary malignancy, fracture type (impending or complete pathologic), lesion location, cement use, concomitant procedures (e.g., other long bone IMN in the same or different setting), blood loss, blood transfusion, perioperative medical and surgical complications, return to operating room (ROR), patient survivorship, and Musculoskeletal Tumor Society (MSTS) upper extremity functional scores. Descriptive and statistical analyses, including 2-sided Fisher’s exact and Student’s t-tests to compare categorical and continuous variables, respectively, and Kaplan-Meier estimates of patient survivorship were performed in R Statistical Software using a p-value of <0.05 as threshold for statistical significance.

RESULTS SECTION: Mean survivorship for all available patients was 10 ±14.3 months [range, 1–86] (Cemented: 8.3 ±9.3 [range, 1–35] vs. Uncemented: 11.6 ±17.7 [range, 1–86] months, p = 0.34). There was no intraoperative mortality but two patients in the cemented group died during same admission at 1 month (p=0.22). The mean MSTS scores increased from 42.4 ±8.4% [range, 28–60] pre-operatively (Cemented: 40.2 ±9.6% [range, 16–64] vs. Uncemented: 66.7 ±28.5% [range, 20–100], p = 0.01) to 89.2 ±5.5% [range, 76–96] at 3-months postoperatively (Cemented: 89.8 ±7.0% [range, 80–100] vs. Uncemented: 90.9 ±1.9% [range, 90–100], p = 0.72) for the overall group (p=0.001). Both cohorts had comparable complication rates (overall [22.6% vs 19.1%]), surgical ([11.3% vs 4.3%] and medical [13.2% vs 14.9%], all p=0.05) and perioperative blood transfusion (204 vs. 271 ml, p = 0.41), but blood loss was significantly higher in the cemented group (126 ml vs. 76 ml, p = 0.003). There was one case of surgical site infection in the cemented group (0.4% vs. 0.8%), and no death. Although no difference was found in the rate of local tumor progression between the two groups (50 vs. 50%, p = 0.36), there were two RORs in the cemented group: one for unrelated cervical spine decompression (2 days) and other for removal of a backed out proximal locking screw (2 years). One planned cemented nail was converted intraoperatively to a plate construct due to lateral nail cut out during insertion.

DISCUSSION: IMN with and without cement augmentation in select patients is a relatively safe and effective therapeutic modality for metastatic humeral disease, with similar clinical outcomes and acceptable complication rates. The use of bone cement is often based on several clinical factors and thus induces bias of surgeon decision-making. Most intraoperative surgical complications resulted from technical errors stemming from bone cement use, and could be minimized with awareness, meticulous attention to surgical technique, and increasing experience. While controlling for possible selection bias, larger-scale, higher-level studies are warranted to validate our results.

SIGNIFICANCE/CLINICAL RELEVANCE: The current study supports the utility of IMN with and without cement augmentation for impending and pathologic fractures of the humerus in multiple myeloma and metastatic disease. The study suggests comparative outcomes between cemented and uncemented humeral IMN in terms of survivorship, functional outcomes, and perioperative complications.

IMAGES AND TABLES: