An External Validation of the Pathologic Fracture Morbidity Index

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INTRODUCTION: Skeletal metastases increase the risk of pathologic fractures in patients, predisposing them to impaired functionality and intractable pain. Prognostication of morbidity in patients who receive operative fixation for impending and actual pathologic fractures remains nonspecific as existing calculators are skewed by the presence of metastatic disease. The derived Pathologic Fracture Morbidity Index (PFMI) was recently developed and internally validated as a more reliable tool to predict 30-day postoperative morbidity and has been modified to further improve predictive value. The purpose of our retrospective analysis was to assess if the modified PFMI accurately predicts morbidity in an external cohort of patients that have undergone internal fixation for impending and actual pathologic fractures of the humerus, femur, or tibia.

METHODS: Statistical analyses were performed on a representative population of patients (n=1,093) that underwent internal fixation for pending and actual pathological fractures at two urban, tertiary medical centers. Excluded patients were those with incomplete data or who underwent additional procedures. For each of the patients in the final dataset (n=697), a modified PFMI, American Society of Anesthesiology (ASA) physical status classification system score, modified 5-item frailty index (mF-I5), and modified Charlson Comorbidity Index (mCCI) was calculated. The AUC was calculated for each risk score calculator to evaluate their discriminative power on our dataset.

RESULTS: Of the 697 patients in this study, the median age was 63. The all-cause morbidity AUC (95% CI) was 0.5 (0.44, 0.57), 0.51 (0.45, 0.57), 0.58 (0.52, 0.65), and 0.48 (0.42, 0.54) for the PFMI, ASA, mF-I5, and mCCI indices, respectively. Medical morbidity AUC (95% CI) was 0.6 (0.5, 0.7), 0.55 (0.44, 0.65), 0.63 (0.53, 0.73), and 0.51 (0.41, 0.61) for the PFMI, ASA, mF-I5, and mCCI indices, respectively. Surgical morbidity AUC (95% CI) was 0.45 (0.37, 0.52), 0.49 (0.41, 0.56), 0.55 (0.47, 0.62), and 0.47 (0.4, 0.55) for the PFMI, ASA, mF-I5, and mCCI indices, respectively. While the mF-I5 had the highest AUC values for all-cause, medical, and surgical morbidity, the differences between the mF-I5 and PFMI were not statistically significant (p=0.562, 0.181, and 0.762, respectively).

DISCUSSION AND CONCLUSION: Based on our analysis, the PFMI performed similarly to existing tools to predict 30-day morbidity. Our study's validation was limited by missing data requiring exclusion of many patients. Further studies with larger samples will be necessary for validation of PFMI. As the PFMI was designed to factor in more clinically relevant input variables than its counterparts, its use in addition to ASA, mF-I5, and mCCI can facilitate the assessment of total, surgical, and medical risk in patients with metastatic bone disease. It remains necessary to explore new instruments to evaluate surgical and medical risk in patients with metastatic bone disease, ideally with AUC curves above 0.80.

Table 1. Summary of point system in modified PFMI scoring tool

Predictor	Point Value
Preoperative hypoalbuminemia (< 3.5 mg/dL)	3
Preoperative BUN > 24 mg/dL	3
Preoperative INR > 1.1	2
Weight loss (≥ 10% in prior 6 months)	2
Pulmonary disease	2
Alkaline phosphatase (> 150 U/L)	1
Dependence for daily living	1
WBC > 12000	1
Preoperative anemia	1
Preoperative SGOT > 40 U/L	1
Diabetes	1
Thrombocytopenia (platelet < 150k/μL)	1

Table 2. All-cause, medical, and surgical morbidity AUCs

Predictive tool	All-cause morbidity AUC (95% CI)	Medical morbidity* AUC (95% CI)	Surgical morbidity** AUC (95% CI)
PFMI	0.5 (0.44, 0.57)	0.6 (0.5, 0.7)	0.45 (0.37, 0.52)
ASA	0.51 (0.45, 0.57)	0.55 (0.44, 0.65)	0.49 (0.41, 0.56)
mF-I5	0.58 (0.52, 0.65)	0.63 (0.53, 0.73)	0.55 (0.47, 0.62)
mCCI	0.48 (0.42, 0.54)	0.51 (0.41, 0.61)	0.47 (0.4, 0.55)

*Medical morbidity variables included occurrence of pneumonia, unplanned intubation, pulmonary embolism, need for ventilator > 48 hours, CVA/stroke with neurological deficit, cardiac arrest requiring CPR, intraoperative or postoperative myocardial infarction, DVT/thrombophlebitis occurrence, sepsis or septic shock, *C. difficile* colitis, and acute renal failure
**Surgical morbidity variables included superficial surgical site infection, organ space SSI, open wound/wound infection, wound disruption, return to the OR, and unplanned reoperation(s)