Temporal and Demographic Trends in Hip Fracture Incidence in End-Stage Renal Disease Patients Through the United States Renal Data System

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INTRODUCTION: The musculoskeletal complications seen in end-stage renal disease (ESRD) predisposes patients to hip fractures. Advances in bone health treatment are limited by the aging population and treatment effects in this population. This is the largest study to date that evaluates the influence of demographics on hip fractures and describes temporal trends in ESRD patients. This study also investigated levels of calcium and parathyroid hormone levels in patients with ESRD, in addition to the influence of vitamin D supplementation on hip fracture risk in this population.

METHODS: A retrospective analysis of data from the United States Renal Data System (USRDS) spanning 1977 to 2012. Two cohorts of 115,386 sex- and age-matched patients with ESRD were studied: patients with hip fractures vs patients without hip fractures. Statistical significance was determined by a p-value ≤ 0.05. Clinical significance was assessed using effect sizes (ES), which varied based on the statistical test used.

RESULTS: The incidence of hip fractures among ESRD patients increased by 3,369% between 1977 and 2007, followed by an 11% decrease from 2007 to 2012. ESRD hip fracture patients were significantly more likely to be white (77.7% vs 76.1%; p<0.001, ES: 0.02) and older (71.6 vs 71.2, p<0.001; ES: 0.03). There was no difference in male (47.0% vs 47.0%) or female (53.0% vs 53.0%) sex between cohorts. Hip fracture patients were significantly more likely to be prescribed both oral (70.5% vs 66.5%; p<0.001, ES: 0.02) and parenteral (19.1% vs 17.5% p<0.001, ES: 0.04) vitamin D at any point. Of patients with documented vitamin D prescription, 70.5% were prescribed non-oral, and 4,683 (19.1%) were prescribed oral vitamin D. Of the non-fracture cohort, 66.5% were prescribed non-oral and 3,689 (17.5%) were prescribed oral vitamin D. When compared to the non-fracture cohort, hip fracture patients on hemodialysis had significantly lower serum PTH levels (273.38 vs 293.23 pg/mL, p<0.001; ES: -0.05) but no significant difference was found between cohorts for patients on peritoneal dialysis (273.90 vs 278.13 pg/mL, p=0.67; ES: -0.01). There was no significant difference in corrected calcium (9.25 vs 9.25 mg/dL, p=0.22, ES: 0.01), or uncorrected calcium (8.89 vs 8.90 mg/dL, p=0.16; ES: -0.01) between either cohort.

DISCUSSION: The temporal trend reflects current ESRD literature but is in contrast to trends seen in the general population, in part due to the increased lifespan of these patients and thus longer dialysis, a known risk factor for fractures, in the context of an already aging population. Our data support current literature that white race was an independent risk factor for hip fractures, which may be due to genetic variations in vitamin D and FGF-23 metabolism and bioavailability. The earlier onset of hip fractures in ESRD patients may mitigate the impact of menopause-driven fractures seen in the general population. Current guidelines for vitamin D effectiveness in preventing hip fractures in End Stage Renal Disease (ESRD) patients remains poorly understood. Historically, IV therapy is reported to have higher compliance and achieve up to four times higher levels of serum 1,25(OH)2D3 than oral dosing. Patients on non-oral vitamin D exhibit a lower incidence of hypercalcemia and hyperphosphatemia, along with a reduced phosphate binder requirement. Despite statistical significance, the clinical impact is minimal based on effect size. This study highlights the need for additional research to fully comprehend the clinical impact on fracture prevention in these patients. In terms of serum ion concentrations, our data aligns with existing literature, showing no statistical or clinical significance in PTH and calcium levels among hemodialysis patients. Maintaining PTH concentrations within recommended range is advised for managing ESRD-related bone issues, but PTH-lowering therapies lack evidence of reducing fracture risk. The efficacy of calcium supplementation for hip fracture prevention is inconclusive according to the United States Preventative Service Task Force. Monitoring serum markers is crucial, yet insufficient evidence supports targeting them for primary prevention in orthopedic management.

SIGNIFICANCE/CLINICAL RELEVANCE: This study enhances our understanding of the factors that contribute to the risk of hip fractures amongst patients with ESRD over a robust time frame (1977 to 2012), which can help refine treatment strategies. The identification of ethnicity as an independent risk factor for hip fractures in ESRD patients suggests the need for tailored interventions and personalized care approaches. In terms of vitamin D administration, this is the largest study to date to evaluate the influence of vitamin D supplementation on hip fracture risk in ESRD patients.