AJKD

Original Investigation

Serious Fall Injuries Before and After Initiation of Hemodialysis Among Older ESRD Patients in the United States: A Retrospective Cohort Study

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Background: Because initiation of dialysis therapy often occurs in the setting of acute illness and may signal worsening health and functional decline, we examined whether rates of serious fall injuries among older hemodialysis patients differ before and after dialysis therapy initiation.

Study Design: Retrospective cohort study of claims data from the 2 years spanning dialysis therapy initiation among patients initiating dialysis therapy in 2010 to 2012.

Setting & Participants: Claims from 81,653 Medicare end-stage renal disease beneficiaries aged 67 to 100 years.

Predictor: Post– versus pre–dialysis therapy initiation periods, defined as on or after versus before dialysis therapy initiation.

Outcomes: Serious fall injuries were defined using diagnostic codes for falls in combination with fractures, brain injuries, or joint dislocation. Incidence rate ratios (overall and stratified) for post– versus pre–dialysis therapy initiation periods were estimated using generalized estimating equation models with a negative binomial link.

Results: Overall, 12,757 serious fall injuries occurred in the pre– and post–dialysis therapy initiation periods. Annual rates of serious fall injuries were 64.4 (95% CI, 62.7-66.2) and 107.8 (95% CI, 105.4-110.3) per 1,000 patient-years, respectively, in the pre– and post–dialysis therapy initiation periods (incidence rate ratio, 1.62; 95% CI, 1.56-1.67). Relative rates of serious fall injuries in the post– vs pre–dialysis initiation periods were of greater magnitude among patients who were younger (<75 years), had pre–end-stage renal disease nephrology care, had albumin levels > 3 g/dL, were able to walk and transfer, did not need assistance with activities of daily living, and were not institutionalized compared with relative rates among their counterparts.

Limitations: Potential misclassification due to the use of claims data and survival bias among those initiating hemodialysis therapy.

Conclusions: Among older Medicare beneficiaries receiving hemodialysis, serious fall injuries are common, the post–dialysis initiation period is a high-risk time for falls, and dialysis therapy initiation may be an important time to screen for fall risk factors and implement multifactorial fall prevention strategies.

Am J Kidney Dis. ■(■):■-■.

INDEX WORDS: Falls; injury; serious fall injuries; fall risk; hemodialysis; end-stage renal disease (ESRD); dialysis initiation; incident ESRD; fall prevention; renal replacement therapy (RRT); modifiable risk factor; US Renal Data System (USRDS).

Falls are a leading cause of injury-related hospitalization, disability, and death among community-dwelling older adults.[1,2] More than 1 in 3 older adults fall each year, and nearly half of all falls result in an injury.[3] When a serious fall injury such as a fracture, head injury, or joint dislocation occurs, older adults are at greater risk for functional decline, restrictions in community mobility and social participation, and nursing home placement.[4,5] Although multifactorial interventions that target patients' individual fall risk factors have been shown to reduce falls, these are not routinely used in clinical practice.[6,7]

Previous studies have shown that serious fall injuries commonly occur among older adults with chronic kidney disease and that higher levels of albuminuria may confer higher risk.[8,9] Studies of older adults receiving long-term dialysis have shown that nearly half these patients may fall each year.[10-13]

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Received August 8, 2016. Accepted in revised form November 27, 2016.

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0272-6386

http://dx.doi.org/10.1053/j.ajkd.2016.11.021

When older adult dialysis patients fall, they may be more susceptible to serious injury such as a fracture and increased mortality compared with those who do not fall.[14,15] However, prior studies of falls in this population have been limited primarily to prevalent dialysis patients recruited from single dialysis centers.

Because initiation of dialysis therapy often occurs in the setting of acute illness and may signal worsening health and functional decline,[16,17] it is possible that rates of serious fall injuries increase after dialysis therapy initiation. Knowledge of rates of serious fall injuries before and after dialysis therapy initiation may be helpful for identifying high-risk periods in which multicomponent fall reduction strategies could be implemented. Therefore, the purpose of this study was to determine the rate of serious fall injuries among older hemodialysis patients and whether this rate differs before and after dialysis therapy initiation. Additionally, we evaluated whether the association of timing (before or after dialysis therapy initiation) with serious fall injury differs by patient characteristics.

METHODS

Study Population and Data Sources

We obtained the Medicare eligibility form (Centers for Medicare & Medicaid Services [CMS]-2728) and Part A (inpatient) and Part B (outpatient) claims data from the US Renal Data System (USRDS).[18] Data for Medicare Part A, which is free for those who have paid Social Security taxes for at least 10 years, covers all inpatient hospital care for patients with end-stage renal disease (ESRD). Medicare Part B data cover doctors' services, including emergency department encounters and outpatient costs, and is paid by a monthly premium for those who opt for this coverage. The study was approved by the Emory Institutional Review Board (approval no. 87700), and informed consent was waived for this retrospective cohort study. Analyses were limited to patients initiating dialysis therapy in 2010 to 2012, the most recent years available such that all patients had at least a year of potential follow-up (through 2013). A total of 152,092 patients aged 67 to 100 years (such that all patients' Medicare coverage and related claims prior to dialysis therapy initiation) who initiated dialysis therapy during January 1, 2010, to December 31, 2012, were identified. Of these, 148,049 had Medicare eligibility form data, 129,527 initiated dialysis therapy, and 121,744 patients initiated hemodialysis therapy. The cohort was further limited to those with optional Part B coverage in the year before dialysis therapy initiation (n = 81,653), which was defined as at least 1 outpatient claim in the 0 to 6 months prior to dialysis, plus at least 1 outpatient claim in the 6 to 12 months prior to dialysis (Fig S1, available as online supplementary material). Patients without Part B claims were excluded to avoid differential ascertainment of serious fall injuries treated initially in the emergency department rather than during an inpatient stay.

Study Variables

Before Versus After Dialysis Initiation

The exposure was after versus before dialysis therapy initiation, defined for each patient as the year after and including the dialysis therapy initiation date and the year prior to the dialysis therapy initiation date.

Serious Fall Injuries

Falls were defined by *International Classification of Diseases, Ninth Revision* codes in combined claims data from inpatient and emergency encounters using a previously published claims-based algorithm.[9,19,20] Emergency encounters were defined as outpatient encounters in which either the place of service or type of provider was identified as emergency department. Only inpatient and emergency claims in the pre– and post–dialysis initiation periods, as defined in a previous paragraph, were included. Serious fall injuries were attributed to claims with a fall-related E code (8800-8889) and an injury code for nonpathologic skull, facial, cervical, clavicle, humeral, forearm, pelvic, hip, fibula, tibia, or ankle fractures (80000-80619, 8070-8072, 8080- 8089, 81000-81419, 8180-8251, or 8270-8291), brain injury (85200-85239), or dislocation of the hip, knee, shoulder, or jaw (8300-83219, 83500-83513, or 83630-83660). For claims without a fall-related E code, claims for the serious injuries listed were defined as a serious fall injury in the absence of a motor vehicle accident E code (8100-8199). Serious fall injury claims within 31 days of another serious fall injury claim were considered duplicates.

Other Variables

Incident age, sex, treatment modality history, and date of dialysis therapy initiation were obtained from the USRDS Standard Analytic Files. Race/ethnicity, smoking status, body mass index, assigned cause of ESRD, presence of comorbid conditions, functional status indicators (inability to ambulate, inability to transfer, needing assistance with activities of daily living [ADLs], and institutionalization) were all provider-reported and obtained from the Medicare ESRD eligibility form (CMS-2728).

Statistical Analysis

Patient characteristics were summarized overall and by whether patients had at least 1 fall in the periods before and after dialysis therapy initiation. Continuous and categorical characteristics were compared by fall status by t and χ^2 tests, respectively. At the population level, monthly risks for serious fall injuries were calculated, with the numerator being the number of serious fall injuries occurring during the month and the denominator being the number of patients alive at the start of the month. An interrupted time series analysis with Newey-West standard errors[21] was used to assess the slope and baseline risks for serious fall injuries in the periods before and after dialysis therapy initiation. Rates of serious fall injuries were calculated overall and by periods before and after dialysis therapy initiation as follows: (total number of serious fall injuries)/(patient-years contributed by all patients). Patient-years after dialysis therapy initiation were censored at switches to peritoneal dialysis therapy (n = 2,006), transplantation (n = 321), or deaths (n = 22,077) that occurred in the first year of dialysis therapy. Incidence rate ratios (IRRs; overall and stratified) were estimated from generalized estimating equation models with a negative binomial link, at the patient level, with number of falls per person per period as the outcome (with an offset of log[follow-up time]) and the period (post– versus pre–dialysis therapy initiation) as the exposure. This method provides a population-averaged IRR while accounting for correlated fall risks within the same individual. Use of negative binomial distribution accounts for violations of the Poisson assumption (that variance is approximately equal to the mean); such violations are likely with zero-inflated data. Sensitivity analyses (1) examining and comparing results among the 86,879 (Fig S1, right) incident hemodialysis and peritoneal dialysis patients and (2) examining Part A–only falls among those with and without Part B coverage were also performed. All analyses were performed with Stata, version 14.1 (StataCorp LP), and the statistical significance threshold was set at α=0.05.