Chapter 33: Falls in Elderly Patients With Kidney Disease

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Falls and associated fragility fractures are a major cause of morbidity and mortality in older persons with kidney disease. In a longitudinal study from one dialysis center for a median of 468 d, 47% fell.[1] The fall incident rate was 1.60 falls per year. Overall studies suggest that the fall rate is much greater in dialysis patients than in the general population. In the general population over 75 yr of age, 30% of persons fall each year, with one in five having an injury. Hip fractures in persons on dialysis occur three to four times more commonly than in the general population. One-year mortality in dialysis patients who have a hip fracture is two to three times of that in older community-dwelling persons who have a fracture. A single fall in a dialysis patient over 65 yr increases the risk of death after adjustment for comorbidities.[2] In the first 2 yr after dialysis, renal transplant patients have a higher risk of fracture than patients on dialysis.[3] Table 1 lists side effects of falls.

A community study of fall prevention in Connecticut showed that a simple education program (focused on medication reduction and balance and gait training) could reduce falls and the need for fall-related medical services[4] (www.fallsprevention.org). Falls can be either caused by extrinsic (environmental) or intrinsic factors. Environmental factors include wet, slippery floors, poor lighting, uneven surfaces, and stairs. Descending stairs is a particular risk factor. There are multiple causes of falls caused by intrinsic factors as shown in Tables 2 and 3.[4] Specific dialysis-related causes of delirium include uremic encephalopathy, dialysis dementia, Wernicke's encephalopathy, and dialysis dysequilibrium.

New onset falls are often caused by delirium. Delirium can present as purely the inability to pay attention. Delirium should be considered as a cause of falling in any patient on dialysis who suddenly starts falling. Delirium has multiple causes such as drugs, infection, active decrease in oxygenation to brain, *e.g.*, pulmonary embolus, myocardial infarction, anemia, stroke, seizures, dehydration, metabolic abnormalities, and subdural hematoma (Table 4). Problems with lower limb strength and balance disorders are common in older dialysis patients and treatable with physical therapy. Drugs associated with falling are listed in Table 6. Studies in older diabetics suggest that falls are reduced when HbA_{1C} is not lowered below 7%.

BP ABNORMALITIES AND FALLS

Postural hypotension is a major cause of falls. It can occur without any dizziness. For this reason, BP needs to be regularly measured in the standing position. Orthostatic hypotension occurs more commonly in the morning, and in an individual with severe orthostasis, it may only be present on one half of the BP measurements. In a group of 23 elderly on dialysis, orthostasis was present in 8 patients before dialysis and 16 of 23 after dialysis.[5] Besides falls, orthostatic hypotension can lead to syncope, myocardial infarction, stroke, and death. Causes of orthostatic hypotension include anticholinergic medications, anemia, prolonged recumbency, dehydration, inadequate salt intake, protein energy malnutrition, adrenal insufficiency, diabetic autonomic neuropathy, Parkinson's disease, and multiple system atrophy (Shy-Drager syndrome).

Postprandial hypotension (a fall in BP of $>$20 mmHg) occurs in up to 25% of older persons and persons with diabetes. Its nadir is reached 1 to 2 h after a meal. It is not necessarily associated with orthostasis. It has also been shown to be present during dialysis in nondiabetic patients.[6] Postpran-

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Table 1. Falls produce

Head injury
Lacerations
Fractures
Hip
Vertebral
Other, *e.g.*, Colles
Soft tissue injuries
Fear of falling
Decreased activity and functional decline
Will cost $55 billion by 2020

dial hypotension is associated with falls, syncope, stroke, myocardial infarction, and death. Treatment can consist of multiple small meals with limited carbohydrate content. Because it is caused by the release of a vasodilatory intestinal peptide, calcitonin gene–related peptide, it can be treated with somatostatin analogs. Recent studies have shown that α-1-glucosidase inhibitors, acarbose and miglitol, can markedly attenuate postprandial hypotension.

LOSS OF CONSCIOUSNESS AND FALLS

Persons who fall with loss of consciousness either have seizures or syncope. More than one half of older persons with seizures have partial complex seizures (unusual behavior not necessarily associated with toxic clonic seizures) explaining why it can take nearly 2 yr to diagnose seizures in older persons. Older persons with syncope need to undergo carotid sinus massage because those who develop bradycardia need a pacemaker.

Table 2. Causes of falls

Extrinsic (environmental)
Uneven pavement
Poor lighting
No grab bar in toilet
Stairs cluttered
Intrinsic
Low levels of 25(OH) vitamin D
Orthostasis
Postprandial hypotension
Medications
Poor vision
Poor balance
Muscle weakness
Gait problems
Dementia (poor ability to "dual-task")
Depression
Loss of consciousness
Syncope
Carotid sinus massage
Event monitor
Seizures
Grand mal
Petit mal
Partial complex

Table 3. Safe and sound mnemonic for renal disease–associated falls

Strength problems
Age
Food associated hypotension
Environmental factors
Atherosclerotic disease (syncope)
Number of drugs
Diabetes
Systolic blood pressure (low predialysis)
Orthostatic hypotension
Unsteady balance
No Vitamin D (<30 ng/ml)
Dialysis disequilibrium or other causes of delirium

Rarely is a diagnosis made when a person has a single syncopal event. If a person has multiple syncopal events, they should be given an event recorder that should be used.

FEAR OF FALLING

Many persons who fall or have disequilibrium develop a "fear of falling." Studies in older persons suggest that fear of falling puts persons at a marked increased risk of falls and other adverse outcomes.

VITAMIN D

A 25(OH) vitamin D (calcidiol) level <75 nmol/L (30 ng/ml) has been identified as a cause of falls that responds to treatment with a reduction in falls.[7] 25(OH) Vitamin D deficiency is very common in renal failure patients.[8] There is some evidence suggesting calcidiol is more effective than calcetriol.[9]

FALLS IN DIALYSIS

There is a paucity of studies examining factors associated with falls in dialysis patients. Cook *et al.*[10] found that age, comorbidity, lower predialysis systolic BP, and a history of falls rep-

Table 4. DELIRIUMS mnemonic for multiple causes of delirium

Drugs/dialysis disequilibrium syndrome
Emotional (depression and psychosis)
Low PO_2 states (pulmonary embolus, myocardial infarction, anemia, and stroke)
Infection
Retention of urine and feces
Ictal or rejection
Uremic encephalopathy
Metabolic (vitamin B_{12} deficiency, hypothyroidism, thiamine deficiency)
Subdural hematoma

Table 5. Treatment of orthostasis

Eliminate medications
Adequate fluid and salt intake
Treat anemia (if present, with erythopoetin)
Elevate head of bed
Bedside commode
Avoid hot showers
Get up slowly
Orthostatic exercises
Jobst stockings
Midodrine (alpha 1 adrenergic antagonist)
Fludrocortisone

resented the major associated factors. Desmet *et al.*[1] reported that age, diabetes, increased number of drugs, antidepressant drug use, and failing a walking test predicted falling in hemodialysis patients. Angalakudi *et al.*[11] found the following comorbidities to be associated with an in-hospital fall in persons with chronic kidney disease (<60 ml/min GFR): dementia, pneumonia, gastrointestinal disease, diabetes, antidepressants, and anticonvulsants.

TREATMENT

The Cochrane Collaboration examined 62 trials on interventions to reduce fall risk.[12] Multidisciplinary, multifactorial programs reduced falls in community-dwelling older persons (RR = 0.73; range = 0.63 to 0.85) and residential care facilities (RR = 0.60; range = 0.50 to 0.73). Programs that had high efficacy at reducing falls were muscle strengthening and balance retraining; home hazard assessment and modifications; withdrawal of psychotropic medications; Tai Chi exercise intervention; and cardiac pacing for falls with cardio-inhibitory carotid sinus hypersensitivity (Tables 5 and 6).

All persons who fall should be enrolled in a home fall prevention program. This is reimbursed by Medicare Part A if homebound and Medicare Part B if not.

FRAGILITY FRACTURES

Fragility fractures (fractures associated with minor trauma) are associated with markedly increased morbidity and mortality in patients on dialysis. The causes of fragility fractures are falls or other trauma and bone disease. In the general population that usually means osteoporosis (Table 7). In renal failure, the picture is complicated because of renal osteodystrophy. Osteodystrophies include osteomalacia caused by vitamin D deficiency, osteitis fibrosa cystica caused by excess parathyroid hormone secretion, and adynamic bone disease caused by aluminum toxicity and/or parathyroid hormone oversuppression. Low bone mineral density may be seen in either osteoporosis or in osteodystrophy. Bone mineral loss in older men correlates with elevated cystatin C and lower estimated GFR.[13] Bone mineral density may be abnormally elevated in the presence of aortic calcification. In dialysis patients, the major risk factors for fragility fracture are older age, female sex, diabetes mellitus, heart disease, longer periods on dialysis, race other than African American, lower body mass index, and low parathyroid levels.[14] In the Dialysis Outcomes and Practice Patterns Study, risk factors were older age, female gender, prior kidney transplant, low serum albumin, selective serotonin reuptake inhibitors, narcotics, benzodiazepines, adrenal steroids, and very high parathyroid hormone levels.[15] Levels of PTH between 600 and 900 pg/ml seemed to have the lowest risk.

The use of bisphosphonates in this population is unclear. In persons who do not have adynamic bone disease or hyperparathyroidism and normal 25(OH) vitamin D levels, bisphosphonates at lower doses can be considered. In most cases, a bone biopsy with tetracycline labeling would be considered necessary before using bisphosphonates to not aggravate adynamic bone disease, although it is feasible that bone markers could be used in persons where no exposure to aluminum exists.[16] Low levels of osteocalcin and bone alkaline phosphatase suggest adynamic bone.

Hypogonadism is common in older males and in renal failure patients. In males with a low free testosterone (either calculated or measured by dialysis) (see www.issam.ch) or bioavailable testosterone (albumin bound and free), the use of testosterone, which should both increase osteoblastic activity and muscle strength, can be considered. Total testosterone should not be used in view of elevated levels of sex hormone binding globulin in older persons.

Table 6. Medications associated with falls

Cardiovascular drugs
Nitrates
Antihypertensives
Diuretics
Antiarrythmics
Anticonvulsants
Antidepressants
Sedative/hypnotics
NSAIDs
Propoxyphene
Antipsychotics
Dopamine agonists
(used for restless legs syndrome in dialysis)

Table 7. Risk factors for osteoporosis

Low calcium intake
Seizure medications (anticonvulsants)
Thin build
Ethanol (excess alcohol)
Hypogonadism
Prior fracture
Thyroid excess
Race (Caucasian/Asian)
Other relatives with osteoporosis/fractures
Steroids
Inactivity
Smoking

Raloxifene increases bone markers of osteoblastic activity in patients on hemodialysis and thus could be used to treat osteoporosis in women on dialysis.

After renal transplantation, there is a rapid decrease in bone mineral density over the first year. This decrease in bone is associated with increased risk of fractures. The causes of this increased loss of bone include renal osteodystrophy, glucocorticoids, immunotherapy, vitamin D deficiency, hypophosphatemia, hypogonadism, and osteoporosis. Bisphosphonates (oral and intravenous), vitamin D, and calcitonin have all been shown to slow the rate of bone loss.[17] There are inadequate data to conclude what are their effects on fracture prevention.

After a hip fracture, a number of factors have been shown to improve outcome in older persons: surgery within 48 h decreases length of hospitalization and possibly mortality; surgery delay for cardiology clearance may increase mortality; better outcomes are obtained with spinal or epidural anesthesia; early mobilization enhances rehabilitation outcomes; delirium reduces functional outcomes and it is reduced by a geriatric consult; vitamin D (calcidiol or calcitriol) will improve outcomes; and the use of bisphosphonates depends on the type of bone disease.

CONCLUSIONS

Falls are extremely common in patients with end-stage renal failure on dialysis. Fall prevention programs that include a medication review, prevention of orthostasis, cardiac pacing where appropriate, home hazard assessment and modifications, and muscle strengthening and retraining are effective. In addition, making sure the 25(OH) vitamin D level is >30 ng/ml has been found to be effective.

Treatment of bone disease is complicated because of the coexistence of osteoporosis and renal osteodystrophy. In persons without adynamic bone disease, low-dose bisphosphonates are possibly indicated. There may be a role for testosterone in males and raloxifene in females.

TAKE HOME POINTS

- Fall prevention programs should be instituted for all older dialysis patients
- All older kidney failure patients should have 25(OH) vitamin D levels replaced to at least 30 ng/ml
- Bisphosphonates, testosterone in males, and raloxifene in females can be used to treat bone disease as long as the type of disease is understood

DISCLOSURES

None.

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REVIEW QUESTIONS: FALLS IN ELDERLY PATIENTS WITH KIDNEY DISEASE

1. To prevent falls, 25(OH) vitamin D levels should be greater than
   a. 10 ng/ml
   b. 15 ng/ml
   c. 20 ng/ml
   d. 25 ng/ml
   e. 30 ng/ml

2. Which of the following drugs can be used to treat postprandial hypotension?
   a. Midodrine
   b. Bromergocriptine
   c. Propoxyphene
   d. Miglitol
   e. Fludrocortisone

3. To determine if there is adynamic bone measure
   a. PTH
   b. Osteocalcin
   c. Testosterone
   d. 25(OH) vitamin D
   e. Vitamin K