Risk Reduction Strategies for Medication-Related Falls (MRFs) in the Elderly: The Story of Humpty Dumpty

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Learning Objectives
1) State the role of Ca and Vit D supplementation to reduce fall risk
2) Identify OTC agents that increase fall risk
3) List pharmaceutical risk reduction strategies for MRFs
4) Describe non-pharmaceutical risk reduction strategies for MRFs
5) Explain the pharmacists role in preventing MRFs

Vitamin D
• Vit D supplementation appears to reduce the risk of falls among ambulatory or institutionalized older individuals with stable health by more than 20%. (JAMA 2004)
• Oral vit D supplementation between 700-800IU/d appears to reduce the risk of hip and nonvertebral fractures in ambulatory or institutional elder persons (JAMA, 2005).

Buchert-Fenat et al. JAMA. 2004 and 2005
**Vitamin D**

- Assist with prevention of muscle atrophy in Type II muscles which are lost with aging
- Increased size, strength and function of muscle fibers when replaced in deficient patients
- Vit D: 800 IU of cholecalciferol + calcium
- Resistance training – improved functional ability - gait speed

Kalyani et al. JAGS, 2010 & Benton, JAGS, 2010

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**Vitamin D**

- Vit D: 200-1,000 IU of cholecalciferol resulted in 14% fewer falls than calcium or placebo
- NNT = 15
- Fewer falls
  - < 80
  - adjunctive Ca
  - no hx of falls or fractures
  - duration longer than 6 months
  - dose of cholecalciferol of 800 IU or greater

Kalyani et al. JAGS, 2010

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**Effects of Atropine**

- 0.5 mg: slight cardiac slowing, xerostomia, inhibits sweating
- 1 mg: xerostomia, thirst, acceleration of heart, dilation of pupil (mydriasis)
- 2 mg: rapid heart rate, dilated pupils
- 5 mg: difficulty speaking, swallowing, restlessness, fatigue, HA, difficulty micturition, reduced GI peristalsis
- 10 mg: hallucinations, delirium, coma

Goodman’s & Gillman, 9th ed.
OTCs & Falls

- OTC Sleep Agents
- OTC Allergy Agents
- Agents w/ Anticholinergic Activity
- Drowsiness-confusion-mydriasis

Anticholinergic OTCs

- Dimenhydrinate (Dramamine®)
- Diphenhydramine (Benadryl®)
- Doxylamine (Unisom Nighttime Sleep Aid®)
- Brompheniramine (Dimetapp Allergy®)
- Chlorpheniramine (Chlor-Trimeton®)
- Dexbrompheniramine (Dimetapp Cold & Allergy®)

Anticholinergics (Antidepressants)

- TCAs: Tertiary Amines
  - Amitriptyline (Elavil)
  - Doxepin (Sinequan)
  - Imipramine (Tofranil)
  - Trimipramine (Surmontil)
- TCAs: Secondary Amines (Preferred TCAs)
  - Desipramine (Norpramin)
  - Nortriptyline (Pamelor)
  - Protriptyline (Vivactil)
Anticholinergic Properties

- Amantadine (Symmetrel®)
- Clozapine (Cozaril®)
- Cyclobenzaprine (Flexeril®)
- Disopyramide (Norpace®)
- Sedating H-1 blockers
  - Diphenhydramine, doxylamine, phenyltoloxamine
  - Hydroxyzine (Atarax®, Vistaril®)
- Orphenadrine (Norflex®)
- Antipsychotic phenothiazines (eg, Thorazine®)

Fall Risk Factors in Older Adults

1. Chronic health conditions
2. Physical and functional impairments
3. Medication and alcohol use
4. Environmental hazards

Falls in Older Adults

- 20% - 30% fear falling\(^4\)
- 35%-40% of people 65+ fall each year\(^2\)
- Those who fall are 2-3 times more likely to fall again\(^3\)
- 10%-20% of falls cause serious injuries\(^4\)

References:
4. Sterling, J Trauma-Injury & Critical Care, 2001
Multifactorial - Falls

**Intrinsic Factors**
- Age changes
- Chronic conditions
- LE weakness

**Extrinsic Factors**
- Medications
- Footwear
- Alcohol
- Environmental factors

**Acquired Factors**
- Assistive device

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American Geriatrics Society: Most Common Intrinsic Fall Risk Factors
1. Muscle weakness
2. History of falls
3. Gait deficit
4. Balance deficit
5. Assistive device use
6. Visual deficit
7. Arthritis
8. Impaired Activities of Daily Living
9. Depression
10. Cognitive Impairment
11. Age >80 years


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Modifiable Intrinsic Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle weakness</td>
<td>4.4 x</td>
</tr>
<tr>
<td>Gait &amp; balance problems</td>
<td>2.9 x</td>
</tr>
<tr>
<td>Vision problems</td>
<td>2.5 x</td>
</tr>
<tr>
<td>Psychoactive medications</td>
<td>1.7 x</td>
</tr>
</tbody>
</table>

2003 American Geriatric Society Clinical Guidelines for the Prevention of Falls. JAGS
Secondary Fall Risk

- Identify **modifiable** risk factors
  Examples: Muscle weakness, poor balance, exercise level, medications, environmental lighting, footwear
- Identify **non-modifiable** risk factors
  Examples: Age, chronic conditions, disability, dementia, vision loss

*Goal* → *Individual will modify (reduce)*
**modifiable risk factors**

ABC’s of Why Older Adults Fall

**Usually ≥1 Risk Factor Contributes to a Fall**

1. Age, ambulatory status, assistive device use
2. Balance, behavior at time of fall
3. Chronic conditions, cognitive deficits
4. Drugs
5. Exercise level, environment
6. Footwear & flooring

Fall Injuries: Older Adults

- Up to 20-30% of falls in older adults result in an injury requiring medical care
- Most fractures in Medicare population are due to falls
- Falls in older adults are the leading cause of traumatic brain injury (TBI)
- Men have a higher rate of fatal falls (due to TBI)
- Women are more likely to have non-fatal falls

[www.cdc.gov/HomeandRecreationalSafety/Falls/adultfalls.html](http://www.cdc.gov/HomeandRecreationalSafety/Falls/adultfalls.html)
9 Classes of Medicines

1. Antihypertensives
2. Diuretics
3. Beta-blockers
4. Sedatives and hypnotics
5. Neuroleptics and antipsychotics
6. Antidepressants (TCAs)
7. Benzodiazepines
8. Narcotics
9. Anti-inflammatory drugs
10. Class 1A antiarrhythmics

3 Medicine Classes

- Sedatives & Hypnotics
- Antidepressants
- Benzodiazepines

Wolcott, Arch Intern Med 2009

Syncope and Its Consequences in Patients With Dementia Receiving Cholinesterase Inhibitors

A Population-Based Cohort Study

Snyder S. Gil, MD, MS; Geoffrey M. Anderson, MD, PhD; Bala D. Prasher, MD; Chuan H. Ho, MD, PhD; Ping Li, PA-C; Sharon Lee C. Vormark, PA-C; Paula A. Rocklen, MD, MVR

Background: Cholinesterase inhibitors are commonly prescribed to individuals with dementia, but their adverse effects have not received much attention. These drugs can produce gastrointestinal disturbances and exacerbate symptoms of depression, which may lead to permanent pacemaker insertion. Drug-induced syncope can also precipitate falls, which are associated with hip fracture.

Methods: In a population-based cohort study, we investigated the relationship between cholinesterase inhibitor use and adverse outcomes using health care claims data from a large health maintenance organization from April 1, 2002, to March 31, 2004. We identified 19,063 patients aged 65 years or older who were prescribed cholinesterase inhibitors and 41,400 controls who were not.

Results: Hospital visits for syncope were more frequent in people receiving cholinesterase inhibitors than in controls (1.51 vs. 1.00 per 1000 person-years; hazard ratio, 1.51; 95% confidence interval, 1.37-1.65). Other syncope-related events were also more common among people receiving cholinesterase inhibitors compared with nonusers: inpatient hospitalization for hip fracture (4.20 vs. 3.90 per 1000 person-years; hazard ratio, 1.09; 95% confidence interval, 1.05-1.13), permanent pacemaker insertion (0.70 vs. 0.50 per 1000 person-years; hazard ratio, 1.40; 95% confidence interval, 1.20-1.61), and hip fracture (22.4 vs. 19.5 per 1000 person-years; hazard ratio, 1.18; 95% confidence interval, 1.04-1.34). Results were consistent in additional analyses in which subjects were either matched on their baseline characteristic (multivariable rate ratio of 1.50; 95% confidence interval, 1.36-1.65).

Conclusions: Use of cholinesterase inhibitors is associated with increased risks of syncope, hip fracture, permanent pacemaker insertion, and hospitalization for hip fracture in patients with dementia. The risk of these previously understudied serious adverse events must be weighed carefully against the drug’s generally modest benefits.

Prescriptions

“I’ve been taking this medication for 50 years and I’m going to sue! The side effects made me wrinkled, fat, and bald!”
Risky Drugs in the Elderly: An Evidenced Based Review

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Stage 1
Unilateral involvement; blank faces; affected arm in semiflexed position with tremor; patient leans to unaffected side. Progression to stage 2 in ~18 months.

Stage 2
Bilateral involvement with early postural changes, slow, shuffling gait with decreased excursion in legs, tremor on both sides, rigidity. To stage 3 in ~25 months.

Stage 3
Pronounced gait disturbances and moderate generalized disability, postural instability with tendency to fall; still independent. To stage 4 in ~42 months.
Stage 4

Significant disability; limited ambulation with assistance. Progression to stage 5 in ~17 months.

Stage 5

Complete invalidism; patient confined to bed or chair; cannot stand or walk with assistance.

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**Fall Risk Assessment**

- **Assess & identify intrinsic (internal) risk factors**
  Examples: Age, osteoporosis, vision loss, dementia

- **Assess & identify extrinsic (external) risk factors:**
  Examples: Medications, footwear, assistive devices, environment

- **Assess & identify acquired risk factors:**
  Examples: Facility or hospital admission due to health change or decline (new environment), delirium due to illness, increased disability due to injury
Fall Prevention Best Practices: Multi-component Programs Combine > 2 Best Practices
1. Individual risk assessment
2. Regular strength & balance exercise
3. Gait & assistive device training
4. Medication review & management
5. Management of chronic conditions
6. Vision correction
7. Education
8. Home safety improvements

WA State Dept. of Health, Falls Among Older Adults: Strategies for Prevention (2002)
Centers for Disease Control

CDC Fall Prevention Recommendations
- Regular exercise
- Medication review
- Vision exam
- Home safety evaluation

Best Practices for Older Adults from Clinical Studies
1. Clinical assessment & risk reduction
2. Exercise to improve balance, gait, strength, endurance, & flexibility
3. Medication management: especially benzodiazepines, antidepressants, sedatives/hypnotics
4. Multi-component programs

Rubenstein et al., Handbook of Injury & Violence Prevention, 2007

1. Exercise
   - multiple component (strength, balance, aerobic) group classes
   - Tai Chi
   - Home programs in adults without severe impairments

2. Multifactorial interventions, delivered by multidisciplinary teams

Gillespie et al. Cochrane Review: Interventions for preventing falls in older people living in the community, April 2009

Preventing Falls

Very important question to ask?
What do you intend to do to prevent another fall?


Summary

- Risk factors, best practices & effective interventions have been identified for community-dwelling older adults after many years of research
- Injury prevention is an important goal in populations at high risk for falls
- Comprehensive prevention plans/programs that include individual risk assessment & individualized multi-component/multi-faceted intervention approaches are the most effective in reducing falls & fall risks
References

• Vitamin D
  – Benton MJ. Vitamin D reduces the risk of falls in older adults compared with calcium or placebo. BMJ 2011;343:d3839.

• Medications

• Falls- Hospitals

• Fall Risk Reduction