

Case Report

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A Case of Atraumatic Fracture Resulting from Physical Restraint in an Elderly Woman

Si Ching Lim* and Peter Chiu Leung Chow

Department of Geriatric Medicine, Changi General Hospital, Singapore

*Corresponding author: Si Ching Lim, Department of Geriatric Medicine, Changi General Hospital, Singapore, Tel: 6568503362; E-mail: si_ching_lim@cgh.com.sg

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Abstract

While physical restraints are commonly used and osteoporosis is a common and silent disease in the elderly patients, it is unusual to develop a bony fracture as an indirect consequence of physical restraint. It is important to find out the possible causes of agitation and restlessness in an elderly with dementia, and applying physical restraint should be a last resort and should be removed at the soonest opportunity.

Keywords: Fracture; Physical restraint; Elderly; Dementia with BPSD

Introduction

Osteoporosis is estimated to affect 200 million women worldwide, and incidence increases with age, affecting two-fifths of women aged 80 and two-thirds of women aged 90 [1]. In female, an accelerated bone loss of about 3% to 5% per annum occurs in the postmenopausal years due to estrogen withdrawal [1]. Worldwide data shows 1 in 3 women over age 50 will experience osteoporotic fractures [1]. Among the Asian countries, Singapore is rapidly ageing. Currently, 7% of Singapore's population is over the age of 65 and, by 2030, this will increase to 19% [1]. As the population ages, the prevalence of osteoporosis will increase. This will create a large impact on the healthcare economy.

Physical restraint has been used worldwide for a long time among the elderly with behavioral problems in both the acute care and residential care settings. In the last few decades, there are initiatives to reduce or remove physical restraints in the elder care settings. Despite these, physical restraints are still widely used in hospitals and elder care facilities.

Case Summary

Madam was an 85-year-old lady who had severe osteoporosis diagnosed in June 2010. Table 1 shows her bone mineral density (BMD) with treatment of osteoporosis. Risedronate and Strontium

were given but there was no significant improvement. No further pharmacological treatment was given from July 2013. Calcium and vitamin D supplement were maintained since 2010. Her serum vitamin D level was 39.4 µg/L in 2013.

She was admitted on March 2015 for an un-witnessed fall at home. She was noted to be unwell for a few days prior to the fall, with fever and productive cough. On arrival at the ED, she was noted to be febrile, drowsy and dehydrated. Clinically, she had signs suggestive of consolidation of the base of her right lung. Her blood gas analysis showed type 2 respiratory failure and her daughter agreed that she is not for CPR in the event of deterioration. The X-ray of pelvis done on the day of admission showed no fracture or dislocation of her right hip. She improved over the next two days with intravenous antibiotics. The physiotherapist started treating her on day 3 of admission for gentle mobilization in the ward. By then she was ambulating with walking stick with minimal supervision in the ward. On day 4 of her admission, during the morning round, we noticed that patient was on bilateral upper limb restraints, and were immediately removed by the medical team. The nursing staff reported that the patient was restless the night before, not sleeping well and was trying to climb out of bed. On and off throughout the day, she was noted to be talking to herself, noisy at times and restless. Physical restraints with bilateral upper limb restraints were applied on and off by the nurses for safety reasons. The physiotherapists and occupational therapists were on board and treating her.

BMD	June 2010	June 2011	May 2012	July 2013
Treatment		After risedronate 35 mg weekly	After another year of risedronate 35 mg weekly	After 1 year of strontium 2 g daily without risedronate
Lumber spine	-4.5	-4.3	-4.1	-4.6
Right hip	-4.6	-4.5	-5.6	-4.7
Ward's triangle	-4.1	-3.9	-5.0	-4.0

Table 1: The patient's BMD and treatment of osteoporosis.

On the third day after she was noticed to be requiring physical restraint, she complained of right hip pain and refused to walk. Clinical examination showed right hip tenderness with limitation of movement. The X-ray of the right hip showed displaced right neck of femur fracture, as shown in Figure 1.



Hemiarthroplasty was suggested by the orthopaedic surgeon; however, because of her advanced dementia and poor pre-morbid function, family opted for conservative management. She developed hospital-acquired pneumonia complicated by seizure and worsening of her type 2 respiratory failure. Unfortunately, she deteriorated and subsequently passed away.

Discussion

Osteoporosis and fracture

Osteoporosis is defined as deterioration in bone mass and microarchitecture of bone, along with increased fragility, that predisposes bones to fracture [1]. Osteoporosis is a silent disease that plagues the ageing population worldwide, whereby most sufferers are undiagnosed and undertreated, even among the highest risk patients who have already had a fragility fracture, especially in Asia [1]. This in turn creates a cascade of individual, social and economic consequence. The disability due to osteoporosis was reported to be greater than that

caused by cancers (except lung cancer) and was comparable to the loss in chronic non-communicable diseases [1].

More than about 50% of all osteoporotic hip fractures will occur in Asia by the year 2050 [1]. Hip fractures are associated with hospitalization, operation, chronic pain, prolonged immobilization, loss of function and cognitive impairment. They might result in long term institutionalization and additional cost. The reported mortality rate is up to 20% to 24% in the first year after a hip fracture and this higher mortality rate persists for at least 5 years afterwards [2].

Treatment of osteoporosis is indicated in patient with (1) history of hip or vertebral fracture, (2) osteoporosis with T score greater than or equal to -2.5 at the femoral neck or spine, and (3) T score between -1 and -2.5 with a 10-year probability of hip fracture more than or equal to 3% or any major osteoporosis-related fracture more than or equal to 20% based on local FRAX algorithm [2].

Management of osteoporosis includes non-pharmacological approach comprising of resistance and weight-bearing exercises, smoking and alcohol cessation. In Women's Health Initiative trial, compared to placebo, women taking calcium and vitamin D showed an increase in BMD and a reduction in hip fracture 12%. Calcium and vitamin D supplementation are therefore routinely recommended [3-6].

Pharmacological treatment can be classified as antiresorptive or anabolic agents. Several large trials showed the inhibitory property of bisphosphonates in bone remodeling and reduction in risk of fracture. They may have long-term residual effect on bone mass. Common side effects are gastric reflux and ulcer while osteonecrosis of the jaw and atypical femoral fractures are the possible long term complications. The first biological agent denosumab, a fully human monoclonal RANKL antibody, inhibits osteoblast activation by preventing binding of RANKL to RANK. In FREEDOM trial, denosumab significantly reduced vertebral fractures, hip fractures and nonvertebral fractures in postmenopausal women aged 60 to 90 years old with lumbar spine or total hip BMD T scores less than -2.5 but more than -4.0 [7-10].

Teriparatide, a parathyroid hormone analogue, is an anabolic agent. Daily intermittent PTH has anabolic skeletal effects. It reduces vertebral fractures risk in patient with prior vertebral fracture. The new agent, abaloparatide, a human recombinant-related PTH hormone, is comparable to teriparatide in reduction of fractures but less hypercalcemia.

Newer medications are being developed due to advances in knowledge of bone biology. Humanized monoclonal antibodies against sclerostin, Romosozumab and Blososumab, decrease bone resorption. Odanacatib, a selective inhibitor of Cathepsin K, inhibits bone resorption and increases BMD [11].

Madam was started on bisphosphonate therapy together with calcium and vitamin D supplement since her BMD results showed severe osteoporosis in 2010. Denosumab and Teriparatide followed by Bisphosphonate may be alternatives when BMD showed no improvement.

Use of restraint in patients with cognitive impairment

The International Physical Restraint Workgroup defined physical restraint as any means that prevent a person's free body movement to a position of choice and/or normal access to his/her body by the use of any physical method, attached or adjacent to a person's body that he/she cannot control or remove easily [2].

A study in a university hospital in Malaysia showed that common reasons of using physical restraint in non-psychiatric wards were patient trying to pull out catheter, restlessness, confused and for fall prevention. The alternatives employed before restraint were reassurance, explanation of consequences to the patient and relatives and parental medication. The restraint usually happened during night shift and two points restraint were most commonly used [2].

Elderly patients with delirium, dementia, or behavioral problems, are at high risk of being restrained. The enforced immobilization through restraint use leads to indirect injuries as shown by Evans, et al. These include loss of bone and muscle mass a decline in cognitive function, skin breakdown, urinary tract infection, incontinence, pneumonia, depression, delirium, decline in activity of daily living and even death. In acute care settings, the patient being restrained have a high risk of failure to be discharged home (OR 12.42), death during

hospitalization (OR 11.24), nosocomial infection (OR 3.46), and fall during hospitalization (OR 6.19). In a study by Tinetti, et al. it was reported there were more falls (OR 4.20), serious falls-related injury (OR 3.60) and falls-related fractures (OR 4.89) in elderly being restrained in residential care setting [2].

The behavioral problems in the elderly should not be dismissed, instead BPSD should be viewed as an attempt to communicate with their caregivers for their unmet needs or an indication of changes in their medical condition. Table 2 lists some of the common causes of agitation among the elderly with dementia. Making sense of the patient's behavior is the key to behavioural intervention. When facing a patient with behavioural symptoms, it is important to exclude physical/medical causes, emotional needs, psychosocial needs, and review medications before prescribing chemical or physical restraints [12,13].

Delirium	Medical causes (e.g. myocardial infarction, stroke, infection, electrolyte disturbance etc.) Surgical causes (e.g. acute abdomen, acute limb ischaemia, gastrointestinal haemorrhage etc.)
Medication	In particular sedatives, psychotropic agents, anticholinergic agents
Pain	Careful pain assessment and titration of analgesia.
Sensory deprivation	Hearing impairment, visual impairment
Barriers in communication	Language barrier, dysphasia
Problems with elimination	Constipation, retention of urine
Unmet needs	Psychological: Loneliness, boredom, anxiety, need for control; Physical: fatigue, hunger, thirst, sleepiness, itchiness, toileting needs, discomfort, physical restraints
Environment	Hot/cold environment, noisy environment, dim lighting, unfamiliar routine and caregivers

Table 2: Causes of agitation in the elderly.

Communication with the elderly can be difficult when they are delirious or at the moderate to severe stages of dementia as they develop language deficits. Making the environment conducive such as by reducing the noise level and enhancing the lighting, would be helpful. A sense of familiarity is effective by encouraging frequent family visit and making their surrounding as home like as possible- such as having photographs of loved ones nearby, their beloved music, etc. might calm them down.

Similar to physical restraint, chemical restraint is not without risk. The frequent use of antipsychotics for the aggressive elderly patients may cause delirium, sedation, fall and increased mortality. The awareness of the cause of agitation in the elderly is essential in the management. The use of chemical and/or physical restraint are indicated only when other measures failed [3].

The patient

The application of bilateral upper limb restraint during the course of the patient's hospital stay was initiated by the night duty nursing staff because of her high fall risk and disruptive behavior. As, a consequence of restricting her independence, the patient became more agitated and was observed to try to get out of the applied restraints repeatedly.

The underlying pathophysiology on how a femoral fracture developed, after the application of restraints, was not fully understood. There was no documented history of direct trauma like falls or trauma

to the hip region against the bed rails. The case presented is concurrent to the development of stress fracture. Stress fractures typically occur following repeated application of submaximal stress which results in disruption in the bone homogeneity. As the patient struggled, repeated stress on the osteoporotic bone contributed to accumulations of microfractures and eventually resulted in stress fracture. The premonitory severe osteoporosis together with aggravated bone loss secondary to immobilization due to restraint may have led to eventual breakage [14-16].

Conclusion

As the population ages, we need to diagnose and treat osteoporosis early to avoid its morbid repercussions from fractures. The use of physical restraint should be employed as a last resort: only when less restrictive means have been ineffective or patients are at risk of harming themselves or others and restraints should be removed at the earliest opportunity. It is also pertinent for clinicians and caregivers looking after people on physical restraints to check on them at regular intervals for injuries and complications such as urinary retention, constipation, pain, etc.

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