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Editorial

Improving the osteoporosis care gap in elderly patients following hip fractures: For the ICHIBAN initiative

1. Introduction

Hip fractures are the most frequently seen serious injuries in hospital patients.¹ Current costs of osteoporotic hip fractures in Australia exceed \$500 million annually.² By 2040, an estimated 512,000 hip fractures will occur in the United States each year at a cost of \$16 billion per year,³ and by 2050 an estimated 76.7 billion Euros in Europe.⁴ One year after fracture, approximately one-third of patients will have died, compared with an expected annual mortality of about 10% in this age group.⁵ More than 10% of survivors will be unable to return to their previous residence. Most of the remainder will have some residual pain or disability.⁶ In Australia, the total cost relating to osteoporosis has been estimated at \$7.4bn per annum⁷ with clinical manifestations affecting two million people⁸; hip fractures are projected to double by 2026 and increase fourfold by 2051.¹

There are currently no specific guidelines for osteoporosis investigation and therapy following a hip fracture in Australia. An evidence-based literature review⁹ suggest that there may be merit in:

- (1) serum 25-hydroxyvitamin D level measurements given the high prevalence of hypovitaminosis D^{10,11} in patients presenting with hip fractures (60–80%), and their utility in monitoring the effectiveness of replacement therapy;
- (2) treatment with calcium and vitamin D supplementation following a hip fracture due to its effectiveness in secondary prevention of osteoporotic fractures^{12–14} and in the rehabilitation process following hip fracture surgery due to improvements in proximal (shoulder, hip) muscle weakness, pain, dynamic balance and performance speed.^{15,16}
- (3) treatment with oral^{17–19} and intravenous bisphosphonates in selected patients due its effectiveness in secondary prevention of osteoporotic fractures and reduction in mortality (for intravenous zoledronic acid).²⁰

Low rates of osteoporotic treatment following hip fracture have previously been documented in several other Australian settings.^{21,22} As the risk of sustaining a second hip fracture is high during the first 12 months following the first, preventive

strategies aimed at immediate effects²³ are warranted. Systems providing specific advice with an inpatient protocol²⁴ or involving a specific fracture clinic assessment have shown encouraging results in hip fracture patients.^{25,26} Our aim is to determine the benefits of an integrated programme (ICHIBAN ('Improving the Care of Hip fractured patients at BANKstown hospital')) to improve this treatment gap at our institution.

2. Methods

2.1. Setting and participants

The clinical records of patients with a hip fracture admitted to the orthopaedic ward over a 22-month period were reviewed in Bankstown–Lidcombe Hospital, a 450 bed tertiary referral hospital in Sydney. Three blinded observers were employed for the study. The inclusion criteria were patients greater than 65 years of age and admitted with a hip fracture (excluding those related to high-speed trauma, or fall from greater than standing height) requiring surgical intervention. Data collection was performed with a structured form that elicited information about fracture and osteoporosis history, dementia status and demographics details.

2.2. Intervention

The ICHIBAN intervention program has been implemented since January 2008. Our main intervention focussed on regular training sessions (2 sessions of ½ hour duration, at the start of the clinical term and 2 weeks following) for junior orthopaedic staff on the evidence for secondary prevention of osteoporotic fractures, and provision of a simple algorithm and summary of the evidence on a double-sided A4 page. One of the mandatory clinical duties was to maintain a 'hip fracture' database on Microsoft ExcelTM (Fig. 1) which documented whether or not investigations had been ordered and what treatment had been initiated, with rationale for non-prescription whenever appropriate, and a policy of calcium, vitamin D supplements and a bisphosphonate or Strontium

	A	B	C	D	E	F	G	H	I
	Pt Initial	MRN	Bloods ordered	Vitamin D #1	Caltrate	Vitamin D	Bisphosphonate	Comments	
2			Yes	Yes	600mg	1000 units	Yes		
3			Yes	Yes	600mg	2000 BD	Yes	Already on aledronate	
4			Yes	Yes	600mg	1000 units	Yes		
5			Yes	Yes	600mg	2000 BD	Yes		
6			Yes	Yes	600 mg	1000 units	Yes		
7			Yes	Yes	600 mg	2000 BD	Yes		
8			Yes	Yes	600 mg	1000 units	Yes		
9			Yes	Yes	600 mg	2000 BD	Yes		
10			Yes	Yes	600 mg	1000 units	Yes		
11			Yes	Yes	600 mg	2000 BD	No	NWB	
12			Yes	Yes	600 mg	1000 units	No	NWB	
13			Yes	Yes	600mg	2000 BD	ICU		
14			Yes	Yes	600mg	1000 units	Yes		
15			Yes	Yes	600mg	2000 BD	Yes		
16			Yes	Yes	600mg	1000units	actonel	GORD	
17			yes	yes	no	2000 BD	No	metastatic colon cancer	
18			yes	yes				patient deceased	
19			Yes	Yes				on dialysis	
20			Yes	Yes	600mg	1000units	Yes		
21			Yes	Yes	no	no	actonel	primary hyperparathyroidism	
22			Yes	Yes	600mg	1000 units	No	deceased	
23			Yes	Yes	600mg	2000 BD	fosamax plus		
24			Yes	Yes	600mg	1000 units	actonel		
25			Yes	Yes	600mg	2000 BD	actonel		
26			Yes	Yes	600mg	1000 units	actonel		
27			Yes	Yes	600mg	2000 BD	actonel		
28			Yes	Yes	600mg	1000 units	No	deceased	
29			Yes	Yes	600mg	2000 BD	actonel		

Fig. 1 – ‘Hip fracture’ database on Microsoft Excel™ documenting osteoporotic investigations and treatment with rationale for non-prescription whenever appropriate.

Ranelate unless contraindicated. For example, calcium carbonate may not be prescribed due to underlying nephrolithiasis or documented hypercalcaemia, and oral bisphosphonates due to previous severe gastrointestinal intolerance, severe renal impairment and/or a projected life-expectancy of less than six months. The programme was co-ordinated through daily ward rounds led by a dedicated ortho-geriatrics registrar and weekly rounds with the consultant orthogeriatrician.

2.3. Outcome measures

Records were reviewed to determine if focussed tests for secondary causes of osteoporosis including 25-hydroxyvitamin D (25-OHD) level, thyroid-stimulating hormone (TSH) and parathyroid hormone (PTH) was performed, as well as whether or not osteoporotic medications consisting of calcium and vitamin D supplements, and a bisphosphonate or other appropriate anti-osteoporosis treatment (such a selective oestrogen receptor modulator or Strontium Ranelate) were commenced prior to discharge.

Descriptive statistics were calculated to describe (1) demographic data (including age, sex, place of residence), (2) clinical data: pre- and post-fracture mobility status; mobility status change; osteoporosis characteristics; hip fracture sub-type according to anatomical location -²⁷ [intracapsular (sub-capital) or extracapsular (perthrochanteric, interthrochanteric or

subtrochanteric fracture]; previous bisphosphonate treatment and dementia status (defined by documented dementia, or Mini Mental Status Examination (MMSE) score of less than 24 points); (3) osteoporotic investigations and (4) osteoporosis management as described above. Patients were also reviewed at 6 months following the programme by a short telephone survey on persistence of osteoporosis medications and reasons for cessation. The study was approved by the Sydney South West Area Health Service Human Research Ethics Committee.

2.4. Statistical analysis

Fisher's exact or chi-square test was used for categorical variables and student's t test or one way ANOVA test was used for continuous variables. A P value less than .05 was considered statistically significant. SPSS for Windows version 15.0 (SPSS Inc., Chicago, IL, USA) was used for data analyses.

3. Results

3.1. Pre-intervention group

Two-hundred and seven patients presented to Bankstown–Lidcombe Hospital during the pre-intervention 12-

month period with a diagnosis of hip fracture. Five patients were excluded as their hip fractures were either related to high-speed trauma, or a fall from greater than standing height, with 202 patients included in review. Nine died during their inpatient stay and were included in the review of osteoporotic investigations but not in the review of osteoporotic treatment on discharge. 95 (47.0%) patients had a subcapital fracture whilst 107 (53.0%) had a trochanteric fracture.

Of the 202 patients with hip fracture, 150 (74.3%) were women (Table 1). Patients more than 70 years old accounted for 90.6% of the fractures. Seventy (34.7%) of the cohort had a history of dementia on admission, and 68 (33.7%) resided in an aged care facility. Those with dementia were more likely to be older ($p < 0.01$) and from an aged care facility ($p < 0.01$). Fifteen (7.4%) had a previous hip fracture. All the patients in this cohort required hospital admission and surgical interventions. Twenty-four participants (11.9%) were taking bisphosphonate therapy, including four with a previous hip fracture, on presentation.

3.1.1. Osteoporotic investigations and management according to dementia status (Table 1)

Of the 202 patients with hip fracture, 9.4% had a full osteoporosis blood screen performed (including 25-OHD, TSH and PTH), and 41.6% were investigated with a serum 25-OHD level during the course of admission. 42% were discharged on vitamin D supplements and 41% were discharged on calcium supplements. In 58% of patients, no vitamin D supplements were prescribed on discharge, consisting of 1 patient with documented severe (≤ 10 nmol/L), 19 with moderate (>10 nmol but ≤ 40), and 13 with mild hypovitaminosis D (>40 nmol/L but ≤ 60). 36% were discharged on oral bisphosphonates. Patients with cognitive impairment were more likely to be older, frailer (lower mean 25-OHD levels) and lived in an aged care

facility pre-fracture, were significantly less likely to be investigated with 25-OHD and focussed osteoporosis tests, and.

3.2. Post-intervention group

A total of 150 patients were reviewed in the 10 months following the programme implementation. Demographic data were similar between this group and the group prior to intervention. Overall, the rates of investigation and treatment increased between two to three-and-a-half times pre-intervention (Fig. 2). In particular, investigation of 25-hydroxyvitamin levels increased to 71.2%, osteoporosis blood screening to 37.1%, prescription of osteoporosis medications improved to 78.2%, 75.6% and 53.8% for vitamin D, calcium supplements and oral bisphosphonates respectively ($p < 0.001$).

A rationale for non-prescription of medications was documented in the majority ($>90\%$) of patients. Several patients were not prescribed calcium due to intolerance and hypercalcaemia, whilst some patients were deemed not suitable for bisphosphonates due to poor mobility status, limited prognosis, renal failure and gastrointestinal intolerance.

A 6-month follow-up of the first 60 patients following the intervention programme showed that 51.6% were still on appropriate treatment. Of these, 64% reported stopping their medications due to reasons including intolerance, 'cost' or concerns about major side effects, whilst the other 36% was not contactable by phone after three attempts during a one-week period.

4. Discussion

In general, this review suggests that an orthogeriatric-led inpatient programme of junior orthopaedic staff education,

Table 1 – Characteristics of baseline study participants (n = 202).

Variable	Participants with cognitive impairment (n = 70)	Participants without cognitive impairment (n = 132)	All participants (n = 202 ^a)	p value ^b
Age (mean $\pm$ SD)	86.2 $\pm$ 6.5	80.2 $\pm$ 10.6	82.4 $\pm$ 9.7	<.01
Gender (female)	55 (78.6)	95 (72.0)	150 (74.3)	.21
Residence in aged care facility	44 (62.9)	24 (18.2)	68 (33.7)	<.01
Previous bisphosphonate use	6 (8.6)	18 (13.6)	24 (11.9)	.15
Osteoporosis Investigation:				
Vitamin D performed ^a (n = 84)	8 (11.4)	76 (57.6)	84 (41.6)	<.01
Vitamin D level (nmol/L)	36.6 $\pm$ 22.8	49.6 $\pm$ 24.1	46.2 $\pm$ 24.2	.03
Vitamin D deficiency ^a				.11
Severe (≤ 10 nmol/L)	2 (25.0)	1 (1.3)	3 (3.6)	
Mod (11–40 nmol/L)	5 (62.5)	32 (42.1)	37 (44.0)	
Mild (41–60 nmol/L)	1 (12.5)	23 (30.3)	24 (28.6)	
Normal (>60 nmol/L)	0 (0)	20 (26.3)	20 (23.8)	
Secondary osteoporosis screen Performed	3 (5.7)	16 (12.1)	19 (9.4)	.02
Osteoporosis treatment on discharge (n = 193) ^a				
Vitamin D	27 (38.6)	54 (40.9)	81 (42.0)	.35
Average vitamin D dose (IU) (n = 81) ^a	950 $\pm$ 60 (n = 27)	1004 $\pm$ 42 (n = 54)	1000 $\pm$ 216	.04
Calcium	20 (28.6)	63 (47.7)	83 (43.0)	.03
Bisphosphonate	13 (18.6)	57 (43.2)	70 (36.3)	.02

All data are expressed in numbers (% of total) except for continuous variables.

a Missing values, excluded from percent count.

b Continuous variables were compared with the use of a student's t test.

Fig. 2 – Osteoporosis investigations and treatments between patients before and following introduction of the ICHIBAN Intervention Program (n = 352). Focussed OP tests denotes TSH, PTH and vitamin D levels.

supervision and maintenance of a structured, quality-assured database of appropriate investigation and management of osteoporosis may improve the delivery of care to at-risk patients following a hip fracture. We have shown that our ICHIBAN programme was able to improve rates of investigation and commencement of calcium, vitamin D supplements and bisphosphonates in hip fractured patients. We believe the sustainability of our programme will be dependent upon the enthusiasm of the orthogeriatrician, cooperation of the orthopaedic department and maintenance of the teaching programme to update junior orthopaedic staff on the latest evidence for treatment of osteoporosis following hip fractures, especially during each term change-over (every 10 weeks), as well ongoing evaluation of the programme.

The 6 months follow-up data shows a 51.6% continuance rate of osteoporosis medications, similar to data from Jones,²⁴ suggesting longer-term benefits of our inpatient-based intervention programme.

Interestingly, we have demonstrated that patients with cognitive impairment tended to be under-investigated and under-treated. We found that patients with dementia were less likely to have a 25-OHD level or focussed osteoporosis tests performed. They were also less likely to be discharged with calcium and bisphosphonates, even for those who were ambulant and were discharged home or to a rehabilitation facility. However, despite having a significantly lower level of 25-OHD (previously documented in a cohort of Japanese patients following hip fracture¹⁰), patients with dementia were not less likely to be discharged on vitamin D replacement. In the community-dwelling ambulant population, patients with mild dementia have been found to be significantly more likely to have hypovitaminosis D, and increased parathyroid hormone levels compared with normal elderly women,²⁸ suggesting further benefits in vitamin D replacement in the cognitively impaired individual. In our study, clinician's expectations of quality of life or life expectancy for elderly patients with

dementia or those living in nursing homes may have been another barrier to commencement of osteoporosis treatment.

Our study suggests further research may be required in evaluating the utility of a follow-up clinic at our institution given that 63.6% had potentially avoidable cessation of their medications due to reasons which may have been addressed in a follow-up clinic, e.g. intolerance, 'cost' or concerns about osteonecrosis of the jaw. A follow-up review several weeks post-discharge would provide an opportunity to monitor safety and side-effect profile of recently introduced medications, address concerns such as cost of medications and conduct bone densitometry which has been previously shown to improve adherence to medications.²⁹

4.1. Limitations and strengths

One foreseeable limitation of this review is that the outcome markers are process markers rather than clinical markers, such as the re-fracture rates or revision rate of post-operative hip fractures, which may be more clinically meaningful outcomes. Nevertheless, the process markers do have enormous indirect implications for the overall wellbeing of the patient and costs to the health budget as alluded to previously. We also recognise that osteoporosis care, whilst crucial, is but one aspect of care in the overall complex care of the elderly person presenting with a hip fracture. A physician review of medical co-morbidities and psychosocial factors, with a special emphasis on falls prevention strategies, is also beneficial.

Another limitation is the lack of post-discharge follow-up involving the cooperation of the general practitioners at the community level. A lack of awareness or knowledge among the general practitioners of the programme may partially explain the discontinuation rate (48%). Education and information sessions for primary care providers, patients and relatives ought to be considered to aid in patient compliance and adherence to medication post-discharge.

Overall, our study has several strengths. It is prospective in its second phase and the sample size is sufficiently large. The study employed three blinded observer to minimise observer bias. The sample population is consistent and comparable as they are extracted from the one health service area, and representative of the Australasian population. The setting of the study takes place at a medium-sized metropolitan hospital, which represents a general standard layout of hospitals across our region. Hip fractures were the subject of choice due to their common occurrence in the elderly population with osteoporosis. By selecting a standard hospital and a common type of fracture, our study provides reproducible and replicable results, which we hope can be adapted to other hospitals across the region.

ICHIBAN is a simple, effective and sustainable strategy which significantly increased osteoporosis care delivery to appropriate at-risk patients following hip fractures according to the best evidence at our institution. Furthermore, it also encouraged rational prescribing following a hip fracture and may be useful in institutions with a full-time dedicated orthogeriatric service. Considering the prevalence of osteoporosis in the elder population and the significant care gap, this type of initiative is extremely important to reduce the occurrence of new osteoporotic fractures.

5. Conclusion

The treatment of osteoporosis in frail older people with hip fractures is improving. However, patients with dementia may be under-investigated and treated. This study provides a clinician-led inpatient programme of evidence-based investigation and prescription of osteoporosis medications, supervision and education of junior orthopaedic staff, and a quality database of patients following hip fractures. The results are significant, reproducible and potentially applicable to other fractures associated with osteoporosis. There may be benefits in a post-discharge follow-up clinic after a hip fracture to monitor safety and side-effect profile of recently introduced medications and address patient concerns. The involvement of general practitioners and the communication of knowledge about osteoporosis in relation to fractures, are paramount towards good patient compliance and adherence to medications post-discharge.

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