



The effect of a multidisciplinary co-management program for the older hip fracture patients in Beijing: a “pre- and post-” retrospective study

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Abstract

Summary Hip fracture becomes a major public health issue with the growing aging population. This study evaluated a multidisciplinary co-management program for older hip fracture patients and found it significantly improved the best practice indicators. It provided preliminary evidence to support the use of such intervention in hip fracture management.

Purpose/introduction Hip fracture leads to high morbidity and mortality in older people. A previous study found a significant disparity in hip fracture management in Beijing Jishuitan Hospital (JSTH) compared to best practice care in the United Kingdom (UK). Following this audit, JSTH launched a multidisciplinary co-management care plan for older hip fracture patients. This study aims to evaluate the effect of this program on the six standards recommended in the UK hip fracture best practice guidelines.

Methods In this retrospective study, electronic medical record data were collected before and after the intervention. Eligible patients were aged ≥ 65 years, had X-ray confirmed hip fracture, and were admitted to JSTH within 30 days of injury. Patient demographic information, time from emergency department presentation to admission, time from admission to surgery, pressure ulcers, osteoporosis assessment, and falls prevention were collected. Multivariable logistic and median regression models were used for binary and continuous outcomes respectively. Segment regression was also performed for time-related outcomes.

Results A total of 3540 eligible patients were identified. After the intervention, half of the patients who received co-management received surgery within 48 h of ward admission compared to 6.4% previously, 0.3% (vs 1.4%) developed pressure ulcers, and 76% (vs 19%) received osteoporosis assessment. No significant differences were observed in fall assessment rates. However, there was a higher rate of ward admission within 4 h of arrival in emergency for patients admitted pre-intervention (61% vs 34%).

Conclusions The introduction of the co-management model significantly reduced the time from admission to surgery and improved other practice outcomes. A multicenter randomized controlled trial is needed to evaluate the impact of this model on patient health outcomes.

Keywords Hip fracture · Older people · Multidisciplinary co-management · China

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Introduction

Hip fractures are common in older people and often result from a minor fall in individuals with pre-existing osteoporosis. The consequences for patients, their families, and the healthcare system can be significant [1]. While there are currently limited data about the burden of hip fracture in China, a study conducted in Beijing showed the 1-year mortality for older people following a hip fracture was 23.4% [2]. Early surgery is known to reduce mortality after hip fracture; [3] a systematic review and meta-analysis demonstrated that surgery within 48 h of admission significantly reduces mortality risk in hip fracture patients (OR 0.74, CI 0.67–0.81) [4]. The UK “Blue Book” guidelines on the care of patients with fragility fracture produced by the British Orthopaedic Association and British Geriatric Society, outlines what is regarded worldwide as best practice hip fracture management [5]. The Blue Book recommends six standards for hip fracture care: admission to the orthopedic ward within 4 h of presentation, receipt of surgery within 48 h of admission, steps to minimize the risk of developing a pressure ulcer, access to orthogeriatric care, receipt of osteoporosis, and falls prevention assessment [5].

Despite established evidence of the benefits of optimized hip fracture management, uptake of such guidelines in China remains limited. A recent retrospective study conducted in a leading orthopedic hospital, Beijing Jishuitan (JST) Hospital, collected data from 780 hip fracture patients aged 60 and above from 2009 to 2011 [6]. Performance outcomes on the six Blue Book hip fracture care standards at JST Hospital were compared with the UK National Hip Fracture Database (NHFD) 2012. The study found significant gaps in hip fracture management; for example, 8% of patients JST Hospital received surgery within 48 h of admission compared to 83% in the UK [6]. After completion of the study, a co-management program was launched in 2015 in JST Hospital with the primary aim of reducing the time from admission to surgery by involving a multidisciplinary team within the hospital.

This study evaluates the effect of the multidisciplinary co-management program on hip fracture care in JST Hospital by comparing pre and post-intervention outcomes on the six standards recommended in the Blue Book [5].

Methods

Study design

This was a single site, pre-post evaluation study. Data were collected from the electronic medical records of all eligible patients admitted to JST Hospital between 1 January 2012 and 30 April 2017. Ethical exemption approval was granted

by the institutional review board at Peking University Health Science Center.

Study site and participants

JST Hospital is a leading national orthopedic hospital in China and the fourth medical college of Peking University. It has approximately 1500 beds and performs over 40,000 orthopedic operations every year.

Included patients were aged 65 years and older, had X-ray confirmed hip fracture (including intracapsular, intertrochanteric, and subtrochanteric fracture) and were admitted into JST Hospital within 30 days of the fracture. Patients with pathological fractures or terminal malignancies were excluded.

Intervention

The intervention was a co-management program involving both orthopedic surgeons and geriatricians [7–12]. This protocol-driven intervention consisted of a pathway of care spanning Emergency Department (ED) presentation to discharge from hospital. Program implementation was led by an orthopedic surgeon and coordinated by a geriatrician. Emergency physicians, anesthesiologists, and physiotherapists also participated in the intervention. The key elements of the program involved standardized ED and preoperative assessments and treatments (including the American Society of Anesthesiologists (ASA) grade and preoperative ulcer management), admission to a specialist orthogeriatrics ward (including geriatrician assessment, postoperative ulcer management, falls assessment, and physiotherapy), early surgery, and early discharge. The intervention was delivered from May 2015 to May 2017.

Data collection

Data collection was conducted between July and September 2017. Patient screening against inclusion criteria was performed by medical record staff. Two staff members independently reviewed the electronic medical records using the same search criteria to ensure all potential eligible patients were included. All patients identified in these searches were then manually screened against inclusion criteria by researchers (JZ and YL). Collected data included patient demographic information, characteristics of fracture and surgery, ASA grade, comorbidities, time from ED presentation to ward admission, time from ward to surgery, osteoporosis assessment, development of pressure ulcers, geriatrician assessment, and falls assessment. Data were entered into Epidata software (version 3.1, Denmark) in Chinese then translated into English for further analysis.

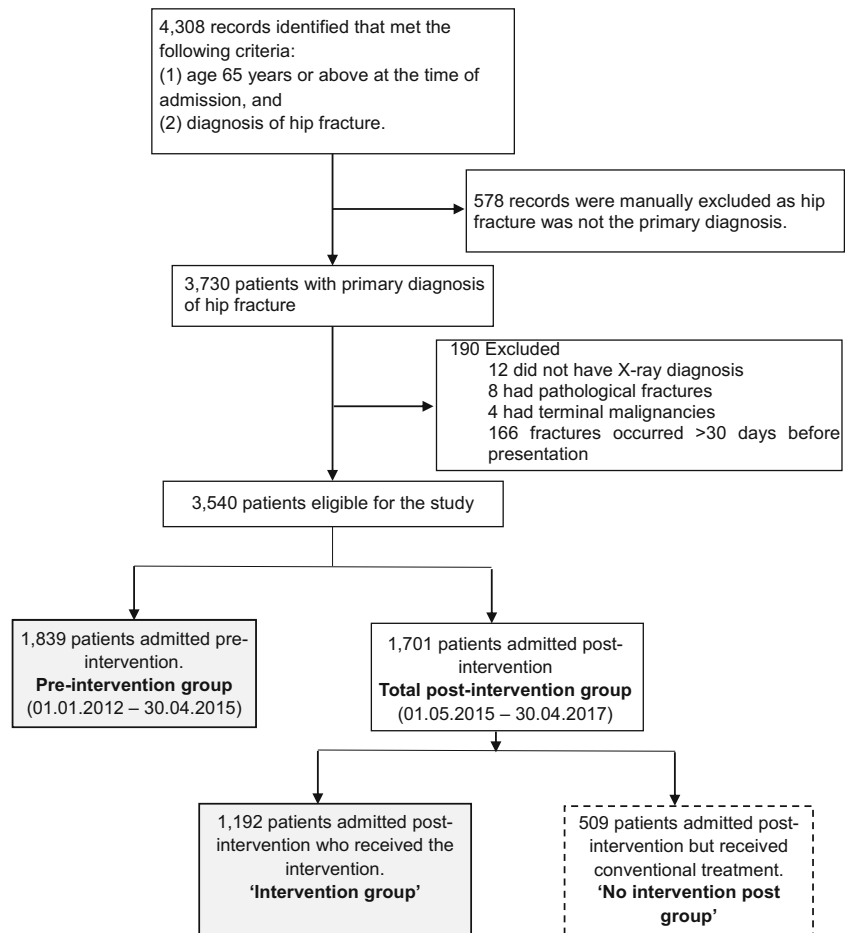
Outcomes

The primary outcome was the proportion of patients who received surgery within 48 h of admission to a ward. Secondary outcomes included the proportion of patients who were admitted to a ward within 4 h of presentation to ED, developed a pressure ulcer, received geriatrician care, and who received osteoporosis and falls prevention assessment.

Statistical analysis

These six best practice outcomes were compared before and after implementation of the co-management program using multivariable logistic regression models for binary outcomes and multivariable median regression models for time-continuous outcomes. Models were adjusted for age, sex, fracture type, side of fracture, and ASA grade. Segmented regression was performed for time-related outcomes, including the proportion of patients admitted to a ward within 4 h from ED presentation and the proportion of patients within 48 h from ward arrival to surgery procedure.

Fig. 1 Study flow chart



Results

Flow chart

A total of 4308 records were identified from the patient screening process. Of these, 578 records were excluded where hip fracture was not the primary diagnosis. A further 190 patients either did not satisfy the inclusion criteria or did satisfy the exclusion criteria (see Fig. 1). Thus, 3540 patients were included in the study. Of those, 1839 patients were admitted before the program began (“pre-intervention group,” 1 January 2012–30 April 2015), while 1701 were admitted during the implementation of the program (“total post-intervention group,” 1 May 2015–30 April 2017). A total of 1192 patients received the intervention (intervention group), while 509 patients received conventional treatment, that is they were admitted to the standard orthopedic ward without geriatrician consult (no intervention post group) (Fig. 1).

Participant characteristics

In this study, only data from the “pre-intervention group” and the “intervention group” are reported (shaded boxes in Fig. 1).

Selected characteristics of the subjects are provided in Table 1. The typical study participant (pre- and post-intervention) was a 78-year-old woman. Participants in the intervention group were significantly older than those in the pre-intervention group (79.6 vs 77.3, $P < 0.0001$). There was no significant difference in fracture side or gender between groups. Patients in the intervention group were more likely to present with a more serious (intertrochanteric) fracture (40.0 vs 45.3, $P = 0.008$) and were also significantly more likely to present with severe systemic disease than those in the pre-intervention group (19.5 vs 36.7, $P < 0.0001$). The proportion of patients who received a hemiarthroplasty was lower in the pre-intervention group than in the intervention group, while the proportion of patients who received a total hip replacement (THR) was higher in the pre-intervention group than in the intervention group.

Primary outcome

The proportion of pre-intervention group patients receiving surgery within 48 h after admission to the ward was low (6.4%). After the intervention, this proportion increased significantly, reaching nearly 50% in the intervention group (OR = 14.9, $P < 0.0001$). The effect of the co-management program on the primary outcome is shown in Fig. 2.

Secondary outcomes

Those who received the intervention had 0.23 times the odds of sustaining a pressure ulcer (OR = 0.23, $P = 0.0063$), more than 13 times the odds of receiving osteoporosis assessment (OR = 13.88, $P < 0.0001$), and more than 664 times the odds of receiving geriatrician assessment (OR = 664.91, $P < 0.0001$) compared than those admitted prior to program implementation. However, there was a significant reduction in the proportion of patients admitted to a ward within 4 h of ED presentation (OR = 0.34, $P < 0.0001$). The proportion of patients receiving falls assessment remained at a constant high-level pre- and post-intervention (99.7% and 99.4% respectively, $P = 0.34$) (Table 2).

Discussion

Our pilot study evaluated the effect of a multidisciplinary co-management program for older hip fracture patients in the China's leading orthopedic hospital. Importantly, the program significantly increased the proportion of patients receiving surgery within the timeframe of 48 h, as recommended in the Blue Book guidelines [5]. There was also a significant decrease in pressure ulcer rates and increase in the receipt of both osteoporosis assessment and geriatrician assessment.

The substantial improvement in 48 h surgery rates is an important finding given the known links between early surgery and reduced mortality after geriatric hip fracture [4, 13–15]. International guidelines that aim to improve clinical outcomes including morbidity and mortality after geriatric hip fracture all recommend early surgery, although the specific recommended time varies between guidelines. While the Blue Book recommends that hip fractures be operated on within 48 h [5], the National Institute for Health and Care Excellence (NICE) Clinical Guideline from the UK recommends that surgery be performed on the day of, or the day after admission [7]. Canadian guidelines state that access to surgery should be no later than 48 h or 2 days after admission to ED [16]. Guidelines in Australia and New Zealand recommended surgery on the day of or the day after presentation to hospital [17]. In the recent UK NHFD 2017 Annual Report, over 70% of patients with hip fracture in the UK received surgery within the day following ED presentation and 97% received surgery within 48 h [8]. In stark contrast, the proportion of patients receiving surgery within 48 h in a recent hospital audit of JST Hospital in China

Table 1 Selected characteristics of the subjects

Characteristic	Pre-intervention group (<i>N</i> = 1839)	Intervention group (<i>N</i> = 1192)
Age, y (SD)	77.3 (6.7)	79.6 (7.1)
65 to 69, %	15.5	10.2
70 to 74, %	19.5	13.3
75 to 79, %	27.1	23.6
80 to 84, %	23.3	27.8
85 or more, %	14.6	25.1
Female, %	69.5	71.7
Side of fracture, %		
Left	51.9	50.6
Right	48.1	49.4
ASA grade, %		
Normal healthy	6.0	2.1
Mild systemic disease	74.3	60.4
Severe systemic disease	19.5	36.7
A constant threat to life	0.1	0.8
Type of fracture, %		
Intracapsular	59.0	53.9
Intertrochanteric	40.0	45.3
Subtrochanteric	1.0	0.8
Type of surgery, %		
Internal fixation	53.6	57.6
Hemiarthroplasty	25.8	38.6
THR*	20.2	3.6
Other	0.4	0.2

*THR, total hip replacement

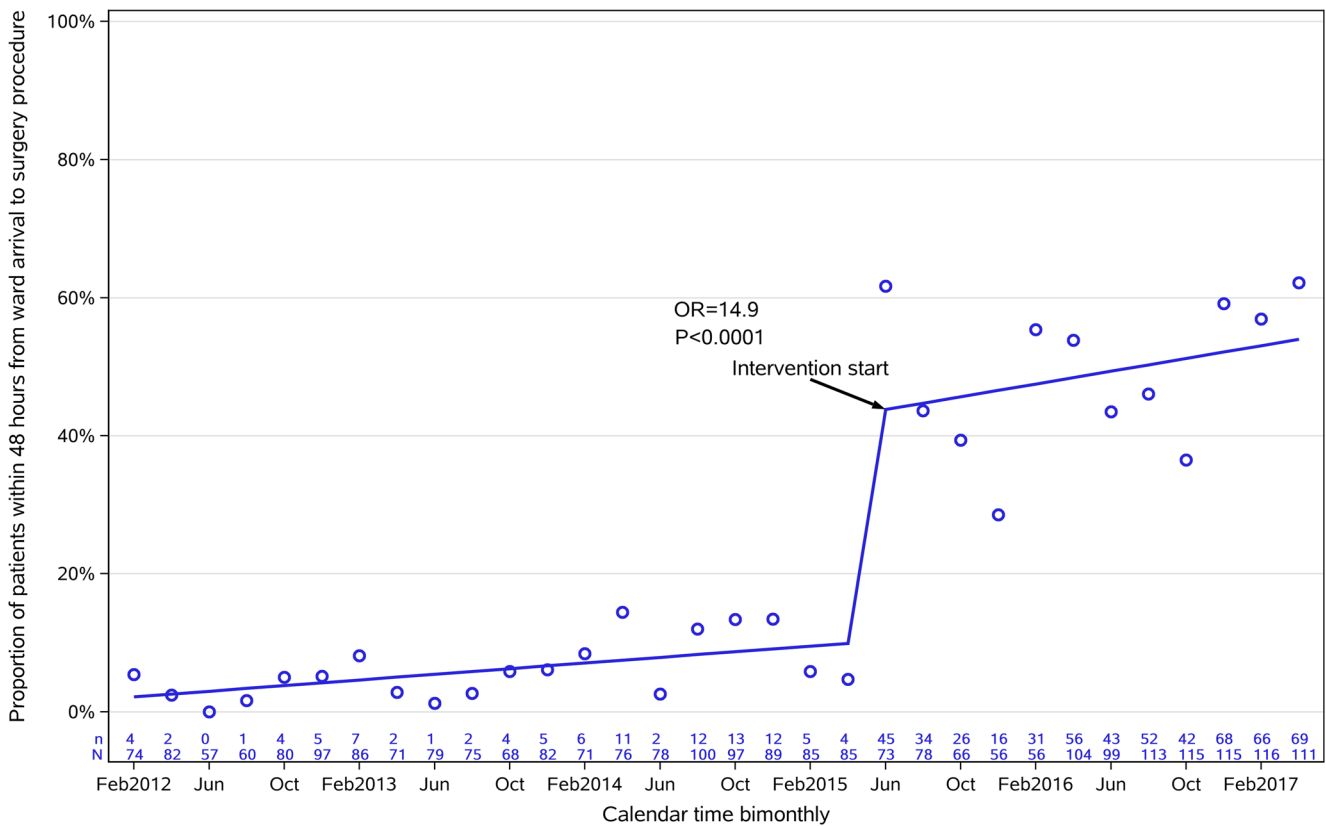


Fig. 2 The proportion of elderly hip fracture patients admitted to JST hospital who received surgery within 48 h of ward admission pre- and-post-intervention. ^Adjusted for age, sex, type of fracture, side of fracture, and ASA grade

was only 8% [6]. This low proportion is similar to that observed in the pre-intervention patients in our study (6.4%). Despite the dramatic increase in this proportion to 50% after the intervention, a notable gap remains in comparison to best practice in developed countries. This suggests that further improvements may yet be made.

One of the key features of this program is the establishment of a multidisciplinary team, particularly the involvement of a geriatrician from the time of admission [10, 13–17]. Several published guidelines emphasize the need for a multidisciplinary team, including the Scottish Intercollegiate Guidelines Network [18], the NICE guideline [7], and the British Orthopaedic Association [5]. In

the UK NHFD 2016 Annual Report, 44% of hospitals provided multidisciplinary management, in which patients were managed by an orthopedic surgeon and orthogeriatrician with an orthogeriatric team. The report indicated that there was a higher proportion of patients receiving surgery within 48 h for patients managed by the multidisciplinary team compared with the traditional orthopedic care service model (72% vs 64%) [19]. In a recent study of 161 geriatric hip fracture patients in the UK, the introduction of a multidisciplinary pathway resulted in reduced time to surgery, a significantly shorter time to geriatrician assessment, shorter length of stay, and a significant decrease in inpatient mortality [10]. The

Table 2 Effect of the co-management program on secondary care outcomes

Secondary outcomes	Pre-intervention group (N= 1993) %	Intervention group (N= 1154) %	Adjusted OR (95% CI)*	P value
Proportion admitted to ward within 4 h from ED	60.5	33.6	0.33 (0.28, 0.39)	< 0.0001
Developed pressure ulcers	1.4	0.3	0.25 (0.09, 0.71)	0.0093
Received falls assessment	99.7	99.4	0.54 (0.15, 1.92)	0.34
Received osteoporosis assessment	19.2	76.4	13.88 (11.59, 16.63)	< 0.0001
Received geriatrician assessment	0.3	100.0	–	< 0.0001

*Adjusted for age, sex, type of fracture and side of fracture

substantial improvements in hospital care outcomes noted in our pilot study likewise suggest the potential impact of the multidisciplinary co-management intervention on clinical outcomes amongst older Chinese hip fracture patients. In some studies, however, a multidisciplinary approach did not improve the time to surgery, primarily due to theater unavailability [20, 21]. These studies highlight the importance of local contextual factors on guideline feasibility and implementation, particularly in low and middle-income countries. Indeed, while this pilot study showed a significant improvement in observed outcomes in China's leading orthopedic hospital, the program may be less effective or may require adaptation for successful implementation, in less well-resourced hospitals in China and beyond.

In our study, the program significantly improved four of the six care standards recommended in the Blue Book, but there was a reverse finding in the proportion of patients admitted to the ward within 4 h from ED. In this pilot study, the specialized orthogeriatrics ward co-managed by the multidisciplinary team had a total of 18 beds, approximately 1/10 of the total beds in the orthopedic ward. The limited number of orthogeriatric beds constrained availability to admit all geriatric hip fracture patients within the recommended timeframe from the ED and also meant that over 500 patients who were eligible for the intervention did not receive it. This suggests the need for more orthogeriatric beds or a second unit to avoid this adverse outcome.

There are several limitations to this study. Firstly, there was a strong, clinically driven selection bias determining who received the multidisciplinary intervention. Older patients with more severe fractures and comorbidities were prioritized to receive the multidisciplinary intervention, while younger patients with more simple fractures and fewer comorbidities received traditional orthopedic care. This bias makes the substantial improvements observed in the intervention group even more remarkable. Secondly, the "pre and post" design of this pilot study relies on historical and not contemporaneous controls. Unlike with a randomized controlled trial, a pre-post study does not exclude the potential that other factors that may also be changing at the same time as the intervention is implemented. This limits the certainty with which the observed changes in care outcomes may be fully attributed to the intervention. As this pilot observed the proportion of patients receiving surgery within the recommended timeframe as the primary outcome, there is always a chance that changes observed were due to unobserved confounding variables and regression to the mean. Thirdly, the quantitative measures in this study are not able to provide in-depth information about which components of the intervention worked and which did not, particularly the barriers and challenges associated with implementation. A mixed methods process evaluation may

provide valuable information to guide the improvement of the program or its implementation in other hospitals in China and other low and middle income countries.

To our knowledge, this is the first study to develop, implement, and evaluate a multidisciplinary co-management intervention for older hip fracture patients in China. The study received strong support from the hospital management team to facilitate the coordination between several departments within the hospital. This was crucial for ensuring the successful implementation of the intervention. This study is significant as it provides preliminary evidence about the feasibility of a multidisciplinary care approach for geriatric hip fracture patients in a Chinese tertiary hospital. It also provides an estimation of the effect size of the intervention that can inform the development of a rigorously designed randomized controlled trial.

In many countries around the world, populations are aging. This is a new situation in many developing countries, where hip fracture is fast becoming a major public health issue. Despite well-established evidence about the benefits of implementing best practice guidelines for hip fracture management in developed countries, their uptake into routine clinical practice in developing countries remains limited and their adaptation for local contexts needs to be considered. Cost-effective approaches for the provision of high-quality care within existing health care systems are urgently needed to combat the growing burden of geriatric hip fracture in developing countries.

This study has provided preliminary evidence to support the use of a multidisciplinary co-management intervention in the care of older hip fracture patients in the leading orthopedic hospital in China. The care model evaluated in this pilot study was feasible and has the potential to be adopted in other hospitals across China. Large-scale cluster randomized controlled trials are needed to evaluate the effect of an enhanced and refined intervention on patients health outcomes and the cost-effectiveness of components of the care model.

Authors' contribution MY, MT, XW, and RI conceptualized the study. MY, MT, JZ, XG, RIL, JJ, XW, WT, and RI participated in the design of the study. JZ and YL coordinated and facilitated the data collection. JCJ and XL drafted the statistical analysis protocol and analyzed the data. MT and JZ drafted the manuscript. MY, MT, XW, MA, and RI participated in the critical review of the manuscript. All authors read and approved the final transcript.

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Compliance with ethical standards

Conflicts of interest None.

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