Optimal setting and care organization in the management of older adults with hip fracture: a narrative review

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Abstract

Hip fracture (HF) is a common event in older adults and is associated with significant morbidity, mortality, reduction of quality of life and costs for the healthcare systems. The expected rise in the total number of HF worldwide, due to improvements in life expectancy, and the growing awareness of HF detrimental consequences have led to the development and implementation of models of care alternative to the traditional ones for the acute and post-acute management of HF older adults. These services were set to streamline hospital care, minimize in-hospital complications, provide early discharge, improve short- and long-term functional and clinical outcomes, and reduce healthcare costs associated with hip and other fragility fractures. The main feature that distinguishes these models is the different healthcare professional that retains the responsibility and leadership during the acute and post-acute phases.

This narrative review has been conceived to provide a brief description of the models implemented in the last twenty years, to describe their potential beneficial effects on the short- and long-term outcomes, and to define the strengths and limitations of these models. On the basis of available studies, it seems that the more complex and sophisticated services, characterized by a multidisciplinary approach with a co-leadership (geriatrician and orthopedic surgeon) or a geriatrician leadership demonstrated to produce better outcomes compared to the traditional or simplest models.

Introduction

Osteoporotic fractures are common events in older adults, both in females and males. Their incidence increases exponentially with age, becoming a serious and disabling healthcare issue especially in frail older adults due to their greater vulnerability. Among fragility fractures, hip fracture (HF) represents the one associated with the most dramatic outcomes, being related with significant morbidity, mortality, disability, deterioration of quality of life and costs for the healthcare systems.[1-3] Total one-year mortality is impressive, ranging between 14% and 36%.[1] In addition, observational studies have reported a high rate (up to 15%) of permanent institutionalization at 12 months post-injury in surviving community-dwelling patients.[1,2]

The growing awareness of the detrimental consequences of hip and other fragility fractures and the expected rise in the total number of osteoporotic fractures worldwide have led to the development and implementation of models of care alternative to the traditional ones for the acute and post-acute management of fractured older adults.[4,5] These services were set to minimize in-hospital complications, streamline hospital care and provide early discharge with the primary objectives of improving survival, functional and clinical outcomes, and reducing the direct and indirect healthcare costs associated with hip and other osteoporotic fractures.

The main features that distinguish these innovative models of care from the traditional ones are the different healthcare provider that retains the responsibility of the care during the acute and post-acute phases, the skilled multidisciplinary team of healthcare professionals, and the organization of the orthogeriatric service/unit.[4,5]

To date, on the basis of available studies, it is not possible to define the best model of care for fractured older adults. However, the more complex and sophisticated services, characterized by a multidisciplinary approach, demonstrated, in randomized-controlled trials (RCTs), before-after observational studies and two meta-analyses, to produce better outcomes compared to the traditional or simplest models.[4-8]

In this narrative review we provide a brief description of the models implemented in the last twenty years, we describe their potential benefits on short- and long-term outcomes, we define the strengths and limitations of these models and we highlight the areas of uncertain, making some considerations about the future of orthogeriatric care.

General considerations: issues related to the setting and care organization

Responsibility and leadership: who is in charge?

The multidisciplinary approach is now the *gold standard* in the healthcare of older adults presenting with hip or other osteoporotic fractures. The basic interdisciplinary team of orthogeriatric models includes the orthopedic surgeon and the geriatrician, supported by the anesthesiologist in the peri-operative phase and other healthcare providers, such as physiotherapist, clinical nurse, nutritionist and social worker, during the acute and post-acute phases.[4,5] Scheduled meetings and written orders are the usual way to share information and to communicate between team members.[4] In some experiences, a skilled care manager takes on the role of coordinating the pathway of care and fostering communications between professionals.[9]

The main feature that distinguishes the huge variety of orthogeriatric models implemented to date concerns the healthcare professional that retains the responsibility throughout the care pathway.[4,5] In the geriatric consultant model, as well as in the traditional one, the overall responsibility of the care is under the orthopedic surgical staff. The geriatric-orthopedic co-managed care model is characterized by the co-management of the patients by the geriatrician and the orthopedic surgeon that share the responsibility and leadership. Finally, the geriatrician leadership distin-

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guishes the third model, usually referred as geriatric-led fracture service.

Comprehensive geriatric assessment approach in orthogeriatric care

Orthogeriatric care was primarily involved in the care and management of fragility hip fractures, but it has recently been expanded to provide specialist care to patients admitted with other various fractures. While comprehensive geriatric assessment (CGA)-based inpatient geriatric consultation service has shown little benefit, the co-management with a geriatrician may be beneficial for hip fracture patients in reducing complications, mortality, readmissions, and delirium.[10-12] A systematic review conducted on 56 studies suggested that age and cognitive impairment were the best CGA-based predictors of long-term care placement after hip fracture.[13] Predictors of increased mortality in long-term care residents after hip fracture were age, male gender, disability, coronary artery disease, pre-surgery anemia, pressure ulcers, and pneumonia, while predictors of subsequent fracture were higher function level, previous fracture, and previous falls.[13]

In conclusion, CGA methodology is an effective and crucial approach to optimize the beneficial effect on short- and long-term outcome of the orthogeriatric model for the management of the older patients with hip fractures.[14]

Time to surgery

Recent data support the beneficial effect of early surgery in the management of older adults presenting with hip fracture. Although the meaning of *early surgery* is still debated, guidelines and *recognized experts* suggest that fit patients should undergo surgery as soon as feasible, while those unfit should be quickly optimized to avoid detrimental delays.[5,15]

The recognition of HF as a clinical emergency requiring early surgery has significantly affected the organization and implementation of the orthogeriatric models. In an ideal model, the patient should be transferred directly to the surgical theatre from emergency department, and admitted to a hospital ward only after surgical repair. The feasibility of this approach has been tested in a study undertaken at the Pitié-Salpetriere Hospital (Paris), where the hip fractured patients, following a fast track procedure, were quickly operated and, only postoperatively, were admitted to a dedicated Geriatric Unit.[16] Indeed, this approach needs a more complex and coordinated organization and it is, therefore, at least in part still theoretical. However, we feel that a model of care based on the fast track in the emergency department and on the emergency surgery will affect significantly the development of orthogeriatric units in the close future.[5]

Length of hospital stay, early and late rehabilitation

In the various countries, the orthogeriatric models of care have been also influenced by the need of reduce acute in-hospital stay and promote early discharge to rationalize the resources. On the other hand, early discharge is affected by the availability of post-acute rehabilitation facilities in the community. Therefore, even when strategies to reduce the length of hospital stay (LOS) are implemented, LOS is largely dependent on the features of the healthcare system, and often related to local organizational factors.

In general, there is an inverse relationship between LOS and rate of transfer to rehabilitation services in the community. The models characterized by short in-hospital stay (between 5 and 7 days) should be supported by the presence of adequate post-acute rehabilitation services, able to take care of the patients undergoing early discharge and community rehabilitation.[16-20] In this scenario up to 70% of hip fracture older adults are usually transferred to inpatient rehabilitation or community skilled-nursing facilities to continue rehabilitation. On the other hand, when the service is organized to commence and continue rehabilitation into the Hospital, the LOS usually exceed 20 days, and most of the patients complete the rehabilitation phase during in-hospital stay, with only a very few proportion of them (less than 20%) transferred to other community services for further rehabilitation/healthcare.[21-24]

In the middle of these two scenarios, there are the majority of European models. In European countries, usually, the LOS ranges between 10 days and 15 days, with the rehabilitation broken down in two phases: an early phase that occurs during in-hospital stay, and later one that takes place after the discharge in the community.[25-33]

Hospital volumes and expertise in managing hip fracture

Kates and colleagues have suggested that there should be a reasonable volume of hip fractures per year to develop sufficient expertise in managing hip fracture patients and to implement an innovative model of care.[4,34] Nowadays, there is no evidence to suggest a precise number of hip fracture cases per year, although it is believed that approximately 100 patients per year could be a reasonable volume to make these programs effective.[34]

A positive relationship between provider volume and outcomes has been shown for a wide range of surgical procedures across a variety of specialties. Particularly, higher surgeon and hospital procedure volumes have been associated with lower mortality rates, fewer complications and shorter LOS.[4]

In the case of hip fracture, two recent studies reported conflicting results.[4,35,36] Forte *et al*. demonstrated a higher inpatient and 30-day mortality in subjects managed at lower-volume hospitals (less than 27 cases per year) compared to those treated in highest-volume hospitals (28 or more cases per year) in a study carried out in the US, considering more than 192,000 elderly patients presenting with intertrochanteric HF.[36] In a study from Finland, Sund did not find a clear relationship between hospital volume and mortality, while reported an association between the rehabilitation unit volume and 4-month mortality.[35]

In conclusion, summarizing available evidence a number of considerations may be drawn: i) a high number of cases per year is needed to implement an orthogeriatric service for the management of HF older adults, since in low-volume hospitals such services may not produce the expected benefits, but a defined number cannot be outlined; ii) not only the acute care ward volume but also the rehabilitation unit volume may be relevant; iii) the concentration of HF services in high-volume hospitals may have significant implications in the (re)distribution of resources, (re)organization of healthcare and costs in developed countries.[4]

Models of integrated care

General considerations

Innovative models of care for the management of older orthopedic patients, particularly hip fracture older adults, have been developed since more than 30 years ago, with the first RCT comparing a traditional model with an orthopedic-geriatric inpatient service published by Gilchrist *et al*. in 1988.[37]

In the traditional model, the fracture patient was admitted to a trauma ward, where the orthopedic surgeon was responsible for the care of the patient, medical queries and complications were dealt by consultative medical services, and the physician's opinion was required only when the surgeon considered it desirable.[4,5,8] In the post-acute phase, early rehabilitation took usually place within the orthopedic ward. After discharge, the patient could be transferred directly home, to a community nursing facility or to a rehabilitation facility, without substantial continuity of care.[4,5]

The first models introduced were simple variations of the traditional one. They were characterized by regular inputs from a specific trained consultant team including several healthcare professionals, with the overall responsibility of the care under the orthopedic surgical staff.[4] Over the years these models developed, being replaced by multidisciplinary and coordinated approaches that demonstrated to be more effective to meet patients' com-

plex needs.[4] These experiences have been designated with different names, such as ortho-geriatric units, co-managed geriatric fracture centers (GFC), or geriatric hip fracture clinical pathway, which in most of the cases, but not always, distinguished dissimilar models in terms of setting and organization. However, the basic idea underlying the development of the se projects was quite always the same: the definition of a multidisciplinary team dedicated to the care of the fractured older adult, to promote continuity of care, rapid management and/or prevention of the potentially undercurrent medical problems, early mobilization and rehabilitation, and coordinated discharge planning.[4,5]

Although a variety of experiences have now been described, the alternative services reported in the available literature can be broken down into 3 main models:[4,5] i) geriatric consultant in the orthopedic ward; ii) geriatric-orthopedic co-managed care; and iii) geriatric-led fracture service with orthopedic consultant (Table 1).

Geriatric consultant in the orthopedic ward

This is a variation of the traditional model, being one of the first services implemented in different developed countries.[4,5,8] The main features that characterize the model are: i) the overall responsibility under the orthopedic surgical staff; ii) the designation of a geriatric team (including several healthcare professionals) for the management of the patients during the acute and post-acute phases; iii) the regular input by the consultant team; iv) the implementation of early discharge programs. The consultant team contribution could start early from hospital admission or lately postoperatively. The team holds weekly or more frequent rounds to develop and monitor treatment plans. The prevention and management of common problems/complications of elderly patients with fracture are based on the choices of the individual surgeon or physician. The orthopedic surgeon settles early mobilization, discharge timing and location.

In observational studies and RCTs, this model did not demonstrate to produce significant beneficial effects, compared to usual care, on the length of hospital stay, mortality, recovery of ambulation and functional abilities, when the consultant team contribution started postoperatively.[4,5] Slightly better results were reported when the consultant team participated early at the time of hospital admission, and with daily visits to the care of the fractured older adults.[4] This approach demonstrated to reduce the length of in-hospital stay and the number of medical complications in hip fracture patients, compared to the traditional model.[4,5]

The beneficial effects on short- and long-term outcomes of geriatric consultant in the orthopedic ward model have been evaluated in a meta-analysis recently published, including ten studies and more than 3000 patients presenting with hip fracture (with 1733 subjects undergoing the intervention protocol and 2025 subjects undergoing standard care).[6] The meta-analysis demonstrated a significant decrease in long-term mortality [relative risk (RR), 0.78; 95% confidence interval (95%CI), 0.65-0.95], in-hospital mortality (RR, 0.51; 95%CI, 0.38-0.69), and time to surgery [standardized mean difference (SMD) between the traditional and innovative model, 0.13; 95%CI, 0.23 to 0.03]. Only very few studies described data about functional recovery or in-hospital complications, reporting a positive effect on the incidence of post-operative delirium and in functional improvements.

Summarizing available evidence, the implementation of a geriatric consultant team in the orthopedic ward seems to add some benefits to the traditional model of care, only when the multidisciplinary team is involved early in the process of care. Although this model has the largest amount of studies published, more evidence are needed, and the results of available trials and meta-analysis should be interpreted with caution due to the extreme heterogeneity of the published trials, to the relatively small sample sizes of some of them, and to some differences between the geriatric consultant models implemented.

Geriatric-orthopedic co-managed care

This is probably the most sophisticated model implemented for the management of fractured older adults. It has been developed in different countries, mainly in North America and Europe, and it has evolved over the last 10 to 15 years with gradual improvements added with time.[3,18,19,21,26,28,34,38-46] The reference model of the geriatric-orthopedic co-managed care is the GFC developed at the University of Rochester (New York).[18,34] The key and characterizing element is the co-management of the fractured patients by a geriatrician and an orthopedic surgeon (orthogeriatric team) that share the responsibility and the leadership from the admission in the orthogeriatric unit to discharge.[4,8] An interdisciplinary team including several healthcare professionals skilled in the care of geriatric orthopedic patients supports this co-direction. Standardized patient-centered, protocol-driven treatments and pathways are implemented.

The two healthcare figures directly involved (geriatrician and surgeon) visit the patient daily, write their own orders and communicate frequently, thus reducing the risk of delays, inappropriate care and iatrogenic errors, and promoting an optimal clinical coordination.[4] Also orders and choices that traditionally are of surgical competence, such as timing of surgery or surgical agenda, are shared and discussed, to optimize the management of the patients.[4]

The beneficial effects on short- and long-term functional and clinical outcomes of this innovative model have been illustrated in a number of well-designed before-after observational studies and RCTs, in their reviews and meta-analyses.[4-7,45] Table 2 and 3 describes most relevant studies published in the last fifteen years. For the sake of simplicity, in Table 2 are described studies reporting only in-hospital outcomes,[18,19,39-42] while in Table 3 are depicted those describing short- and long-term outcomes.[3,26,33,43,44,46] Trials are quite heterogeneous in terms of design, duration of follow-up and outcomes considered. In most of them, the implementation of a geriatric-orthopedic co-managed care model for the elderly patients with HF demonstrated to offer many benefits to the patients, reducing short- and long-term adverse events. Overall, the results of the different studies were not always consistent and sometimes skewed. Essentially, the geriatric-orthopedic co-managed care model demonstrated consistently to reduce short- and long-term mortality and in-hospital complication,[3,18,19,39,42,43,46] and, in one RCT, to improve functional outcomes,[43] compared to the traditional model where only the orthopedic staff

Table 1. Models of integrated care for the management of the older adults presenting with fragility fracture: main features.

Models of integrated care	Setting	Leadership	Consultative service
Traditional model	Orthopedic ward	Orthopedic Surgeon	Medical service on request
Geriatric consultant in the orthopedic ward	Orthopedic ward	Orthopedic Surgeon	Geriatric team with regular input
Geriatric-orthopedic co-managed care	Ortho-geriatric unit	Orthopedic Surgeon and Geriatrician	None (interdisciplinary team)
Geriatric-led fracture service with orthopedic consultant	Geriatric ward	Geriatrician	Orthopedic Surgeon

was responsible of the management of the patient. For example, in two trials (one RCT and one before-after observational trial), the one-year survival rates were about 10% higher in the geriatric orthopedic co-managed care group than in the controls.[3,43] Vidan *et al*.[43] also reported, after adjustment for confounding variables, a significant 45% lower probability of death or major complications with their model of co-managed care.

In their meta-analysis including five studies and around 1800 patients with HF (955 undergoing the intervention protocol and 905 treated with standard care), Grigoryan *et al*.[6] demonstrated a shortened length of in-hospital stay (SMD, 0.61; 95%CI, 0.95 to 0.28) and a reduced incidence of in-hospital complications with the geriatric orthopedic co-managed care. The very small number of studies included and the relevant heterogeneity strongly hampered the possibility to demonstrate significant beneficial effects on other short and long-term outcomes.

In conclusion, the geriatric orthopedic co-managed care service represents a valuable and more effective alternative to the traditional programs in the acute and post-acute management of HF older adults. Due to its complexity, the implementation of such services requests considerable efforts, consistent administrative support and strong physician leadership.[4]

Geriatric-led fracture service with orthopedic consultant

The overall management and healthcare pathway take place in a geriatric ward, under the complete responsibility of the geriatrician.[4] The central role of the geriatrician as the primary attending physician for all patients from hospital

Table 2. Geriatric-orthopedic co-managed care service: studies evaluating in-hospital outcomes.

Study design		Khasraghi (US)[39] Before-after retrospective	Friedman (US)[18] Retrospective cohorts	Gonzalez-Montalvo (SP)[40] Randomized-controlled	Biber (GER)[41] Before-after retrospective	Zeltzer (AUS)[42] Retrospective multicenter	Flikweert (NL)[19] Before-after prospective
Number of patients	Intervention	273	193	101	114	4575	256
	Control	237	121	123	169	5026	145
Mean age (years)	Intervention	80	85*	85	82	84	78
	Control	80	82	87	82	84	80
In-hospital mortality (%)	Intervention	NA	1.6	5.9	4.4	6.5*	2.0*
	Control	NA	2.5	6.5	5.9	8.1	5.5
Length of stay [mean days (SD or IQR)]	Intervention	6 (NR)*	5 (3)*	12 (4)*	14 (7)*	30 (23)*	7 (6-10)*
	Control	8 (NR)	8 (6)	18 (8)	17 (10)	29 (30)	11 (7-16)
Time to surgery [mean days (SD or IQR)]	Intervention	1.1 (NR)*	1.0 (0.7)*	5 (3-6)*	2.1 (1.8)*	1.8 (2.7)	NR
	Control	1.9 (NR)	1.6 (2.7)	6 (5-9)	3.1 (4.6)	1.7 (13.2)	NR
In-hospital complications (%)	Intervention	36*	31*	NA	NA	NA	51
	Control	51	46	NA	NA	NA	49

US, United States; SP, Spain; GER, Germany; AUS, Australia; NL, the Netherlands; NA, not assessed; SD, standard deviation; IQR, interquartile range; NR, data assessed but not reported. *Statistical significant difference between intervention group and control group.

Table 3. Geriatric-orthopedic co-managed care service: studies evaluating short- and long-term outcomes.

Study design		Vidan (SP)[43] Randomized-controlled	Barone (IT)[3] Before-after prospective	Cogan° (IR)[26] Before-after retrospective	Gregersen (DK)[33] Before-after retrospective	Watne (NOR)[44] Randomized-controlled	Suhm (SW)[46] Before-after prospective
Number of patients	Intervention	155	272	98	233	163	224
	Control	164	252	103	262	166	269
Mean age (years)	Intervention	81	84	82*	83	84	84
	Control	83	84	75	82	85	84
In-hospital mortality (%)	Intervention	0.6*	4.8*	8.2	7.7	3.7	1.8
	Control	5.5	9.9	20.4	6.1	1.8	2.2
12-month mortality (%)	Intervention	18.9	25.0*	33.7	NA	28.2	28.6*
	Control	25.6	35.3	44.6	NA	25.9	19.7
Length of stay [mean days (SD or IQR)]	Intervention	16 (5)	21 (11)	30 (NR)	13 (NR)*	11 (8-15)*	9 (4)*
	Control	18 (8)	21 (13)	23 (NR)	15 (NR)	8 (5-11)	11 (5)
Time to surgery [mean days (SD or IQR)]	Intervention	3.2 (1.8)	NA	1.9 (0.9)	0.9 (0.8)*	1.1 (0.7-1.8)	1.3 (1.2)
	Control	3.3 (2.2)	NA	1.9 (1.9)	0.7 (1.0)	1.0 (0.7-1.6)	1.2 (1.0)
In-hospital complications (%)	Intervention	45*	NA	NA	NA	44	59*
	Control	62	NA	NA	NA	46	73
Functional status recovery 3 month (%)	Intervention	57*	NA	NA	NA	NA	NA
	Control	44	NA	NA	NA	NA	NA

SP, Spain; IT, Italy; IR, Ireland; DK, Denmark; NOR, Norway; SW, Sweden; NA, not assessed; SD, standard deviation; IQR, interquartile range; NR, data assessed but not reported. *Statistical significant difference between intervention group and control group. °The Authors did not reported the statistical significance in the between groups comparisons.

admission to discharge distinguishes the service.[4,5] The geriatrician evaluates the patient on admission and during in-hospital stay, coordinates the timing of surgery, procedures, diagnostics, treatments and transition/discharge planning. The geriatrician, the orthopedic surgeon and the anesthesiologist manage together the patients in the pre- and peri-operative phase, while, during the post-operative phase, the orthopedic surgeon is a consulting physician that follows the patients until complete wound healing. An interdisciplinary team, including different healthcare professionals, is integrated in the service. Standardized orders and protocols are implemented.

Usually, the hip fracture patient is admitted directly from the emergency department to the geriatric ward, where he/she is evaluated and prepared for surgery, transferred to the operating room and then returned to the geriatric ward. The post-acute rehabilitative phase may take place in the same setting under the healthcare of the same geriatric interdisciplinary team,[24,47,48] or in the community within a skilled nursing facility.[49]

The reference model of the geriatric-led fracture service with orthopedic consultant is the *Sheba* model implemented by Adunsky and colleagues in 1999 (Israel).[24,47,48] More recently, similar services have been adopted also in United Kingdom, United States and Europe.[12,49-52]

In Table 4[12,16,46-49,52] are depicted relevant studies designed to evaluate the geriatric-led fracture service. In contrast to the wealth of data published for the other models described, information regarding the efficacy of the geriatric-led fracture service is relatively limited. The model originally proposed by Adunsky *et al*., and recently implemented in other Countries, demonstrated to improve the long-term functional outcomes,[12,47,52] and, in some cases, to reduce time to surgery and in-hospital stay, compared to the traditional orthopedic-centered approach.[4,5,24,47,48,52] On the other hand, none of the trials published to date, reported a consistent and significant reduction in short- and long-term mortality (Table 4).

In the *geriatrician-led hip fracture program* developed in Portland (Oregon, United States) by Miura *et al*., the HF subject is rapidly transferred to a community skilled-nursing facility early after surgery (3 days) for further rehabilitation, with a mean LOS lower than 5 days.[49] This approach, alternative to the *Sheba* model, demonstrated to reduce significantly the direct and indirect cost.

In conclusion, on the basis of available evidence, a geriatrician-led fracture service with orthopedic consultant approach seems feasible, applicable and effective in terms of functional outcomes, when the overall care takes place in the same setting.[4] The beneficial effects of a the model in which the geriatric leadership is limited to the acute phase still need to be established, although a separation of the intensity of care from the acute to the post-acute phase seems economically more suitable.[4,49]

Early supported discharge and post-acute care

General considerations

The concept of using forms of intermediate care, such as skilled nursing or community facilities and early home-based rehabilitation, to allow earlier discharge from the acute ward, has been introduced in the United States many years ago and more recently adopted also in UK and other European Countries.[4,22] The main objectives of these post-acute care services were to alleviate the pressure on hospital bed capacity, to reduce LOS and to promote earlier discharge, while maintaining an acceptable quality of care and without worsening short- and long-term outcomes.[2,4,5,49,53]

For hip fracture older adults, home-based supported rehabilitation (HBR) and geriatric orthopedic rehabilitation units (GORU) represented the more consistently implemented approaches to face these needs.[2,4,53-57]

These innovative schemes should be considered as possible post-acute transitions that could be used in tandem with any of the aforementioned models, rather than a *real* and comprehensive model of care for the management of HF older adults, since they interest only a part of the overall healthcare pathway of HF patients.[4] Indeed, the implementation of these services without a model including an early intervention may not produce the expected benefits.[4]

Home-based supported rehabilitation

Early discharge and HBR after hip fracture have been developed since 1986 in Europe, Australia and North America.[4] The implementation of this service requires adequate community resources, and, in particular, the presence of hospital at home community nursing services in the healthcare district where the program is introduced. To be suitable for early discharge and HBR, subjects should be com-

Table 4. Geriatric-led fracture service with orthopedic consultant: studies evaluating short- and long-term outcomes.

Study design		Stenvall (SW)[52] Randomized-controlled	Miura (US)[49] Before-after° prospective	Adunsky (ISR)[47,48] Retrospective cohort	Della Rocca (US)[46] Before-after retrospective	Boddaert (FR)[16] Prospective cohorts	Prestmo (NOR)[12] Randomized-controlled
Number of patients	Intervention	102	91	847	115	203	198
	Control	97	72	2267	31	131	199
Mean age (years)	Intervention	82	80	82*	82	86	83
	Control	82	81	81	82	85	83
In-hospital mortality (%)	Intervention	5.9	NA	1.9	4.3	3.0	NR
	Control	7.2	NA	3.0	9.7	7.6	NR
Long-term mortality (%)	Intervention	15.7	NA	14.8	31.3	14.3	15.2
	Control	18.6	NA	17.3	45.2	23.7	18.6
Length of stay [mean days (SD or IQR)]	Intervention	30 (18)*	5 (1)*	32 (20)*	7 (NR)*	11 (8-16)*	13 (0.4)*
	Control	40 (41)	6 (2)	25 (31)	10 (NR)	13 (10-20)	11 (0.5)
Time to surgery [mean days (SD or IQR)]	Intervention	1.0 (0.7)	NA	3.0 (2.9)*	1.2 (NR)	0.9 (0.5-1.4)	1.2 (1.1)
	Control	1.0 (0.6)	NA	2.9 (6.5)	1.5 (NR)	1.0 (0.6-1.7)	1.2 (0.9)
Discharge to pre-admission place of residence (%)	Intervention	84	NA	NA	NA	NR	25*
	Control	76	NA	NA	NA	NR	11

SW, Sweden; US, United States; ISR, Israel; FR, France, NOR, Norway; NA, not assessed; NR, data assessed but not reported; SD, standard deviation; IQR, interquartile range. *Statistical significant difference between intervention group and control group. °The Authors did not reported the statistical significance in the between groups comparisons.

munity dwelling, living with relatives or other informal support, and clinically stable without any relevant acute illness.[2,4,53]

The patient is usually assessed on admission for eligibility, and to set up a discharge planning. Early after surgery, the patient is transferred directly home for rehabilitation. An interdisciplinary team, including a geriatrician, a geriatric nurse and a physical therapist, is usually involved in the care of the older adult in collaboration with the general practitioner.[4]

A number of RCTs and prospective observational studies have evaluated the potential beneficial effects of HBR.[2,4,53,55,58-62] Published studies demonstrated that HBR services in elderly patients after hip fracture are feasible, safe and effective producing comparable results in terms of functional outcomes, and reducing length of in-hospital stay compared to traditional programs.[4] These results were confirmed also when patients with pre-fracture cognitive decline or disability were considered suitable for these programs.[2,53]

Geriatric orthopedic rehabilitation units

The GORU is a variation of the traditional geriatric rehabilitation unit, fully dedicated to the care of older adults presenting with a fragility fracture.

In general, once the orthopedic surgeon, the geriatrician or the orthogeriatric team judges that the patient is medically fit to be moved to a rehabilitation ward, he/she is rapidly transferred to a GORU.[4] Basically, the presence of a geriatrician as supervisor and leader, supported by a multidisciplinary team, distinguishes this service from other rehabilitation programs.

The GORU demonstrated to produce short- and long-term better outcomes compared to traditional rehabilitation units. In several well-designed trials, patients admission to GORU after hip fracture produced a significant reduction in length of stay, a greater recovery of functional status, a lower risk of institutionalization and a higher rate of survival.[52,56-58,63,64] Finally, it should be emphasized that this rehabilitation approach demonstrated to be really successful also in patients with moderate to severe dementia.[64]

Conclusions

In this narrative overview we have characterized and described a number of innovative models of care for the management of older adults with hip fracture. These services were distinguished mainly on the basis of the role of the healthcare professionals involved in the healthcare pathway, with particular attention to the figure (orthopedic surgeon or geriatrician) that retains the responsibility and leadership throughout the clinical pathway.

The HF services implemented in the different countries are quite heterogeneous, and frequently represent a combination of different models. The development and implementation of a service for HF management should, in fact, consider the best available evidence, but also existing resources, willingness to pay and actual local organization of the healthcare system.[4]

Relevant differences in the trials interventions, populations and outcomes hamper our ability to define which model, setting and care organization is the optimal, or superior to the others, in terms of short- and long-term outcomes. However, our review underlines a tendency to better overall outcomes in patients receiving the more complex approach based on the co-management of the patient. On the other hand, it should be emphasized that there is still insufficient evidence to draw conclusions about how effective these models are for patients with pre-fracture cognitive decline (or severe disability), as recently highlighted in a review/meta-analysis about rehabilitation and care models for HF older adults with dementia.[65]

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