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The implementation of a Geriatric Fracture Centre for hip fractures to reduce mortality and morbidity: an observational study

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Abstract

Introduction The aim of this study was to evaluate the effect of an orthogeriatric treatment model on elderly patients with traumatic hip fractures (THF). The Geriatric Fracture Centre (GFC) is a multidisciplinary care pathway with attention for possible age-related diseases, discharge management and out-of-hospital treatment.

Materials and methods A prospective cohort study with a historical cohort group was conducted at a level I trauma centre in Switzerland. Patients over the age of 70 years with THFs who underwent surgical treatment at GFC in 2013 and 2016 were included. Primary outcomes were mortality and complications. Secondary outcomes were hospital length of stay (HLOS), time to surgery and place of discharge.

Results A total of 322 patients were included in this study. In 2016, mortality showed a reduction of 2.9% at 30 days ($p=0.42$) and 3.4% at 90 days ($p=0.42$) and 0.1% at 1 year ($p=0.98$). The number of patients with a complicated course showed a decrease of 2.2% in 2016 ($p=0.69$). A significant increase in the diagnosis of delirium by 11.2% was seen in 2016 ($p<0.001$). The median HLOS was significantly reduced by 2 days ($p<0.001$). An increase of 21.1% was seen in patients who were sent to rehabilitation in 2016 ($p<0.001$). Day-time surgery increased by 10.2% ($p=0.04$).

Conclusion The implementation of the GFC leads to improved processes and outcomes for geriatric patients with THFs. Increased awareness and recognition led to an increase in the diagnosis of complications that would otherwise remain untreated. Expanding these efforts might lead to more significant effects and an increase in the reduction of morbidity and mortality in the future.

Keywords Clinical pathway · Hip fracture · Geriatrician · Elderly

Introduction

The population of elderly patients has grown in the recent decades due to life expectancy increases. As a result, the incidences of hip fractures in elderly patients are rising [1].

Frail elderly patients often experience limitations in performing activities of daily living (ADL) and have reduced physiological capabilities to withstand major injuries like hip fractures without further loss of function and further compromise of health status [2]. The literature shows that up to 25% of patients die within the first year after a hip fracture. This risk increases with age [3]. Patients over the age of 50 years have a five- to eightfold increased risk for all-cause mortality during the first 3 months after hip fractures [4]. Additionally, comorbidity and polypharmacy complicate treatment and increase the risks of complications and losses of functionality [5, 6]. The costs of treatment are high and are expected to rise in the future [7]. There is sufficient literature to justify paying extra attention to the needs of this frail population.

In Switzerland, more than half of patients with hip fractures needed help with ADL before the fracture, and well

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over one-third were diagnosed with, or were suspected of having dementia. Many of them had co-morbidities. One year after a hip fracture, 30% of the patients who were ADL independent prior to the fracture, required assistance with ADL [8].

To improve care for this patient population, various co-managed approaches to optimise care and provide appropriate support to the growing number of geriatric fracture patients were developed to reduce mortality and morbidity [9, 10].

In central Switzerland, a GFC did not yet exist. Therefore, in 2015, the first certified (DGU®) Geriatric Fracture Centre of central Switzerland was established [11]. Geriatric care pathways were developed for the treatment of fractures in the elderly population. In this study, we evaluated the impact of the implementation of a geriatric care pathway for patients with traumatic hip fractures (THF). We hypothesised that the implementation of the GFC concept would reduce mortality, morbidity and hospital length of stay (HLOS). Primary outcomes were mortality and complications. Secondary outcomes were HLOS, time to surgery and place of discharge.

Methods

This article was written in accordance with the STROBE criteria [12].

Study design

A single centre combined retrospective and prospective cohort study in elderly trauma patients was conducted. Ethical approval for the quality improvement project was given by the responsible ethical commission (Ethikkommission Nordwest- und Zentralschweiz, EKNZ 2014-343).

Study population

We retrospectively analysed all patients over the age of 70 years with THFs in 2013. This cohort was used as baseline.

Prospectively, an analysis of all patients over the age of 70 years admitted with THFs between January 2016 and December 2016 was performed. Patients were excluded if they had periprosthetic fractures or if the fractures were treated non-operatively. Patients who were treated in 2014 and 2015 were excluded to reduce the interference of the transition period to a Geriatric Fracture Centre (GFC).

Geriatric Fracture Centre concept

The GFC officially became a certified geriatric trauma centre in 2015 after completing the certification process necessary for a hospital to receive the designation 'AltersTraumaZentrum, DGU®'. The criteria for this certificate were endorsed by the German trauma organisation (Deutsche Gesellschaft fur Unfallchirurgie, DGU®) [13]. The GFC was co-directed by a trauma surgeon and a geriatrician with shared leadership responsibilities as described by Friedman et al. [10]. The multidisciplinary team consisted of trauma surgeons, geriatricians, anaesthetists, physiotherapists, rheumatologists, nurses, social (discharge) workers, psychiatrists and dieticians who worked together to provide a pathway with the potential to optimise outcome for each individual patient both during hospital admittance and after discharge. The GFC was carried out hospital-wide and every member of the team was committed to implementing these new improvements. During the planning of each step of treatment, the individual values of both patients and relatives were considered. The patients received well-coordinated treatment that, alongside the acute problem, involved attention for possible age-related diseases, discharge management and out-of-hospital treatment.

Geriatric care pathway for traumatic hip fractures

The geriatric care pathway provided extra care in both the pre-, peri- and postoperative phase.

Preoperative pathway

Preoperatively, the P-Possum score was calculated by the anaesthesiologist or a resident on admission. The P-Possum scoring system is a method of calculating expected surgical outcome defined as risk of mortality [14]. All patients followed the same pathway, with allowances for individual patient needs if deemed necessary after comprehensive geriatric assessment. A case manager was involved in care planning throughout the duration of the hospital admission. The patients' medications were evaluated, and all patients received extensive blood testing (type and screen, coagulation, electrolytes, [para]thyroid hormones, vitamin deficiencies, liver enzymes, [pre]albumin and renal lab). Furthermore, specific attention was given to screen for and prevent delirium (confusion assessment method) and nutrition risk scores (NRSs) during admission [15, 16]. Surgery was scheduled within 24 h after arrival when possible, preferably during daytime. If surgery was delayed, patients received preoperative physiotherapy that focussed on respiratory therapy and on maintaining strength in the upper extremities.

Perioperative pathway

The aim of surgical treatment was to achieve direct postoperative full-weight bearing. Therefore, surgical concepts

with minimal iatrogenic injury and implants designed for patients that are likely to have osteoporosis were used.

Postoperative pathway

Postoperatively, patients did not receive non-steroidal anti-inflammatory drugs (NSAIDs) or benzodiazepines. At the first postoperative day, routine blood tests and mini-mental state examinations (MMSEs) were performed [17]. Mobilisation began on the first post-operative day, since it reduces incidences of delirium and pneumonia, improves function and is associated with lower mortality [18]. Daily visits by the treating surgeon and a geriatrician took place until discharge. The geriatrician was responsible for the patients' comprehensive geriatric assessment. A dietician was actively involved during the recovery period at the ward. The hospital's pain-management team was on standby for consultation when needed. Depending on the patients' medical conditions and other contextual factors, they were referred either to their homes, rehabilitation clinics, nursing homes (temporary or permanent) or to nearby acute geriatric rehabilitation clinics. The entire multidisciplinary team, the patients and their relatives were involved in the decision-making process.

Multidisciplinary follow-up visits with the involvement of the geriatrician, surgeon and physiotherapist were scheduled. Thereby, the geriatrician was responsible for the comprehensive geriatric assessments of the patients, and the surgeon assessed the surgical outcomes. Furthermore, a dedicated physiotherapist performed standardised fall risk—e.g., mobility—assessments and talked with the patients about their individual goals. Osteoporosis screening was either performed by the geriatrician or the dedicated physiotherapist. According to the findings of the multidisciplinary evaluation, further steps considering the rehabilitation process were discussed and planned. The general practitioner and the treating physiotherapist received letters containing the evaluations and recommended actions.

Data collection

Data were collected through MedFolio, a web-based clinical electronic patient documentation (EPD) system, which was developed for use of both clinicians and clinical support staff. All extracted data were added into pre-formatted Excel spreadsheets.

Baseline data included: age, sex, American Society of Anaesthesiologists (ASA) classification and fracture type according to the Arbeitsgemeinschaft für Osteosynthesefragen (AO) [19, 20].

The following peri-operative data were retrieved: time to surgery (hours); time of surgery (daytime: 7:00–18:59, out-of-office hours 19:00–6:59); type of surgery (hemiarthroplasty, total hip prosthesis, intramedullary nail, sliding hip screw (including Dynamic Hip Screw [Depuy Synthes, Oberdorf Switzerland], Targon FN [B-Braun AG, Melsungen, Germany] and/or the use of cannulated screws).

Post-operative outcomes were: HLOS (days), number of complications per patient, number of patients with complicated courses and types of complications.

Post-operative complications were divided into two groups: surgical-related and non-surgical-related complications. Surgical-related complications included: wound infection (CDC guidelines), hematoma, acute anaemia (defined as blood loss requiring transfusion), revision of implant due to loss of reduction, screw cut-out/through, nail breakage, loss of fixation, joint infection, pulmonary embolism and gastro-intestinal bleeding.

Non-surgical-related complications included pneumonia (according to CDC guidelines), delirium (based on CAM and/or DOS), urinary tract infection (UTI) (according to CDC guidelines), cardiac failure (according to ESC guidelines), decubital ulcer, renal insufficiency, reanimation and cerebrovascular incident (CVI) [21–23].

Each complication that occurred fewer than five times in the entire cohort less was grouped under 'other'. Furthermore, data on place of discharge (home, nursery home, rehabilitation) were gathered for analysis.

Mortality was analysed through patient documentation at 30 days, 90 days and 1 year after surgery.

Statistical analysis

Categorical variables were expressed as percentages, and numerical data as median and interquartile range (IQR). Categorical variables were compared by the Chi-squared test or Fisher's exact test (two-tailed), and continuous variables by the Mann–Whitney *U* test. A two-sided p value of < 0.05 was considered statistically significant. Data were analysed with the SPSS software package version 25.0 (IBM Corp., Armonk, NY, USA), for Windows.

Results

Participants

A total of 350 patients over 70 years of age with THFs underwent operations in 2013 and 2016. Of the 164 patients analysed in 2013, 154 were included. In 2016, 186 patients were analysed, and 168 were included. In total, 322 patients were included for analysis. Further information on in- and exclusion is shown in Fig. 1.

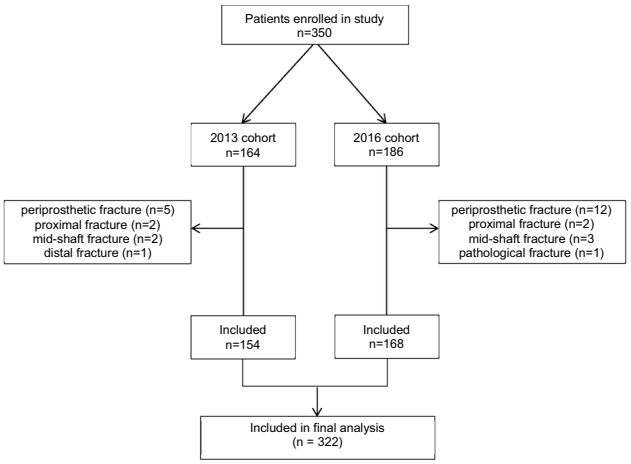

Fig. 1 Flowchart of patient inclusion

Table 1 Baseline characteristics

	2013 ($N=154$)	2016 ($N=168$)	p value
Age (years) median (IQR)	86 (81–90)	85 (82–89.75)	0.87
Gender			0.70
Male, *n* (%)	43 (27.9)	44 (26.2)	
Female, *n* (%)	111 (72.1)	124 (73.8)	
ASA classification			0.09
ASA classification 1, *n* (%)	0 (0)	0 (0)	
ASA classification 2, *n* (%)	42 (27.3)	38 (22.6)	
ASA classification 3, *n* (%)	102 (66.2)	107 (63.7)	
ASA classification 4, *n* (%)	10 (6.5)	23 (13.7)	
Type of fracture			0.40
Femoral neck, *n* (%)	70 (45.5)	81 (48.2)	
PTF, *n* (%)	76 (49.3)	83 (49.4)	
Subtrochanteric, *n* (%)	8 (5.2)	4 (2.4)	

Numbers are noted in percentages of the total number of patients at the hospital

N number of patients, *n* number of patients, *ASA classification* American Society of Anesthesiologists Physical Status Classification System, *ASA classification 1* a normal healthy patient, *ASA classification 2* a patient with mild systemic disease, *ASA classification 3* a patient with severe systemic disease, *ASA classification 4* a patient with severe systemic disease that is a constant threat to life, *PTF* peritrochanteric fracture

Baseline characteristics

No significant differences were noted between the groups in terms of patient characteristics (Table 1).

Perioperative outcomes and postoperative complications and outcome measures can be found in Tables 2 and 3, respectively.

Primary outcomes

In 2016, mortality showed a reduction of 2.9% at 30 days (13.6% vs. 10.7%; $p=0.42$) and 3.4% at 90 days (19.5% vs. 16.1%; $p=0.42$). No difference was seen in mortality at 1 year in 2016 (29.9% vs. 29.8%; $p=0.98$).

The number of patients with a complicated course and the number of complications per patient did not show significant decrease. When delirium was omitted as a complication, patients with complicated courses showed a reduction of 8.4% in 2016; however, this was not significant (54.3% vs, 45.9%; $p=0.15$).

Surgical-related complications: no significant differences were seen in the surgical-related complications anaemia, hematoma and other.

Non-surgical-related complications: delirium was diagnosed significantly more often in 2016 (1.9% vs. 13.1%; $p<0.001$). Categories of pneumonia, UTI, cardiac failure and 'other' showed no significant differences.

Secondary outcomes

Hospital length of stay was reduced by 2 days in 2016 ($M=10.45$ vs. $M=8.36$; $p<0.001$). Time to surgery showed no reduction in 2016 ($M=23{:}43$ vs. $M=19{:}41$; $p=0.32$). A difference was also seen in places of discharge. In 2016, fewer patients were sent back home (14.9% vs. 4.8%; $p=0.002$) or to a nursing home (74.0% vs. 63.1%; $p=0.04$). In 2016, more patients were sent to a rehabilitation facility (11.0% vs. 32.1%; $p<0.001$).

Additional outcomes

In 2016, there were significantly more daytime surgeries (51.9% vs. 63.1%; $p=0.04$).

Discussion

Summary of main results

The goal of the GFC concept was the optimisation of treatment for geriatric patients both during admission and after discharge by means of implementing a multidisciplinary care pathway. This retrospective and prospective cohort study analysed the effect of the concept on the following performance indicators: mortality, complications, HLOS, place of discharge, time to surgery and timing of surgery.

Table 2 Peri-operative outcomes

	2013 ($N=154$)	2016 ($N=168$)	p value
Time to surgery			
Time to surgery (hh:mm) median (IQR)	15:34 (8:03–25:27)	18:51 (9:09–24:50)	0.32
Time of surgery			0.04
Day-time (7:00–18:59), *n* (%)	80 (51.9)	106 (63.1)	
Out-of-office hours (19:00–6:59), *n* (%)	74 (48.1)	62 (36.9)	
Type of surgery			0.51
Hemiarthroplasty, *n* (%)	58 (37.7)	68 (40.5)	
Total hip prothesis, *n* (%)	5 (3.2)	6 (3.6)	
Pertrochanteric fixation nail, *n* (%)	70 (45.5)	77 (45.8)	
Dynamic hip screw/targon fixation nail, *n* (%)	16 (10.4)	16 (9.5)	
Other *n* (%)	5 (3.2)	1 (0.6)	

Numbers are noted in percentages of the total number of patients at the hospital

N number of patients, *n* number of patients, *IQR* interquartile range

Table 3 Post-operative outcomes

	2013 ($N=154$)	2016 ($N=168$)	p value
HLOS (days) median (IQR)	9 (7–12)	7 (5–10)	<0.001
Complications			
Patients with complicated courses, *n* (%)	85 (55.2)	89 (53.0)	0.69
Complications per patient			0.66
0 complications, *n* (%)	69 (44.8)	79 (47.0)	
1 complication, *n* (%)	60 (39.0)	58 (34.5)	
≥ 2 complications, *n* (%)	25 (16.2)	31 (18.5)	
Surgical-related complications			
Anemia, *n* (%)	66 (42.9)	61 (36.3)	0.23
Hematoma, *n* (%)	6 (3.9)	2 (1.2)	0.16
Other, *n* (%)	4 (2.6)	5 (3.0)	1.00
Non-surgical-related complications			
Pneumonia, *n* (%)	8 (5.2)	7 (4.2)	0.66
Delirium, *n* (%)	3 (1.9)	22 (13.1)	<0.001
Urinary tract infection, *n* (%)	13 (8.4)	20 (11.9)	0.31
Cardiac failure, *n* (%)	7 (4.5)	12 (7.1)	0.32
Other, *n* (%)	6 (3.9)	4 (2.4)	1.00
Discharge disposition			
Home, *n* (%)	23 (14.9)	8 (4.8)	0.002
Nursing home, *n* (%)	114 (74.0)	106 (63.1)	0.04
Rehabilitation, *n* (%)	17 (11.0)	54 (32.1)	<0.001
Mortality			
30-day mortality, *n* (%)	21 (13.6)	18 (10.7)	0.42
90-day mortality, *n* (%)	30 (19.5)	27 (16.1)	0.42
1-year mortality, *n* (%)	46 (29.9)	50 (29.8)	0.98

Numbers are noted in percentages of the total number of patients at the hospital

N number of patients, *n* number of patients, *SD* standard deviation, *IQR* interquartile range, *HLOS* hospital length of stay. *Cardiac failure* consists of myocardial infarction, decompansatio cordis and reanimation. Other consists of complications with a total incidence ≤ 5

Our study found no significant reduction in mortality and no reduction of the number of patients with a complicated course. However, a reduction of approximately 3% in short- and intermediate-term mortality was noted. HLOS was reduced significantly, significantly more patients were sent to rehabilitation, time to surgery was less than 24 h

and significantly more patients were treated during daytime hours.

Primary outcomes

Literature showed that the implementation of a clinical pathway for hip-fracture patients may lead to reductions in mortality and complications [24–28]. Thus, far a direct comparison between studies with various clinical pathways has proven difficult because of differences in study design, variety in the composition of pathways and the use of different outcome measures [9]. However, recent studies comparing different orthogeriatric care models showed that an integrated co-managed care model, as implemented in this study, was more successful than a geriatric consultation service [29, 30].

This study did not show a significant decrease in mortality at 30 and 90 days and at 1 year. However, a reduction of approximately 3% at 30 and 90 days was noted.

The question arises of whether every geriatric patient aged 70 years and above and with two or more comorbidities will benefit from this model of care. In addition, better identification of the subpopulations that benefit from a multidisciplinary approach could lead to better resource allocation, which may further reduce costs and streamline processes. However, with the traditional performance indicators analysed in this study, this question is difficult to answer. Since hip-fracture patients are among the frailest, a bias towards increased mortality is inherent [31]. Therefore, the effect of the GFC concept on patients who survive may not be measured adequately with these indicators, and consequently, they do not properly reflect the GFC's true impact and potential. While multiple studies have shown that geriatric care models show improvements regarding mortality, complications and HLOS, little is known about the long-term outcomes of patients who were treated within a geriatric care model [25, 28]. Therefore, future studies should also focus on the effect of geriatric care models on functional recovery and quality of life after surgery to determine the impacts of these models on patients who survived THFs.

The number of patients with complicated courses and complications per patient did not change. Both surgical-related complications and non-surgical-related complications did not show significant differences, except for a significant increase of delirium diagnoses in 2016. A recent Cochrane review also found that comprehensive geriatric assessment may make little or no difference for major postoperative complications [32].

The increase in patients diagnosed with delirium after the implementation of the GFC may be related to the increased awareness, routine CAM screening for early signs of delirium and a more structured registration. Another reason that the number of complications did not decrease significantly could be due to the fact that data from 2013 were retrospectively analysed. This may have led to an underestimation of patients who were diagnosed with delirium during admission. When patients who were diagnosed with delirium as a single complication were omitted, the number of patients with a complicated course showed a reduction of 8.4% in 2016. Folbert et al. found a similar increase in delirium diagnoses after the implementation of a geriatric care pathway [33].

Secondary outcomes

As previously mentioned, all performance indicators that can be attributed directly to the implementation of a GFC showed improvements. Previous literature showed that the implementation of a GFC led to a decrease in HLOS and time to surgery [24, 25]. This study found that HLOS was reduced significantly, by 2 days. Other studies demonstrated that the reduction in HLOS by orthogeriatric care models led to an additional reduction in costs [34, 35]. Furthermore, this reduction in HLOS is especially noteworthy because significantly more patients were sent to a rehabilitation facility, which usually leads to longer HLOS due to paucity in rehabilitation institutions; therefore, a well-organised pathway facilitated more efficient processes. A significant shift in place of discharge was seen after GFC implementation. In 2013, 11.4% of the patients went to rehabilitation after discharge; this number in 2016 was 32.1%.

Time to surgery remained relatively low despite the fact that more operations were performed during the day-time. A meta-analysis on this topic found that a surgical delay of more than 48 h increases the risk of death [36]. Therefore, it is questionable whether the achieved reduction in time to operation is clinically relevant given that the time to surgery was already less than 24 h in 2013.

Lastly, this study found that daytime surgeries increased significantly in 2016. Daytime surgery was preferred to minimise circadian rhythm disruption, to decrease the risk of delirium. Most importantly, patient visits by a geriatrician and other specialists within the multidisciplinary team could be carried out directly upon admission during daytime surgeries, while admission during out-of-office hours causes a delay in this process. Nonetheless, night-time surgery should not be a reason to postpone hip surgery in hip-fracture patients who would otherwise benefit from early operations [37].

Limitations

This study had a non-randomised prospective design and a historical control group with its known and unknown forms of bias. Furthermore, the patient population was relatively small.

This study focused primarily on in-hospital treatment and short-term outcomes of the GFC. Data on long-term outcomes, such as mobility, place of discharge at 1-year follow-up and quality of life assessments are needed to assess the long-term effects of the GFC. A cost-effectiveness analysis was not performed.

Conclusion

This study of the first DGU®-certified GFC for hip-fracture patients in central Switzerland was a success in terms of the implementation itself. All performance indicators that could be affected directly by the hospital—such as HLOS, discharge disposition and timing of surgery—showed improvements. Increased awareness and recognition led to an increase in the diagnoses of some complications that would otherwise have remained untreated. In conclusion, the implementation of the GFC has led to beneficial results and expanding these efforts might lead to larger effects in the reduction of morbidity and mortality.

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Compliance with ethical standards

Conflict of interest J. Q. Kusen, B. Schafroth, B. Poblete, P. C. R. van der Vet, B.C. Link, F. J. G. Wijdicks, R. H. Babst and F. J. P. Beeres declare that they have no conflict of interest.

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