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ORIGINAL ARTICLE

The implementation of a clinical pathway enhancing early surgery for geriatric hip fractures: how to maintain a success story?

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Abstract

Background Timing of surgery in geriatric hip fracture treatment remains controversial. Early surgery is acknowledged as a quality indicator and NICE guidelines recommend surgery within 0–48 h from admission. In 2014 we implemented the indicator of early surgery in our institution, enhancing operative treatment within the next calendar day. We aimed to evaluate the implementation, define the room for improvement and provide strategies to maintain the quality indicator.

Methods Clinical outcome of 744 patients (January 2011–December 2013) before early surgery was implemented, compared to 817 patients (June 2014–May 2017) after implementation of early surgery with a follow-up of 6 months. Data-analysis was done by Pearson's Chi-square test and Mann–Whitney *U* test.

Results Early surgery was achieved in 47.6% and 85.7% in the preimplementation and postimplementation group, respectively ($P<0.001$). Both 30 days and 6 months mortality were similar (6.0% *vs*. 5.4%, $P=0.573$ and 18.7% *vs*. 16.9%, $P=0.355$, preimplementation *vs*. postimplementation, respectively). Early surgery resulted in a significantly shorter total length-of-stay (14 vs. 12 days, $P<0.001$, preimplementation *vs*. postimplementation, respectively). Early surgery did not reduce the readmission rate.

Conclusions The indicator of early surgery has been successfully implemented. Early surgery resulted in a significantly shorter LOS. No significant reduction in 30 days and 6 months mortality, and 90 days readmission was observed. To maintain early surgery, continuous engagement and monitoring is required by all shareholders involved and if necessary, adjustment of the clinical route is appropriate.

Keywords Geriatric hip fracture · Early surgery · Quality indicator

Introduction

Hip fractures are a common entity in the elderly and mainly results from low-energy trauma because of underlying osteoporosis. Consequently, the incidence of hip fractures is the highest among female patients and patients older than 75 years [1, 2]. Hip fractures are a major issue in our healthcare system because of their high mortality and morbidity. Mortality associated with hip fractures may reach 10% at 1 month, 20% at 4 months and 30% at 1 year [2]. As life expectancy increases, patients present with more comorbidities and polypharmacy, leading to an extended time to surgery as these comorbidities, as well as coagulation status need to be corrected preoperatively [2, 3].

Early surgery is acknowledged as a quality indicator in several guidelines reducing specific complications associated with prolonged bed rest (e.g. thromboembolism,

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pressure ulcers and atelectasis) [4]. Time to surgery is a quality indicator for public reporting as well. For example, it is included in the set of Inpatient Quality Indicators from the US Agency for Healthcare Research. However, the exact optimal timing of surgery is still controversial [5, 6]. NICE guidelines recommend surgery at day of or day after admission. Correctable comorbidities (e.g. anaemia, anticoagulation, electrolyte imbalance) should be treated immediately to prevent delay of surgery [7, 8]. Moreover, surgery must be planned on a planned trauma list as it has been proven that surgeries being performed by lower qualified surgeons lead to an increased adjusted risk of 30- and 90-day mortality [9]. It has been shown recently that waiting times of more than 24 h represent a threshold for higher 30-day mortality and complications [10].

In 2011, the Flemish government introduced "Vlaams Indicatoren Project voor Patiënten en Professionals" (VIP2, "Flemish Indicator Project for Patients and Professionals"), a quality project defining multiple quality indicators in health care [11]. Since 2015, the results of these quality indicators are used for public reporting [12]. Early surgery for hip fractures is one of the indicators in the field of orthopaedics and trauma surgery. This quality indicator measures the percentage of patients aged 65 years and over with a hip fracture being operated within the next calendar day.

In the current study, we analyzed the implementation of the clinical pathway enhancing early surgery for geriatric hip fractures and we defined room for improvement by providing strategies to maintain high adherence to this quality indicator. Therefore, we assessed the surgical delay as well as the clinical outcome 3 years before and after implementation of the quality indicator early surgery at the Department of Trauma Surgery of the University Hospitals Leuven.

Patients and methods

Patients

Between January 1st 2011 and May 31st 2017, a total of 1661 consecutive patients were included in this study. All patients were treated for an acute (< 3 weeks) AO/OTA type 31 hip fracture at the Department of Trauma Surgery of the University Hospitals Leuven. Follow-up was until November 30th 2017, resulting in a minimal follow-up time of 6 months. Patients aged < 65 years were excluded, as well as pathologic fractures and patients requiring revision surgery. Clinical data were collected retrospectively from the hospital's database KWS (Klinisch Workstation), including age, sex, ASA-score, date and time of hospital admission, surgical delay, type of surgery, total length-of-stay (LOS) and readmission rate. Early surgery was defined as surgery within the next calendar day. Total LOS was defined as the number of consecutive hospital admission days. Readmission was defined as rehospitalization within 90 days after discharge. The time of death was obtained from the federal database (Kruispuntbank). The type of surgery was classified as either osteosynthesis (screw, nail, hook plate or Dynamic Hip Screw) or hip arthroplasty (hemi or total). This study was completed in compliance with national legislation and the guidelines of the ethics committee of the University Hospitals Leuven.

Evaluation of the clinical pathway enhancing early surgery for geriatric hip fractures

Between January 1st 2014 and May 31st 2014 a clinical pathway enhancing early surgery at the department of Trauma Surgery of the University Hospitals Leuven was implemented. According to the VIP2, Flemish Indicator Project for Patients and Professionals, patients aged 65 and over with an acute hip fracture should be operated within the next calendar day (before midnight). Stakeholders were involved and arrangements and protocols were made. We aimed a monthly threshold of at least 80% of all geriatric patients (≥ 65 years old) being operated within the next calendar day. Next, we compared the characteristics of the patients who were admitted to the hospital and surgically treated for a hip fracture in the period January 2011–December 2013 (before the implementation of early surgery) to those who were treated after the implementation of the clinical pathway enhancing early surgery (June 2014–May 2017). The endpoints were early surgery (surgical treatment within the next calendar day), scheduled surgery (planned surgery before 10 pm) and room for improvement after implementation, total length-of-stay (LOS), intensive care unit (ICU) admission, as well as 30-day and 6-month mortality, 90 days readmission rate.

Implementation of a clinical pathway enhancing early surgery for geriatric hip fractures

The milestones in the implementation of early surgery, as well as the immediate effect on the timing of surgery are illustrated in Fig. 1. In January 2014, the Department of Trauma Surgery of the University Hospitals Leuven defined the quality improvement project: implementation of the quality indicator of the Flemish government on the timing of surgery for geriatric hip fracture patients. In February and March 2014, the two most important stakeholders in this project were involved. The first stakeholder, the Department of Anaesthesiology, agreed on priority for hip fracture treatment. A preoperative protocol clearing the patients for surgery was prepared in collaboration with the geriatric department of our hospital. Hip fracture surgery will only be postponed if the medical condition of the patients can

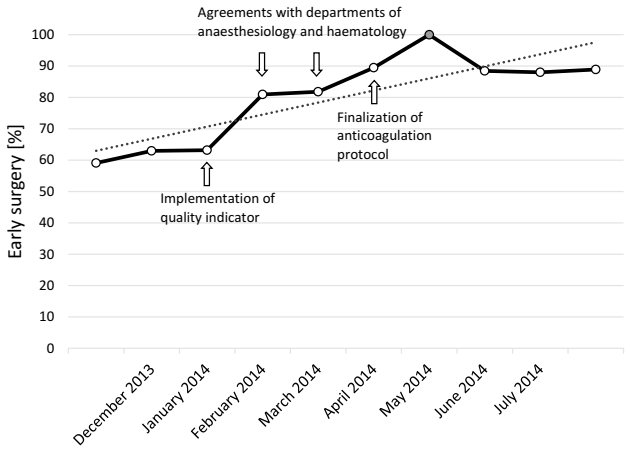

Fig. 1 Milestones in implementation of early surgery. Immediate effect of the implementation of a clinical pathway enhancing early surgery for geriatric hip fractures between January 1st 2014 and May 31st 2014

be improved within 24–48 h. Furthermore, arrangements were made about the availability of operating rooms and the presence of surgical nurses, anaesthesiologists and trauma surgeons.

Secondly, a collaboration was set up with the second stakeholder, the Department of Haematology, on the development of an anticoagulation protocol (supplement 1–3) for patients on anticoagulation drugs. In April 2014 this anticoagulation protocol was ready for use and in May 2014 all patients were operated within the next calendar day. The implementation period comprised exactly 100 patients.

Statistics

Statistical analyses were conducted using SPSS Statistics 25. Continuous variables were noted as median and interquartile range (IQR) and categorical variables were expressed as numbers and percentages. Categorical variables were analysed with the Pearson Chi-square test and continuous variables were investigated using the Mann–Whitney *U* test. A *P* value less than 0.05 was considered statistically significant.

Funding

This study has been conducted without any external financial support.

Results

All clinical variables are summarized in Table 1. Age and sex were equally distributed between the preimplementation and postimplementation groups. The ASA-scores differed significantly between the preimplementation and postimplementation groups, indicating more comorbidities in the postimplementation group. Fracture type was also equally distributed between the preimplementation and postimplementation groups. The implants used were fairly distributed in favor of osteosynthesis (62.6% preimplementation vs. 61.6% postimplementation). Compared to

Table 1 Comparison of patient characteristics before and after early surgery implementation

	Preimplementation ($n=744$)		Postimplementation ($n=817$)		*P* value
Age (years)	83	(77–88)	84	(78–88)	0.213
Sex					0.490
Male	205	27.6%	238	29.1%	
Female	539	72.4%	579	70.9%	
ASA-score					< 0.001
1	14	1.9%	7	0.9%	
2	279	37.5%	205	25.1%	
3	426	57.3%	545	66.7%	
4	25	3.3%	60	7.3%	
Fracture type					0.077
Femoral neck	341	45.8%	411	50.3%	
Trochanteric	403	54.2%	406	49.7%	
Treatment type					< 0.001
HHA	250	33.6%	296	36.2%	
THA	28	3.8%	18	2.2%	
PFNA	394	53.0%	400	49.0%	
SOS	49	6.6%	92	11.3%	
130 hookplate	6	0.8%	0		
DHS	17	2.2%	11	1.3%	
Scheduled surgery					< 0.001
Yes	737	99.1%	782	95.7%	
No	7	0.9%	35	4.3%	
Surgical delay (hours)	37.3	20.9–57.1	18.7	10.2–25.8	< 0.001
Early surgery					< 0.001
Yes	354	47.6%	700	85.7%	
No	390	52.4%	117	14.3%	
LOS (days)	14	(10–21)	12	(8–20)	< 0.001
ICU admission	20	(2.7%)	25	(3.1%)	0.661
ICU-stay (days)	3	(1–6)	4	(2–7)	0.326
30 days mortality	45	6.0%	44	5.4%	0.573
6 months mortality	139	18.7%	138	16.9%	0.355
90 days readmission	36	4.8%	46	5.6%	0.484

Age, surgical delay, LOS and total healthcare costs are expressed as median and interquartile range and compared using the using Mann–Whitney *U* test. Categorical variables are expressed as numbers and percentages and compared with the Pearson Chi-square Pearson test

AO/OTA Arbeitsgemeinschaft fur Osteosynthesefragen/Orthopedic Trauma Association, *HHA* hemi hip arthroplasty, *THA* total hip arthroplasty, *PFNA* proximal femoral nail antirotation, *SOS* screw osteosynthesis, dynamic hip screw, *LOS* length-of stay, *ICU* intensive care unit

preimplementation, in the postimplementation group significantly more hemi hip arthroplasties were performed than total hip arthroplasties ($P=0.049$). The total number of total hip arthroplasties was rather low in both study groups (28 in the preimplementation and 18 in the postimplementation group), due to the fact that total hip arthroplasty was only considered in patients with femoral neck fractures, if they were independent of walking aids before sustaining the fracture and could walk a significant distance (more than 100 m) on a regular base. As the median age of the patients was 83 and 84 years in the pre- and postimplementation groups and the ASA-score was 3 in 57.3% and 66.7% of the study groups respectively, there were only a few indications for total hip arthroplasty resulting in both study groups.

Significantly less patients were operated on a planned trauma list in the postimplementation group: 95.7% compared to 99.1% in the preimplementation group ($P<0.001$). The surgical delay in the postimplementation group was only half of the surgical delay in the preimplementation group (18.7 vs. 37.3 h, postimplementation vs. preimplementation, respectively, $P<0.001$). 85.7% of the patients of the postimplementation group were operated within the next calendar day compared to 47.6% in the preimplementation group. In parallel, the LOS was significantly shorter after implementation of early surgery (12 vs. 14 days, postimplementation vs. preimplementation, respectively, $P<0.001$). The number of patients, as well as the duration of stay of the patients admitted at the ICU was equally distributed between the preimplementation and postimplementation groups. The 30 days and 6 months mortality, as well as the 90-days readmission rates were equal between the preimplementation and postimplementation groups. Although we could not reveal a significant difference in both 30 days and 6 months mortality between patients treated for a femoral neck and trochanteric fracture, the 90-days readmission rate was significantly lower in patients treated for a trochanteric fracture (7.3% vs. 3.3%, $P \leq 0.001$, femoral neck vs. trochanteric fracture, respectively).

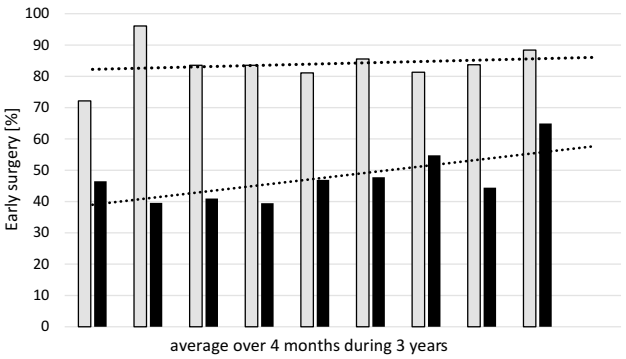

Fig. 2 Early surgery before and after implementation of the quality indicator. Percentage of patients operated within the next calendar day (X-axis) shown per trimester during the 3 years before (black bars) and 3 years after (gray bars) implementation of a clinical pathway enhancing early surgery for geriatric hip fractures (Y-axis)

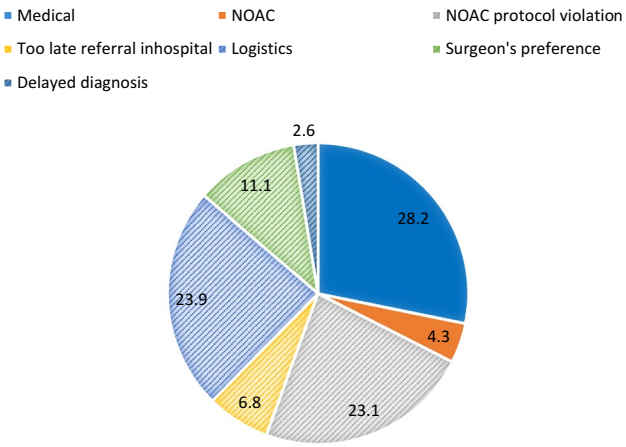

Fig. 3 Room for improvement: reasons for surgical delay. *NOAC* new oral anticoagulants

Room for improvement after implementation of a clinical pathway enhancing early surgery

Before implementation, there was a clear rising trend towards early surgery reaching 64.9% at the last trimester before implementation of the clinical pathway enhancing early surgery (Fig. 2). After implementation, early surgery was averaging 85.7%. Except for the first trimester showing a longer surgical delay, this delay was rather constant during the following 3 years (Fig. 2). To define room for improvement, the surgical delay of all postimplementation patients ($n=117$) who were not operated within the next calendar day, was categorized (Fig. 3): 33 patients (28.2%) could not allow early surgery for medical reasons. It concerned here mainly medical complications (infectious, cardiovascular or pulmonary comorbidities urging immediate treatment before hip surgery or anticoagulation medication not allowing for surgery within 24 h after latest intake; five patients (4.3%) used a new oral anticoagulants (NOACs) without an available antidote; 27 patients (23.1%) were delayed due to incorrect use of the anticoagulant protocol for patients taking anticoagulants; eight patients (6.8%) were referred too late inhospital; 28 patients (23.9%) experienced logistic problems; 13 patients (11.1%) were delayed due to the surgeon's decision; and three patients (2.6%) had a delayed diagnosis of hip fracture.

Discussion

The goal of this study was to evaluate the implementation of a clinical pathway enhancing early surgery for geriatric hip fractures. We compared the surgical delay and clinical outcome 3 years before and after implementation of the clinical pathway and defined the room for improvement and provide strategies to maintain the quality indicator of early surgery.

The implementation, as well as maintenance of the quality indicator early surgery for geriatric hip fracture patients at the Department of Trauma Surgery of the University Hospitals Leuven have been successful. By the end of implementation in May 2014, all geriatric patients with an acute hip fracture were operated within the next calendar day. Unfortunately, it was impossible to hold on to this maximum. During the 3 years after implementation of early surgery, approximately 85% of the patients had their surgeries performed on the day of or day after admission, leading to a significantly shorter total LOS.

As visualised in Fig. 3, approximately one-third of all patients who were not operated within the next calendar day, early surgery was not possible as a result of the medical comorbidities of the patients, and of the use of new oral anticoagulants. Despite any effort, in this group of patients surgery within the next calendar day after admission will never be possible. However, in the remaining two-thirds of the patients, there is room for improvement. In these cases, the following reasons for delayed surgery were recorded: incorrect use or violation of the anticoagulant protocol, late inhospital referral, intermittent organizational problems leading to postponed surgery (i.e. operating theatre logistics: no availability of personnel or theatre), delayed diagnosis and surgeon's personal preference. Here we think education and sensitization of all caregivers involved may lead to improvement and thus shortening of the interval to surgery. Keeping the whole team's attention for the timing of geriatric hip fracture surgery is extremely important. Maintaining communication with the stakeholders (i.e. department of haematology and anaesthesiology), may lead to improvement of existing protocols, like for instance the availability of a new antidote for NOACs (i.e. idarucizumab, Praxbind →). Finally, feedback sessions on the adherence to quality indicators may lead to a better outcome as well, since team members shall feel more responsible.

The successful implementation of the actual quality indicator proves the importance of good communication between the different stakeholders and the hospital-wide coordination of quality improvement initiatives, as well as the need for strong physician leadership [13]. Note well, over the last years University Hospitals Leuven strategically invested in a care program methodology. This methodology strongly encourages the development of multidisciplinary state-of-the-art protocols and human resources to the easing of stakeholder alignment and coordination of interdepartmental uptake of new protocols.

Both communication and leadership skills are crucial in the development of protocols on medical components like anticoagulation and on logistics like availability of operating theatres and operating room personnel. Even with more comorbidities present, as there were significantly more patients with ASA 3 in the intervention than in the control group, more patients could be operated on the day of or day after admission. Furthermore, almost all patients (in both the control and intervention group) got surgery on a planned schedule. This is probably due to the optimization of protocols but also to sensitization of all stakeholders. This balance between performing surgery as soon as possible and preferably by an experienced surgeon has been proven crucial in geriatric hip fracture treatment [9]. The actual protocol (i.e. need for surgery within the next calendar day) allows for a more pragmatic approach allowing hip fracture treatment to be planned as first surgery in the next morning and being performed by a dedicated team.

However, no effect on the 30-days and 6 months mortality rate could be found. This might be due to the lack of power of the actual study as the mortality rate is low in both the intervention and the control group. Larger sample sizes are needed to clearly understand the effect of time to surgery on mortality. For this reason, we are currently initiating a large retrospective cohort study on the effect on mortality of early vs. late surgery in geriatric hip fracture patients. However, the mortality rates in both the control and intervention group are still very low compared to the literature. Recent studies describe a 1-year mortality between 21.5 and 33% [14–16]. As we performed a retrospective analysis with only very limited exclusion criteria, selection bias cannot be the cause. One should wonder, however, if mortality is a good outcome parameter for studies in a geriatric patient population as the mortality in this population is high due to patient characteristics despite any intervention. For this reason, we would like to emphasize on the difference in complications between both study groups.

In parallel, ICU admission (as well as duration of ICU-stay), and the 90-days readmission rate were equal between the preimplementation and postimplementation groups. The readmission rate provides crude information on the quality of surgery. Unfortunately, complication registration over time was incomplete, and therefore, was not included in this study.

Furthermore, the significantly shorter LOS should cut down complications associated with bed rest. Finally, LOS also is the most important parameter determining the total cost of operative fracture treatment. This has been shown in

the Belgian situation in a study on operative ankle fracture treatment [17].

Despite these promising results of early surgery in geriatric hip fracture treatment, there still is room for improvement. At first, further optimization of preoperative protocols should be done. There still is a small group of patients who could not be operated within the proposed time span. By reviewing their medical records in detail, various reasons for postponed surgery were found. On the one hand, some patients were not ready for surgery because of medical reasons, comorbidities or correction of anticoagulation. On the other hand, some patients had a delay to surgery caused by organizational problems. In both of these groups, there is room for improvement by extending the already existing protocols. Furthermore, a continuous assessment of patient outcomes should be done as has been proposed by other authors [18].

A careful selection of performance metrics must be done to reflect on the potential impact of the pathway. As the time to surgery, length of stay and complication rate are often used as outcome measures, our evaluation method seems valuable. Finally, we should proceed in assessing and reassessing these measures at regular time intervals and communicating the results to the whole team to keep all stakeholders involved.

Last but not least new stakeholders should be involved. Due to our change in protocol, geriatric hip fracture patients are operated as soon as they are fit for surgery, therefore, they have their surgeries performed any day of the week, even during the weekend. Physiotherapy, however, is only available from Monday to Friday. Following the available evidence on early mobilisation after surgery, a study was set up introducing weekend physiotherapy for geriatric hip fracture patients [19, 20]. The results of this study will be available by the end of 2018 but the main hypothesis is that early mobilisation might further reduce all complications associated with bed rest like thromboembolic phenomena but pneumonia and pressure ulcers as well.

Conclusion

Based on the outcome data of the actual study, we can conclude that the quality indicator of early surgery for geriatric hip fractures at the department of Trauma Surgery of the University Hospitals Leuven, has been successfully implemented. Early surgery resulted in a significantly shorter LOS. Due to a lack of power, no significant reduction in 30 days and 6 months mortality, and 90 days readmission could be observed, however. Nevertheless, a small increase in odds per hour increase in delay for mortality advocate a pragmatic approach with hip surgery as soon as medically possible [21]. To maintain high adherence to the quality indicator of early surgery, continuous engagement and monitoring is required by all the stakeholders involved and if necessary, adjustment of the clinical route is appropriate.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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