Implementing a clinical pathway for hip fractures; effects on hospital length of stay and complication rates in 526 patients

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Abstract

Purpose: Modern management of the elderly with a hip fracture is complex and costly. The aim of this study was to compare the treatment-related hospital length of stay (HLOS) before and after implementing a clinical pathway for patients undergoing hip fracture surgery.

Methods: Retrospective, before-and-after study. The first period ranged from June 21, 2008 to November 1, 2009 (N= 212), the second was from January 7, 2010 to July 7, 2011 (N= 314). The electronic hospital system and patients records were reviewed for demographics, HLOS, mortality, complications and readmissions.

Results: In the first period 53% had a femoral neck fracture, of which 57% was treated with hemiarthroplasty. In the second period this was 46% and 71%. Pertrochanteric fractures were treated with a Gamma nail in 85% in the first period, 92% in the second period. The median HLOS decreased from nine to six days ($p<0.001$). For the hemiarthroplasty group HLOS decreased from nine to seven days ($p<0.001$), for internal fixation there was no significant difference (five versus six days, $p=0.557$) and after Gamma nailing it decreased from ten to six days ($p<0.001$). For mortality no statistically significant difference was found (6% versus 5%, $p= 0.698$). Complications decreased for the Gamma nail group (44% versus 31%, $p= 0.049$). Readmissions for the total group were not different (16% versus 17%, $p= 0.720$).

Conclusions: Implementing a clinical pathway for hip fractures is a safe way to reduce the HLOS and it improves the quality of care.

Introduction

Optimal modern management of the elderly with a hip fracture is complex and costly. The incidence of hip fractures increases exponentially with age, resulting in a 1-year incidence of 1% in women aged 80 years in Western countries [1]. An expected increase in life expectancy, higher activity levels of the elderly and a subsequent higher risk of falling, cause hip fractures to be an increasing challenge for health care systems [1, 2].

The total costs of health care for hip fractures in 2007 in the Netherlands were €378 million, of which 54% was generated during the in-hospital stay [3]. Over 40% of the patients, admitted from their home setting are not able to return to their home setting after surgery [4]. Waiting lists for medical rehabilitation facilities and nursing homes result in prolonged hospital stay and associated increasing costs [3].

To reduce these health care costs the Dutch Ministry of Health, Welfare and Sport propagates an early transfer to medical rehabilitation facilities [4]. Implementing a multidisciplinary clinical pathways may improve the logistic management of the growing population of elderly patients with a hip fracture. It tends to have positive effects on mortality, postoperative complications, and in-hospital stay, consequently leading to reduced costs [5, 6]. The aim of this study was to compare the treatment-related hospital length of stay before and after implementing a clinical pathway for all patients undergoing hip fracture surgery.

Patients and Methods

Study

A retrospective single-center before-and-after study. The first period ranged from June 21, 2008 to November 1, 2009. The second period was from January 7, 2010 to July 7, 2011.

Clinical pathway

The clinical pathway was developed by a multidisciplinary team and adapted to the local needs and circumstances. The team consisted of trauma surgeons, an anesthesiologist and a geriatrician, a physiotherapist, the unit coordinator and team leaders of the surgical ward, a representative of the emergency department, the head of the hospital logistic department and of the department for patient education and the managers of the rehabilitation centers involved. This team was responsible for training and implementing the pathway per stage on the different departments. Five stages were defined: pre-, peri-, post-operative, transfer and follow-up. The primary goal was to reduce the hospital length of stay. The standardized protocol covered the emergency department (ED) with a rapid assessment of the patient, immediate video assisted education for patient and relatives about recommended treatment and prognosis. Other medical disciplines should be consulted preoperatively on the ED if necessary. The protocol continues on the clinical ward with consulting supportive disciplines such as physical therapists and a geriatrician. It also includes appointments with three surrounding rehabilitation facilities aiming at transferring the patient to a patient-centered destination as soon as possible. This pathway was standard of care from November 2, 2009 onwards.

Patients

All patients admitted to the department of surgery of the IJsselland Ziekenhuis, Capelle aan den IJssel, the Netherlands for fractures of the proximal femur were included. Patients were identified by searching the electronic hospital database for CTG Code (Centraal orgaan

Tarieven Gezondheidszorg; CTG38565 hemiarthroplasty; CTG38533 internal fixation for proximal femoral fracture (IF); CTG38535 internal fixation for pertrochanteric fracture. Pathologic fractures and treatments with total hip arthroplasty were excluded. The following data were collected from the electronic patient files:

– Patient characteristics: gender, date of birth, date of fracture, date and time of admission, date and length of surgery, ASA classification (American Society of Anesthesiologists).

– Treatment characteristics: use of cancellous screws (Synthes, Paoli, USA), sliding hip screw (Synthes, Paoli, USA), Thompson hemiarthroplasty (Stryker, Newbury, United Kingdom), (Long) Gamma3^{TM} nail (Stryker, Schönkirchen, Germany), specialty of surgeon (trauma surgeon, general surgeon or surgical resident). The type of treatment was determined by the (supervising) surgeon.

– Post-surgery characteristics: re-admission date, date and type of complications categorized by: superficial wound infection, deep wound infection with or without re-operation, revision surgery, implant removal, death, neurologic complications, cardiac complications, miscellaneous (*e.g.*, delirium, medication related, urinary tract infection, pneumonia, etc.), date and cause of death.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 16.0 (SPSS Inc. Released 2007, SPSS for Windows, Chicago, SPSS Inc). Normality of continuous data was assessed by frequency histograms (Q-Q plots). Descriptive analysis was performed for describing patient-, fracture and treatment-related variables. Continuous variables were all non-parametric and are shown as medians with the first and third quartiles. Categorical variables are presented as numbers with percentages. Differences between the two periods were compared using a Mann-Whitney U-test (continuous data) or a Chi-squared test (categorical data). A p-value <0.05 was considered statistically significant.

Results

Patient demographics, fracture and treatment characteristics

In total 526 patients were admitted, 212 in the first period and 314 in the second. Patient characteristics are shown in Table 1. The median age was 84 years (P_{25}-P_{75} 78-89 years) and 391 patients were woman (74%). Two-hundred ninety one patients were classified as ASA class II (55%) and 181 as ASA class III (34%). The median age (p= 0.512), gender (p=0.919) and pre-operative ASA class (p=0.366) did not differ. In the first period 53% of the patients had sustained a femoral neck fracture, in the second period this was 46% (p=0.110). In the first period 57% of the patients were treated with a Thompson hemiarthroplasty versus 71% in the second period (p=0.024). Of the population with a pertrochanteric fracture 85% was treated with a Gamma Nail, 8% with a Long Gamma Nail, and 7% with a SHS. In the second period these rates were 92%, 7%, and 1% (p=0.062).

Hospital length of stay

Table 2 shows the median hospital length of stay (HLOS), which for the total group was nine versus six days (p<0.001). For patients treated with hemiarthroplasty the median HLOS was two days shorter (nine versus seven days, p<0.001). For the IF group no difference was found (median HLOS: five versus six days, p=0.557). For patients treated with Gamma nail it was four days shorter (ten versus six days, p<0.001).

Mortality

Detailed mortality rates are shown in Table 3. No statistically significant difference was found for the 30-day mortality (6 versus 5%, p= 0.698). None of the patients treated with SHS for pertrochanteric fractures died within 30 days after admission.

Complications

Tables 4 and 5 show the post-operative complications. A total of 214 (41%) patients had at least one complication. Ninety-five patients had a complication in the first period and 119 in

the second period (45 vs 38%, p=0.124). The complication occurred within 30 days after admission for 54 patients in the first period and for 73 patients in the second period (57 vs 61%, p=0.576).

In patients treated with hemiarthroplasty, 69 (42%) had a post-operative complication. No difference was found between the two periods (41 versus 42%, p=0.873). Forty six complications (67%) occurred within 30 days after surgery, which was similar for both periods (65 versus 67%, p=1.000). Of the IF group 48% developed a complication in the first period versus 51% in the second period (p=0.833). Thirty four percent of complications occurred within 30 days after surgery, which was similar for both periods (26% versus 43%, p=0.342). For hemiarthroplasty surgical site infections were the main hip-related complication (31%). Implant removal and conversion surgery accounted for 71% of the complications after internal fixation for femoral neck fratcures.

A complicated course was found in 85 patients (35%) treated with a Gamma nail. In the second period a reduction was found for complication rates (44% versus 31%, p= 0.049). Fifty-six complications (67%) occurred within 30 days after surgery, which was similar for both periods (65 vs 67%, p=1.000).

Readmissions

Readmission rates are shown in Tables 6 and 7. In total, 86 patients (16%) were readmitted, without difference between the two periods (16% vs 17%, p= 0.720). The readmission rate within 30 days after discharge was higher in the second period (18 vs 43%, p= 0.020). The readmission rate after hemiarthroplasty was not significantly different between the periods (16 vs 21%, p= 0.540). No significant difference was found for the readmission rate within 30 days after hemiarhtroplasty (50 vs 62%, p= 0.701). After IF no difference was found in the total readmission rate (33% vs 44%, p= 0.383) nor in the readmission rate within 30 days (6 vs 33%, p= 0.090). After Gamma nail treatment six patients were readmitted in the first

period and 12 in the second period (7 vs 8%, p=1.000). None of the patients in the Gamma nail group was readmitted within 30 days in the first period, but four patients were readmitted in the second period (0 vs 33%, p= 0.245).

Discussion

Implementing a clinical pathway for the treatment of patients with a proximal femoral fracture is efficient and safe. It resulted in a significant reduction of the median hospital length of stay by three days, without significantly influencing the rates of mortality, complications, and readmissions.

To streamline the increasing demand for beds for patients with proximal femoral fractures, these results are of importance. Findings from a previous study (1996) showed a mean hospital stay of 21 days for these patients [7]. In 2002, Van Balen *et al.* reported a reduction of the median hospital stay from 18 to 11 days after implementing an "early discharge regimen" in the same geographical area [8]. The British national audit report described a 5% reduction in average hospital stay between 2011 and 2012 [9]. In contrast, the current study showed a 33% reduction of HLOS. This difference cannot solely be explained by "natural reduction" as found by the audit, which itself might be partly caused by the increase in use of clinical pathways for hip fracture patients. The comparison with only the clinical pathway as a variable, consistency of the findings with literature and the explicable underlying mechanism jointly support causality.

Literature on effects of clinical pathways for hip fractures generally shows positive results, although some publication bias cannot be excluded [10-13]. A recent review by Leigheb *et al.* showed similar reductions in the hospital length of stay in eight out of twelve studies [6]. Three studies reported a longer hospital stay [14-16] and one did not find any difference after implementing a clinical pathway [17].

The main strength of the current study is that it is one of the first to report differences per treatment subgroup of a hip fracture population. The median age of the IF group was almost 10 years younger compared to the other treatment groups (77 versus 85 and 86 years, respectively). These younger patients were likely in better physical and mental condition and

thus sooner fit for discharge to their own house. They had no waiting time for rehabilitation at all. In contrast, Hommel *et al.* did not find any significant differences between patients with different kind of operation types [15].

The total number and percentage of patients primarily treated with total hip arthroplasty was very small and did not contribute substantially to the total group. Moreover these patients were treated on another ward and by the orthopedic surgical team. For these reasons this small group was not taken into account in the current analysis. Hemiarthroplasty was used more frequently in the second period despite similar patient characteristics and relative frequency of femoral neck fractures. Participation in an internal fixation randomized trial during the first period could have led to a lower threshold for applying internal fixation [18]. Other known variables that may influence the choice of treatment (*e.g.* membership of the supervising staff, internal hospital procedures, daily ward affairs and procurement of medical supplies) did not change during the study. Moreover, the fact that people treated with hemiarthroplasty had a longer HLOS would rather have led to an underestimation of the effects. It is very unlikely that potential unknown or unmeasured changes have influenced the outcomes of this order. Therefore the clinical pathway seems to be responsible for the changes in HLOS.

The unchanged readmission and complication rates (decreased from 45 to 38%) support the safety of the implemented care pathway. The observed difference in type of treatment did not influence the complication rates as the treatment-related complication rates were the same in both groups. For a major part this was due to the decreasing rate in the Gamma nail group. This observation lacks a clear clarification in view of the implementation. The rate of complications within 30 days was also unchanged between the periods. The total complication rates were comparable with rates found in literature [19]. The safety of implementing a clinical pathway for hip fractures is further supported by a meta-analysis of nine studies (involving 4637 patients), focusing on co-morbidities and postoperative complications [20]. It

was found that complications during hospitalization in patients with hip fractures be treated in a clinical pathway were less prevalent. A third parameter for safety would be mortality. Due to the low mortality rate within 30 days after surgery, no definitive conclusions can be drawn on the effect of the clinical pathway on this parameter. However, the 30-day mortality rates (6% versus 5%) are in accordance with those from the meta-analysis. The combined in-hospital/ 30-day mortality was reported 8% (118 of out 1520 patients) in the pathway group and 9% (141 out of 1522 patients) in the non-pathway group [20].

In the current study, the majority of complications after hemiarthroplasty (72%) and Gamma nail (75%) occurred within 30 days after surgery, whereas only a minority of complications after IF (32%) occurred early after surgery. General complications such as delirium, urinary tract infection, and medication related complications occurred most frequently (53%) after treatment with Gamma nail. These data can inform patients and their relatives about what clinical outcomes and problems they may expect after surgery. The type of surgeon: general surgeon, trauma surgeon, or surgical resident did not influence the complication rates (data not shown), which is also reported in literature [21]. Moreover, the same brand and type of materials were used for all standardized surgical procedures during the entire study period.

This study had a few limitations. Although multiple digital hospital systems and patient files were used to identify complications, a slight underestimation due to the retrospective design of the study cannot be ruled out. Secondly, some interesting parameters, such as long term follow up, functional recovery by patient reported outcome measures, costs and total duration of institutionalization could not be investigated due to the retrospective design. Van Balen *et al.* found no reduction in total costs after implementation of an early discharge regimen, with a shift from the hospital to the nursing home. However, they reported in 2002 a median total hospital stay of 26 days [8].

Despite these limitations, the study provides evidence that in our institute implementing the clinical pathway has led to a higher level of organisation and improvement of the quality of care for patients with a fracture of the proximal femur.

Conclusion

Implementing a clinical pathway for proximal femoral fractures resulted in a significant reduction of hospital length of stay for patients treated with hemiarthroplasty or Gamma Nail but not after treatment with internal fixation. No differences were found for rates of mortality, complication and readmission. The use of a clinical pathway for hip fractures is a safe way to reduce the hospital length of stay and it contributes to improvement of quality of care of this fragile population.

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Table 1. Patient, fracture and treatment characteristics before and after the implementation of the clinical pathway

Characteristic	Total	Before	After	p-value
N	526	212	314	
Female gender[1]	391 (74)	157 (74)	234 (75)	0.919
Age[2]	84 (78-89)	84 (77-89)	84 (79-89)	0.512
Pre-operative ASA-score [1]				
ASA I	39 (7)	19 (9)	20 (6)	0.366
ASA II	291 (55)	130 (61)	161 (51)	
ASA III	181 (34)	60 (28)	121 (39)	
ASA IV	12 (2)	1 (1)	11 (4)	
Unknown	3 (1)	2 (1)	1 (0)	
Fracture type[1]				
Femoral Neck	255 (48)	112 (53)	143 (46)	0.110
Pertrochanteric	271 (52)	100 (47)	171 (54)	
Surgical procedure[1]				
Femoral Neck				
Hemiarthroplasty	166 (65)	64 (57)	102 (71)	0.024
Internal fixation	89 (35)	48 (43)	41 (29)	
Pertrochanteric				
SHS	9 (3)	7 (7)	2 (1)	0.032
Gamma nail	242 (89)	85 (85)	157 (92)	
Long Gamma nail	20 (7)	8 (8)	12 (7)	

[1] Patient numbers are displayed, with the percentages given within brackets;
[2] Data are displayed as median, with the first and third quartile given within brackets;

Table 2. Median hospital length of stay in days by type of fracture, treatment and period

	Total	Before	After	p-value
Total	7 (5-10)	9 (5-14)	6 (5-8)	<0.001
Femoral neck	7 (7-4)	8 (4-12)	6 (4-8)	0.024
Hemiarthroplasty	8 (5-10.25)	9 (6-14)	7 (5-8.25)	<0.001
Internal Fixation	5 (3-9)	5 (3-10.5)	6 (4-7.50)	0.557
Pertrochanteric	7 (5-11)	10 (6-16)	6 (5-8)	<0.001
SHS	9 (6-13)	9 (7-10)	15 (3-15)	1.000
Gamma nail	7 (5-10)	10 (5-17)	6 (4-8)	<0.001
Long Gamma nail	10 (7-12)	10 (11-16)	8 (6-10)	0.014

Data are displayed as median, with the first and third quartile given within brackets

Table 3. Mortality within 30 days after admission by type of fracture, treatment and study period

	Total	Before (N= 212)	After (N= 314)	p-value
Total	29/ 526 (6)	13/ 212 (6)	16/ 314 (5)	0.698
Femoral neck	18/ 255 (7)	6/ 112 (5)	12/ 143 (8)	0.462
Hemiarthroplasty	15/ 166 (9)	4/ 64 (6)	11/ 102 (11)	0.411
Internal Fixation	3/ 89 (3)	2/ 48 (4)	1/ 41 (2)	1.000
Pertrochanteric	11/ 271 (4)	7/ 100 (7)	4/ 171 (2)	0.106
SHS	0/ 9 (0)	0/ 7 (0)	0/ 2 (0)	1.000
Gamma nail	9/ 242 (4)	7/ 85 (8)	2/ 157 (1)	0.010
Long Gamma nail	2/ 20 (10)	0/ 8 (0)	2/ 12 (17)	0.495

Patient numbers are displayed, with the percentages given within brackets

Table 4. Complication rate by type of treatment and study period

Characteristic	Total	Before	After	p-value
Total	214/ 526 (41)	95/ 212 (45)	119/ 314 (38)	0.124
Femoral Neck	113/ 255 (44)	49/ 112 (44)	64/ 143 (45)	0.237
Hemiarthroplasty	69/ 166 (42)	26/ 64 (41)	43/ 102 (42)	0.873
Internal fixation	44/ 89 (49)	23/ 48 (48)	21/ 41 (51)	0.833
Pertrochanteric	101/ 271 (37)	46/ 100 (46)	55/ 171 (32)	0.027
SHS	3/ 9 (33)	2/ 7 (29)	1/ 2 (50)	1.000
Gamma nail	85/ 242 (35)	37/ 85 (44)	48/ 157 (31)	0.049
Long Gamma nail	13/ 20 (65)	7/ 8 (88)	6/12 (50)	0.158

Patient numbers are displayed, with the percentages given within brackets

Table 5. Rate of complications within 30 days after surgery by type of treatment and study period

Characteristic	Total	Before	After	p-value
Total	127/ 214 (59)	54/ 95 (57)	73/ 119 (61)	0.576
Femoral Neck	61/113 (54)	23/ 49 (47)	38/ 64 (59)	0.253
Hemiarthroplasty	46/ 69 (67)	17/ 26 (65)	29/ 43 (67)	1.000
Internal fixation	15/ 44 (34)	6/ 23 (26)	9/ 21 (43)	0.342
Pertrochanteric	66/ 101 (65)	31/ 46 (67)	35/ 55 (64)	0.834
SHS	2/ 3 (67)	2/ 2 (100)	0/1 (0)	0.333
Gamma nail	56/ 85 (66)	24/ 37 (65)	32/ 48 (67)	1.000
Long Gamma nail	8/ 13 (62)	5/ 7 (71)	3/ 6 (50)	0.592

Patient numbers are displayed, with the percentages given within brackets

Table 6. Readmission rate by type of fracture, treatment and study period

Characteristic	Total	Before	After	p-value
Total	86/ 526 (16)	33/ 212 (16)	53/ 314 (17)	0.720
Femoral Neck	65/ 255 (25)	26/ 112 (23)	39/ 143 (27)	0.474
Hemiarthroplasty	31/ 166 (19)	10/ 64 (16)	21/ 102 (21)	0.540
Internal fixation	34/ 89 (38)	16/ 48 (33)	18/ 41 (44)	0.383
Pertrochanteric	21/ 271 (8)	7/ 100 (7)	14/ 171 (8)	0.817
SHS	1/ 9 (11)	0/ 7 (0)	1/ 2 (50)	0.222
Gamma nail	18/ 242 (7)	6/ 85 (7)	12/157 (8)	1.000
Long Gamma nail	2/ 20 (10)	1/ 8 (13)	1/ 12 (8)	1.000

Patient numbers are displayed, with the percentages given within brackets

Table 7. Rate of readmission within 30 days after discharge by type of fracture, treatment and study period

Characteristic	Total	Before	After	p-value
Total	29/ 86 (34)	6/ 33 (18)	23/ 53 (43)	0.020
Femoral Neck	25/ 65 (38)	6/ 26 (23)	19/ 39 (49)	0.043
Hemiarthroplasty	18/ 31 (58)	5/ 10 (50)	13/ 21 (62)	0.701
Internal fixation	7/ 34 (21)	1/ 16 (6)	6/ 18 (33)	0.090
Pertrochanteric	4/ 21 (19)	0/ 7 (0)	4 /14 (29)	0.255
SHS	0/ 1 (0)	0/ 0 (0)	0/ 1 (0)	1.000
Gamma nail	4/ 18 (22)	0/ 6 (0)	4/ 12 (33)	0.245
Long Gamma nail	0/ 2 (0)	0/ 1 (0)	0/ 1 (0)	1.000

Patient numbers are displayed, with the percentages given within brackets