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ปัจจัยที่มีผลต่อระยะเวลาในการนอนโรงพยาบาลหลังผ่าตัดกระดูกหักบริเวณข้อสะโพกในผู้ป่วยสูงอายุในโรงพยาบาลแม่สอด

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Prognostic Factors for Prolonged Length of Stay in Hip Fracture Patients: A Retrospective Cohort Study at Mae Sot Hospital

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บทคัดย่อ

ภูมิหลังและวัตถุประสงค์: กระดูกสะโพกหักในผู้สูงอายุเป็นภาวะที่สัมพันธ์กับอัตราการป่วย การเสียชีวิต และการใช้ทรัพยากรทางการแพทย์จำนวนมาก ระยะเวลาการนอนโรงพยาบาลหลังผ่าตัดที่ยาวนานถือเป็นตัวชี้วัดทางคลินิกที่สำคัญ เนื่องจากอาจสะท้อนถึงการฟื้นตัวที่ล่าช้า เพิ่มภาระค่าใช้จ่าย และสัมพันธ์กับผลลัพธ์การรักษาที่ไม่พึงประสงค์ อย่างไรก็ตาม ข้อมูลเกี่ยวกับปัจจัยที่อาจปรับเปลี่ยนได้ซึ่งสัมพันธ์กับการนอนโรงพยาบาลนานในโรงพยาบาลทั่วไปของประเทศไทยยังมีจำกัด การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาปัจจัยพยากรณ์ที่สัมพันธ์กับการนอนโรงพยาบาลนานในผู้ป่วยสูงอายุที่ได้รับการผ่าตัดกระดูกสะโพกหักที่โรงพยาบาลแม่สอด รวมถึงเพื่อประเมินความสัมพันธ์ของการนอนโรงพยาบาลนานกับค่าใช้จ่ายในการรักษาและอัตราการเสียชีวิตภายใน 1 ปี

วิธีการศึกษา: เป็นการศึกษาแบบ retrospective cohort โดยรวบรวมข้อมูลผู้ป่วยอายุ 60 ปีขึ้นไปที่ได้รับการผ่าตัดรักษากระดูกสะโพกหักที่โรงพยาบาลแม่สอด ช่วงเดือนมกราคม พ.ศ. 2561 ถึงธันวาคม พ.ศ. 2566 โดยกำหนดให้นอนโรงพยาบาลนาน (prolonged length of stay; LOS) หมายถึงการนอนโรงพยาบาลมากกว่า 10 วัน ข้อมูลด้านประชากรศาสตร์ ลักษณะทางคลินิก ปัจจัยรบกวนการผ่าตัด และระยะเวลาด้านการฟื้นฟูสมรรถภาพหลังผ่าตัดถูกนำมาวิเคราะห์ ใช้การวิเคราะห์แบบ univariable และ multivariable regression เพื่อหาปัจจัยที่สัมพันธ์กับการนอนโรงพยาบาลนาน และวิเคราะห์เพิ่มเติมถึงความสัมพันธ์ระหว่างการนอนโรงพยาบาลนานกับค่าใช้จ่ายในการรักษาและอัตราการเสียชีวิตภายใน 1 ปี

ผลการศึกษา: พบว่าผู้ป่วยทั้งหมด 223 ราย มีการผ่าตัดที่ล่าช้ามากกว่า 3 วัน มีความสัมพันธ์อย่างมีนัยสำคัญกับการนอนโรงพยาบาลนาน ขณะที่การเริ่มฟื้นฟูสมรรถภาพตั้งแต่ระยะต้นมีความสัมพันธ์กับโอกาสการนอนโรงพยาบาลนานที่ลดลง นอกจากนี้ การนอนโรงพยาบาลนานยังสัมพันธ์กับค่าใช้จ่ายในการรักษาที่เพิ่มขึ้น และจากการวิเคราะห์แบบตัวแปรเดียวพบว่า การนอนโรงพยาบาลนานมีความสัมพันธ์กับอัตราการเสียชีวิตภายใน 1 ปีที่สูงขึ้น

สรุป: ในบริบทของโรงพยาบาลทั่วไป การผ่าตัดล่าช้าและการไม่ได้รับการฟื้นฟูสมรรถภาพตั้งแต่แรก เป็นปัจจัยสำคัญที่สัมพันธ์กับการนอนโรงพยาบาลนานหลังผ่าตัดกระดูกสะโพกหัก นอกจากนี้การนอนโรงพยาบาลนานยังสัมพันธ์กับค่าใช้จ่ายในการรักษา

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ที่สูงขึ้นและอัตราการรอดชีวิตภายใน 1 ปีที่ลดลง ผลการศึกษานี้ชี้ให้เห็นถึงความสำคัญของการผ่าตัดที่ทัน่วงที และการเริ่มฟื้นฟูสมรรถภาพหลังผ่าตัดอย่างเหมาะสม ในผู้ป่วยสูงอายุที่มีกระดูกสะโพกหัก

คำสำคัญ: กระดูกสะโพกหัก, ระยะเวลาอนโรงพยาบาล, อัตราการเสียชีวิต, ผู้สูงอายุ และค่าใช้จ่าย

Abstract

Background and objectives: Hip fracture in older adults is associated with substantial morbidity, mortality, and healthcare utilization. Prolonged hospital length of stay (LOS) after hip fracture surgery is clinically important because it may reflect delayed recovery, increase resource use, and be associated with poorer outcomes. However, evidence on potentially modifiable predictors of prolonged LOS in general hospitals in Thailand remains limited. This study aimed to identify prognostic factors associated with prolonged hospital LOS in elderly patients undergoing hip fracture surgery at Mae Sot Hospital. Secondary objectives were to evaluate the association of prolonged LOS with hospitalization cost and 1-year mortality.

Methods: This retrospective cohort study included patients aged 60 years or older who underwent surgery for hip fracture at Mae Sot Hospital between January 2018 and December 2023. Prolonged LOS was defined as a hospital stay of more than 10 days. Demographic, clinical, perioperative, and rehabilitation-related variables were analyzed. Univariable and multivariable regression analyses were performed to identify factors associated with prolonged LOS. Additional analyses were conducted to examine the association of prolonged LOS with hospitalization cost and 1-year mortality.

Results: A total of 223 patients were included. Delayed surgery of more than 3 days was independently associated with prolonged LOS, whereas early rehabilitation was associated with a reduced likelihood of prolonged LOS. Prolonged LOS was also associated with increased hospitalization cost. In univariable analysis, prolonged LOS was associated with higher 1-year mortality.

Conclusions: In this general hospital setting, delayed surgery and lack of early rehabilitation were important factors associated with prolonged hospitalization after hip fracture surgery. Prolonged LOS was also associated with higher hospitalization cost and worse 1-year survival. These findings support efforts to improve early surgical access and timely postoperative rehabilitation in elderly hip fracture care.

Keywords: hip fracture, length of stay, mortality, elderly and cost

Hip fractures are a significant public health concern, particularly among the elderly population. Hip fractures are associated with a high level of morbidity and are known to significantly impact patient outcomes, healthcare costs, and resource utilization. Of particular concern is the issue of prolonged hospitalization in hip fracture patients, which has been linked to a range of adverse outcomes, including increased healthcare costs and higher mortality rates.

Numerous factors contribute to post-operative complications and mortality rates in elderly patients with hip fractures. The most common factor is post-operative pneumonia. Previous studies [5,6] have indicated that post-operative pneumonia in patients is associated with an increased mortality rate, as highlighted in the following data. The timing of surgery [7-10] for hip fractures is a critical factor that can significantly impact patient outcomes. The goal is to perform surgery as soon as possible after the fracture to optimize results. The optimal timing can vary depending on the specific clinical circumstances, but the general guideline is to operate within 48 hours of admission. Other factors, of equal significance,

Early postoperative rehabilitation is an important component of recovery in hip fracture patients. Prior studies have shown that early mobilization after surgery can reduce length of hospital stay and improve functional recovery [19,20]. However, in resource-limited settings, delays in rehabilitation remain common and may contribute to prolonged hospitalization and poorer long-term outcomes.

However, evidence regarding factors associated with prolonged hospital length of stay in elderly hip fracture patients remains limited in Thailand, particularly in general hospitals. A better understanding of these factors may help improve perioperative care pathways, optimize resource utilization, and support better outcomes in this vulnerable population. We hypothesized that delayed surgery and delayed initiation of rehabilitation are associated with prolonged hospital length of stay in elderly patients with hip fractures. Therefore, the primary objective of this study was to identify prognostic factors associated with prolonged hospital length of stay (LOS) in elderly patients undergoing hip fracture surgery at Mae Sot Hospital. The secondary objectives were to evaluate the association of prolonged LOS with hospitalization cost and 1-year mortality.

Study design and participants

This retrospective study included patients aged 60 years or older were included, as this age group represents the typical population affected by fragility hip fractures who underwent surgery for hip fracture at Mae Sot Hospital between January 2018 and

December 2023. The study focused on hip fractures resulting from low-energy trauma, such as a fall from standing height, which is typical of fragility fractures in older adults. Patients were excluded if they had pathological fractures, high-energy trauma, multiple traumatic injuries involving other anatomical regions, incomplete essential clinical data, or died before surgery. This study was approved by the Ethics Committee of Mae Sot Hospital, Thailand (Approval No. MSHP 32/2568). Patient data were retrieved from medical record and anonymized prior to analysis. All data were handled in accordance with institutional guidelines, and patient confidentiality was strictly maintained. No identifiable personal information was included in the dataset.

Data collection and study variables

Clinical data were retrieved from the hospital medical record system and related databases. The collected variables included demographic characteristics, comorbidities, preoperative laboratory results, perioperative factors, rehabilitation timing, length of hospital stay, hospitalization cost, and 1-year mortality. Demographic and clinical variables included age, sex, ambulatory status, American Society of Anesthesiologists (ASA) classification, DM, hypertension (HT), CVD, COPD, renal impairment or chronic kidney disease (CKD), and preoperative anemia. Operative variables included type of surgery, time from admission to surgery, and time from surgery to initiation of rehabilitation. Multi-comorbidity was defined as the presence of two or more comorbid conditions in the same patient, including DM, HT, CVD, CKD, and COPD, based on available medical records.

Rehabilitation initiation was defined as the first postoperative mobilization, including sitting at the bedside, standing, or assisted ambulation, as recorded in the medical record. Early rehabilitation was defined as initiation of rehabilitation within 72 hours after surgery. Variables were categorized into patient-related factors (e.g., age, sex, comorbidities, nutritional status, dementia) and treatment-related factors (e.g., time

to surgery, type of surgery). Hospitalization cost was defined as the total direct medical cost incurred during the index admission, from admission to discharge, obtained from the hospital billing system. Indirect and non-medical costs were not included. The analysis was conducted from the healthcare provider perspective.

Outcomes

The primary outcome of this study was prolonged hospital length of stay (LOS), defined as more than 10 days. This cutoff was chosen based on previous literature demonstrating that hospital stays beyond 10 days are associated with poorer clinical outcomes, including increased mortality [1], and provides a clinically meaningful threshold for identifying prolonged hospitalization in routine clinical practice. Factors associated with prolonged LOS were evaluated. Secondary outcomes were hospitalization cost and 1-year mortality.

Statistical analysis

Categorical variables were presented as frequencies and percentages, while continuous variables were summarized as mean $\pm$ standard deviation or median with interquartile range, as appropriate. Comparisons between groups were performed using the chi-square test or Fisher's exact test for categorical variables, and the independent t-test or Mann-Whitney U test for continuous variables, as appropriate.

Univariable analysis was first performed to identify factors associated with prolonged LOS. Variables considered clinically relevant, together with those showing significance in univariable analysis, were entered into the multivariable model. Multivariable logistic regression was used to identify independent factors associated with prolonged LOS, and Multivariable logistic regression analysis was performed, and adjusted odds ratios (aORs) with 95% confidence intervals were reported.

For secondary outcomes, multivariable linear regression was used to evaluate factors associated with hospitalization cost. For 1-year mortality, univariable logistic regression was performed because mortality was analyzed as a binary outcome at 1 year after surgery. Results for mortality analysis are presented as odds ratios with 95% confidence intervals. A p-value of less than 0.05 was considered statistically

significant. All statistical analyses were performed using Stata version 14.1 (StataCorp, College Station, TX, USA).

Results

Baseline characteristics

Baseline demographic and clinical characteristics of the study population are summarized in Table 1.

Table 1 Baseline characteristics of the study population

Variables	Total (n = 233) n (%)	LOS ≤10 days (n=184)	LOS >10 days (n=39)	p-values
Age, years (mean ± SD)	75.48 ± 9.67	74.53±9.62	79.97±8.70	0.001
Sex, Female	153 (68.61)	130	23	0.15
ASA classification, n (%)				
High (III-IV)	161 (72.20)	126	35	0.007
DM	48 (21.52)	35	13	0.048
HT	141 (63.23)	114	27	0.39
CVD	21 (9.42)	15	6	0.16
COPD	25 (11.21)	20	5	0.73
Renal impairment or CKD	179 (80.27)	142	37	0.012
Multi-comorbidity (≥2)	84 (37.67)	62	22	0.008
Type of surgery				
Hip replacement	77 (34.53)	58	19	0.04
Internal fixation	146 (65.47)	126	20	
Time to surgery (day)	2.58 ± 2.99	2.13±2.61	4.74±3.68	<0.001
Time surgery to rehab (day)	3.46 ± 6.41	2.67±4.73	7.29±10.82	<0.001
LOS (day)	8.08 ± 8.71	5.79±1.93	18.84±16.75	<0.001
Cost (Baht)	69142.32 ± 38645.13	59249.53±16781.56	115816±68256.9	<0.001

Factors associated with prolonged length of hospital stay (LOS) (>10 days)

Among the 223 patients, 59 (26.5%) experienced prolonged LOS (>10 days). In univariable analysis, age, high ASA classification (III–IV), multi-comorbidity (≥2), delayed surgery of more than 3 days, and absence of

early rehabilitation were significantly associated with prolonged LOS. Procedure type, diabetes mellitus, and kidney dysfunction also showed significant associations in univariable analysis, while intraoperative hypotension showed a borderline association (Table 2).

Table 2 Univariable analysis for factors associated with prolonged LOS

Factors	p-values
Age	0.0013
ASA high	0.007
Multi-comorbidity ≥ 2	0.008
Time to surgery $>3d$	<0.001
Early rehabilitation	<0.001
Procedure type (arthroplasty vs fixation)	0.04
DM	0.048
Kidney dysfunction	0.012

In multivariable logistic regression analysis, delayed surgery of more than 3 days remained a strong independent factor associated with prolonged LOS (OR 13.11, 95% CI 4.69–36.60, $p < 0.001$). Early rehabilitation was associated with a lower likelihood of prolonged LOS (OR 0.16, 95% CI 0.06–0.44, $p < 0.001$). Older age was also independently associated with prolonged LOS (OR 1.07, 95% CI 1.01–1.13, $p = 0.017$) (Table 3).

Table 3 Multivariable logistic regression analysis for predictors of prolonged LOS (AOR, 95% CI)

Factors	AORs (95% CI)	p-values
Age	1.07 (1.01–1.13)	0.017
ASA high	1.16 (0.30–4.48)	0.83
Procedure (arthroplasty)	1.14 (0.47–2.74)	0.77
Time to surgery $>3d$	13.11 (4.69–36.60)	<0.001
Early rehabilitation	0.16 (0.06–0.44)	<0.001
Multi-comorbidity ≥ 2	2.02 (0.85–4.74)	0.11

Factors associated with hospitalization cost

Hospitalization cost was further analyzed as a secondary outcome. In multivariable linear regression analysis, each additional hospital day was associated with a 2.12% increase in total hospitalization cost (95% CI 1.70%–2.55%, $p < 0.001$). High ASA

classification (III–IV) was also independently associated with a 19.5% increase in hospitalization cost (95% CI 8.8%–30.2%, $p < 0.001$). Procedure type was significantly associated with increased cost, whereas multi-comorbidity was not significantly associated with cost in the final model (Table 4).

Table 4 Factors associated with increased hospitalization cost (multivariate linear regression analysis)

Factors	% increase in cost	95% CIs	p-values
LOS (per 1 day)	2.12	1.70 – 2.55	<0.001
ASA high (III–IV)	19.5	8.8 – 30.2	<0.001
Multi-comorbidity ≥ 2	2.39	-5.16 – 9.95	0.535
Procedure (arthroplasty vs Fixation)	35.44	25.42 – 45.45	<0.001

Association between prolonged LOS and 1-year mortality

During the 1-year follow-up period, 32 patients (14.3%) died. In univariable analysis, prolonged LOS (>10 days), older age, and lower preoperative hemoglobin were associated with 1-year mortality, whereas kidney dysfunction and high ASA classification were not statistically significant in univariable analysis, prolonged LOS (>10 days) was significantly associated with increased 1-year mortality (OR 3.05, 95% CI 1.33–7.01, $p = 0.009$).

Discussion

This retrospective cohort study identified several factors associated with prolonged hospital length of stay (LOS >10 days) in elderly patients undergoing hip fracture surgery at Mae Sot Hospital. Delayed surgery of more than 3 days and the absence of early rehabilitation were the most important factors associated with prolonged LOS [9]. However, implementation in general hospitals may be more challenging than in large centers because of differences in staffing, operative capacity, referral patterns, and rehabilitation resources. Compared with studies from tertiary or high-volume centers, our findings suggest that system-level factors, such as resource availability and workflow efficiency, may play a more prominent role in general hospital settings. In contrast, while previous studies have reported a stronger impact of comorbidities on length of stay, this effect was less pronounced in our cohort. This difference may reflect variations in patient characteristics, care pathways, and healthcare system constraints in resource-limited settings. For this reason, our findings may be especially useful for hospitals working under similar real-world limitations.

Our multivariable model for prolonged LOS was designed to focus on clinically relevant and practically applicable factors. In this context, variables such as time to surgery and rehabilitation timing were retained not only because of their statistical association, but also because they are potentially modifiable and have

been consistently emphasized in previous studies [3,19,21]. This is particularly important in a general hospital setting, where improvements in coordination and process of care may be more feasible than expanding highly specialized services.

From a cost-analysis perspective, each additional day of hospital stay was associated with a 2.12% increase in hospitalization cost. High ASA class (III-IV) also contributed significantly to increased cost, and procedure type was associated with greater expenditure. These findings are consistent with prior economic evaluations indicating that prolonged LOS is a key cost driver in hip fracture care [20,22-24]. In Thailand's public health system, where resources are constrained, this finding supports the practical value of reducing avoidable delay while maintaining quality of care. In general hospitals, where bed turnover and staffing limitations directly affect service delivery, shortening unnecessary LOS may be particularly relevant for everyday hospital management.

This study has several important strengths. First, it was conducted in a general hospital setting, which may better reflect real-world clinical practice compared with studies from tertiary or high-volume centers. In addition, our findings highlight the role of modifiable perioperative factors, particularly surgical delay and early rehabilitation, as key determinants of prolonged length of stay. These factors represent practical targets for improving patient outcomes in resource-limited settings. Furthermore, to our knowledge, this is one of the few studies focusing on this patient population in a non-tertiary hospital context in our region, providing data that may be more applicable to similar healthcare systems.

A crude association between prolonged LOS and 1-year mortality was observed in univariable analysis. This finding should be interpreted cautiously. Although prolonged LOS was associated with 1-year mortality in univariable analysis, this finding should be interpreted with caution, as it may reflect underlying patient factors rather than a direct causal relationship. Prolonged LOS may reflect greater

frailty, perioperative complexity, postoperative complications, or a higher burden of illness among patients requiring longer hospitalization, rather than LOS itself being the sole explanation for mortality risk [1,4,25-27]. In contrast, higher hemoglobin levels were protective [4], suggesting that perioperative anemia may still be clinically relevant. Because mortality was a secondary outcome in this study, the observed association is better interpreted as a clinically relevant signal than as definitive evidence of an independent prognostic effect.

These results suggest that hospital administrators and clinicians should focus on practical system-level improvements, particularly timely surgical access and early rehabilitation. Such measures may be especially valuable in general hospitals, where workflow constraints and resource limitations differ substantially from large referral centers. These findings suggest that optimizing timely surgery and early rehabilitation may be important targets for improving outcomes in general hospital settings. In addition, the study was conducted at a single general hospital, which may limit generalizability to other settings, especially large tertiary or university hospitals with different infrastructure and care pathways. However, this may also be considered a strength, as the findings are likely to reflect real-world practice in general hospitals more directly. Furthermore, although hospitalization cost and 1-year mortality were evaluated as secondary outcomes, the study was primarily designed to identify factors associated with prolonged LOS. Future research should explore whether improvement of perioperative care pathways can reduce LOS and improve efficiency in similar hospital settings.

Conclusion

This study identified delayed surgery (>3 days) and absence of early rehabilitation as key factors associated with prolonged hospital length of stay in elderly patients undergoing hip fracture surgery. These findings emphasize the importance of timely surgical management and early postoperative mobilization as

potentially modifiable targets in general hospital settings. Further studies are warranted to evaluate whether optimizing these factors can translate into improved patient outcomes.

Conflict of interest

The authors have no conflicts of interest to report.

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