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Research Article

Analysis of Prognostic Parameters for Postoperative Mortality in Multifragmentary Hip Fracture: What is the Difference of the Re-Enablement Period?

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Abstract

Objectives: Re-enablement, also called restorative care, in 5-7 days after surgery generally provides information about the outcome of anesthetic management, and in the first 30 days after surgery provides information about the quality of home care for elderly patients.The aim of this study was to determine the factors affecting mortality in patients over 60 years of age with an unstable femoral trochanteric fracture treated with a single-type of implant.

Methods: Between 2015 and 2020, 268 patients with an unstable trochanteric fracture operated with a short proximal femoral nail were retrospectively evaluated. The research data were obtained from the preoperative anesthesia records and patient medical records using the electronic medical record system. The mortality data were taken from the National Population Management System. The decedents were categorized into three groups according to the period of death as those who died in the first 7 days after surgery, those who died in the first 30 days, and those who died during the entire study period.The relationship of mortality with certain factors such as sex, age, American Society of Anesthesiology (ASA)score, type of anesthesia used, Charlson comorbidity index (CCI), intensive care unit (ICU) stay, hemoglobin level, time of fracture occurrence (within or out of working hours), operation time (within or out of working hours), surgical complications, reoperations, time between fracture and entry into the operating room, need for blood support, and postoperative duration of hospital stay were assessed.

Results: Non-survived patients in all groups, had a higher mean age. The patients who died in the first 30 days and throughout the study had higher CCI and ASA scores. It was observed that non-survived patients were hospitalized longer. The duration of ICU stay was significantly longer in non-survived. In our entire sample group, the time to surgery was longer in non-survived patients. More blood units were consumed by non-survived patients. The preoperative hemoglobin values of non-survived patients were significantly lower than those of the patients who survived.

It was found that there was a statistically significant correlation between the patients who suffered fractures during the weekend (especially in the evening) and those who died in the first week. Apart from this, the time of fracture occurrenceand the timing of surgery had no effect on mortality. When the groups were compared according to Alzheimer's and Diabetes Mellitus, ıt has been observed that DM is not as effective as Alzheimer's on death in the first 30 days.

Conclusion: There are several factors that influence mortality in geriatric patients with hip fracture, a patient group with multiple comorbidities. Our findings can be used to identify hip fracture patients who are at high risk for premature death. Knowledge of the causes of death can be utilized to improve services and develop a more didactic care pathway.

Keywords: Re-enablement, anesthetic management, quality of home care, unstable trochanteric fracture, short proximal femoral nail, hip fracture, comorbidities, Alzheimer's, first 30 days, mortality.

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Hip fractures are the most common fractures in the elderly population and cause high morbidity and mortality.[1] The incidence of hip fractures has increased significantly in recent years with the increase in the elderly population, and it is expected to increase gradually in the future.[2,3]

Due to osteoporosis, low-energy trauma can easily lead to intertrochanteric femur (ITF) fractures, especially in people older than 65 years. ITF is responsible for approximately 45% of hip fractures.[4]

Most patients with hip fractures are at an advanced age and have more than one concomitant disease.[5,6] Hip fractures are associated with poor outcomes and a high annual mortality rate of up to 33% (14-47%) in elderly patients.[7,8] At least one organ function is more or less impaired in many elderly patients with pertrochanteric femoral fractures. The incidence of postoperative complications and mortality is high, so the risk of surgery is extremely high. There are studies in the literature showing that ITFs cause more complications and postoperative mortality than femoral neck fractures.[9] Other factors such as the location of the fracture and the type of surgery may also be associated with increased mortality in hip fractures.Therefore, it is important to develop effective perioperative methods to help reduce the morbidity and mortality rates associated with ITFs.[10]

Re-enablement, also called restorative care, in 5-7 days postoperatively, generally provides information about the outcome of anesthetic management, whereas inthe first 30 days after surgery provides information about the quality of home care for elderly patients. In this study, it was aimed to confirm the risk factors that may be associated with the re-enablement period (5-7 days postoperatively) which is generally thought to indicate the outcome of anesthesia management, and early mortality (mortality in the first 30 days postoperatively) in patients over 60 years of age with an unstable femoral trochanteric fracture treated with a single type of implant. We aimed to confirm the risk factors reported in the literature and analyze the new associated risk factors that may contribute to mortality.

Methods

The study was designed as a retrospective cohort study after being approved by the local ethics committee under the number 21-KAEK-216.

The study evaluated 268 patients diagnosed with unstable trochanteric fracture (31A2) and treated with a short proximal femoral nail (TrigenIntertan "Smith and Nephew©, Memphis, Tennessee") in a single center between 2015 and 2020. Patients (122 men, 146 women) who met the inclusion criteria (acute hip fracture < 7 days; age ≥ 60 years, low-energy trauma, Closed Reduction Internal Fixation (CRIF) with intertan nail) were included in the study. Patients with bilateral hip fractures, fractures that extended into the subtrochanteric region of the femoral shaft, pathologic fractures, and multiple fractures with multi trauma, as well as those with incomplete clinical data and severe cognitive impairment, were excluded. The study data were obtained from preoperative anesthesia records and patient medical records using an electronic medical record system (ENLIL, version: v2.19.46 20191118).The mortality data were taken from the National Population Management System.

The primary outcome was death. The deceased patients were categorized into three groups according to the period of death as those who died in the first 7 days after surgery, those who died in the first 30 days and those who died during the entire study period (Fig. 1). The relationship of mortality with certain factors such as sex, age, preoperative ASA score, type of anesthesia, CCI, ICU admission, hemoglobin level, time of the occurrence of fracture, time of surgery, surgical procedures, reoperation, time to enter the operating room (days), blood requirement, postoperative period of hospital stay were assessed.

Age at admission was categorized into the following groups: (i) 60-74 , (ii) 75-79 , (iii) 80-84, (iv) 85-90 and (v) 91 and above. The admission time to the operating room was calculated from the time the fracture patients admitted to the emergency room to the time they entered the anesthesia room. The ASA score, which is a subjective measure of the patient's preoperative health status, was scored from 1 to 5. The time of fracture occurrence was categorized as morning, noon, evening, night, weekday, and weekend. The type of anesthesia was classifiedascombined, spinal and general. The patientsin terms of hemoglobin level at the time of admission weregrouped as 10 and below, 10.1-10.9, 11.0-11.9, 12.0-12.9, 13 and above. The effect of operation time on mortality was assessed by comparing the patients undergoing surgery in working hours and those operated in out-of hours. Working hours included the patients whose operations started and ended before 4:00 pm on weekdays, and out-of-hours included the patients whose operations started after 4:01 pm

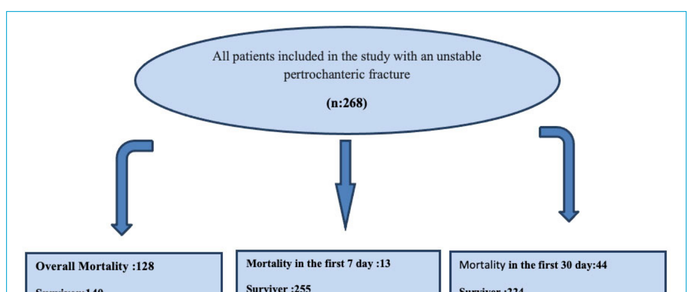

Figure 1. Schematic view of sample grouping.

in the afternoon or evening and on weekends. Early mortality was evaluated by comparing the difference between the patients who died in the first week and those who died within the first month.

The patients who had underwent surgery in the supine position were allowed to stand up. All patients were allowed to take medications prescribed for their concomitant diseases. All patients received daily subcutaneous enoxaparin sodium and anti embolic stockings for prophylaxis of deep vein thrombosis. A traction table was not used in any patient during surgery.

Statistical Analysis

The data obtained were evaluated using IBM SPSS Statistics (Software Version 23.0)software. The distrubution of the collected data was checked by the Kolmogorov-Smirnov test. The data were presented as mean±SD. Non-normally distributed data were evaluatedwith Mann-Whitney U test between groups. Chi-square test, Fisher Exact test and the Fisher-Freeman-Halton tests wereused to evaluate the categorical variables. Survival analysis was conducted using the Kaplan Meier test.Breslow test was performedin the evaluation of categorical variables affecting early survival. Coxregression models were applied for evaluating mortality risk. A p-value of <0.05 wasconsidered statistically significant in all analyses.

Results

The analysis of the study data showed that 128 patients (13 in the first 7 days, 44 in the first 30 days, 93 in the first year) died. Our 1-year mortality rate was 34.7% (Fig. 2). Non-survived patients had a higher mean age (86.1±7.3) (p<0.001),

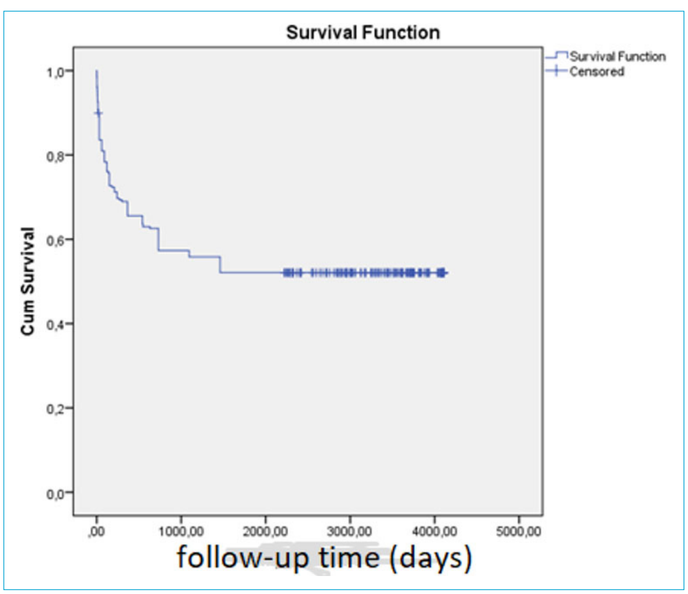

Figure 2. Survival analysis of the patients.

and the patients who died in the first seven days and in the first 30 days were significantly clustered in the age range of 85-90 and over 90 years (p<0.001). When gender distribution was examined, 146 (54.5%) of the patients were female and 122 (45.5%) were male. The gender distribution was homogeneous in all groups and had no significant effect on exitus (p>0.05).

The mean CCI value of the patients was 1.58 (0-7). Non-survived patientshad a significantly higher CCI (1.88±1.15) than those who survived (p<0.001). While the effect of CCI on mortality was not significant in the group that died in the first seven days, the CCI values was significantly higher in the patientswho died in the first 30 days than in those who died in the first seven days. When the ASA scores, which is a relative indicator of the general condition of the patients,were examined, the number of ASA 4 patients were significantly higherthan the other ASA groups (p<0.001). While the ASA score did not affect mortality in the group that died in the first seven days, it was significantly higher in the group that died in the first 30 days. The effect of the type of anesthesia applied wasnot significant on mortality in any group (p=0.595) (Table 1).

The time to surgery did not significantly affect mortality in the patients who died in the first sevendays and in the first 30 days. However, considering all patients included in study, it was observed that non-survived patientshad waited for longer time to surgery (2.96±1.98) (p=0.029). It was also found that non-survived patientswere hospitalized longer (9.37±8.4) (p=0.002). The length of stay in ICU (2.9±8.3) was significantly longer in non-survived patients in all groups (p<0.001) (Table 1).

When hemoglobinvalues at the time of admission were examined, the preoperative hemoglobin values of non-survived patients (11.0±1.79) were significantly lower than those of survivors (p=0.005). The difference in hemoglobin values of the patients died in the first seven days and the first 30 days were not statistically significant when compared to those of survived patients. There was no statistically significant difference in terms of hemoglobin values between the patients who died in the first seven days, in the first 30 days and those who survived.

The hemoglobin values of non-survived patients were significantly concentrated inbelow 10.0 and 10.1-10.9 groups compared to survived patients (p=0.007). The mean blood requirement of all patients was 1.1 units (0-6). It was observed that more units of blood (1.35±1.61) were transfused to survived patients (p=0.039). The need for bloodtransfusion was not significantly different between the patients who died in the first seven days and in the first 30 days (Table 1).

Table 1. Distribution of variables according to the groups

	Death in the first 7 days			Death in the first 30 days			Overall status		
	Non-Ex (n=255)	Ex (n=13)	p	Non-Ex (n=224)	Ex (n=44)	p	Non-Ex (n=140)	Ex (n=128)	p
Gender									
Female	139	7	0.963	122	24	0.748	82	64	0.159
Male	116	6		102	20		58	64	
Age Groups									
60-74	46	0	0.058**	46	0	<0.001	39	7	<0.001
75-79	44	0		42	2		24	20	
80-84	45	3		41	7		30	18	
85-90	66	4		53	17		27	43	
Above 90	54	6		42	18		20	40	
ASA Classification (II/III/IV)									
ASA II	18	0	0.163**	18	0	<0.001**	14	4	<0.001
ASA III	194	8		176	26		111	91	
ASA IV	43	5		30	18		15	33	
Type of Anesthesia									
CSE	21	1	>0.999**	20	2	0.594**	11	11	0.385
SA	129	7		111	25		66	70	
GA	105	5		93	17		63	47	
ICU admission									
None	113	3	0.132	109	7	<0.001	73	43	0.002
Admitted	142	10		115	37		67	85	
Admision Hemoglobin (g/L)									
10 and below	61	2	0.884**	48	15	0.247	25	38	0.001
10.1-10.9	42	2		38	6		15	29	
11.0-11.9	63	5		55	13		42	26	
12.0-12.9	41	2		39	4		31	12	
13and above	48	2		44	6		27	23	
Day of fracture									
Weekday Morning	21	1	0.007**	19	3	0.352**	11	11	
Weekdays Noon	69	1		59	11		37	33	
Weekday Evening	88	2		76	14		46	44	
Weekday Night	17	1		14	4		7	11	0.492**
Weekend Morning	10	0		10	0		8	2	
Weekend Noon	23	2		22	3		16	9	
Weekend Evening	14	5		12	7		9	10	
Weekend Night	13	1		12	2		6	8	
Day of surgery									
Day Time	121	6	0.927	103	24	0.298	66	61	
After Hour	134	7		121	20		74	67	
Reoperation									
None	241	12	0.535*	119	134	0.478*	119	134	0.635
Done	14	1		8	7		8	7	

Ex: exitus; CCI: Charlson Comorbidity Index; ASA: American Society of Anesthesiologists Score; ICU: intensive care unit; CSE: combined spinal-epidural anesthesia; SA: spinal anesthesia; GA: general anesthesia. *Fisher's exact test. ** Fisher-Freeman-Halton test.

When evaluating the time of fracture, it was found that the need for blood transfusion was statistically significant in the patients who suffered a fracture during the weekend and especially in those who died in the first week (p=0.001). No significant difference was found in the group that died in the first 30 days and when evaluating all those who died. The time of fracture occurrenceand the timing of surgery did not affect mortality (p=0.336). There was no difference among the patients who died in the first seven days, in the first 30 days and those who died during the entire study period in terms of in- and out-of-hospital complications (p>0.999), reoperations (p=0.635), and ICU admission (p=0.454) (Table 1).

Reoperation was performed in 15 (5.6%) patients. Thirteen patientsunderwent surgery due to problems with the implant and two patientsunderwentsurgery for deep infection. Although the patients who underwent reoperation died earlier, this did not have a statistically significant effect on mortality (p=0.954). Two (0.7%) patients who developed deep infection died earlier (p=0.001) (Table 1).

For all parameters, non-survived patients had a higher mean age (86.1±7.3) (p<0.001). The CCI values ofnon-survived patientswere higher. Non-survived patientswere observed to be hospitalized for a longer period of time. The length of stay in the ICU was significantly longer in non-survived patients. Time to surgery was longer and more units of blood were consumed in the patients who died. The preoperative hemoglobin values were significantly lower in the patientswho died than inthose who survived (Table 2).

When the groups were compared according to Alzheimer's and Diabetes Mellitus, even a global disease like DM has not been found to be as effective on death as Alzheimer's as a result of keeping it under control (Table 3).

Discussion

Although there are many studies reporting various risk factors for mortality after hip fracture surgery, preventable risk factors for mortality after hip fracture surgery have not been fully defined.[11] The mortality rate in the first year after hip fracture in our country, Turkey, is 29%, 17,[12] and 33% (2.4%-47%)globally.[7,8,13] In our study, the mortality rate in the first year was similar to the mortality rate in our country and worldwide.[7,8,12,13] It has been indicated that mortality rates in the first 30 days after hip fracture ranged from 1.4%[14] to 15.4%.[15] In our study, the mortality rate in the first 30 days was 16.4%, similar to several other studies.[16-18]

It has been reported that advanced age is strongly associated with mortality after hip fracture surgery.[19,20] In our study, non-survived patients were significantly clustered in the age range of 85-90 and >90, confirming the results in the literature. Male gender is strongly associated with highermortality after hip fracture. The studies have shown that the male gender increases the risk of mortality and is a known determinant of mortality after hip fracture.[16,21,22]

Table 2. Distribution of quantitative variables according to the survival status of the patients

	Overall Mortality		
Variables	**Survived (n=140)**	**Non-Survived (n=128)**	**p**
Age (years)	80.06±8.85	86.1±7.3	<0.001
Follow-up (days)	3.344.2±656	336.5±431.6	<0.001
CCI	1.32±1.08	1.88±1.15	<0.001
Length of hospital stay (days)	7.44±4.5	9.37±8.4	0.002
Length of ICU stay (days)	0.99±1.6	2.9±8.3	<0.001
Time to surgery (days)	2.69±2.65	2.96±1.98	0.029
Blood transfusion (units)	0.95±1.41	1.35±1.61	0.039
Admision Hemoglobin (g/L)	11.6±1.53	11.0±1.79	0.005

Table 3. Comparison of groups according to Alzheimer and Diabetes Mellitus

	Death in the first 7 days			**Death in the first 30 days**			**Overall status**		
	Non-Ex (n=255)	**Ex (n=13)**	**p**	**Non-Ex (n=224)**	**Ex (n=44)**	**p**	**Non-Ex (n=140)**	**Ex (n=128)**	**p**
Alzheimer									
No	219	11	>0.999*	198	32	0.006	134	96	<0.001
Yes	36	2		26	12		6	32	
Diabetes Mellitus									
No	195	9	0.517*	172	32	0.564	106	98	0.871
Yes	60	4		52	12		34	30	

*Fisher's exact test.

It was found in our study that gender was not a factor affecting mortality. This could be due to multifaceted factors affecting mortality rates such as sample size between studies, female to male ratio, additional comorbid conditions of patients and racial differences.

In several medical settings, the CCI has been shown to accurately predict 30-day, 90-day, and 1-year postoperative mortality for both elective surgery and breast cancer.[24-26] Another study, with a contrary opinion, has not recommended the use of the CCI to predict 12-month mortality.[27] Although the CCI predicts in-hospital mortality in patients with hip fractures, other factors may influence this situation in trauma patients and it is maybe the reason why it was ineffective in predicting mortality in the first seven days in our study.

Our study showed that the ASA score was independently associated with 30-day mortality and all-cause mortality which was consistent with the literature.[8,27,28] There are only a few studies on the association between anesthetic techniques and mortality in patients with hip fractures. While some reported that mortality decreased with the use of spinal anesthesia, others found no difference between general and spinal anesthesia.[29-31] In our study, the type of anesthesia did not contribute to mortality. White et al.[31] stated that even very large observational studies are insufficient to show significant differences in mortality after spinal anesthesia when compared to general anesthesia, and that unless randomized controlled trials with very large sample size (>3,000 patients per group) are conducted, the likelihood of finding significant differences in mortality is low.

Opinions differ among orthopaedic surgeons about the relationship between the timing of surgery and mortality in hip fractures. Many authors still report that early surgery is an important factor for improving survival.[32-34] On the other hand, many studies indicate that there is little association between delayed surgery and postoperative mortality.[35-37] This suggests that surgery may be safer in patients with problems such as anemia, electrolyte imbalance, uncontrolled diabetes, ventricular failure, arrhythmias, chest infections, and correctable coagulation disorders after stabilization of these complications.[38] In our study, the effect of time to surgery was not significant on mortality in the patients who died in the first seven days and in the first 30 days. However, in our whole sample group, it was observed that non-survived patientshad waited longer for surgery. The approach to anesthesia for hip fracture in our hospital was to perform surgery after stabilization of additional comorbid conditions, and it was determined that multidisciplinary resolution of additional comorbidities that may affect mortality appeared to reduce mortality.

In our study, it was observed that non-survived patientsstayed longer period of time in the hospital and ICU. Many studies have shown that early surgery in elderly patients with hip fractures is associated with a shorter hospital stay.[35,39,40] In these patients, surgery is often postponed because there is insufficient time and space in the operating room.[41] In addition, the length of stay in the ward and/or ICU was longer due to the additional comorbidities of non-survived patients.

The studies investigating the impact of anemia on hip fracture outcomes at the time of admission have found a correlation with mortality.[40,42] Our study supports this literature. Anemia-related morbidity and mortality may be due to anemia sequelae such as hypoperfusion, increased cardiac demand, and transfusion-related complications, as well as to underlying chronic comorbidities causing the anemia itself.[42-45] Some authors have suggested that risk factors for anemia have a better prognosis for postoperative morbidity/mortality than anemia itself.[43,44]

In our study, although a statistically significant correlation was found between the patients who sustained fractures during the weekend and especially in the evening of the weekend and those who died in the first week when evaluated according to the time of fracture, no significant difference was found in the group who died in the first 30 days and when evaluating all those who died. In our study, although a statistically significant correlation was found between having a fracture on the weekend especially in the evening of the weekend and being died in the first week, when evaluated according to the time of fracture, the effect of the time of fracture was not significant on mortality in the group who died in the first 30 days and when evaluating all those who died.

The time of fracture occurrence and timing of surgery did not affect mortality in any group. While some studies in the literature have reported that mortality increases in patients admitted on weekends compared to weekdays,[46-48] some othershave reported the opposite.[17, 49-53] This difference between studies can be attributed to the fact that the post-operative outcome may be adversely affected as a result of staffing reductions during the vacation season in the units giving care for patients with hip fractures. This could have important implications for both outcome analysis of procedures and resource management planning in surgical departments. In addition, the operative time frame of fractures did not affect mortality in all groups. These data showed that there is no significant weekend effect in hip fracture surgery and that mortality is influenced by patient comorbidities and delay of surgery.[19,54,55]

Since patients with hip fractures are elderly, complications often occur only in the hospital.[9] It has been reported that the mortality rate in patients with hip fractures with complications is up to 5.8 times higher than in patients without complications.[9,12] In our study, it was seen that deep wound infection increases mortality and this confirms the literature.

In our study, it was shown that the mortality rates of Alzheimer's patients were low in the first 7 days. Based on this result, it shows that although the care of Alzheimer's patients in the hospital is sufficient, unfortunately, many Alzheimer's patients cannot be cared for at home and they need to be cared for by outside professionals. Long-term care in professional centers may be the best decision for the best care of Alzheimer's patients with hip fractures.

Conclusion

Our study is important in that it examined several parameters that may be associated with mortality in patients over 60 years of age with an unstable femoral trochanteric fracture treated with a single type of implant. Advanced age, high CCI, high ASA score, longer time to surgery, low preoperative hemoglobin, increased blood transfusion, longer ICU stays, and postoperative complications were the factors that increased mortality.

Even a global disease such as DM is not as effective as Alzheimer's on mortality as a result of keeping it under control. However, Alzheimer's patients are not well taken care of at home, the risk of death increases in the first 30 days after surgery. Alzheimer's patients cannot be cared for well at home and must be looked after by professionals at home.

In evaluating our results, it is important to note that the study included patients who underwent surgery with one type of fracture and one type of implant. The limitations of our study are that it was retrospectively designed in a single center,and the sample size was not large enough.

Disclosures

Ethics Committee Approval: The study was designed as a retrospective cohort study after being approved by the local ethics committee under the number 21-KAEK-216.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – O.B.; Design – O.B.; Supervision – O.B.; Materials – O.B., H.A., F.E., M.G.B., E.C.Z., M.B.E.; Data collection &/or processing – O.B., H.A., F.E., M.G.B., E.C.Z., M.B.E.; Analysis and/or interpretation – O.B., H.A., F.E.; Literature search – O.B., H.A., F.E.; Writing – O.B., H.A., F.E.; Critical review – O.B., H.A., F.E., M.G.B., E.C.Z., M.B.E.

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