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Impact of orthogeriatric care, comorbidity, and complication on 1-year mortality in surgical hip fracture patients

An observational study

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Abstract

After acute hip surgery, the 1-year mortality rate is high. Therefore, this study evaluated the risk factors for 1-year mortality. The purposes of this study was first to examine the effect of integrated care on 1-year mortality in surgical patients and secondly to explore magnitude of comorbidity and complication on mortality.

This retrospective cohort study included 313 patients received surgery for hip fragility fracture. Patients with multiple fractures or combined trauma were excluded. The patients were grouping into integrated (n = 106) and non-integrated care group (n = 207) models. Univariate and multiple Cox regression were used to examine effect of care model, comorbidity, and complication event.

One-year mortality in integrated and non-integrated patients was 4.7% and 14.0% respectively. After adjustments, patients in non-integrated care, have 2.89 times (95% confidence interval [CI] 1.07–7.81) likely to die 1-year after discharged.

Patients had elevated comorbidity or postoperative complications contributed to the mortality. Our study found the effect of patients treated by integrated care models, compared with usual model, significantly reduced 1-year mortality rate. Appropriated treatment of comorbidities during hospitalization and after discharge is critical to post-surgical survival. The findings imply that the co-care for hip fracture of hip surgical patients with orthogeriatricians is strongly recommended, particularly for those with >3 comorbidities.

Abbreviations: ASA = American Society of Anesthesiologists, BMI = body mass index, CCI = Charlson comorbidity index, CI = confidence interval, HR = hazard ratio, OR = odds ratio, USD = United States Dollars.

Keywords: co-care, hip fracture surgery, integrated care, orthogeriatrician, risk factor, survival

1. Introduction

Osteoporotic hip fractures cause acute pain and loss of function and often lead to hospitalization.[1] Although hip fractures account for only <20% of all osteoporotic fractures, they constitute the majority of fracture-related health care expenditures and are the major cause of mortality in individuals older than 50 years.[2] The incidence of hip fractures is expected to increase with the aging of the population. Because most of these patients require hospitalization for treatment, the annual health care costs, currently estimated at $10.3 to $15.2 billion, are also expected to increase.[3]

The principal treatment for hip fracture in elderly patients is surgery. After acute hip surgery, the 1-year mortality rates may be as high as 13.4%.[4] Patients with hip fractures also exhibit a high incidence of comorbidities, which majorly affect mortality. A previous study demonstrated that the presence of ≥3 comorbidities is the strongest preoperative risk factor for mortality in patients with hip fractures.[5] During hospitalization, postoperative complications lead to longer hospitalization and higher medical costs.[6]

Orthogeriatric care provided by geriatricians and orthopedic surgeons has a long history, and the orthogeriatric field was

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C-HC and P-JH have contributed equally.

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developed in England in the late 1950s. The form of orthogeriatric care models appeared at different models, from comanaged, multidisciplinary care by orthopedic surgeon, and geriatrician to nursing units.[7] Previous studies demonstrated that orthogeriatric care models, as compared with conventional model, appeared greater advantage in reduce mortality rates,[8,9] shorter length of hospital stay,[9] decrease institutional costs[10] in surgical hip fracture patients. Despite the promising results of the care provided by orthogeriatricians in western counterparts, there are very few studies to reveal the benefit of integrated care model in Asian population. However, though the promising results of the care provided by orthogeriatricians, most hospitals still lack an orthogeriatrician.

Therefore, our primary interest is to examine whether an integrated care by orthopedic surgeons acting like orthogeriatricians can reduce 1-year mortality. The second interest is to explore to what extent degree that the comorbidity and complication affect the 1-year mortality.

2. Methods

2.1. Study population and sample

This retrospective cohort study was conducted at a tertiary referral hospital, a 1300-bed hospital located in Southern Taiwan. All patients with fragile hip fracture who were aged >65 years and who underwent surgery between January 2009 and December 2010 were included in this study. The exclusion criteria were concomitant fractures other than hip fracture and concomitant injury that required surgery. A total of 383 patients were initially included in this study. After the exclusion of 48 patients with other concomitant fractures and 22 with concomitant injury that required surgery, 313 were finally enrolled in this study. A total of 106 (33.9%) of patients received care from integrated care group. This study was approved by the institutional review board of the Kaohsiung Medical University Hospital (KMUH-IRB-20120334).

2.2. Data source

Data were retrospectively derived from different data sources. For patients' clinical variables, the electrical hospital medical charts review was completed by orthopedic senior nursing specialists and reviewed by a senior orthopedic surgeon. Death information was from Taiwan national death registry and merged with patient identification. To insure the quality of data, data elements were randomly doubled check by one of authors.

2.3. Outcomes

The outcome was 1-year mortality, or time-to-event, was calculate from the date of discharge after hip fracture surgery to recorded date of death. In other words, all surgical patients were followed up to 365 days or death event, which came first.

2.4. Predictors: care model, and comorbidity and complication

The type of medical provider was categorized into a specialized hip surgeon acting like an orthogeriatrician with routine consultation of medical specialists in patients with sugar >200 mg/dL or $HbA1_C$ higher than 8%, blood pressure >180 mmHg, heart failure, angina and dyspnea (integrated care), and into a general orthopedic surgeon (non-integrated care). In integrated care model, the comorbidities were treated by the suggestion of medical specialists after consultation. The treatment strategy with multiple comorbidities was determined after discussion with several medical specialists by the specialized hip surgeon. After discharge, the comorbidities were further cared in the clinic of medical specialists. Other orthopedic surgeons in the department as routine care (non-integrated care group) cared all other patients.

Medical comorbidity was assessed using the Charlson comorbidity index (CCI),[11] a validated measure that consists of a weighted scale of 17 comorbidities (including cardiac, pulmonary, renal, and hepatic diseases; diabetes; cancer; and hemiplegia) and is expressed as a summative score.[12,13] In this study, the CCI was categorized as none, 1, 2, or 3 or more comorbidities, as previously described.[14] Complication was measured by the new undesirable situation after admission including post-surgical anemia, urinary tract infection, delirium, gastro-intestinal tract bleeding, urinary retention, electrolyte imbalance, pneumonia, acute renal failure, arrthymia, acute myocardial infarction, respiratory failure, pulmonary edema, pleural effusion, stroke, hematuria, heart failure, pulmonary embolism, exacerbation of chronic obstructive pulmonary disease, ileus, implant failure, drop foot, bed sore, and sepsis.

2.5. Adjusted or control variables

The adjusted variables at the study included demographic characteristics (i.e., sex, age, and body mass index [BMI]), clinical characteristics (e.g., fracture type, cause of fracture, comorbidity, American Society of Anesthesiologists [ASA] grade, and time to surgery), surgical characteristics (e.g., transfusion, type of surgery, surgical time, blood loss, and bone grafting). The patient characteristics and clinical variables were categorized as follows: age was categorized into 65 to 69, 70 to 74, 75 to 79, and ≥80 years; BMI into underweight (BMI < 18.5), normal (BMI = 18.5–25), overweight (BMI = 25–30), and obese (BMI > 30), as per the World Health Organization classification[15]; fracture type into intracapsular or extracapsular; and cause of fracture into slipping down, falling from stairs, or traumatic insult. The ASA grades were categorized into grades I to III and IV. Time to surgery was categorized into ≤24 hours (early), 24–48 hours, and ≥48 hours (delayed), whereas the type of surgery was categorized into cannulated screws, dynamic hip screw, unipolar hemiarthroplasty, or bipolar hemiarthroplasty. Blood loss in the operative room was categorized into <471 mL (mean plus one standard deviation [SD]) or ≥471 mL.

2.6. Statistical analysis

Descriptive analyses were performed to reveal the numbers of the study population by integrated and non-integrated group, and survival status for demographic, patients clinical, and treatment variables. Continuous variables are tested by *t* test and Analysis of Variance (ANOVA), whereas, categorical variables are examined by the chi-square. We performed Cox proportional hazards regression analysis to identify the relatively risk in predicting variables, i.e., care model, overall system illness of patients (CCI), and complication (yes/no) was used to estimate 1-year mortality. Statistical significance was set at $P < .05$. All statistical analyses were performed using (SPSS 19.0 Inc., Chicago, IL, USA).

3. Results

3.1. Patient demographic characteristics between non-integrated care and integrated care groups

Table 1 presents the baseline characteristics between 2 group subjects. No significant differences were observed in most

variables in patient demographic and clinical, and surgical characters. Between non-integrated care and integrated care groups, except for sex, fracture type, and bone grafting, which was only required for unstable extracapsular fracture. A higher proportion of patients in the integrated care group underwent bone grafting (19.8%) than that of the non-integrated care group (6.3%).

Table 1

Patient demographic and clinical variables in integrated and non-integrated care group.

Variables	Integrated care (N = 106)		Non-integrated care (N = 207)		*P*-value
	N	%	N	%	
Age					
65–69	14	13.2	19	9.2	.668
70–74	18	17.0	39	18.8	
75–79	25	23.6	56	27.1	
≥80	49	46.2	93	44.9	
Gender					
Male	23	21.7	69	33.3	.032
Female	83	78.3	138	66.7	
BMI					
<18.5	12	11.8	21	10.4	.683
18.5–24	60	58.8	111	55.2	
≥24	30	29.4	69	34.3	
Fracture type					
Intra-capsule	72	67.9	110	53.1	.012
Extra-capsule	34	32.1	97	46.9	
Cause					
Non-slipping down	18	17.0	55	26.6	.058
Slipping down	88	83.0	152	73.4	
ASA grade					
ASA I–III	93	87.7	183	88.4	.862
ASA IV	13	12.3	24	11.6	
Comorbidity (CCI)					
0	34	32.1	54	26.1	.634
1	25	23.6	57	27.5	
2	23	21.7	42	20.3	
≥3	24	22.6	54	26.1	
Time to surgery, h					
≤24	42	39.6	94	45.4	.079
24–48	17	16.0	47	22.7	
≥48	47	44.3	66	31.9	
Type of surgery					
Cannulated screws	11	10.4	18	8.7	.088
Dynamic hip screw	34	32.1	97	46.9	
Unipolar hemiarthroplasty	25	23.6	41	19.8	
Bipolar hemiarthroplasty	36	34.0	51	24.6	
Bone graft					
No	85	80.2	194	93.7	<.001
Yes	21	19.8	13	6.3	
Surgical time, min	99.3	±40.59	93.3	±38.30	.194
<134.4	88	83.0	180	87.0	.347
≥134.4	18	17.0	27	13.0	
Transfusion					
No	53	50.0	130	62.8	.030
Yes	53	50.0	77	37.2	
Blood loss, mL	267.6	±230.62	227.8	±228.20	.147
<470.7	88	83.0	187	90.3	.061
≥470.7	18	17.0	20	9.7	
Complication					
No	43	40.6	102	49.3	.144
Yes	63	59.4	105	50.7	
1 year mortality					
Survival	101	95.3	178	86.0	.012
Died	5	4.7	29	14.0	

ASA = American Society of Anesthesiologists, BMI = body mass index, CCI = Charlson comorbidity index.

Table 2

Distribution in risk factors of 1-year mortality.

Variables	Survival (N = 279)		Died (N = 34)		*P*-value
	N	%	N	%	
Care model					
Non-integrated care	178	63.8	29	85.3	.012
Integrated care	101	36.2	5	14.7	
Age					
65–69	29	10.4	4	11.8	.519
70–74	53	19.0	4	11.8	
75–79	74	26.5	7	20.6	
≥80	123	44.1	19	55.9	
Gender					
Male	82	29.4	10	29.4	.998
Female	197	70.6	24	70.6	
BMI					
<18.5	30	11.1	3	9.1	.049
18.5–24	146	54.1	25	75.8	
≥24	94	34.8	5	15.2	
Clinical character					
Fracture type					
Intra-capsule	162	58.1	20	58.8	.932
Extra-capsule	117	41.9	14	41.2	
Cause					
Non-slipping down	66	23.7	7	20.6	.690
Slipping down	213	76.3	27	79.4	
ASA grade					
ASA I–III	249	89.2	27	79.4	.094
ASA IV	30	10.8	7	20.6	
Comorbidity (CCI)					
0	85	30.5	3	8.8	<.001
1	76	27.2	6	17.6	
2	59	21.1	6	17.6	
≥3	59	21.1	19	55.9	
Time to surgery, h					
≤24	125	44.8	11	32.4	.269
24–48	54	19.4	10	29.4	
≥48	100	35.8	13	38.2	
Surgical character					
Type of surgery					
Cannulated screws	28	10.0	1	2.9	.241
Dynamic hip screw	117	41.9	14	41.2	
Unipolar hemiarthroplasty	55	19.7	11	32.4	
Bipolar hemiarthroplasty	79	28.3	8	23.5	
Bone graft					
No	248	88.9	31	91.2	.686
Yes	31	11.1	3	8.8	
Surgical time, min	95.9	±40.53	90.7	±24.75	.297
<134.4	238	85.0	30	90.9	.360
≥134.4	42	15.0	3	9.1	
Treatment effectiveness					
Transfusion					
No	169	60.6	14	41.2	.030
Yes	110	39.4	20	58.8	
Blood loss, mL	249.9	±237.68	170.6	±126.39	.003
<470.7	244	87.1	31	93.9	.258
≥470.7	36	12.9	2	6.1	
Complication					
No	137	49.1	8	23.5	.005
Yes	142	50.9	26	76.5	

ASA = American Society of Anesthesiologists, BMI = body mass index, CCI = Charlson comorbidity index.

3.2. Analysis of risk factors for 1-year mortality

Table 2 dispatch all variables between groups in death and survivors. There are 34 patients died 1 year after the hip fracture, which accounted for 10.9%. Patients received non-integrated care model ($P = .012$), with >3 comorbidities ($P < .001$), received transfusion ($P = .013$), and incurred complications ($P = .005$), were associated higher percentage in with 1-year mortality. Although ASA grade IV seemed to lead to higher 1-year mortality, this increase was not statistically significant ($P = 0.094$). Time to surgery were not were statistically associated with risk of 1-year death.

3.3. Treatment effectiveness between non-integrated care and integrated care groups

More patients in the integrated care group required blood transfusion, but no significant difference was observed in blood

Table 3

Comparison factors related to 1-year mortality between groups.

	Non-integrated care (N = 207)					Integrated care (N = 106)				
	Survival (N = 179)		Died (N = 28)			Survival (N = 101)		Died (N = 5)		
Variables	N	%	N	%	*P*-value	N	%	N	%	*P*-value
Age										
65–69	17	89.5	2	10.5	.346	12	85.7	2	14.3	.282
70–74	35	89.7	4	10.3		18	100.0	0	0.0	
75–79	51	91.1	5	8.9		24	96.0	1	4.0	
≥80	76	81.7	17	18.3		47	95.9	2	4.1	
Gender										
Male	60	87.0	9	13.0	.886	22	95.7	1	4.3	.925
Female	119	86.2	19	13.8		79	95.2	4	4.8	
BMI										
<18.5	19	90.5	2	9.5	.074	11	91.7	1	8.3	.325
18.5–24	90	81.1	21	18.9		56	93.3	4	6.7	
≧24	64	92.8	5	7.2		30	100.0	0	0.0	
Clinical character										
Fracture type										
Intra-capsule	94	85.5	16	14.5	.648	68	94.4	4	5.6	.553
Extra-capsule	85	87.6	12	12.4		33	97.1	1	2.9	
Cause										
Non-slipping down	48	87.3	7	12.7	.840	18	100.0	0	0.0	.300
Slipping down	131	86.2	21	13.8		83	94.3	5	5.7	
ASA grade										
ASA I–III	162	88.5	21	11.5	.017	88	94.6	5	5.4	.392
ASA IV	17	70.8	7	29.2		13	100.0	0	0.0	
Comorbidity (CCI)										
0	51	94.4	3	5.6	<.001	34	100.0	0	0.0	.393
1	54	94.7	3	5.3		23	92.0	2	8.0	
2	37	88.1	5	11.9		22	95.7	1	4.3	
≥3	37	68.5	17	31.5		22	91.7	2	8.3	
Time to surgery, h										
≤24	84	89.4	10	10.6	.379	41	97.6	1	2.4	.653
24–48	38	80.9	9	19.1		16	94.1	1	5.9	
≥48	57	86.4	9	13.6		44	93.6	3	6.4	
Surgical character										
Type of surgery										
Cannulated screws	17	94.4	1	5.6	.294	11	100.0	0	0.0	.696
Dynamic hip screw	85	87.6	12	12.4		33	97.1	1	2.9	
Unipolar hemiarthroplasty	32	78.0	9	22.0		23	92.0	2	8.0	
Bipolar hemiarthroplasty	45	88.2	6	11.8		34	94.4	2	5.6	
Bone graft										
No	169	87.1	25	12.9	.298	80	94.1	5	5.9	.255
Yes	10	76.9	3	23.1		21	100.0	0	0.0	
Surgical time, min	93.9	±39.96	89.5	±25.36	.441	99.5	±41.27	96.0	±25.35	.852
Treatment effectiveness										
Transfusion										
No	119	91.5	11	8.5	.006	50	94.3	3	5.7	.647
Yes	60	77.9	17	22.1		51	96.2	2	3.8	
Blood loss, mL	236.7	±238.82	171.3	±132.12	.159	272.9	±233.89	161.0	±116.75	.292
Complication										
No	96	94.1	6	5.9	.002	41	95.3	2	4.7	.979
Yes	83	79.0	22	21.0		60	95.2	3	4.8	

ASA = American Society of Anesthesiologists, BMI = body mass index, CCI = Charlson comorbidity index

loss between the 2 groups. Although a higher proportion of the integrated care group underwent bone grafting, blood loss was not significantly higher in this group. The integrated care group exhibited longer hospitalization (11.6 ± 7.9 days) than did the non-integrated care group (7.0 ± 3.2 days) ($P < .001$). Moreover, the integrated care group received more consultation (2.6 ± 1.2 times) than did the non-integrated care group (0.7 ± 0.7 times) ($P < .001$). Besides, integrated care group received more follow-up of comorbidities other than orthopedics in medical department mostly in cardiology, pulmonology, and endocrinology 1 month after discharge (4.1 ± 1.3 times) than did the non-integrated care group (1.3 ± 0.8 times) ($P < .001$). During hospitalization more expenditure was noted in the integrated care group (3054 ± 2177 USD) than in the non-integrated care group (2367 ± 696 USD) ($P = .001$). The 1-year mortality rate was much lower in the integrated care group (4.7%) than in the non-integrated care group (14.0%). The reduced mortality is significant in patients with age ≥80 (18.3–4.1%), ASA grade 4 (29.2%–0), ≥3 comorbidities (31.5–8.3%), transfusion (22.1–3.8%), and postoperative complications (21.0–4.8%) in integrated care group. The mortality is statistical significance in ASA grade ($P = .017$), comorbidities ($P < .001$), transfusion ($P = .006$), and postoperative complications ($P = .002$) in non-integrated care group, however, the mortality is not statistical significance in ASA grade, transfusion, and postoperative complications in integrated care group. The mortality can be significantly reduced in high-risk patients (Table 3).

3.4. Analysis of risk factors for 1-year mortality non-integrated care and integrated care groups

The Kaplan–Meier survival curves revealed that 1-year mortality was related to the presence of 3 or more comorbidities ($P < .001$), care model ($P = .014$), blood transfusion ($P = .033$), and complications ($P = .005$), but not fracture type, type of surgery, time to surgery, blood loss, or surgical time. The most critical risk factor was integrated care group, which significantly reduced the 1-year mortality rate (Table 4, Fig. 1).

Multiple Cox regression analysis of the risk factors for 1-year mortality revealed that patients with CCI ≥3 had higher 1-year mortality (hazard ratio [HR]: 6.35, 95% confidence interval [CI]: 1.81–22.31; $P = .004$). Patients in the integrated care group had lower 1-year mortality (HR: 0.33, 95% CI: 0.12–0.88; $P = .027$). Postoperative complications were also related to 1-year mortality (odds ratio [OR]: 2.97, 95% CI: 1.19–7.39; $P = .019$; Table 5).

4. Discussion

Hip fractures often lead to hospitalization with high 1-year mortality. In this study, we evaluated the risk factors related to 1-year mortality and the effect of integrated care performed by orthopedic surgeons like orthogeriatricians. Multiple consultations for treating comorbidities during hospitalization with intergraded care by specialized hip surgeons and treatment of comorbidities in Medical clinic after discharge significantly reduced 1-year mortality.

This study demonstrated that the presence of ≥3 comorbidities and the occurrence of postoperative complications were associated with high 1-year mortality, consistent with the findings of previous studies.[16,17] In the present study, the presence of >3 comorbidities and the occurrence of complications during hospitalization, but not age, male sex, or ASA grade,

Table 4

Kaplan–Meier analysis of 1-year mortality.

	Total	N	Mean, mo	95% CI		Log rank
				Low	Upper	*P*-value
Variables						
Age						
65–69	33	4	11.0	10.06	11.94	.520
70–74	57	4	11.4	10.68	12.16	
75–79	81	7	11.6	11.29	11.95	
≥80	142	19	11.2	10.74	11.60	
Gender						
Male	92	10	11.2	10.69	11.77	.979
Female	221	24	11.3	11.04	11.65	
BMI						
<18.5	33	3	11.5	10.51	12.40	.046
18.5–30	171	25	11.0	10.55	11.42	
>30	99	5	11.8	11.60	12.01	
Clinical character						
Fracture type						
Intra-capsule	182	20	11.3	10.89	11.62	.912
Extra-capsule	131	14	11.4	11.01	11.78	
Cause						
Non-slipping down	73	7	11.6	11.13	11.99	.663
Slipping down	240	27	11.2	10.91	11.56	
ASA grade						
ASA I–III	276	27	11.3	11.06	11.61	.102
ASA IV	37	7	11.1	10.21	12.06	
Comorbidity (CCI)						
0	88	3	11.9	11.59	12.12	<.001
1	82	6	11.4	10.97	11.91	
2	65	6	11.6	11.12	12.04	
≥3	78	19	10.3	9.55	11.14	
Time to surgery, h						
≤24	136	11	11.5	11.18	11.88	.265
24–48	64	10	11.0	10.30	11.73	
≥48	113	13	11.2	10.75	11.70	
Surgical character						
Type of surgery						
Cannulated screws	29	1	11.6	10.89	12.35	.235
Dynamic hip screw	131	14	11.4	11.01	11.78	
Unipolar hemiarthroplasty	66	11	10.8	10.05	11.59	
Bipolar hemiarthroplasty	87	8	11.5	11.01	11.91	
Bone graft						
No	279	31	11.3	10.97	11.56	.657
Yes	34	3	11.7	11.42	12.05	
Surgical time, min						
<134.4	268	31	11.3	10.96	11.56	.328
≥134.4	45	3	11.6	11.23	12.06	
Medical provider						
Care model						
Non-integrated care	207	29	11.1	10.79	11.51	.014
Integrated care	106	5	11.6	11.30	11.97	
Treatment effectiveness						
Transfusion						
No	183	14	11.5	11.15	11.76	.033
Yes	130	20	11.1	10.65	11.58	
Blood loss, mL						
<470.7	275	32	11.3	10.96	11.55	.239
≥470.7	38	2	11.7	11.02	12.46	
Complication						
No	145	8	11.7	11.41	11.93	.005
Yes	168	26	11.0	10.57	11.44	

ASA = American Society of Anesthesiologists, BMI = body mass index, CCI = Charlson comorbidity index.

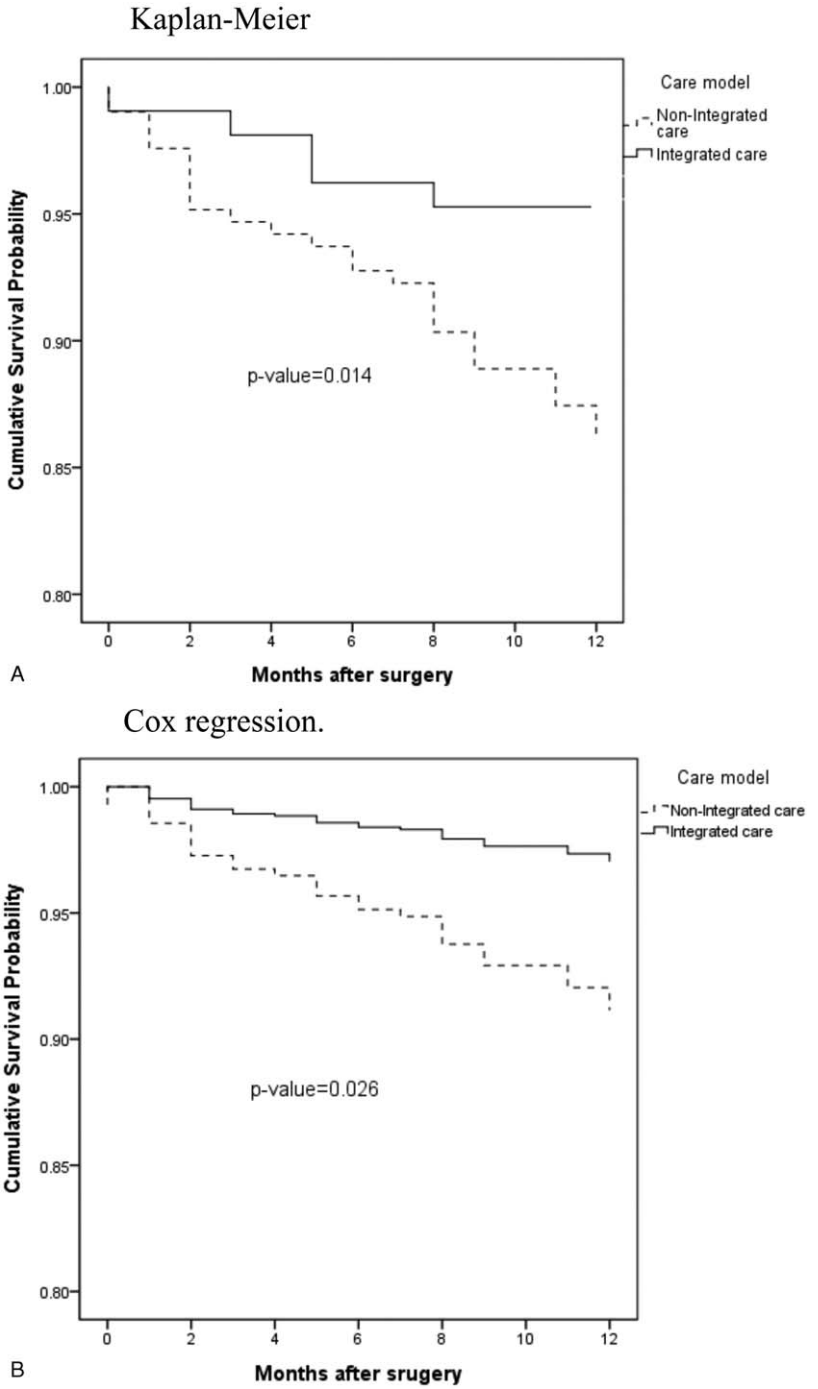

Figure 1. Kaplan–Meier and Cox regression models predicting surgeon related to 1-year mortality. The model was adjusted for patient, clinical, medical provider, and treatment effectiveness characteristics.

were related to 1-year mortality, although the prefracture activities of daily living index have also been inferred to be related to comorbidities. A common finding is that a higher CCI leads to higher 1-year mortality. In the present study, the mortality rate was 6.35 times higher in those with >3 comorbidities than in those without comorbidities. Roche et al[5] reported higher 1-year mortality in patients with a CCI of ≥3 (OR: 2.4). Vestergaard et al[17] reported a 1-year mortality rate of 19%, with an annual increase of 1.8%, but their major cause was the fracture event, rather than pre-existing comorbidities. Recently, Mariconda et al[16] reported a 1-year mortality rate of 18.8%, which was significantly related to an age of >80 years, male sex, ASA grade, prefracture activities of daily living index, and complications during hospitalization. Their study did not state that a special care model was applied for patients with hip fractures. Sircar et al[18] reported less complications in patients undergoing early surgery (14.7%) and more complications in those undergoing delayed surgery (33.3%). Similarly,

Table 5

Multiple Cox regression analysis in 1-year mortality.

	Univariate				Multivairate			
		95% CI				95% CI		
Variables	HR	Low	Upper	*P*-value	HR	Low	Upper	*P*-value
Medical provider								
Care model								
Non-integrated care (Ref)								
Integrated care	0.32	0.13	0.84	.020	0.33	0.13	0.85	.021
Age								
65–69 (Ref)								
70–74	0.56	0.14	2.24	.412				
75–79	0.68	0.20	2.32	.536				
≥80	1.09	0.37	3.19	.880				
Gender								
Male (Ref)								
Female	0.99	0.47	2.07	.979				
BMI								
<18.5 (Ref)								
18.5–24	1.66	0.50	5.51	.405				
≥24	0.54	0.13	2.26	.399				
Clinical character								
Fracture type								
Intra-capsule (Ref)								
Extra-capsule	0.96	0.49	1.91	.913				
Cause								
Non-slipping down (Ref)								
Slipping down	1.20	0.52	2.76	.665				
ASA grade								
ASA I–III (Ref)								
ASA IV	1.97	0.86	4.52	.110				
Comorbidity (CCI)								
0 (Ref)								
1	2.21	0.55	8.85	.261	1.71	0.41	7.16	.464
2	2.77	0.69	11.07	.150	2.69	0.67	10.76	.162
≥3	8.05	2.38	27.22	.001	6.90	2.03	23.39	.002
Time to surgery, h								
≤24 (Ref)								
24–48	2.01	0.85	4.73	.111				
≥48	1.46	0.65	3.25	.360				
Surgical character								
Bone graft								
No (Ref)								
Yes	0.77	0.23	2.51	.659				
Surgical time, min								
<134.4 (Ref)								
≥134.4	0.56	0.17	1.83	.337				
Treatment effectiveness								
Blood loss, mL								
<470.7 (Ref)								
≥470.7	0.44	0.10	1.82	.254				
Complication								
No (Ref)								
Yes	2.95	1.34	6.52	.007	2.85	1.13	7.19	.027

ASA = American Society of Anesthesiologists, BMI = body mass index, CCI = Charlson comorbidity index.

Lefaivre et al[19] reported more complications in patients undergoing delayed surgery (OR: 2.21). In the present study, delayed surgery was not related to 1-year mortality. Treatment of comorbidities preoperatively led to delay surgery but not increased 1-year mortality. The effect of delay surgery may need further studies to validate. However, the most crucial finding of this study is that 1-year mortality rate of 4.7% and a 67% reduction in mortality was achieved in integrated care group. This finding has not been reported previously.

Because of the unavailability of an orthogeriatrician or a co-care system at the time of the study, orthopedic surgeons had to care for patients through multiple consultations, if necessary, before finally making a care decision. In this situation, the care experience of the medical provider is extremely crucial, particularly for more effective decision-making and for reducing mortality. Encouraging patients with multiple comorbidities to keep treatment after discharge is extremely crucial. Although hospitalization was 11.6 days, expenditure was only US$3054. Because the medical cost is much lower in Taiwan than in the United States, longer hospitalization for improved control of patients' comorbidities may be beneficial in reducing the 1-year mortality rate despite the increase in expenditure. Although the integrated care group had longer hospitalization with more expenditure, more consultation during hospitalization, more follow-up of comorbidities 1 month after discharge and more expenditure, the group achieved a much lower 1-year mortality rate. The most significant difference is reducing mortality in high-risk patients such as age ≥80, ASA grade 4, ≥3 comorbidities, transfusion, and postoperative complications.

Because patients with hip fracture usually exhibit one or more comorbidities and because surgical intervention is required, the involvement of an orthogeriatrician in the management of certain conditions is desirable. A previous study reported that the co-care of patients with hip fracture by an orthogeriatrician could reduce mortality. The co-care of patients by orthopedic surgeons and geriatricians can reduce hospitalization to 4.3 days, the 30-day readmission rate to 10.4%, and the 17-month reoperation rate to 1.9%. The cost of care is US$15,188 if the 1-year mortality rate is 21.2%.[20] One review reported that the 1-year mortality in 4 studies decreased from 17.71% in the control group (n = 1432) to 11.68% in the integrated care group (n = 1340).[21] Vidan et al[8] reported that a joint model of care through admission to a dedicated orthopedic ward with shared responsibility for the patient by the orthopedic surgeon and geriatrician considerably reduced hospital mortality from 5.5% to 0.6%, but the decrease in 1-year mortality was not substantial (which decreased from 25.3% to 19.9%; $P = .18$). Leung et al[22] also reported that patients managed by an orthopedic team with regular geriatrician review and multidisciplinary input on patient care reduced the 1-year mortality rate from 20.4% to 11.6%. In this study, we found less mortality rate in patients with higher risks; for example; age ≥80, ASA grade 4, ≥3 comorbidities, transfusion, and postoperative complications.

In the present study, integrated care group led to a 1-year mortality rate of 4.7%. The cause of death in hip fracture patients is comorbidity related, but no fracture itself related. We infer that encouraging the patients to receive treatment of comorbidity at the Medical departments such as cardiology, endocrinology, and pulmonology may be the most important factor to reduce 1-year mortality rate. Nevertheless, co-care with geriatric specialists focusing on patients with hip fracture is still recommended to reduce mortality, particularly when patients exhibit >3 comorbidities.

4.1. Limitations

This study had a number of limitations. First, this is a retrospective cohort study not a prospective randomized control study. The results need further confirmation. Second, the numbers of patients are still small. Third, the medical costs after discharge and re-admission rates were not evaluated.

Fourth, patients with concomitant fractures other than hip fracture and concomitant injury that required surgery was excluded which may lower 1-year mortality. Even the limitations above, we found treatment of comorbidity is an important factor to reduce 1-year mortality after hip fracture.

5. Conclusions

Improving care quality during hospitalization and encouraging the patients to treat comorbidities after discharge can reduce mortality after hip fracture.

Author contributions

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