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Factors Predictive of In-Hospital Mortality in Patients with Systemic Lupus Erythematosus: A Single-Centre Retrospective Analysis

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Abstract

Objective. We aimed to investigate the causes and factors predictive of in-hospital death among patients with systemic lupus erythematosus (SLE) admitted to a tertiary care hospital in Thailand. **Materials and Methods.** We retrospectively reviewed the records of patients with SLE admitted between 2017 and 2021. We collected data related to age, sex, body mass index, comorbidities, disease duration, medication usage, clinical symptoms, vital signs, laboratory results, evidence of infection, presence of systemic inflammatory response syndrome, quick sepsis-related organ assessment scores, and SLE disease activity on the date of admission. The length of hospitalization, treatment administered, and subsequent clinical outcomes (including in-hospital complications and death) were also recorded. **Results.** Among 267 enrolled patients, the overall in-hospital mortality rate was 25.5%, and infection was the most common cause of death (75.0%). Multivariate analysis revealed that prior hospitalization within 3 months (odds ratio [OR]: 2.311; 95% confidence interval [CI]: 1.002–5.369; P=0.049), initial infection on admission (OR: 2.764; 95% CI: 1.006–7.594; P=0.048), use of vasopressor drugs (OR: 2.940; 95% CI: 1.071–8.069; P=0.036), and mechanical ventilation (OR: 5.658; 95% CI: 2.046–15.647; P=0.001) were independent risk factors for in-hospital mortality. **Conclusion.** Infection was the major cause of mortality in patients with SLE. Prior hospitalization within 3 months, initial infection on admission, vasopressor use, and mechanical ventilation during admission are independent risk factors for in-hospital mortality in patients with SLE.

Key Words: Risk Factor ▪ In-Hospital Death ▪ Mortality ▪ Predictor ▪ Systemic Lupus Erythematosus.

Introduction

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease characterized by multiple organ system involvement and patterns of relapse and remission, resulting in major morbidity and mortality. Despite improvements in both diagnosis and treatment modalities over the past decade (1), the SLE mortality rate remains high, at approximately 2–3 times that observed in the general population (2-4).

Primary reasons for hospitalization among patients with SLE include disease activity, infection, and concurrent infection during disease flares (5, 6). Given the cumulative organ damage and high rate of infection, patients with SLE are considered to have an increased risk of mortality during hospitalization (7, 8). The in-hospital mortality during SLE-related hospitalization maybe up to 70% (8). Understanding these outcomes and their prognostic factors is necessary for optimal management of patients with SLE. However, differences in geographic region, ethnicity, and socioeconomic status can influence SLE disease patterns and outcomes (9-11). Most studies conducted in developed or high-income countries report improved survival outcomes (9, 10). whereas studies conducted in developing countries report relatively worse outcomes (12). To date, there is a paucity

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of clinical data regarding the factors influencing in-hospital mortality in patients with SLE in developing countries, where healthcare resources are relatively limited.

To address this issue, we aimed to investigate the causes and factors predictive of in-hospital mortality in patients with SLE admitted to a tertiary care hospital in Thailand.

Methods

Study Design and Patient Population

This retrospective study was conducted at Hatyai Hospital (a regional tertiary center in southern Thailand). The study protocol was approved by the institutional ethics committee (protocol number 57/2564) and was conducted in accordance with the Declaration of Helsinki. The need for informed consent was waived because patient information was anonymized prior to analysis.

The study included patients with SLE aged >18 years admitted to the Department of Internal Medicine at Hatyai Hospital between January 2017 and December 2021. The exclusion criteria were as follows: (a) coexistence of other connective tissue diseases, (b) coexistence of antiphospholipid syndrome (APS), (c) pregnancy or lactation, (d) concurrent malignancy, (e) elective admission for diagnostic procedures (e.g., kidney biopsy) or scheduled intravenous administration of SLE-specific therapy (e.g., intravenous methylprednisolone and cyclophosphamide), and (f) insufficient data. SLE was diagnosed based on the 1997 American College of Rheumatology revised criteria for SLE and/or Systemic Lupus International Collaborating Clinics (13, 14).

Data Collection and Definitions

Data from each patient's medical records were manually collected and reviewed retrospectively. Each admission was treated as a separate observation for the analysis. For each patient, we collected data related to age, sex, body mass index, comorbidities, disease duration, medication usage, history of prior hospitalization within three months, clinical symptoms, vital signs, laboratory results, evidence of infection, presence of systemic inflammatory response syndrome [SIRS], quick sepsis-related organ assessment (qSOFA) scores (15), and SLE disease activity (measured using the modified SLE Disease Activity Index -2 K [Modified SLEDAI-2K] score) (16) on the admission date. In addition, the length of hospitalization, treatment administered, need for admission to the intensive care unit (ICU), and subsequent clinical outcomes (including in-hospital complications and death) were recorded.

Active SLE was defined as a modified SLEDAI-2K score >4. SIRS was considered to be present in patients exhibiting two or more of the following: (a) body temperature >38°C or <36°C; (b) heart rate >90 beats per minute; (c) respiratory rate >20 breaths per minute; and (d) white blood cell count >12,000 cells/mm^3, <4,000 cells/mm^3, or >10% of band forms (17). Infections were diagnosed based on either bacteriological, radiological, or serological findings and on the treatment response to antibiotic therapy. Patients who met both the definitions of active SLE and infection were classified as having infection concurrent with disease flare. Prior hospitalization included only admissions for SLE-related reasons, such as disease flare and/or infection, and not diagnostic procedures or scheduled intravenous medication administration. The primary outcome was in-hospital mortality, which was defined as any death that developed during the admission period.

Statistical Analysis

Categorical variables were evaluated using frequency statistics and compared using Pearson's chi-square or Fisher's exact test, as appropriate. Continuous variables are presented as means with standard deviations (SD) or medians with interquartile ranges (IQR) and were compared using Student's t-test and the Wilcoxon rank-sum test. The associations between the variables and in-hospital mortality were determined using a logistic regression analytic model that was adjusted for possible confounders. In the first model (model 1), only age and sex were included. Then, additional multiple regression modeling was performed by including

clinical characteristics (age, sex, Modified SLEDAI-2K score, organ damage comorbidity, preadmission medication) that were known to influence patients' prognosis (model 2). Finally, we performed additional multiple regression modeling to identify predictors of in-hospital mortality using the variables in model 2 and other variables that were significantly associated with in-hospital mortality (P-values <0.05) in the univariate analyses (model 3). Analyses were performed using STATA version 15.1 software (StataCorp LLC, College Station, TX, USA). Statistical significance was set at P<0.05.

Results

Baseline Characteristics and Causes of Death

Among 503 patients identified during the study period, 267 patients met the inclusion criteria and were enrolled in the study. The average age among the included patients was 34.4±13.2 years, 93.3% of whom were female, and the median duration between disease onset and admission was 15 (IQR: 2–50) months (Table 1). Two hundred and thirty-six patients were excluded because of undergoing scheduled intravenous medication administration

Table 1. Baseline Clinical Characteristics of Lupus Patients (N=267) and Clinical Outcome during Admission

Baseline characteristics	Value N (%)
Female sex	249 (93.3)
Age (years), mean ± SD*	34.4±13.2
Classification diagnostic criteria	
ACR97†	225 (84.2)
SLICC12‡	235 (88.0)
Comorbidities	
Hypertension	37 (13.9)
Dyslipidemia	27 (10.1)
Diabetes mellitus	17 (6.4)
Chronic kidney disease	74 (27.7)
Lupus nephritis	132 (49.4)
Use of corticosteroid prior to admission	226 (84.63)
Use of antimalarial agents prior to admission	119 (44.6)
Use of immunosuppressive agents prior to admission	
None	158 (59.2)
Azathioprine	25 (9.45)
Cyclophosphamide	54 (20.2)
Mycophenolate mofetil	30 (11.2)
Duration of disease before admission (months), median (IQR§)	15 (2–50)
Cause of admission	
Disease activity	109 (40.8)
Infection	57 (21.3)
Infection concurrent with disease flare	101 (37.8)
Symptom or organ involvement at admission	
Fever	174 (65.2)
Mucocutaneus	47 (17.6)
Musculoskeletal	17 (6.4)
Neuropsychiatric lupus	29 (10.9)
Cardiovascular-pulmonary	41 (15.4)
Gastrointestinal	10 (3.7)
Leukopenia	20 (7.5)
Autoimmune hemolytic anemia	35 (13.1)
Thrombocytopenia	32 (12.0)
Vasculitis	10 (3.7)
Renal	157 (58.8)
Presence of SIRs at admission	152 (56.9)
Length of hospitalization (days), median (IQR§)	10 (5–19)
In-hospital mortality	68 (25.5)

*Standard deviation; †American College of Rheumatology revised criteria for SLE 1997; ‡Systemic Lupus International Collaborating Clinics 2012; §Interquartile range.

and kidney biopsy (N=157), coexistence of other connective tissue diseases or APS (N=11), concurrent malignancies (N=5), and incomplete information (N=63). The reasons for admission included disease activity, infection, and concurrent infection with active disease, accounting for 40.8%, 21.3%, and 37.8%, respectively. The mean modified SLEDAI-2k scores at admission across hospitalization type were as follows: 7.0 for admission due to SLE disease flare, 3.2 for admission due to initial infection, and 7.0 for admission due to concurrent infection with SLE disease flare. Among all patients, 155 had lupus nephritis (58.8%); 54.1%, 11.5%, and 34.4% of patients were admitted due to SLE disease flare, initial infection, and concurrent infection with SLE disease flare, respectively.

There were 68 in-hospital deaths, corresponding to an overall in-hospital mortality rate of 25.5%. Infection was the most common cause of death (N=51; 75.0%), followed by SLE disease flare (N=17; 25%). Infection could be classified as concurrent infection with SLE disease flare (N=39; 57.4%) and initial infection on admission (N=12; 17.6%).

Comparison of Baseline Characteristics and Clinical Outcomes Among Survivors and Non-Survivors

Tables 2 and 3 show the baseline characteristics, treatment modalities, and clinical outcomes for survivors and non-survivors. Mean age (P=0.003)

Table 2. Comparison of Characteristics of Patients Who Survived (N=199)Versus Those Who Did Not Survive (N=68)

Variables	Survivors N (%)	Non-survivors N (%)	P value
Female sex	185 (93.0)	64 (94.1)	1.000
Age (years), mean±SD*	33.1±13.0	38.5±12.8	0.003
Comorbidities			
Hypertension	20 (10.1)	17 (25.0)	0.002
Dyslipidemia	17 (8.5)	10 (14.7)	0.146
Diabetes mellitus	10 (5.0)	7 (10.3)	0.150
Chronic kidney disease	46 (23.1)	28 (41.2)	0.004
Lupus nephritis	95 (47.7)	37 (54.4)	0.400
Use of corticosteroid prior to admission	169 (84.9)	57 (83.8)	0.846
Use of antimalarial agents prior to admission	93 (46.7)	26 (38.2)	0.224
Use of immunosuppressive agents prior to admission			
None	123 (61.8)	35 (51.5)	0.134
Azathioprine	22 (11.1)	3 (4.4)	0.147
Cyclophosphamide	34 (17.1)	20 (29.4)	0.029
Mycophenolate mofetil	20 (10.1)	10 (14.7)	0.294
Duration of disease before admission (months), median (IQR†)	15 (3–50)	17.5 (2–58)	0.697
Modified SLEDAI-2K score††, median (IQR†)	8 (2–14)	8 (2–16)	0.780
Modified SLEDAI-2K score†† >4	122 (61.3)	46 (67.6)	0.350
Equivalent dose to prednisolone dose, mg/day, median (IQR†)	20 (5–60)	20 (5–60)	0.750
Prior hospitalization within 3 months	67 (31.8)	42 (58.3)	<0.001
SLE** flare at admission	94 (47.2)	15 (22.1)	<0.01
Mucocutaneus	18 (9.0)	5 (7.4)	0.668
Lupus nephritis	120 (60.3)	37 (54.4)	0.394
Hematological	47 (23.26)	18 (26.5)	0.636
Neurological	23(11.6)	12 (17.6)	0.199
Others	15 (7.5)	7(10.3)	0.475

Continuation of Table 2.

Variables	Survivors N (%)	Non-survivors N (%)	P value
Initial infection on admission	105 (52.8)	53 (77.9)	<0.001
Bacteremia	27 (13.6)	16 (23.5)	0.059
Urinary tract infection	34 (17.1)	49 (25.0)	0.152
Pneumonia	24 (12.1)	22 (32.4)	<0.001
Deep skin infection	26 (13.1)	19 (27.9)	0.005
Infective diarrhea	16 (8.0)	5 (7.4)	0.856
Unidentified source infection	5 (2.5)	2 (2.9)	1.000
Laboratories test at admission			
Hemoglobin (g/dL), mean±SD*	9.0 ± 2.4	8.3 ± 2.1	0.020
White blood cell count ($\times10^3$/μL), median (IQR†)	8.3(5.0–13.0)	8.6 (4.0–13.5)	0.980
Proportion of white blood cell count <4×10^3	32 (16.1)	15 (22.1)	0.264
Platelet count ($\times10^3$ /μL), median (IQR†)	918 (122–283)	148 (113–235)	0.008
Proportion of platelet count <50×10^3/μL	7 (3.5)	5 (7.4)	0.189
Creatinine (mg/dl), median (IQR†)	1.3 (0.7–2.8)	1.9 (1.0–4.14)	0.006
UPCR‡ (mg/g), median (IQR†)	2275 (250–4,924)	2498 (365–5840)	0.908
Albumin (g/dL), mean±SD*	2.6 ± 0.8	2.4 ± 0.6	0.037
qSOFA§ score >2	16 (8.0%)	19 (27.9%)	<0.001
SIRS‖ >2 score	99 (49.7%)	53 (77.9%)	<0.001

*Standard deviation; †Interquartile range; †† Modified SLE Disease Activity Index -2 K; **Systemic lupus erythematosus; ‡Urine protein creatinine ratio; §Quick sepsis-related organ assessment;‖Systemic inflammatory response syndrome. P value= For bivariate two-sided comparisons between the two groups, Pearson chi-square test or Fisher's Exact test was used for categorical variables, and the Student's t-test and Wilcoxon rank-sum test was used for continuous variables.

Table 3. Comparison of Treatment Modality and Outcome between Patients Who Survived (N=199) Versus Those Who Did Not Survive (N=68)

Variables	Survivors N (%)	Non-survivors N (%)	P value
Vasopressors use	15 (7.5)	41 (60.3)	<0.001
Mechanical ventilator	40 (20.1)	55 (80.9)	<0.001
Renal replacement therapy	22 (11.1)	24 (38.3)	<0.001
Median dose equivalent to prednisolone (mg), median (IQR*)	225 (775–1,120)	365 (60–1,150)	0.683
Pulse methylprednisolone pulses (>500 mg)	71 (35.7)	27 (39.7)	0.552
Cyclophosphamide use	30 (15.1)	1 (1.5)	0.002
Intravenous immunoglobulin G use	6 (3.0)	3 (4.4)	0.697
Plasma exchange	10 (5.0)	11 (16.2)	0.003
Nosocomial bacteremia	6 (3)	8 (11.8)	0.010
Length of stay (day), median (IQR*)	9 (5–18)	12 (6–28)	0.175

*Interquartile range. P value=For bivariate two-sided comparisons between the two groups, Pearson chi- square test or Fisher's Exact test was used for categorical variables, and the Wilcoxon rank-sum test was used for continuous variables.

and rates of underlying hypertension (P=0.002), chronic kidney disease (P=0.004), and cyclophosphamide use within 3 months prior to admission (P=0.029), history of admission within 3 months prior to the current admission (P<0.001), and initial infection on admission (P<0.001) were higher among non-survivors than among survivors. Serum creatinine levels (P=0.006), the frequency of SIRS on admission (P<0.001), and the proportion of patients with qSOFA scores >2 (P<0.001) were also higher among non-survivors than among survivors. In contrast, hemoglobin (P=0.020) and serum albumin levels (P=0.037) were higher among survivors than among non-survivors.

During admission, patients in the non-survivor group were more often require vasopressor agents, mechanical ventilation, renal replacement therapy, and plasma exchange and were more experience nosocomial infection, while those in the survivor group more often received cyclophosphamide administration.

Factors Predictive of In-Hospital Mortality

Logistic regression analysis was performed to identify risk factors for in-hospital mortality (Table 4). Age over 45 years was positively associated with in-hospital mortality in model 1 (odds ratio [OR]: 1.953, 95% confidence interval [CI]: 1.036–3.683; P=0.038) but not in model 2. According to model 3, prior hospitalization within 3 months (OR: 2.311; 95% CI: 1.002–5.369; P=0.049), initial infection on admission (OR: 2.764; 95% CI 1.006–7.594; P=0.048), use of vasopressor drugs (OR: 2.940; 95% CI 1.071–8.069; P=0.036), and mechanical ventilation (OR: 5.658; 95% CI: 2.046–15.647; P=0.001) were independent risk factors for in-hospital mortality.

Table 4. Predictor Factors for Mortality by Univariate and Multivariate Logistic Regression Analyses

Variables	Univariate analysis		Multivariate analysis					
	OR (95% CI)	P value	Model 1		Model 2		Model 3	
			OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Female sex	1.211 (0.385–3.812)	0.744	1.115 (0.323–3.846)	0.863	1.115 (0.323–3.846)	0.863	2.210 (0.284–17.216)	0.449
Age >45 years	1.956 (1.046–3.659)	0.036	1.953 (1.036–3.683)	0.038	2.004 (0.964–4.164)	0.063	1.630 (0.609–4.367)	0.331
Modified SLEDAI-2K score* (every 1 unit increased)	1.013 (0.977–1.051)	0.487	-	-	1.024 (0.982–1.063)	0.267	1.029 (0.972–1.089)	0.321
Hypertension	2.983 (1.456–6.114)	0.003	-	-	2.033 (0.882–4.683)	0.096	2.264 (0.725–7.072)	0.160
Chronic kidney disease	2.328 (1.298–4.178)	0.005	-	-	1.603 (0.793–3.243)	0.189	1.056(0.337–3.315)	0.925
Lupus nephritis	1.307(0.752–2.270)	0.343	-	-	1.063(0.542–2.083)	0.859	1.222 (0.468–3.187)	0.682
Medication within 3 months prior to admission								
Corticosteroid	0.920 (0.433–1.954)	0.828	-	-	0.669 (0.266–1.685)	0.394	0.750 (0.211–2.661)	0.656
Azathioprine	0.317 (0.108–1.282)	0.117	-	-	0.427 (0.111–1.644)	0.216	0.882 (0.164–4.728)	0.883
Cyclophosphamide	2.022 (1.067–3.831)	0.031	-	-	1.818 (0.823–4.014)	0.319	1.751 (0.580–5.281)	0.320
Mycophenolate mofetil	1.543 (0.683–3.485)	0.297	-	-	1.624 (0.628–4.200)	0.317	1.757 (0.461–6.894)	0.409
Antimalarial	0.706 (0.402–1.239)	0.225	-	-	0.972 (0.506–1.863)	0.932	0.927 (0.378–2.273)	0.867
Prior hospitalization within 3 months	2.710 (1.542–4.763)	0.001	-	-	-	-	2.311 (1.002–5.369)	0.049
Laboratory at admission								
Hemoglobin <8 (g/dL)	1.423 (0.813–2.491)	0.216	-	-	-	-		
Creatine >1.5 (mg/dL)	2.262 (1.282–3.985)	0.005	-	-	-	-	1.323 (0.488–3.587)	0.582
Albuminemia <3.5 (g/dL)	1.863 (0.821–4.224)	0.136	-	-	-	-		
Present of SIRS† on admission	3.569 (1.888–6.748)	<0.001	-	-	-	-	1.153 (0.445–2.987)	0.770
qSOFA‡ >2 scores	4.435 (2.215–9.258)	<0.001	-	-	-	-	1.825 (0.581–5.732)	0.303
Initial infection	3.163 (1.673–5.982)	<0.001	-	-	-	-	2.764 (1.006–7.594)	0.048
Nosocomial infection	10.904 (5.362–22.172)	<0.001	-	-	-	-	2.268 (0.819–6.285)	0.115

Continuation of Table 4.

Variables	Univariate analysis		Multivariate analysis					
	OR (95% CI)	P value	Model 1		Model 2		Model 3	
			OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Vasopressor drugs	18.627 (9.101–38.123)	<0.001	-	-	-	-	2.940 (1.071–8.069)	0.036
Mechanical ventilator	16.816 (8.378–33.758)	<0.001	-	-	-	-	5.658 (2.046–15.647)	0.001
Plasma exchange	3.647 (1.474–0.926)	0.005	-	-	-	-	0.857 (0.197–3.736)	0.838
Intravenous cyclophosphamide use during admission	0.085 (0.011–0.629)	0.016	-	-	-	-	0.213 (0.023–1.981)	0.174

*Modified SLE Disease Activity Index -2 K; †Systemic inflammatory response syndrome; ‡ Quick sepsis-related organ assessment.

Discussion

In this study, we investigated factors predictive of in-hospital mortality among patients with SLE. Our analysis indicated that infection was the most common cause of death in this population, followed by disease activity. Initial infection on admission, prior hospitalization within 3 months, and the use of vasopressors and mechanical ventilators during admission were positively associated with the in-hospital mortality rate.

Our study, which was based on data collected from a government hospital in Thailand, reflects "real-life" outcome data from a developing country with relatively limited medical resources. The overall mortality rate among included patients was 25.5%, and the most common cause of death was infection (including infection on admission and concurrent infection with SLE flare). This result is consistent with the findings of previous studies conducted in developing countries, which have reported relatively higher mortality rates than studies conducted in developed countries. Such studies have also reported infection and disease flares as the leading causes of in-hospital death (12, 18-20). Differences in ethnicity, socioeconomic status, regional cultural background, and the availability of medical resources have been shown to influence disease patterns and treatment outcomes in patients with SLE (11). The current study was conducted in a hospital in an urban area of Thailand, and most patients had a low socioeconomic status, which has been associated with non-adherence to medical care and poor outcomes. Identifying risk factors in these populations can aid in the development of more effective strategies based on regional and cultural variations.

Previous studies revealed different patterns of mortality by age of onset in patients with SLE. SLE patients with younger age of onset tended to die due to active disease or infection (21, 22), while those with older age of onset tended to die due to cardiovascular causes and malignancy (23). In our study, the study population had younger onset SLE (mean age of participants of 34.4 years) and most patients died due to active disease or infection, thus confirming the results of previous studies.

In contrast to current guidelines that mention that antimalarial agents should be prescribed for all SLE patients unless contraindicated (24), the rate of antimalarial drugs use in this study was relatively low (44.6%). There are many possible reasons to explain this finding. First, for patients who were newly diagnosed during admission, physicians tended to commence antimalarial drugs in the outpatient setting after the disease had subsided. Second, some patients had contraindications for antimalarial drugs. Third, decision making can vary depending on the physician's specialty. Finally, this result may be influenced by the socioeconomic factors in the population studied. We plan to conduct further research to assess the rate of adherence to guidelines regarding antimalarial drugs use, explore the reasons for non-adherence, and identify the factors affecting non-adherence. The use of antimalarial agents has established beneficial effects on long term outcomes (25, 26). Thus, antimalarial drugs use could have an important influence on the course of the disease during admission. However, antimalarial agents use was not associated with better short-term survival as evidenced by in-hospital mortality rates in this study.

Previous studies have identified several risk factors for in-hospital mortality among patients with SLE. Another study conducted in Thailand reported that, among patients with SLE admitted to medical ICUs, the need for vasopressor therapy and ventilator-associated pneumonia was associated with higher mortality during ICU admission (27). In accordance with this finding, the use of vasopressors and the need for mechanical ventilator treatment were identified as independent risk factors for in-hospital death in the current study, with odds ratios of 2.94 and 5.66, respectively. Patients with SLE meeting the criteria for admission to a critical care setting usually require more complex treatment modalities, including vasopressor therapy, mechanical ventilation, and renal replacement therapy, which are associated with a longer duration of hospitalization and a higher incidence of treatment-related complications, thereby increasing the risk of death.

Prior hospitalization within 3 months was identified as an independent predictor of mortality in the current study. Consistent with previous findings, patients with SLE required frequent readmission, with disease activity as the primary reason for readmission (28). Previous studies have identified numerous risk factors associated with repeated remission, including disease flares, lupus nephritis, serositis, and thrombocytopenia. In addition, patients who required readmission within a short period of time had more severe clinical manifestations than those who did not (6, 29). Both disease activity and intensive immunosuppressive therapy make patients with SLE more susceptible to infection, contributing to increases in in-hospital mortality (28). Taken together, the available evidence highlights the importance of outpatient care, adherence to treatment, and patient education to reduce the risk of readmission and death.

In our study, qSOFA >2, SIRS on admission, initial infection on admission, and nosocomial infection were associated with in-hospital mortality in univariate analyses. However, after multivariate analysis, only initial infection on admission was positively associated with in-hospital mortality. This finding underscores the impact of infection as major presenting problem in patients with SLE. Regular surveillance of SLE patients with infection-related risk factors (e.g., lupus nephritis, immunosuppressive therapy, and use of high dose glucocorticoids) and prompt recognition of infections (as soon as possible) may reduce the risk of development of disease complications and in-hospital mortality.

The strength of the present study is that it has been conducted in a regional tertiary government hospital in Thailand, which is a developing country where medical resources are limited. The results of our study reflect the outcomes of real-world treatment of SLE patients better than those of studies conducted in university affiliated hospitals. However, this study had several limitations. First, the study was retrospective in nature. All information was manually evaluated via a review of each patient's medical charts, which may have resulted in misclassification bias and missing data. Lupus nephritis-related variables, which could interfere with in-hospital mortality, especially the time to diagnosis of lupus nephritis, its duration, and specific treatments, were not obtained. Second, this was a single-center study, which limits the generalizability of the study results. Third, some therapies (including vasopressor support and mechanical ventilation) may lead to higher mortality rates because these variables are surrogate markers of disease severity. Therefore, these factors must be interpreted carefully. Fourth, we included only patients admitted to the Department of Internal Medicine and excluded some conditions such as the coexistence of Sjogren syndrome, APS, pregnancy, and malignancy; this may result in selection bias. Fourth, the lack of information regarding the site, foci, and microbiological etiology of the infections may affect the outcomes. Finally, we did not investigate the predictors of disease activity or infection. Future trials investigating in this aspect are needed. While multi-center trials with larger sample sizes are required to investigate this association as well as potentially protective factors, our results may aid in clinical decision making and management of SLE during admission.

Conclusion

The present results indicated that infection was the most common cause of death among hospitalized patients with SLE. The clinical variables of underlying, prior hospitalization within 3 months, initial infection on admission and the use of vasopressors and mechanical ventilators during admission were positively associated with in-hospital mortality. While multicenter trials with larger sample sizes are required to investigate this association as well as potentially protective factors, our results may aid in clinical decision making and management of SLE during admission.

What Is Already Known on This Topic:

The clinical complexity of systemic lupus erythematosus (SLE) makes accurate prediction of hospital outcomes difficult. Most studies reporting improved survival outcomes have been conducted in developed or high-income countries, while studies from developing countries have reported relatively worse outcomes. Furthermore, clinical data related to the factors that influence in-hospital mortality in patients with SLE in developing countries, where healthcare resources are relatively limited.

What This Study Adds:

In Thailand, infection was the most common cause of death in this population, followed by disease activity. Prior hospitalization within 3 months, initial infection on admission, and the use of vasopressors and mechanical ventilators during admission were positively associated with the in-hospital mortality rate.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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