



Clinico-Laboratory Features and Associated Factors of Lupus Mesenteric Vasculitis

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ABSTRACT

Introduction: Lupus mesenteric vasculitis (LMV) is a rare but potentially life-threatening clinical entity in systemic lupus erythematosus (SLE) patients.

Objective: The present study was initiated to explore the clinical features and associated factors of LMV in SLE patients.

Methods: We conducted a retrospective study on 50 cases of SLE patients with lupus mesenteric vasculitis (LMV) from January 2010 to December 2019 and 89 cases of non-LMV-SLE

patients with similar demographic and comorbidities were included as control. All the data regarding clinical features, laboratory findings, and treatment were reviewed independently by two experts in the field. Both univariate and multivariate logistic regression analyses were employed to identify the associated factors of LMV.

Results: The incidence of LMV was 2.9% among hospitalized SLE patients in the current study. The most frequent symptom and physical sign of LMV were respectively abdominal pain (48, 96%) and abdominal tenderness (45, 90%). Through univariate and subsequent multivariate analysis, oral ulcer (OR, 4.25; $P = 0.024$), urinary tract involvement (OR, 5.23; $P = 0.021$), and elevated D-dimer (OR, 1.121; $P = 0.008$) were demonstrated to be positively associated with LMV, while percentage of lymphocytes (OR, 0.928; $P = 0.004$) and complement 3 (OR, 0.048; $P = 0.008$) were negatively correlated with LMV.

Conclusions: Oral ulcer, urinary tract involvement, reduced percentage of lymphocytes and complement 3, elevated D-dimer could be associated factors for LMV in SLE patients.

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Keywords: Systemic lupus erythematosus; Lupus mesenteric vasculitis; Associated factors; Oral ulcer; Urinary tract involvement; Percentage of lymphocytes; C3; D-dimer

Key Summary Points

Why conduct this study?

Mesenteric vasculitis is a rare but potentially life-threatening clinical entity in SLE patients. The heterogeneity and lack of comprehensive understanding of LMV made prompt and accurate diagnosis of LMV a big challenge.

Hence, this study aimed to explore the clinico-laboratory features and associated factors of LMV.

What was learned from the study?

The most frequent symptom and physical sign of LMV were respectively abdominal pain and abdominal tenderness.

Most of the LMV patients could achieve clinical remission after appropriate treatment.

Oral ulcer, urinary tract involvement, reduced percentage of lymphocytes and complement 3, and elevated D-dimer could be associated factors of LMV in SLE patients.

DIGITAL FEATURES

This article is published with digital features, including a summary slide, to facilitate understanding of the article. To view digital features for this article go to <https://doi.org/10.6084/m9.figshare.14579568>.

INTRODUCTION

Systemic lupus erythematosus (SLE) is an autoimmune inflammatory disease characterized by the loss of self-tolerance and formation of nuclear auto-antigens and immune complexes, and may virtually attack every organ [1]. Lupus mesenteric vasculitis (LMV) is a rare but

serious complication of SLE patients [2]. Severe bowel ischemia caused by LMV could lead to life-threatening bowel infarction and perforation [3–5]. LMV is also the leading cause of acute abdominal pain in SLE patients [6]. Abdominal computed tomography (CT) scans with contrast could provide pivotal diagnostic information for LMV [7, 8]. However, its heterogeneous presentations complicated the prompt and accurate diagnosis of LMV [9]. Several clinical retrospective studies have been carried out on clinical features [6, 10, 11] and associated factors for the recurrence and prognosis of LMV [11]. However, the clinical study on LMV in southwest of China is still limited. Thus, the present study was initiated to explore the clinical features and associated factors of LMV in SLE patients.

METHODS

Patients and Setting

Fifty cases of LMV patients and 89 cases of non-LMV-SLE patients that were admitted to the First Affiliated Hospital of Chongqing Medical University from January 2010 to December 2019 were enrolled in the current study. The contemporaneous non-LMV-SLE patients had similar demographic characteristics, with common SLE symptoms such as rash and arthralgia as chief complaints, but without LMV. They were randomly selected in control group. Medical records including clinical features, laboratory findings, and treatment were reviewed independently by two experts in the field. This study was performed in accordance with the Helsinki Declaration of 1964, and its later amendments. This retrospective study was reviewed and approved by the Ethics Committee of The First Affiliated Hospital of Chongqing Medical University. For this type of study, formal consent is not required.

Diagnostic Criteria

LMV was defined as: (1) clinical evidence of multifocal bowel or multiple vascular territories

involvement, duodenal ischemic changes, bowel wall thickening [12, 13], and clinical improvement when treated with intravenous steroid or immunosuppressant [14, 15]; or (2) pathological verification of vasculitis changes or satisfaction of at least three of the following signs demonstrated by abdominal computed tomography (CT)—bowel wall thickening, target sign, dilatation of intestinal segments, engorgement of mesenteric vessels, and increased attenuation of mesenteric fat [12].

SLE was diagnosed according to the 2010 revised Chinese Rheumatology Association (CRA) revised classification criteria [16, 17]. Meanwhile, patients with antiphospholipid syndrome were excluded.

Oral ulcer was defined as painless and non-specific oral mucosal erosion. Only oral ulcers occur within 3 months of the flare stage of LMV and/or SLE were included. Additionally, oral ulcers caused by drugs, microbial infection, and mechanical damage were excluded in the current study.

Lupus nephritis (LN) was defined if clinical and laboratory manifestations met the ACR criteria [18]. Lupus urinary tract involvement means the following signs were identified by ultrasonography/abdominal CT: stenosis/dilatation of the ureters, bladder wall thickening, and hydronephrosis. Meanwhile, urinary tract involvement caused by non-SLE related factors such as infection, urinary calculus, malignancy, neuropathy, and side effects of medication were ruled out. Remission of LMV was defined as disappearance of gastrointestinal manifestations or improvement of bowel wall edema confirmed by CT scan.

Study Variables

Clinico-laboratory information of LMV and SLE was extracted from clinical records. If the data of an indicator were missing, we evaluated the importance of the indicator, and analyzed the normality of the index data. Firstly, if the missing data is of importance, we discarded the case. If the data of the indicator are normal, we would use its mean to replace the missing data. Otherwise, we would replace missing data with

the median. Systemic lupus erythematosus disease activity index 2000 (SLEDAI-2K) was employed to evaluate SLE [19].

Statistical Analysis

Variables were presented as median (interquartile range) (median (IQR)) and categorical data was outputted as the absolute count and percentage.

Statistical analyses in the current study were conducted using SPSS Statistical Software version 22.0 (SPSS Inc., Chicago, IL, USA). First, each variable was separately evaluated using univariate analysis. The differences of continuous variables were compared using Wilcoxon rank-sum test (non-normally distributed variables). Meanwhile, a Chi-square test or Fisher's exact test was employed to compare the differences of categorical variables. The odds ratio (OR) and 95% confidence interval (CI) were obtained to evaluate the degree of any correlation. Furthermore, variables with $P < 0.1$ in prior comparisons were included in the stepwise multivariate logistic regression analysis. Logistic regression was performed via enter method. $P < 0.05$ was considered to be statistically significant for all calculations.

RESULTS

Clinical Features of Lupus Mesenteric Vasculitis (LMV)

Clinical Manifestations of LMV

Among all the 1724 SLE patients admitted to our hospital during 2010–2019, 50 patients were diagnosed as LMV, with a 2.9% incidence. The 50 LMV patients had an SLE duration (median (interquartile range)) of 10 (3–90) days, with LMV being the initial presentation of SLE in 13 patients. The most frequent symptom and physical sign were abdominal pain (48, 96%) and abdominal tenderness (45, 90%), respectively. Most patients (31/48, 64.58%) suffered from acute, persistent, and diffuse abdominal pain, and the remaining 17 (17/48, 35.42%) patients experienced paroxysmal or

Table 1 Clinical characteristics of 50 patients with lupus mesenteric vasculitis (LMV)

Features	LMV (<i>N</i> = 50)
SLE duration, day, median (IQR)	10 (3–90)
Abdominal pain, <i>n</i> (%)	48 (96.0)
Abdominal distension, <i>n</i> (%)	43 (86.0)
Diarrhea, <i>n</i> (%)	29 (58.0)
Nausea, <i>n</i> (%)	42 (84.0)
Vomiting, <i>n</i> (%)	34 (68.0)
Alimentary tract hemorrhage, <i>n</i> (%)	11 (22.0)
Abdominal tenderness, <i>n</i> (%)	45 (90.0)
Intestinal obstruction, <i>n</i> (%)	7 (14.0)
Intestinal perforation, <i>n</i> (%)	1 (2.0)
Lupus urinary tract involvement, <i>n</i> (%)	16 (32.0)

IQR interquartile range, *N* number, *SLE* systemic lupus erythematosus, *LMV* lupus mesenteric vasculitis

intermittent pain. When concerned with pain intensity, the patients complained of mild (20/48, 41.67%), moderate (21/48, 43.75%), and severe (7/48, 14.58%) abdominal pain. Only 2 patients complained of abdominal distension and fatigue without abdominal pain. Besides, abdominal distension (43, 86%), nausea (42, 84%), vomiting (34, 68%), and diarrhea (29, 58%) were common manifestations in LMV patients. Additionally, 7 LMV patients (7/50, 14%) were complicated with intestinal obstruction (Table 1).

Apart from impairment of digestive system itself, LMV was usually accompanied by concurrent damage to other organs. Among the 50 LMV patients, 16 (32.0%) demonstrated lupus urinary tract involvement, mainly presenting as bladder irritation symptoms and dysuria (Table 1). A close review of the diagnostic process found that many patients were admitted as abdominalgia yet to be investigated. Due to non-specific manifestation of LMV, many patients were admitted to un-appropriate departments and initially misdiagnosed as acute gastroenteritis (9/50), intestinal tuberculosis/peritoneal tuberculosis (5/50), urinary tract

Table 2 Abdominal CT findings of 50 lupus mesenteric vasculitis (LMV) patients

Features	Number	Percentage
Engorgement of mesenteric vessels	50	100
Bowel wall thickening	49	98
Increased attenuation of mesenteric fat	44	88
Ascites	32	64
Target sign	35	70
Comb sign	21	42
Dilatation of intestinal segments	11	22
Intestinal segment being involved		
Jejunum and ileum	19	38
Colon and rectum	8	16
Both small and large intestine	22	44
Hydroureteronephrosis	10	20
Stenosis/dilatation of the ureters	8	16
Bladder wall thickening	7	14

infection/urinary calculi (4/50), pancreatitis (4/50), and hepatitis (3/50).

Imaging Features of LMV

Abdominal CT (computed tomography) scan could provide essential evidence to make an accurate diagnosis of LMV. Table 2 demonstrated the imaging features of abdominal CT in LMV patients. Abdominal CT revealed engorgement of mesenteric vessels (50/50, 100%), bowel wall thickening (49/50, 98%), and increased attenuation of mesenteric fat (44/50, 88%). “Target sign” and “comb sign”, as the well-acknowledged and classical features of LMV, were noted in 35(70%) and 21(42%) LMV patients, respectively. Meanwhile, dilatation of bowel segments was observed in 11 patients, and 64% of LMV patients (32/50) experienced ascites. Although jejunum and ileum (41/50, 82%) were the predilection sites of LMV, impairment was not limited to small intestine.

Table 3 Comparison of demographic and clinical features between LMV and SLE patients

Features	LMV	SLE	P value
Male/female, N (%)	2/48	9/80	0.200
Age(year), median (IQR)	41 (26.0–51.5)	40.5 (26.75–50.0)	0.787
SLEDAI, median (IQR)	16 (12–18.25)	11 (8–14.5)	0.001 [†]
Weight loss, N (%)	14 (28.0)	11 (12.4)	0.021 [†]
Skin rash, N (%)	25 (50.0)	29 (32.6)	0.043 [†]
Arthritis, N (%)	23 (46.0)	50 (56.2)	0.249
Neurologic involvement, N (%)	5 (10.0)	13 (14.6)	0.438
Oral ulcers, N (%)	19 (38.0)	12 (13.5)	0.001 [†]
Alopecia, N (%)	22 (44.0)	23 (25.8)	0.028 [†]
Fever, N (%)	15 (30.0)	31 (34.8)	0.561
Fatigue, N (%)	31 (62.0)	38 (42.7)	0.029 [†]
Myositis (%)	11 (22.0)	17 (19.10)	0.421
Edema, N (%)	7 (14.0)	7 (7.9)	0.249
LN, N (%)	29 (58.0)	42 (47.2)	0.289
Lupus urinary tract involvement, N (%)	16 (32.0)	8 (9.0)	0.001 [†]

SLEDAI Systemic Lupus Erythematosus Disease Activity Index, *IQR* interquartile range, *N* number, *SLE*, systemic lupus erythematosus, *LMV*, lupus mesenteric vasculitis

[†] Represents $P \leq 0.05$

In all, 60% of LMV patients (30/50) suffered large intestinal lesion of lupus. Additionally, 16 LMV patients had lupus urinary tract involvement, including hydroureteronephrosis (10/16, 62.5%), stenosis/dilatation of the ureters (8/16, 50.0%), and bladder wall thickening (7/16, 43.75%).

Treatment and Outcomes

Fifty patients with LMV received administration of glucocorticoid, and the dosage of glucocorticoid was adjusted dynamically or combined with other drugs according to their state of illness. While two patients with LMV died during hospitalization because of life-threatening intestinal perforation and severe nervous system impairment, the other 48 (96%) LMV patients achieved clinical remission after appropriate treatment. Among them, 15

patients were treated with prednisone (0.5–1 mg/kg days) or methylprednisone alone, and 17 patients were treated with prednisone combined with antimalarial drugs with a dosage mentioned above. In addition, seven patients were administered to pulse therapy with methylprednisone (1000 mg qd) for 3–4 days because of insufficient relief of symptoms after conventional dosage of prednisone for 3–7 days. Three cases received pulse therapy of methylprednisolone with 1000 mg/days for 3 days, and one of the patients was also given a single dose of cyclophosphamide 600 mg. Another six patients were treated with oral and conventional dose of prednisone plus azathioprine or methotrexate.

Table 4 Comparison of laboratory indexes between LMV and SLE patients

Index	LMV	SLE	Normal range	<i>P</i> value
WBC ($\times 10^9$), median (IQR)	4.68 (3.33–7.52)	4.13 (2.90–6.5)	3.5–9.5	0.431
HGB(g/l), median (IQR)	112.0 (90.0–131.0)	100.50 (84.0–119.0)	115.0–150.0 (F) 130.0–170.0 (M)	0.022 [†]
PLT ($\times 10^9$), median (IQR)	167.5 (116.5–222.25)	126 (84–237.75)	101–320 (F) 85–303 (M)	0.255
N%, median (IQR)	76.10 (70.15–85.90)	70.15 (62.65–76.30)	40.0–75.0	0.002 [†]
L%, median (IQR)	15.0 (8.90–20.55)	21.35 (16.80–27.20)	20.0–50.0	< 0.001 [†]
Pyuria, <i>N</i> (%)	22 (44.0)	30 (33.71)	WBC/HPF \leq 5	0.154
Hematuria, <i>N</i> (%)	18 (36.0)	22 (24.72)	RBC/HPF \leq 5	0.113
Proteinuria, <i>N</i> (%)	17 (34.0)	19 (21.35)	Urinary protein (24 h) \leq 500 mg	0.077
ANA (+), <i>N</i> (%)	49 (98.0)	89 (100.0)	< 1:100	0.360
Anti-dsDNA Ab (+), <i>N</i> (%)	31 (62.0)	54 (60.7)	< 100 IU/ml	0.878
SSA, <i>N</i> (%)	39 (78.0)	52 (58.4)	Negative	0.020 [†]
C3, median (IQR) (g/l)	0.36 (0.23–0.45)	0.42 (0.31–0.57)	0.79–1.52	0.007 [†]
C4, median (IQR) (g/l)	0.06 (0.03–0.11)	0.10 (0.05–0.14)	0.16–0.38	0.017 [†]
IgG, median (IQR) (g/l)	16.10 (11.75–20.70)	19.90 (16.33–26.03)	7.51–15.60	< 0.001 [†]
D-D, median (IQR) (mg/l)	3.83 (1.12–8.24)	1.24 (1.00–4.67)	0–0.55	< 0.001 [†]
ESR, median (IQR)(mm/h)	55.5 (14.75–91.0)	59 (33.75–84.0)	2–43, M, A > 60; 2–21, M, A \leq 60; 2–38, F, A > 50; 2–26, F, A \leq 50	0.01 [†]
CRP, median (IQR) (mg/l)	33.62 (10.68–88.86)	20.10 (11.73–30.5)	< 10	0.237
Anticardiolipin Ab (RU/ml)	3.24 (0.81–9.84)	9.95 (8.11–14.57)	4.20	0.002 [†]
Cre, median (IQR) (μ mol/l)	73.50 (46.75–107.75)	59.0 (48.5–76.75)	41–73	0.004 [†]
ALB, median (IQR) (g/l)	30.0 (25.50–35.0)	34.50 (29.0–40.0)	40–55	0.001 [†]

Table 4 continued

Index	LMV	SLE	Normal range	P value
ALT, median (IQR) (U/l)	27.0 (17.0–46.0)	17.0 (13.0–29.0)	13–69	0.004 [†]
AST, median (IQR) (U/l)	30.0 (22.0–56.0)	24.0 (17.0–38.0)	15–46	0.019 [†]

IQR interquartile range, SD standard deviation, N number, WBC white blood cells, HGB hemoglobin, PLT platelet, N% percentage of neutrophils, L% percentage of lymphocytes, ANA (+) positive for titer of antinuclear antibody, Anti-dsDNA Ab (+), positive of anti-double-stranded DNA antibody, SSA anti-Ro antibody, C complement, D-D D-dimer, ESR erythrocyte sedimentation rate, CRP C-reactive protein, Cre creatinine, ALB Albumin, ALT alanine aminotransferase, AST aspartate transaminase

[†] Represents $P \leq 0.05$

Table 5 Associations of D-D, C3, and L% with LMV

Indexes	β	SE	χ^2	DF	Adjusted OR(95%CI)	P value
OU	1.446	0.641	5.082	1	4.25 (1.208, 14.926)	0.024
UTI	1.655	0.718	5.310	1	5.23 (1.281, 21.387)	0.021
D-D	0.115	0.043	7.147	1	1.121 (1.031, 1.220)	0.008
C3	- 3.035	1.144	7.039	1	0.048 (0.005, 0.453)	0.008
L%	- 0.075	0.026	8.298	1	0.928 (0.882, 0.976)	0.004

SE standard error, DF degrees of freedom, UTI urinary tract involvement, OU oral ulcers, D-D D-dimer, C complement, L% percentage of lymphocytes

Associated Factors of Lupus Mesenteric Vasculitis (LMV) in Systemic Lupus Erythematosus (SLE) Patients

Comparison of Demographic and Clinical Features Between LMV and Non-LMV-SLE Patients

Altogether, 50 LMV and 89 non-LMV-SLE patients were enrolled in the current study. Demographic and clinical information of LMV and non-LMV-SLE patients are summarized in Table 3. Notably, there was no statistical difference between the two groups regarding sex ratios, mean age and incidence of arthritis, neurologic involvement, fever, and edema. However, the LMV group showed a higher SLEDAI score than non-LMV-SLE, with 90% (45/

50) of the LMV patients demonstrating SLEDAI scores higher than 10. Meanwhile, there were statistical differences between LMV and non-LMV-SLE concerning incidence of weight loss, skin rash, oral ulcers, alopecia, fatigue, and lupus urinary tract involvement. LMV patients more frequently suffered from oral mucosa ulcer than non-LMV-SLE controls (19/50, 38% for LMV, and 12/89, 13.5% for SLE).

Comparison of Laboratory Characteristics Between LMV and SLE Patients

As was shown in Table 4, there was no significant difference between LMV and non-LMV-SLE in aspects of white blood cell (WBC), hemoglobin (HGB), antinuclear antibody (ANA) titer, anti-double-stranded DNA antibodies (dsDNA),

anti-La antibody (SSB), ribonucleoprotein (RNP), C-reactive protein (CRP), etc. However, the serum level of albumin (ALB) in LMV was significantly lower than that in SLE ($P = 0.001$). With regard to indexes of complete blood cell count (CBC), neutrophil percentage (N%) in LMV was significantly higher than that in non-LMV-SLE ($P = 0.002$), while lymphocyte percentage (L%) in LMV was significantly lower than that in SLE ($P < 0.001$).

Erythrocyte sedimentation rate (ESR) increased in both non-LMV-SLE and LMV groups, but it was relatively lower in LMV than in non-LMV-SLE. Similarly, serum levels of complement 3 (C3) ($P = 0.007$), C4 ($P = 0.017$), and IgG ($P < 0.001$) in LMV were considerably lower than in non-LMV-SLE. Besides, anti-Ro antibody (SSA) positivity in LMV was significantly higher than those in SLE ($P = 0.02$). Also, plasma concentration of D-dimer (D-D) ($P < 0.001$) and serum creatinine ($P = 0.004$) in LMV was notably higher than those in non-LMV-SLE. Importantly, concerning hepatic injury indexes, more LMV patients demonstrated abnormally elevated alanine aminotransferase (ALT) ($P = 0.037$) and aspartate transaminase (AST) ($P = 0.047$) than non-LMV-SLE. Nevertheless, levels of serum γ -glutamyltransferase (γ -GGT) and alkaline phosphatase (ALP) showed no difference.

Associated Factors of LMV

Multivariable logistic analysis revealed that oral ulcers (OR, 4.25; $P = 0.024$), urinary tract involvement (OR, 5.23; $P = 0.021$) and elevated D-D (OR, 1.121; $P = 0.008$) were positively associated with occurrence of LMV, while C3 (OR, 0.048; $P = 0.008$) and L% (OR, 0.928; $P = 0.004$) were negatively associated factors for LMV (Table 5).

DISCUSSION

LMV is a rare but serious gastrointestinal complication in SLE patients presenting acute abdominal pain. The prevalence of LMV ranges from 0.2 to 9.7% in SLE patients [2, 11] and its incidence was 2.9% among hospitalized SLE patients in the current study. Generally, the

manifestations of LMV were nonspecific. Most LMV patients complain of abdominal pain [20]. However, the pain degree and property vary from mild to severe, mimicking acute surgical abdomen. In the current study, many LMV patients were admitted to inappropriate departments and initially misdiagnosed as acute gastroenteritis, intestinal tuberculosis, peritoneal tuberculosis, urinary tract infection, urinary calculi, pancreatitis, and hepatitis because of its nonspecific symptoms and signs. Additionally, 26% of LMV patients had LMV as onset without any SLE-related history [21]. The heterogeneity and lack of comprehensive understanding of LMV made prompt and accurate diagnosis of LMV a big challenge. Therefore, it is demanding to explore associated factors of LMV.

This study aimed to explore the possible associated factors of LMV. We demonstrated that oral ulcers could be an associated factor of LMV. Oral ulcers are the most common non-infectious and non-traumatic oral mucosal ulcerative disorders and are relevant to systemic disorders [22]. Also, aphthous ulcer is an important evaluating indicator in SLEDAI [23], and oral ulcerations could foretell a severe systemic disease flare [24]. A nationwide population-based study in Korea has demonstrated that oral ulcers were associated with an increased risk of systemic autoimmune diseases including SLE, and this study indicated that oral ulcers could be an early manifestation of systemic autoimmune disease [25]. Meanwhile, persistent palatal ulcerations could be a potential sign of SLE in adolescents [26]. We identified that the incidence of LMV in SLE patients with oral ulcers was four times those without oral ulcers. To avoid LMV, physicians should be cautious when oral ulcers appear in patients with SLE and provide a strategy for clinical treatment and precaution.

Meanwhile, urinary tract involvement was as another independent associated factor of LMV. Urinary tract involvement was reported to occur in 0.5–1.0% of SLE patients. We found that SLE patients accompanied with lupus urinary tract involvement had a fivefold greater risk of encountering LMV. Several studies reported that lupus bowel involvement was frequently

associated with lupus urinary tract impairment [27–29]. The associations between urinary tract lesions and LMV had successfully triggered a serial of scientific assumption and exploration. Though the specific relationship and mechanism between lupus urinary tract impairment and LMV are still unrevealed, some scholars proposed that this was caused by vasculitis and anti-smooth muscle antibody, which was shared by gastrointestinal wall and bladder [30, 31]. Therefore, clinicians should suspect the possibility of LMV when clinico-laboratory results suggested lupus involvement of urinary system.

Interestingly, we demonstrated that LMV patients got significantly lower levels of L% than SLE, and reduced L% was an independent associated factor of LMV. To our knowledge, this finding has not been reported in the literature. It is well known that lymphopenia is one of the clinical parameters used to assess disease activity in the Systemic Lupus Activity Measure (SLAM) [23]. In addition, previous studies reported a higher rate of T-lymphocyte (especially the CD4 + T-lymphocyte) apoptosis in active SLE patients and that T-lymphocyte apoptosis was directly correlated with lupus activity [32, 33]. These findings suggested that there was significant correlation between a higher ratio of T-lymphocyte apoptosis and lupus activity. It is a peripheral blood marker that is easy to monitor and operate. Thus, L% could be applied as a preliminary screen test for SLE patients. Other examinations such as endoscopy and CT scan should be recommended for SLE patients with reduced L% and GI symptoms or signs.

Complement activation was the essential mechanism of immune-complex-mediated mesenteric vasculitis [2]. Multiple clinical studies reported that serum levels of C3 and C4 were rather lower in LMV patients [6, 11, 34], and the decrease of C3 was correlated with the clinical progression of LMV [34]. This study demonstrated that reduced C3 was an associated factor of LMV. So continuous hypocomplementemia of C3 could be helpful for clinical recognition of LMV in SLE patients.

It is widely acknowledged that thrombotic is one of the pivotal pathological mechanisms of

LMV [2, 35, 36]. SLE patients with normal D-D levels are at low risk for thrombosis, however, those with persistent unexplained elevated D-D levels are at high risk for thrombosis [37]. The current study proved that elevated D-D could be an associated factor of LMV. Elevated D-D levels have been reported as a strong factor of SLE-induced abdominal pain [6, 37]. Therefore, the plasm level of D-D should be closely evaluated and precisely regulated to prevent the onset of LMV.

The present study has its own limitations. This study is a single-centered retrospective investigation, suggesting potential selection bias and small sample size are objective existence. In the future, multicentered, prospective, and long-term follow-up studies will be necessary to confirm our findings.

In conclusion, LMV could occur at any stage of SLE. Most of the LMV patients could achieve clinical remission after appropriate treatment. When SLE patients present with abdominal pain or abdominal tenderness and with oral ulcers, urinary tract involvement, reduced lymphocytes, C3 or elevated D-D should be highly suspected of LMV. On the other side, SLE patients should be informed to note the five factors, changes of them may forebode the onset risk of LMV.

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Authorship Contributions. Wenxian You and Gao Qing designed this cohort study. Guanyi Liao and Sirui Ren gathered the clinical records of both LMV and SLE. Hongxu Wang and Wenxian You performed statistical analysis together. Hongxu Wang wrote the manuscript and all authors reviewed the manuscript.

Disclosures. Hongxu Wang, Gao Qing, Guanyi Liao, Sirui Ren, and Wenxian have nothing to disclose.

Compliance with Ethics Guidelines. This study was performed in accordance with the Helsinki Declaration of 1964, and its later amendments. This retrospective study was reviewed and approved by the Ethics Committee of The First Affiliated Hospital of Chongqing Medical University. For this type of study, formal consent is not required.

Data Availability. The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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