Identification of Risk and Prognostic Factors for Transverse Myelitis in Systemic Lupus Erythematosus

Minhui Wang
Peking Union Medical College Hospital
Ziqian Wang
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Li Zhang
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Jiuliang Zhao
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Di Wu
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Jing Li
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Qian Wang
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Jinmei Su
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Dong Xu
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Shangzhu Zhang
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital
Mengtao Li (mengtao.li@cstar.org.cn)
Department of Rheumatology and Clinical Immunology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College https://orcid.org/0000-0003-4252-2889
Xiaofeng Zeng
Peking Union Medical College Hospital Eastern Branch: Peking Union Medical College Hospital

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Research article

Keywords: Systemic lupus erythematosus, Transverse myelitis, Risk, Prognosi

Posted Date: August 13th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-792438/v1

Abstract

Purpose: Our aim in this study was to describe the clinical characteristics and outcomes of patients with transverse myelitis (TM) as a rare phenotype of systemic lupus erythematosus (SLE) and to identify the risk and prognostic factors for SLE-related TM.

Methods: The analysis was based on 58 patients with SLE-related TM admitted to Peking Union Medical College Hospital between January 1993 and May 2021.The control group included 101 patients, randomly selected from our SLE patient group, without TM, using propensity score matching for age at SLE diagnosis, sex, and SLE disease course. Conditional logistic regression and Cox proportional hazard regression were used to identify risk and prognostic factors for SLE-related TM.

Results: Multivariate analysis revealed that anti-SSA($p<0.001$) and anti-RNP positivity ($p=0.005$) were independent risk factors for SLE-related TM. With regard to prognosis, an American Spinal Injury Association Impairment Scale (AIS) grade of A or B at the early stage of TM ($p<0.001$) and hypoglycorrhachia ($p=0.016$) were independent risk factors for unfavourable neurological outcomes. In regard to neurological recovery at 3 months, an American Spinal Injury Association Impairment Scale (AIS) grade of A, B, or C at the early stage of TM was the only prognostic factor for SLE-related TM (hazard ratio, 0.26; 95% confidence interval, 0.08-0.91; $p=0.035$).

Conclusions: Anti-SSA and anti-RNP positivity were independent risk factors for TM in patients with SLE. Initial severe myelitis and hypolycorrhachia are predictive of a poor prognosis. Glucocorticoid pulse therapy provided within 2 weeks of TM onset may improve TM prognosis. Understanding the risk and prognostic factors of TM is important as permanent neurological disability persists in a significant proportion of patients with SLE-related TM.

Introduction

Systemic lupus erythematosus (SLE) is a prototypic systemic autoimmune disease that can affect multiple organs and systems. Transverse myelitis (TM) is a rare but serious phenotype of SLE, characterised by an acutely progressive course of paralysis, sensory deficit, and sphincter dysfunction. The estimated incidence rate of TM is 1-2% among patients with SLE[1-3], although the reported rate does vary widely between studies.

As the incidence rate of TM is low, overall, the risk factors for this phenotype of SLE largely remain to be defined. The prognostic factors of TM also remain to be identified, with current prognostic evidence based on case series and small retrospective cohort studies[4-7]. Understanding the risk and prognostic factors of TM is important when considering that, despite aggressive treatment, permanent disability of variable extent persists in a significant proportion of patients with SLE-related TM. Therefore, our aim in this study was to identify the risk and prognostic factors for SLE-related TM in a large clinical population, to inform surveillance, risk factor modification, prognostication, and treatment strategies.

Methods

Ethics Statement and Patients

Our study was approved by the Research Ethics Committee of the Peking Union Medical College Hospital (PUMCH). This was a retrospective study of patients with SLE-associated TM admitted to PUMCH between January 1993 and May 2021. Patients with a diagnosis of SLE without TM, treated at our hospital over the same time period, were randomly selected and matched to the TM group, for age at onset of SLE, sex, and clinical course of the SLE disease, using propensity score matching with an approximate 2:1 (control-to-TM group) ratio.

Inclusion/Exclusion Criteria

Included were patients with SLE who fulfilled the 1997 ACR revised criteria[8] or the ACR/Systemic International Collaborating Clinics (SLICC) 2012 criteria[9]. Respecting SLE-related TM, patients met the Transverse Myelitis Consortium Working Group definition of myelitis[10]. Excluded were patients with TM related to central nervous system infections, multiple sclerosis, and structural lesions, including tumour metastasis, herniated disk, or vertebral fracture.

Definitions of TM-related Deficits

Neurological deficits at the time of admission and at follow-up visits were assessed using the American Spinal Injury Association Impairment Scale (AIS), graded from A, no sensory or motor function below the injured spinal level, to E, normal sensory and motor function[11]. The Systemic Lupus Erythematosus Disease Activity Index 2000 (SLEDAI-2K) was used to evaluate SLE disease activity at the time of TM diagnosis[12]. Longitudinal extensive TM (LETM) was defined as a spinal cord lesion extending over ≥3 vertebral segments[13]. Neuromyelitis optica spectrum disorder (NMOSD) concomitant with SLE-related TM was diagnosed if the 2015 International Consensus Diagnostic Criteria for NMOSD were fulfilled[14]. Hypoglycorrhachia was defined as a blood glucose level <2.8 mmol/L or <50% of the glucose level in the cerebrospinal fluid. Lastly, AIS classifications of A, B, or C at initial presentation were classified as severe myelitis[6].

Data for Analysis

The following data were extracted from the medical records for analysis. Demographic data included sex, age at onset of TM, systemic manifestations, and physical signs (including neurological signs), at the time of diagnosis. Laboratory data included the erythrocyte sedimentation rate (ESR) and levels of C-reactive protein (CRP), immunoglobulin, complement, antinuclear antibody (ANA), anti–extractable nuclear antigen antibodies, anti-double stranded DNA (anti-dsDNA; Farr assay), and antiphospholipid (aPL), including lupus anticoagulant [LA], anti–β2-glycoprotein I [β2GPI], and anticardiolipin antibody [aCL]. Biochemical analyses of the cerebrospinal fluid (CSF) and magnetic resonance imaging (MRI)were performed. Clinical information on treatment and prognosis was also compiled.

Endpoint

The main endpoint was neurological impairment (AIS grade) at 3 months after the first onset of myelitis. Patients whose AIS grade improved after treatment were classified as the ‘recovered’ group. The ‘non-recovered’ group included patients with permanent neurological impairments, despite treatment. An unfavourable neurological outcome was defined as an AIS grade A, B, or C at the 3-month follow-up. The occurrence of relapse of myelitis during the follow-up period, defined as TM-compatible neurological symptoms confirmed by MR imaging after a period of neurological improvement, was also evaluated. The follow-up period was defined as the time from the first onset of myelitis to the last time-point of follow-up or a relapse.

Statistical Analysis

All statistical analyses were performed using STATA 15 (Stata Corporation, College Station, TX, United States). Continuous variables with a normal distribution were reported as a mean±standard deviation, with between-group comparison using Student's t-test. Variables with a non-normal distribution were reported as a median (range), with between-group differences evaluated using the Mann-Whitney test. The risk factors for SLE-related TM were estimated by calculating the odds ratios (ORs) and 95% confidence intervals (CIs) using conditional logistic regression analysis, matched for age, sex, and disease course between the TM and control group. Variables with a P-value <0.1 on univariate regression, as well as variables considered to be of clinical significance, were included in a multivariate conditional logistic regression analysis. Given the lack of long-term neurological evaluation in most patients, we explored only the influence of short-term (3-month) prognosis of SLE-related TM using a Cox proportional hazard regression to calculate the hazard ratio (HR). The P-value for significance was set at <0.05. The Kaplan-Meier method was used to draw the recovery curve and to calculate the cumulative remission rate.

Results

Demographic and Clinical Characteristics

Fifty-eight patients with SLE-related TM met our inclusion criteria and were included in our study group. The clinical characteristics, treatment regimens, and outcomes of these patients are described in Table 1, with key characteristics summarised as follows. The median age at TM diagnosis was 34.5 years (interquartile range (IQR), 25.75–45.25 years). TM presented as one of the initial manifestations of SLE in 8/58 (13.8%) cases. The most common neurological presentation of TM was symmetrical flaccid paraparesis, with anaesthesia/hypoesthesia and sphincter dysfunction below the level of inflammation. Patients in the early stage after onset were classified based on their neurological deficits, according to the AIS grade: grade A, 10/58 (17.2%) of patients; grade B, 8/15 (13.8%); grade C, 5/58 (8.6%); and grade D, 35/58 (60.3%). Concomitant NMOSD was present in 25/49 (51.0%) of cases.

Laboratory and Imaging Findings

Laboratory tests, including CSF examinations and imaging findings, are listed in Table 1. Data on the white blood cell count, platelet count (PLT), ESR, and levels of CRP, anti-dsDNA antibody, complements, and antiphospholipid antibodies (aPL),including LA, anti–β2GPI,aCL,were available for the vast majority of the patients. A positive aPL screen was identified in 22/53 (41.5%) patients. LA was positive in 15/54 (27.8%) of these patients, aCL in 9/51 (17.6%), and anti-β2GPI antibodies in 11/56 (19.6%). The most frequent antibody at the time of TM diagnosis was anti-SSA, identified in 37/58 (62.1%) of patients, followed by anti-dsDNA in 36/58 (62.1%) of cases. Spinal cord MR imaging was performed in 56/58 patients. LETM was observed in 71.4% of patients, with the thoracic spine being the most common site of involvement (18/56), followed by the cervical spine (15/56).

Treatment and Outcomes

Intravenous methylprednisolone pulse therapy was provided to 53/58 (91.4%) of patients, 1000 mg for 3-6 days. This treatment was provided within 2 weeks of TM diagnosis in 26/53 (48.3%) of these patients. Cyclophosphamide (CYC) was provided to 42/58 (72.4%) of patients. Other treatments provided included: immunoglobulin therapy in the acute phase in 27/58 (%) of patients and rituximab in 9/58 (15.5%) of patients. All 58 patients had an AIS grade at the 3-month follow-up, with a functional recovery attained in 77.6% of patients, with an unfavourable outcome (AIS grade A, B, or C at 3 months) in 18/58 (31.0%) of patients. A relapse of TM was identified in 16/40 (40%) of patients, with more than half of these patients having only one relapse episode over the follow-up period.

Risk factors for SLE-related TM

The analysis of risk factors included 101 patients in the control group (SLE without TM) and 56 in the SLE-related TM group. The TM group had a higher prevalence of vital organ involvement and a higher ESR compared to the control group. On multivariate analysis (Table 2), anti-SSA positivity (OR, 6.04; 95% CI, 2.74-13.29; p<0.001) and anti-RNP positivity (OR, 4.10; 95% CI, 1.52-11.04; p=0.005) were retained as independent risk factors for SLE-related TM.

Prognosis factors for SLE patients with TM

The analysis of prognostic factors included all 58 patients with SLE-related TM, with the neurological outcome (AIS grade) measured at 3 months post-diagnosis (Table 3). Age at onset of TM (p=0.05), an AIS grade A or B at the early phase of TM (p<0.001), hypoglycorrhachia(p<0.001), and methylprednisolone pulse therapy within 2 or 4 weeks of diagnosis(p=0.004 and p=0.041, respectively) were retained as predictive factors of an unfavourable prognosis (namely, an AIS grade A, B, or C at 3-months). In the regression model adjusted for age at SLE diagnosis, sex, and SLE disease course, an AIS grade A or B at the early phase of TM (OR, 209.58; 95% CI, 11.31-3881.63; p<0.001) and hypoglycorrhachia (OR, 55.98; 95% CI, 2.11-1488.85; p=0.016) were retained as independent risk factors for an unfavourable neurological outcome of SLE-related TM. When considering neurological recovery at 3 months post-diagnosis (Table 4), age at TM diagnosis (p=0.024), initial severity of TM (p<0.001), hypoglycorrhachia(p=0.001), thoracic segment involvement(p=0.018), and methylprednisolone pulse

within 2 weeks (p=0.009) were significantly associated with neurological recovery at 3 months post-diagnosis. On multivariate analysis, initial TM severity (AIS grade A, B, or C) was the only associated risk factor of a poor neurological recovery at 3 months (HR, 0.26; 95% CI, 0.08-0.91; p=0.035).

Discussion

As SLE-related TM is relatively rare, our current understanding of risk and prognostic factors of TM are based on small sample sized studies, with few studies having explored the risk factors for SLE-related TM. To our knowledge, our study is the largest study to date to have evaluated the risk and prognostic factors of SLE-TM. We found that anti-SSA and anti-RNP positivity increased the risk for SLE-related TM. Moreover, the initial severity of the myelitis (AIS grade A, B, or C in the early phase) and hypoglycorrhachia were predictive of a worse neurological prognosis.

We found that the majority of patients developed TM after the diagnosis of SLE, a finding which is consistent with those of previous studies[4, 15-18]. Of note, the diagnosis of SLE-associated TM is usually simple when the TM occurs in the background of SLE, while the development of TM as the first manifestation of SLE may pose a challenge to SLE diagnosis due to the heterogeneity of presenting clinical characteristics. In our study of 58 patients with SLE-related TM, TM was the initial complaint in 8 (13.8%) patients. In these cases, it would be essential to make a diagnosis of the underlying SLE to allow from prompt adequate treatment to be provided. Hence, immunological screening for SLE, including ANA, anti-dsDNA, anti-Sm, and aPL screening, should be considered for patients presenting with TM.

To date, our understanding of the pathogenic mechanism of SLE-related TM is limited to injuries resulting from vascular pathologies, including inflammatory or embolic/thrombotic/ischaemic conditions[19]. However, while some researchers believe that an autoimmunologic process dominates, others have postulated on the presence of thrombosis, fibrinoid arteries, perivasculitis, spinal cord softening, and peripheral white-matter degeneration at multiple spinal cord levels as causes of SLE-related TM[20, 21].In our study, the high frequency of aPL (22/53 cases, 41.5%, of SLE-related TM) was comparable to the overall prevalence of aPL previously reported in the general population of SLE[22]. The presence of anti-phospholipid antibodies should always be considered as a possible aetiology for SLE-related TM through their thromboembolic effects on the microcirculation of the spine[22]. However, the diagnostic value of aPL remains controversial[5, 7, 23].In our review of the literature, we found that although the presence or absence of aPL has been examined in the diagnosis of SLE-related TM, the individual subtypes of aPL (LA, ACL, and anti-β2GPI) have not been considered. In our study, aPL and its subtypes were not predictive of short-term TM prognosis. Therefore, the role of aPL and its subtypes as a risk factor for SLE-related TM may not be powerful.

We identified anti-SSA positivity as an independent risk factor for SLE-related TM. To our knowledge, this is the first report of anti-SSA as a potential risk predictor for SLE-associated TM. Interestingly, the target protein of anti-SSA antibodies also plays an important role in the regulation of inflammation in lupus[24]. As well, the presence of anti-SSA antibodies in SLE-associated TM has been shown to predict a relapse in

the disease course24. The specific role of anti-SSA in the pathogenesis of SLE-related TM requires further clinical studies and research.

As to the prognosis of SLE-related TM, we identified that the presence of hypoglycorrhachia and the initial severity of myelitis were associated with an unfavourable neurological outcome over the short-term (3 months) follow-up. These factors have already been referred to in a previous study[4], which may demonstrate the important role of glucose metabolism in central nervous function. These results provide clues regarding the mechanisms underlying the function of TM-related nerve injury which could inform treatment. However, it is important to note that we did not identify a strong correlation between anti-dsDNA or hypocomplementemia and the prognosis of TM, which is consistent with previously reported findings[4, 6, 23]. Differences in the sample populations across studies may contribute to noted differences.

MR imaging is considered as the diagnostic method of choice to confirm SLE-related TM[25, 26]. The most commonly affected region was the thoracic spine in our study, which is consistent with previous findings[16, 27]. However, we identified that involvement of the thoracic spine was associated with better recovery of neurological function recovery, compared to involvement of other spinal segments, a finding not previously reported. We also noticed that abnormality on MR imaging was not always consistent with clinical manifestations. Currently, the evidence of MR image findings in patients with SLE-related TM is limited, with heterogeneous findings having been reported, including ‘normal’ MR images in cases of severe SLE-related TM[28, 29].In our analysis, longitudinal spinal involvement (LETM) was not associated with a worse prognosis, which is consistent with the results of a previous retrospective study[18].

There was no obvious difference in anti-dsDNA antibody, complement level, and SLEDAI between patients with SLE-related TM and patients with SLE without TM in our study. It has been reported that 40-50% of NPSLE occurs in the presence of generalised SLE disease activity[30]. However, SLE-related TM can occur in the absence of other disease activity[18]. Taking into account the above, even in the absence of other lupus activity, SLE-related TM might occur as part of the effect of lupus on the central nervous system; however, this hypothesis will require further confirmation.

No consensus on the best treatment recently for SLE-related TM. However, the use of glucocorticoids in combination with immunosuppressants provides a cornerstone to treat the inflammatory manifestations of SLE. Nevertheless, early aggressive treatment may be crucial in achieving favourable response[31, 32]. We found that the key window period to maximise the likelihood of a better outcome of SLE-related TM was within 2 weeks after onset of TM symptoms, using glucocorticoid pulse therapy. Early induction therapy, using high doses of glucocorticoid combined with cyclophosphamide, has previously been used as a first line treatment for SLE-related TM[33]. Saison et al.[6] reported that the non-use of cyclophosphamide was associated with unfavourable neurological outcomes of SLE-related TM. However, we did not identify a specific value of cyclophosphamide use on neurological outcomes in our study. Again, differences in sample populations and size between studies may be an explanatory factor. Concerning anticoagulation therapy, a previous study did not show a positive effect of this therapy on

neurological outcomes of SLE-related TM, even among aPL-positive patients[34]. Furthermore, since the characteristics of TM (ischaemic or vasculitic) are not easy to define, anti-aggregation or anticoagulation treatment would be worthwhile to further study.

Limitations

The limitations of our study should be acknowledged in the interpretation of results. Foremost is the retrospective nature of the study which may include biases affecting the outcomes and conclusions of our study. Second, the study sample was selected from a single centre with limited variability in patient ethnicity and the possibility of referral bias. Third, the lack of widespread use of scales, such as AIS, especially by non-neurologists, would lead to the absence of long-term neurological prognosis assessment.

Despite these shortcomings, our study has several strengths. Foremost, it is the largest SLE-related TM cohort to have been evaluated to date. As well, this is the first study to explore the risk factors of lupus-related myelitis. Our findings may help to uncover pathologic mechanisms underlying the development and prognosis of SLE-related TM, adding some evidence to the prediction of SLE-related TM to inform future research and clinical practice.

Conclusions

Anti-SSA and anti-RNP positivity are independent risk factors for TM, which is a relative rare phenotype of SLE. These factors may help diagnosis of SLE for patients in whom TM is the presenting feature. The initial severity of myelitis and hypolycorrhachia are factors predictive of a poor neurological outcome of TM. Glucocorticoid pulse therapy provided within 2 weeks of TM onset can improve patient prognosis.

Abbreviations

SLE: systemic lupus erythematosus; TM: transverse myelitis; AIS: American Spinal Injury Association Impairment Scale; SLEDAI-2K: Systemic Lupus Erythematosus Disease Activity Index 2000; LETM: longitudinal extensive transverse myelitis; NMOSD: neuromyelitis optica spectrum disorder; ESR: erythrocyte sedimentation rate; CRP: C-reactive protein; ANA: antinuclear antibody; aPL: Antiphospholipid antibodies; aCL: anticardiolipin antibody; anti-β2GPI: Anti-β2-glycoprotein antibody; LA: lupus anticoagulant; CSF: cerebrospinal fluid;

Declarations

Acknowledgements

The authors thank the Department of Rheumatology at the Peking Union Medical College Hospital for providing the database.

Honorarium

Not applicable.

Authors' contributions

MHW contributed to the statistical analysis and wrote the article. ZQW contributed to the collection, supplement, and management of clinical data. LZ, JLZ, DW, JL, QW, JMS, DX, and XFZ equally contributed to the recruitment of patients. SZZ and MTL provided guidance, checked the data, and revised the content. All authors read and approved the final edition.

Fundings:

This study was supported by the Chinese National Key Technology R&D Program, Ministry of Science and Technology (2017YFC0907601, 2017YFC0907602, 2017YFC0907603), Beijing Municipal Science & Technology Commission (No. Z201100005520022, 23, 25-27), and CAMS Innovation Fund for Medical Sciences (CIFMS) (2019-I2M-2-008).

Availability of data and materials

Data are available from the corresponding authors upon request.

Declarations

Ethics approval and consent to participate

The study was approved by the medical ethics committee of Peking Union Medical College Hospital and was conducted in accordance with the Declaration of Helsinki principles.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Department of Rheumatology and Clinical Immunology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College; National Clinical Research Center for Dermatologic and Immunologic Diseases (NCRC-DID), Ministry of Science & Technology; State Key Laboratory of Complex Severe and Rare Diseases, Peking Union Medical College Hospital (PUMCH); Key Laboratory of Rheumatology, and Clinical Immunology, Ministry of Education, Beijing 100730, China

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Tables

Table 1 Demographic and Clinical Features

Features	N=58
Female	56 (96.6)
Age at SLE onset	30.66±13.05
Age at myelitis onset	34.50 (25.75-45.25)
SLE duration (years)	2.00 (0.00-7.25)
TM after SLE diagnosis	50 (86.2)
Clinical manifestations	
TM as the first symptom	8 (13.8)
Paraparesis	23 (39.7)
Sensory deficit	18 (31.0)
Sphincter dysfunction	41 (70.7)
AIS A/B at nadir	18 (31.0)
With NMOSD	25/49 (51.0)
Renal involvement	24 (41.4)
Hematological involvement	25 (43.1)
Leucopaenia	9/57 (15.5)
Thrombocytopaenia	
Laboratory findings	
Hyperproteinorachia	40 (72.4)
Hypoglycorrhachia	16 (27.6)
Hypocomplementaemia	34 (58.6)
Anti-dsDNA positive	36 (62.1)
Anti-sm positive	8 (13.8)
Anti-RNP positive	20 (34.5)
Anti-SSA positive	37 (63.8)
Anti-SSB positive	15 (25.9)
aPL positive	22/53 (41.5)

aCL positive	11/56 (19.6)
Anti-β2GPI positive	9/51 (17.6)
LA positive	15/54 (27.8)
SLEDAI-2K	9.50 (4.00-16.00)
LETM	40/56 (71.4)
Affected segments	
Thoracic	18/56 (32.1)
Cervical	15/56 (26.8)
Treatment	
MP impulse	53 (91.4)
CTX	42 (72.4)

SLE: systemic lupus erythematosus; TM: transverse myelitis; AIS: American Spinal Injury Association Scale; NMOSD: neuromyelitis optica spectrum disorder; aPL: antiphospholipid; aCL: anticardiolipin antibodies; Anti-β2GP1: Anti-beta 2 glycoprotein 1; LA: lupus anticoagulation; LETM: longitudinal extensive transverse myelitis; MP: methylprednisolone; CTX: cyclophosphamide.

Table 2 Risk factors associated with SLE-related TM

	Univariate logistic regression		Multivariate logistic regression	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Characteristics				
Clinical manifestations				
Lupus nephritis	0.607 (0.313-1.174)	0.138		
Laboratory findings				
Leucopaenia	2.002 (1.014-3.955)	**0.046**		
Thrombocytopaenia	2.045 (0.812-5.151)	0.129		
Elevated ESR	2.840 (1.230-6.556)	**0.014**		
Elevated CRP	1.166 (0.566-2.402)	0.667		
Hypocomplementaemia	0.992 (0.469-1.816)	0.815		
Autoantibody profiles				
anti-dsDNA	1.100 (0.565-2.142)	0.779		
anti-sm	0.769 (0.311-1.901)	0.569		
anti-SSA	6.857 (3.312-14.198)	**<0.001**	6.036 (2.741-13.292)	**<0.001**
anti-SSB	3.329 (1.380-8.035)	**0.007**		
anti-RNP	4.673 (1.986-10.997)	**<0.001**	4.012(1.524-11.041)	**0.005**
anti-rRNP	2.000 (0.806-4.964)	0.135		
aPL	1.919 (0.943-3.095)	0.072		
aCL	3.435(1.246-9.470)	**0.017**	3.031(0.914-10.058)	0.070
anti-β2 GP1	2.112 (10.928-4.807)	0.075		
LA	1.669 (0.651-4.278)	0.286		
SLEDAI	1.028 (0.978-1.079)	0.279		

ESR: erythrocyte sedimentation rate; CRP:C-reactive protein; aPL: antiphospholipid; aCL: anticardiolipin antibodies; Anti-β2GP1: Anti-beta 2 glycoprotein 1; LA: lupus anticoagulation.

Table 3 Prognostic factors for unfavorable neurological outcome of Myelitis

	Univariate logistic regression		Multivariate logistic regression	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Characteristics				
Age at myelitis onset	0.95 (0.90-1.00)	0.05		
SLEDAI-2K	1.02 (0/94-1.1)	0.668		
SLEDAI-2K≥10	1.92 (0.62-5.97)	0.259		
Neurological impairment				
AIS A/B at nadir	152 (19.67-1175.01)	**<0.001**	209.58 (11.31-3881.63)	**<0.001**
Laboratory findings				
Hyperproteinorachia	3.00 (0.74-12.11)	0.123		
Hypoglycorrhachia	18 (4.33-74.76)	**<0.001**	55.98 (2.11-1488.85)	**0.016**
Hypocomplementaemia	1.64 (0.51-5.23)	0.83		
Increased CRP	2.11 (0.66-6.73)	0.207		
Increased ESR	4.25 (0.49-36.87)	0.189		
Anti-dsDNA positive	0.67 (0.22-2.10)	0.494		
aPL positive	0.35 (0.09-1.40)	0.137		
aCL positive	0.31 (0.04-2.54)	0.277		
Anti-β2GP1 positive	0.20 (0.02-1.90)	0.163		
LA positive	0.33 (0.06-1.74)	0.193		
Spinal cord MRI				
LETM	2.60 (0.64-10.64)	0.184		
Affected segments				
Thoracic	0.80 (0.28-2.26)	0.671		
Treatment				

MP pulse within 2 weeks	0.17 (0.05-0.56)	**0.004**	0.53 (0.002-1.134	0.06
MP pulse within 4 weeks	9.15 (1.10-76.18)	**0.041**		
CTX	1.5 (0.41-5.51)	0.541		

AIS: American Spinal Injury Association Scale; aPL: antiphospholipid; aCL: anticardiolipin antibodies; Anti-β2GP1: Anti-beta 2 glycoprotein 1; LA: lupus anticoagulation; LETM: longitudinal extensive transverse myelitis; MP: methylprednisolone; CTX: cyclophosphamide.

Table 4 Prognostic factors for recovery outcome of myelitis within 3 months of follow-up

	Univariate analysis		Multivariate analysis	
	HR (95% CI)	p-value	HR (95% CI)	p-value
Characteristics				
Age at myelitis	1.03 (1.00-1.06)	**0.024**		
SLEDAI-2K	0.99 (0.95-1.03)	0.57		
Neurological impairment				
AIS A at nadir	0.05 (0.01-0.36)	**0.003**		
AIS A/B at nadir	0.12 (0.05-0.29)	**<0.001**		
AIS A/B/C at nadir	0.11 (0.05-0.26)	**<0.001**	0.26 (0.08-0.91)	**0.035**
Laboratory findings				
Hyperproteinorachia	0.60 (0.32-1.12)	0.107		
Hypoglycorrhachia	0.26 (0.12-0.59)	**0.001**		
Hypocomplementaemia	0.733 (0.40-1.33)	0.306		
Increased CRP	0.84 (0.43-1.60)	0.585		
Increased ESR	0.56 (0.26-1.22)	0.143		
Anti-dsDNA positive	0.87 (0.48-1.57)	0.637		
aPL positive	0.85 (0.53-1.35)	0.486		
aCL positive	0.82 (0.47-1.46)	0.508		
Anti-β2GP1 positive	0.82 (0.54-1.26)	0.376		
LA positive	0.85 (0.52-1.40)	0.535		
Spinal cord MRI				
LETM	0.88 (0.46-1.67)	0.693		
Affected segments				
Thoracic	1.95 (1.12-3.39)	**0.018**		
Treatment				

MP pulse within 2 weeks	2.44 (1.25-4.76)	**0.009**
MP pulse within 4 weeks	0.54 (0.28-1.03)	0.061
CTX	0.80 (0.42-1.52)	0.49

AIS: American Spinal Injury Association Scale; aPL: antiphospholipid; aCL: anticardiolipin antibodies; Anti-β2GP1: Anti-beta 2 glycoprotein 1; LA: lupus anticoagulation; LETM: longitudinal extensive transverse myelitis; MP: methylprednisolone; CTX: cyclophosphamide.

Figures

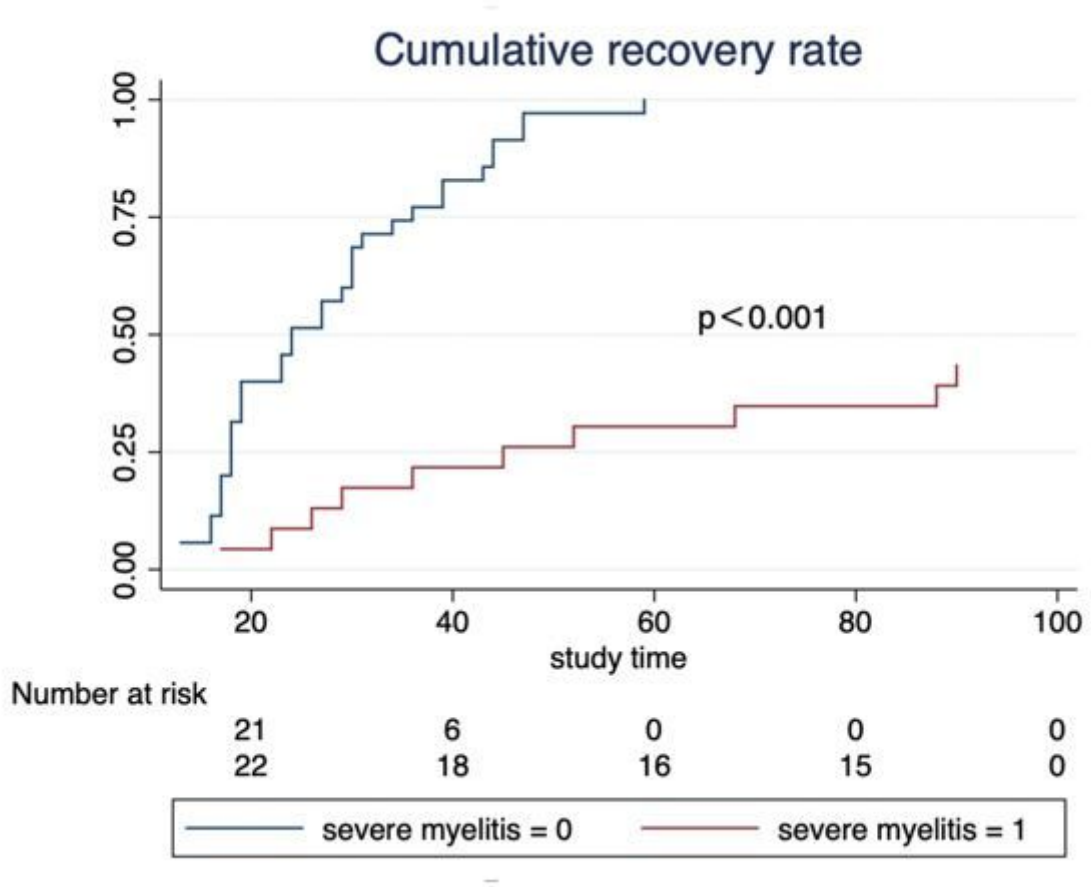

Figure 1

Kaplan–Meier survival curves of systemic lupus erythematosus patients with transverse myelitis for severe myelitis-cause cumulative recovery rate.

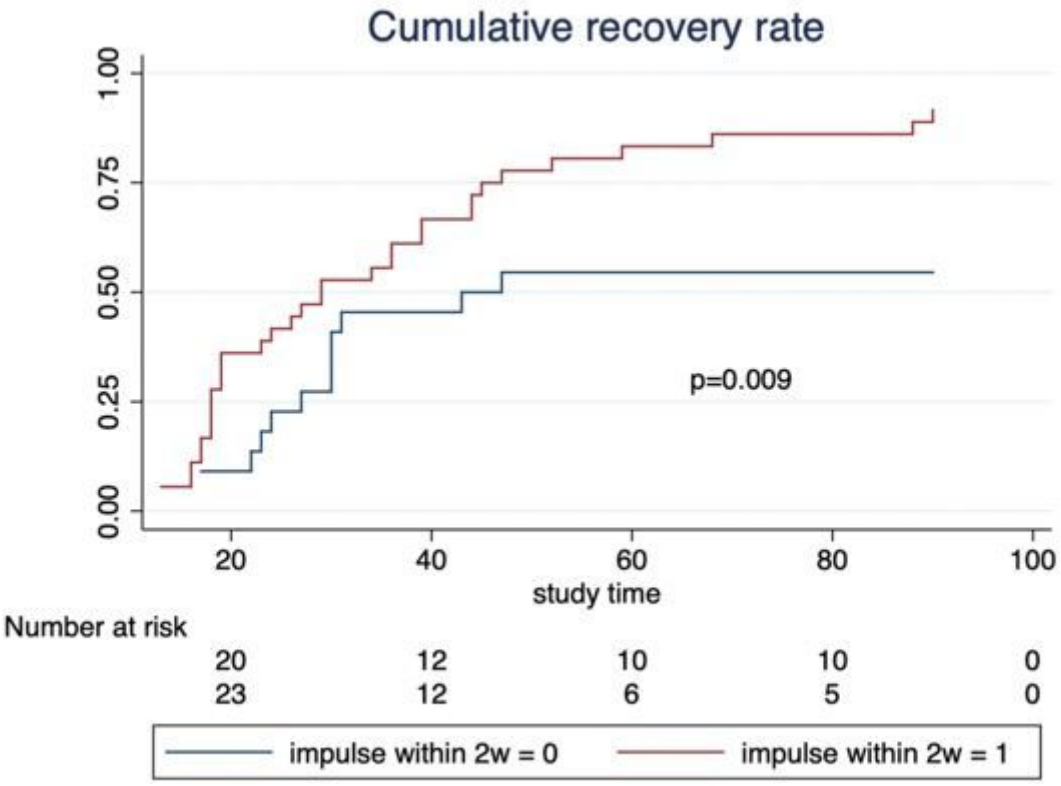

Figure 2

Kaplan–Meier survival curves of systemic lupus erythematosus patients with transverse myelitis for methylprednisolone impulse within 2 weeks-cause cumulative recovery rate.