Advances in Rheumatology

RESEARCH

Open Access

Fever in the initial stage of IIM patients: an early clinical warning sign for AE-ILD

Ting Liu[1], Haifeng Chen[1], Yitian Shi[1], Wei Xu[1] and Fenghong Yuan[1*]

Abstract

Background Fever is a common symptom of Idiopathic inflammatory myopathies (IIM). However, the exact correlation between fever and the prognosis of IIM is still unclear. This study aims to clarify if the IIM patients initiated with fever are associated with poorer outcomes.

Methods This was a single-center retrospective cohort study. Data were collected from 79 newly diagnosed, treatment-naive IIM patients in the Affiliated Wuxi People's Hospital of Nanjing Medical University (Wuxi, Jiangsu, China) from November 2016 to June 2020. According to the presence or absence of fever at the onset, the IIM patients were divided into two groups(fever group n = 28, without fever group n = 51) Clinical characteristics, laboratory data, treatment, and outcomes were recorded. The Kaplan-Meier and log-rank tests were used to compare the all-cause mortality, relapse rate, and acute exacerbation of interstitial lung disease (AE-ILD) incidence. The association of fever with the outcomes was assessed in the unadjusted and adjusted forward logistic regression model.

Results Compared with the non-fever group, the age at onset of the fever group was higher, and mechanic's hands (MH) and interstitial lung disease (ILD) were more common. Systemic inflammation (CRP and ESR) was significantly higher in the fever group, while the level of albumin(ALB) and muscle enzymes were lower. The fever group seemed to be received more aggressive treatment, with higher dose glucocorticoids and higher rates of intravenous immunoglobulins(IVIG) use. The all-cause mortality rate and the incidence rate of AE-ILD were higher in the fever group. Even adjusted for the age at onset and treatments, fever was significantly associated with AE-ILD and all-cause mortality.

Conclusion Our study has demonstrated that fever at initial diagnosis is associated with AE-ILD and mortality. Fever should serve as an early clinical warning sign for poor outcomes in IIM patients.

Keywords Idiopathic inflammatory myopathies, Fever, Clinical characteristics, Prognosis

*Correspondence:
Fenghong Yuan
yfh222222@163.com
[1]Department of Rheumatology, The Affiliated Wuxi People's Hospital of Nanjing Medical University, Wuxi People's Hospital, Wuxi Medical Center, Nanjing Medical University, Wuxi 214023, Jiangsu, China

Background

Idiopathic inflammatory myopathies (IIM) are rare, heterogeneous, autoimmune diseases, characterized by muscle weakness, as well as the involvement of the lung, heart, skin, and joints. Several studies presented have shown different mortality rates in various countries and nationalities [1–3], with the 10-year survival percentages varying from 18% to 90%, and the overall mortality ratio in IIM patients remains three-fold higher than that of the general population in presence of immunosuppressants (IS) and other therapies [4]. In China, the in-hospital mortality rate of IIM patients has been up to 4.58% [5].

Fever is a common symptom of many rheumatic diseases, including IIM. A recent study has shown fever occurs in 41% of patients with IIM patients with interstitial lung disease (ILD) [6]. It has been proposed that proinflammatory cytokines promote prostaglandin E2 synthesis and binding in the preoptic hypothalamus to produce fever [7]. However, the exact correlation between fever and the prognosis of IIM is still unclear. Our study mainly focused on the clinical characteristics of IIM patients with fever in the initial stage and examined whether fever is predictive of a poor prognosis, especially acute exacerbation of interstitial lung disease (AE-ILD), in patients with IIM.

Methods

Study design and patients

This single-center retrospective cohort study was conducted at the Affiliated Wuxi People's Hospital of Nanjing Medical University (Wuxi, Jiangsu, China). Adult patients with a newly diagnosed IIM hospitalized from November 2016 to June 2020 were reviewed and collected.

The inclusion criteria of this study were: (1) age over 18 years old; (2) the diagnosis of IIM fulfilled the ACR/EULAR 2017 criteria-confirmed diagnosis [8], or 2010 Connor's criteria [9]; (3) newly diagnosed and treatment-naive; (4) completed the myositis antibody profiles. The exclusion criteria were: (1) malignancy-associated IIM; (2) overlap syndrome with other connective tissue diseases; (3) complications with pre-existing lung disease, such as silicosis, pulmonary bulla, chronic obstructive pulmonary disease (COPD), or chronic bronchitis; (4) active infection; (5) loss to follow-up after discharge.

The study was approved by the ethical committee in our institution (KY21045) by the principles of the Declaration of Helsinki.

Data collection

Medical records of all patients enrolled were collected by reviewing the electronic medical record system. The demographic data including age at onset, duration of diagnosis delay, sex, complications, clinical manifestations, time of follow-up, laboratory findings, medications, as well as the outcome were acquired and analyzed. The identification of the anti-synthetase autoantibodies (ASS, anti-Jo-1, anti-PL-7, anti-PL-12, anti-OJ, anti-EJ) and anti-melanoma differentiation-associated gene 5 (anti-MDA5) were measured using an immunoblotting method (EUROLINE, EUROIMMUN AG, Germany).

The definitions of special characteristics are as follows: ***Fever*** was defined as an oral temperature > 37.5℃ lasting for at least 3 days at disease onset, excluding infection based on clinical manifestations and etiological examination; ***The characteristic rashes*** include heliotrope erythema, V sign, shawl sign, and Gottron's sign; ***Muscle involvement*** was defined as abnormal findings of electromyography or muscle magnetic resonance, or elevation of creatine kinase (CK) > 2-fold; ***ILD*** was evaluated by radiologists using high-resolution computed tomography (HRCT); ***Complications*** included diabetes mellitus, hypertension, myocardial infarction, cerebrovascular disease, acute kidney disease and chronic renal insufficiency.

Follow-up and endpoints

The follow-up time was defined as the time between the first visit for our cohort to the death or the end of November 2020.

The primary endpoint of this study was AE-ILD, and secondary endpoints included death and relapse. In absence of diagnostic criteria dedicated to AE-ILD in patients with CTD, updated criteria of acute exacerbation of idiopathic pulmonary fibrosis (AE-IPF) [10] was adopted based on the experience of published studies on AE-ILD in IIM patients. We defined ***AE-ILD*** as after diagnosis with IIM, acute worsening or development of dyspnea typically < 3 months duration, computed tomography with new bilateral ground-glass opacity and/or consolidation, and deterioration not fully explained by cardiac failure or fluid overload. ***Relapse of IIM*** was defined as follows: acute exacerbation of myositis, skin involvement, and ILD after improvement or stable maintenance for at least 3 months in treated or untreated IIM patients, which lead to at least one of the following treatment changes: ≥50% increase in the corticosteroid dosage, the addition of an IS or switch to a different IS and addition of intravenous immunoglobulins (IVIG) [11].

Statistical analysis

Data were analyzed using SPSS23.0 software. Continuous variables were analyzed using the unpaired, 2-tailed t-test for normally distributed variables or the Kruskal-Wallis test for continuous variables with the nonnormal distribution. The Pearson χ^2 test was used for categorical variables tests. Survival outcomes, relapse, and AE-ILD incidence were analyzed using the Kaplan-Meier method. A Log-rank test was performed to examine the differences between groups. The

association of fever with the outcomes was assessed in the unadjusted and adjusted forward logistic regression model. ORs and 95% confidence intervals were calculated. The difference was statistically significant when $P<0.05$.

Results

Clinical characteristics of the fever and non-fever group

A total of 79 IIM patients were included in the study, 28(35.4%) patients in the fever group and 51(64.6%) patients in the non-fever group. According to the different subgroups, the proportion of fever was 34.8%(3/23) in dermatomyositis (DM), 25.0%(5/20) in polymyositis (PM), 41.7%(15/36) in clinically amyopathic dermatomyositis (CADM), 37.8%(13/37) in ASS and 48.0%(12/25) in anti-MDA5(+) IIM. The baseline demographic data and IIM type were not significantly different between the two groups, except for an older age at the onset of the disease in the fever group (58.29 ± 11.27 vs. 49.71 ± 12.81; $p=0.004$). Clinical presentations showed that mechanic's hands (MH) (64.3 vs. 39.2%; $\chi p=0.033$) and ILD (89.3 vs. 64.7%; $\chi p=0.018$) were more common in fever cases than non-fever cases. Systemic inflammation especially as measured by CRP (6.85 vs. 1.50; $p=0.001$) and ESR (50 vs. 18; $p=0.000$) was significantly higher in the fever group. This was accompanied by a decrease in the albumin (ALB) level (31.7 vs. 34.1; $p=0.001$). The level of creatine kinase(CK) (90 vs. 330; $p=0.012$) in the fever group was lower than in the non-fever group. No significant difference was found in the distributions of ASS, anti-MDA5, anti-RO52 antibody, or antinuclear antibodies (ANA) between the two groups. All patients received glucocorticoid therapy, but the dose of glucocorticoids in the fever group was significantly higher than that in the non-fever group. Compared with the non-fever group, more patients were treated with calcineurin inhibitors (CNIs) (53.6 vs. 37.3%; $p=0.044$) and IVIG (35.7 vs. 13.7%; $p=0.023$) in the fever group. The general characteristics of the enrolled 79 IIM cases are summarized in Table 1.

Prognosis of IIM patients with or without fever

The all-cause mortality rate in this study was 16.5% (13/79), while 84.6% (11/13) of the patients died within 3 months after diagnosis. The incidence rate of AE-ILD and relapse were 27.9% (22/79). the fever group had a higher incidence of all-cause mortality (32.14 vs. 7.84%;χ $p=0.014$) and AE-ILD (53.57 vs. 13.72%; $\chi p=0.000$) than the non-fever group. However, the difference in relapse was not statistically significant (Table 2). Kaplan-Meier survival analysis also revealed that the fever group had a higher rate of AE-ILD (Log-rank $p=0.000$) and all-cause mortality (Log-rank $p=0.000$) (Fig. 1). Without or with adjustment for age and treatments both showed that fever was significantly associated with AE-ILD and all-cause mortality(Table 3).

Discussion

To the best of our knowledge, although this is a single-center retrospective cohort study with a small sample size, this is the first study to systematically explore the clinical characteristics and prognosis of IIM patients with fever in the initial stage. Previous studies on fever and disease prognosis mainly focused on traumatic brain injury [12] and malignant tumors [13]. However, fever was also a general problem for hospitalized patients with IIM. The differential workup of fever remains a special challenge for clinicians, particularly in the context of the initial diagnosis of IIM and also in the course of the disease in IIM patients. In the present study, the fever group showed no response to antimicrobial treatment or no evidence of pathogenic origin, including clinical signs and etiologic tests. Body temperature was restored to a normal level after they were treated with glucocorticoid and/or IS. Due to this fact, the initial fever of IIM patients was mainly attributed to the disease activity. Our study revealed that patients with fever at initial diagnosis have unique clinical features and fever was a risk predictor for poor outcomes of IIM.

Fever was common (35.4%) in our cohort, similar to the incidence that 34.9% (67/192) of feverish patients with IIM in Zhejiang, China. Although the IIM type and MSA (ASS and anti-MDA5) were not significantly different between the two groups, our cohort is consistent with previous findings [14] showing that fever seemed more common in CADM, ASS, and anti-MDA5(+) IIM. One study [15] reported that ~60% of ASS experienced one or more febrile episodes during an average follow-up of 5 years, which is higher than in our cohort, but in the present study, we focused on the initial stages of febrile episodes.

As a frequent extra-muscular manifestation, ILD leads to increased mortality in patients with IIM [2, 3]. The frequency of ILD in patients with IIM has been widely reported (8.6–85.6%), and a meta-analysis of 23 studies revealed that 834/2079 patients with IIM (40.1%) had ILD [16]. In the present cohort, We identified a slightly higher rate of ILD, especially in the fever group, than that has been reported in previous studies. The underlying mechanism between fever and ILD in IIM is not clear, maybe suggest both represent components of profound systemic inflammation. Previous studies also reported that the prevalence of MH ranged from 5 to 56% in given IIM populations [17]. Importantly, MH has been already a risk factor for ILD [18].

Table 1 The general characteristics of the enrolled 79 IIM cases

	non-Fever n = 51	Fever n = 28	*p*-value
Patients' characteristics			
Age at onset (years)	49.71 ± 12.81	58.29 ± 11.27	0.004*
Delay of diagnosis (months)	3(0, 108)	2(0, 180)	0.075
Male (n, %)	8(15.7)	6(21.4)	0.740
Complications (n, %)	16(31.4)	10(35.7)	0.694
IIM type (n, %)			
DM	15(29.4)	8(28.6)	0.937
PM	15(29.4)	5(17.9)	0.259
CADM	21(41.2)	15(53.6)	0.290
Clinical manifestations(n, %)			
Characteristics rashes	34(66.7)	22(78.6)	0.265
Mechanic's hands	20(39.2)	18(64.3)	0.033*
Raynaud's phenomenon	5(9.8)	4(14.3)	0.818
Muscle involvement	28(54.9)	11(39.3)	0.184
Dysphagia	9(17.7)	2(7.1)	0.342
Joint involvement	14(27.5)	6(21.4)	0.556
ILD	33(64.7)	25(89.3)	0.018*
Laboratory tests			
NLR	3.53(0.81, 20.64)	4.27(1.93, 21.57)	0.094
CRP (mg/ml)	1.50(0.50, 28.90)	6.85(0.5, 46.2)	0.001*
ESR (mm/H)	18(3, 80)[a]	50(5, 110)	0.000*
CK (U/L)	330(26, 14,352)	90(14, 7767)	0.012*
ALB (g/L)	34.10(26.80, 44.60)[a]	31.70(19.30, 38.70)	0.003*
PaO2/FiO2	453.71 ± 72.55[b]	420.37 ± 123.47[c]	0.168
Fer (ng/ml)	197.25(4.60, 1485.90)[d]	560.95(75.00, 1500.00)[e]	0.121
Myositis-specific autoantibodies(n, %)			
ASS	23(45.1)	14(50.0)	0.676
Anti-MDA5	13(25.5)	12(42.9)	0.112
RO-52(n, %)	32(62.8)	19(67.9)	0.650
ANA (n, %)	24(47.1)	13(46.4)	0.957
Treatments			
Glucocorticoid (mg/d)	70(30, 300)	100(50, 300)	0.033*
Immunosuppressants (n, %)			0.044*
MMF	24(47.1)	13(46.4)	
CNIs	19(37.3)	15(53.6)	
Others	6(11.8)	0(0.0)	
None	2(3.9)	0(0.0)	
IVIG (n, %)	7(13.7)	10(35.7)	0.023*

[a] number of subjects, n = 50

[b] Number of subjects, n = 43

[c] Number of subjects, n = 24

[d] Number of subjects, n = 16

[e] Number of subjects, n = 10

IIM: idiopathic inflammatory myopathies; DM: dermatomyositis; PM: polymyositis; CADM: clinically amyopathic dermatomyositis; ILD: interstitial lung disease; NLR: neutral lymphoid ratio; CK: creatine kinase; ALB: albumin; Fer: ferritin; ASS: anti-synthase antibodies;MDA5: melanoma differentiation-associated protein 5; ANA: antinuclear antibodies; MMF: mycophenolate mofetil; CNIs: calcineurin inhibitors; IVIG: intravenous immunoglobulins.

Consistent with ILD, MH occurred more frequently in the fever group [19]. In addition to the above, the level of muscle enzyme in the fever group was much lower than in the control group. A growing body of evidence suggests that the clinical manifestations of IIM are a spectrum in which at one end, patients have prominent muscle symptoms, higher CK levels, and less extra muscular involvement, whereas, at the other end, patients have fewer muscular symptoms, modest increases in CK levels, and more skin and pulmonary involvement [20]. Our study shows patients with fever

Table 2 The outcomes of the enrolled 79 IIM cases

	non-Fever n = 51	Fever n = 28	*p*-value
Follow-up (months)	19(2, 46)	12(1, 50)	0.350
AE-ILD	7(13.7)	15(53.6)	0.000*
All-cause mortality	4(7.8)	9(32.1)	0.014*
Relapse	13(25.5)	9(32.1)	0.664

AE-ILD: acute exacerbation of ILD.

are more likely at this "less muscular" end, exhibiting lower CK levels and an increased risk of ILD.

We also found the fever group has higher levels of CRP and ESR, but lower albumin, suggesting a hyperinflammatory state in these patients. Among these serological parameters, the ratio of ESR to CRP was used for distinguishing flare and infection in SLE feverish patients [21]. Recently, it has been proposed that hypoalbuminemia and elevated CRP values independently predicted 30-day mortality [22].

Our study assayed the prognosis of fever in the initial stage from multiple perspectives, including the incidence of AE-ILD, relapse, and all-cause mortality. In our cohort, 53.6% of the fever group exhibited AE-ILD, remarkably much more than 13.7% of the non-fever group. The increased all-cause mortality rate was also observed in the fever group. Since age at onset and treatments were different between these two groups as previously described, forward logistic regression multivariable analysis was used to provide further evidence that fever in the initial stage was the strongest independent factor in poor prognosis, both AE-ILD and all-cause mortality. The result was consistent with a previous report by Chanyuan Wu et al. showing that fever was more common in the in-hospital death group [23].

There were several limitations of this study. The major limitations of this study were the retrospective single-center design and the limited number of patients. Larger, independent, multicenter studies ideally covering different ethnic populations are mandatory to thoroughly evaluate the prognostic value of fever in the initial stage. Second, fever is a common symptom of many rheumatic diseases. Clinically, it is difficult to identify the cause, although feverish patients with infection are excluded based on clinical manifestations and etiological examination. Third, Although these patients were treated with glucocorticoid combined with IS, the specific treatment regimens (e.g. the glucocorticoid protocols and IS treatments) were not consistent.

Conclusions

In summary, our study has demonstrated that fever in the initial stage is an early clinical warning sign predicting a poor outcome in IIM patients. Fever should be applied in the clinically reliable predictive model, which may be helpful for physicians to fully recognize IIM disease and initiate individualized treatment

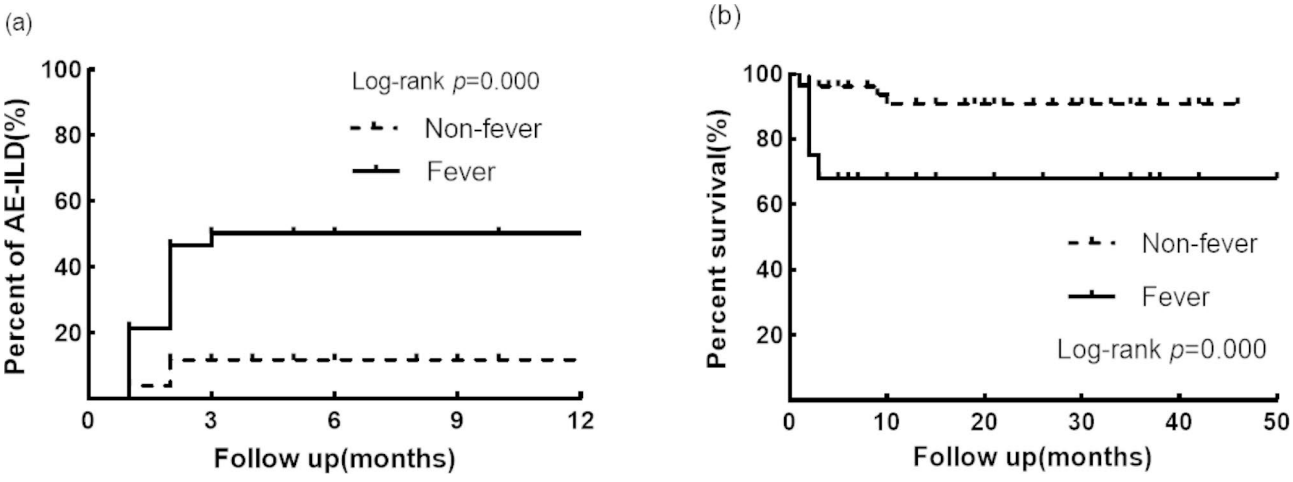

Fig. 1 Kaplan–Meier curves of IIM patients with and without fever: (**a**) IIM patients with fever had a higher rate of AE-ILD (Log-rank $p = 0.000$) ; (**b**) IIM patients with fever had a higher mortality rate (Log-rank $p = 0.000$)

Table 3 Multivariate models of AE-ILD and death in IIM patients

	AE-ILD		Death	
	OR (95%CI)	*p*-value	OR (95%CI)	*p*-value
unadjusted model	7.253(2.439,21.567)	0.001*	5.566(1.528,20.274)	0.009*
adjusted model[a]	12.025(2.728,53.016)	0.000*	4.711(1.178,18.847)	0.028*

[a]adjusted by age of onset, the dose of glucocorticoid, immunosuppressants, and IVIG.

as early as possible. Further prospective studies are needed to better define the risk factors for IIM in the long term.

Abbreviations

AE-ILD	Acute exacerbation of interstitial lung disease
AE-IPF	Acute exacerbation of idiopathic pulmonary fibrosis
ALB	Albumin
ANA	Antinuclear antibodies
ASS	Anti-synthase antibodies
CK	Creatine kinase
CNIs	Calcineurin inhibitors
COPD	Chronic obstructive pulmonary disease
HRCT	High-resolution computed tomography
IIM	Idiopathic inflammatory myopathies
ILD	Interstitial lung disease
IS	Immunosuppressants
IVIG	Intravenous immunoglobulins
MDA5	Melanoma differentiation-associated protein 5
MH	Mechanic's hands

Acknowledgements
Authors are grateful to Dr. Wang Qiang, professor of the department of Rheumatology, the First Affiliated Hospital with Nanjing Medical University, for fruitful scientific discussions and critical review of the manuscript.

Authors' contributions
Ting Liu and Fenghong Yuan were equally involved in study conceptualization, study design, and data analysis. Haifeng Chen is responsible for the writing of the original draft. Yitian Shi and Wei Xu critically revised the report and commented on drafts of the manuscript. All authors read and approved the final manuscript.

Funding
Not applicable.

Data Availability
The study database was anonymized. The datasets generated during and/or analyzed during the current study are not publicly available [due to them containing information that could compromise research participant privacy/consent]; however, they are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study was approved by the ethical committee in our institution (KY21045) by the principles of the Declaration of Helsinki. Patient identity and database were concealed in this study.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 4 December 2022 / Accepted: 26 June 2023
Published online: 13 July 2023

References
1. Bronner IM, van der Meulen MF, de Visser M, Kalmijn S, van Venrooij WJ, Voskuyl AE, et al. Long-term outcome in polymyositis and dermatomyositis. Ann Rheum Dis. 2006;65(11):1456–61.
2. Dobloug GC, Svensson J, Lundberg IE, Holmqvist M. Mortality in idiopathic inflammatory myopathy: results from a swedish nationwide population-based cohort study. Ann Rheum Dis. 2018;77(1):40–7.
3. Yamasaki Y, Yamada H, Ohkubo M, Yamasaki M, Azuma K, Ogawa H, et al. Longterm survival and associated risk factors in patients with adult-onset idiopathic inflammatory myopathies and amyopathic dermatomyositis: experience in a single institute in Japan. J Rheumatol. 2011;38(8):1636–43.
4. Marie I. Morbidity and mortality in adult polymyositis and dermatomyositis. Curr Rheumatol Rep. 2012;14(3):275–85.
5. Liu H, Xie S, Liang T, Ma L, Sun H, Dai H, et al. Prognostic factors of interstitial lung disease progression at sequential HRCT in anti-synthetase syndrome. Eur Radiol. 2019;29(10):5349–57.
6. Zuo Y, Ye L, Liu M, Li S, Liu W, Chen F, et al. Clinical significance of radiological patterns of HRCT and their association with macrophage activation in dermatomyositis. Rheumatology (Oxford). 2020;59(10):2829–37.
7. Blomqvist A, Engblom D. Neural mechanisms of Inflammation-Induced Fever. Neuroscientist. 2018;24(4):381–99.
8. Bottai M, Tjärnlund A, Santoni G, Werth VP, Pilkington C, de Visser M, et al. EULAR/ACR classification criteria for adult and juvenile idiopathic inflammatory myopathies and their major subgroups: a methodology report. RMD Open. 2017;3(2):e000507.
9. Connors GR, Christopher-Stine L, Oddis CV, Danoff SK. Interstitial lung disease associated with the idiopathic inflammatory myopathies: what progress has been made in the past 35 years. Chest. 2010;138(6):1464–74.
10. Collard HR, Ryerson CJ, Corte TJ, Jenkins G, Kondoh Y, Lederer DJ, et al. Acute Exacerbation of Idiopathic Pulmonary Fibrosis. An International Working Group Report. Am J Respir Crit Care Med. 2016;194(3):265–75.
11. Vuong V, Duong TA, Aouizerate J, Authier FJ, Ingen-Housz-Oro S, Valeyrie-Allanore L, et al. Dermatomyositis: factors predicting relapse. J Eur Acad Dermatol Venereol. 2016;30(5):813–8.
12. Bao L, Chen D, Ding L, Ling W, Xu F. Fever burden is an independent predictor for prognosis of traumatic brain injury. PLoS ONE. 2014;9(3):e90956.
13. Gong ZJ, Cheng JW, Gao PT, Huang A, Sun YF, Zhou KQ, et al. Clinical characteristics and prognostic factors of patients with Intrahepatic Cholangiocarcinoma with Fever: a propensity score matching analysis. Oncologist. 2019;24(7):997–1007.
14. Kishaba T, McGill R, Nei Y, Ibuki S, Momose M, Nishiyama K, et al. Clinical characteristics of dermatomyosits/polymyositis associated interstitial lung disease according to the autoantibody. J Med Invest. 2018;65(34):251–7.
15. Sun S, Chen Z, Zhang D, Xu W, Wu W, Sun F, et al. Description and analysis of a Novel subtype of the anti-synthetase syndrome characterized by frequent attacks of fever and systemic inflammation in a Single-Center Cohort Study. Front Immunol. 2021;12:729602.
16. Zhang L, Wu G, Gao D, Liu G, Pan L, Ni L, et al. Factors Associated with interstitial lung disease in patients with Polymyositis and Dermatomyositis: a systematic review and Meta-analysis. PLoS ONE. 2016;11:e0155381.
17. Concha J, Merola JF, Fiorentino D, Werth VP. Re-examining mechanic's hands as a characteristic skin finding in dermatomyositis. J Am Acad Dermatol 2018;78:769 – 75.e2.
18. Ang CC, Anyanwu CO, Robinson E, Okawa J, Feng R, Fujimoto M, et al. Clinical signs associated with an increased risk of interstitial lung disease: a retrospective study of 101 patients with dermatomyositis. Br J Dermatol. 2017;176:231–3.
19. Go DJ, Lee EY, Lee EB, Song YW, Konig MF, Park JK. Elevated erythrocyte sedimentation rate is predictive of interstitial lung Disease and Mortality in Dermatomyositis: a korean Retrospective Cohort Study. J Korean Med Sci. 2016;31:389–96.
20. Huang HL, Lin WC, Yeh CC, Sun YT. Serological risk factors for concomitant interstitial lung disease in patients with idiopathic inflammatory myopathy. J Clin Neurosci. 2020;74:32–5.
21. Littlejohn E, Marder W, Lewis E, Francis S, Jackish J, McCune WJ, et al. The ratio of erythrocyte sedimentation rate to C-reactive protein is useful in distinguishing infection from flare in systemic lupus erythematosus patients presenting with fever. Lupus. 2018;27:1123–9.
22. Eckart A, Struja T, Kutz A, Baumgartner A, Baumgartner T, Zurfluh S, et al. Relationship of nutritional status, inflammation, and serum albumin levels during acute illness: a prospective study. Am J Med. 2020:713–722.
23. Wu C, Wang Q, He L, Yang E, Zeng X. Hospitalization mortality and associated risk factors in patients with polymyositis and dermatomyositis: a retrospective case-control study. PLoS ONE. 2018;13:e0192491.

Publisher's Note