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RESEARCH ARTICLE

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Evaluation of β2-microglobulin in the condition and prognosis of psoriasis patients

Ling Han[a‡], Yixiao Gan[b‡], Juan Du[a‡], Yao Hu[c], Yanwen Chen[c], Qiong Huang[a], Zhenghua Zhang[a], Nikhil Yawalkar[d], Kexiang Yan[a] and Zhicheng Wang[b]

[a]Department of Dermatology, Huashan Hospital, Fudan University, Shanghai Institute of Dermatology, Shanghai, PR China; [b]Department of Transfusion Medicine, Huashan Hospital, Fudan University, Shanghai, China; [c]Department of Laboratory Medicine, Huashan Hospital, Fudan University, Shanghai, China; [d]Department of Dermatology, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland

ABSTRACT

Background: Numerous studies have linked the inflammatory pathway in psoriasis and metabolic disease, while no specific marker defined it. It is worth exploring the association of β2-microglobulin (β2M) in psoriasis severity and comorbidities.

Objectives: To investigate the correlation between blood β2M level and psoriasis severity, to explore the inflammatory factors influencing the occurrence of psoriasis comorbidities such as arthritis, diabetes, and hypertension.

Methods: Ninety-seven psoriasis patients were analyzed in the cohort retrospective study during 12 weeks.

Results: Significantly higher levels of blood β2M and ESR were observed in the group that patients' PASI ≥10 than in the group that PASI <10. Blood β2M level had strong significantly positive correlations with the PASI in Pearson's correlation analysis. In the model that systemic inflammatory factors to find psoriasis comorbidity risk factors, logistic regression analysis showed that blood β2M level was the significant risk factor associated with diabetes and hypertension. High-sensitivity C-reactive protein (hsCRP) was the significant risk factor associated with arthritis.

Conclusions: Patients with a severer psoriasis tended to have higher blood β2M levels and severer inflammatory state. In the systemic inflammation indexes, the level of blood β2M affected the risk of hypertension and diabetes, and hsCRP affected the risk of arthritis in patients with psoriasis.

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Psoriasis; β2-microglobulin; ESR; hsCRP; cardiovascular disease; systemic inflammation

Introduction

Psoriasis is a chronic immune-mediated inflammatory skin disease that primarily involves the skin. In the past 20 years, the number of patients with psoriasis, the age-standardized prevalence rate, the number of patients with psoriasis, and the age-standardized incidence rate all showed a continuously increasing trend (1,2). By 2019, psoriasis prevalence was 0.56% in China, the huge population base made it more complex to launch the epidemiological survey. Long and recurrent course affects the patient's physical, psychological, and economic aspects, it also put pressure on social and public health at the same time (3).

It is generally considered that psoriasis is a systemic disorder frequently associated with various comorbidities such as cardiovascular diseases, metabolic syndrome, arthritis, glucose intolerance, and obesity (4,5). A considerable number of studies (6,7) have linked the inflammatory pathway in psoriasis and metabolic disease, while there are no currently clinically useful biomarkers indicating the progression and severity of psoriasis, as well as the risk factors of comorbidities.

The inflammatory response involved in the disease process is mainly the infiltration of inflammatory cells and the release and activation of proinflammatory cytokines by immune cells, which is a complex feedback loop from the local formation of psoriatic plaques to global, thus leading to the persistent systemic inflammation (8). The inflammation state can be assessed by many biochemical and serum markers for feedback such as high-sensitivity C-reactive protein (hsCRP) and erythrocyte sedimentation rate (ESR) (9–11).

Biomarkers are important in clinical practice because they provide an objective and quantitative assessment of the diagnosis, disease processes, and therapy response (12). Moreover, similar to other chronic inflammatory diseases, life expectancy of patients with psoriasis is substantially reduced, with cardiovascular diseases contributing the most (13). β2-microglobulin (β2M) is a kind of blood globulin (GLO) that keep stable in concentration normally, it can assess kidney function sensitively, combined with other indicators to reflect renovascular function thus predicting an increased risk of cardiovascular disease (14,15). In the current environment with a strong emphasis on early prevention and management of chronic diseases, it is important to screen for important and fatal comorbidities in psoriasis patients who already have a higher incidence of cardiovascular disease than the general population (16,17). If the detection of systemic inflammatory indicators in

CONTACT Zhicheng Wang ahwzc@126.com Department of Transfusion Medicine, Huashan Hospital, Fudan University, Shanghai 200040, China; Kexiang Yan ykx2292002@aliyun.com Department of Dermatology, Huashan Hospital, Fudan University, Shanghai 200040, China
‡These authors contributed equally to this work.

patients with psoriasis is carried out to prevent the occurrence of comorbidities in advance, it can be very effective in improving the quality of life of patients and prolonging life expectancy (18). β2M deserves more attention based on its bridge effect between inflammation situation and occurrence of comorbidity besides the hsCRP and the ESR in psoriasis patients.

Currently, the detailed data in severity of psoriasis, comorbidity condition and β2M have not been reported and analyzed clearly. Present study aimed to retrospectively compare the level of blood β2 macroglobulin among different severity psoriasis patients and to build a link with the levels of three systemic inflammation parameters (β2M, ESR, and hsCRP) with the morbidity of psoriasis comorbidities.

Materials and methods

Patients

This study was performed at Huashan Hospital, Fudan University, Shanghai, China including 197 psoriatic patients (140 males, 57 females, mean age: 45 years, range 11–86 years) who were first diagnosed as psoriasis in dermatology clinic. Diagnosis of psoriasis was based on typical clinical and/or histopathological criteria. After diagnosis, patients received a 12-weeks systemic methotrexate (MTX) at a dose of 2.5 mg × 3 − 2.5 mg × 5 per week according to the Guideline for the Diagnosis and Treatment of Psoriasis in China (2018 edition).

Moll and Wright's criteria were applied for psoriatic arthritis diagnosis. Patients' basic information, clinical characteristics, and laboratory data were collected from the medical records and Laboratory Information System (LIS). Blood samples were obtained from the first diagnosis (we marked this timing as week 0). The patients were divided into two groups according to psoriasis area and severity index (PASI) based on clinical dermatologists' assessments. Informed consent was obtained from all the participants. Guidelines vary from country to country for grading the severity of psoriasis (China, other Asian countries, and the United States are classified as mild, moderate, or severe, while European and French guidelines are classified as mild or moderate). Patients with PASI ≥10 were classified as 'severe psoriasis', PASI <10 were classified as 'mild and moderate psoriasis' according to the Guideline for the Diagnosis and Treatment of Psoriasis in China (2018 edition) and the classification method recommended by the International Psoriasis Council (IPC) (19–21).

There were no significant differences in demographic characteristics between the two groups (Table 1). The study was approved by Ethics Committees of the Huashan Hospital.

Methods

The blood β2M level was determined using particle-enhanced immunonephelometry (Siemens, Munich, Germany). Hitachi 7600 fully automatic biochemical analyzer (Hitachi Ltd, Tokyo, Japan) was used to test all chemical indexes. Routine blood tests were performed by Beckman Coulter UniCel DxH800 (Brea, CA).

Statistical analysis

The statistical analysis was performed by using SPSS v.23.0 (IBM Corp., Armonk, NY). The Kolmogorov–Smirnov test was used to determine the normality of the data distribution. Normally distributed numeric parameters are presented as mean ± SD, while non-normally distributed parameters are shown as medians. Categorical variables are expressed as number sand percentages.

Table 1. Demographic characteristics and disease profiles of psoriatic patients in the different PASI.

Characteristic	PASI ≥ 10 (n = 141)	PASI < 10 (n = 56)	p
Age, years	44.82 ± 15.21	46.84 ± 16.45	.413
Age at one set, years	32.38 ± 16.32	34.20 ± 17.62	.517
BMI, kg/m^2	24.85 ± 3.10	25.04 ± 3.50	.748
Sex (male/female)	105/36	35/21	.095
Disease duration, years	12.35 ± 10.05	12.65 ± 10.15	.849
MTX dosage, mg	143.19 ± 19.12	141.16 ± 19.11	.502
Average PASI (0 week)	17.79 ± 7.48	7.40 ± 2.06	<.001*
Average PASI (12 weeks)	4.91 ± 5.39	2.92 ± 2.21	.000*
PASI change (%)	0.725 ± 0.235	0.574 ± 0.324	.002*
SBP, mmHg	130.7 ± 15.1	138.0 ± 20.7	.046*
DBP, mmHg	83.9 ± 11.7	85.9 ± 11.5	.345
Average BSA (0 week)	34.53 ± 22.61	9.76 ± 7.77	.000*
Average BSA (12 weeks)	10.50 ± 19.15	3.36 ± 4.81	.060
BSA change (%)	0.710 ± 0.390	0.565 ± 0.468	.001*
Smoking, n (N%)	64 (45.4%)	24 (42.9%)	.747
Alcohol, n (N%)	67 (47.5%)	30 (53.6%)	.443
Arthritis, n (N%)	60 (42.6%)	23 (41.1%)	.849
Diabetes, n (N%)	23 (16.3%)	13 (23.2%)	.258
Hypertension, n (N%)	43 (30.5%)	21 (37.5%)	.344

MTX: methotrexate; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure.
MTX dosage was the sum of 12 weeks of patient treatment. Values are mean ± SD, median (range), or percentage.
*p Values were obtained using the Chi-square test and Student's t-test. $p < .05$.

Inter-group differences in normally distributed numeric parameters were analyzed by using the t-test for independent samples, while inter-group differences in non-normally numeric parameters were analyzed by the Mann–Whitney U-test. The logistic regression analysis after correction for potential confounding factors such as age and gender was used to assess whether these inflammatory parameters (β2M, ESR, and hsCRP) are the risk factors of psoriasis comorbidities. The relationships among the inflammatory indices were analyzed using Spearman's correlation. All statistical tests were two-tailed, and $p < .05$ was considered statistically significant, and $p < .01$ was considered highly statistically significant.

Results

Patient characteristics

The 197 psoriatic patients were divided into two groups according to PASI based on clinical dermatologists' assessment: patients' PASI ≥10 group (105 men and 36 women, mean age, 44.82 ± 15.21 years and mean age at disease on set was 32.38 ± 16.3 years); and patients' PASI < 10 group (35 men and 21 women; mean age, 46.84 ± 16.45 years and mean age at disease on set was 34.20 ± 17.62 years). There were no significant differences in demographic characteristics, disease duration, MTX dosage, diastolic blood pressure (DBP), average body surface area (BSA) (12 weeks), smoking, and alcohol percentage between the two groups (Table 1). The average PASI (12 weeks), PASI change (%), and average BSA (0 week) in the PASI ≥ 10 group were significantly higher than the PASI < 10 group ($p < .05$). Finally, there was no significant difference in the rate of complications (arthritis, diabetes, and hypertension) between the PASI ≥ 10 group and the PASI < 10 group ($p > .05$).

Comparison of laboratory indexes between PASI ≥10 and PASI < 10 groups

The mean and SD of blood β2M level, ESR, gamma-glutamyltransferase (GGT), and lipoprotein A (Lp(a)) in the PASI ≥ 10 group were 2.11 ± 0.68 mg/L, 3.35 ± 3.18 mm/h, 30.03 ± 31.00 U/L,

Table 2. Laboratory biochemical index of psoriatic patients in the different PASI.

Biochemical index	PASI ≥ 10 (n = 141)	PASI < 10 (n = 56)	p
β2M, mg/L	2.11 ± 0.68	1.87 ± 0.43	.018*
hsCRP, mg/L	12.62 ± 14.14	9.29 ± 9.66	.107
ESR, mm/h	3.35 ± 3.18	2.22 ± 2.74	.014*
GLU, mmol/L	5.77 ± 1.84	5.60 ± 1.04	.527
HBALC, mmol/L	5.85 ± 1.06	5.81 ± 0.65	.766
BUN, mmol/L	4.88 ± 1.19	5.40 ± 1.82	.051
CRE, μmol/L	67.6 ± 13.6	66.3 ± 14.1	.530
UA, mmol/L	0.3699 ± 0.0904	0.3639 ± 0.0879	.673
ALT, U/L	27.8 ± 18.8	26.9 ± 16.6	.763
AST, U/L	22.9 ± 9.6	22.7 ± 6.9	.887
TBIL, μmol/L	10.74 ± 4.67	10.64 ± 3.83	.890
DBIL, μmol/L	3.41 ± 1.56	3.21 ± 1.32	.420
TBA, μmol/L	5.27 ± 6.80	5.00 ± 2.45	.773
ALP, U/L	92.65 ± 35.08	88.65 ± 22.44	.436
GGT, U/L	30.03 ± 31.00	23.13 ± 12.57	.030*
TP, g/L	77.94 ± 5.143	77.92 ± 3.88	.984
ALB, g/L	46.40 ± 3.58	47.16 ± 2.30	.084
GLO, g/L	31.54 ± 5.32	30.76 ± 3.60	.248
A/G	1.517 ± 0.299	1.555 ± 0.206	.311
PA, mg/L	254.58 ± 49.67	259.37 ± 48.52	.564
HCY, μmol/L	16.306 ± 15.050	13.606 ± 6.523	.197
ApoA, g/L	1.052 ± 0.179	1.071 ± 0.169	.497
ApoB, g/L	0.690 ± 0.154	0.728 ± 0.153	.120
CHO, mmol/L	4.636 ± 0.822	4.905 ± 0.927	.050
ApoA/ApoB	1.580 ± 0.569	1.514 ± 0.481	.451
LDL, mmol/L	2.858 ± 0.765	3.045 ± 0.800	.133
HDL-C, mmol/L	1.163 ± 0.289	1.204 ± 0.296	.371
LDL/HDL-C	2.507 ± 0.943	2.591 ± 0.841	.563
Lp(a), mg/L	158.9 ± 185.4	103.0 ± 110.0	.011*
TG, mmol/L	1.648 ± 1.203	1.889 ± 1.235	.216

CHO: cholesterol; GLU: glucose; HCY: homocysteine; HDL-C: high-density lipoprotein-cholesterol; LDL: low-density lipoprotein; TG: triglyceride; TP: total protein.
*p < .05.

and 158.9 ± 185.4 g/dL, respectively; the mean and SD of blood β2M level, ESR, GGT, and Lp(a) in the PASI < 10 group were 1.87 ± 0.43 mg/L, 2.22 ± 2.74 mm/h, 23.13 ± 12.57 U/L, and 103.0 ± 110.0 g/dL, respectively; the mean blood β2M level, ESR, GGT, and Lp(a) were significantly higher in the PASI ≥ 10 group than in PASI < 10 group (p < .05); no significant differences were noted in the other biochemical indexes between the two groups (Table 2).

The mean percentage of lymphocyte and neutrophil in the PASI ≥ 10 groups was 24.04% ± 6.78% and 66.34% ± 7.33%; the mean percentage of lymphocyte and neutrophil in the PASI < 10 groups was 28.11% ± 8.10% and 62.10% ± 9.97%. The mean percentage of neutrophil was significantly higher in the PASI ≥ 10 group than in the PASI < 10 group (p < .05) but result percentage of lymphocyte percentage was reverse in the two groups; no significant differences were noted in the other blood parameters between the two groups (Table 3).

Table 3. Blood routine index of psoriatic patients in the different PASI.

Blood index	PASI ≥ 10 (n = 141)	PASI < 10 (n = 56)	p
BASO (%)	0.46 ± 0.23	0.45 ± 0.21	.842
HCT (%)	44.69 ± 3.92	43.72 ± 3.45	.126
HGB, g/L	150.0 ± 14.5	147.2 ± 12.1	.221
LYMPH (%)	24.04 ± 6.78	28.11 ± 8.10	.001***
MCH, pg	30.32 ± 1.74	30.28 ± 1.51	.888
MCHC, g/L	335.5 ± 10.5	336.8 ± 9.28	.468
MCV, fL	90.33 ± 4.36	89.94 ± 3.69	.573
MONO (%)	6.94 ± 1.87	6.77 ± 1.89	.591
MPV, fL	10.29 ± 1.65	10.65 ± 0.98	.152
NEUT (×10^9/L)	4.718 ± 1.403	4.496 ± 1.552	.358
NEUT (%)	66.34 ± 7.33	62.10 ± 9.97	.002**
PDW, fL	12.38 ± 2.68	12.95 ± 2.11	.181
P-LCR (%)	28.45 ± 8.91	30.48 ± 7.87	.16
PLT (×10^9/L)	246.28 ± 72.00	231.50 ± 65.27	.206
RBC (×10^9/L)	4.960 ± 0.507	4.871 ± 0.452	.278
RDW-CV (%)	12.64 ± 0.777	12.52 ± 0.60	.317
RDW-SD, fL	41.62 ± 3.14	41.13 ± 2.58	.334
WBC (×10^9/L)	7.041 ± 1.703	6.963 ± 1.818	.785
EO (%)	2.21 ± 1.68	2.30 ± 1.72	.763

HCT: hematocrit.
**p < .01; ***p < .001.

Table 4. Correlation among inflammatory parameters of patients.

	Blood β2M	
Variable	r	p
hsCRP	0.407	<.0001***
ESR	0.467	<.0001***
PASI	0.33	<.0001***
LYMPH (%)	−0.126	.05*
MONO (%)	0.301	<.0001***
NEUT (%)	0.027	.674
EO (%)	0.111	.085
PLT	0.055	.396
RBC	−0.102	.113
WBC	−0.043	.505
APOA	−0.06	.349
APOB	0.058	.362
CHO	0.025	.694
HDL	−0.1	.117
LDL	0.034	.598
LP(a)	0.063	.319
TG	−0.028	.659
GLU	0.031	.633
HAB1C	0.222	.001***
ALT	0.066	.285
AST	0.133	.031*
TBIL	−0.025	.684
DBIL	0.019	.762
ALP	0.152	.015*
GGT	0.1	.108
ALB	−0.346	<.0001***
TP	0.03	.631
GLO	0.259	<.0001***
A/G	−0.283	<.0001***
PA	−0.202	.002**
HCY	0.079	.203
BUN	0.187	.002**
CRE	0.363	<.0001***
UA	0.293	<.0001***

GLU: glucose.
*p < .05; **p < .01; ***p < .001.

Correlation among inflammatory parameters of patients

As shown in Table 4, we analyzed the correlations among inflammatory indices in the psoriatic patient cohort.

Blood β2M was significantly related to some parameters: including inflammatory parameters and indicators of liver and kidney function. In particular, a stronger positive correlation was calculated between blood β2M and hsCRP (r = 0.407, p < .0001), ESR (r = 0.467, p < .0001), and the PASI (r = 0.330, p < .0001). The percentage of monocyte was positively associated with blood β2M (r = 0.301, p < .0001) and there existed a significantly negative correlation between the percentage of lymphocyte and blood β2M (r = −0.126, p = .05). Except for these parameters, blood β2M was also found to be correlated significantly with other indicators that reflect liver and kidney function. Glycosylated hemoglobin (HBA1C), aspartate aminotransferase (AST), alkaline phosphatase (ALP), GLO, serum urea nitrogen (BUN), creatinine (CRE), uric acid (UA) were positively associated with blood β2M, while ALB, albumin/globulin (A/G), and prealbumin (PA) were negatively associated with blood β2M (Table 4).

Table 5. Univariate and multivariate analyses to link inflammatory indexes with psoriasis comorbidity.

		Univariate analysis		Multivariate analysis	
Comorbidity	Variables	OR (95%CI)	*p* Value	OR (95%CI)	*p* Value
Arthritis	Blood β2M	1.819 (1.147–2.882)	.004**	0.947 (0.540–1.660)	.848
	ESR	1.038 (1.012–1.064)	.011*	1.023 (0.995–1.052)	.115
	hsCRP	1.218 (1.105–1.343)	<.0001***	1.192 (1.068–1.330)	.002**
Diabetes	Blood β2M	1.662 (1.041–2.654)	.033*	2.003 (1.103–3.637)	.022*
	ESR	1.018 (0.994–1.043)	.136	1.008 (0.981–1.035)	.56
	hsCRP	0.999 (0.889–1.122)	.983	1.099 (0.905–1.125)	.869
Hypertension	Blood β2M	2.289 (1.409–3.718)	.001***	1.866 (1.006–3.460)	.048*
	ESR	1.022 (1.000–1.045)	.052	1.011 (0.982–1.042)	.458
	hsCRP	1.077 (0.982–1.181)	.115	0.917 (0.795–1.056)	.229

*$p < .05$; **$p < .01$; ***$p < .001$.

Association of inflammatory indices with psoriasis comorbidities

Table 5 summarizes the results of binomial logistic regression analyses about three systematic inflammatory parameters. The blood β2M level was significantly correlated with the occurrence of diabetes and hypertension both in the univariate logistic regression analysis and in the multivariate analysis adjusted for confounding factors; the hsCRP level was significantly correlated with the occurrence of arthritis both in the univariate logistic regression analysis and in the multivariate analysis adjusted for confounding factors. The ESR level was significantly correlated with the occurrence of arthritis in the univariate logistic regression analysis.

Here, we showed that the occurrence of diabetes and hypertension were positively associated with β2M (diabetes, OR = 2.003, $p = .022$; hypertension, OR = 1.866; $p = .0048$), the occurrence of arthritis was positively associated with hsCRP (OR = 1.192, $p = .002$) (Table 5).

Discussion

In this study, the mean blood β2M level, ESR, Lp(a), lymphocyte, and neutrophil count were significantly higher in the group that patients' PASI ≥10 than in the group that PASI < 10. In psoriasis patients, the level of hsCRP is the significant risk factor of psoriatic arthritis. Different from the hsCRP, another index – blood β2M level, shows no significant correlation with the occurrence of psoriatic arthritis, but it is a strong risk factor of hypertension and diabetes. The present study combined with the systemic inflammation indexes and the occurrence of comorbidities in psoriatic patients. We compared the blood biochemical indexes, including inflammatory pathways closely related to cell proportion and biochemical indexes in the two degrees of severity among psoriatic patients.

Psoriasis is a kind of chronic inflammatory skin disease which is common in clinics and easy to relapse. Numerous reports and studies have pointed out that the severity of psoriasis could be associated with the concurrent metabolic syndrome (22). For example, patients with severe psoriasis had increased mortality due to comorbid cardiovascular disease, and it was regrettable to simply reduce the PASI score and dermatological signs without considering the reduction of cardiovascular comorbidities and metabolic syndrome (23). Therefore, we believed that summarizing the regularity of the level of systemic inflammatory parameters related to the comorbidities of psoriasis, timely prognostic monitoring, and appropriate systemic anti-inflammatory therapy can delay or even avoid the comorbidities of psoriasis such as hypertension, diabetes, and cardiovascular disease.

β2 microglobulin is a kind of low molecular weight protein synthesized by nucleated cells *in vivo*. The synthesis and release rate of β2M in normal people are very constant, so normally β2M has a very low concentration in the blood. Blood β2M level is a sensitive indicator of glomerular filtration function. From a genetic perspective, β2M is associated with many congenital autoimmune diseases. β2M is a component of class I MHC molecules, including HLA-B27 and HLA-Cw6. HLA-B27 is the major genetic risk factor for spondylarthrosis (SpA) and HLA-Cw6 is the most likely susceptibility allele in psoriasis susceptibility locus 1 (PSORS1), accounting for up to 50% of disease heritability (24).

From the perspective of systemic inflammation, some studies had demonstrated that SpA was clinically and pathophysiologically closely related to psoriasis as they are both tissue inflammation driven by interleukin-23/Th17 axis (25,26). Interestingly, modulation of β2M expression levels in the HLA-B27 transgenic rat model of SpA did profoundly affect the phenotype of the disease, confirming the potential importance of this molecule in SpA (27,28). Similarly, there is also evidence of an association between HLA-B27 and psoriatic arthritis (29,30). Combined with the collected data, β2M expression levels would also affect the clinical manifestations of psoriasis patients, including the degree of skin lesions and the corresponding indicators of comorbidities. Clinical studies have shown that β2M can detect the impairment of glomerular function earlier than serum CRE. Therefore, it could also be an early indicator of frontal kidney injury caused by diabetes and hypertension instead of blood glucose level and CRE level change (31,32). That is to say, at the initial diagnosis of psoriasis, increased β2M levels should be noted, which often indicates a highly active macrophage inflammatory state, as well as vascular and renal impairment (33,34). In addition to vascular effects, differences in metabolic function are also worth noting. From the results, we can know that psoriasis patients with higher blood β2M levels were accompanied by higher occurrence of hypertension and diabetes.

Second, β2M level is positively correlated with the proportion of peripheral monocytes, which is related to inflammatory reactions, such as the infiltration of macrophages in the tissues. In psoriasis, monocytes and macrophages have a positive contribution to the development of psoriasis (35). In cardiovascular disease, atherosclerosis is an important driver, and in general, inflammatory macrophages carry out processes that promote atherosclerosis progression, including plaque necrosis and thinning of a protective fibrous cap (36).

In clinical practice, hsCRP and ESR have been used as markers of systemic inflammation, are related to acute inflammation and reflect the condition of the body at a certain time. Generally speaking, both of the two indicators above are susceptible to the influence of many other non-pathological factors. The limited sensitivity and specificity explain why hsCRP and ESR can be useful biomarkers at the group level (such as in clinical trials) but lack sufficient in individual patients. In terms of inflammatory pathway, hsCRP does not appear to be associated with monocyte activity in psoriasis patients because of abnormal activation of

neutrophils, which release NETS as an autoantigenic protein, exacerbating the autoimmune state by IL-17, and is also induced by IL-22 chemotaxis (37–39). In this process, changes in hsCRP also affect ESR, so if psoriasis patients show progressive increases in both, clinicians should be aware of the potential for arthritis; simultaneously, the lesion area of this part of patients was poorly improved, which may be caused by the associated IL-22 regulating keratinocyte migration and interfering with physiological desquamations (40).

Numerous studies have provided evidence supporting systemic inflammation in psoriasis leading to complications, including psoriatic arthritis, nonalcoholic fatty liver disease, metabolic syndrome, and cardiovascular disorders, all of which contribute substantially to morbidity and mortality in patients with psoriasis (7,41,42). ESR is associated with psoriatic arthritis but is less accurate risk factor of cardiovascular disease as a complication. The pathogenetic link between psoriasis and cardiovascular comorbidity is likely provided through insulin resistance and endothelial dysfunction, as these are known drivers for atherosclerosis and diabetes mellitus (43). In addition to its essential glucose metabolic actions, insulin has important vascular actions that involve the stimulation of the production of nitric oxide from the endothelium, leading to vasodilation (44). Inflammation in psoriasis drives cardiovascular disease through two pathways: the first is the immune response of the affected endothelial cells, the upregulation of adhesion molecules drives atherosclerosis; the second is that the phenomenon of insulin resistance induces endothelial dysfunction, resulting in vascular stiffness at the functional level. In the process of elevated biomarkers of systemic inflammation, blood β2M level can be another clinical marker for predicting liver and kidney lesions, and cardiovascular complications in patients with psoriasis, showing a more comprehensive inflammatory pathway than hsCRP and ESR.

There are several limitations in this study. First, this single-center retrospective study may have inherent biases due to missing data. Second, some psoriasis patients' subsequent illness and the severity of complications had not been followed up for a long time. A larger sample size and multiple-center studies that extend postoperative follow-up time would clarify the value of inflammatory indices in characterizing the association with psoriatic system disorders and predicting the occurrence and progression of psoriatic comorbidities in our future studies.

Conclusions

In summary, our study demonstrated that patients with more severe psoriasis were associated with more severe inflammation and poor metabolic status, characterized by higher blood β2M expression and higher ESR levels as well as higher lymphoid and neutrophil counts in blood cell count.

Blood β2M level significantly affected the liver and kidney function of patients with psoriasis. Blood β2M level, ESR, and hsCRP could be used as risk factors in the occurrence and progression of psoriatic comorbidities (diabetes, hypertension, and psoriatic arthritis), which is of great significance for the early prevention of atherosclerosis and cardiovascular and cerebrovascular diseases.

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Ethical approval

The study protocol was approved by the Medical Ethics Committee of Huashan Hospital, Fudan University (approval MTX201501), and was conducted in accordance with the Declaration of Helsinki.

Consent form

Written informed consent was provided by each patient prior to participation.

Author contributions

Study design: NY, KY, ZZ, and ZW; data collection: LH, YG, QH, JD, and YC; data analysis: LH, YG, and YH; manuscript writing: YG, KY, and ZW. All authors read and approved the final manuscript.

Disclosure statement

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Data availability statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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