Article

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Effect of Colchicine on Systemic Inflammation, Peripheral Blood CD4$^+$ T Cell Subsets and Oxidative Stress in Patients with Coronary Heart Disease Combined with Gout after Percutaneous Coronary Intervention

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Background & Objective: Colchicine improves cardiovascular outcomes in patients with coronary heart disease, but the underlying mechanisms remain incompletely elucidated. The aim of this study was to evaluate the effects of colchicine on systemic inflammation, peripheral blood CD4$^+$ T cell subsets, and oxidative stress after percutaneous coronary intervention in patients with coronary heart disease combined with gout from the perspective of population study.

Methods: From January 2019 to June 2022, a total of 128 patients with coronary heart disease combined with gout who underwent percutaneous coronary intervention (PCI) at our hospital were retrospectively collected and divided into colchicine group (n = 64) and control group (n = 64) according to whether colchicine was routinely used or not. Systemic inflammation (tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and hypersensitivity C-reactive protein (hs-CRP)), peripheral blood CD4$^+$ T cell subsets (Th1 cells, Th17 cells, and regulatory T cells), and oxidative stress indicators (serum superoxide dismutase (SOD) and malondialdehyde (MDA)) were compared between the two groups after PCI. hs-CRP $\geq$2 mg/L was defined as a patient at risk of residual inflammatory. Logistic regression was used to analyze the association between colchicine treatment and the risk of residual inflammation.

Results: There was no significant difference between the two groups in terms of age, gender, smoking history, disease history, body mass index (BMI), time from symptom onset to PCI, blood pressure, hypersensitivity troponin I (hs-TnI), neutrophils, triglyceride (TG), total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), serum creatinine, and the equilibrium was comparable ($p > 0.05$). After PCI treatment, TNF-α and IL-6 levels were significantly decreased in both groups, and the levels of TNF-α and IL-6 in the colchicine group were significantly lower than control group (TNF-α: 22.5 $\pm$ 4.9 vs 41.6 $\pm$ 4.1 µg/L; IL-6: 21.3 $\pm$ 12.8 vs 40.9 $\pm$ 17.5 ng/L; both $p < 0.001$). Patients in the colchicine group had a significantly proportion of risk of residual inflammation compared with controls (37.5% vs 62.5%, $p = 0.005$). Logistic regression showed that, using the control group as a reference, we still found that colchicine use was independently associated with a reduced risk of residual inflammation when corrected for other confounders (odds ratio [OR], 0.372; 95% confidence interval [CI], 0.156–0.889; $p = 0.026$). Regarding peripheral blood CD4$^+$ T cell subsets, Th1 cell, Th17 cell, and regulatory T cell counts were significantly higher in the colchicine group than control group after PCI treatment ($p < 0.01$). As for oxidative stress indicators, SOD levels were significantly higher and MDA levels were significantly lower in the colchicine group after PCI treatment compared with the control group ($p < 0.001$).

Conclusions: Colchicine administration was associated with reduced systemic inflammatory indexed, promoted proliferation of peripheral blood CD4$^+$ T cells, and improved oxidative stress levels in patients with coronary heart disease combined with gout after PCI.

Keywords: colchicine; coronary heart disease combined with gout; inflammatory markers; CD4$^+$ T cells; oxidative stress

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Introduction

Coronary heart disease (CHD) is an ischemic heart disease caused by atherosclerotic plaques in the coronary arteries and the narrowing or blockage blood vessels, which can lead to myocardial ischemia, hypoxia or even necrosis when the plaques are unstable or ruptured, and may be accompanied by chest tightness, chest pain and discomfort [1]. CHD is more common in adults over 40 years of age, more men than women, and can be mainly divided into two main categories: chronic coronary artery disease and acute coronary syndrome [2]. Despite tremendous advances in drugs and interventional technologies, cardiovascular disease remains the primary burden of disease, with an estimated 420 million people worldwide suffering from cardiovascular disease in 2015, including 17.92 million deaths due to cardiovascular disease [3]. In addition to traditional cardiovascular disease factors such as obesity, blood pressure, blood glucose, lipid profile, and insulin resistance, systemic inflammation and endothelial dysfunction are important aspects that contributed to increased risk of CHD [4]. There is growing evidence suggests the important role of inflammation in the formation and evolution of atherosclerotic plaques, and the pathogenic role of inflammation in CHD is becoming more and more clear [5], The role of inflammation in CHD has been largely clarified. After the control of cardiovascular risk factors, antiplatelet therapy, and lipid-regulating therapy, anti-inflammatory therapy is expected to become a new milestone in the pharmacological treatment of CHD in the near future [6]. However, during the development of drugs, translating the inflammatory theory of CHD into effective anti-inflammatory treatment strategies in the clinical setting is challenging.

An important feature of CHD is chronic immune-inflammation and fibroproliferative coronary lesions caused by lipids. The inflammatory theory of CHD is very complex. In the past few decades, a variety of immune cells such as T cells and neutrophils, inflammatory mediators such as C-reactive protein and interleukin-6 have been shown to be involved in the development and progression of CHD [7]. Colchicine, a lipophilic alkaloid extracted from the plant colchicine, is a classical drug used mainly in the treatment of acute gout, familial Mediterranean fever, and acute pericarditis [8]. As a convenient, low-cost and easily available anti-inflammatory drug, the use of colchicine in the anti-inflammatory treatment of CHD has been a hot topic of interest in the academic community [9]. An observational study showed cardiovascular benefit of colchicine in patients with gout [10], which suggests that colchicine may have a potential role in reducing inflammation-related cardiovascular risk. Large cardiovascular outcomes trials in recent years have also supported that colchicine may reduce future cardiovascular events in patients with acute coronary syndrome and chronic coronary disease [11,12]. The mechanism of the lipid-lowering effect by statins on improving cardiovascular events has been demonstrated [13], but the mechanisms of cardiovascular benefit by colchicine remain undetermined. Colchicine is currently known to play an important role in inhibition of microtubulin polymerization and microtubule production, cell adhesion molecules, and inflammatory chemokines [4], but the role of colchicine in affecting peripheral blood T cell subsets and oxidative stress levels remains unclear.

Therefore, the aim of this study was to evaluate the effects of colchicine on systemic inflammation, peripheral blood $CD4^+$ T cell subsets and oxidative stress after percutaneous coronary intervention in patients with CHD combined with gout from the perspective population study, providing a clinical basis for elucidating colchicine, inflammatory immunity, and cardiovascular benefits.

Materials and Methods

Study Subjects

We included 64 patients with coronary heart disease and gout who used colchicine. Then, 64 patients with comparable clinical characteristics ($p > 0.05$) in control group were selected. Therefore, a total of 128 patients with CHD combined with gout who underwent percutaneous coronary intervention (PCI) at our hospital were retrospectively collected from January 2019 to June 2022. Inclusion criteria: (1) Age ≥18 years; (2) patients diagnosed with CHD combined with gout by combining symptoms, signs, coronary angiography and other laboratory tests [14,15]; (3) the need of PCI treatment after evaluation. Exclusion criteria: (1) Patients who were not suitable for stenting after coronary angiography, or who choose conservative treatment; (2) the presence of severe cardiac, hepatic and renal disease or other contraindications to PCI; (3) Pregnant women or those who with mental disorders that prevented them from cooperating to complete the treatment; (4) In an active period of gout. The study was approved by the Ethics Committee of Cangzhou Central Hospital, with the approval number 2022-051-02(z). According to the above inclusion and exclusion criteria, 128 patients with CHD combined with gout who underwent PCI were finally included, and demographic characteristics, smoking history, history of previous disease, body mass index (BMI), blood pressure, and other laboratory tests were retrospectively collected from the patients.

Data Collection

Patients were divided into colchicine group (n = 64) and control group (n = 64) according to whether colchicine was routinely used or not. Patients in both groups were treated with PCI, and patients in the control group were given optimal drug therapy after PCI (including antiplatelet medications and statins), while the colchicine group were given colchicine orally (0.5 mg, twice a day; Guangdong

Table 1. Clinical characteristics of patients in colchicine group and control group.

	Colchicine group	Control group	*t*-values/χ^2 values/Z values	*p* value
N	64	64	-	-
Age, years	58.7 ± 11.0	60.9 ± 9.7	–1.202	0.232
Male, n (%)	41 (64.1)	37 (57.8)	0.525	0.469
BMI, kg/m^2	26.5 ± 4.0	25.4 ± 5.6	1.216	0.226
Smoking, n (%)	29 (45.3)	27 (42.2)	0.127	0.772
Diabetes mellitus, n (%)	29 (45.3)	26 (40.6)	0.287	0.592
Hypertension, n (%)	36 (56.3)	39 (60.9)	0.290	0.590
Hyperlipidemia, n (%)	38 (59.4)	43 (67.2)	0.841	0.359
Time from start of symptoms to PCI, min	195 ± 26	189 ± 20	1.470	0.144
Systolic blood pressure, mm Hg	141.5 ± 12.0	137.1 ± 12.6	2.034	0.044
Diastolic blood pressure, mm Hg	75.5 ± 16.8	74.0 ± 17.2	0.489	0.626
hs-TnI, median (25th, 75th), pg/mL	105.0 (89.3, 650.0)	100.0 (95.0, 555.0)	0.604	0.546
Neutrophil count, $\times 10^9$/L	7.7 ± 1.4	6.9 ± 1.7	2.672	0.009
TG, mmol/L	1.67 (1.30, 2.84)	1.71 (1.29, 2.14)	1.103	0.270
TC, mmol/L	4.96 ± 1.06	4.54 ± 1.10	2.181	0.031
LDL-C, mmol/L	2.52 ± 0.48	2.63 ± 0.39	–1.450	0.150
Serum creatinine, μmol/L	74 ± 14	71 ± 16	1.068	0.287

Continuous variables were expressed as mean ± standard deviation or median (25th, 75th), and categorical variables were expressed as frequencies (percentages).

BMI, body mass index; PCI, percutaneous coronary intervention; TG, triglyceride; TC, total cholesterol; LDL-C, low density lipoprotein cholesterol; hs-TnI, hypersensitivity troponin I.

Bidi Pharmaceutical Co., Ltd.; The national drug approval number: H20113208; Lot number: 2018) on the top of the control group.

Fasting venous blood samples were collected before PCI and 7 days after PCI, centrifuged and tested for the following indexes: (1) Systemic inflammatory indexes: tumor necrosis factor-α (TNF-α) levels and interleukin-6 (IL-6) were measured by enzyme-linked immunosorbent assay (ELISA) (E-EL-SR002, Elabscience Biotechnology Co., Ltd., Wuhan, China), hypersensitivity C-reactive protein (hs-CRP) was measured by immunoturbidimetric assay (20092401371, Orion Diagnostica Oy, Shanghai, China). (2) Peripheral blood CD4$^+$ T cell subsets: Th1 and Th17 cells staining: The density gradient centrifugation method was used to separate mononuclear cells of peripheral blood (PBMCs) for the detection of Th17 and Th1 cells. CD3-FITC and CD4-PC5 monoclonal antibodies was added to the isolated PBMCs, mixed and incubated at room temperature for 20 minutes. The incubated PBMCs was added to the RPMI-1640 culture system. The cell fixation, membrane breaking, and extracellular staining were performed. Then, PE-anti-human IFN- embrane breaking, and ext were added. Treg cells staining: 1 mL of peripheral blood was directly used for the detection of regulatory T cells. The 200 μL peripheral blood was add with CD4-FITC and CD25-PC5 monoclonal antibodies. Then, hemolysin was added to dissolve red blood cells, followed by cell fixation, membrane rupture, and extracellular staining. Then, PE-anti-human Foxp3 monoclonal antibody was added. Detection of Th1, Th17 and Treg cells by flow cytometry: The flow cytometry was used to measure the fluorescence intensity of various fluorescent elements in lymphocytes and cell membranes, including Th1 (CD3$^+$, CD4$^+$, IFN-γ^+), Th17 (CD3$^+$, CD4$^+$, IL-17$^+$) and Treg cells (CD4$^+$, CD25$^+$, Foxp3$^+$). Data were acquired on 10,000 cells, then gated and analyzed using Cell Quest software to determine the frequencies of CD4$^+$ T cell subsets. Absolute numbers of CD4$^+$ T cell subsets (Th1, Th17, and Treg cells) were calculated by multiplying the percentage of each subset by the absolute number of total CD4$^+$ T cells. (3) Oxidative stress indicators: serum superoxide dismutase (SOD) level was detected by xanthine oxidase method (ST362, Beyotime biotechnology, Shanghai, China) with nitro-blue tetrazolium (NBT) [16], and serum malondialdehyde (MDA) was detected by thiobarbituric acid spectrophotometry method (S0131S, Beyotime biotechnology, Shanghai, China) [17].

Statistical Analysis

IBM SPSS 26.0 (IBM Corp., Chicago, IL, USA) was used for statistical analysis, and Graphpad Prism 6.0 (Dotmatics, Boston, MA, USA) was used for graphing. Continuous variables were expressed as mean ± standard deviation or median (25th, 75th), and differences between two groups were compared using *t*-test or Man-Whitney test. Categorical variables were expressed as frequencies (percentages) and chi-square tests was used to compare the differences between the two groups. The differences in TNF-α, IL-6, peripheral blood CD4$^+$ T cell counts, SOD and MDA levels between colchicine and control patients after PCI treatment were compared using the independent samples *t*-test. The differences in TNF-α, IL-6, peripheral

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Table 2. Effect of colchicine on TNF-α (µg/L) and IL-6 (ng/L) after PCI in patients with coronary heart disease complicated with gout.

	TNF-α (µg/L)				IL-6 (ng/L)			
	PCI Pre	PCI Post	*t* value	*p* value	PCI Pre	PCI Post	*t* value	*p* value
Colchicine group	59.7 ± 7.9	22.5 ± 4.9	31.332	<0.001	59.4 ± 16.1	21.3 ± 12.8	52.516	<0.001
Control group	59.3 ± 8.7	41.6 ± 4.1	14.197	<0.001	60.9 ± 17.5	40.9 ± 17.5	18.176	<0.001
t value	0.287	–23.867			–0.520	–7.267		
p value	0.775	<0.001			0.604	<0.001		

TNF-α, tumor necrosis factor-α; IL-6, interleukin-6; PCI, percutaneous coronary intervention.

Table 3. Logistic regression of colchicine on residual inflammation risk (hs-CRP ≥2 mg/L).

	B	S.E.	Wald χ^2 values	*p* value	OR (95% CI)
Unadjusted	–1.022	0.365	7.828	0.005	0.360 (0.176, 0.736)
Model 1	–1.034	0.369	7.827	0.005	0.356 (0.172, 0.734)
Model 2	–1.012	0.378	7.158	0.007	0.364 (0.173, 0.763)
Model 3	–0.989	0.444	4.955	0.026	0.372 (0.156, 0.889)

Model 1: Adjusted for age and sex.

Model 2: BMI, smoking, diabetes, hypertension, hyperlipidemia, and symptom-to-PCI start time were adjusted on the basis of Model 1.

Model 3: Systolic blood pressure, diastolic blood pressure, hs-TnI, neutrophil count, TG, TC, LDL-C, and serum creatinine were adjusted on the basis of Model 2.

OR, odds ratio; CI, confidence interval; hs-CRP, hypersensitivity C-reactive protein.

blood $CD4^+$ T cell counts, SOD and MDA levels in the same group before PCI and after PCI treatment were compared using the paired-sample *t*-test. Patients with hs-CRP ≥2 mg/L were defined as having residual inflammatory risk [18]. The association between colchicine treatment and the risk of residual inflammation was analyze by logistic regression using the control group as a reference. $p < 0.05$ was considered statistically significant differences.

Results

Clinical Characteristics

As shown in Table 1, a total of 128 patients with CHD combined with gout who underwent PCI were included in this study. Patients in the colchicine group were 58.7 ± 11.0 years. There were 41 males in the colchicine group. In the colchicine group, 45.3% (29/64), 45.3% (29/64), 56.3% (36/64), and 59.4% (38/64) had smoking history, diabetes history, hypertension history, and hyperlipidemia history, respectively. Patients in the colchicine group had a BMI of 26.5 ± 4.0 kg/m^2, systolic blood pressure of 141.5 ± 12.0 mmHg, and diastolic blood pressure of 75.5 ± 16.8 mmHg. In the colchicine group, triglyceride (TG), total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), and serum creatinine levels were 1.67 (1.30, 2.84) mmol/L, 4.96 ± 1.06 mmol/L, respectively, 2.52 ± 0.48 mmol/L and 74 ± 14 µmol/L. The patients in the control group were 60.9 ± 9.7 years. There are 37 males in the control group. In the control group, 42.2% (27/64), 40.6% (26/64), 60.9% (39/64) and 67.2% (43/64) had smoking history, diabetes history, hypertension history and hyperlipidemia history, respectively. In the control group, BMI was 25.4 ± 5.6 kg/m^2, systolic blood pressure was 137.1 ± 12.6 mmHg, and diastolic blood pressure was 74.0 ± 17.2 mmHg. In the control group, TG, TC, LDL-C, and serum creatinine levels were 1.71 (1.29, 2.14) mmol/L, 4.54 ± 1.10 mmol/L, 2.63 ± 0.39 mmol/L, and 71 ± 16 mol/L, respectively. Colchicine was associated with higher systolic blood pressure, higher neutrophil counts, and higher TC levels compared with controls ($p < 0.05$). However, there was no significant difference between the two groups in age, gender, smoking history, disease history, BMI, time from symptom onset to PCI, blood pressure, hypersensitivity troponin I (hs-TnI), neutrophils, TG, TC, LDL-C, and serum creatinine, which were balanced and comparable ($p > 0$ .05).

Effect of Colchicine on Systemic Inflammatory Parameters TNF-α and IL-6

As shown in Table 2, TNF-α levels in patients in the colchicine group (59.7 ± 7.9 µg/L) were not significantly different from control group (59.3 ± 8.7 µg/L) before PCI ($p > 0.05$). After PCI, TNF-α levels decreased significantly in both groups and were significantly lower in the colchicine group than control group (22.5 ± 4.9 vs 41.6 ± 4.1 µg/L, $p < 0.001$). Before PCI, IL-6 levels were not significantly different between patients in the colchicine group and controls (59.4 ± 16.1 vs 60.9 ± 17.5 ng/L, $p > 0.05$). After PCI, IL-6 levels decreased significantly in

Table 4. Effect of colchicine on CD4$^+$ T cell subsets in peripheral blood of patients with coronary heart disease complicated with gout after PCI.

	Th1 (cells/μL)				Th17 (cells/μL)				Regulatory T cells (cells/μL)			
	PCI Pre	PCI Post	*t* value	*p* value	PCI Pre	PCI Post	*t* value	*p* value	PCI Pre	PCI Post	*t* value	*p* value
Colchicine group	127 ± 79	170 ± 75	–12.455	<0.001	12 ± 3	20 ± 3	–62.544	<0.001	30 ± 11	51 ± 11	–29.934	<0.001
Control group	129 ± 62	134 ± 57	–3.178	<0.001	11 ± 3	16 ± 3	–62.218	<0.001	29 ± 11	34 ± 10	–6.724	<0.001
t value	–0.164	3.055			1.625	6.652			0.466	9.195		
p value	0.870	0.003			0.107	<0.001			0.642	<0.001		

Table 5. Effect of colchicine on SOD (μg/L) and MDA (mmol/L) after PCI in patients with coronary heart disease complicated with gout.

	SOD (μg/L)				MDA (mmol/L)			
	PCI Pre	PCI Post	*t* value	*p* value	PCI Pre	PCI Post	*t* value	*p* value
Colchicine group	268.1 ± 38.6	316.9 ± 38.3	–114.200	<0.001	5.13 ± 1.66	2.44 ± 1.59	8.839	<0.001
Control group	273.7 ± 34.6	293.8 ± 34.5	–73.881	<0.001	4.84 ± 1.28	3.85 ± 1.17	15.101	<0.001
t value	–0.871	3.591			1.127	–5.677		
p value	0.386	<0.001			0.262	<0.001		

SOD, serum superoxide dismutase; MDA, malondialdehyde.

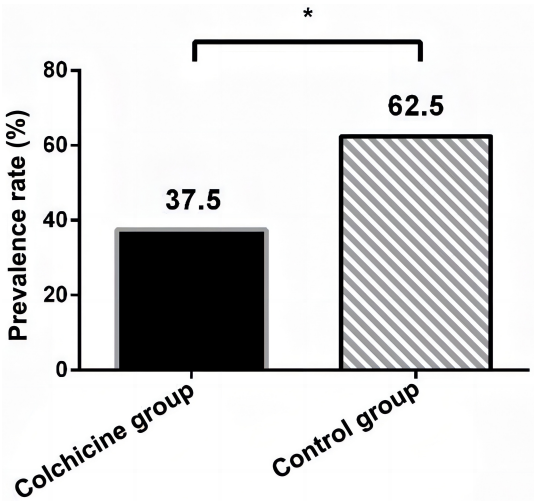

Fig. 1. Proportion of patients at risk for residual inflammation (hs-CRP ≥2 mg/L) in the colchicine and control groups. p = 0.005 (colchicine vs control = 37.5% vs 62.5%). hs-CRP, hypersensitivity C-reactive protein. *$p < 0.05$.

both groups, and IL-6 levels were significantly lower in the colchicine group than in the control group (21.3 ± 12.8 vs 40.9 ± 17.5 ng/L, $p < 0.001$).

Effect of Colchicine on Residual Inflammatory Risk (hs-CRP ≥2 mg/L)

As shown in Fig. 1, patients in the colchicine group had a significantly lower risk of residual inflammation compared with the controls (37.5% vs 62.5%, p = 0.005). we further analyzed logistic regression of colchicine on the risk of residual inflammatory. OR and 95% confidence interval [CI] for patients in the colchicine group were 0.360 (0.176, 0.736) without correction for other factors using the control group as a reference (See Table 3). Model 1, corrected for age and sex, showed a 64.4% reduction in the risk of having residual inflammation in the colchicine group compared to the control group (p = 0.005). Model 2, corrected for BMI, smoking, diabetes, hypertension, hyperlipidemia and symptoms to the start of PCI on the basis of Model 1, was still found to have a 63.6% reduction in the risk of residual inflammation in the colchicine group compared with the control group (p = 0.007). In Model 3, corrected for systolic blood pressure, diastolic blood pressure, hs-TnI, neutrophil count, TG, TC, LDL-C, and serum creatinine on the basis of Model 2, we still found that colchicine use was independently associated with a reduced risk of residual inflammation (OR, 0.372; 95% CI, 0.156–0.889; p = 0.026).

Effect of Colchicine on Peripheral Blood CD4$^+$ T Cell Subsets

As shown in Table 4, there was no significant differences in Th1 cells, Th17 cells, and regulatory T cells in patients in the colchicine group compared with the control group before PCI ($p > 0.05$). After PCI, the Th1 cells were significantly increased in both groups, and Th1 cell counts were significantly higher in the colchicine group than control group (170 ± 75 vs 134 ± 57 cells/μL, $p <$ 0.01). After PCI, Th17 cells were significantly increased in both groups, and there were significantly more Th17 cells in the colchicine group than control group (20 ± 3 vs 16 ± 3 cells/μL, $p < 0.01$). Compared with controls, patients in the colchicine group had significantly more regulatory T cell counts after PCI (51 ± 11 vs 34 ± 10, $p < 0.01$).

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Effect of Colchicine on Oxidative Stress Markers SOD and MDA

As shown in Table 5, before PCI, SOD levels and MDA levels in patients in the colchicine group were not significantly different from those in the control group ($p > 0.05$). After PCI, the levels of oxidative stress markers (SOD and MDA) were improved in both groups, and the indicators in the colchicine group were more significantly improved than those in the control group ($p < 0.001$). SOD levels were significantly higher in colchicine patients after PCI compared with controls (316.9 ± 38.3 vs 293.8 ± 34.5 μg/L, $p < 0.001$). After PCI, MDA levels were significantly lower in both groups, and were significantly lower in the colchicine group than control group (2.44 ± 1.59 vs 3.85 ± 1.17 mmol/L, $p < 0.001$).

Discussion

In this study, we found that the intervention with colchicine was associated with a decrease in systemic inflammatory markers and independently with a decrease in the risk of residual inflammation in patients with CHD combined with gout after PCI compared with controls. Colchicine may also have promoted proliferation of peripheral blood $CD4^+$ T cells and improved oxidative stress levels.

Recent evidence suggests that colchicine may also exert anti-inflammatory and immunomodulatory effects in people with coronary heart disease combined with gout in the following ways. Colchicine may act on mast cells and T cells, affecting the expression of interleukins and transforming growth factors, and may also affect the maturation of dendritic cells and antigen presentation process to $CD4^+$ T cells [8]. Evidence suggests that patients with gout have phenotypic abnormalities in peripheral blood T cell subsets, and such phenotypic abnormalities may also be involved in renal impairment in gout [19]. Th17 cells are involved in the pathogenesis of inflammatory and autoimmune diseases by secreting a variety of cytokines, while regulatory T cells maintain their own immune tolerance function by controlling and limiting deleterious immune responses [20,21]. This study found that colchicine may ameliorate immune abnormalities in patients with coronary heart disease and gout after PCI.

Previous mechanistic studies have suggested that the anti-inflammatory effects of colchicine are mainly mediated by affecting the synthesis of microtubulin. Colchicine disrupts cytoskeleton and neutrophil migration by affecting synthesis of microtubulin and inhibiting polymerization of microtubulin [22]. In addition, colchicine mediates the downregulation of nod-like receptor protein 3 inflammatory vesicles, which reduces the production of IL-1β and IL-18, which in turn leads to a decrease IL-6 and hs-CRP concentrations [23]. However, clinical studies of colchicine anti-inflammatory therapy with colchicine have yielded inconsistent evidence. Some studies suggested that elevated hs-CRP levels are associated with an increased risk of recurrent cardiovascular events and increased mortality [24]. In contrast, colchicine did not significantly reduce hs-CRP levels in another randomized controlled trial [25]. However, this present study found that colchicine administration was significantly associated with a decrease in TNF-α, IL-6, and hs-CRP concentrations. Animal study suggests oxidative stress disorders in gout patients, with increased levels of the oxidative stress parameter MDA and decreased anti-oxidative stress parameter SOD [26], while the results of this study suggest that colchicine use is associated with improved levels of oxidative stress.

In this study, from the perspective of population studies, it is clear that the use of colchicine is associated with a decrease in inflammatory markers, an increase in $CD4^+$ T cells, and an improvement in oxidative stress indicators, providing a reference value for the clinical application of colchicine. In addition, the results of this study support the preference of colchicine in people with gout and coronary heart disease. It should be noted that the following limitations remain in this study. First, this study was a small retrospective study and could not address the causal relationship between colchicine and improvement in various parameters, which needs to be addressed in future prospective cohorts or randomized controlled trials. Second, this study included people with coronary heart disease and gout who may have used colchicine or other drugs. While the results of this study suggest a rationale for preferring colchicine, it still needs to be carefully assessed in future clinical practice. Third, the variables measured in this study were limited and may not have been able to correct for some potential confounders. Fourth, we only record the specific number of Th1, Th17 and Treg, but did not record the flow data plots.

Conclusions

In this study, we found that the use of colchicine was associated with a decrease in systemic inflammatory parameters in patients with coronary heart disease and gout after PCI, promoting the proliferation of peripheral blood $CD4^+$ T cells and improving oxidative stress levels, which is worthy of further clinical exploration.

Availability of Data and Materials

All experimental data included in this study can be obtained by contacting the corresponding author if needed.

Author Contributions

YL, RZ and WH designed the research study. BW, ZM and BL performed the research. YL, JP, WY and ZX collected and analyzed the data. YL and ZX drafted this manuscript. All authors contributed to important editorial changes in the manuscript. All authors read and approved

the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of Cangzhou Central Hospital, with the approval number 2022-051-02(z). As this study was a retrospective study, the Ethics Committee of Cangzhou Central Hospital waived oral or written informed consent from patients.

Acknowledgment

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest.

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