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Original Article

CRP-to-lymphocyte ratio as a predictor of MRI-confirmed spondylodiscitis in RBT-positive patients with suspected brucellosis

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Abstract

Introduction: Brucellosis is a zoonotic infection that is endemic in many regions, including Türkiye. Spondylodiscitis is one of its most significant complications. This study evaluated the association of hematologic parameters, particularly C-reactive protein (CRP) and the CRP-to-lymphocyte count (CRP/LC) ratio, with serological titers and magnetic resonance imaging (MRI)-confirmed spondylodiscitis, and explored their potential role as supportive markers for risk stratification and identifying patients who may benefit from further imaging.

Methodology: This retrospective cross-sectional study analyzed 1,568 patients with positive Rose Bengal test results between 2014 and 2022. Hematologic and serologic data were evaluated, and imaging findings [MRI/computed tomography (CT)] were reviewed for spondylodiscitis. Serum tube agglutination (STA) titers ≥ 1/160 were considered as indicative of acute infection. Statistical methods included correlation, multiple linear regression, receiver operating characteristic (ROC) analysis, and non-parametric tests.

Results: STA titers ≥ 1/160 were more frequent in males (68.87%) than females (29.69%) ($p < 0.001$). CRP, LC, and CRP/LC ratio were significantly higher in patients with elevated STA titers and MRI-confirmed spondylodiscitis. Correlations between hematologic markers and STA titers were generally weak to modest. Multiple linear regression identified CRP and LC as independent predictors of STA titer. ROC analysis showed that CRP (AUC: 0.67; area under the curve) and CRP/LC ratio (AUC: 0.66) had the highest discriminative performance. MRI-confirmed spondylodiscitis was detected in 2.3% patients.

Conclusions: CRP and CRP/LC ratio appear to be useful supportive markers for identifying patients with high STA titers and MRI-confirmed spondylodiscitis and may help clinicians prioritize imaging studies in specific cases.

Key words: brucellosis; C-reactive protein; lymphocytes; spondylodiscitis; imaging.

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Introduction

Brucellosis is one of the most common zoonotic infections worldwide and remains a serious public health problem, particularly in endemic regions such as Türkiye [1,2]. The disease can affect multiple organs and systems, but osteoarticular involvement is the most frequent focal complication. Among these, spondylodiscitis is one of the most severe manifestations, often causing chronic pain, disability, and neurological deficits when diagnosis and treatment are delayed [3–5]. Despite progress in imaging and serological testing, early diagnosis of brucellar spondylodiscitis remains difficult. The Rose Bengal test (RBT) and serum tube agglutination (STA) test are widely used for serologic confirmation [6], yet antibody titers may not always correspond to disease severity. Some patients with magnetic resonance imaging (MRI)-confirmed spondylodiscitis present with low or even negative STA titers [7].

The immune response in brucellosis involves complex activation of both innate and adaptive components [8]. C-reactive protein (CRP) reflects acute-phase inflammation, while lymphocyte count (LC) indicates adaptive immune competence. The CRP/LC ratio combines these parameters, offering an integrated view of systemic inflammation and immune modulation, and has been applied in the infectious disease literature as a prognostic or diagnostic marker [9]. However, its role in brucellosis is not established. Previous studies have shown that CRP levels and hematologic indices such as the neutrophil count (NC)-to-lymphocyte count ratio (NLR) are altered in brucellosis [3,5]. However, the potential supportive role of CRP/LC in identifying spondylodiscitis has not yet been clearly defined.

This study aimed to evaluate whether CRP and the CRP/LC are associated with higher STA titers and with MRI-confirmed spondylodiscitis in RBT-positive patients with suspected brucellosis. The hypothesis was that elevated CRP/LC values could identify patients at

increased risk for spinal involvement even when STA titers were low or equivocal. By integrating serological, hematological, and imaging data, this study evaluated whether CRP/LC may serve as a simple and cost-effective adjunctive marker to support clinical decision-making and to help identify patients who may benefit from MRI evaluation for suspected brucellar spondylodiscitis.

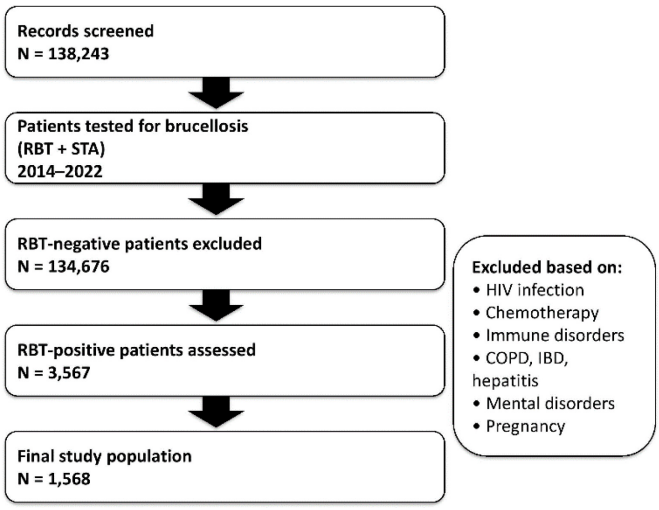
Methodology

Ethical approval for this retrospective, cross-sectional study was obtained from the Non-Interventional Clinical Research Ethics Committee of Gaziantep Islam Science and Technology University (Decision No: 170.21.07, dated 01.10.2023).

A total of 138,243 patient records were retrospectively reviewed from individuals who presented to the infectious diseases' outpatient clinics of Dr. Ersin Arslan Training and Research Hospital between 1 January 2014 and 31 October 2022, with complaints such as fever, fatigue, weight loss, joint or back pain, abdominal discomfort, nausea, vomiting, or hepatosplenomegaly. These patients were tested for brucellosis using the RBT and STA test [1,10].

A total of 134,676 patients with negative RBT results were excluded. Repeat test results from follow-up visits were also excluded from the remaining 3,567 RBT-positive patients. Additional exclusion criteria included patients with human immunodeficiency virus (HIV) infection, those undergoing chemotherapy, and individuals with immune-related conditions such as asthma, chronic obstructive pulmonary disease, inflammatory bowel disease, hepatitis, acute coronary syndrome, or mental health disorders (e.g., depression, bipolar disorder). Patients with hearing impairments, communication difficulties, or pregnancy were likewise excluded. After applying these criteria, a total of 1,568 unique patients were included in the final analysis (Figure 1).

Figure 1. Flowchart of the study.



COPD: chronic obstructive pulmonary disease; HIV: human immunodeficiency virus; IBD: inflammatory bowel disease; RBT: Rose Bengal test; STA: serum tube agglutination.

Venous blood samples were collected from all RBT-positive patients at admission. Complete blood counts and biochemical parameters were measured using standard automated analyzers in the hospital's central laboratory. CRP levels were recorded in milligrams per liter (mg/L), and LC were obtained as × 10^9/L. CRP/LC was calculated by dividing the serum CRP concentration by the absolute LC. NLR was also calculated for comparative analysis as the absolute NC divided by the LC.

RBT is a screening method that detects *Brucella* antibodies using an antigen prepared by staining the *Brucella abortus* S99 strain with Rose Bengal dye. For the procedure, 1 drop of serum was placed on a clean slide, followed by 1 drop of antigen from the Sero-Lam *Brucella* Rose Bengal Plate Test kit (SEROMED, İstanbul, Türkiye). The slide was manually rotated for 4 minutes and examined for agglutination. Samples showing agglutination were considered positive; those without were deemed negative. Patients with positive screening results underwent the STA test (SEROMED, İstanbul, Türkiye). The titer levels were determined and categorized as follows: 1) 0–1/40, 2) 1/41–1/80, 3) 1/81–1/160, 4) 1/161–1/320, 5) 1/321–1/640, 6) 1/641–1/1280 and 7) 1/1280. Positive RBT results were confirmed with STA, which measures the total level of agglutinating antibodies (IgG and IgM). STA titers of 1/160 or higher were accepted as indicative of acute infection [11,12].

MRI was performed in a selected subgroup of patients with clinical suspicion of spondylodiscitis, particularly those presenting with persistent back pain and neurological symptoms or deficits, such as radicular pain, sensory disturbances, or motor weakness. The diagnosis of spondylodiscitis on MRI required the presence of characteristic signal changes, including T1-weighted hypointensity and T2-weighted or short tau inversion recovery (STIR) hyperintensity involving the adjacent vertebral endplates and intervertebral discs. Post-contrast enhancement of the endplates and disc space was also required for confirmation. Associated findings such as paravertebral or epidural abscess formation were recorded when present.

Table 1. Comparison of genders in terms of age and certain hematological parameters.

	Male	Female	
Age	38 (24–51)	44 (33–56)	$p < 0.001$
CRP (mg/L)	6.2 (2.0–26.4)	4.7 (1.8–12.3)	$p < 0.001$
LC	2.46 x 10^3/µL (2.01–3.13)	2.39 x 10^3/µL (1.90–2.96)	$p < 0.05$
NC	3.70 x 10^3/µL (2.72–5.17)	3.74 x 10^3/µL (2.72–4.91)	$p > 0.05$
MC	0.60 x 10^3/µL (0.45–0.78)	0.51 x 10^3/µL (0.40–0.65)	$p < 0.001$
NLR	1.46 (1.0–2.2)	1.47 (1.0–2.12)	$p > 0.05$
CRP/LC	2.57 (0.77–9.81)	1.91 (0.74–5.18)	$p < 0.01$
MC/LC	0.24 (0.17–0.32)	0.21 (0.16–0.28)	$p < 0.001$
*Titration level in STA test ≥ 1/160 (%)	68.87	29.69	$p < 0.001$

CRP, C - reactive protein; LC, lymphocyte count; MC, monocyte count; NC, neutrophil count; NLR, neutrophil count/lymphocyte count ratio; STA, serum tube agglutination. Descriptive variables of the male and female patients are expressed in terms of median and first–third quartile range [median (Q_1–Q_3)]. * ≥ 1/160 corresponds to the titration values which are 1/160 and greater. Age, CRP, LC, NC, MC, NLR, CRP/LC and MC/LC variables were compared by using Mann-Whitney U test. Titration levels between genders were compared by using Pearson Chi-square test.

Statistical analyses

All statistical analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp, Armonk, NY, USA). The Kolmogorov–Smirnov test was used to assess the normality of data distribution. Normally distributed variables were expressed as mean ± standard deviation (SD), whereas non-normally distributed variables were expressed as median (interquartile range) (Q1–Q3).

Intergroup comparisons were performed using the independent-samples t-test for normally distributed data and the Mann–Whitney U test for non-normal data. The Kruskal–Wallis test followed by Dunn's post hoc test was applied for multiple group comparisons of non-normally distributed variables. Categorical variables were analyzed using the Pearson Chi-square test or Fisher's exact test, as appropriate, and effect sizes were reported as contingency coefficient (CC), Phi, or Cramer's V.

Spearman's rank correlation coefficient was used to evaluate associations between continuous variables, including CRP, CRP/LC, and STA titers. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the ability of hematological markers to discriminate between patients with STA titers ≥ 1/160 and those with MRI-confirmed spondylodiscitis. The area under the curve (AUC), optimal cutoff values, sensitivity, and specificity were reported. A p value < 0.05 was considered statistically significant.

Results

A total of 514 male and 1,054 female patients with suspected brucellosis were included in the study. The median age of the males was significantly lower than that of the females ($p < 0.001$). Median CRP and LC values were significantly higher in males ($p < 0.001$ and $p = 0.01$, respectively). Monocyte count (MC) was also markedly higher in males ($p < 0.001$). There were no significant differences in NC or NLR levels between the genders. However, both CRP/LC ($p < 0.01$) and MC/LC ($p < 0.001$) were significantly elevated in males (Table 1).

Among all the patients, 37.1% had a positive STA

Table 2. Correlations between STA titers and hematologic parameters (Spearman's rho).

		Age	CRP	LC	MC	NC	CRP/LC	NLR	MC/LC	Titration
Age	Spearman's rho	1	0.133**	- 0.007	0.066*	0.057*	0.128**	0.057*	0.070**	- 0.003
	p		< 0.001	0.775	0.012	0.029	< 0.001	0.030	0.008	0.912
CRP	Spearman's rho		1	- 0.015	0.224**	0.098**	0.970**	0.066*	0.207**	0.320**
	p			0.593	< 0.001	0.001	< 0.001	0.021	< 0.001	< 0.001
LC	Spearman's rho			1	0.271**	0.191**	- 0.223**	- 0.435**	- 0.480**	0.084**
	p				< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002
MC	Spearman's rho				1	0.314**	0.151**	0.090**	0.645**	0.115**
	p					< 0.001	< 0.001	0.001	< 0.001	< 0.001
NC	Spearman's rho					1	0.050	0.747**	0.133**	- 0.145**
	p						0.076	< 0.001	< 0.001	< 0.001
CRP/LC	Spearman's rho						1	0.162**	0.308**	0.290**
	p							< 0.001	< 0.001	< 0.001
NLR	Spearman's rho							1	0.415**	- 0.170**
	p								< 0.001	< 0.001
MC/LC	Spearman's rho								1	0.041
	p									0.129
Titration	Spearman's rho									1
	p									

Values are expressed as Spearman's correlation coefficient (ρ). ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). CRP: C–reactive protein; LC: lymphocyte count; MC: monocyte count; NC: neutrophil count; NLR: neutrophil count/lymphocyte count ratio: STA: serum tube agglutination test titration. Titration, individuals were ranked according to the titration results in increasing order.

Table 3. Age, CRP, LC, MC, NC and NLR compared between the two groups of patients who had STA titration values < 1/160 and ≥ 1/160.

	All cases			Female			Male			
	STA titration ≥ 1/160	**STA titration < 1/160**	***p***	**STA titration ≥ 1/160**	**STA titration < 1/160**	***p***	**STA titration ≥ 1/160**	**STA titration < 1/160**	***p***	****p***
Age	42.50 (28.00–57.00)	42.00 (31.00–52.00)	$p = 0.719$	47.50 (32.00–58.00)	43.00 (33.00–53.00)	**$p < 0.01$**	36.00 (27.75 – 52.00)	39.00 (26.00–51.00)	$p = 0.23$	**$p < 0.001$**
CRP	9.50 (3.13–29.90)	3.43 (1.30–8.50)	**$p < 0.001$**	8.50 (3.00–24.70)	3.40 (1.35–8.30)	**$p < 0.001$**	11.10 (3.35 – 37.81)	3.50 (1.30–10.50)	**$p < 0.001$**	$p = 0.063$
LC	2.50 (1.90–2.90)	2.38 (1.98–3.15)	**$p < 0.01$**	2.44 (1.92–3.07)	2.37 (1.90–2.89)	$p = 0.073$	2.54 (2.01 – 3.25)	2.40 (1.96–2.92)	**$p = 0.033$**	$p = 0.073$
MC	0.55 (0.42–0.67)	0.52 (0.2–0.64)	**$p < 0.01$**	0.52 (0.42–0.67)	0.50 (0.38–0.64)	**$p = 0.015$**	0.59 (0.44 – 0.77)	0.59 (0.44–0.79)	$p = 0.876$	**$p < 0.001$**
NC	3.43 (2.62–4.44)	3.89 (2.85–5.15)	**$p < 0.001$**	3.52 (2.62–4.44)	3.87 (2.81–5.15)	**$p < 0.001$**	3.50 (2.63 – 4.91)	4.13 (2.85–5.60)	**$p < 0.01$**	$p = 0.22$
NLR	1.33 (1.00–1.95)	1.55 (1.00–2.88)	**$p < 0.001$**	1.33 (1.00–1.91)	1.51 (1.00–2.22)	**$p < 0.001$**	1.29 (1.00 – 1.97)	1.68 (1.01–2.43)	**$p < 0.001$**	$p = 0.51$
CRP/LC	3.73 (1.26–11.68)	1.37 (0.58–3.66)	**$p < 0.001$**	3.27 (1.20–10.29)	1.38 (0.60–3.66)	**$p < 0.001$**	4.51 (1.33 – 14.55)	1.33 (0.56–4.67)	**$p < 0.001$**	$p = 0.10$
MC/LC	0.22 (0.17–0.30)	0.21 (0.16–0.29)	$p = 0.503$	0.21 (0.17–0.28)	0.20 (0.15–0.28)	$p = 0.394$	0.23 (0.16 – 0.31)	0.24 (0.18–0.32)	$p = 0.256$	$p = 0.052$

All pairwise comparisons were executed by using Mann-Whitney U test. Continuous variables are presented as median (Q1–Q3) due to non-normal distribution. **p*, all cases with STA ≥ 1/160 compared according to the genders. CRP: C–reactive protein; LC: lymphocyte count; MC: monocyte count; NC: neutrophil count; NLR: neutrophil count/lymphocyte count ratio; Q1: first quartile; Q3: third quartile; STA: serum tube agglutination test titration.

result with a titer of 1/40, 18.8% at 1/80, 13.9% at 1/160, and 30.3% at titers above 1/160. STA titers differed significantly between genders: the median titer in males was 1/160 (interquartile range 1/40–1/640), while in females it was 1/80 (1/40–1/160) ($p < 0.001$). The Chi-square test demonstrated a significant association between gender and the frequency of high STA titers (≥ 1/160). High titers were more frequently observed in males (354/514) than in females (313/1054) ($\chi^2 = 47.94$, $p < 0.001$). (Table 1).

Table 2 presents the correlations between STA titers and hematologic parameters. Although several associations were statistically significant, the correlation coefficients were generally weak to modest, indicating limited clinical relevance. The strongest association with STA titers was observed for CRP, followed by LC and MC; while overall relationships with inflammatory and immune-related parameters remained modest.

Patients with STA ≥ 1/160 had significantly higher CRP, LC, MC, and CRP/LC; while NC and NLR were lower. Higher titers (≥ 1/160) in females were associated with older age; increased CRP, MC, and CRP/LC; and lower NC and NLR values. CRP, LC, and CRP/LC were significantly higher; and NC and NLR lower; among the males with higher titers (Table 3).

A multiple linear regression analysis was performed to assess whether CRP, LC, MC, NC, NLR, and age predicted STA titer levels. The overall model was significant ($F = 12.244$, $p < .001$), with an adjusted R^2 of 0.055, indicating that the model explained approximately 5.5% of STA titer variability. Among the predictors, CRP was the strongest independent variable ($\beta = 0.217$, $p < 0.001$), followed by LC ($\beta = 0.080$, $p = 0.002$) (Table 4).

In ROC analysis, the optimal cut-off values for CRP and CRP/LC provided the best balance of sensitivity and specificity for detecting STA ≥ 1/160. CRP ≥ 5.05 mg/L in males and ≥ 4.13 mg/L in females showed the highest discriminatory performance. Other hematologic parameters did not show significant discriminative performance (Figure 2).

MRI was not feasible in a subset of patients (n = 36), due to contraindications, including pacemaker implantation, metallic devices, or severe claustrophobia. Therefore, computed tomography (CT) imaging was performed as an alternative modality for radiological assessment. CT scans were obtained from

Table 4. Multiple linear regression analysis with the assigned independent variables of CRP, lymphocyte, monocyte, neutrophil, NLR, and age; and dependent variable of titration level in STA.

	B	**Std. Error**	**ß**	***p***
(Constant)	2.162	0.236		< 0.001
CRP	0.013	0.002	0.217	< 0.001
LC	0.162	0.068	0.080	0.002
MC	0.193	0.224	0.027	0.388
NC	0.014	0.012	0.112	0.238
NLR	- 0.051	0.034	- 0.142	0.138
Age	- 0.003	0.003	- 0.024	0.409

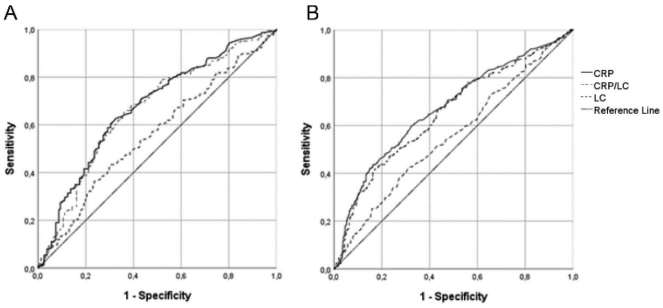
Model: adjusted R^2 value = 0.055 ($p < 0.001$). CRP: C–reactive protein; LC: lymphocyte count; MC: monocyte count; NC: neutrophil count; NLR: neutrophil count/lymphocyte count ratio.

22 female and 14 male patients. Sacral spondylodiscitis was identified in a 15-year-old male (STA = 1/320), cervical spondylodiscitis in a 21-year-old male (STA = 1/1280), and lumbar spondylodiscitis in a 54-year-old female (STA = 1/160).

MRI was performed in 179 patients, including 66 males. Spondylodiscitis was diagnosed in 18 females and 18 males. Among males, MRI revealed cervical involvement in 1, thoracic in 2, lumbar in 9, and sacral in 6 cases. Among females, thoracic involvement occurred in 2, lumbar in 6, and sacral in 10 cases (Table 5).

Out of all the laboratory parameters, only STA titers differed significantly between patients who underwent MRI and those who did not ($p < 0.001$, Mann–Whitney U test). The CRP values were significantly higher in patients with MRI-confirmed spondylodiscitis [10.15 (3.75–31.82)] than in those without [5.00 (1.80–15.17)] ($p = 0.02$).

Figure 2. Discriminative performance of hematological markers for STA titers ≥1/160. ROC analysis results.



CRP: C-reactive protein; LC: lymphocyte count; STA: serum tube agglutination; ROC: receiver operating characteristic.

Table 5. Patients with diagnosis of spondylodiscitis.

	n	Diagnosis of spondylodiscitis (n)	Age (years)	Gender	Titration level in STA test	Region of the spondylodiscitis
Computed tomography scanned	36	3	15	M	1/320	Sacral
			21	M	1/1280	Cervical
			54	F	1/160	Lumbar
Magnetic resonance imaging scanned	179	36	26	F	1/20	Sacral
			38	F	1/320	Sacral
			75	F	1/320	Thoracic
			66	M	1/40	Lumbar
			16	M	1/320	Cervical
			24	F	1/160	Lumbar
			52	F	1/640	Lumbar
			39	M	1/160	Sacral
			54	M	1/640	Lumbar
			51	F	1/320	Sacral
			49	M	1/1280	Lumbar
			34	M	1/160	Lumbar
			75	F	1/640	Thoracic
			46	M	1/2560	Lumbar
			35	M	1/2560	Lumbar
			52	F	1/320	Lumbar
			16	F	1/160	Sacral
			22	M	1/160	Sacral
			54	F	1/160	Lumbar
			39	M	1/80	Thoracic
			75	M	1/640	Lumbar
			48	M	1/40	Sacral
			38	F	1/320	Lumbar
			59	M	1/320	Lumbar
			43	F	1/640	Lumbar
			18	F	1/320	Sacral
			50	M	1/320	Thoracic
			50	M	1/40	Sacral
			54	F	1/320	Sacral
			27	M	1/40	Sacral
			32	M	1/80	Lumbar
			52	F	1/1280	Sacral
			46	F	1/320	Sacral
			38	F	1/1280	Sacral
			42	M	1/40	Sacral
			37	F	1/160	Sacral

F: female; M: male; STA: serum tube agglutination test titration.

Similarly, STA titers were higher in MRI-positive patients [1/320 (1/160–1/640)] than in MRI-negative patients [1/160 (1/40–1/640)] ($p = 0.04$). The CRP/LC ratio was also elevated in MRI-positive cases [4.36 (1.77–13.78)] compared with MRI-negative cases [2.03 (0.75–6.32)] ($p = 0.04$). Although these findings were statistically significant ($p = 0.04$ and 0.04), their borderline nature warrants cautious interpretation [13]. No significant differences were observed for age, LC, NC, MC, or NLR ($p > 0.05$ for all).

Importantly, 8 patients with MRI-confirmed spondylodiscitis had STA titers below 1/160, yielding serologically non-confirmatory results. Additionally, the proportion with titers ≥ 1/160 was significantly higher among all patients who underwent MRI, than among those without MRI ($\chi^2 = 7.542$, $p < 0.01$).

Discussion

This study evaluated the potential role of CRP/LC in RBT-positive patients with suspected brucellosis and its relationship with MRI-confirmed spondylodiscitis. The main findings were that both CRP and CRP/LC were significantly higher in patients with elevated STA titers and in those with MRI evidence of spinal involvement. Importantly, CRP/LC remained informative even in cases with low or non-confirmatory STA titers, suggesting that it may help identify patients with possible spinal involvement, particularly MRI-confirmed spondylodiscitis, when standard serologic tests are inconclusive.

Brucellosis remains a diagnostic challenge due to its wide clinical spectrum and nonspecific laboratory findings. Although STA is still considered the standard serologic test, antibody titers do not always correspond to disease activity or focal organ involvement. In a previous study, seronegativity was reported in 22 of 200 patients with confirmed brucellar spondylitis. However, this study also indicates that STA titers have a high sensitivity in patients with brucellar spondylitis [14]. Another study reported that all 22 patients with brucellar spondylodiscitis had STA titers of ≥ 1/160 [15]. Taken together, these findings suggest that serologic titers may not always fully reflect focal spinal involvement in brucellosis.

The associations between CRP, lymphocyte count (LC), and STA titers observed in the regression analysis suggest a relationship between inflammatory markers and serologic activity in brucellosis. However, these findings should be interpreted with caution, as the regression analysis does not establish causality. Although CRP remained the strongest independent predictor, the overall explanatory power of the model was limited (adjusted $R^2 = 0.055$), indicating that other clinical and biological factors likely contribute to STA variability [1,6,10]. The association with LC, although modest, may reflect underlying immunological processes, but this interpretation remains speculative and requires further investigation [8].

ROC analysis further demonstrated that CRP and the CRP/LC may assist in identifying patients with higher STA titers (≥ 1/160) and MRI-confirmed spondylodiscitis. CRP cut-off values of ≥ 5.05 mg/L in males and ≥ 4.13 mg/L in females showed the highest discriminative performance in this cohort. CRP/LC provided additional discriminatory value, particularly in patients with borderline serologic findings [9]. These findings suggest that CRP/LC may serve as a simple and cost-effective adjunctive marker to complement STA testing. By integrating inflammatory and immune-related indices, CRP/LC may support clinical decision-making and help identify patients who could be considered for further imaging, including MRI, rather than serving as a standalone or definitive tool for prioritizing imaging [3,5].

The present findings also underscore the diagnostic challenges of brucellosis, particularly in patients with MRI-confirmed spondylodiscitis and low or non-confirmatory serologic results. Eight patients in this cohort had MRI-confirmed spondylodiscitis despite STA titers below 1/160, indicating that low serologic titers do not exclude spinal involvement [7]. Elevated CRP and CRP/LC values may provide additional supportive information in these cases, suggesting that inflammatory biomarkers can complement clinical assessment in the early recognition of spondylodiscitis. Although the *p* values for CRP/LC and STA differences in MRI-positive versus MRI-negative groups were borderline (0.040–0.049), these findings should be interpreted with caution, particularly given the limited size of the MRI-positive subgroup [13].

Several limitations should be acknowledged. First, this was a retrospective, single-center study based primarily on serologic and imaging findings. The absence of microbiological confirmation (e.g., positive culture or polymerase chain reaction, PCR) limits the ability to fully exclude other infectious etiologies, a challenge common to studies in endemic regions. Nevertheless, the consistent clinical presentation, high regional prevalence, and typical MRI features support the likelihood of *Brucella* etiology. Second, MRI was not performed in all RBT-positive patients, which may have led to underestimation of spondylodiscitis prevalence. Third, although the regression models demonstrated statistically significant associations, their

explanatory power was modest, suggesting that multiple factors contribute to STA variability. Finally, due to the retrospective nature of data collection, important clinical variables such as symptom duration and prior antibiotic exposure were not consistently available, limiting the ability to distinguish disease stages and to control for potential confounders.

Future prospective studies incorporating microbiological verification and comprehensive clinical data are needed to validate these findings and to further evaluate the potential role of CRP/LC in supporting clinical decision-making regarding MRI evaluation.

Conclusions

In this large cohort of RBT-positive patients with suspected brucellosis, higher CRP and CRP/LC values were significantly associated with elevated STA titers and MRI-confirmed spondylodiscitis. These findings suggest that CRP/LC, reflecting the balance between systemic inflammation and adaptive immune response, may serve as a practical adjunctive biomarker to identify patients at increased risk of spinal involvement—even when serologic titers are low or inconclusive. Although the discriminative performance of CRP/LC was modest and its interpretation is limited by the retrospective design and lack of microbiological confirmation, it may serve as a simple and cost-effective parameter that could support clinical decision-making regarding MRI evaluation, particularly in settings where imaging resources are limited. Future prospective, multicenter studies incorporating microbiological verification are warranted to validate these results and define optimal CRP/LC thresholds for clinical use.

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Data availability statement

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

Authors' contributions

MG: idea/hypothesis; HG, HB: design; SA, AŞ, İHT: data collection/data processing; MG, SA, HB, AŞ, İHT: data analysis; MG, İHT: manuscript preparation.

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Conflict of interest

No conflict of interest is declared.

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