Original paper

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Correlation between erythrocyte sedimentation rate and C-reactive protein level in patients with rheumatic diseases

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Abstract

Objectives: Erythrocyte sedimentation rate (ESR) and serum level of C-reactive protein (CRP) are the acute phase reactants most commonly determined in patients with rheumatic diseases. The indices are affected by different factors, but both of them are applied for evaluation of the disease activity in patients with inflammatory disorders of the musculoskeletal system.

Material and methods: The authors compared the results of ESR and CRP, which were carried out during routine diagnosis in 200 patients admitted to the Department of Rheumatology.

Results: A significant correlation between ESR and CRP was found (ESR after 1 h/CRP: correlation coefficient 0.6944, ESR after 2 h/CRP: correlation coefficient 0.6126). There was no difference in ESR or CRP between male and female patients, and patients older than 40 years had higher ESR and CRP.

Conclusions: The obtained results support the usefulness of both indices in the clinical practice of rheumatologists.

Key words: erythrocyte sedimentation rate, C-reactive protein, rheumatic diseases.

Introduction

The erythrocyte sedimentation rate (ESR) is the oldest acute phase index. The phenomenon was described by John Hunter [1] and applied as a laboratory test by Edmund Biernacki [2]. Erythrocyte sedimentation rate was probably the most commonly used laboratory test in the 20th century. Currently, the clinical usefulness of ESR is questioned, and the C-reactive protein (CRP) level is widely applied. C-reactive protein was discovered in 1930 by William S. Tillet and Thomas Francis, and the test has experienced a revival in the last two decades due to the discovery of the role of inflammation in atherosclerotic disease [3, 4].

Despite the diminished role of ESR in modern diagnostics, the test is still used in rheumatology. Moreover, some disease activity indices are based on either ESR or CRP. This applies to the indices DAS and DAS28 used to determine activity of rheumatoid arthritis [5].

The comparative value of ESR and CRP in measuring disease activity was investigated in groups of patients with certain rheumatic disorders. De Vries et al. [6] reported that ESR and CRP (as well as serum amyloid A) were significantly associated with the Bath Ankylosing Spondylitis Activity Index in 15 155 patient with ankylosing spondylitis, and the ESR association was the strongest. The erythrocyte sedimentation rate and CRP are found to be sensitive markers of disease activity in patients with rheumatoid arthritis, as reviewed by Ruof and Stucki [7]. The juvenile arthritis disease activity score is calculated using ESR or CRP, and Nordal et al. [8] found that results of both ways of calculation of the score lead to very similar results. Thus they recommended both of them for assessing disease activity in patients with juvenile idiopathic arthritis. Several other reports indicate similar alterations in ESR and CRP in various diseases including systemic lupus erythematosus (SLE) [9] and rheumatoid arthritis (RA) [10, 11].

The present study was designed to determine the correlation of ESR and CRP in patients admitted to the rheumatologic ward due to various rheumatic disorders.

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Material and methods

We evaluated the results of the documentation of 200 patients admitted consecutively to the Department of Internal Medicine and Rheumatology in Katowice who were routinely diagnosed. The patients suffered from various disorders, but all of them represented more severe cases than average patients with rheumatic disease, because most of the patients remained under care of the out-patient clinics.

The characteristics of the investigated patients are summarized in Table I. In all patients ESR and CRP were determined at admission with routine methods. The erythrocyte sedimentation rate was measured after the 1st and 2nd hours (denoted as ESR1 and ESR2, respectively).

Table I. Characteristics of patients

Characteristic feature	Result
Male/female	51 (25.5%)/149 (74.5%)
Age (years) (mean ± SD)	48.0 ±14.1
Duration of overt disease (years) (mean ± SD)	6.1 ±5.3

Table II. Erythrocyte sedimentation rate and C-reactive protein and their correlation in all the patients

Indice	Results (x ± SD)
ESR1 (mm/1 h)	25.3 ±21.4
ESR2 (mm/2 h)	50.5 ±31.4
CRP (mg/l)	18.7 ±28.9
correlation ESR1/CRP (correlation coefficient)	0.6944
correlation ESR1/CRP (correlation coefficient)	0.6126
correlation ESR1/ESR2 (correlation coefficient)	0.9524

Results

The erythrocyte sedimentation rate and CRP in all the patients and correlations of the indices are shown in Table II. As expected, enhanced ESR1, ESR2 and CRP were found in the patients. A significant correlation between ESR (both ESR1 and ESR2) and CRP was found. Additionally, a very strong correlation of ESR1 and ESR2 was observed, but it reflects the nature of the ESR phenomenon. In Table III, the patients are divided into subgroups. It was found that the values of ESR and CRP were very similar in female and male patients. Patients older than 40 had higher ESR and CRP.

The most common groups of patients in the investigated cohort were those with RA (60 patients), SLE (25 patients), and systemic sclerosis (19 patients). The next groups of the patients were those with ankylosing spondylitis (17 patients) and systemic vasculitis other than granulomatosis with polyangiitis (formerly Wegener's granulomatosis) (16 patients).

Discussion

The erythrocyte sedimentation rate is a physical phenomenon related to plasma viscosity and the number of red cells. Plasma viscosity, or more precisely the albumin/globulin ratio, is altered in an acute phase reaction and is probably the most significant factor affecting ESR. An additional factor which influences ESR is serum fibrinogen level [12]. The test is simple and very cheap. C-reactive protein is an acute-phase protein belonging to the highly conserved pentraxin family. C-reactive protein is synthesized in the hepatocyte and its

Table III. Erythrocyte sedimentation rate and C-reactive protein in subgroups of the patients

Subgroup of the patients	ESR1	ESR2	CRP	ESR1/CRp	ESR2/CRP
male	26.0 ±18.3	52.1 ±28.7	20.0 ±24.9	0.7057	0.6756
female	25.1 ±22.4	49.9 ±32.3	18.3 ±30.2	0.6916	0.5970
aged < 40 years	21.5 ±18.9	43.7 ±28.3	14.3 ±20.7	0.6608	0.3911
> 41 years	27.1 ±22.3	53.7 ±32.4	20.9 ±30.0	0.7057	0.6775
systemic lupus erythematosus	31.2 ±33.2	55.6 ±43.9	19.3 ±38.8	0.8634	0.8476
rheumatoid arthritis	23.9 ±19.6	49.8 ±31.0	17.0 ±30.6	0.6318	0.6091
systemic vasculitis (other than granulomatosis with polyangiitis)	26.5 ±23.9	52.4 ±35.3	15.9 ±33.9	0.6146	0.5859
ankylosing spondylitis	30.6 ±7.1	59.6 ±16.1	26.7 ±12.4	0.9229	0.8384
systemic sclerosis	23.0 ±16.3	49.6 ±26.5	26.4 ±31.3	0.7358	0.6666

transcription is mainly regulated by interleukin-6. Biological functions of CRP are partially known and include activation of complement via the classical pathway and contribution to opsonization and phagocytosis of some microorganisms as well as clearance of necrotic cells [3].

Our studies did not reveal any difference in the investigated acute phase reactants between female and male patients. Studies on early RA showed that female patients had higher ESR [12]. It is concomitant with other findings that ESR tends to be more elevated in women than in men [13]. There is no generally accepted agreement on sex difference in serum CRP level. Some reports suggested higher values in men [14], while others revealed opposite results [15]. Our studies are concomitant with findings indicating higher ESR and CRP in older patients [12]. It is important to take this into consideration, because the disease activity calculated on the basis of acute phase reactants might be overestimated.

Despite different factors affecting ESR and CRP, a significant positive correlation between the tests was found in all investigated patients and especially in those with ankylosing spondylitis and SLE. In patients with SLE, the correlation between ESR and CRP is not so clear, and the elevation of inflammatory markers is considered to be a factor associated with a poorer prognosis [16]. In the present study, the group of SLE patients was relatively small and as mentioned above showed a strong positive ESR and CRP correlation. Among the patients studied there were no patients with Sjögren's syndrome, but it is known that in this autoimmune disease with hypergammaglobulinemia the ESR is often increased without clinical signs and without a significant increase of CRP, and these patients have not been taken into account.

The obtained results support the view of concomitant application of ESR and CRP in calculation of the disease activity indices in certain disorders, including rheumatoid arthritis, juvenile idiopathic arthritis and ankylosing spondylitis. This finding is concomitant with the suggestion of Kay et al. [17] to obtain both ESR and CRP from rheumatoid arthritis patients at the initial visit. An association of acute phase reaction and radiographic progression of the disease in these patients has also been reported [18]. Similar observations were made in patients with spondyloarthropathies, but the range of the acute reaction in these patients was generally lower [19].

Conclusions

In summary, the performed analysis confirmed the usefulness of both ESR and CRP in the clinical practice of rheumatologists, but understanding of different underlying mechanisms leading to enhanced test results should always be taken into consideration.

The authors declare no conflict of interest.

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