Relationship between erythrocyte sedimentation rate and serum C-reactive protein in rheumatoid arthritis

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SUMMARY Serum C-reactive protein (CRP) and the erythrocyte sedimentation rate (ESR) were compared in 241 patients with rheumatoid arthritis (RA). There was a positive linear correlation between the 2 measurements with a high degree of variability. Neither age nor duration of RA had a detectable influence. The relationship between CRP and ESR was, however, altered by treatment with gold, penicillamine, or high doses of prednisone. It is suggested that serum CRP is the more sensitive measurement, but that CRP and ESR do not have identical clinical significance.

The two most commonly used laboratory tests for assessing inflammation are the erythrocyte sedimentation rate (ESR) and serum C-reactive protein (CRP). The ESR depends on many factors (Zacharski, 1976), some of them independent of the inflammatory response, but despite this it is a good practical guide in several diseases. CRP, an 'acute phase protein', is not detectable in normal serum; it is, however, present in all febrile inflammatory conditions and following trauma. It is produced in the liver, and increased serum levels are due to increased synthesis. Control mechanisms are not understood (Koj, 1974).

Although these measurements are generally assumed to reflect the same process, direct comparisons have seldom been made. McConkey *et al.* (1972) found a significant correlation between them in patients with rheumatoid arthritis (RA), but Fischer and Gill (1975) found that CRP did not correlate with ESR in a variety of nonspecified conditions.

When considering which is the better test, practical considerations such as sensitivity, cost, and reproducibility must be taken into account. Before an evaluation of this sort, however, it is necessary to know whether ESR and serum CRP reflect the same changes in clinical conditions.

Patients and methods

The patients studied comprised all those with definite RA (American Rheumatism Association criteria)

Accepted for publication 13 September 1978

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seen by us in 1976, except those who recently had infections or operations. There were 241 patients, 175 women and 66 men. Ninety-five patients, 67 women and 28 men, were having nonsteroid anti-inflammatory drugs (NSAID), usually aspirin, indomethacin, ibuprofen, or naproxen. Fifty-five patients, 45 women and 10 men, were receiving gold, penicillamine, or dapsone; this group is later designated 'other drugs'. Ninety-one patients, 63 women and 28 men, were having prednisone.

Results

Neither age nor duration of RA influenced ESR or serum CRP levels, or the relationship between the 2 values. There was a positive correlation between ESR and serum CRP. The relationship was linear but with a high degree of variability greatest in the 'other drugs' group (Table 1).

Table 1 Correlation coefficients between serum CRP and ESR, and mean values ($\pm$ SE) in 3 groups of patients

Drug	No. of patients	Correlation coefficient	CRP mg/l mean (SE)	ESR mm/h mean (SE)
CRP vs. ESR				
1. Nonsteroid anti-inflammatory drugs	95	0.71	43 ($\pm$ 4)	49 ($\pm$ 3)
2. 'Other'*	55	0.52	35 ($\pm$ 6)	52 ($\pm$ 5)
3. Prednisone	91	0.65	27 ($\pm$ 3)	42 ($\pm$ 7)
High dose (10 mg or more)	38	0.72	28 ($\pm$ 4)	51 ($\pm$ 6)
Low dose (<10 mg)	53	0.67	26 ($\pm$ 4)	34 ($\pm$ 5)

* Penicillamine, gold or dapsone.

In patients receiving NSAID the mean serum CRP and mean ESR were roughly equivalent (Table 1). In patients receiving 'other drugs' or prednisone, however, the mean ESR was about 50% higher than the mean serum CRP.

Patients receiving low doses of prednisone (<10 mg daily) had mean serum CRP and ESR values similar to each other. At higher doses, however, serum CRP was much lower than ESR. The correlation coefficients were similar for the 2 groups.

Discussion

The relationship between ESR and serum CRP in patients with RA is roughly linear. Linear dependence of either variable on the other could account for about 40% of its variability. This relationship, however, alters under the influence of different drugs. Thus, patients receiving NSAID, which do not affect either measurement (McConkey *et al.*, 1973; Amos *et al.*, 1978), had serum CRP and ESR levels that were roughly equivalent. Drugs like gold, penicillamine, and prednisone, which are known to lower both measurements (McConkey *et al.*, 1973; Constable *et al.*, 1975; McConkey *et al.*, 1979), had a greater effect on serum CRP than ESR. High serum CRP or ESR levels are associated with progression of radiographic lesions in RA, the association being closer for serum CRP than ESR (Amos *et al.*, 1977). This earlier finding, and those of the present study, suggest it may be better to monitor the progress of RA by serial measurements of serum CRP than ESR.

Comparisons between patients having low doses of prednisone and those on higher doses suggest that at low doses prednisone acts like an NSAID by affecting CRP and ESR to roughly equal degree,

whereas at high doses its effect is different. This finding constitutes an argument for carrying out, and comparing, both measurements. Further work is needed to determine the longer term clinical significance of discrepancies between serum CRP and the ESR.

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