THE VALUE OF C-REACTIVE PROTEIN AND ERYTHROCYTE SEDIMENTATION RATE IN SPINAL SURGERY

Özlem KANDEMİR*, Abtullah MİLCAN **, Celal BAĞDATOĞLU *,**
Handan ÇAMDEVİREN **, Kayhan UĞUZ*, Ali KAYA***

ABSTRACT

Purpose: To determine the postoperative C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) values of the patients who had various spinal operations.

Materials and methods: Lumbar discectomy was done in 30 patients (group 1), and 15 patients had spinal fusion with instrumentation (group 2). CRP and ESR measurements were made before surgery and at 1, 3, 5, 7, 14 and 30 days after surgery. Level of C-reactive protein (CRP) was analysed in serum samples by immunoturbidimetric method (Roche Cobas Integra 700, Roche Diagnostics, Mannheim, Germany). The ESR was assayed by the Westergren method.

Results: In both types of operations CRP reached its maximum level on the 3rd day, then with a steep decline reached its 50% value on the 5th day. After the fusion operations ESR increased on the 3rd day , reached its peak value on the 7th day, after remaining at this level for a certain period of time, its decline commenced on the 14th day. However after disc operations ESR, which has not markedly increased, declined on the 7th day and stayed at this level. Both CRP and the ESR was observed to increase significantly after fusion operations ($p< 0,005$). Length of the incision at the operation site, the type of the operation and blood transfusion have all affected CRP, while blood loss and the type of operation affected ESR.

Conclusion: The fact that after spinal operations CRP values increase rapidly and return to its normal value early renders it more sensitive to diagnosis of early onset infection. The place of ESR is found to be limited.

Key words: Spine surgery, C-reactive protein, Erythrocyte sedimentation rate

* Mersin University, School of Medicine, Department of Clinical Microbiology and Infectious Diseases, Mersin
** Mersin University, School of Medicine, Department of Orthopaedics and Traumatology, Mersin
*** Mersin University, School of Medicine, Department of Neurosurgery, Mersin
**** Mersin University, School of Medicine, Department of Biostatistics, Mersin

ÖZET

C-REAKTİF PROTEİN VE ERİTROSİT SEDİMANTASYON HIZININ SPİNAL CERRAHİDEKİ ÖNEMİ

Amaç: Çeşitli spinal operasyon geçiren hastalarda, postoperatif C-reaktif protein (CRP) ve eritrosit sedimantasyon hızı (ESR) değerlerinin belirlenmesi.

Materyal ve metod: 30 olguda lomber diskektomi (Grup 1), 15 olguda spinal füzyon ve enstrümantasyon (Grup 2) uygulandı. CRP ve ESR ölçümleri, operasyon öncesi ve operasyon sonrasında 1, 3, 5, 7, 14 ve 30. günlerde yapıldı. CRP düzeyleri, serum örneklerinde immünoturbidimetrik metodla, ESR düzeyleri ise Westergren metodu ile incelendi.

Bulgular: Her iki grupta da, CRP maksimum düzeyine 3. günde ulaştı ve 5. gün dik bir inişle değerinin % 50'sine düştü. Füzyon operasyonlarından sonra, ESR 3. günde yükseldi, 7. günde pik değerine çıktı ve bu değerde bir sure kaldıktan sonra düşüşü 14. günde başladı. Disk operasyonlarından sonra fazla yükselmeyen ESR, 7. gün düşmeye başladı ve bu düzeyde kaldı. Hem CRP, hem ESR değerlerinin füzyon operasyonlarından sonra, önemli derecede arttığı gözlendi ($p<0,005$). İnsizyon uzunluğu, operasyon tipi ve kan transfüzyonu, CRP'yi etkilerken kan kaybı ve operasyon tipi ESR'yi etkiledi.

Sonuç: Spinal operasyonlardan sonra CRP değerlerinin hızla yükselip erken dönemde normale düşmesi, erken başlangıçlı enfeksiyonun tanısında daha duyarlı olduğunu gösterir. ESR'nin yeri, sınırlı olarak bulunmuştur.

Anahtar sözcükler: Omurga cerrahisi, C-reaktif protein, Eritrosit sedimantasyon hızı

INTRODUCTION

Although infection rate after spinal operations is rather low, it is essential to diagnose infection early to prevent catastrophic results (2, 3, 11). There are numerous studies done regarding acute phase reactants which are important early infection markers (1, 10, 13). Infection, tissue damage, immunological reactions and inflammation processes trigger systemic reactions that emerge in hours or days. Metabolic, endocrinological, neurological and immunological changes take place while fever, granulocytes, increase in ESR, decrease in the synthesis of albumin and increase in the synthesis of some other plasma proteins, changes in vascular permeability accompany. The proteins that are synthesized in the liver and of which the plasma levels either increase or decrease are called acute phase reactants. CRP is the acute phase reactant which increases significantly in the postoperative period and the one most frequently used. CRP is a homogenous protein with a molecular weight of 120.000 which is defined by Tillet and Francis for the first time (14). ESR is the second commonly used acute phase reactant. Nevertheless multiple factors affect ESR. These are: erythrocyte aggregation rate, haematocrit value, morphology of erythrocyte and changes of its size and density, changes in plasma viscosity and plasma proteins (15).

Some authors suggest measurement of CRP values in the early phase of inflammation (first 24 hours), and ESR values after 24 hours (6). However it has been shown that these acute phase reactants also increase in the presence of inflammation other than infection (15).

The aim of this prospective study was to determine the value of ESR and CRP in patients who had two types of spinal surgery, spinal fusion with instrumentation and lumbar discectomy.

MATERIALS AND METHODS

For this study two groups of patients were examined: The first group that underwent lumbar disk herniation on surgery without instrumentation (n=30) and the second group that underwent spinal decompression and fusion surgery with spinal instrumentation (n=15). Of the 45 patients, 22 (48.9%) were female, and 23 (51.1%) male. The CRP and ESR were measured the day before surgery and on days 1, 3, 5, 7, 14, 30 after surgery.

The patients were evaluated for the risk factors namely obesity, diabetes mellitus, smoking, chronic disease, steroids, infection and cerebral palsy, and the data was recorded. Total blood loss, blood transfusion, the area of the operation site and the operation time were also recorded.

The level of C-reactive protein (CRP) was analysed in serum samples by immunoturbidimetric method (Roche Cobas Integra 700, Roche Diagnostics, Mannheim, Germany). The procedure was done according to the manufacturer's recommendations. The ESR was assayed by the Westergren method.

The mean values obtained for each group were compared statistically using independent –t test. The difference in CRP, ESR and the white blood cell count between different operations was analysed by the co-variance technique. The value of each parameter is evaluated separately in each measurement period, and gender, risk factors, operation time, blood loss or transfusion and age formed the co-variants.

RESULTS

The presence of infection in two female patients with spinal operations rendered them ineligible for the statistical analysis. They were assessed separately.

CRP values increased significantly in the spinal fusion with instrumentation group as compared to lumbar discectomy group (p<0,005). CRP values were also significantly high in the patients who had transfusions, and had a length of incision >5 cm. (p<0,005). The type of operation i.e.: employment of spinal instrumentation, blood loss of >500 ml. significantly increased ESR (p<0,005). The values of CRP and ESR measured before and after different operations are shown in graphs 1 and 2 respectively.

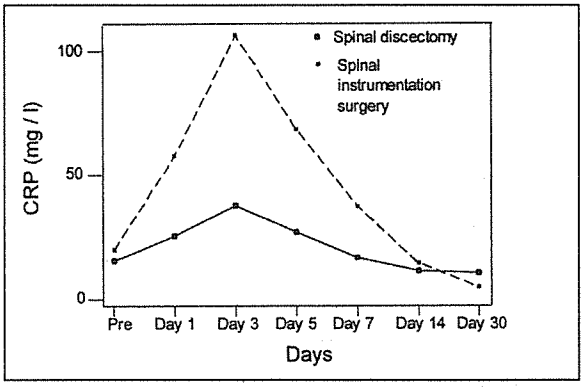

Figure 1. Mean CRP values obtained on preoperative and postoperative days in spinal fusion and instrumentation and discectomy.

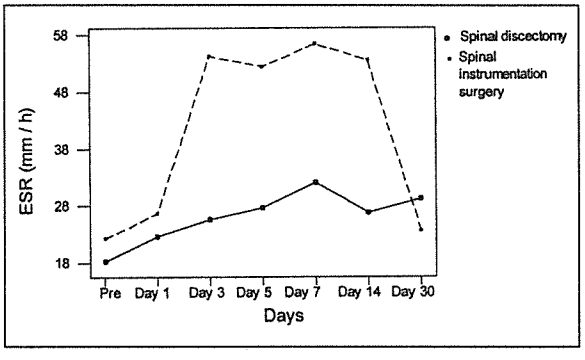

Figure 2. Mean ESR values obtained on preoperative and postoperative days in spinal fusion and instrumentation and discectomy.

Accordingly the value of CRP starts to increase on the first postoperative day, reaches its peak level on the 3rd day and with a steep decline reaches to 50% of its peak value on the 5th postoperative day. The peak value in the fusion with instrumentation group was 106.77±75,92(18-231), while in the lumbar discectomy group it was 37.98±49.6 (3,3-190).

ESR increased rapidly in both groups in the first 3 postoperative days, reached its peak value on the 7th

day, and started its declination on the 14th postoperative day in group 2. In group 1, the value of ESR declined minimally and sustained its new level during the study period. The maximum ESR values in group 1 was 26,13±25,1(2-79), and 59,75±27,99 (9-107) in group 2.

Of the two cases excluded for statistical analysis, one had epidural abscess and osteomyelitis after lumbar discectomy performed at another center. Radical debridement was done. Recurrence of infection lead to repeat radical debridement, and anterior and posterior fusion. Irrigation with vancomycine is done for postoperative 14 days. Antibiotherapy with Teikoplanin was commenced when Methicillin resistant staph. aureus (MRSA) was cultured. CRP and ESR levels of the patient after the first and second operations, and during the follow up are depicted in graph 3.

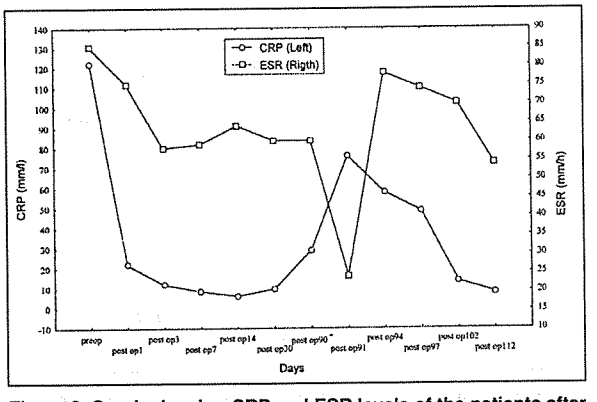

Figure 3. Graph showing CRP and ESR levels of the patients after the first and second operations, and during the follow up.

The second patient was operated for degenerative L4-5 spondylolisthesis and posterior fusion with instrumentation was performed. Infection developed in the postoperative 3rd month, the patient was re-operated. Radical debridement was done and irrigation employed via an indwelling catheter. Urine bacteriological culture revealed E.coli, and antibiotherapy in the form of Ciprofloksasin was initiated after antibiotic sensitivity test. After the treatment, CRP values rapidly declined to normal where as ESR values did not change significantly. CRP and ESR values of this patient are displayed in graph 4.

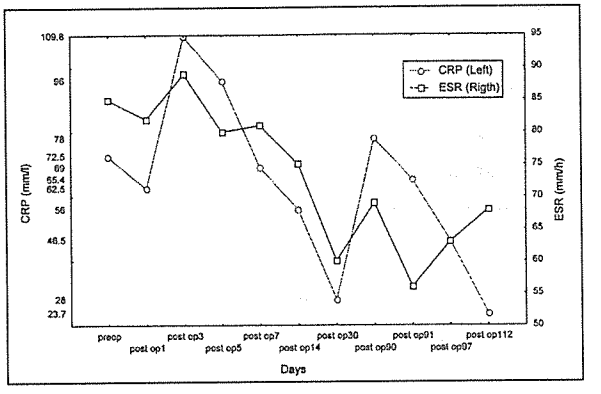

Figure 4. Graph showing CRP and ESR values obtained in a patient who developed urinary tract infection.

DISCUSSION

Infection, which may have dismal consequences is a rare complication observed after spinal surgery (13). Nevertheless due to ambiguity of the clinical findings, unavailability of pathognomonic biochemical tests and radiological findings, diagnosis is indeed a dilemma (9, 13). The postoperative levels of CRP and ESR were studied to delineate infection. Their progression under normal circumstances and during infection was identified in order to detect infection when the normal pathway is distorted (5, 7, 10, 12, 13). CRP seems to be more sensitive than ESR in detection of bacterial infection, differential diagnosis of viral and bacterial infections, and in follow up of antibacterial treatment (13). In our study CRP and ESR values were determined in the pre and postoperative period in the lumbar discectomy and fusion with spinal instrumentation groups. In both groups CRP values increased rapidly in the early postoperative period, a finding concurrent with the literature (8, 10). However CRP values were higher in group 2. In their study, Rosahl et al. (10) stated that the maximum level of CRP was observed in the patients who had large exposures. Consequently the minimum level was

attained in the microdiscectomy group. The fact that CRP values are higher in group 2 can be explained by the fact that instrumentation requires extensile approach which in turn renders increased inflammationary response. Our study revealed that factors beside blood transfusion did not affect CRP values as in the study of Thelander et al. (13) which stated hemodilution caused by blood transfusion affected CRP values.

ESR peaks in both groups on the 7th postoperative day, and starts to decline on the 14th day. In the 2nd group, it approached its normal value on the 30th postoperative day, while in the 1st group it was still above the normal level. In their study, Jönsson et al. (5) have shown that ESR peaks on the 4th postoperative day and declines to the normal level in the 2nd week. On the other hand Rsahl et al. (10) have stated that ESR peaked on the 3rd postoperative day, but a notable decline was not present even after postoperative 10 days. Our findings, in accordance with the literature, showed that ESR value declined slower than that of CRP.

Although ESR is influenced by age, gender, plasma viscosity, haematocrit, and erythrocyte morphology , in our study, only the type of operation and total blood loss affected ESR values. Blood loss via changes in heamotocrit levels might have affected ESR (4).

The two infected cases had high values of CRP and ESR before the operation. In one of our case in which urinary infection had developed, CRP values increased after having declined to the postoperative normal level. However no change was observed in the ESR value which had never declined. In the other case, the CRP value rapidly declined after abscess drainage, but increased again when epidural abscess recurred in the postoperative 3rd month. After the second operation, CRP level declined to normal on approximately 7th postoperative day. ESR values exhibited inconsistent ondulations.

In conclusion:

1. The CRP value reaches its peak level on the 3rd postoperative day regardless of the spinal procedure, and declines to the normal value on the 7th day.

2. ESR value reaches its peak value on the 7th postoperative day, stays at this level for some period of time, and declines to the normal value on the 14th day.

3. CRP and ESR values increase significantly in cases that have spinal fusion with instrumentation. The size of the operative field plays a major role.

4. Of the parameters that are studied, only blood loss and transfusion affect the ESR and CRP by altering the peripheral blood value.

5. If detection of infection is aimed, then CRP values should be measured after the 5th postoperative day when the increased CRP on the 3rd postoperative day returns to 50% of its peak value. The role of the ESR in the diagnosis of early onset infection is considered to be limited.

REFERENCES

1. Aalto K, Osterman K, Peltola H: Changes in erythrocyte sedimentation rate and C-reactive protein after total hip arthroplasty. Clin Orthop 1984; 184:118-120.

2. Dietze DD Jr, Fessler RG, Jacob RP: Primary reconstruction for spinal infections. J Neurosurg 1997; 86: 981-989.

3. Ghanayem AJ, Zdeblick TA: Cervical spine infections. Orthop Clin North Am 1996; 27: 53-67.

4. International Committee for Standardization in Haematology. Guidelines on selection of laboratory tests for monitoring the acute phase response. J Clin Pathol 1988; 41: 1203-1212.

5. Jönsson BO, Söderholm R, Strömqvist B: Erythrocyte sedimentation rate after lumbar spine surgery. Spine 1991;16:1049-1050.

6. Kallio MJ, Unkila-Kallio L, Aalto K: Serum C-reactive protein, erythrocyte sedimentation rate and white blood cell count in septic arthritis of children. Pediatr Infect Dis J 1997; 16: 411-413.

7. Kock-Jensen C, Brandslund I, Sogaard I: Lumbar disc surgery and variations C-reactive protein, erythrocyte sedimentation rate and complement split product C3d. Acta Neurochir 1988; 90: 42-44.

8. Palosuo T, Husman T, Koistinen J: C-reactive protein in population samples. Acta Med Scand 1986; 220: 175-179.

9. Puranen J, Makela J, Lahde S: Postoperative intervertebral discitis. Acta Orthop Scand 1984; 55: 461-465.

10. Rosahl SK, Gharabaghı A, Zınk PM, Samii M: Monitoring of blood parameters following anterior cervical fusion. J Neurosurg 2000; 92: 169-174.

11. Seifert V, Zimmermann M, Stolke D: Spondylectomy, microsurgical decompression and osteosynthesis in the treatment of complex disorders of the cervical spine. Acta Neurochir 1993; 124: 104-113.

12. Takahashi J, Ebara S, Kamimura M: Early-phase enhanced inflammatory reaction after spinal instrumentation surgery. Spine 2001; 26:1698-1704.

13. Thelander U, Larsson S: Quantitation of C-reactive protein levels and erythrocyte sedimentation rate after spinal surgery. Spine 1992; 17: 400-404.

14. Tillet WS, Francis TJ: Serological reactions in pneumonia with a non-somativ fraction of pneumococcus. J Exp Med 1930; 52: 561-571.

15. Whicher JT, Dieppe PA: Acute phase proteins. Clin Immunol Allergy 1985; 5: 425-446.

Corresponding Address:

Abtullah MİLCAN

Barbaros mah., 2186 sok., Kadıoğlu apt., No.2, D.13

33150, Mersin

E-mail: amilcan@mersin.edu.tr

Fax: 0324 337 43 05