

Mean Platelet Volume as a Predictive Marker for Inflammatory Reactivation after Total Hip Arthroplasty

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ABSTRACT

Objectives: Mean platelet volume (MPV) is associated with platelet function and activation. Increased MPV values indicate elevated platelet functions and are associated with inflammation. We investigated postoperative MPV changes of the patients with osteoarthritis (OA) after total hip arthroplasty.

Material and Method: This retrospective study was conducted on 813 patients with coxarthrosis and 152 patients without primary coxarthrosis (control group). The patients were divided into two groups. The first group was treated with total hip arthroplasty (n=312) and the second with conservative methods (n=501). MPV, ESR, and CRP were evaluated. Early phase (up to 10 days after the operation), and late phase (>30 days postoperation) data of the patients with total hip arthroplasty were recorded.

Results: Statistically significant differences on the mean MPV values were found between control and conservative treatment groups, and also between control and early phase surgical treatment groups (p=0.001 and p=0.005, respectively). No statistically significant difference was determined between control and late phase surgical treatment groups (p=0.796). Statistically significant differences were determined in the mean MPV values between conservative treatment and late phase surgical treatment groups (p=0.001), but no statistically significant difference was determined between conservative treatment and late phase surgical treatment groups (p=0.057).

Conclusion: We think that changes in serum MPV values can be used as a predictive marker for inflammatory reactivation following total hip replacement surgery. The serum MPV values obtained in our study may guide future studies investigating inflammatory reactivation in hip arthroplasty surgeries

Keywords: Mean platelet volume, inflammatory markers, synovial tissue, aseptic loosening

ÖZ

Total kalça artroplastisi sonrası inflamatuvar reaktivasyonun bir belirteçi olarak ortalama trombosit hacmi

Amaç: Ortalama trombosit hacmi (MPV) trombosit fonksiyonu ve aktivasyonu ile ilişkilidir. Artan MPV değerleri, trombosit fonksiyonlarının yükseldiğini ve inflamasyonu ile birlikteliği göstermektedir. Total kalça artroplastisi sonrası osteoartritli (OA) hastaların postoperatif MPV değişikliklerini araştırdık.

Gereç ve Yöntem: Bu retrospektif çalışma, koksartrozlu 813 hasta ve primer koksartrozu olmayan 152 hasta üzerinde yapıldı (kontrol grubu). Hastalar iki gruba ayrıldı. Birinci grup total kalça artroplastisi (n=312) ve ikinci grup konservatif yöntemlerle (n=501) tedavi edildi. MPV, ESR ve CRP değerlendirildi. Total kalça artroplastisi uygulanan hastaların erken evre (operasyondan sonra 10 güne kadar) ve geç evre (operasyondan 30 gün sonrası) verileri kaydedildi.

Bulgular: Kontrol grubu ile konservatif tedavi grubu arasında ve kontrol grubu ile erken evre cerrahi tedavi grubu arasında istatistiksel olarak anlamlı ortalama MPV değerleri bulundu (sırasıyla p=0.001 ve p=0.005). Kontrol grubu ile geç evre cerrahi tedavi grubu arasında istatistiksel olarak anlamlı fark bulunmadı (p=0.796). Konservatif tedavi grubu ile geç evre cerrahi tedavi grubu arasında ortalama MPV değerleri istatistiksel olarak anlamlı bulundu (p=0.001), ancak konservatif tedavi grubu ile geç evre cerrahi tedavi grubu arasında istatistiksel olarak anlamlı fark yoktu (p=0.057).

Sonuç: Total kalça protezi ameliyatı sonrası inflamatuvar reaktivasyonu belirlemeye yönelik yeni çalışmalarda belirlediğimiz MPV değerlerindeki değişikliklerin katkı sağlayacağını düşünüyoruz.

Anahtar kelimeler: Ortalama trombosit hacmi, inflamatuvar belirteç, sinovyal doku, aseptik gevşeme

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INTRODUCTION

Osteoarthritis (OA) is a common degenerative joint disease, in which the hip joint is often affected (1,2). Localized and asymptomatic synovitis mostly coexist with degenerative process of OA. Localized synovial inflammatory and proliferative changes may cause pain and joint dysfunction. Activated synovium disrupts other tissues of joint and extracellular matrix of cartilage. This disruption accelerates progression of OA. The severity of synovial reaction is associated with structural and metabolic factors of joints and disease duration. The inflammatory process contributes to progression and development of the disease (3-7). Peripheral blood platelet count is a marker for inflammatory process (8). Additionally, C reactive protein (CRP) and erythrocyte sedimentation rate (ESR) are used as markers of acute phase response (9-13). Mean platelet volume (MPV) is a parameter of complete blood count (CBC) and is associated with platelet function and activation. The size of platelets increase when activated and secrete inflammatory factors such as cytokines, chemokines, and coagulation factors. Increased MPV values indicate elevated platelet functions and are associated with inflammation (14). Some recent studies suggest that MPV can be used as a marker for determination of prognosis and severity of inflammatory systemic diseases (15-18).

Normally synovial fluid is essential for cartilage and joint functions. Synovial fluid increase in the joint is an indication of synovial activation (19). Aseptic loosening and periprosthetic osteolysis may be associated with increased synovial fluid in the joints of patients with total hip arthroplasty (19,20). Elevated synovial fluid causes aseptic loosening by factors that regulate bone turnover (21). In management of total hip arthroplasty sufficient excision of joint capsule, synovium, and other pathological tissues are required for implant stability. However, sufficient removal of these tissues cannot be made during surgery.

In this study, we aimed to investigate postoperative MPV, ESR and CRP changes of patients with OA after total hip arthroplasty.

MATERIAL AND METHOD

This retrospective study was conducted on 813 patients with grade IV primary coxarthrosis and 152 participants with

similar demographic features without primary coxarthrosis (control group) who were admitted to our physical therapy and rehabilitation or orthopedics and traumatology clinics between June 2006 and March 2013.

Patient's positive for rheumatoid factor and anti-CCP or with chronic inflammatory diseases (such as ankylosing spondylitis or rheumatoid arthritis), systemic diseases (such as hypercholesterolemia, hypertension, diabetes mellitus, myocardial infarction, stroke, peripheral artery disease), active infection, a history of term medication, trauma to the hip and smoking were excluded from the study. Also, patients, whose records for direct hip radiographs, CBC, MPV, ESR, and CRP values could not be retrieved were excluded.

All patients were operated with modified Gibson incision. The joint capsule and periarticular tissues were excised before implantation. All patients received polyethylene insert and no cement was used.

The patients were divided into two groups. One group were treated with total hip arthroplasty (n=312) and the other with conservative methods (n=501). The age, sex, laboratory values and X-ray findings of the patients were evaluated. CBC, MPV, ESR, CRP values and direct anterior-posterior X-ray radiograph of the hips were evaluated. The rating of osteoarthritis on the X-rays was made according to Kellgren-Lawrence scale (22). Early phase (up to postoperative 10 days), and late phase (after postoperative 30 days) data of the patients with total hip arthroplasty were recorded.

Statistical Analysis

SPSS (Statistical Package for the Social Sciences) software 17.0 (SPSS Inc, Chicago, IL, USA) was used for all analyses. Kolmogorov-Smirnov and Levene tests were used to analyze distribution and homogeneity of data. Statistical comparison of four groups was made by the one way ANOVA test. Bon- Ferroni test was used to compare differences between two groups when these were statistically significant. Pearson correlation test was used for correlation analyzes. p values <0.05 were considered as statistically significant.

RESULTS

There were 501 patients in conservative treatment group. 377 (75.24%) were female and 124 (24.75%) were

male. There were 312 patients in surgical treatment group. 231 (74.03%) were female and 81 (25.96%) were male. The control group consisted of 152 patients, of whom 39 (25.65%) were female and 113 (74.34%) were male. The mean ages of conservative treatment, surgical treatment and the control groups were 67 ± 12 , 63 ± 11 and 74 ± 2 years, respectively. The demographic features of the participants are shown at Table 1.

CRP values of conservative treatment group and early phase surgical treatment group were higher than the control group ($p=0.002$). ESR values of early phase surgical treatment group were higher than those of the control group ($p=0.043$). No statistically significant differences were found between groups on other comparison (Tables 2, 3).

Mean MPV values of conservative treatment group,

early phase surgical treatment group, late phase surgical treatment group and the control group were 8.05 ± 1.35 (4.73-19.70) fL, 7.86 ± 1.28 (4.72-13.30), 7.55 ± 1.19 (4.77-13.20) fL, and 7.50 ± 1.35 (4.98-14.40) fL, respectively. Statistically significant differences on mean MPV values were determined between control and conservative treatment groups, and also early phase surgical treatment group ($p=0.001$, and $p=0.005$, respectively). No statistically significant difference was determined between control and late phase surgical treatment groups ($p=0.796$) (Tables 4). Statistically significant differences were determined in mean MPV values between conservative treatment and late phase surgical treatment groups ($p=0.001$), but no statistically significant difference was determined in late phase surgical treatment group ($p=0.057$) (Tables 2, 3).

Table 1: Demographical features of the study participants

Participants	Surgical treatment group (n=312)	Conservative treatment group n=501	Control group n=152
Male n (%)	81 (25.96)	124 (75.24)	86 (24.75)
Female n (%)	231 (74.03)	377 (45.0)	86 (45.0)
Age in years \pm SD	63.85 ± 11.68	67.14 ± 12.99	74.55 ± 2.60

Table 2: Comparison of MPV, ESR, CRP values between conservative treatment group and surgical treatment group

Variable	Conservative treatment group	Surgical treatment group	
		Early phase (p)	Late phase (p)
MPV (fL)	8.05 ± 1.35	7.86 ± 1.28 (0.057)	7.69 ± 1.79 (0.001)
ESR (mm/h)	23.72 ± 17.31	25.51 ± 20.55 (0.418)	23.56 ± 19.44 (0.963)
CRP (mg/dl)	1.282 ± 3.220	2.019 ± 3.158 (0.100)	0.877 ± 1.155 (0.300)

Table 3: The comparison of MPV, ESR, CRP values between conservative treatment group and the control group

Variable	Conservative treatment group	Control group (p)
MPV (fL)	8.05 ± 1.35	7.50 ± 1.35 (0.000)
ESR (mm/h)	23.72 ± 17.31	21.37 ± 11.81 (0.061)
CRP (mg/dl)	1.282 ± 3.220	0.661 ± 0.708 (0.001)

Table 4: The comparison of MPV, ESR, CRP values between surgical treatment group and the control group

Variable	Control group	Surgical treatment group	
		Early phase (p)	Late phase (p)
MPV (fL)	7.50 ± 1.35	7.86 ± 1.28 (0.005)	7.69 ± 1.79 (0.796)
ESR (mm/h)	21.37 ± 11.81	25.51 ± 20.55 (0.043)	23.56 ± 19.44 (0.310)
CRP (mg/dl)	0.661 ± 0.708	2.019 ± 3.158 (0.002)	0.877 ± 1.155 (0.185)

DISCUSSION

OA, occurring mostly in advanced age, is a degenerative disease that affects articular cartilage and adjacent anatomical structures (15). Synovial cytokine generation and cartilage degeneration related symptoms begin before development of radiological findings. The inflammatory process of the synovitis contributes to the pathogenesis of OA (4,15). Increase in synovial fluid in the joint is associated with synovial activation. Aseptic loosening may be caused by increased synovial fluid in patients with total hip arthroplasty. During total hip arthroplasty sufficient excision of synovium, and other pathological tissues are important. However, sufficient removal of these tissues cannot be always achieved during surgery (19-21). Histological alterations associated with synovitis include synovial hyperplasia, macrophage and lymphocyte infiltration and fibrosis with the formation of new blood vessels in the synovium. Synovitis is an inflammatory event and contributes to the degenerative process (3,15). It also causes aseptic loosening of prosthetic joints applied into the degenerative area (19,20). MPV values increase in inflammatory events (14), which include other diseases such as diabetes mellitus, cerebral infarction, renal artery stenosis or preeclampsia (14,23). Also, CRP and ESR values change in inflammatory events (9,11).

Increased MPV values show large and activated platelets. Large platelets are younger and more reactive, and they aggregate faster with adrenaline, collagen, and ADP than small platelets, and have higher densities granules. They have more capacity to produce and release prothrombotic and inflammatory agents such as tromboxan A₂ and B₂, serotonin and thromboglobulin than smaller platelets. There is a reverse correlation between MPV and platelet count. Thus, remain a certain level of total platelet mass can be ensured at (14,23,24).

Platelet size is determined during megakaryocytopoiesis. This event is partially regulated by thrombopoietin. Growth factors and cytokines ensure production and reactivation of platelets in the bone marrow (25). Platelets can be affected by various biochemical processes and structural change occurs as a result. Inflammatory and prothrombotic agents which alter the microenvironment of platelets activate

them. When this agents contact platelet membrane, volume increases and platelet shape changes from discoid to spherical (14,23,26). The lifetimes of platelets are about 8-10 days (27).

Serum MPV values may be used as a marker of inflammation in determining the severity of osteoarthritis (28). However, degenerative changes in our patient cohort were Kellgren-Lawrence grade IV. All of our patients received regional anesthesia, and our literature search showed no relationship between the anesthetic management and serum MPV values.

In our study, patients with OA have statistically significant higher mean MPV values than the control group. We believed that, these changes were caused by inflammatory process of joints. These findings support the notion that MPV values can be used as an inflammatory marker. If this hypothesis is correct, removal of inflamed tissues (sufficient excision of the capsule, synovium and other pathological tissues) in patients who undergo total hip arthroplasty should result in a decrease in MPV. The postoperative mean MPV values of patients with total hip arthroplasty were lower than conservative treatment group. This difference was not statistically significant at early phase, but it became significant after one month. The early phase MPV values were derived from the postoperative 5-7 days. We think that, because of platelet lifetime (8-10 days), the large platelets which were produced preoperatively due to inflammation persisted in the circulation, and newly generated platelets did not have time to replace them. Therefore, the changes in MPV values did not become significant in the early phase. However, sufficient time was allowed for new platelets to replace the inflammatory ones in the late phase, thus resulting in statistically significant differences.

The main weakness of this study is its retrospective nature, and the results from a single center. A prospective evaluation of the same patient cohort may provide significant information to the management of total hip arthroplasty.

In conclusion, MPV values are higher in OA. These increased values gradually decrease after surgery in patients undergoing total hip arthroplasty and return normal levels one month postoperatively. Increased MPV values can be associated with inflammatory process in OA, which can be cured by operative removal of inflamed joint

tissues and fluids. Also, if the capsule, inflamed synovium and other tissues cannot be sufficiently excised during surgery, reactivation of these pathological tissues and increase in joint fluid may occur. This situation may cause aseptic loosening of the prosthesis. We think that MPV values may be used as a predictive marker of this inflammatory reactivation after total hip arthroplasty. Further prospective, controlled, randomized studies are needed to evaluate the association between MPV and inflammatory reactivation following OA.

Ethics Committee Approval: Ethics committee approval was received for this study from the local ethics committee.

Informed Consent: Informed consent was obtained.

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