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## Is MPV Predictive for Avascular Necrosis in Patients with DDH who Treated with Closed Reduction and Spica Cast?

**Objective:** Closed reduction (CR) and spica cast immobilization for DDH treatment provide a good choice in in congenital hip displasia. Complication rates have been reported as high as 79%, and avascular necrosis (AVN) has proven to be particularly problematic. The exact etiology of AVN is unknown but likely multifactorial. Thrombocyte volume has been defined as a marker of thrombocyte activation. It is measured as mean platelet volume (MPV). The aim of this study was to investigate whether thrombocyte volume changes affect the femoral head.

**Materials and Methods:** We reviewed the medical records of all patients who underwent closed reduction of the hip for DDH at N.E. University Meram School of Medicine Hospital from 2013 to 2017. Pre- and early postoperative and first monthly complete blood counts (CBC) and MPV values were evaluated. We divided all patients in four groups in terms of age as Group1 birth to 6<sup>th</sup> month, Group 2 7<sup>th</sup> to 12 month, Group 3 13<sup>th</sup> to 18 month and Group4 older than 18 month.

**Results:** Patients are followed up 40.5 months (16–66). 39 patients were included and 43 hips were treated with CR and spica cast. AVN was occurred in 8 patients (18.6%). Patients with AVN, MPV increased at early postoperative period (P<0.05).

**Conclusion:** MPV can be predictive value for AVN for DDH patients who were treated with CR and hip spica casting. MPV increasing in early postoperative period close follow-up should be applied

**Key words:** *Closed reduction, avascular necrosis, mean platelet volume*

### Kapalı Redüksiyon ve Pelvipedal Alçı Uygulanan DDH Hastalarda MPV Avasküler Nekroz için Belirteç midir?

**Amaç:** Kapalı redüksiyon (KR) ve pelvipedal alçılama (PPA) gelişimsel kalça displazisinde iyi bir seçenektir. Komplikasyon oranları %79'lara ulaşabilmektedir ve avasküler nekroz (AVN) özellikle problemlidir. AVN'nin tam nedeni bilinmemektedir ve çok faktörlüdür. Trombosit aktivitesi, trombosit hacmi yani ortalama trombosit hacmi (OTH) olarak ölçülür. Çalışmanın amacı trombosit hacim değişimlerinin femur başına etkilerinin olup olmadığını araştırmaktır.

**Gereç ve Yöntem:** N.E. Üniversitesi Meram Tıp Fakültesi hastanesinde 2013 ila 2017 yılları arası KR PPA yapılan hastalar retrospektif incelendi. Ameliyat öncesi sonrası ve 1. ay tam kan sayımları ve MPV incelendi. Hastalar yaşlara göre 4 gruba ayrıldı; Grup 1 doğum–6. ay, Grup 2 7–12. ay, Grup 3 13–18. ay ve Grup 4 18 ay sonrası.

**Bulgular:** Hastalar ortalama 40.5 ay (16–66) takip edildi. 39 hastanın 43 kalçası KR ve PPA ile tedavi edildi. AVN 8 hastada görüldü (%18.6) AVN li hastalarda erken ameliyat sonrası dönemde MPV artmış bulundu.

**Sonuç:** MPV, KR ve PPA uygulanan GKD li hastalarda önceden tahmin etmemize yararlı olabilir. Erken ameliyat sonrası dönem MPV yüksekliği olan hastaların AVN gelişimi açısından daha yakın takibi önerilir.

**Anahtar Kelimeler:** *Kapalı redüksiyon, avasküler nekroz, ortalama trombosit hacmi*

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### Introduction

Developmental dysplasia of the hip (DDH) has an estimated incidence of 1.5–20 per 1000 births (1). The aim of treatment for DDH is to obtain a stable and concentric reduction in the hip. Closed reduction (CR) and spica cast immobilization under general anesthesia are provide a good reduction (2, 3). Complication rates have been reported as high as 79%, and avascular necrosis (AVN) has proven to be particularly problematic. This major complication has a reported incidence of up to 47% and can result in limb length discrepancy, joint incongruity, persistent subluxation, coxa valga, and other sequelae (4). Although many factors play role on developing AVN, the exact etiology of AVN is unknown but likely multifactorial. Among of them thrombotic activity is important (5).

Thrombocyte volume has been defined as a marker of thrombocyte activation and function and it is measured as mean platelet volume (MPV). MPV shows the mean volume of circulating thrombocytes and it is one of the routine parameters in complete blood count. Increased thrombocyte volume is associated with thrombocyte activation.

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There is a relation between AVN and high thrombotic activity (6). We hypothesized that AVN after treated with closed reduction and spica casting DDH is related to MPV.

The aim of this study was to investigate whether thrombocyte volume changes affect the femoral head's development after closed reduction of DDH.

### Materials and Methods

We reviewed the medical records of all patients who underwent closed reduction of the hip for DDH at Necmettin Erbakan University Meram School of Medicine Hospital from 2013 to 2017. Inclusion criteria were diagnosed with DDH and treated with closed reduction and spica cast under general anesthesia, diagnosis of AVN according to the criteria given by Salter et al. (7)'s. Exclusion criteria was diagnosed with neuromuscular, malformation, deformity, syndromic disorders, and other similar diagnoses and underwent a surgical procedure requiring opening of the capsule of the hip joint within 1 year after the initial closed reduction.

All patients with DDH was operated by the same surgeon. Under general anesthesia hips were reduced closed fashion and spica cast immobilisation was performed. The range of motion within safe zone limits were checked for all hips. The spica cast was applied with the hip held in 100° of flexion and 70° of abduction, but never in forced abduction. Spica cast duration was 3 months. No traction was applied to any patient preoperatively.

Demographic data were obtained, including sex, side of DDH, side of AVN of the femoral head, age at reduction, interval between the reduction and presence of AVN, the presence of the femoral head ossific nucleus. Hips were classified on the basis of Tönnis's classification (8). The pelvis X-rays at final follow up were evaluated and graded on the basis of Kalamchi and MacEwen (9)'s classification. Pre- and early postoperative and at first month complete blood counts (CBC) were collected and recorded MPV values. At the final follow up duration MPV value also was recorded.

We divided all patients in four groups in terms of age as Group 1 birth to 6th month, Group 2 7<sup>th</sup> to 12 month, Group 3 13th to 18 month and Group 4 older than 18 month. The data collected were processed for statistical analysis using the SPSS statistical software package, version 16.0.

### Results

Patients are followed up 40.5 months (16-66). Demographic and baseline data are presented in Table 1. 39 patients were included and 43 hips were treated with closed reduction and spica cast. AVN was occurred in 8 patients (18.6%) and shown in Table 2. No patients had bilateral AVN.

MPV values of the patients with AVN or no AVN are presented in Table 3. In patients with AVN, MPV

increased at early postoperative period and first month. This increase was statistically significant ( $P < 0.05$ ). Between the patients with AVN and noAVN, MPV levels were observed as also statistically significant ( $P < 0.05$ ).

There was not relation between MPV and other parameters (age, sex, side, Kalamchi and MacEwen (9) types, presence of the femoral head ossific nucleus, Tönnis classification).

**Table 1.** Demographic and baseline data

Number of patients (hips)	39 (43)
Sex M/F	8/31
Side R/L	14/29
Age Group At Reduction	
Group 1	3
Group 2	23
Group 3	9
Group 4	4
Tönnis classification	
I	5
II	22
III	11
IV	5
Resence of the femoral head ossific nucleus	
Yes	34
No (Group 1, Group 2)	9 (6; 3)

**Table 2.** Results of AVN based on the classification of Kalamchi and MacEwen (9)

	Number of hips/patients	Kalamchi and MacEwen type
No AVN	35/31	-
Group 1	1/1	Type 1
Group 2	4/4	Type 2:1:1:3 (respectively)
Group 3	2/2	Type 2:4 (respectively)
Group 4	1/1	Type 3

**Table 3.** MPV values

	Preop.	Early postop.	1. Month	At last control
NoAVN	7.35±0.98	7.41±0.90	7.53±0.79	7.36±0.12
AVN	7.36±0.85	7.821±1.03	8.01±1.09	7.66±0.83

### Discussion

Our study showed that MPV can be a predictive value for AVN for DDH patients who were treated with closed reduction and hip spica casting. Especially, at the early postoperative period, MPV increasing was significant.

Several studies have been tried to determine predictive values in an effort to predict the severity of AVN or growth disturbance (5). These studies have cited various possible risk factors of AVN, including age, gender, laterality, absence of proximal femoral ossific nucleus, use of pre-reduction traction, preliminary/history of hip abduction bracing, adductor

tenotomy, and hip abduction angle incast (7, 11-16). AVN is still the main concern following the treatment of DDH by closed reduction and cast immobilization. The reported rate of AVN ranges from 0 to 67%. Brougham et al. (15) reported on 184 patients who underwent closed reduction of 210 hip dislocations and noted AVN in 99 (of 210 affected hips, 47%). In the studies of Herold et al. (450 hips) (17), Gregosiewicz et al. (1211 hips) (18) and Kruczynskiet al. (823 hips) (19), the reported incidences of AVN were 12%, 21%, and 14%, respectively, and the mean AVN rate of these studies was 17%. In our study AVN rate was found 18.6%. Risk of AVN was unaffected by age, gender, laterality, previous use of hip abduction orthosis, or adductor tenotomy (15, 19, 21).

There is no study in the literature including relationship between femoral head AVN and MPV. Increase of platelet count and activation may be important on hypercoagulopathy. (16) Any inflammatory stress generation during closed reduction

and hip spica casting can trigger coagulability. The increase in MPV was related to an increase in pro-inflammatory cytokine levels. TNF- $\alpha$  and IL-6 are the cytokines that cause osteonecrosis, and they are linked with enhanced oxidative stress, which contributes to platelet activation (20). This pathogenesis may explain the increase of MPV in the early postoperative period. MPV levels increased in all AVN patients. According to us, this finding is very important to explain the relation of MPV with AVN.

The most important limitations of our study are its retrospective nature and small sample size.

In conclusion, MPV can be considered as a predictive parameter for avascular necrosis in patients with DDH who treated with closed reduction and spica cast. Checking the MPV levels in early postoperative period close follow-up can be an indicator for developing AVN.

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