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# Mean platelet volume measurement, EDTA or citrate?

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**Abstract**

Most laboratories use EDTA for anticoagulation of whole blood prior to automated cell counting but due to platelet swelling, mean platelet volume (MPV) values may increase with its use. MPV changes may be less with acid citrate based anticoagulation. As MPV is a marker of platelet function and its precise measurement is important in a number of clinical situations, this study was performed to assess if EDTA and citrate based anticoagulated blood samples can be used interchangeably for MPV measurement.

In this cross sectional descriptive study, EDTA and citrate based anticoagulated blood samples of the same patients were assessed by auto-analyzer within 1 h of sampling. In the 61 evaluated patients, there was a close correlation between MPV as measured by EDTA and citrate, but mean MPV measured from EDTA samples was 0.66 fL (9%) more than citrate. There was also a significant negative correlation between platelets count and MPV by both methods. The results of our study reveal that MPV can be measured accurately by both methods of anticoagulation; EDTA and citrate if analysis be performed within 1 h of sampling.

**Keywords:** *MPV, anticoagulant, EDTA, citrate, automated counters*

## Introduction

Platelets play a key role in thrombus formation and mean platelet volume (MPV) is a marker of their function. Larger platelets contain more dense granules and produce more thromboxane $A_2$. Increased MPV has been associated with greater *in vitro* aggregation in response to ADP and collagen [1].

Elevated MPV levels have been identified as an independent risk factor for various conditions associated with metabolic syndromes, which include myocardial infarction [2], acute ischemic stroke [3], diabetes [4] and also for death or recurrent vascular events after myocardial infarction [5]. Moreover, increased platelet size has been reported in patients with vascular risk factors such as preeclampcia [6–8].

The metabolic syndromes, have a number of defined components (abdominal obesity plus two out of an elevated triglyceride, elevated fasting plasma glucose, elevated blood pressure and decreased HDL). The correlation of MPV and these components is uncertain yet. In this background, a study was designed to assess the correlation of MPV with components of metabolic syndrome.

Most laboratories use EDTA for anticoagulation of cell count samples but previous studies reported that MPV values increase due to platelet swelling when EDTA is used as anticoagulant [9,10], on the other hand a recent study demonstrated that this increase of platelet size amounts to approximately $< 0.5$ fL when the analysis is performed within 2 h after venipuncture [2]. Some studies reveal that MPV changes may be less with acid citrate based anticoagulation than with EDTA [11].

This primary study was performed to assess if EDTA and citrate based anticoagulated blood samples can be used interchangeably for MPV measurement.

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## Materials and methods

This is a cross sectional descriptive study. The blood samples from patients with different conditions, referred for blood count and erythrocyte sedimentation rate (ESR) measurement, were assessed by auto-analyzer. About 4 ml of blood was taken, 2 ml for each citrate and EDTA tubes. Samples were anticoagulated by EDTA for cell count and citrate for ESR. In our study, the same standardized blood tubes were used for sampling and all blood samples were analyzed within 1 h after venipuncture. Cell counts were performed by Sysmex K-1000 auto analyzer. ESR was measured by LENA (linear chemicals, sl) system, both under a routine daily quality control at the Isfahan Endocrine and Metabolism Research Center.

The results of mean platelet volume and platelet count assessed by two methods and the ESR were statistically analyzed. Pearson correlation was used for assessment of correlation of the following variables:

(a) MPV by two methods;
(b) platelet counts by two methods;
(c) correlation of MPV and platelets count by each method; and
(d) correlation of MPV by each method and ESR.

MPV and platelet count were compared by *t* test. All the statistical analyses were performed by SPSS software 11.5

## Results

About 61 participants entered the present study.

The mean MPV measured from EDTA samples was 7.860 ± 0.8924 fL.

The mean MPV measured from citrate samples was 7.200 ± 0.7901 fL.

The mean MPV measured from EDTA samples was 0.66 fL (9%) more than citrate.

There was a close correlation between MPV as measured by two methods ($p$: 0.000) (Figure 1).

The mean platelets count measured from EDTA samples was 202.557 ± 44.5071.

The mean platelets count measured from citrate samples was 148.082 ± 39.3019.

The mean platelets count measured from citrated samples was 36% less than EDTA samples.

There was a significant negative correlation between platelets count and MPV by both methods ($p < 0.015$).

There was a significant positive correlation between platelet count and first and second hour ESR ($p$: 0.031 and 0.002, respectively).

There was no correlation between MPV (by both methods) and ESR.

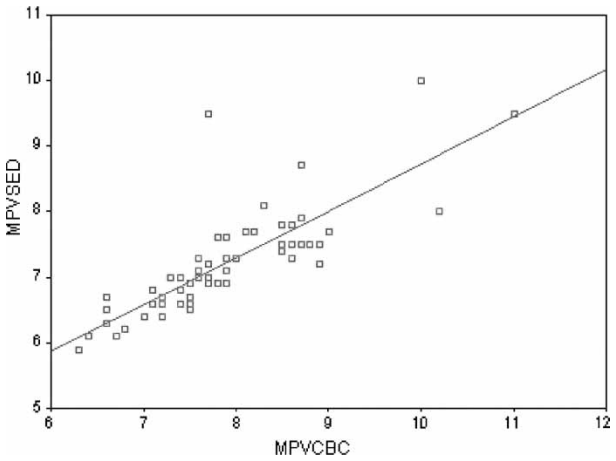


Figure 1. Correlation of MPV by citrate and EDTA.

## Discussion

The results of our study reveal a close correlation between MPV measurement by EDTA and citrate. As MPV measured by EDTA is more than citrate, it confirms the previous studies revealing platelet swelling with EDTA [12]. This difference (0.66 fL), is statistically significant ($p$: 0.000) but its clinical importance must be confirmed.

The negative correlation between platelets count and MPV raises the possibility that increasing MPV is due to production of larger platelets in thrombocytopenia, as observed in ITP [12,13], but as the minimum platelets count was 120,000, this was not an area of bias.

The positive correlation between ESR and platelet count confirms their role as an acute phase reactant.

Platelet size is determined at the level of the progenitor cell (i.e. the megakaryocyte). Some studies reported that cytokines such as interleukin-3 or interleukin-6 influence megakaryocyte ploidy and can lead to the production of more reactive, larger platelets [14–16]. It means that a proinflammatory state may confer a higher MPV and a prothrombotic condition. In our study, there was no correlation between MPV (by both methods) and ESR. So our study does not support the above-mentioned relation between platelets size and inflammation.

Elevated MPV levels have been identified as an independent risk factor for myocardial infarction in patients with coronary heart disease [2] and also for death or recurrent vascular events after myocardial infarction [5]. Moreover, increased platelet size has been reported in patients with preeclampcia [6–8], acute ischemic stroke [3], diabetes mellitus [4], hypercholesterolemia [17], smoking [18], renal artery stenosis and chronic obstructive airway disease [19]. In contrast, data regarding the association between MPV and stroke severity or stroke outcome have been controversial. On the other hand, some studies have

demonstrated negative association between MPV and inflammatory bowel disease [20,21]. Such broad association predicts increasing use of MPV as a prognostic factor in different vascular disorders and also as a useful marker for follow up of response to treatment.

## Conclusion

The results of our study reveal that MPV can be measured accurately by both methods of anticoagulation; EDTA and citrate, if analysis be performed within 1 h of sampling. Both methods can be used for follow up if only one is selected during this time.

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