ACU Sağlık Bil Derg
https://doi.org/10.31067/0.2018.76

ARAŞTIRMA YAZISI / ORIGINAL ARTICLE **Acil Tıp** / Emergency Medicine

Do Hemogram Parameters Correlate With The Level and Location of The Obstruction in Acute Mesenteric Ischemia Patients?

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Received : January 17, 2018
Revised : February 18, 2018
Accepted : February 19, 2018

ABSTRACT

Background and Objectives: Acute mesenteric ischemia (AMI) is a disease with high mortality that needs early diagnosis and management. There has been a recent trend in the search for a fast prognostic tool for AMI. Hemogram parameters are widely used tools in emergency departments since they are inexpensive and fast.

In this study our primary objective was to evaluate the significance of hemogram parameters in predicting the level of obstruction in superior mesenteric artery (SMA) and truncus coeliacus (TC). Our secondary objective was to evaluate the significance of hemogram parameters in predicting the location of obstruction in AMI patients.

Methods: In this retrospective study, we reviewed medical records of 214 AMI patients including; hemoglobin, hematocrit, platelet, mean platelet volume, red blood cell distribution width counts and computed tomography scan results. Patients with missing data were excluded and 208 patients were enrolled.

Results: Among 208 AMI patients, 123 (59.1%) were male. The median age was 68 (IQR: 59, 77). There were no significant differences between the obstruction level groups for the hemogram parameters neither in SMA nor in TC. The difference between obstruction location groups for hemogram parameters were clinically insignificant.

Conclusion: We found that hemogram parameters do not correlate with the level and location of the obstruction in AMI patients. Other pathophysiological processes seem to be more important for the survival of those patients.

Keywords: Acute mesenteric ischemia, Hemogram parameters, Computed tomography, RDW, MPV.

AKUT MEZENTER İSKEMI HASTALARINDA HEMOGRAM PARAMETRELERI TIKANIKLIĞIN DÜZEYI VE YERI İLE İLIŞKILI MIDIR ?

ÖZET

Amaç: Akut mesenterik iskemi (AMİ), erken teşhis ve tedaviye ihtiyaç duyan yüksek mortaliteye sahip bir hastalıktır. AMİ için hızlı bir prognostik araç araştırılmaktadır. Hemogram parametreleri ise; ucuz ve hızlı olduklarından, acil servislerde yaygın olarak kullanılan tanısal araçlardır.

Bu çalışmadaki birincil amacımız, superior mezenterik arter (SMA) ve trunkus çöliyakustaki (TÇ) obstrüksiyon düzeylerinin öngörülmesinde, hemogram parametrelerinin öneminin değerlendirilmesidir. İkincil amacımız ise AMİ hastalarında obstrüksiyonun yerinin belirlenmesinde hemogram parametrelerinin öneminin değerlendirilmesidir.

Yöntemler: Bu retrospektif çalışmada, 214 AMİ hastasının tıbbi kayıtları incelenerek; hemoglobin, hematokrit, trombosit, MPV, RDW değerleri ve bilgisayarlı tomografi sonuçları kaydedilmiştir. Kayıtlarında eksikleri olan hastalar dışlanmıştır ve 208 hasta çalışmaya dahil edilmiştir.

Bulgular: 208 AMİ hastasının 123'ü (% 59.1) erkekti. Medyan yaş 68 idi (IQR: 59, 77). SMA'da ve TÇ'da obstrüksiyon düzeyi grupları arasında, hemogram parametreleri açısından anlamlı bir farklılık saptanmadı. Obstrüksiyon lokasyon grupları arasındaki fark da hemogram parametreleri açısından klinik olarak anlamlı değildi.

Sonuç: AMİ hastalarında, hemogram parametrelerinin, obstrüksiyonun düzeyi ve lokasyonu ile ilişkili olmadığını tespit ettik. Diğer patofizyolojik süreçler, bu hastaların hayatta kalması için daha önemli gibi görünmektedir.

Anahtar sözcükler: Akut mezenterik iskemi, Hemogram parametreleri, Bilgisayarlı tomografi, RDW, MPV.

Acute mesenteric ischemia (AMI) is an urgent condition that needs early diagnosis and management, including surgery and/or medical treatment, since the viability of the effected segment is short (1, 2). Although there have been many developments in diagnosis, treatment and postoperative care in AMI through the past years, the mortality rate remains high (40-70%) (3). The non-specific nature of the clinical findings, lack of simple diagnostic tools, and delay in the diagnosis are the major factors contributing to the high mortality and morbidity of those patients (4). Early diagnosis and surgery may prevent sepsis and reduce in-hospital mortality rate (5).

Recently, the search for fast and reliable diagnostic and/or prognostic tools for AMI patients has gained pace and hemogram was the primary test of interest, since it is inexpensive, routinely used and fast (6-13). Hemogram parameters (especially RDW and MPV) were shown to be highly predictive of mortality and morbidity in AMI patients in most of those studies. In fact, majority of AMI cases have an obstructive etiology (80-90%) (14). However, the disease process, anatomical location and severity of the obstruction is highly variable, and it is unclear if the severity of obstruction can also be predicted by the hemogram parameters. To the best of our knowledge, there are no studies evaluating the utility of hemogram parameters in predicting the level and the location of obstruction in AMI patients.

The primary aim of this study was to evaluate the diagnostic utility of hemogram parameters in predicting the level of obstruction in superior mesenteric artery (SMA) or celiac trunk (TC) in patients with AMI. We also aimed to determine the utility of hemogram parameters in predicting the location of obstruction.

Methods

Patients and study design

This was a retrospective cohort study conducted in the Emergency Department (ED) of a university hospital with an annual patient load of 500.000. After the institutional ethics committee approval (ID=09.2017.273), all baseline data were collected from patient's medical records between April 2015 and April 2017, all AMI patients admitted to ED between April 2015 and April 2017 were identified according to ICD-10 codes (International Statistical Classification of Diseases and Related Health Problems - 10th revision) from the Hospital Information System (HIS). From this dataset of 214 patients, all adult patients who were older than 18 years of age with a confirmed diagnosis of AMI according to computed tomography (CT) reports were included in the study (n=208). Patients with missing data were excluded (n=6).

Laboratory examination and computed tomography

The following data were extracted from the HIS: demographics, initial hemogram parameters, and abdominal CT reports. Initial hemogram was defined as the first test performed during the first 3 hours of admission. Hemogram parameters specifically tested for were hemoglobin (Hg) levels (g/dL), hematocrit (Hct) values (%), platelet count (PC) counts (x10^3/uL), *mean platelet volume* (MPV) counts (fL), red blood cell distribution width (RDW) counts (%) and all blood count was measured by a hematology analyzer (Beckman Coulter -LH 780, Beckman Coulter Inc, Brea, CA). The normal reference ranges for Hb level, Htc value, *platelet volume,* MPV, RDW used were 12-17 g/dL, 36-50 %, 150-440 x10^3/uL, 7.4-11.6 fL, 11.6-16.5 %, respectively. Contrast enhanced abdominal computed tomography (CT) scans were performed by a 128 Slice CT Scanner (Siemens Somatom Definition AS, Siemens AG, Germany). CT scan results consisted of the location of the obstruction; in superior mesenteric artery (SMA), in truncus coeliacus (TC) and both in superior mesenteric artery and truncus coeliacus (SMA+TC), and the levels of obstruction consisted of; no obstruction (0%), hemodynamically unimportant obstruction (1-10%), mild obstruction (11-30%), moderate obstruction (31-60%), severe obstruction (61-99%) and complete obstruction (100%).

Statistical analysis

Continuous data were tested against normal distribution by Kolmogorov-Smirnov test and presented with median and interquartile ranges (IQR). Kruskal-Wallis H test was used to compare medians, and chi-squared test was used to compare proportions among groups. The Mann-Whitney U test was used as the post-hoc test of Kruskal-Wallis H test, and significance threshold was accepted as $p<0.0083$ after Bonferroni correction. Type 1 error was accepted as %5. All statistical analyses were performed by using MedCalc Statistical Software version 17.9.2 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2017).

Results

Among 208 AMI patients, 123 (59.1%) were male and the median age was 68 years (IQR: 59, 77). A moderate to complete (moderate, severe or complete) obstruction of SMA or TC was present in 54 (26.0%), and 58 (27.9%) patients,

Table 1. Characteristics of Study Population

Characteristic	
Age (years), n=208, median (IQR)	68 (59, 77)
Male, n (%)	123 (59.1)
Laboratory Values, median (IQR)	
Hemoglobin (g/dL), n=208	12.55 (10.80, 13.70)
Hematocrit (%), n=208	38.50 (33.20, 41.88)
Platelet (x1000/uL), n=208	250.0 (187.25, 301.75)
RDW (%), n=208	14.8 (13.9, 16.2)
MPV (fL), n=208	8.20 (7.50, 9.07)
Level of obstruction in SMA, n (%)	208 (100.0)
None	72 (34.6)
Hemodynamically unimportant	33 (15.9)
Mild	49 (23.6)
Moderate	33 (15.9)
Severe	15 (7.2)
Complete	6 (2.9)
Level of obstruction in TC, n (%)	208 (100.0)
None	42 (20,2)
Hemodynamically unimportant	31 (14,9)
Mild	77 (37,0)
Moderate	28 (13,5)
Severe	26 (12,5)
Complete	4 (1,9)

IQR: Interquartile range, **SMA:** Superior mesenteric artery, **TC:** truncus coeliacus, **RDW:** Red blood cell distribution width, **MPV:** Mean platelet volume

respectively. Demographics, hemogram parameters and the distribution of patients according to levels of obstruction is presented in Table 1. The median levels of each hemogram parameter according to the obstruction level in SMA and TC are presented in Table 2 and 3. No significant difference was observed between the median MPV, RDW, hemoglobin, hematocrit or platelet levels among groups of different obstruction severity in SMA or TC. The comparison of the median levels of each hemogram parameter among SMA, TC or SMA+TC is presented in Table 4, and median hemoglobin and hematocrit were found to be significantly different among AMI locations (p=0.006, and 0.003, respectively). Post-hoc analysis showed that median hemogram levels were significantly different when SMA (12.30 g/dL) and TC (13.25 g/dL), and TC (13.25 g/dL) and SMA+TC (11.95 g/dL) were compared. The difference for hematocrit originated from the difference between TC (%40.20) and SMA+TC (%36.55).

Discussion

AMI is an uncommon disease with high mortality rate if not treated and management is vital in most cases (1, 2, 15). This was the main drive of the studies evaluating the utility of hemogram parameters (especially RDW and MPV) for the diagnosis of AMI (6-13). MPV is one of the most studied hemogram parameters in AMI patients, and higher levels of MPV values were shown to be associated with a higher rate of mortality. Bilgic et al. reported that median (IQR) MPV values of survivors were significantly lower than non-survivors in AMI patients in their retrospective study

Table 2. Comparison of Obstruction Level Groups for Hemogram Parameters in SMA

	Hemogram Parameters				
Level of obstruction in SMA, Median (IQR)	***MPV (fL)***	***RDW (%)***	***Hemoglobin (g/dL)***	***Hematocrit (%)***	***Platelet (x1000/uL)***
None	8.05 (7.23, 9.10)	14.25 (13.42,15.40)	13.25 (11.78, 14.23)	40.20 (36.40, 42.72)	255.00 (189.50, 293.50)
Hemodynamically unimportant	8.30 (7.60, 9.05)	14.70 (13.80,16,55)	11.80 (9.75, 13.25)	37.20 (30.25, 40.45)	224.00 (165.50, 289.00)
Mild	8.0 (7.50, 8.85)	14.50 (13.65, 16.25)	12.00 (10.75, 13.50)	36.20 (32.35, 41.10)	247.00 (189.50, 313.00)
Moderate	8.50 (7.55, 9.40)	15.20 (14.25, 16.90)	12.30 (10.30, 13.75)	37.90 (32.30, 42.10)	266.00 (212.50, 315.50)
Severe	8.19 (7.50, 8.70)	14.90 (14.20, 15.90)	12.30 (10.10, 13.90)	37.20 (31.00, 42.40)	236.00 (115.00, 294.00)
Complete	8.35 (7.80, 10.95)	15.25 (14.35, 15.82)	12.05 (10.42, 13.60)	37.35 (31.93, 40.00)	270.00 (151.00, 328.75)
p value	0.875	0.022	0.043	0.029	0.778

IQR: Interquartile range, **SMA:** Superior mesenteric artery, **TC:** truncus coeliacus, **RDW:** Red blood cell distribution width, MPV: Mean platelet volume, p<0.0083 is set as significant after Bonferroni correction

Table 3. Comparison of Obstruction Level Groups for Hemogram Parameters in TC

	Hemogram Parameters				
Level of obstruction in TC, Median (IQR)	***MPV (fL)***	***RDW (%)***	***Hemoglobin (g/dL)***	***Hematocrit (%)***	***Platelet (x1000/uL)***
None	8.55 (7.80, 9.02)	14.75 (13.40, 16.12)	12.30 (10.77, 13.75)	37.95 (32.87, 42.15)	261.00 (189.00, 308.75)
Hemodynamically unimportant	8.00 (7.20, 8.60)	14.90 (14.00, 16.60)	11.50 (9.80, 12.90)	36.20 (30.30, 39.10)	249.00 (162.00, 316.00)
Mild	8.00 (7.40, 9.10)	14.30 (13.65, 15.30)	12.80 (11.35, 13.90)	38.80 (35.05, 42.50)	242.00 (190.00, 313.50)
Moderate	8.00 (7.32, 9.20)	15.05 (14.00, 16.87)	12.80 (10.65, 13.47)	38.70 (32.72, 41.57)	236.50 (182.75, 289.25)
Severe	8.80 (7.65, 9.62)	14.95 (13.87, 16.87)	13.29 (11.35, 14.30)	40.80 (36.02, 42.17)	263.50 (193.50, 305.00)
Complete	7.50 (7.42, 8.32)	17.10 (15.12, 21.10)	10.90 (7.80, 13.62)	34.20 (27.40, 41.07)	308.00 (181.50, 646.75)
p value	0.240	0.083	0.166	0.118	0.326

IQR: Interquartile range, **SMA:** Superior mesenteric artery, **TC:** truncus coeliacus, **RDW:** Red blood cell distribution width, **MPV:** Mean platelet volume, p<0.0083 is set as significant after Bonferroni correction

Table 4. Comparison of Obstruction Location Groups for Hemogram Parameters

	Hemogram Parameters				
Location of obstruction, Median (IQR)	***MPV (fL)***	***RDW (%)***	***Hemoglobin (g/dL)***	***Hematocrit (%)***	***Platelet (x1000/uL)***
SMA n (%) = 42 (20.2)	8.55 (7.80, 9.02)	14.75 (13.40, 16.12)	12.30 (10.77, 13.75)	37.95 (32.87, 42.15)	261.00 (189.00, 308.75)
TC n (%) = 72 (34.6)	8.05 (7.22, 9.10)	14.25 (13.42, 15.40)	13.25 (11.77, 14.22)	40.20 (36.40, 42.72)	255.00 (189.50, 293.50)
SMA+TC n (%) = 94 (45.2)	8.00 (7.50, 9.00)	14.95 (14.07, 16.60)	11.95 (10.27, 13.40)	36.55 (31.75, 40.90)	246.50 (183.00, 312.75)
p value	0.249	0.090	0.006	0.003	0.664

IQR: Interquartile range, **SMA:** Superior mesenteric artery, **TC:** truncus coeliacus, **SMA+TC:** Superior mesenteric artery and truncus coeliacus, **RDW:** Red blood cell distribution width, **MPV:** Mean platelet volume, P<0.016 is set as significant after Bonferroni correction

(7.6 fL [6.6, 8.9]; 8.4 fL [5.5, 10.4], p<0.01) (6). Altintoprak et al. conducted a similar study in 2013 among 30 AMI patients, and showed a significantly lower mean MPV value in survivors compared to non-survivors (7.80 fL; 9.01 fL, p=0.002) (7). In 2016, Degerli et al. stated that AMI patients with concomitant diseases had a higher mean MPV value compared to patients without concomitant diseases (9.65 ± 1.31 fL; 8.79 ± 0.80 fL, p<0.001) (8). All these studies have shown that a lower MPV level may be associated with a better survival. In this study, we showed than median MPV level does not change according to the severity or location of obstruction (Table 1). RDW was another widely-studied parameter in AMI patients. Kisaoglu et al. stated that AMI patients have higher RDW values when compared to patients with no AMI (%15.05 ± %1.82, %14.08 ± %1.40) in their retrospective study of 2017 (9). RDW values were reported to be significantly lower in survivors of AMI (%13.72, vs %14.60) in two recent retrospective studies conducted in 2014 (10, 11). Median RDW value of our study population was similar to those studies, without any significant difference according to severity and location of obstruction. The findings of these previous studies are consistent with the pathophysiological approach claiming that the severity of the host reaction to inflammatory disease processes is more important than the level and location of the obstruction in AMI patients. Therefore, an approach to prevent infection and inflammation control, and treatment over diagnosis should be preferred rather than the use of several imaging modalities to pin-point the exact location and severity of obstruction. From this

point of view, earlier use of surgical or invasive vascular approaches to maintain blood flow may be considered to prevent further deterioration of patients.

Hemoglobin, hematocrit and platelet levels have also been popular markers for AMI patients. Turkoglu et al. reported a mean hemoglobin value of 13.1 ± 1.8 g/dL and a mean platelet value of 255 ± 49 (x1000/uL) in their retrospective study of 90 AMI patients (12) Altintoprak et al. reported a mean hemoglobin value of 13.4 g/dL and a mean hematocrit value of 40.3% (7). Wang et al. conducted a retrospective study in 2017 with 45 AMI patients and reported a mean platelet value of 207 (x1000/uL) (13). Not only were the results of these three studies similar to each other, but they were also similar to our findings. We were unable to show a clinically significant difference in hemogram parameters according to the location and severity of obstruction in AMI patients. The hypothesis of increased obstruction levels should equate to increased mortality and morbidity due to decreased blood flow to intestines seems to be unfounded. On the other hand, some recent studies have stated that increased MPV and/or RDW values predict mortality and/or morbidity. Bilgic et al. and Altintoprak et al. conducted similar studies and found MPV values to be higher in non-survivors when compared to survivors among AMI patients (6, 7). Dinc et al. and Bilgic et al. made a similar statement on RDW in their retrospective studies (10, 11). Degerli et al. reported that higher MPV values were correlates with comorbidities (8).

Limitations

The major limitation of this study was its retrospective nature. Some of the AMI patients may have been missed, and could not be identified from the HIS.

Conclusion

Hemogram parameters do not correlate with the level and location of the obstruction in AMI patients. Different mechanisms seem to be more important than the level and location of the obstruction for the survival of AMI patients. It seems that mortality is directly related to the extent of bacterial translocation, comorbidities, hemodynamic and septic shock rather than the anatomy of ischemia. Therefore, clinicians should focus on early and fast diagnosis-treatment options rather than expensive and time-consuming imaging modalities.

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