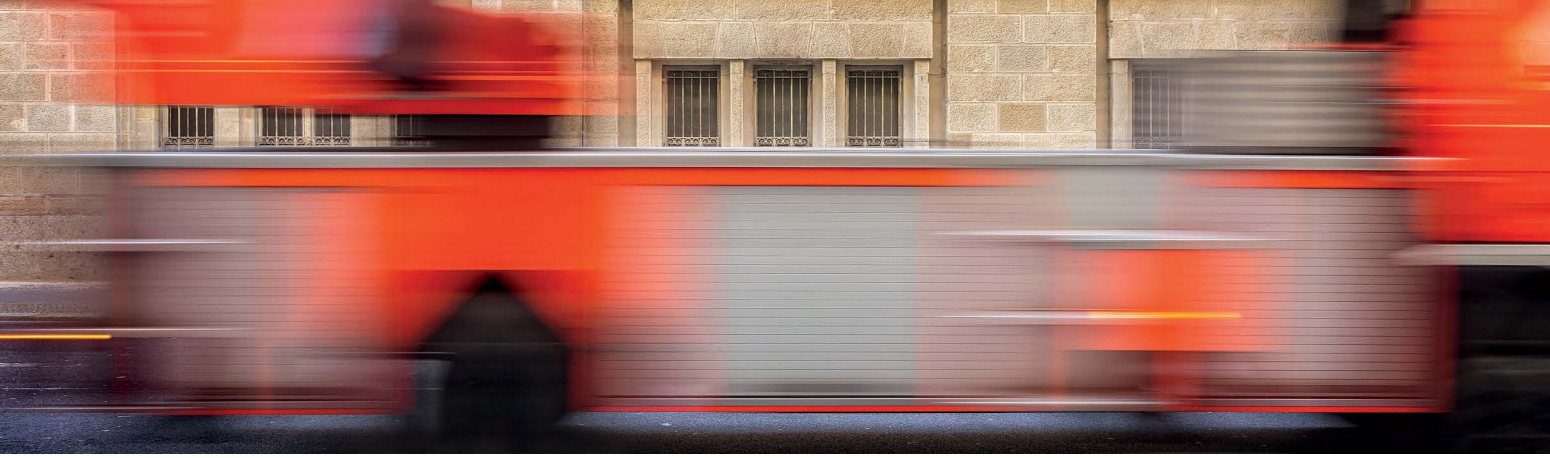

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CAN HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS FASTEN THE DIAGNOSIS OF COVID-19 IN EMERGENCY DEPARTMENTS?

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ABSTRACT

INTRODUCTION: The primary aim of the study was to compare the laboratory and radiological parameters of COVID-19 positive and negative patients confirmed by Real-Time Reverse Transcription Polymerase Chain Reaction (RT-PCR), and Chest Computed Tomography (CCT) of patients admitting with the suspicion of COVID-19. The secondary purpose of the study was to find objective parameters to speed up the clinician for further examination, treatment or referral decision in COVID-19 suspicion.

MATERIAL AND METHODS: A total of 61 COVID-19 suspected patients were evaluated in the study. Swab samples were taken for RT-PCR analysis. CCT was taken for 42 patients who described dyspnea.
According to CCT and RT-PCR results, the patient population was divided into 2 groups as COVID-19 positive group (n = 32); and COVID-19 negative group (n = 29). Between two groups; demographic, clinical, laboratory and radiological parameters were compared.

RESULTS: Male gender (p = 0.03), PLR value (p = 0.021) and CO-RADS scores were higher in the COVID-19 positive group. Oxygen saturation (SaO_2) (p = 0.027) and PCT, WBC, Neutrophil count, Lymphocyte count values were significantly low in COVID-19 positive group (p = 0.03, p = 0.001, p = 0.017, p = 0.021, respectively). PLR showed a positive correlation with fever, CRP, neutrophil count and NLR, which are indicators of inflammation.

CONCLUSIONS: SaO_2, WBC, lymphocyte count, neutrophil count and low PCT levels, and PLR elevation showed a significant difference in COVID-19 patients in our retrospective cohort study examining the Turkish population. We believe that these results will allow clinicians to make quick decisions in patient management more simply.

KEY WORDS: CBC, COVID-19, CO-RADS, PLR, RT-PCR

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INTRODUCTION

The disease that was caused by SARS-CoV-2 (COVID-19) first appeared in Wuhan, China in December 2019, then affected the whole world, and was recognized as pandemic by the World Health Organization (WHO) on February 11, 2020 [1].

COVID-19 is a very contagious disease and usually manifests with nonspecific respiratory symptoms like fever, cough, and shortness of breath [2]. The clinical manifestation of the disease usually occurs as fever (body temperature 37–38°C), cough, nasal congestion and fatigue, which usually begin in 1 week in symptomatic patients [3], and can then progress to pneumonia [4].

Although it was shown that COVID-19 first occurred as a respiratory infection, the data that emerged later suggested that it should be considered as a systemic disease involving many systems, including cardiovascular, respiratory, gastrointestinal, neurological, hematopoietic and the immune system itself [5, 6]. Since there are nonspecific symptoms and rapid deterioration of the clinical manifestations, the importance of accessible laboratory tests has increased to enable us to obtain quick results in the diagnosis of COVID-19 allowing us to determine its prognosis. Hematological and biochemical biomarkers provide us both objective perspective during the course of the disease and help to classify the disease as mild, severe or critical, allowing the diagnosis and treatment process to proceed faster [7].

For this reason, there are many studies that evaluate the relation of laboratory parameters with COVID-19, and these studies are usually associated with the clinical progression of COVID-19 [7].

The primary purpose of the present study was to compare the laboratory and radiological parameters of COVID-19 positive and negative patients confirmed by Real-Time Reverse Transcription Polymerase Chain Reaction (RT-PCR), and Chest Computed Tomography (CCT) of patients admitting with the suspicion of COVID-19. The secondary purpose of the study was to find objective parameters to speed up the clinician for further examination, treatment or referral decision in COVID-19 suspicion.

MATERIAL AND METHODS

Before the study was initiated, approval was obtained from the Ethics Board of Ufuk University (No: 20200521/9). A total of 61 COVID-19 suspected patients according to the Turkish Republic Ministry of Health COVID-19 Guideline, admitting to the university hospital emergency department between 05.03.2020 and 27.04.2020 were evaluated in the study [8]. According to the anamnesis of the patients; the demographic data, comorbidities, and smoking habits were recorded as the admission complaints. Detailed physical examinations were made after the vital findings of the patients were recorded. The Complete Blood Count (CBC), (including White Blood Cell (WBC), lymphocyte count, neutrophil count, platelet (PLT), Mean Platelet Volume (MPV), plateletcrit (PCT), Platelet Distribution Width (PDW), which are infection-related parameters in suspected patients of COVID-19, lactate dehydrogenase (LDH) from biochemical markers, C-reactive protein (CRP) and ferritin from acute phase reactants, and D-Dimer tests were performed for thrombosis. Also, Neutrophil/Lymphocyte Ratio (NLR) and Platelet-Lymphocyte Ratio (PLR) were calculated. Swab samples were taken for RT-PCR analysis. CCT was carried out for 42 patients who described dyspnea. The CCTs were classified by a radiologist according to CO-RADS 1–6 [9]. As previously defined, CO-RADS 1–3 groups were included in the Radiological COVID19 negative group; and CO-RADS 4–6 were included in the COVID-19 positive group.

According to CCT and RT-PCR results, the patient population was divided into 2 groups as COVID-19 positive patients COVID-19 positive group (n = 32); and according to CCT and RT-PCR results, COVID-19 negative patients COVID-19 negative group (n = 29).

Exclusion criteria: The patients who were diagnosed with other pulmonary infections other than COVID-19, those with malignancies, those under the age of 18, and pregnant women were not included in the study.

The demographic, clinical, laboratory and radiological parameters between COVID-19 positive and negative groups were compared.

Statistical Analysis

Statistical analysis was performed with SPSS, v.23.0 statistical software (SPSS, Inc., Chicago, IL, USA). The categorical variables were described as frequencies and percentages. Continuous variables were presented as mean and standard deviations. Chi-square (2) tests were used to evaluate the relationship between categorical variables of study subgroups. Independent T test and Mann Whitney U test for the comparison of two groups were the

tests used in continuous variables. Pearson's correlation coefficients of continuous variables were also calculated. P values below 0.05 were considered statistically significant.

RESULTS

The mean age of the patients was 46.6 ± 18.6, and the male/female ratio was 44.3%/55.7% (27/34). A total of 45.9% (28/61) patients did not have comorbidities, ut 27.9% (17/61) had multiple comorbidities, and among the comorbidities, the mostly detected ones were; hypertension: 37.7% (23/61), diabetes mellitus: 13.1% (8/61), coronary artery disease: 11.4% (7/61), asthma: 8.2% (5/61), respectively. A total of 29.3% patients had a smoking habit. Multiple admission complaints were determined in 41% patients (25/61), and the most common complaints were cough, fever and shortness of breath, respectively. CCT was performed because of clinical suspicion in 68.9% (42/61) patients. According to CCT results, in COVID-19 Reporting and Data System (CORADS) classification, the following results were obtained: CORADS1: 22 (52.4%), CORADS 2:5 (11.9%), CORADS 3: 2 (4.8%), CORADS 4: 5 (11.9%) CORADS 5: 1(2.4%) CORADS6: 7(16.7%). A total of 26 patients (42.6%) were reported to be RT-PCR positive. Covid-19 was detected to be positive in 52.5% (32/61) (CO-RADS 4-5-6 and/or RT-PCR+), and negative in 47.5% (29/61) (CO-RADS 1-2-3 and RT-PCR).

The following were determined in the evaluation of the demographic, clinical, laboratory and radiological parameters of COVID-19 positive and negative groups. Male gender was more dominant in demographic parameters in COVID-19 positive group ($p = 0.03$); oxygen saturation (SaO_2) ($p = 0.027$) from clinical parameters, and PCT, WBC, Neutrophil count, Lymphocyte count values were low at significant levels ($p = 0.03$, $p = 0.001$, $p = 0.017$, $p = 0.021$, respectively); PLR value was significantly higher ($p = 0.021$), and the CO-RADS scores from radiological parameters were higher as expected in COVID-19 positive group ($p < 0.001$) (Tab. 1).

In the correlation analysis: SaO_2 showed a negative correlation with neutrophil count, NLR, WBC, CRP, ferritin, D-dimer and LDH. NLR showed a positive correlation with WBC, CRP and D-Dimer. PCT showed a negative correlation with LDH and positive correlation with CRP. PLR showed a positive correlation with fever, CRP, neutrophil count and NLR, which are indicators of inflammation. Details of the correlation analysis are shown in Table 2. Scatter Plots of laboratory parameters are shown in Figure 1.

DISCUSSION

It was shown in previous studies that although the first clinical symptom in detecting cases was pneumonia in COVID-19, it was also shown that it can also proceed with gastrointestinal symptoms or asymptomatically [10]. COVID-19 needs to be continuously improved and accelerated in terms of clinical diagnosis and treatment to control the spread, considering its spread and serious systemic effects [10, 11].

CCT is one of the most important means of diagnosis in many lung diseases, including pneumonia [12]. It was reported that the COVID-19 Reporting and Data System (CO-RADS) Classification for COVID-19 pneumonia is a categorical evaluation scheme for pulmonary involvement in unenhanced CCT, which has a predictive value in COVID-19 in patients with moderate and severe symptoms [9, 13]. In our study, a total of 42 patients who described dyspnea complaints underwent CCT, and 13 patients (30.9%) were reported to have findings associated with pneumonia.

In a study, it which COVID-19 positive 75 patients were evaluated, 60% of the patients were identified as male. In our study, male gender was found to be dominant in COVID-19 positive group, which is in line with the literature [14].

It was reported previously that the presence of comorbidity and smoking deteriorated the prognosis of COVID-19 patients [17]. In our study, 45.9% of patients had no comorbidities, and 29.3% of them were active smokers. However, no differences were detected between COVID-19 positive and negative groups in terms of smoking and comorbidity.

The most common complaints detected in COVID-19 patients were determined as fever, cough and sore throat [14]. In our study; however, the most common admission complaints were cough, fever and shortness of breath, respectively.

Huang et al. [16] referred to SaO_2 as another indicator of the disease progression. It was reported previously that SaO_2 was in close relation with hospitalization and mortality, and the cut-off value for SaO_2 was 93% in determining COVID-19 seriousness. In our study, SaO_2 value was 94.06% in the COVID-19 positive group, and 95.9% in the COVID-19 negative group, and this difference was found to be

Table 1. Demographic, clinical, laboratory and radiologic results of the study group

Parameters	Total (n = 61)	COVID-19+ (n = 32)	COVID-19- (n = 29)	p
Demographics				
Age	46.6 ± 18.6	44.25 ± 21.25	49.24 ± 15.13	0.45
Sex (men/women) n (%)	27/34 (44.3/55.7)	20/12 (62.5/37.5)	7/22 (24.1/75.9)	**0.003**
Comorbidity n (%)	33 (54.1)	16 (50)	17 (56.6)	0.5
Smoking (+) n (%)	24 (39.3)	11 (34.4)	13 (44.8)	0.44
Clinical Parameters				
SaO_2 (%)	94.84 ± 7.4	94.06 ± 8.2	95.9 ± 6.3	**0.027**
Fever (C0)	36.79 ± 0.64	36.9 ± 0.64	36.6 ± 0.62	0.143
Laboratory Parameters				
WBC ($10^3/\mu L$)	8.06 ± 4.27	6.90 ± 4.72	9.34 ± 3.36	**0.001**
Neutrophil ($10^3/\mu L$)	5.52 ± 3.9	5.01 ± 4.37	6.08 ± 3.37	**0.017**
Lymphocyte ($10^3/\mu L$)	2.06 ± 1.1	1.79 ± 0.96	2.37 ± 1.18	**0.021**
NLR	4.67 ± 7.3	5.23 ± 8.86	4.06 ± 5.21	0.977
CRP (mg/L)	26.93 ± 55.1	29.09 ± 56.29	24.55 ± 54.77	0.322
D-DIMER $\mu g/L$	326.77 ± 575.6	304.40 ± 299.93	351.44 ± 780.56	0.056
FERRITIN $\mu g/L$	213.75 ± 378	278.96 ± 481.75	141.79 ± 197.81	0.549
LDH U/L	205.49 ± 137	219.28 ± 178.84	190.27 ± 68.61	0.301
PLT 103/μL	257.50 ± 68.9	250.93 ± 71.10	265.03 ± 68.05	0.52
MPV fL	7.58 ± 1.34	7.36 ± 1.07	7.83 ± 1.58	0.37
PCT (%)	0.19 ± 0.04	0.18 ± 0.04	0.20 ± 0.04	**0.03**
PDW (10(GSD))	20.29 ± 1.14	20.23 ± 0.95	20.35 ± 1.34	0.913
PLR	165.49 ± 126.39	187.64 ± 136.4	141.06 ± 111.48	**0.021**
Radiological Parameters				
CORADS n (%) 1 2 3 4 5 6	 22 (52.4) 5 (11.9) 2 (4.8) 5 (11.9) 1 (2.4) 7 (16.7)	 0 0 0 5 (38.5) 1 (7.7) 7 (53.8)	 22 (75.9) 5 (17.2) 2 (6.9) 0 0 0	**< 0.001**

LDH — lactate dehydrogenase PLT; MPV — Mean Platelet Volume; NLR — Neutrophil/Lymphocyte Ratio CRP; PCT — plateletcrit; PDW — Platelet Distribution Width; PLR — Platelet-Lymphocyte Ratio; SaO_2 — oxygen saturation; WBC — White Blood Cell

significant (p = 0.027). We believe that the low SaO_2 levels in our patient group were because of the damage the virus did directly on the lungs.

Yang et al. [17] classified COVID-19 patients as severe/non-severe. WBC was found to be higher at significant levels in the severe group, and a significant correlation was detected between NLR elevation and COVID-19 risk. Terpos et al. [18] reported that the WBC count was normal or slightly lower in the early stages of the disease. Similarly, in a study investigating laboratory parameters in the diagnosis of COVID-19 in the first 2 months of the outbreak, WBC was detected to be decreased in 33.7% of patients [3]. In our study, on the other hand, the WBC count was found to be low in the COVID-19 positive group. This decrease can be associated with the decrease in neutrophil and lymphocyte parameters, but according to the data we obtained, we believe that it does not provide adequate data in COVID-19 suspicion.

It was shown in different studies that COVID-19 positive patients had decreased lymphocyte count,

Table 2. Details of correlation analysis

	Fever		WBC		Neutrophil		NLR		CRP		Ferritin		D-Dimer		LDH	
	p	r	p	r	p	r	p	R	p	r	p	r	p	r	p	r
SaO_2	0.329	-0.127	**0.000**	-0.731	**0.000**	-0.818	**0.003**	-0.379	**0.001**	-0.407	**0.000**	-0.616	**0.000**	-0.771	**0.000**	-0.669
NLR	0.092	0.218	**0.002**	0.381	**0.000**	0.508		1	**0.017**	0.304	0.080	0.226	**0.008**	0.338	0.280	0.141
PLR	**0.013**	0.316	0.603	0.068	**0.047**	0.255	**0.000**	0.554	**0.007**	0.342	0.258	0.147	0.211	0.162	0.288	-0.138
PCT	0.552	-0.80	0.617	-0.067	0.060	0.249	0.754	-0.042	**0.038**	0.273	0.185	-0.177	0.662	0.059	**0.034**	-0.279

CRP — C-reactive protein; LDH — lactate dehydrogenase; NLR — Neutrophil/Lymphocyte Ratio; PCT — plateletcrit; PLR — Platelet-Lymphocyte Ratio; SaO_2 — oxygen saturation; WBC — White Blood Cell

which was associated with the prognosis [14, 17]. It was determined that this was because of the lithic effect of SARS-COV-2 in the cells and the atrophy effect of cytokine activation on lymphoid organs after SARS-COV-2 binds to angiotensin-converting enzyme 2 (ACE2) receptors expressed on the lymphocyte surface, which altogether caused a decrease in the lymphocyte turnover rate [19, 20]. In our study, the lymphocyte count was measured to be significantly low in the COVID-19 positive group ($p = 0.021$).

Neutrophil count was found to be elevated in severe COVID-19 group in various studies [14, 17]. In a prospective study that included 416 patients, 19.7% of the patients had myocardial damage, and these patients had a higher number of neutrophils than others [21]. It was considered that these results were associated with the septic condition and advanced organ damage [17, 21]. Contrary to these data, the number of neutrophils was found to be lower in COVID-19 positive group in our study ($p = 0.017$). We believe that this is related to the fact that the patients included in our study were in good condition, and were patients in the early stages of the disease.

It was reported that the NLR level is high in severe COVID-19 group, which was associated with in-hospital mortality [14, 15]. In our study; however, no differences were detected in terms of NLR in COVID-19 positive group compared to the negative group. The reason for the difference between previous studies might be methodological, or can be explained with the fact that no significant elevation was detected in neutrophil count in our study.

In a previous study examining the relations between PLT parameters and mortality, it was determined that thrombocytopenia and low PCT were associated with an increase in in-hospital mortality; however, increases were detected in the PLT values in surviving patients during the disease, and low PCT was identified as an independent risk factor for mortality [22]. In our study, although the PLT count and MPV values were below the reference values in COVID-19 positive group, no significant differences were detected in this regard. It was found that the PCT value was lower in the COVID-19 positive group, which, as a finding, also has the potential to show that the COVID-19 positive patient group had a higher risk than the COVID-19 negative group ($p = 0.03$).

PLR is a new index that shows inflammation. It was shown previously that PLR can be used as

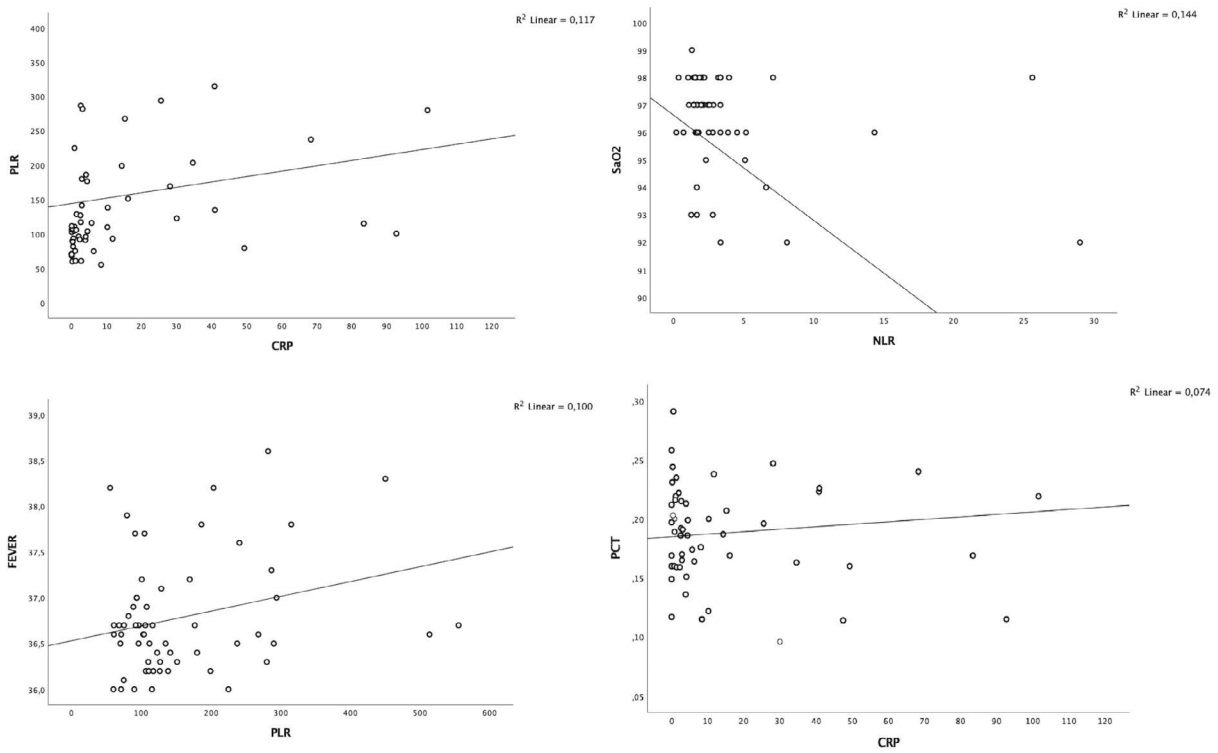

FIGURE 1. Scatter plots of laboratory parameters

the potential inflammatory indicator for clinical diagnosis of community-based pneumonia [23]. Qu et al. [23] showed the relation of low lymphocyte levels in admission with prognosis. Also, low PLT levels were associated with more serious diseases, and elevated PLR showed the degree of cytokine storm in monitoring COVID-19 patients. In our study, PLR value was higher in COVID-19 positive patients ($p = 0.021$); and in the correlation analysis, it was shown that PLR had a positive correlation with inflammation indicators, fever, CRP, neutrophil count and NLR. The significantly high PLR levels in COVID-19 positive patient group in our study may provide the clinician with an idea on early diagnosis. According to the results of our study, we believe that PLR might have an important value in COVID-19 suspected patients in terms of the severity of inflammation, it may be supportive in the decision for tomography in patients admitted to emergency department with suspicion of COVID-19, and may be an important indicator in the hospitalization decision of COVID-19 positive patients.

It was determined in our study that the lymphocyte count, neutrophil count, WBC and PCT were low in COVID-19 positive patients; and PLR and CO-RADS were determined to be high. These parameters were associated with disease severity in previous studies. Depending on the density in the laboratory work, the hemogram result can be obtained in approximately 5 minutes, and RT-PCR result must be expected after at least 1–3 hours. Rapid identification and isolation of people suspected of SARS-CoV-2 infection are essential [24]. In this context, we believe that these parameters, especially the PLR elevation, which supports the presence of inflammation, will provide important clues to the clinician for hospitalization, timely treatment and early isolation of patients admitted to the emergency department with non-specific symptoms and findings.

CONCLUSION

The SaO_2, WBC, lymphocyte count, neutrophil count and low PCT levels, and PLR elevation showed a significant difference in COVID-19 patients in our retrospective cohort study examining the Turkish population. We believe that these results will allow clinicians to make quick decisions in patient management more simply; however, more studies are needed with wider patient populations.

Ethics: Consent according to Helsinki declaration was taken from Ufuk University Faculty of Medicine ethics committee before the study (No: 20200521/9).

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PLACE OF MAGNESIUM SULFATE IN CARDIOPULMONARY RESUSCITATION. A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

INTRODUCTION: Sudden cardiac arrest treatment is challenging, And the effectiveness of resuscitation procedures — especially in pre-hospital conditions — is low. The purpose of this meta-analysis is to investigate the effects of magnesium sulfate ($MgSO_4$) in cardiac arrest on the return of spontaneous circulation (ROSC) and survival to hospital discharge.

MATERIAL AND METHODS: We searched in MEDLINE, EMBASE, Scopus, and ClinicalTrials.gov, Web of Science up to May 25, 2020, and we conducted a systematic review and meta-analysis. We synthesized results by using mean differences, and odds ratios. The overall incidence and outcome of cardiac arrest were assessed using a random-effects meta-analysis.

RESULTS: A total of 5 eligible studies were included in this meta-analysis. Survival to discharge was higher in magnesium sulfate group compared to placebo group (9,5% vs. 8.2% respectively; OR = 1.17; 95% CI: 0.61, 2.23; p = 0.64). Higher survival rate to hospital admission was observed in the placebo group — 26.9% compared to the group where magnesium was administered — 25.7% (OR = 0.93; 95% CI: 0.59, 1.47; p = 0.77.

CONCLUSIONS: In conclusion, this meta-analysis indicates no statistically significant benefit of resuscitation with magnesium sulfate compared to the placebo. Thus, due to the low number of studies we recommend future randomized controlled trials to identify which anti-arrhythmic drug we should use on shock-refractory cardiac arrest.

KEY WORDS: magnesium sulfate, antiarrhythmic agents, cardiopulmonary resuscitation, advanced cardiovascular life support, meta-analysis, a systematic review

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INTRODUCTION

Magnesium is an important cofactor of several critical enzymes in the human body and is used both in pre-hospital care and in hospital wards. Assorting to the Deheinzelin et al. study incidence of hypo-

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magnesemia was reported in up to 65% in critically ill patients [1].

The therapeutic effect of magnesium sulfate is based on the antagonistic effect concerning calcium ions (Ca^{2+}) or blocking the release of catecholamines. This is due to the stabilizing effect of cell membranes by forming complexes with membrane phospholipids, which reduces the fluidity and permeability of cell membranes. $MgSO_4$ also presents an effect on neuromuscular conduction by increasing the excitability threshold, which results in a decrease in the contractility of both striated and smooth muscles.

According to the characteristics of the drug $MgSO_4$ is used in the treatment of magnesium deficiency: a) confirmed hypomagnesemia (e.g. In children with primary congenital hypomagnesemia, adults with malabsorption syndrome after persistent diarrhea, chronic alcoholism or prolonged parenteral nutrition); b) in the prevention and treatment of hypomagnesemia in patients who are parenterally fed exclusively; c) in the control and prevention of seizures in severe pre-eclampsia; d) in the control and prevention of recurrence of eclampsia; e) in torsade de pointes.

The use of MgSO4 requires medical personnel to monitor the patient as well as monitor blood magnesium levels. If magnesium concentration is > 6.2 mmol/l (15 mg%), bradycardia may occur, while if magnesium concentration is > 7.5 mmol/l (18 mg%), conductivity disturbances and cardiac arrest due to hypermagnesemia may occur.

The advantages of administering magnesium in deficient states are known, but the benefits of routine administration of this element during a cardiac arrest have not been documented. However, some studies have shown that magnesium can be beneficial in resistant VF. Magnesium has well-known electrophysiological effects and normal concentrations are required to maintain normal cardiac conduction and rhythm. These actions of magnesium sulfate make it applicable in shock-resistant VF when hypomagnesemia is suspected; ventricular tachyarrhythmia when hypomagnesemia is suspected; torsades de pointes (polymorphic ventricular tachycardia) or digoxin poisoning. In stock-resistant VF, an initial dose of 2 g should be administered intravenously (4 ml of 50% magnesium sulfate = 8 mmol) to the peripheral vascular bed in 1–2 minutes. It can be repeated after 10–15 minutes.

Therefore, we performed an updated meta-analysis of randomized controlled trials, addressing whether magnesium sulfate, compared with placebo, improves survival outcome and good neurological outcome (Cerebral Performance Categories Scale, CPC 1, 2) in adult patients with cardiac arrest. Besides, we analyzed outcomes of subgroups according to the location of arrest (out-of-hospital or in-hospital cardiac arrest). The primary objective was to determine whether magnesium sulfate results in better survival to discharge outcomes.

MATERIAL AND METHODS

This systematic review and meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [2] and is part of a larger systematic review that evaluated pharmacological effectiveness in cardiac arrest. Before starting the study, all authors agreed on the analysis methods and the inclusion and exclusion criteria to be applied. The protocol of this meta-analysis study has not been registered.

Search strategy

We searched Medline, PubMed, EMBASE, Scopus, Web of Science, and the Cochrane Database of Systematic Reviews from inception to 25 May 2020. The search terms were "magnesium" or "$MgSO_4$" and "cardiac arrest" or "IHCA" or "OHCA" or "ventricular fibrillation" or "VF" or "ventricular tachycardia" or "VT" or "CPR" or "cardiopulmonary resuscitation" or "sudden cardiac death" or "survival rate" or "mortality" or "return of spontaneous circulation". Only articles published in English were considered. Additionally, relevant clinical guidelines, systematic reviews, meta-analysis, and references of relevant publications were used to identify additional studies.

Inclusion criteria and exclusion criteria

Studies were included if they met the following eligibility criteria: a) evaluated adults aged at least 18 years old with cardiac arrest; b) compared magnesium sulfate with placebo; c) reported outcomes of interest; and d) were English language articles. We contacted the corresponding authors to obtain further information when these values could not be obtained from the reported data. Review articles, letters to the editor, conference papers, guidelines, editorials, and case reports were excluded.

Data extraction

Two independent reviewers (K. L. and J. S.) screened the titles and abstracts of all citations using pre-

specified inclusion and exclusion criteria. Studies included by either reviewer were retrieved for full-text screening. The same reviewers then screened the full-text version of eligible references. The following data were extracted from the studies: the first author's name, year of publication, a region of publication, number of patients, sex (male), age of patients. The rate of survival to hospital discharge was considered as the primary outcome. ROSC, survival with favorable neurological outcomes were also analyzed as outcome variables. Discrepancies between the reviewers were resolved through discussion. If consensus could not be reached, a third reviewer (L. S.) resolved the disagreement.

Quality assessment

Two authors (L. S. and J. S.) estimated the risk of bias. They evaluated the risk of bias of the included studies using Cochrane Collaboration "risk of bias" tool Review Manager software, version 5.3 (RevMan; Cochrane Collaboration, Oxford, UK) for randomized trials. According to the Higgins assessing the risk of bias guidelines [3] and previous meta-analysis the following domains were evaluated for RCTs: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other bias [4]. Each was graded "yes", "no", or "unclear", which reflected a high risk of bias, low risk of bias, and uncertain bias, respectively. The review authors' judgments about each risk of bias item are provided in Supplementary digital file. The overall risk of bias for the study was rated 'low' if 7 or more domains were rated low, 'moderate' if 4 to 6 domains were rated low, and 'high' if 1 to 3 domains were rated low.

Statistical analysis

All statistical analyses were conducted using Review Manager version 5.3 (Cochrane Collaboration, Oxford, UK). A random-effects model was used to estimate the outcomes among cardiac arrest patients who received magnesium. The Mantel-Haenszel method was used to pool dichotomous data and to compute pooled odds ratios (ODs) with 95% confidence intervals (CIs). The inverse variance method was used to pooled continuous data and to calculate weight mean differences with 95% CIs. When the continuous outcome was reported in a study as median, range, and interquartile range, we estimated means and standard deviations using the formula described by Hozo et al. [5]. Statistical heterogeneity across studies was assessed with the I^2 statistic, where values of 25%, 50%, and 75% represented the cut-off points for low, moderate, and high levels of heterogeneity, respectively [6]. All statistical tests were two-sided and were considered when $p < 0.05$.

Subgroup analyses stratified by cardiac arrest place (in-hospital or out-of-hospital) were conducted to investigate potential sources of heterogeneity across subgroups. We performed sensitivity analyses by omitting one study at a time to assess the influence of any single study on the pooled survival rate estimates.

RESULTS

On May 25, 2020, 387 studies were retrieved from our literature search for review. After removing duplicate articles, we further excluded 289 articles based on titles and abstracts. A total of 22 articles were selected for further full-text assessment. After retrieving the full text for evaluation in detail, 17 articles were excluded because they did not meet our outcomes. Finally, a total of five studies were included in the present meta-analysis [7–11] (Fig. 1).

Characteristics and quality of the studies included

The characteristics of the 5 included studies are shown in Table 1. Three of those studies were conducted in the USA [7, 10, 11], one in Australia [8], and one in the UK [9]. The year of publication ranged from 1997 to 2002. In total, 449 cardiac arrest patients were involved in this study. Five studies reported the incidence of return of spontaneous circulation [7–11], four the incidence of survival to hospital admission (or 24 hours survival) [7–9, 11], five studies survival to hospital discharge [7–11] and one study survival with favorable neurological outcome [10].

Survival to discharge

Survival to discharge was reported by five trials [7–11] and was higher in magnesium sulfate group compared to placebo group (9,5% vs. 8.2% respectively; OR = 1.17; 95% CI: 0.61, 2.23; p = 0.64) (Fig. 2).

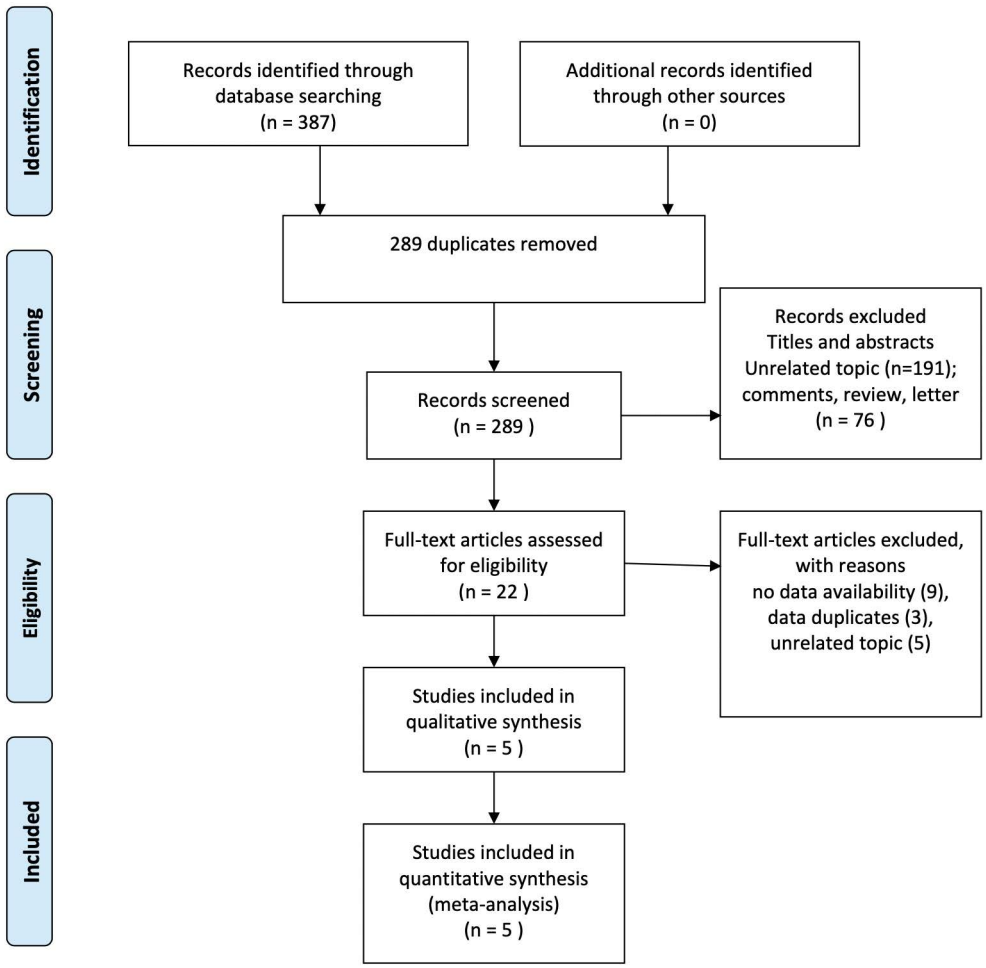

FIGURE 1. Flow diagram showing stages of database searching and study selection.

Table 1. Baseline demographic data of the included studies

Study	Country	Study design	$MgSO_4$ group			Control group		
			n	Age	Sex, male	n	Age	Sex, male
Allegra et al. 2001	USA	Double-blinded RCT	58	65 (13)	33 (56.9%)	58	65 (14)	27 (46.6%)
Fatovich et al. 1997	Australia	Double-blinded RCT	31	64 (11.1)	25 (80.6%)	36	65 (12.8)	31 (86.1%)
Hassan et al. 2002	United Kingdom	Double-blinded RCT	52	65 (15)	37 (71.2%)	53	67 (12)	37 (55.2%)
Miller et al. 1995	USA	Open label randomized study	23	72.3	NR	33	73.6	NR
Thel et al. 1997	USA	Open label randomized study	76	61.8 (3.5)	46 (60.5%)	80	67 (2.7)	43 (53.8%)

NR — Not reported; RCT — Randomized controlled trial

In out-of-hospital cardiac arrest survival to hospital discharge for magnesium was 3.6% and was 1.5% higher than in the placebo group (OR = 1.60; 95% CI: 0.40, 6.43; p = 0.51). In in-hospital cardiac arrest group survival to hospital discharge in magnesium sulfate group and placebo group varied and amounted to 17.2% vs. 15.9% respectively (OR = 1.07; 95% CI: 0.51, 2.23; p = 0.86).

Return of spontaneous circulation

Five studies reported a return of spontaneous circulation [7–11]. In pooled analysis range of ROSC for

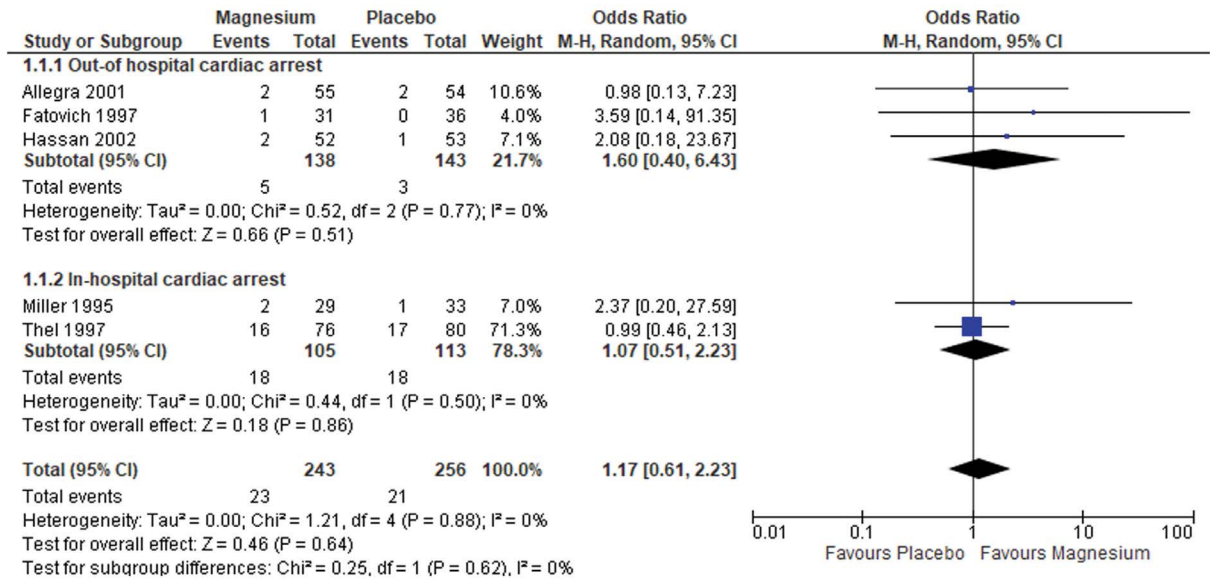

FIGURE 2. Forest plot of survival to discharge in magnesium vs. non-magnesium groups. The center of each square represents the odds ratio for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results.

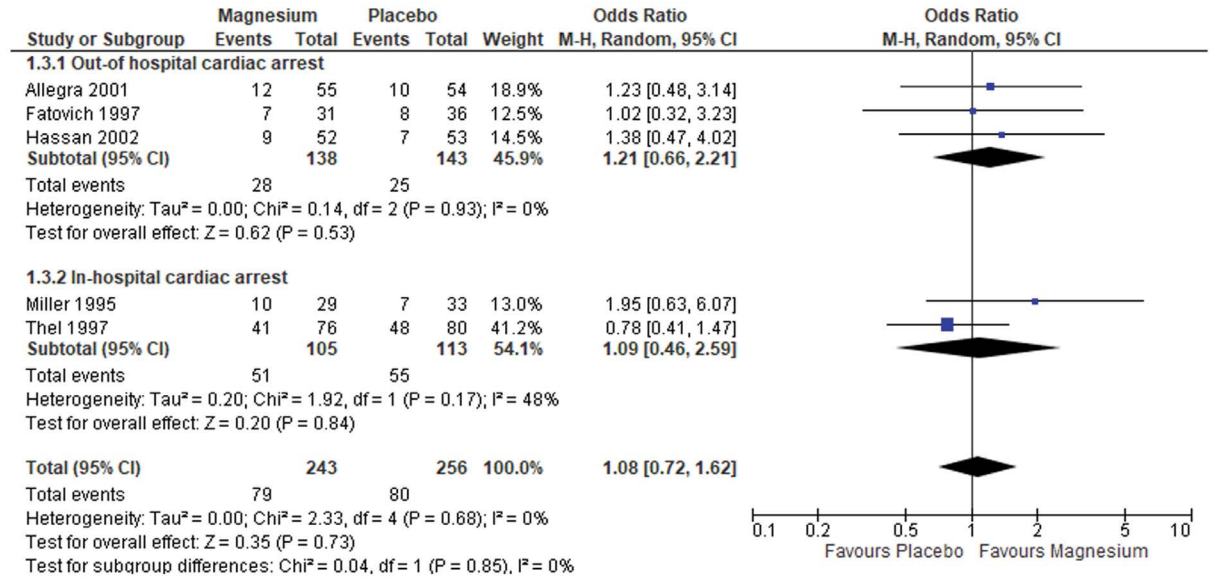

FIGURE 3. Forest plot of return of spontaneous circulation in magnesium vs. non-magnesium groups. The center of each square represents the odds ratio for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results.

magnesium was 32.5% and was slightly higher than for placebo — 31.3% (OR = 1.21; 95% CI: 0.66, 2.21; p = 0.73) (Fig. 3). Subgroup analysis showed that for out-of-hospital cardiac arrest the efficacy of ROSC was observed in 20.3% of cases in the magnesium group and 17.5% in the placebo group (OR = 1.21; 95% CI: 0.66, 2.21; p = 0.53). In in-hospital cardiac arrest the rate of ROSC was 48.6% vs. 48.7% respectively (OR = 1.09; 95% CI: 0.46, 2.59; p = 0.84).

Survival to hospital admission/24 hours

Four studies reported survival to hospital admission or 24 hours survival [7–9, 11]. Higher survival rate was observed in the placebo group — 26.9% compared to the group where magnesium was admin-

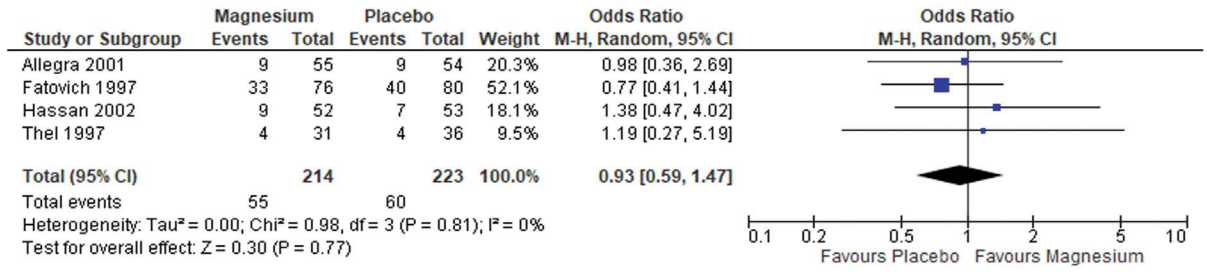

FIGURE 4. Forest plot of survival to hospital admission in magnesium vs. non-magnesium groups. The center of each square represents the odds ratio for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results.

istered — 25.7% (OR = 0.93; 95% CI: 0.59, 1.47; p = 0.77) (Fig. 4).

Survival with favorable neurological outcome

Only study by Miller et al. [10] reported survival to hospital discharge with favorable neurological outcome. This outcome was comparable between the groups magnesium sulfate vs. placebo (3.4% vs. 3.0%; OR = 1.14; 95% CI: 0.07, 19.13; p = 0.93).

DISCUSSION

We conducted a systematic review and meta-analysis to evaluate the association magnesium sulfate with survival after out-of-hospital as well as in-hospital cardiac arrest.

Magnesium sulphate has a wide range of applications in emergency medicine. It is mainly used in ventricular fibrillation or shock-resistant tachycardia as well as in other life-threatening tachyarrhythmias, especially when they result from hypomagnesemia, in *torsades de pointes* [12, 13] or in situations where there is a suspicion of cardiac arrest due to poisoning with cardiac glycosides [14], in acute asthma [15, 16] or acute stroke [17, 18].

Magnesium itself is a component of many enzymatic systems that determine the production of energy in the muscles. It is also an antagonist of calcium ions causing a decrease in the systolic strength and heart rate while improving the systolic activity of the myocardium [18].

Magnesium sulfate is considered an antiarrhythmic drug. Currently, there is no unanimous approach to its use during cardiopulmonary resuscitation. In a trial by Fatovich et al. high dose of magnesium as first-line drug therapy for out-of-hospital cardiac arrest was not associated with significantly improved survival [8]. The Hassan et al study also reached similar conclusions [9].

A study performed by Upala et al. found a strong association between hypomagnesemia and increased mortality in ICU patients [20]. In turn, a study by Johnson et al. relating to the evaluation of the correlation between cord blood magnesium concentration and the effectiveness of resuscitation concerning neonatal resuscitation showed no relationship between cord blood Mg and delivery room resuscitation [21].

An increase in adrenaline levels during resuscitation may increase the release of magnesium, which creates a toning effect utilizing negative feedback resulting in the release of magnesium from the storage pool and thus lowering the adrenaline levels as a final result [22, 23]. Magnesium ions, as already mentioned in the introduction, influence the activity of enzymes regulating carbohydrate metabolism and modulate the supply of glucose to nerve cells. Magnesium ions also have a stabilizing effect on the cell membranes of thrombocytes, thus reducing platelet aggregation [24, 25].

The present study has several potential limitations. We only these studies published in English were included in this meta-analysis and studies in other languages were omitted. Another limitation is the small number of studies on the effectiveness of magnesium sulfate during cardiopulmonary resuscitation.

CONCLUSIONS

In conclusion, this meta-analysis indicates no statistically significant benefit of resuscitation with magnesium sulfate compared to the placebo. Thus, due to the low number of studies we recommend future randomized controlled trials to identify which

anti-arrhythmic drug we should use on shock-refractory cardiac arrest.

Supplementary digital file

Supplementary material related to this article can be found, in the online version, at: https://journals.viamedica.pl/disaster_and_emergency_medicine/article/view/DEMJ.a2020.0041#supplementaryFiles

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ASSOCIATION OF CARBON MONOXIDE RATIO WITH NEUTROPHIL-LYMPHOCYTE RATIOS AND CARDIAC INDICATORS IN CARBON MONOXIDE INTOXICATION; A PILOT STUDY

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ABSTRACT

INTRODUCTION: Carbon monoxide is still a public health problem in developing countries. Brain and heart tissues are mostly affected by intoxications. Carbon monoxide poisoning causes the development of cardiac ischemia and cardiac conduction disorders. Our aim is to study the associations of NRL with cardiac indicators in patients with acute carbon monoxide poisoning.

MATERIAL AND METHODS: Patients who admitted to the E.R. between the dates 01.10.2015–01.06.2017 were examined retrospectively. Of 54 patients diagnosed with carbon monoxide intoxication, 41 patients with complete parameters and follow-ups were included in the study. Their demographic information, complete blood count, troponin and CK-MB values and carbon monoxide levels were recorded.

RESULTS: Of the patients who included in the study, 18 (43.9%) were female and 23 (43.9%) were male. Their age average was 43.7 ± 18.9. Troponin, CK-MB, neutrophil-lymphocyte ratio levels of the patients were not correlated with carbon monoxide levels (respectively $p = 0.238$, 0.707, 0.364). Troponin levels of the patients had a positive correlation with neutrophil-lymphocyte ratio (r: 0,309, $p = 0.049$).

CONCLUSIONS: Neutrophil-lymphocyte ratio can be used to identify an early diagnosis of cardiac impacts in carbon monoxide poisonings. However, more studies on the subject are needed.

KEY WORDS: carbon monoxide, neutrophil lymphocyte ratio, cardiac biomarkers

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INTRODUCTION

Carbon monoxide poisoning is still a public health problem in developing countries [1]. Carbon monoxide, a colorless and odorless gas produced by incomplete burning of hydrocarbon gasolines, is not irritant [2]. Carbon monoxide has 210 times greater affinity for hemoglobin than oxygen. When carbon monoxide is bound to the hemoglobin, the oxygen disassociation curve shifts to the left. Intoxication reveals itself as tissue hypoxia and direct damage at the cellular level [1]. As carboxyhemoglobin value increases, symptoms of the intoxication show a large range from non-specific symptoms such as dizziness and nausea to coma and death [3–5].

Intoxication has the most sensitive and most frequent impact on brain and heart tissues [6, 7]. In order to identify the effects of carbon monoxide poisoning in heart, electrocardiogram and cardiac bio

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indicators have been used [6, 8]. Carbon monoxide poisoning may develop both cardiac ischemia and cardiac conduction disorders. The literature has many studies describing those cases [9, 10]. Myocardium damage in carbon monoxide poisoning has been described as the cause of mortality for a long time [11].

Neutrophil-lymphocyte ratio is an easy, quick and accessible non-invasive bio indicator which shows the inflammatory state [12, 13]. This ratio has recently been studied on especially cardiovascular and inflammatory diseases. Neutrophil refers to general inflammation whereas lymphocyte indicates unhealthiness in general physiology [13]. The ratio has also been associated with studies on cardiac ischemia [14–16].

Inflammation has a role in the pathophysiology of acute carbon monoxide poisoning. For that reason, we think that cardiac impact has an association with neutrophil lymphocyte ratio (NLR). In this pilot study, we studied the association of NLR with cardiac indicators in patients with carbon monoxide poisoning.

MATERIAL AND METHODS

This retrospective study examined the patients who admitted to E.R. in Ataturk Research Training Hospital, a tertiary healthcare service in Ankara, between the dates 01.10.2015–01.06.2017. 54 patients were seen to have been diagnosed with carbon monoxide intoxication. Of those patients, 41 patients with complete parameters and follow-up were included in the study. Their demographic information, complete blood count, troponin and CK-MB values and carbon monoxide levels were recorded. SPSS 15.0 for Windows program was used for the analysis. Spearman correlation test was applied and p-value < 0.05 was accepted to be significant.

Findings

Of the patients who included in the study, 18 (43.9%) were female and 23(43.9%) were male. Their age average was 43.7 ± 18.9. Carbon monoxide level average of the patients was 20.91 ± 8.95. Troponin and CK-MB levels of the patients were not correlated (respectively $p = 0.238$, 0.707). Carbon monoxide level and neutrophil-lymphocyte ratio of the patients were not found to be correlated ($p = 0.364$). Troponin values and neutrophil-lymphocyte ratio of the patients had positive correlation ($r = 0.309$, $p = 0.049$). CK-MB level and neutrophil-lymphocyte ratio of the patients were not found to be correlated ($p = 0.19$). However, a positive correlation was seen between CK-MB levels and WBC ratios of the patients ($r = 0.333$, $p = 0.033$).

DISCUSSION

The early assessment of cardiac impacts in carbon monoxide intoxications is important. In our study, troponin, which is the most valuable cardiac bio indicator in patients with carbon monoxide intoxication, and neutrophil-lymphocyte ratio show an association.

Former studies showed that NLR indicated an association with central nerves system depression and cardiac complications, which were seen in patients with carbon monoxide intoxications [17–19]. Korkmaz et al. in one of their studies showed that more troponin increase was seen in patients with high NLR [20]. Those results display an association with our results. Gunaydın et al. in their study stated that there was not seen a correlation between NLR, troponin and CK-MB [21].

Karabacak et al. in their study showed that WBC and NLR values were found to be higher in patients with carbon monoxide intoxication [13].Similarly, NLR and troponin levels were found to have an association in our study. Additionally, WBC ratio was associated with CK-MB value. This situation made us think that as the level of carbon monoxide increased, inflammation increased as well, by which cardiac impacts developed.

Gazi et al. showed that complications were seen to be higher when NLR increased in myocardial infarction patients [22]. Our study also similarly displayed that NLR was higher in patients with high troponin, who namely had the development of complications.

Restrictions

Among the restrictions of our study, the paucity of the number of the patients included in the study can be counted. The hospital where the study was conducted is situated in a region that economic welfare is higher compared to the other regions in the city. Even though it is a tertiary health care service, fewer cases of carbon monoxide intoxications are admitted to the hospital. Additionally, other restrictions are that complications apart from cardiac ones were not able to be examined and long-lasting follow-up was not able to be done.

RESULTS

Neutrophil-lymphocyte ratio can be used for early diagnosis of cardiac impacts in carbon monoxide intoxications. However, more research is needed for the subject.

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CHANGES IN AIR QUALITY AND ITS EFFECT ON EMERGENCY ADMISSIONS

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ABSTRACT

INTRODUCTION: Air pollution is an emerging problem in developing countries as well as the world. Effects of air pollution due to short-term exposure may lead to increase in daily mortality, respiratory and cardiovascular hospital admissions, respiratory and cardiovascular emergency room admissions, respiratory and cardiovascular primary care visits and acute respiratory symptoms. The objective of our study was to examine the relationship between air pollution and diagnoses of patients in family medicine outpatient clinic located in emergency room.

MATERIAL AND METHODS: Our study enrolled 17869 patients who were admitted to the family practice outpatient clinic implemented in emergency department. The relationship between patients' diagnosis and air quality was examined.

RESULTS: The genders of the patients were 50.8% female (n = 9077) and 49.2% male (n = 8792). The mean age was 43.9 ± 19.9. Respiratory system diagnosis showed a statistically significant relationship with the air quality measurement of PM10 ($p < 0.05$). Patients diagnosed with upper respiratory tract disease and fatigue and hypertension on sensitive air days were found to be significantly higher than those with good air quality. There was a statistical significance between air temperature, and fatigue and cough complaints ($p < 0.05$).

CONCLUSIONS: For human health protection, continuity of life, and environmental sustainability, air pollution should be reduced and brought under control. In our study, with the increase of particulate matter, we observed that patients with respiratory system diseases, fatigue complaints, and hypertension increased. Sharing these results with province-wide authorities may help the settlement and industrial planning in the upcoming years.

KEY WORDS: air pollution, emergency admission, family medicine

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INTRODUCTION

Air pollution is an emerging problem in developing countries as well as the world. Air pollution is related to many factors such as population growth, usage of fossil fuels, industrialization, and increased utilization of vehicles using combustion engines [1]. Air pollution can be defined as the rise of chemical substances above certain limits which threatens the wellbeing of living in form of dust, smoke, gas, and vapour. Particulate Matter (PM) 10, which is particularly responsible for air pollution, is a complex mixture of extremely small particles and liquid droplets consisting of acids, organic chemicals, metals, and soil or dust particles. Normally, particles with a particulate matter size greater than 10 μm cannot reach alveoli. PM10 value indicates the number of ultrafine particles found in the air that are smaller than 10 μm. These particles can especially reach the

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alveoli by passing through the airways. The amount of PM10 has been shown to cause cardiovascular and cerebrovascular diseases by activating systemic inflammation and direct and indirect coagulation in the human organism [2].

According to the World Health Organization (WHO) report, outdoor air pollution causes 4.2 million premature deaths annually. 58% of premature deaths are due to ischemic heart disease and stroke; 18% are due to chronic obstructive pulmonary disease and acute lower respiratory tract disease, and 6% are due to lung cancer [3]. Effects of air pollution due to short-term exposure may lead to increase in daily mortality, increase in respiratory and cardiovascular hospital admissions, increase in respiratory and cardiovascular emergency room admissions, increase in respiratory and cardiovascular primary care visits, an increase in acute respiratory symptoms (wheezing, cough, sputum production, respiratory tract infections) [4].

The monitoring of air quality is carried out by both the Ministry of Environment and Urbanization and the weather monitoring stations of some municipalities. At the stations where air quality is monitored, the data of PM10, O_3 (Ozone), SO_2 (Sulfur Dioxide), NO (Nitric Oxide), CO (Carbon Monoxide), air temperature, air pressure, and relative humidity are monitored and presented as hourly and daily data. Based on these data, vehicle traffic is the most important NOx source in Europe and it is the primary source of PM10 and the second most important source of PM2.5. In Turkey, with increasing, fossil fuel consumption, particularly for air pollution PM10 parameter; Kahramanmaras, Istanbul, and Ankara are in the top three among air polluted cities [5].

The objective of our study was to examine the relationship between air pollution and diagnoses of patients by studying the relationship between the International Classification of Diseases (ICD)-10 data, where the patients admitted to family practice outpatient polyclinics, especially in emergency rooms are diagnosed, and the PM10 and NO values in air quality.

MATERIAL AND METHODS

Our study enrolled 17869 patients who were admitted to the family practice outpatient clinic implemented in the emergency department of Istanbul Medeniyet University Faculty of Medicine Emergency Department and whose addresses are in Kadıköy district in Istanbul between May 2017–May 2018. The diagnoses of the patients were retrospectively screened using the ICD-10. In this period, PM10 and NO measurement values of Göztepe Station of the Ministry of Environment and Urbanization were evaluated by considering the 24-hour average data. The relationship between patients' ICD-10 diagnosis codes and air quality was examined. In PM10 evaluation, which is one of the air quality parameters, PM10 0–50 μg/m3 was characterized as **'Good'**, 51–100 μg/m3 as **'Medium'**, 101–260 μg/m3 as **'Sensitive'**, 261–400 μg/m3 as **'Unhealthy'**, 401–520 μg/m3 as **'Bad'**, and $>$ 520 μg/m3 as **'Dangerous'**. In the European Union member states, while the average limit value of PM10 for 24 hours is 50 μg/m3, the average limit value of NO_2 for 24 hours is 200 μg/m3 [6]. For the research, authorization was obtained from Istanbul Medeniyet University Faculty of Medicine Ethics Committee in 2019.

Statistical Analysis

Descriptive values of the data obtained were calculated as mean ± Standard Deviation (SD), median, number and % frequency. The suitability of air quality parameters to normal distribution was examined with the Kolmogorov-Smirnov test. The differences between PM10 and NO_2 values, which are among the air quality parameters obtained from the measurement stations, and patient diagnoses were evaluated with the Kruskal Wallis test and the posthoc test was used to determine different measurement values. Statistical significance level was $p < 0.05$ and IBM SPSS (ver. 22.0, Armonk, NY: IBM Corp.) software was used in calculations.

RESULTS

The genders of the patients who participated in our study were 50.8% female (n = 9077) and 49.2% male (n = 8792). The mean age and SD of our patients were calculated as 43.9 ± 19.9. Descriptive values of patient diagnoses and air quality measurement values were calculated (Tab. 1). The diagnoses of patients who were admitted to emergency family practice were examined in terms of air quality measurements PM10 and NO_2 (Tab. 2) and it was determined that they did not demonstrate normal distribution. Patients diagnosed with a respiratory system diagnoses showed a statistically signifi-

Table 1. Descriptive statistics

	n (days)	Mean ± SD	Median (Min–Max)
Diagnosis J(0–99)	251	38.14 ± 19.89	35 (1–111)
Diagnosis M(0–99)	250	14.41 ± 6.76	14 (1–40)
Diagnosis R53	205	6.69 ± 6.54	4 (1–44)
Diagnosis R05	194	4.87 ± 3.70	4(1–20)
Diagnosis I10	242	2.66 ± 1.49	2 (1–7)
SO_2	364	3.90 ± 2.38	3 (1–18)
PM10	365	48.37 ± 35.77	37 (8–199)
CO_2	365	607.18 ± 331.15	560 (69–2843)
NO	362	55.21 ± 69	30.5 (0–377)
NO_2	362	64.14 ± 24.09	61 (19–148)
NOX_2	362	119.29 ± 88.38	89.5 (20–485)
O_3	365	19.47 ± 9.56	18 (4–48)
HUMIDITY	365	74.09 ± 11.25	74 (39–98)
HOT WEATHER	365	18.16 ± 6.93	18 (2–33)
AIR PRESSURE	365	1014.66 ± 6.42	1014 (997–1033)

CO_2 — Carbon Dioxide; NO_2 — Nitrogen Dioxide; NOX_2 — NADPH oxidase 2; O_3 — Ozone; PM — Particulate Matter; SD — Standard Deviation; SO_2 — Sulphur dioxide

Table 2. Comparison of the diagnoses of the patients and the air quality measurement values

Diagnosis	PM10	n (days)	Median (Min–Max)	p	NO_2	n (days)	Median (Min–Max)	p
J/Diseases of the Respiratory System	0–50	172	35 (4–94)	**0.009***	0–100	206	36 (4–111)	**0.009***
	51–100	52	42 (13–111)		101–120	23	45 (13–77)	
	101–260	27	46 (23–81)*		> 121	19	49 (23–81)*	
M/Diseases of Musculoskeletal System	0–50	172	14 (2–30)	0.608	0–100	206	14 (2–31)	0.410
	51–100	51	16 (2–40)		101–120	22	17 (3–40)	
	101–260	27	14.5 (12–20)		> 121	19	15 (13–20)	
R53/Fatigue	0–50	140	5 (1–44)	**0.005***	0–100	173	4 (1–44)	0.095
	51–100	43	3 (1–18)*		101–120	14	3 (1–18)	
	101–260	22	2.5 (1–23)*		> 121	18	3 (1–23)	
R05/Cough	0–50	135	4.5 (1–18)	0.309	0–100	160	4 (1–18)	0.686
	51–100	36	3 (1–20)		101–120	16	3 (1–12)	
	101–260	23	4 (1–11)		> 121	16	5 (1–20)	
İ10/Hypertension	0–50	164	2 (1–7)	**0.033***	0–100	199	3 (1–7)	0.073
	51–100	53	3 (1–7)		101–120	22	2 (1–5)	
	101–260	25	2 (1–3)*		> 121	18	2 (1–3)	

NO_2 — Nitrogen Dioxide; PM — Particulate Matter

cant relationship with the air quality measurement of PM10 ($p < 0.05$). Patients diagnosed with upper respiratory tract disease on sensitive air days were found to be significantly higher than those with good air quality. There was a statistically significant relationship between PM10 and patients diagnosed with fatigue ($p < 0.05$). It was observed that the admissions to the emergency room of the patients diagnosed with fatigue decreased significantly as the weathers quality becomes lower. A statistically significant relationship was found between PM10 and patients diagnosed with hypertension

($p < 0.05$). No statistically significant relationship was found between the patients diagnosed with M(00–99). Diseases of the musculoskeletal system and connective tissue and PM10 ($p > 0.05$). Finally, among the diagnoses that were examined, no significant relationship was found between cough and PM10 ($p > 0.05$). There was a statistical significance between air temperature, and fatigue and cough complaints ($p < 0.05$). There was no statistical significance between humidity and the complaints. When the diagnoses of the patients are examined in terms of NO_2, another parameter used in the evaluation of air quality; a statistically significant relationship was observed in the diagnosis codes of J(00–99) in terms of respiratory system diseases ($p < 0.05$). As the air quality became more sensitive, the number of patients diagnosed with respiratory system diseases increased significantly in the upper J(00–99) diagnostic codes. No statistically significant relationship was found between the patients diagnosed with M(00–99) Diseases of the musculoskeletal system and NO_2 ($p > 0.\ 0.05$). Patients with diagnosed with pain, fatigue, cough, and hypertension respectively were not found to be significantly related to the NO_2 measurement levels ($p > 0.\ 0.05$, $p > 0.\ 0.05$, $p > 0,\ 0.05$, and $p > 0.05$).

DISCUSSION

With the industrial revolution, air pollution has become one of the biggest problems faced in the 19th century, and due to increasing use of fossil fuels and industrialization in our country, it is increasing day by day. Depending on short-term and long-term exposure to air pollution, its effects on human health may vary. Especially after exposure to particulate matter, air pollution has been shown to cause an average decrease of 1–2 years in life expectancy [7,8]. It has been shown that exposure to pollutants such as PM and ozone in the air is associated with increased mortality and hospitalizations due to respiratory and cardiovascular diseases [9].

In research studies examining the effects of air pollution on hospital admissions in Europe and the United States of America (USA), it has been shown that, depending on the increase in PM10 levels, the rates of admission to hospital emergency rooms and mortality due to asthma and chronic obstructive pulmonary disease (COPD) in patients aged 65 years and older have increased [10, 11]. In a study conducted in Seattle, USA, it is shown that every 10 μg/m3 increase in PM10 caused an increase of 13–3.7% in COPD and asthma patients. In the study conducted in Zonguldak province, a positive and weak relationship was detected between all respiratory diseases and SO_2 and PM10 [12]. In another study conducted in Balikesir province, no relation was found between PM10 levels and respiratory diseases [13]. In our study, we detected that more patients diagnosed with respiratory system diseases were admitted on days when air pollution was intense compared to other days.

In a study conducted in Switzerland, every 10 μg/m3 increase in PM10 caused an increase in symptoms of chronic cough, sputum, and daytime shortness of breath in individuals between the ages of 18 and 60. In our study, we observed that as the PM10 value increased, more patients diagnosed with R 05 'Cough' were not admitted to the emergency service. We consider these patients are evaluated primarily in the emergency higher priority areas and/or have different diagnoses.

In a study conducted in Hong Kong, the effects of air pollutants on COPD exacerbations were investigated, and a significant direct relationship was detected between the hospitalization due to COPD acute exacerbations and increased air content of SO_2, NO_2, PM10, and PM2.5. High levels of air pollutants increase both the hospitalizations and emergency admissions due to acute exacerbation of COPD [11]. It has been shown that, at times of air pollution, the number of consultations to family physicians for asthma and lower respiratory tract diseases, although not specific for COPD, increased [14].

It has been shown that particulate matter levels are associated with increased systemic inflammation. Especially with increasing PM values, the average values of C reactive Protein (CRP), IL-6, and White Blood Count (WBC) increase and this increase has been shown to adversely affect the prognosis of patients with diabetes, obesity, and hypertension [15]. In animal experiments on the effects of air pollution, dogs exposed to particulate matter have been shown to have increased systolic blood pressure, diastolic blood pressure, mean arterial pressure, and increased heart rate [16]. In addition, it has been shown that particulate matter levels are associated with acute peripheral artery narrowing and arterial reactivity by disrupting endothelial function [17, 18]. In a study conducted in the Republic of China, it was

shown that every 10 μg/m3 increase in PM values caused an increase in the number of admissions to emergency rooms due to hypertension [19]. In our study, consistently with the literature, we also found that the admissions to green areas of the emergency room due to hypertension increased on days when PM10 was high in the air.

The effect of temperature on human health has been investigated, but the studies on the effect of humidity are somewhat more limited. As a rule of thumb, the adverse effects of relative humidity on human health can be reduced to a minimum level by keeping the humidity between 40% and 60%; in case of relative humidity above and below these levels, physical discomfort can be encountered. In a study, it was observed that admissions to family practice polyclinics due to respiratory infections increased with increasing humidity levels [20]. In our study, no relationship was found between humidity and the complaints. This may be because patients are climatized due to the constant high humidity in Istanbul.

In the study of Makinen et al. [21], it was stated that low temperature was the cause of recurrent respiratory tract infections. In a retrospective study conducted by Danielides et al. [22], it was shown that cold temperatures increased the incidence of acute laryngitis. In another study, [23] it was shown that in every 1.8 Celsius temperature increase exceeding the seasonal threshold, admissions to the hospital with complaints about respiratory tract diseases increased by 4.5%. In our study, in parallel with the literature, it was observed that with temperature drops, cough and fatigue complaints increased.

RESULTS

For human health protection, continuity of life, and environmental sustainability, air pollution should be reduced and brought under control. In our study, with the increase of particulate matter, which is one of the air pollution parameters, we observed that patients with respiratory system diseases, fatigue complaints, and hypertension increased. Since NO_2 values were much lower than the limit values in the region where we conducted our study, we have only seen an increase in the admissions for respiratory diseases. Sharing these results with province-wide authorities may help the settlement and industrial planning in the upcoming years.

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THE RELATIONSHIP OF MIGRAINE WITH SMARTPHONE USE

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ABSTRACT

INTRODUCTION: It was aimed to determine the existence of a relationship between smartphone use and the severity and frequency of attacks of migraine in patients diagnosed with migraine who were admitted to the emergency department of a university hospital with the complaint of headache by using the survey method.

MATERIAL AND METHODS: Migraine patients who came to the emergency department with headache in the last 1 year, were retrospectively analyzed. Afterwards, 119 patients who were readmitted within 3 months from this patient group were included in the survey study. All patients were asked about their preferences for smartphone use, duration of phone use, and whether they had received migraine treatment previously. The severity of pain was determined according to the visual analog scale.

RESULTS: The migraine attacks of 38 patients with drug use were observed 7.65 times on average in a year. In the group without drug use, they were observed 9.80 times on average in a year. While the number of patients, who preferred talking as a preference for smartphone use, was 35 (29.4%), 7 (5.8%) patients preferred messaging, 10 (8.4%) patients preferred playing games, and 67 (56.3%) patients preferred surfing social media — the internet. No significant relationship was found between the severity of migraine pain and the preference for phone use ($p = 0.08$) (Tab.2).

CONCLUSIONS: There is a need for more comprehensive experimental and epidemiological studies to confirm the relationship between migraine severity and the devices with high-frequency electromagnetic areas such as smartphones.

KEY WORDS: migraine, smartphone, electromagnetic areas

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INTRODUCTION

Headache is a symptom that is one of the most common complaints in the world and occurs for various reasons. Primary headaches (tension-type headache, cluster-type headache, and migraine) constitute the majority of patients presenting with headache [1]. Migraine is an episodic headache type accompanied by neurological, gastrointestinal, and autonomic changes. It is a significant health problem, which is the second most common in primary headaches, affects approximately more than 10% of the general population, and impairs the quality of life [2]. Since migraine attacks may last for hours and sometimes for days, it leads to the restriction of daily activities of people [3].

The use of smartphones and computers has increased significantly since the 1990s, especially in recent years around the world [4]. Along with the fact that smartphones have become lighter with each passing day, they have become easy to carry and have surpassed computer use. Since these phones have many features such as messaging, camera,

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game, access to the internet and social networks, videos, multimedia and navigation, they cause more time to be spent during the day. As a result of limited studies, it was reported that smartphone users had mild side effects such as headache, sleep disorder, attention deficit, short-term memory loss, dizziness, tinnitus, and chronic fatigue [5]. The use of smartphones has been increasing significantly, especially among young people. On the other hand, complaints of headache are increasing around the world. However, the causal relationship between phone use and headache has not been fully explained yet [6]. It was observed that the survey studies discussing the relationship between the severity and frequency of attacks of migraine and smartphone use were not sufficient. In our study, it was aimed to determine the existence of a relationship between the daily duration of smartphone use and the severity and frequency of attacks of migraine in patients diagnosed with migraine, who were admitted to the emergency department, by using the survey method.

MATERIALS AND METHODS

Approval for the study was obtained from the Ethics Committee of Kafkas University, Faculty of Medicine (Ethics committee date: 30.10.2019, Decision Number: 80576354-050-99/237). Three hundred thirty-seven patients diagnosed with migraine according to the ICD diagnosis code, who had been admitted to our hospital's emergency department with headache in the last 1 year, were retrospectively examined. It was planned to conduct a voluntary survey when these patients would be admitted to our emergency department again. Among 337 patients with a diagnosis of migraine, 135 patients who were admitted to the emergency department for the second time between 01.11.2019–01.02.2020 were included in the survey study. Information about the study was provided, 9 people refused to participate in the study, and 7 people were excluded from the study since they used classic phones. The survey study was conducted with the remaining 119 patients. In the form, participants were asked about their first preference for smartphone use, daily duration of phone use, educational status, and whether they had received migraine treatment previously. The pain severity of patients was evaluated by the Visual Analog Scale (VAS) because of its quick and simple scoring. Individuals were told that they could evaluate their pain from 0 to 10 on a 10 cm line, the place marked by the individual on the chart was measured with a ruler, and the value found was written as the severity of pain [7, 8]. It was considered that the patients with a VAS score of 30 mm or less had mild pain, those with a VAS score of 70 mm or more had severe pain, and those with a VAS score of over 30 mm and below 70 mm had moderate pain [9]. In this study, it was aimed to determine the relationship between the exposure to smartphone use and migraine attack and severity. The patients were examined for the duration of migraine (in years), the frequency of attacks (the number of attacks experienced in 1 year), the duration of attacks (how many hours they last), educational status, drug use status, and pain severity.

Statistical analysis

The demographic data of the patients were determined by statistical analyses. The Pearson chi-square test was performed between the groups determined. The data obtained were statistically analyzed using the IBM SPSS 20 program. $P < 0.05$ was considered significant for all statistical data.

RESULTS

One hundred nineteen patients diagnosed with migraine who were included in the study consisted of 53 males and 66 females. The average age of the patients was 33.34 ± 11.35 (min. age = 19, max. age = 69). In our study, it was observed that smartphone users' daily duration of time spent on the phone was maximum 8 hours and minimum 1 hour. The average period of migraine attacks of 119 patients was observed to be approximately 12 times a year. It was found that the frequency of migraine attacks was less frequently observed among those with drug use compared to those without drug use. While the average of migraine attacks of 38 patients with drug use was 7.65 times on average in a year, it was observed to be 9.80 times in a year in the group without drug use.

According to educational status, while 5 of those with drug use were primary and secondary education graduates, 11 of them were high school graduates, 19 of them were university graduates, and 3 of them had a master's degree. While 13 of those without drug use were primary and secondary education graduates, 14 of them were high school

graduates, 45 of them were university graduates, and 9 of them had a master's degree (Tab. 1).

In migraine patients who were asked about their preferences for smartphone use, while 35 people used it for talking purposes, 10 people used it for gaming purposes, 67 used it for surfing social media and the internet, and 7 people used it for messaging purposes. The frequency of migraine attacks was observed to be 8.73 times on average in a year in individuals who spent time on the phone primarily for surfing the internet and social media. Migraine attacks were observed 8.28 times on average in a year in those who used it for messaging purposes, they were observed 9.11 times on average in a year in those who used it for talking purposes, and they were observed 12.4 times on average in a year in those who used it for gaming purposes (Tab. 2).

According to the VAS, the patients were classified separately as those with regular drug use and those without drug use. These two groups were examined under three groups as mild, moderate, and severe according to the severity of pain (Tab. 3).

As a result of the chi-square test, no significant relationship was found between the severity of migraine pain and the duration of phone use ($p = 0.18$) No significant relationship was found between the severity of migraine pain and the preference for phone use ($p = 0.08$). A significant relationship was found between the severity of migraine pain and the number of migraine attacks per year. Accordingly, there was a relative increase between moderate pain observed 2–4 times a year according to the VAS and severe pain observed 6–12 times a year according to the VAS ($p < 0.05$) ($p = 0.01$). It was observed that no significant relationship was found between the severity of migraine pain and gender ($p = 0.57$).

Table 1. Relationship between the level of education and drug use

Educational status	Those with drug use	Those without drug use
Primary and secondary education	5 (13.1%)	13 (16%)
High school	11 (28.9%)	14 (17.2%)
University	19 (50%)	45 (55.5%)
Master's and doctorate degrees	3 (7.9%)	9 (11.1%)

Table 2. Relationship between preferences for phone use and the frequency of migraine attacks

Preference for use	Number of people	Number of migraine attacks
Talking	35 (29.4%)	9.11 (23.6%)
Messaging	7 (5.8%)	8.28 (21.5%)
Playing games	10 (8.4%)	12.40 (32.2%)
Social media Surfing the Internet	67 (56.3%)	8.73 (22.6%)

Table 3. Relationship between drug use and Visual Analog Scale

VAS severity	Those with drug use	Those without drug ufse
Mild	5 (13.1%)	13 (16.1%)
Moderate	13 (34.2%)	42 (51.8%)
Severe	20 (52.7%)	26 (32.1%)

VAS — Visual Analog Scale

DISCUSSION

Migraine, a common type of headache, affects approximately 12% of the population, mostly young and middle-aged individuals around the world [10]. Migraine is more common in women than men in society. When the studies were considered, it was observed that the prevalence of migraine was found to be two times higher in women compared to men in the general population [11]. When age groups were examined, it appeared that the prevalence of migraine peaked in the 3rd decade in women; however, it was observed at the highest level in the 4th decade in men [12]. Preventive treatment should be administered for all patients with chronic migraine. However, in the studies conducted, it was observed that only 3–13% of the patients used prophylactic drugs [13]. In our study, a high rate of drug use was found by 32%. We considered that it was due to easy access to the physician because of the small size of the city we were in and a good health literacy level of patients.

When the frequency of attacks was examined, playing games was the most common reason for attacks by 12.40%, we found that the preference for talking on the phone was the second most common reason for attacks by 9.11%, and smartphone users' daily duration of the time spent on the phone was 4 hours 33 minutes. In the study carried out by Kucer N and Pamukcu T, the group with a daily duration

of cell phone usage of > 16 minutes (min) was compared with the group with a daily duration of cell phone usage of < 16 minutes. It was reported that there were significant increases in headache, hearing loss, and joint and bone pain in people with a duration of cell phone usage of > 16 minutes [14].

Our body has a weak electromagnetic area (EMA) since it consists of water, ions, and electrolytes by 70%. We are exposed to EMAs, mostly due to power lines, computers, televisions, radios, and phones [15]. The frequency ranges of mobile phones are between 10 MHz–3000 GHz, and they have hyper frequency EMAs [16]. These mobile phones with powerful frequency may have destructive effects on tissues containing high concentrations of electrons and ions. In the studies, it was observed that EMA had some effects on cell behaviors, such as changing the function of the cardiovascular system and bone marrow [17, 18]. There are different studies revealing that EMAs caused by phones had significant side effects such as headache, decreased memory performance, impaired sleep and quality of life, attention and concentration impairment [19–21].

Insomnia, hormonal changes, fasting, alcohol intake, certain foods, weather condition, light, and noise, which are among the triggering factors, increase the frequency of migraine attacks. Although we know the presence of many factors which are considered to trigger migraine attacks, how migraine pain begins, in which region of the brain it begins, which regions of the brain are active in the stages of a migraine, and what kind of relationship there is between these triggering factors and migraine are among the issues that have not been clarified yet [22, 23]. Although there are few studies on determining these triggering causes, they have gained speed recently. There are scientific studies especially about the effect of electromagnetic waves emitted by mobile phones on human health [24]. The excessive use of smartphones is estimated to cause some organic and psychological health problems. In the studies conducted, it was reported that many people had problems such as eye fatigue, burning eyes, eye redness, eye dryness, blurred vision, neck pain, decreased proprioception, posture disorder, anxiety, depression, and headache after the long-term use of smartphones [25, 26]. In accordance with a similar study on this subject, it was demonstrated that excessive smartphone use increased migraine headache [27]. In this study, no significant relationship was found between the severity of migraine pain and preferences for smartphone use (talking on the phone, messaging on the phone, playing games on the phone, and using the Internet — social media) ($p = 0.08$). However, the group playing games on the phone had the highest percentage of migraine attacks by 32.2%. We considered that it was due to the fact that focusing on the constantly changing colored light on the screen for a long time while playing games could be a triggering factor that could increase the frequency of attacks.

Unlike other headaches, migraine headache increases with light. Various studies have been carried out on it using electrophysiological tests. It was demonstrated that white, blue, and red lights increased migraine headaches more than other color lights [28]. In the study carried out by Park JM et al., it was found that the excessive use of smartphones could be a triggering factor for migraine attacks since it would always expose patients to light [29].

In our survey study carried out to find out the relationship between smartphone use and the severity and frequency of attacks of migraine, we found no relationship. When we consider the results of our study, we estimate that smartphones may have adverse effects on the human brain. We can predict that the prevalence of digital screen exposure will be even higher along with the advancement of technology in the future. The investigation of triggering factors will help us to understand the pathophysiology of migraine more clearly and to develop a preventive strategy for these triggering factors. There is a need for comprehensive experimental and epidemiological studies to investigate the effects of devices with high-frequency EMAs on human health.

Limitations

Nevertheless, there are some limitations to our current study. The city where our hospital is located has a low population. It was less than expected for patients to participate in the survey study and hence a multicenter study with a large number of patients is needed.

CONCLUSIONS

We recommend that the long-term use of smartphones, which is considered to be among the causes of migraine and migraine attacks, should be avoided. Furthermore, it is necessary to raise the awareness of people with headaches in society regarding

the harmful effects of smartphone exposure on migraine.

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IS PLATELET TO MONOCYTE RATIO A USEFUL INFLAMMATORY DETERMINANT OF ST-ELEVATION MYOCARDIAL INFARCTION?

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ABSTRACT

INTRODUCTION: The main factors in the development of ST-segment elevation myocardial infarction (STEMI) are inflammatory processes and pathophysiological changes due to oxidant stress. The aim of this study is to evaluate the association of prevalent STEMI with markers of inflammatory and oxidative stress. The platelet to monocyte ratio (PMR) was evaluated as a new hematological inflammatory marker.

MATERIAL AND METHODS: The study is a retrospective observational study conducted in the emergency department between January 2018 and January 2019. In the study, all patients who were diagnosed with STEMI were considered in the study group. Evaluations of inflammatory and oxidant stress markers, PMR value of STEMI patients were performed.

RESULTS: Neutrophil to lymphocyte ratio (NLR) value of 5.63 (3.35–7.84), Monocyte count to high-density lipoprotein cholesterol ratio (MHR) value of 16.10 (12.73–19.52), gamma-glutamyl transferase (GGT) value of 31.00 (21–39) and CRP value of 5.10 (2.77–9.34) were significantly higher in STEMI cases ($p < 0.005$). The lymphocyte to monocyte ratio (LMR) value of 2.57 (2.00–3.61) and the PMR value of 24.52 ± 7.60 in STEMI cases were significantly lower ($p < 0.001$, $p = 0.014$).

CONCLUSIONS: In STEMI patients NLR, GGT, and MHR rates increase significantly and LMR decreases. PMR values were also lower in STEMI cases. This shows us that PMR is a new determinant that can be used in inflammatory events. However, none of these inflammatory markers and oxidant stress markers can be used as diagnostic tests, rather they should be considered as surrogate markers for disease.

KEY WORDS: STEMI, NLR, LMR, PMR, inflammation, oxidative stress

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INTRODUCTION

ST-segment elevation myocardial infarction (STEMI) manifests as acute thrombotic coronary artery occlusion caused by atherosclerotic plaque rupture, plaque erosion or calcific plaque and is the leading cause of death worldwide [1, 2]. The main factors in the development of this condition are inflammatory processes and pathophysiological changes due to oxidant stress [3].

Many complete blood count (CBC) parameters are useful predictive markers in cardiovascular events [4]. The increase in the neutrophil to lymphocyte ratio (NLR), the increase in monocyte count, the decrease in lymphocyte count and as a result the decrease in the lymphocyte to monocyte ratio (LMR), are considered indicative hematological biomarkers of inflammatory processes. At the same time, these

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markers are accepted as predictors both of the severity of the disease and the prognosis in coronary procedures for atherosclerotic diseases [5]. Gamma-glutamyl transferase (GGT) plays a role in the transport of glutathione, which in turn plays a role in intracellular antioxidant mechanisms. GGT levels increase in the case of an acute coronary syndrome such as atherosclerosis induced by oxidant stress [6]. High-density lipoprotein cholesterol (HDL-C) has a protective role against inflammation, oxidant stress and thrombus development. Monocytes are known to play a role in the development of atherosclerotic plaque [7]. Monocyte count to high-density lipoprotein cholesterol ratio (MHR) has been reported to increase in serious cardiovascular events as a result of the development of atherosclerosis [8].

The aim of this study was to evaluate the STEMI status in which inflammation and oxidant stress play a role together with factors such as NLR (which is an inflammatory marker) and GGT and MHR (which are oxidant stress markers). In addition, the platelet to monocyte ratio (PMR) was evaluated as a new hematological inflammatory marker in STEMI patients.

MATERIAL AND METHODS

Study design and population

The study is a retrospective observational study conducted in the emergency department of Bozok University Faculty of Medicine between January 2018 and January 2019. The methodology of the study was in accordance with the protocol approved by the University Local Ethics Committee.

All patients who were admitted to the emergency department with chest pain and were diagnosed with STEMI or referred from the external center with the diagnosis of STEMI and whose blood was taken on arrival were considered for the study. All data were obtained by examining patients' files, electronic records in the hospital information system and angiography reports. STEMI was diagnosed by the presence of ST-segment elevation in at least two consecutive leads in electrocardiography (ECG), which was taken from patients with persistent chest pain or other suggestive symptoms of ischemia. STEMI diagnoses were confirmed by angio reports. There were 134 patients admitted with STEMI during the study period. The following patients (n = 48) were excluded from the study: those under the age of 18, patients that had consumed alcohol, those with chronic liver function impairment or chronic liver disease (both of which can affect the GGT levels), patients with deep vein thrombosis, peripheral arterial disease, diabetes mellitus, metabolic syndrome, heart failure, rheumatic diseases, inflammatory bowel diseases, thyroid diseases and inflammatory diseases (which affect hematological inflammatory parameters), sufferers of familial hypercholesterolemia (which affects the HDL-C), patients receiving anticoagulant and antiaggregant treatment (which may cause a change in platelet counts) and patients with inadequate data. The remaining STEMI patients [n = 86: 28 (32.6%) female; 58 (76.4%) male]. Healthy volunteers were included in the study as the control group, [n = 82: 37 (44.6%) female; 45 (54.2%) male].

The following blood hematological parameters were examined from the first blood tests: hemoglobin (Hb), hematocrit (Htc), leucocyte, monocyte, neutrophil, red blood cell distribution width (RDW), mean platelet volume (MPV), mean corpuscular hemoglobin concentration (MCHC), platelet (Plt). GGT levels and lipid panels were also examined from the first blood samples. In addition, evaluations of NLR, LMR, platelet to lymphocyte ratio (PLR), PMR, MHR values of STEMI patients were performed.

Laboratory analysis

Tubes containing EDTA (Ethylenedinitrile-tetraacetic acid) were used for complete blood count (CBC) from all four groups. In order to prevent errors in platelet and other hematological parameters, samples were studied in the biochemistry laboratory with an XN-1000 hematology analyzer (Sysmex Corporation, Kobe, Japan) within the first hour. Serum gel tubes were used for biochemical analysis before centrifugation. Measurements of GGT, C-reactive protein (CRP), HDL-C were performed on a Cobas 6000 analyzer (Roche Diagnostics, Mannheim, Germany).

Statistical analysis

IBM SPSS Statistics for Windows version 23.0 (IBM, Armonk, NY, USA) was used for statistical analysis. The Kolmogorov–Smirnov test was used as a test for normality of continuous data and the results were expressed as the median with 25th and 75th percentiles. A non-parametric Mann–Whitney U test was used to compare the medians between the two groups. ROC (receiver operating characteristic) analysis was performed to evaluate NLR, MHR, PLR, LMR and PMR for predicting disease status. The area

under the curve and the cut-off value were calculated for each value. Sensitivity, selectivity, positive predictive value and negative predictive value were calculated to evaluate the diagnostic test performance of each score. The statistical significance level was accepted as $p < 0.05$.

RESULTS

Our study investigated the two groups: STEMI patients and the control group. The mean age of the STEMI group (n = 86) was 61 ± 13 years and the mean age of the control group (n = 82) was 62 ± 12 years. In the STEMI group, 43 (50%) patients had inferior MI, 30 (34.9%) had anterior MI, 1 (1.2%) had lateral MI, 3 (3.5%) had posterior MI, 9 (10.5%) had multiple vascular involvement MI.

Comparison of the groups

Table 1 shows the comparison of demographic data and laboratory parameters of the patient and control groups. NLR value of 5.63 (3.35–7.84), MHR value of 16.10 (12.73–19.52), GGT value of 31.00 (21–39) and CRP value of 5.10 (2.77–9.34) were significantly higher in STEMI cases compared to the control group ($p < 00.5$). The LMR value of 2.57 (2.00–3.61) and the PMR value of 24.52 ± 7.60 in STEMI cases were significantly lower compared with the control group ($p < 0.001$, $p = 0.014$) (Fig. 1). When Hb, HCT, MCHC, PLT, HDL-C and PLR values were examined, no statistically significant difference was found between the two groups ($p > 0.05$).

ROC analysis

Table 2 shows the sensitivity, specificity, positive predictive values, negative predictive values and area under curve values of the patients and the control group according to ROC analysis. In the analysis, high GGT, MHR and NLR were found to be significant in favor of the disease ($p < 0.001$), whereas low LMR and PMR were found to be significant in favor of the disease ($p < 0.001$, $p = 0.014$). In Figure 2, ROC analysis graphs of GGT, NLR, MHR, PLR, LMR and PMR values are given.

DISCUSSION

Because both inflammatory processes and oxidant stress play an important role in the pathophysiology of acute coronary syndrome, blood parameters associated with these two conditions were examined together in this study. While NLR, GGT and MHR

Table 1. Comparison of laboratory parameters between case and control group

	Case n = 86	Control n = 82	p value
Age	61 ± 13	62 ± 12	0.674
WBC	11.90 (9.82–13.40)	7.26 (6.36–8.52)	**< 0.001**
Neutrophil	9.01 (6.70–11.26)	4.36 (3.70–5.50)	**< 0.001**
Lymphocyte	1.71 (1.30–2.20)	2.19 (1.77–2.61)	**< 0.001**
Monocyte	0.68 ± 0.20	0.55 ± 0.13	**< 0.001**
Hb	14.00 ± 1.78	14.12 ± 1.44	0.638
Htc	41.65 ± 5.42	42.38 ± 4.00	0.324
MCV	88.29 ± 5.05	85.47 ± 5.23	**0.001**
MCHC	33.12 ± 1.57	33.31 ± 1.12	0.549
RDW	13.20 ± 1.35	13.55 ± 1.08	**0.045**
PLT	258.40 ± 68.56	274.27 ± 53.93	0.099
MPV	11.50 ± 9.32	10.18 ± 0.81	**0.018**
GGT	31.00 (21–39)	17.00 (13–23)	**< 0.001**
CRP	5.10 (2.77–9.34)	2.49 (1.34–3.58)	**< 0.001**
HDL-C	42 (38–48)	41.2 (37–51)	0.894
NLR	5.63 (3.35–7.84)	2.08 (1.48–2.70)	**< 0.001**
PLR	151 (105–200)	124(104–166)	0.075
LMR	2.57 (2.00–3.61)	3.96 (2.83–4.78)	**< 0.001**
PMR	24.52 ± 7.60	27.17 ± 6.08	**0.014**
MHR	16.10 (12.73–19.52)	12.75 (8.96–16.38)	**< 0.001**

Data were expressed as Mean ± SD and median (25%–75% interquartile range).

CRP — C-reactive protein; GGT — gamma-glutamyltransferase; Hb —hemoglobin; HDL-C — High density lipoprotein cholesterol (HDL-C); Htc — hematocrit; LMR — lymphocyte to monocyte ratio; MCHC — mean corpuscular hemoglobin concentration; MCV — main corpuscular volume; MHR — monosite to HDL-C; MPV — mean platelet volume; NLR — neutrophil to lymphocyte ratio; PLR — platelet to lymphocyte ratio; PLT — platelet; PMR — platelet to lymphocyte ratio; RDW — Red blood cell distribution width

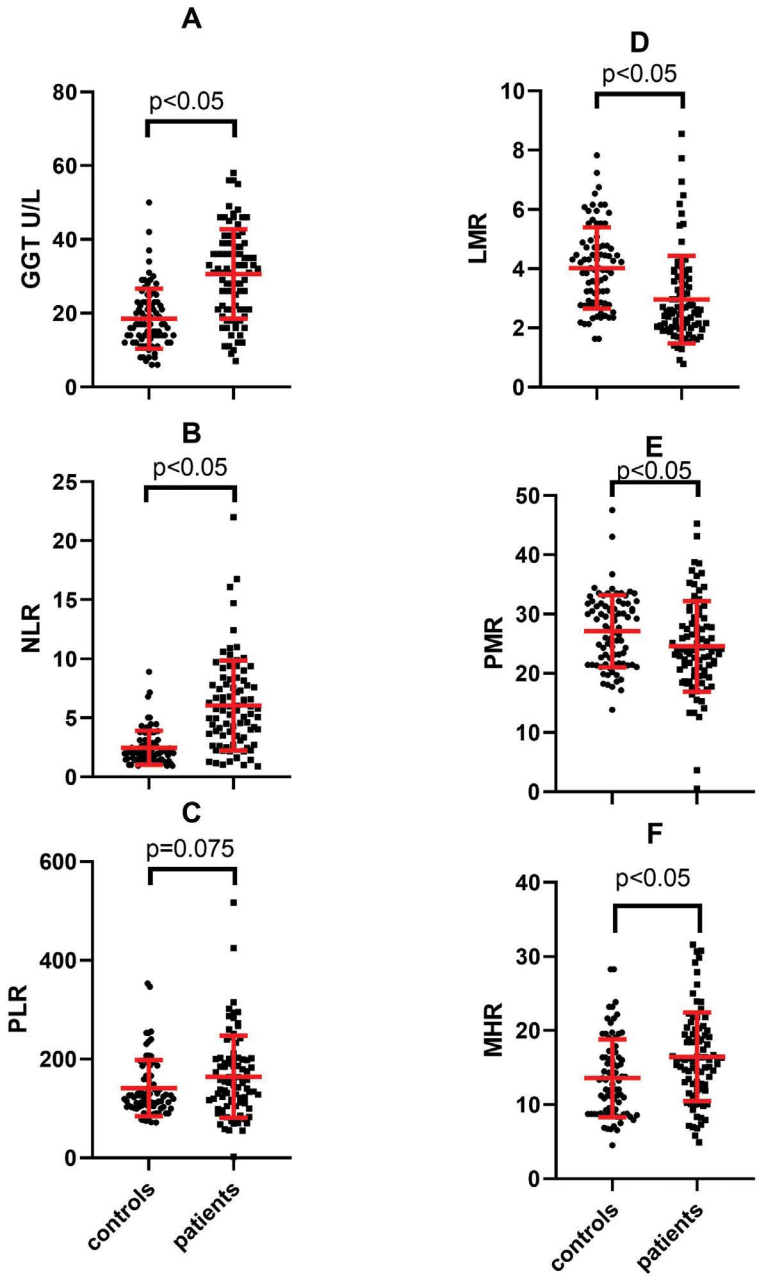

FIGURE 1. Relationship between parameters and disease

Table 2. Comparison of GGT, NLR, PLR, LMR, PMR values according to disease status

Variables	Statistical diagnostic measures					ROC curve statistics	
	Cutoff	SEN (95% CI)	SPE (95% CI)	PPV (95% CI)	NPV (95% CI)	AUC	p
GGT	17.5	0.839	0.568	83.9	56.8	0.793	< 0.001
NLR	2.152	0.897	0.580	89.7	58.0	0.836	< 0.001
MHR	14.370	0.667	0.605	66.7	60.5	0.642	0.001
PLR						0.580	0.075
LMR*	2.722	0.840	0.586	41.4	84.0	0.747	< 0.001
PMR*	19.692	0.914	0.253	74.7	8.6	0.610	0.014

AUC — Area under curve; CI — Confidence interval; GGT — gama-glutamyl transferase; LMR — lymphocyte to monocyte ratio; MHR — monosite to HDL-C; NLR — neutrophil to lymphocyte ratio; NPV — Negative predictive value; PLR — platelet to lymphocyte ratio; PMR — platelet to lymphocyte ratio; PPV — Positive predictive value; ROC — Receiver operating characteristic; SEN — Sensitivity; SPE — Specificity

* a decrease in the value causes the disease

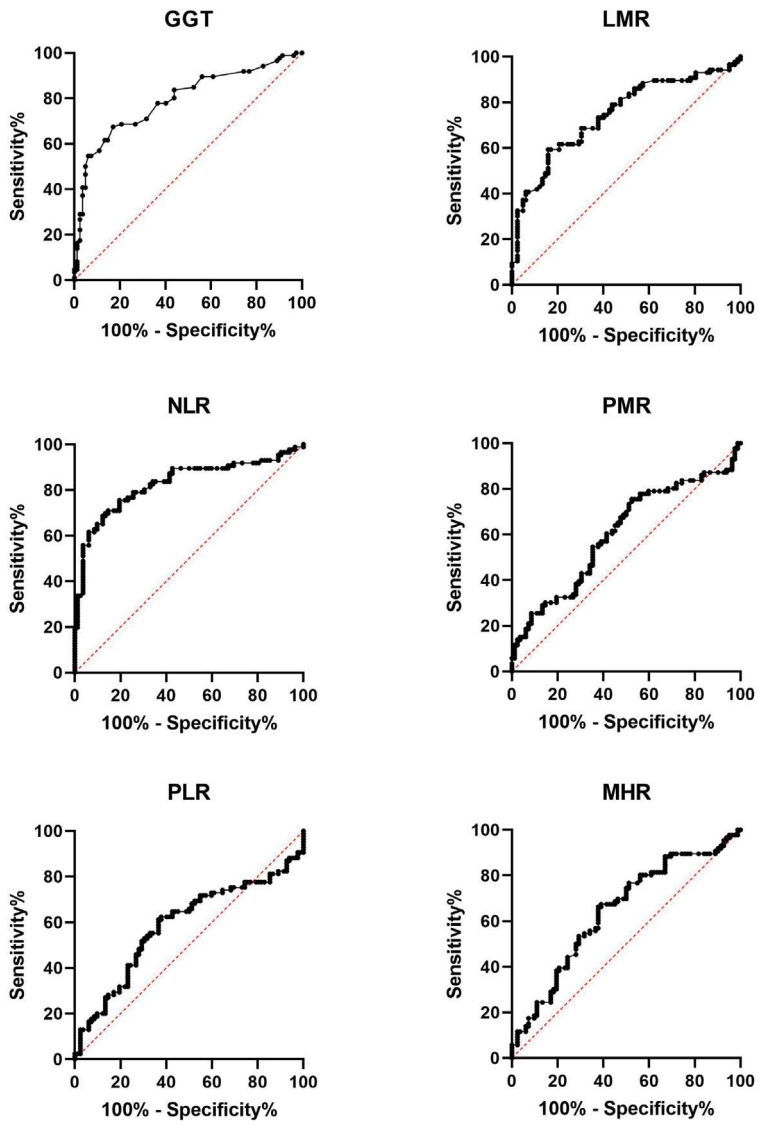

FIGURE 2. Receiver operating characteristic curves of inflammatory parameters according to the presence of ST-elevation myocardial infarction

rates were found to be significant in terms of STEMI disease, low LMR and PMR values were also significant in terms of disease. It has been determined that MHR cannot be used as a marker of disease, but it can be useful in terms of prognosis and guidance. In addition, low levels of PMR can be used as an inflammatory marker in STEMI cases.

NLR, PLR and LMR values are used as markers that determine the inflammatory response in many diseases including in cancer cases such as CRP [9, 10]. In addition to elevated systemic inflammatory response, high levels of NLR has been reported to be an independent risk factor for increased mortality and long-term poor prognosis in both acute coronary syndrome and STEMI patients [11]. In our study, high levels of NLR support this information. In the evaluations for PLR, both platelet increase and lymphocyte decrease have been shown to be a poor prognosis predictor for coronary events. Azap et al. [10] found that PLR increase is a predictor of long-term mortality in non-STEMI cases. In our study, although the PLR rates in STEMI cases were higher than the control group, no statistical significance was found. It has been emphasized in many studies that LMR, which is expected to decrease in cases of malignancy and viral infection, is a predictor of coronary slow flow in patients with coronary artery disease and has a negative correlation with both CRP and NLR [12–14]. Another study showed that increased platelet and monocyte activity was found to be the predictor of atherosclerosis in hemodialysis patients and peritoneal dialysis patients [15]. In

a study on patients with chronic obstructive pulmonary disease (COPD), platelet-monosyte interaction was found to have increased [16] but to our knowledge, PMR has not been considered as an inflammatory marker in any study including coronary artery disease. In patients with coronary artery disease, no change was reported in platelet levels unless antiaggregant treatment was used, but changes in platelet shape and volumetric measurements, such as MPV, were detected [17]. In our study, patients receiving anticoagulant and antiaggregant treatment were excluded and no difference was found between STEMI cases and the control group in terms of platelet measurements. The ratio of platelets to monocytes as a result of inflammatory processes was found to be low in STEMI cases.

It has been shown that the level of GGT increases both in hepatobiliary system pathology and with alcohol use and is accepted as a marker for these conditions [18, 19]. In addition to being an oxidant stress biomarker [6], GGT was also found to be active in the oxidation of low-density lipoprotein (LDL) and the development of atheroma plaques in the coronary arteries [20]. Valjevac et al. [21] found a positive correlation between GGT and CRP in patients with the acute coronary syndrome. The GGT elevation in STEMI cases detected in our study confirms this finding.

Monocytes, macrophages and dendritic cell precursors play a key role in the development of atherosclerosis. Circulating monocytes in patients with cardiovascular disease have a high level of surface receptors in the inflammatory response. Monocytes present in the inflammation area form a complex with oxidized LDL. This complex is described as a dendritic cell or inflammatory macrophage. These cells cause atherosclerosis by forming oily streaks or foam cells [22]. HDL-C has anti-inflammatory and antioxidant effects on endothelial functions, in particular, by interfering with or even reversing monocyte activation and adhesion [7]. A literature search in the light of this information showed that MHR is an independent risk factor for five-year mortality in STEMI patients [8]. Demir et al. [23] found that MHR was elevated in patients with metabolic syndrome. This increase is due to decreasing HDL-C levels in metabolic syndrome. The antioxidant activity of HDL-C is well known [24]. We found that since there was no significant difference between HDL-C levels in STEMI patients and the control group, the elevation of MHR was independent of antioxidant mechanisms and due to the increase in monocytes as an inflammatory marker.

There are some limitations to our study. Firstly, it was a single-center study and therefore we had a limited number of patients. Secondly, our study was retrospective and based on files and electronic records. Multi-center studies with larger patient groups are needed.

CONCLUSIONS

Previous studies have investigated hematological inflammatory markers and oxidant stress markers separately in STEMI cases. However, to the best of our knowledge, there has not been a study that examines all of these markers together. In STEMI patients NLR, GGT, and MHR rates increase significantly and LMR decreases. Cut off values for GGT and NLR show high sensitivity for the disease. In our study, PMR values were also lower in STEMI cases. This shows us that PMR is a new determinant that can be used in inflammatory events. However, none of these inflammatory markers and oxidant stress markers can be used as diagnostic tests, rather they should be considered as surrogate markers for disease.

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VIA MEDICA

CASE REPORT

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SUCCESSFUL MANAGEMENT OF SEVERE EXERTIONAL HEAT STROKE COMPLICATED BY VENTRICULAR FIBRILLATION IN 19 YEARS OLD MALE

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ABSTRACT

Heatstroke is a heat-related disease that is highly fatal. However, it is significant that if symptoms are quickly recognized, the outcome remains satisfactory. In this paper, the authors present the case of a 19-year-old physical worker in whom heatstroke was complicated by cardiac arrest. The proper action and full diagnosis of the underlying cause of cardiac arrest allowed for a full recovery. Attention was also drawn to the lack of appropriate equipment for active cooling and potential use of automatic chest compressions devices.

KEY WORDS: exertional heat stroke, sudden cardiac arrest, prehospital care

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INTRODUCTION

Heatstroke is one of the forms of overheating associated disease. Early recognition of symptoms and withdrawal of exposure to heat, as well as activation of appropriate treatment, enable to avoid complications [1]. Heatstroke is a life-threatening condition with a high risk of death. In France, mortality rates have been reported to be 58 and 71% for 28-day and 2-year, respectively. Moreover, the authors of this research highlighted that by the 2050s, heat stroke-related deaths are expected to rise by 2.5 times. Also, dramatic alteration in functional status was recorded in most surviving patients. If the symptoms are diagnosed early enough, and the appropriate treatment is initiated, heatstroke can be prevented [2].

Sudden Cardiac Arrest (SCA) accounts for approximately 1% of all emergency ambulance responses [3]. The European Resuscitation Council (ERC) defined reversible causes of cardiac arrest. These include, among others, hypovolaemia, electrolyte disorders, and coronary embolism. During cardiopulmonary resuscitation (CPR), all of them should be considered and treated if necessary. The survival of out-of-hospital-hospital SCA remains unsatisfactory [4]. Providing CPR in a two-rescuer team is a big challenge. It has been shown that such a team cannot perform all activities according to the recommended algorithm [5].

In this paper, the authors reported a case of a young man in whom heat stroke was complicated by SCA. The authors aimed to highlight the problem of overheating associated disease and indicate potential difficulties in patient care.

CASE REPORT

On a hot summer day (ambient temperature 37°C) at 18:13, the Medical Rescue Team, consisting of two paramedics, responded to SCA in a 19 years-old male. The patient was working on building a stable. According to the witnesses of the incident, the cause of the SCA was probably an electric shock.

The paramedics arrived at the scene after about 7 minutes. During the initial assessment, the para-

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medics paid attention to the electric wires lying near the patient. From bystanders' reports, at the time of the event, the victim was repairing the hydrophor — hence the electric shock (230V) was highly suspected. The owner of the property could not disconnect the power source — he did not know where the main switch was located. The paramedics confirmed the cardiac arrest and immediately took over the CPR. The first rhythm was ventricular fibrillation (VF). Therefore, 200J energy defibrillation was performed. After the cardiac arrest had been confirmed, a physician-staffed helicopter emergency medical service (HEMS) was dispatched. Due to the lack of family at the site, the detailed medical history was impossible to be collected. The witnesses of the event presented inconsistent accounts. Due to difficulties in determining the course of events and the impossibility of excluding the participation of third parties, the Police was called.

The airway was secured with an oropharyngeal tube, bag-valve-mask ventilation was applied, and a peripheral G18 intravenous access was established. After 2 minutes of resuscitation, the monitor presented ventricular tachycardia (VT) with QRS frequency exceeding 180/min. The presence of pulse on the carotid artery and no pulse on peripheral arteries were confirmed. The patient was breathing spontaneously at a rate of 20/min. Oxygen saturation was 92%. The skin was pale, sweaty, warm, without visible external injuries suggesting trauma or electric shock. Systolic blood pressure 70 mmHg. Pupils narrow, equal, and adequately responding to light. Capillary glucose level was 194 mg/dl. No obvious injuries revealed in the head-to-toe examination.

The cooling treatment was implemented. The patient was transferred to an air-conditioned ambulance. The body was covered in hydrogel dressings. Oxygen supplementation was initiated. Normal sinus rhythm was restored with 150 mg of amiodarone. Hypovolaemia was treated with repetitive boluses of crystalloids. Due to agitation, 5 mg of midazolam was administered.

In the meantime, the paramedics were informed by the witnesses of the incident that the patient had been working in full sun for 7 hours without headgear for laying paving stones. He also did not take enough fluids. This information, together with the lack of evidence confirming the electric shock, made the victim of hyperthermia suspected. This hypothesis was confirmed by the value of the measured body temperature in the tympanic membrane. The thermometer indicated 41.2°C.

HEMS doctor decided to perform endotracheal intubation in the rapid sequence intubation protocol. In the ultrasound performed on the e-FAST protocol, the presence of free fluid in the abdomen and pneumothorax were excluded. A Foley catheter was inserted, and 20 mg of furosemide was administered. The patient was transported to the emergency department by HEMS.

The patient was admitted to the emergency department with full consciousness. Echocardiography and CT scan were performed. These tests did not show any abnormalities. Myocardial ischemia requiring urgent coronary angiography was also not found. Laboratory tests revealed the following abnormalities: leucocytes: 25.2*10^3/μL, ALT: 617 U/L, AST: 448 U/L, Creatinine: 127 μmol/L, Chloride: 109 mmol/L, cTnI: 182ng/L, CKI: 355 IU/L. The patient was transferred to the Intensive Care Unit and discharge after 11 days with full recovery and no neurological disabilities.

During the whole event, the 12-lead ECG was performed several times. At first, VT was present. After the sinus rhythm was restored, the flattening and then reversion of T-waves were revealed.

DISCUSSION

Heatstroke is the last expression of the body's reaction to overheating. It occurs when the physiological mechanisms are not sufficient to release the accumulated excess heat. The phases preceding heatstroke are: overheating with heat cramps and heat exhaustion. A distinction is made between: Exercise Heat Stroke (EHS) and Non-Exercise Heat Stroke (NEHS), also called the Classical Heat Stroke. By definition, EHS is a hyperthermic condition that occurs in individuals performing intense exercise, typically in warm environments. EHS is characterized by severe hyperthermia (> 40.5°C) and organ insufficiency, which typically manifests as central nervous system (CNS) dysfunction. It occurs most often in healthy people, young people, working or exercising in high-temperature conditions [6]. In contrast, NCHS occurs mainly in the elderly and infants. In these age groups, the physiological mechanisms of thermoregulation are compromised. However, it should be noted that even in cooler conditions, strenuous physical activity by itself may result in an individual succumbing to EHS [7].

Physiological body temperature is maintained at approximately 37.5°C by the hypothalamus. The mechanisms related to heat exchange are radiation, convection, conduction, and vaporization. The effect of temperature increase is the dilation of blood vessels in the skin. This process supports the above-mentioned thermoregulatory mechanisms. The skin may be red and hot. In the first phase, when the thermoregulatory mechanisms are effective, abundant sweating is observed. When these mechanisms fail, the skin becomes dry. Lack of sweat is one of the symptoms that distinguish heat stroke from heat cramps and heat exhaustion. Cutaneous vasodilation causes the blood to move to the peripheral parts of the body. This, in turn, leads to relative hypovolemia. Syncope may be the first symptom observed by witnesses. As a result, reduced organ perfusion causes progressive multi-organ failure. Water and electrolytes are lost as a result of perspiration. Tachycardia and hypotension may be present. Muscle cramps can be the presentation of dyselectrolytemia. In patients with impaired peripheral perfusion, the skin may be pale and sweaty. At this point, it is worth mentioning that the temperature tolerance is different for different people. The body's response depends, among other things, on the overall performance of the cardiovascular system. It is therefore essential not to make a decision solely based on temperature measurement, but after a thorough examination of the patient [6, 8, 9]. Direct cytotoxic effects of heat followed by the inflammatory and coagulation responses, injure the vascular endothelium. This might be clinically manifest as DIC [1]. In NEHS, there is a high prevalence of atrial arrhythmias, low-voltage p waves, low limb lead QRS voltage, QTc prolongation, right bundle branch block and repolarisation abnormalities [10].

The ERC recommends taking temperature measurements in the oesophagus, rectum, bladder, or tympanic membrane [11]. Of the methods available for emergency teams, only the latter is possible. In the case of hypothermia, accurate measurement is much more critical. The patient's classification into the appropriate therapeutic class of hypothermia depends on the exact body temperaturę [12]. In the case of overheat illnesses, the combination of history and symptoms with high body temperature is crucial. Incidents, where the death occurred in patients with both lower and extremely high body temperatures, were described.

The purpose of cooling treatment is to reduce the time when the patient is hyperthermic. The notable increase in organ damage and mortality occurs after 30 minutes of hyperthermia. Thus, rapid cooling must be provided in 30 minutes from the time of collapse [13]. The recommended rate of cooling is at least 0.15°C per minute. Cooling should be finished when the body temperature reaches 38.6°C to minimize the risk of severe hypothermia. The goal is to create conditions where the energy accumulated in the body could be transferred to an external medium. It is most beneficial to use all the mechanisms of heat exchange. Coldwater immersion is considered to be the standard gold treatment for EHS [1]. Unfortunately, this method is not available in pre-hospital care. In an ambulance, low ambient temperatures, the use of wet or hydrogel dressings can be helpful. If possible, a cooling airflow should be directed towards the patient. In the presented case, the paramedics used small hydrogel dressings. Such dressings are also available as a blanket. It is also necessary to correct hypovolemia and electrolyte disruptions. At present, in the Polish Medical Rescue System, there is no equipment dedicated to the treatment of heatstroke.

Ventricular fibrillation (VF) may occur as a result of acute myocardial ischemia, electrolyte disorders or electric shock. In a young person also cardiomyopathy should be considered. In this case, the patient was young, thus cardiovascular diseases are unlikely. However, the initial assessment of the situation indicated the possibility of electrocution. Young age, VF, CPR has undertaken by witnesses of the event and short duration of SCA are positive prognostic factors [14, 15].

In the case of CPR extending beyond 15 minutes, the patient should also be considered for extracorporeal CPR (ECPR). The use of extracorporeal oxygenation membrane (ECMO) therapy increases the patient's chances of survival. In the case of irreversible cardiac arrest, however, it allows sustaining organ perfusion for transplantation. Puslecki et al. performer high fidelity medical simulations, proving the possibility of combine ECMO and pre-hospital care in Poland [16–18].

Providing CPR under the conditions on the scene can be challenging. Chest compressions are exhausting for the rescuer. There are currently no clear recommendations for the routine use of automatic chest compression devices (ACCD). A positive effect of these devices on the long-term survival of an SCA incident has not been defined. However, ACCDs pro-

vide high-quality compressions, especially in a team of only two people [19]. Under such environmental conditions, the use of ACCD may be necessary to maintain high-quality chest compressions.

The ambulance team noted difficulties in attaching ECG leads to the patient — despite an attempt to dry the victim's sweaty, damp chest, the electrodes did not adhere properly to the patient's body. A similar situation can occur for any patient in shock. Alternative fixtures such as pilers and bulb suckers are a good alternative. They do not require sticking but must be disinfected after each use. Currently rarely used in ambulances.

In the presented case, attention is drawn to the lack of ability of construction workers to disconnect the power source. Additionally, the lack of headgear, an insufficient supply of fluids, and the lack of breaks in work shows low awareness of workers in terms of occupational health and safety.

CONCLUSIONS

The analysis of the presented case suggests that Medical Rescue Teams are not properly prepared to treat EHS patients. Attention should be paid to providing appropriate resources for quick and effective body cooling — especially during the summer. It may also be useful to create a prehospital EHS treatment procedure. High ambient temperatures should be considered as a potential indication for the use of ACCD for safety reasons.

Conflict of interests: The authors do not declare.

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RESEARCH LETTER

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THE IMPACT OF COVID-19 ON AIRWAY MANAGEMENT IN PREHOSPITAL RESUSCITATION

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KEY WORDS: COVID-19, SARS-CoV-2, airway management, endotracheal intubation, supraglottic airway device, prehospital, resuscitation, OHCA

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Since the end of 2019, the world has been struggling with the SARS-CoV-2 virus and the COVID-19 disease it causes. According to the Johns Hopkins University of Medicine, 55.333.374 people have now been infected and the death rate from COVID-19 is 2.4%. However, as shown by studies including Chen et al. [1] and Borkowska M. [2], the effectiveness of cardiopulmonary resuscitation, especially in the aspect of out-of-hospital cardiac arrest, is insufficient and lower than it was before the pandemic. One of the key elements of cardiopulmonary resuscitation is securing the airway potency and implementing respiratory support [3, 4]. However, as shown by many studies, the performance of medical procedures in personal protective equipment for aerosol-generating procedures (PPE AGP) is difficult and often requires a much longer time than it would have been in normal conditions without PPE AGP [5]. Guidelines for CPR recommend minimizing interruptions in chest compressions to increase the effectiveness of CPR. For this purpose, the respiratory tract should be secured with an endotracheal tube or with epiglotting ventilation devices.

This meta-analysis was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines and reported in accordance with the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) statement. Three authors (LS, KL and MP) searched electronic resources (Medline, Medline in process, Embase, Cochrane Library for clinical trials, PubMed, Web of Science, SCOPUS) from databases inception to November 12, 2020, using the query: 'airway management' or 'endotracheal intubation' or 'intubation' or 'ETI' or 'supraglottic airway device*' or 'SAD*' and 'cardiopulmonary resuscitation' or 'CPR' or 'out-of-hospital cardiac arrest' or 'OHCA' and 'COVID-19' or 'SARS-CoV-2' or 'coronavirus'.

Systematic review and meta-analysis were performed to assess the impact of the COVID-19 pandemic on the method of securing the potency of the respiratory tract during resuscitation. Finally, four studies including 27.330 patients were included [6–9]. Four studies showed the frequency of intubation use in COVID-19 and pre-COVID-19 periods. Polled analysis show intubation rate in COVID-19 and pre-COVID-19 periods varied and occurred to 47.4% vs. 43.8% (OR = 0.53; 95% CI: 0.33, 0.85; $p = 0.008$; Fig. 1). In the case of SADs, the frequency of using this form of airway protection during COVID-19 period was 26.9% compared with 7.3% for the non-COVID-19 period (OR = 2.38; 95% CI: 1.74, 3.25; $p < 0.001$).

In conclusion, the meta-analysis carried out showed the pandemic caused that advanced airway management is used statistically significantly more often during out-of-hospital cardiac arrests. EMS

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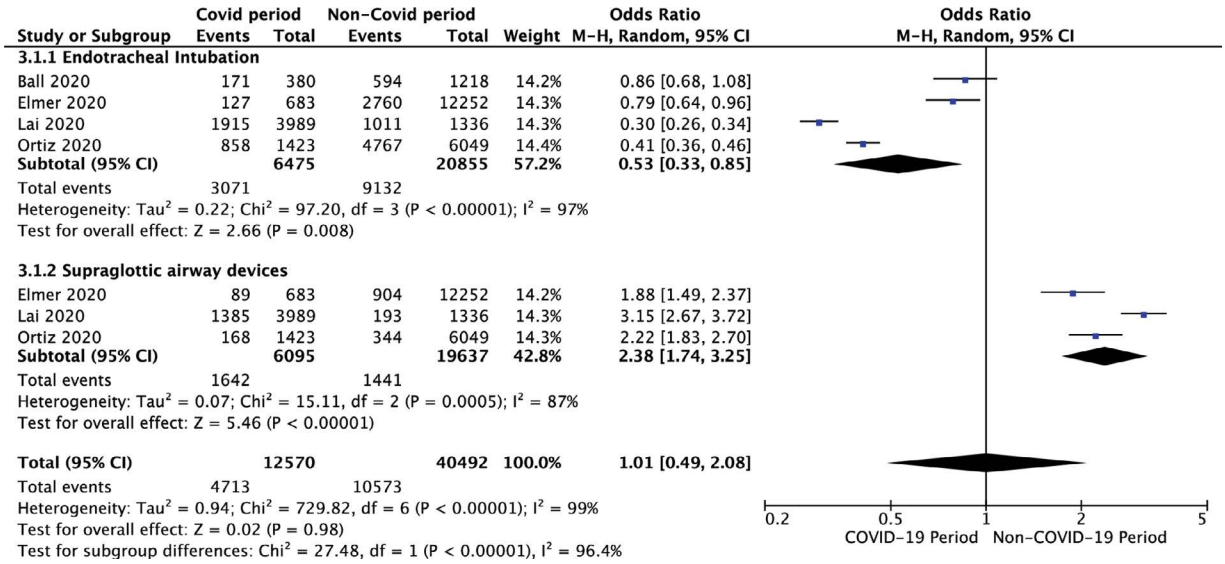

FIGURE 1. Forest plot of airway management methods in COVID-19 vs. non-COVID-19 periods. The centre of each square represents the weighted odds ratios for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results

staff uses endotracheal intubation less than twice as often as supraglottic airway devices.

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LETTER TO THE EDITOR

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PARAMEDICS' SAFETY DURING TRANSPORTATION OF THE PATIENT UNDER ONGOING NEBULIZATION IN THE CONTEXT OF COVID-19 OUTBREAK

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KEY WORDS: COVID-19, SARS-CoV-2, nebulization treatment, ambulance, nebulizers, occupational safety

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Dear Editor,

a novel coronavirus (COVID-19) is associated with human-to-human transmission. The ongoing outbreak of COVID-19 has spread rapidly and sparked global concern. Healthcare workers are highly exposed to the infection because of aerosol possible transmission [1]. Prehospital clinicians should pay particular caution if an aerosol-generating procedure, such as a bag valve mask ventilation, suctioning, endotracheal intubation, nebulizer treatment or resuscitation is being provided [2].

Heinzerling et al. have proved that 67% of medical personnel who assisted COVID-19-infected patients undergoing nebulization, have developed infection themselves. It is important to mention that the virus has spread within hospital environment. Therefore, it can be assumed that in a limited space of an ambulance chances of getting an infection are significantly higher [3].

Nebulizer therapy is the basis for the treatment of patients with asthma or COPD exacerbation. In such patients, the administration of betasympathomimetic, cholinolytics and steroids in nebulization is a standard procedure. Unfortunately, some patients infected with COVID-19 remain asymptomatic and may be the source of infection. In a specific group of patients, nebulization may be postponed until a patient is admitted to the emergency department. This group includes patients whose epidemiological history indicates a high risk of COVID-19 infection and who do not present signs of respiratory failure. However, there remains a group of patients who do not show signs of infection but suffer from an asthma attack.

The authors intended to estimate the possibility of paramedic's exposure to the aerosol generated during nebulization inside an ambulance medical compartment. The authors made a self-designed system, simulating the patient's expiration and nebulization procedure was simulated. Nebulization mask was applied to the face of ResusciAnne mannequin. On the other side of the face, the face mask was tightly fixed and connected to the ventilator (Weinmann Medumat Standard, Weinmann Emergency Medical Technology GmbH, Hamburg, Germany). The settings of the ventilator were as follows: ventilation rate 12/min, minute ventilation 10l/min, maximum pressure 20mbar. The UV-marker solution was poured into the nebulizer tank (FluoAdd, B. Braun Medical AG, Sempach, Switzerland). The oxygen flow to nebulizer was set to 6l/min a procedure was carried out during 10 minutes. Figure 1 and 2 illustrate how a nebulizer aerosol reaches a paramedic's seat.

The most frequent treatment introduced by paramedics for patients with dyspnea is nebulization,

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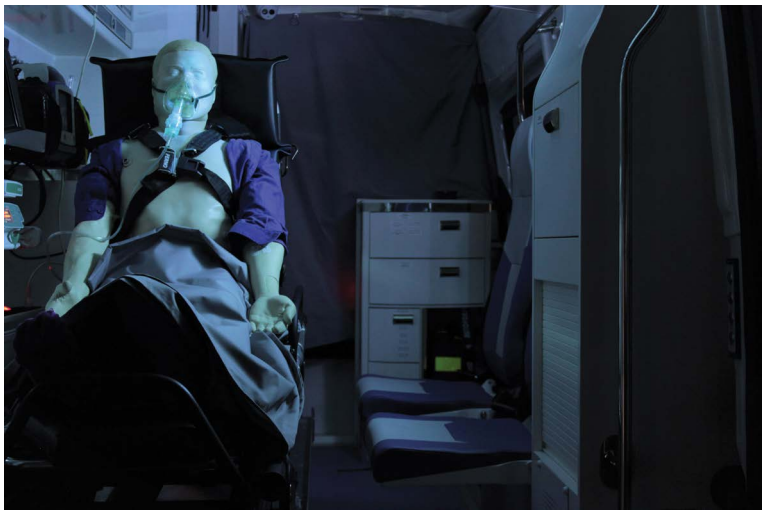

FIGURE 1. The space without aerosol

FIGURE 2. Aerosol coverage around paramedic's seat

which results in producing large amounts of aerosol that enables easier transmission of infectious pathogens, including COVID-19. Postpone the treatment for patients with clear indications for nebulization is against the proper guidelines [4]. The additional research has proved that ambulance ventilation turning on the system does not have influence on decreasing the risk of aerosol spread for paramedics. Aerosol exposures were not significantly different at various locations within the compartment, including locations behind and beside the patient [5].

The results of the research are disconcerting for paramedics. Patients showing no symptoms of COVID-19, but having indications for nebulization, remain a considerable danger for paramedics. The authors see the need to implement proper, ambulance dedicated tools, including personal protective equipment for safe procedures during transportation.

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LETTER TO THE EDITOR

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ROLE OF A FIELD HOSPITAL IN COVID-19 PANDEMIC

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KEY WORDS: SARS-CoV-2, COVID-19, pandemic, field hospital, mobile hospital, medical treatment, organization

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At the end of 2019, a new type of coronavirus appeared in China — SARS-CoV-2, which challenged healthcare facilities around the world. Currently, according to Johns Hopkins University, there are more than 54.615.099 confirmed cases of COVID-19 infection worldwide. In many regions, the demand for in-hospital emergency health services has exceeded the capabilities of hospital systems, and it was necessary to create field hospitals used as part of a response strategy [1, 2]. This strategy involves relieving the burden on specialist health care facilities by transporting patients in mild to moderate conditions who, for many reasons, have to be taken care of in the hospital to field hospitals. Many patients in mild to moderate conditions use beds in specialist centres without requiring constant specialist supervision. Transportation of such patients to field hospitals will provide free space for patients in critical conditions and will allow to provide them with appropriate care, which in many cases would be impossible due to lack of free hospital beds. As the examples from China, which after the experience with SARS were prepared for a possible new pandemic on a large scale, began to create field hospitals, numerous medical staff from all over China were sent to mobile hospitals in the most vulnerable areas. Two hospitals were established for patients in critical conditions and fifteen for patients with mild symptoms. During the epidemic, mobile field hospitals played a great role in fighting the epidemic. This strategy has yielded very good results and allowed both to relieve the burden on specialist facilities and to limit the spread of the virus [3]. In the early weeks of the COVID-19 pandemic, a large number of patients with acute respiratory failure represented a very serious burden on American health care systems. In Massachusetts, predictive models showed that up to 15.000 hospital beds were needed to handle the sudden increase in the number of cases, while the Massachusetts Department of Public Health reported that there were only 11.000 before the pandemic. These models showed that at peak incidence during the first wave of infections, COVID-19 beds might run out in the first weeks of April [4]. It became necessary to establish field hospitals, which resulted in the first field hospital in Massachusetts in the Worcester congress centre in early April. Many other states have taken similar steps and started field hospitals, such as those in New York and Boston. More than 41.000 people are currently being hospitalized because of COVID-19 in the United States, a 40 per cent increase over the past month according to the COVID Tracking Project in October, which further highlights the need to build and use field hospitals to prepare for the huge number of patients. Nowadays, apart from China and the United States of America, similar solutions have already been used practically all over the world, both in the form of temporary expansion of the hospital base and huge facilities such as congress halls or stadiums transformed into field hospitals [5, 6]. An example of such a solution is the Temporary Hospital

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FIGURE 1. An example of the arrangement of conservative beds in a temporary hospital

of the Central Clinical Hospital of the Ministry of the Interior and Administration in Warsaw created in one of the most recognizable buildings in Warsaw — the National Stadium. As of 20 November 2020, the hospital has 500 beds dedicated to patients with COVID-19, with the possibility to extend the number of beds to 1200.

The current criteria for admission to a Temporary Hospital may raise doubts both among medical personnel and the public, but this is due to a misunderstanding of the concept of creating temporary hospitals and their specificity. As already mentioned in the introduction, temporary hospitals do not fulfil the function of specialized hospitals and their role is limited to relieving specialized inpatient hospitals of patients in mild and middle status, to unblock hospital beds for patients requiring specialized treatment, including, among others, interventional cardiology, neurology, oncology or surgery. For example, Wang et al. indicated that patients were only admitted to a Mobile Cabin Hospital if they met all of the following criteria: 1. mild or moderate symptoms; 2. normal activities of daily living; 3. no important organ dysfunction; 4. no psychiatric history; and 5. resting pulse oxygen saturation > 95% [7]. In turn, Xu et al. indicated that in the event of a patient's condition deterioration they were quickly transferred to the designated higher-level hospitals. The inclusion criteria involved: 1. met the criterion of severe or critical; 2. lung imaging showing a greater than 50% progression of lesions within 24–48 h; 3. development of a basic disease, such as hypertension, diabetes, coronary artery disease, etc. the patient should be transferred to the designated hospital [8].

It is extremely difficult or even impossible to quickly organize a fully functional hospital with full diagnostics, operating theatres, capabilities of advanced treatment in various fields of medicine. The concept of creating a temporary hospital is based on the idea of focusing on patients whose condition will not require advanced treatment of coexisting diseases while relieving the burden of hospitals operating on normal principles, whose task is precisely the treatment of patients requiring complex diagnostics and cooperation of physicians specialists in various fields of medicine. The concept of creating temporary hospitals, which is currently being sometimes criticized, has been tested in other countries, and if the number of patients requiring hospitalization due to COVID-19 increases further, these hospitals may prove extremely useful. The usefulness of a temporary hospital should always be assessed in terms of the number of patients with COVID-19 requiring hospitalization. The experience gained during the development of a temporary hospital will allow for better preparation of further such units and more optimal use of medical personnel and equipment.

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THE SILENT EFFECT OF COVID-19 ON EMERGENCY DEPARTMENTS: HOW TO AVOID COMPLACENCY?

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1. THE EFFECT OF COVID-19 ON EMERGENCY DEPARTMENTS

The course of pandemic morbidity is highly significant for health services and especially for emergency departments (EDs), which serve as a gateway for the severely ill. However, countries have followed remarkably different strategies in attempting to reduce health services loads.

The understanding of a temporarily calm period due to lack of symptoms preceding a dramatic increase in workload is of great importance for ED preparedness.

For example, the ED at the Rambam Health Care Campus, a tertiary hospital in northern Israel, experienced a smaller number (~30) of patient arrivals throughout the day compared with hundreds during similar periods in previous years.

Overall, in Israel, there is a significant decrease of ~80% in ED admission rates since COVID-19 began to spread. This decrease may be related to patients' fears of infection alongside cost-benefit considerations of whether to visit the ED. Simultaneously, most of the moderate-to-severe COVID-19 patients in Israel are still in their early stages, identified as carriers of pneumonia and generally treated at community facilities. As their medical conditions worsen, a massive patient flow to the ED is expected, as was seen in Italy [1]. As described by Dr Daniele Macchini, an intensive care unit physician in Bergamo, near Milan, the EDs experienced a calm period, a respite with 50% occupancy. This period was characterized by medical staff uncertainty and slight indifference due to lower ED arrival rates. Then, one morning the first patient arrived; within a few hours, hundreds more did, leading Italian EDs and hospitals to a catastrophic state. As the doctor said: "I myself watched with some amazement the reorganization of the entire hospital in the past week… all this rapid transformation brought an atmosphere of silence and surreal emptiness to the corridors of the hospital that we did not yet understand, waiting for a war that was yet to begin and that many (including me) were not so sure would ever come with such ferocity."

In times of ED overload, with hundreds of complex patients simultaneously, the whole medical system becomes overwhelmed, and treatment necessarily becomes less efficient [2]. In addition, given the severe burdens, infection rates among staff members also increase. As health workers are at the front line of the COVID-19 outbreak response and as such are exposed to hazards that put them at risk of infection medical staff member infection is widespread globally [3]. For example, in Italy, France, and Spain, more than 60 health care professionals have died of the coronavirus, and thousands of others have had to self-isolate. In Spain alone, 14% of confirmed COVID-19 patients are medical professionals [4]. In the United States, the University of Washington Medicine began testing employees with symptoms at the beginning of March; 4.4% tested positive. In addition, at least 88 health care workers in Snohomish County have tested positive for the coronavirus, out of 1.300 total cases. In Yakima County, the numbers approximate 30% [5].

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This phenomenon can be explained by the load that directly increases both the rate and the risk of infection. Handling increasing numbers of patients reduces the attention to hygiene and sanitation rules required to manage the virus, as the main concern is survival and not prevention [6].

Implications for disease spread where clinician infections are not being captured may affect many aspects [7]. As health care systems, already crumbling under the strain of an expanding pandemic, they would not be able to handle the increased burden if medical professionals fall sick.

Simultaneously, a lack of resources and appropriate medical equipment aggravates the situation and emphasize the necessity of suitable organization and management of patients with diagnosed or suspected infection [8]. Imperial College London predicted that, by mid-June, even with social distancing and household quarantines, the demand for intensive care beds in the United States will exceed capacity [9].

Many concerns about capacity limits during the coronavirus pandemic have led hospitals and health care providers in the United States to appeal for donations of protective equipment, like masks, gloves, and gowns, to protect themselves from COVID-19 during what may turn out to be the early stages of the pandemic, knowing that sick health care providers will most likely worsen the crisis. It was estimated that with a combination of full protective equipment and the testing of 100% of symptomatic providers, they would be able to increase ICU capacity by an average of 1.824 patients per day over the first 200 days [10].

For example, nurses in Washington State and California said they have had to beg for N95 masks, which are thicker than surgical masks and block out much smaller particles, and have faced ridicule from colleagues when expressing concerns about catching the highly contagious virus. Others have complained about being pulled out of quarantine early to treat patients because of staff shortages [10].

2. PRACTICAL SUGGESTIONS FOR IMPROVING PREPAREDNESS

We believe that several activities that focus on ED nurses can improve preparedness for the COVID-19 pandemic.

1. Strengthening resilience and awareness among staff members — for example, embedding mindfulness intervention in the routine ED workflow [11].
2. Establishing knowledge and preparedness for the treatment of severely ill patients — preserving knowledge about operating mechanical ventilation equipment and managing patients with the life-threatening respiratory condition [12], all while performing simulations and practising the use of respiratory machines, addressing the machine's alarm, and identifying patients whose medical condition may worsen.
3. Ongoing practice by the entire hospital team — including the secretary team — in the identification and proper safety management of patients suspected of having COVID-19 [13].
4. Maintaining a journal club and updating it with the world's knowledge about the pandemic. Strengthening evidence-based knowledge among nursing staff on a daily basis before the start of each shift or on a weekly level.
5. Regularly maintaining emergency inventories, including robes, masks, and respirators, stored in a designated locked location until needed, in addition to maintaining supply lines through states of emergency [14].
6. Creating a staffing-based workflow chart [15], placing a "strong team" in key positions, and assembling organic teams in schedule shifts to prevent cross-infection and discontinuance of all working teams.

In conclusion, we believe that assimilating appropriate organizational practices with an emphasis on primary prevention in identifying the period of "calm before the storm" will strengthen staff preparedness, thereby improving care provided to patients and their families.

We all hope to overcome this pandemic with a minimal number of casualties and to become better prepared for future emergencies.

Declarations

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THE APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS IN DISASTER AND EMERGENCY MANAGEMENT IN EUROPE

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Today, the effectiveness of public administration depends on the speed of collecting, processing, and providing information. This effectiveness translates into public satisfaction, which is important for maintaining power in democratic countries. What is more, European society, following the example of developed societies from Asia and USA, demands a constant increase in the level of security in practically every area of life [1]. This task, under the will of the majority of voters, is shifted to the governmental and local governmental authorities, which in Europe results from two factors. First, the public sector can accumulate human, financial, logistic, etc. resources on a scale inaccessible to residents, communities, or private sector entities. Secondly, public institutions have the right to apply coercion in specific situations.

The unique powers of the government or local government, granted indirectly by the constitution or directly by statute, may result in the limitation of civil liberties. The social system, structured in this way, requires public entities to also take responsibility for crisis management, and for neutralizing security threats [2]. In the age of computerization and social demands, preparedness for disasters must be increasingly based on real-time acurrate information in which geographical information systems (GIS) play an increasingly important role.

Government entities need to collaborate with private industry partners to create a compatible and interoperable infrastructure to support metadata-described spatial data sets, services, processes and procedures and the technical support to utilize spatial information in disaster and emergency settings.

Advances in computer engineering and the development of GIS enable the synthesis of multiple data sources to provide digital visualization and sophisticated simulation simulations to aid in disaster and crisis preparedness and response [3–5].

Computerization and development of GIS enabled the digital visualization of space for interactive analysis of multiple data in the form of models or simulations [3, 4]. On the other hand, computerization of the environment has become a source of new threats for the state, society and the individuals themselves, especially in the area of personal data protection. However, technical and technological progress seems nowadays to be indispensable, due to the possibilities it provides, for example, in the area of geoinformation.

GIS has fundamentally impacted the effectiveness of the public sector response to crisis and disaster preparedness in Europe. For the past few decades, the advantages of GIS have contributed to an increased sense of security for European citizens. During the COVID-19 response, governments have relied on visual data provided by GIS to make critical decisions. Further integration across the

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European continent of GIS will require a significant capital investment. Government policy makers should consider high level standardization that addresses privacy and security concerns while providing real time accurate data that is accessible on mobile platforms. COVID-19 is an example of why accurate, real time data provided by GIS is an essential tool used to manage a public health crisis. In a pandemic and other disasters speed in which data can be collected, analyzed and disseminated across a standardized information-sharing platform is of paramount concern for planners, responders and hospital emergency department who will ultimately be treating patients.

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