PREVALENCE OF THROMBOCYTOPENIA IN THE FIRST WEEK AFTER BURN INJURY AND ITS RELATIONSHIP WITH BURN SEVERITY IN SHAHID MOTAHARI HOSPITAL OVER A PERIOD OF 6 MONTHS IN 2017

PRÉVALENCE DES THROMBOPÉNIES DURANT LA PREMIÈRE SEMAINE D'HOSPITALISATION ET LEURS RELATION AVEC LA SÉVÉRITÉ DES BRÛLURES. ÉTUDE SUR 6 MOIS EN 2017 À L'HÔPITAL SHAHID MOTAHARI

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SUMMARY. A platelet count of less than 150,000 per microliter of blood is called thrombocytopenia. Platelet count monitoring is essential in the care of burn patients. The aim of this study was to evaluate platelet count in groups of patients with different percentage of burns on the body surface and its relationship with the severity of burns and mortality. This retrospective descriptive cross-sectional study was performed on patients admitted to Shahid Motahari Hospital over a period of six months. The study was conducted on burn patients who were admitted to the hospital on the first day after injury. Patients were divided into two groups of with or without thrombocytopenia in the first week. Demographic information and treatment information about the patients were recorded. SPSS V.26 software was used for the statistical analysis of data. In this study, the prevalence of thrombocytopenia in the first week after burns was 36%. The variables of age, sex, duration of hospitalization, burn agent, percentage of burns and use of silver sulfadiazine ointment were significantly different in the two groups of patients. The group without thrombocytopenia had a mortality rate of 5.1%, while the group with thrombocytopenia had a rate of 32.2%. Based on the results of this study, thrombocytopenia is significantly associated with mortality in burn patients. Furthermore, the results of this study indicate that age, sex, burn agent, percentage of burns, and the use of silver sulfadiazine ointment have a clear impact on the thrombocytopenic status of patients.

Keywords: thermal burns, thrombocytopenia, prevalence, percentage of burns

RÉSUMÉ. *La thrombopénie est définie par un compte plaquettaire < 150 000/mm³, et la surveillance de la numération plaquettaire (NP) fait partie de la biologie de routine chez les brûlés. Cette étude a pour but l'évaluation de la cinétique de la NP chez des brûlés sur des surfaces variables et sa relation avec la sévérité de la brûlure et la mortalité. Il s'agit d'une étude rétrospective auprès de patients admis dans les 24h suivant leur brûlure dans le CTB de l'hôpital Shahid Motahari durant une période de 6 mois. Nous avons comparé ceux ayant subi une thrombopénie dans la première semaine aux autres (démographie, traitement), les statistiques ayant été réalisées avec SSPS version 26. La prévalence de la thrombopénie précoce est de 36%. Âge, sexe, cause, surface brûlée, recours à la sulfadiazine argentique et durée d'hospitalisation étaient différents entre les deux groupes. La mortalité des patients thrombopénique était de 32,2% VS 5,1%. Elle est significativement associée à la mortalité. L'âge, le sexe, la cause, la surface et la sulfadiazine argentique sont associées à la survenue de thrombopénie.*

Mots-clés: *brûlure, thrombopénie, prévalence, surface brûlée*

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Introduction

Severe burns are an important issue in the public health of developing countries and one of the leading causes of death in Iran. According to reports, the prevalence of burns leading to hospitalization is 13.5 per 100,000 people per year - 18 per 100,000 per year in women and 9.1 per 100,000 in men.[1] The average age of people with burns is 18 years old, with 58% being under 20 years old. Flames, boiling water and contact with hot objects are the most common causes of burns. Patients with extensive burns suffer from the most severe types of trauma. The pathological changes in the respiratory and circulatory systems in these patients are very complex. Even with the advancement of burn care in recent years, treating patients with severe burns has remained a major challenge.[2-3] According to recent findings, the mortality rate in burn patients is 69% among people who have burns on more than 70% of their entire body.[4] Burns are a set of injuries that are classified based on the depth of the burn, the size and area involved, age, and general health status.[5-7] To treat patients, it is important to assess the extent of the burn, expressed as the mean percentage of total body surface area. The famous rule of nine is most used in assessing the extent of burn injury in adults: the body is divided into several regions, and each region is assigned a specific percentage. The head with the neck and upper limbs each comprises 9%, the anterior and posterior parts of the trunk each 18%, the lower limbs each 18% and the remaining 1% the genital and perineal areas. Temperature injuries damage the structure of the skin and cause it to lose its function. Tissue damage is a direct result of thermal coagulation of the protein structure, while injury progression depends on released mediators, vascular changes, tissue edema and infection.[5-6]

In burn patients, the balance of homeostasis and immune response is severely impaired and platelets play an important role in modulating the two. Thrombocytopenia, described as a platelet count of less than 150,000 per microliter of blood, is one of the most common disorders in patients with severe burns and is associated with infection and increased mortality.[8-9] Thrombocytopenia in the first week after a burn is also defined as a platelet count of less than 150,000 per microliter of blood recorded on one or more days during the first week after a burn. The incidence of thrombocytopenia varies from 23% to 41% in different studies. Studies have shown that 26.9% of mortality in burn patients was due to platelet depletion.[9]

Thrombocytopenia is often associated with infection and usually increases platelet consumption, and is an early sign of bacterial infection in burn patients. Daily measurement of platelets and attention to their reduction is one of the methods for early detection of infection after burns. Platelets are small pieces of the cytoplasm of megakaryocytes. They play a fundamental role in primary and secondary homeostasis. In the initial phase of acute burns, there is a tendency to bleed, and in the next phase coagulation occurs.[10] Furthermore, although the primary function of platelets is to regulate homeostasis, they can also act as inflammatory cells. They release inflammatory mediators that react with leukocytes and endothelial cells and thus participate in acute and chronic immune responses.[11-13] Moreover, if the TBSA is greater than 30%, inflammatory mediators are released and cytokines migrate into the systemic circulation, inducing inflammatory responses. Various studies have shown that the decrease in platelets occurs early and usually in the first 3-4 days, and reaches normal ranges in 10-14 days.[14-19]

Based on the above information, it can be concluded that monitoring platelet count is very important in the resuscitation and care of severely burned patients. Research studies on the role of platelets and platelet counts are rare, old, and are mostly case reports on burn patients. The aim of this study was to evaluate platelet count in groups of patients with different percentages of burns on the body surface, and its relationship with severity of burns and survival and death of the patients. According to research conducted by Dr. Roos Elisabeth Mark and colleagues at the Beverwijk Burn Center in the Netherlands on 244 burn patients, of whom 153 (63%) were men and 91 (37%) were women with a mean age of 45 years, 10 of the patients (4%) developed sepsis and 22 (9%) died. In all study groups, platelet counts decreased sharply in the first 6 days (below 150,000 per microliter) and peaked by day 18 (650,000 per microliter). The incidence of thrombocytopenia in

people over the age of 49 and with a high percentage of burns (more than 29%) and in patients with sepsis is much higher than in other groups.[20]

According to research conducted at Imam Hossein Hospital, thrombocytopenia is a known and life-threatening complication in the ICU that can play a role in the prognosis of patients. Data from 531 patients were reviewed and 394 patients over 18 years of age who remained in the ICU for more than 48 hours with normal platelet count were studied. The prevalence of thrombocytopenia at the beginning of ICU admission was 32.6% (173 out of 531 patients). At least one thrombocytopenia case occurred in 61.4% of enrolled patients who were not initially thrombocytopenic (242 out of 394 patients). The maximum prevalence of thrombocytopenia was on the fourth day of ICU admission. The lowest platelet count occurred in all patients on the fourth day of hospitalization. Mortality rate in the intensive care unit in patients without thrombocytopenia was 9.2% (14 out of 152 patients) and in patients with thrombocytopenia it was 28.5% (69 out of 242 patients). Thus, mortality was significantly higher in patients with thrombocytopenia compared with those with normal platelet counts.[21]

In a study conducted by Dr. Lara Melivoj and colleagues on two groups of patients, one with low burn intensity (less than 10%) and the other with moderate to severe burn intensity (more than 10%), platelet depletion on the fourth day and the seventh after burn in these two groups is different according to the severity of the burn. Furthermore, platelet count on the fourth day compared to the first day in moderate and severe burns decreased significantly. According to the study, significant platelet depletion was associated with more fatal outcomes.[22]

Material and method

This is a retrospective cross-sectional study conducted in Shahid Motahari Hospital in Tehran, Iran. The study was conducted on patients who were referred to the hospital from April to October 2017 with complaints of burn injuries. Patients were excluded from the study if they did not want to participate in a research project, there was incompleteness in their records in terms of variables collected in the study, they were not admitted to Motahari Hospital on the first day after injury, were discharged with a doctor's diagnosis in the first week, or according to medical records, they had underlying diseases of thrombocytopenia or thrombocytosis. The sampling method was through census, and all the patients who met the above criteria were included. In this study, platelet count tests were collected every day of the first week after burn injury (in the case of death of the patient in the first week, until the day of death). Patients' platelet counts were collected according to length of hospital stay on days 14, 21 and 28. In addition, history of silver sulfadiazine in these patients was collected from their files. Thrombocytopenia in the first week was defined as the patient having a platelet count below 150,000 per microliter per day in the first week after admission. A checklist was used to analyze data relating to the patient. This checklist included information on:

- demographic information of patients: age, sex, marital status, employment status;
- cause of heat burn: oil and gasoline, hot water, flame, gas;
- platelet count on days 1 to 7, 14, 21 and 28;
- thrombocytopenia status and silver sulfadiazine use;
- burn information including burn percentage, length of stay, mortality.

After collecting the data, data analysis was performed and, first, the prevalence of thrombocytopenia in the first week and its relationship with the severity of burns was determined. The obtained data were analyzed using SPSS v.26 statistical software. The results were expressed as mean and standard deviation (mean ± SD) for quantitative variables and as frequency and frequency percentage for stratified qualitative variables. The characteristics of thrombocytopenic and non-thrombotic groups in the first week were calculated in terms of mean age, sex percentage, burn percentage, cause of injury, length of hospital stay and mortality. If the distribution was normal, the chi-square test and the relationship between burn percentage and thrombocytopenia were calculated using independent t-test. If the distribution was not normal, non-parametric equivalent tests

were used. Logistic regression analysis was also used to investigate the effect of multivariate mortality. A significance level of 0.05 was considered.

Ethical considerations

After obtaining the consent of the Ethics Committee, all collected information was kept confidential and analyzed without a specific name. Patients' private and personal information was protected. The people in the project adhered to all the Helsinki ethics. It should be noted that this study does not contradict the religious and cultural norms of society.

Results

From April to October 2017, 397 patients had burn injuries, of which 143 patients had thrombocytopenia in the first week, with a prevalence of about 36% (in the first week). In this study, the information of all 397 patients with thermal burns who were referred to Shahid Motahari Hospital from April to October 2017 was included in the checklist. The frequency or average of demographic and clinical variables in all participants in the study were recorded (*Table I*).

Age and thrombocytopenia

The mean total age of patients with heat burns was 34.5 years - 38.4 years and 32.3 years in the two groups with and without thrombocytopenia in the first week, respectively (*Tables I and II*). The minimum age was 1 year, and the highest age was 93 years. Also, the mean age between the two groups in terms of thrombocytopenia in the first week was significantly different (p=0.0001) (*Table II*). Furthermore, by classifying patients into three groups of under 18, 19 to 49 and above 49, it was found that the most heat burns occurred in the age group of 19 to 49 years (51.4%). After separating the age groups according to thrombocytopenic status in the first week, the observed result showed that in both groups it was still more frequent in the age group of 19 to 49 years, but between thrombocytopenic and non-thrombocytopenic conditions in the first week a difference of about 20% is seen in the 19 to 49 years group (*Table III*).

Mortality and thrombocytopenia

The overall mortality rate in this study was 14.9% (*Table I*). While in the group without thrombocytopenia in the first week this percentage was equal to 5.1%, in the group with thrombocytopenia in the first week this number reached 32.2%. This means that, firstly, there is a significant difference in mortality between the two groups according to the status of thrombocytopenia in the first week (p=0.0001), and secondly, the group with thrombocytopenia in the first week had significantly more mortality (*Table III*).

Burn percentage and thrombocytopenia

According to the results of this study, it was observed that about 44.3% of patients had burns of less than 20% (*Table I*). In the non-thrombocytopenic group in the first week, the 0% to 20% group had a frequency of 59.8%, which was the most prevalent group of burn percentage in the population. Conversely, in the thrombocytopenic group in the first week, the 50% to 100% group had 44.8%, which was the most prevalent group of burn percentage in this population (*Table III*). Furthermore, the mean extent of burns in the group with thrombocytopenia was also higher than in the group without thrombocytopenia (*Table II*).

Cause of burn and thrombocytopenia

In this study, the most common causes of burns were gas (32%) and oil and gasoline (30.2%) (*Table I*). While the same is true for the thrombocytopenic group in the first week, in the non-thrombocytopenic group in the first week hot water burns appear to be more abundant than in the thrombocytopenic group (*Table III*). In a way, it appears that more hot water burns have led to a non-thrombocytopenic condition in the first week, and more gas, oil, and gasoline burns have led to a thrombocytopenic condition in the first week.

Length of hospitalization and thrombocytopenia

About 45% of people had experienced between 8 and 14 days of hospitalization in this study (*Table I*). While in both groups the length of hospitalization had a similar percentage in the same range, in the group of people with thrombocytopenia in the first

Table I - The status of the frequency or average of demographic and clinical variables in all people with burns

Type of variable	Variable	Mean	Standard Deviation
Quantitative	**Age (years)**	34.54	21.60
	Days hospitalized	13.98	9.94
	Platelet count day 1 per microliter	260,64	109,79
	Platelet count day 2 per microliter	222,770	101,120
	Platelet count day 3 per microliter	207,230	106,250
	Platelet count day 4 per microliter	211,910	112,080
	Platelet count day 5 per microliter	227,010	104,960
	Platelet count day 6 per microliter	247,280	122,310
	Platelet count day 7 per microliter	289,040	126,730
	Platelet count day 14 per microliter	366,190	158,100
	Platelet count day 21 per microliter	334,980	144,280
	Platelet count day 28 per microliter	314,080	147,290

Type of variable	Variable	Answers	Value and Percentage
Qualitative	**Sex**	Male	284 (71.5%)
		Female	113 (28.5%)
	Age group	Under 18 years old	91 (22.9%)
		19 to 49 years old	204 (51.4%)
		Above or equal to 50 years old	102 (25.7%)
	Marital status	Married	206 (51.9%)
		Single	191 (48.1%)
	Mortality	Yes	59 (14.9%)
		No	338 (85.1%)
	Occupational status	No occupation	58 (14.6%)
		Housewife/Househusband	71 (17.9%)
		Employee	22 (5.5%)
		Self-employed	96 (24.2%)
		Manual worker	50 (15.1%)
		Student	42 (10.6%)
		Child	48 (12.1%)
	Hospitalization period	Less than 8 days	91 (22.9%)
		8-14 days	178 (44.8%)
		14+ days	128 (32.2%)
	Percentage of burns	0%-20%	176 (44.3%)
		20%-50%	116 (29.2%)
		50%-100%	105 (26.4%)
	Cause of burns	Oil and gasoline	120 (30.2%)
		Flames and sparks	47 (11.8%)
		Hot water	103 (25.9%)
		Gas	127 (32.0%)
	Thrombocytopenia in the first week	Yes	143 (36%)
		No	254 (64%)

Table II – Quantitative demographic information about all patients, grouped by thrombocytopenic and non-thrombocytopenic

Type of variable	Variable	Mean ± Standard Deviation			P Value
		All 397 patients (100%)	143 patients with thrombocytopenia in the first week (36%)	254 patients without thrombocytopenia in the first week (64%)	
Quantitative	Platelet count of the first week per microliter	239,680 ± 32,950	162,000 ± 29,620	289,540 ± 35,400	0.0001
	Platelet count of the 14th day per microliter	366,190 ± 158,100	326,100 ± 122,640	406,270 ± 179,110	0.015
	Platelet count of the 21st day per microliter	334,980 ± 144,280	306,320 ± 141,530	367,080 ± 143,310	0.309
	Platelet count of the 28th day per microliter	314,080 ± 147,290	278,460 ± 148,040	367,500 ± 135,940	0.333
	Age (years)	34.54 ± 21.60	38.41 ± 18.50	32.37 ± 22.92	0.028
	Burn percentage (%)	34.49 ± 8.52	48.70 ± 10.11	26.49 ± 6.63	0.001
	Number of hospitalized days	13.98 ± 9.94	16.58 ± 11.36	12.51 ± 8.74	0.0001

week, the percentage of patients who were hospitalized for more than 14 days was about three times the percentage of patients hospitalized for less than 8 days (*Table III*). This can be attributed to the fact that in the thrombocytopenic group, hospitalization under 8 days occurred much less than in other categories, and thrombocytopenic patients in the first week needed more hospitalization days according to their condition.

Use of silver sulfadiazine and thrombocytopenia

Silver sulfadiazine ointment had been used in 363 out of 397 patients with heat burns in this study (*Table I*). While 97.2% of the patients in the non-thrombocytopenic group used this ointment in the first week, in the thrombocytopenic group only 81.8% of the patients used this ointment in the first week. As a result, a significant difference was observed between the two groups in this regard (p=0.0001), which could indicate that the use of silver sulfadiazine ointment is probably effective in reducing thrombocytopenia in the first week (*Table III*).

Platelet counts

In this study, the platelet counts of each study group were also analyzed. It was observed that from the first to the seventh day (p=0.0001), and the fourteenth day (p=0.004), there is a significant difference in platelet count of patients in the two groups (with the thrombocytopenic group having a lower platelet count), which seems natural and clear, because the classification of thrombocytopenia in the first week was based on the same counts. However, on the 21st and 28th day, the platelet count did not show a significant difference between the two groups. Furthermore, the platelet count in both groups of patients decreased until day 3, and increased afterwards, which can indicate when the process of normalization of platelet count begins after a burn injury (*Table IV*). Moreover, in patients who passed away during the first seven days, the platelet count appears to be lower than in patients who did not pass away (*Table V*).

Burn percentage and mortality

A secondary goal of this study was to analyze the correlation between the burn percentage of patients and mortality rates. Here, it was observed that with increasing percentage of burns both in all patients and in the thrombocytopenic group in the first week, the number of deaths also increased (*Table VI*). Therefore, burn percentages can also be considered a factor in the mortality and general health of patients. However, the number of deaths in the thrombocytopenic group in the first week was higher than in the non-thrombocytopenic group in the first week, and it can be deduced that a thrombocytopenic condition can lead to higher mortality rates (*Table III*).

Table III - Qualitative demographic information about all patients, grouped by thrombocytopenic and non-thrombocytopenic

Type of variable	Variable	Answer	Mean ± Standard Deviation			P Value
			All 397 patients (100%)	143 patients with thrombocytopenia in the first week (36%)	254 patients without thrombocytopenia in the first week (64%)	
Qualitative	Age group	Under 18 years	91 (22.9%)	13 (9.1%)	78 (30.7%)	0.002
		19-49 years	204 (51.4%)	92 (64.3%)	112 (44.1%)	
		50 years or above	102 (25.7%)	38 (26.6%)	64 (25.2%)	
	Sex	Male	284 (71.5 %)	115 (80.4%)	169 (66.5%)	0.013
		Female	113 (28.5%)	28 (19.6%)	85 (33.5%)	
	Mortality	Yes	59 (14.9%)	46 (32.2%)	13 (5.1%)	0.0001
		No	338 (85.1%)	97 (67.8%)	241 (94.9%)	
	Hospitalization period	Less than 8 days	91 (22.9%)	20 (14.0%)	71 (28.0%)	0.018
		8-14 days	178 (44.8%)	66 (46.2%)	112 (44.1%)	
		More than 14 days	128 (32.2%)	57 (39.9%)	71 (28.0%)	
	Burn percentage category	0%-20%	176 (44.3%)	24 (16.8%)	152 (59.8%)	0.0001
		21%-50%	116 (29.2%)	55 (38.5%)	61 (24.0%)	
		51%-100%	105 (26.4%)	64 (44.8%)	41 (16.1%)	
	Use of silver sulfadiazine	Yes	363 (91.4%)	116 (81.1%)	247 (97.2%)	0.0001
		No	34 (8.6%)	27 (18.9%)	7 (2.8%)	
	Cause of burns	Oil and gasoline	120 (30.2%)	54 (37.8%)	66 (26.0%)	0.0001
		Flames	47 (11.8%)	15 (10.5%)	32 (12.6%)	
		Hot water	103 (25.9%)	14 (9.8%)	89 (35.0%)	
		Gas	127 (32.0%)	60 (42.0%)	67 (26.4%)	

Table IV - Status of mean platelet count in people with heat burns by study group

Days	Thrombocytopenia in the first week	Mean platelet count ± standard deviation	P Value
Day 1	Yes	205,970 ± 95,500	0.0001
	No	291,380 ± 105,410	
Day 2	Yes	159,840 ± 60,640	0.0001
	No	262,050 ± 101,580	
Day 3	Yes	131,360 ± 42,250	0.0001
	No	258,240 ± 105,910	
Day 4	Yes	131,670 ± 52,830	0.0001
	No	267,190 ± 108,700	
Day 5	Yes	147,650 ± 49,550	0.0001
	No	282,600 ± 97,560	
Day 6	Yes	160,040 ± 57,490	0.0001
	No	305,100 ± 119,630	
Day 7	Yes	197,480 ± 67,300	0.0001
	No	360,210 ± 308,570	
Day 14	Yes	326,100 ± 122,640	0.004
	No	406,270 ± 179,110	
Day 21	Yes	306,320 ± 141,530	0.127
	No	367,080 ± 143,310	
Day 28	Yes	278,460 ± 148,040	0.142
	No	367,500 ± 135,940	

Table V - Average platelet count in people with heat burns by mortality

Day	Mortality	Mean ± standard deviation	P Value
Day 1	Yes	244,820 ± 127,980	0.240
	No	263,350 ± 106,340	
Day 2	Yes	165,210 ± 65,890	0.0001
	No	234,850 ± 103,140	
Day 3	Yes	142,820 ± 62,740	0.0001
	No	221,960 ± 108,730	
Day 4	Yes	139,890 ± 61,330	0.0001
	No	228,180 ± 114,590	
Day 5	Yes	145,050 ± 63,630	0.0001
	No	243,780 ± 103,930	
Day 6	Yes	159,370 ± 73,030	0.0001
	No	267,310 ± 122,530	
Day 7	Yes	177,410 ± 68,140	0.0001
	No	321,000 ± 275,150	

Table VI - The relationship between thrombocytopenia in the first week and other studied variables, with mortality in patients with heat burns

Dependent variable	Independent variable	P Value
Mortality	**Thrombocytopenia in the first week**	0.0001
	Burn percentage	0.0001
	Age	0.0001
	Gender	0.380
	Hospitalization period	0.0001
	Cause of burns	0.0001
	Use of silver sulfadiazine	0.391

Discussion

Severe burns are an important issue in the public health of developing countries and one of the leading causes of death in Iran.[1] Platelets play an important role in homeostasis and the immune response, both of which are severely impaired in burn patients. Thrombocytopenia refers to a platelet count of less than 150,000 per microliter of blood and is one of the most common disorders in patients with severe burns. It is associated with infection and increased mortality.[8-9] Although the primary function of platelets is to regulate homeostasis, they can also act as inflammatory cells.[11-13] Thrombocytopenia in burn patients can be due to medication, acute respiratory failure, blood transfusion, and implantation of a pulmonary catheter; but the most common and important cause is sepsis. Thrombocytopenia in burn patients is thought to be due to the release of inflammatory mediators, which can lead to increased consumption and increased platelet degradation. Bone marrow suppression may also be associated with decreased platelet production.[8] In previous studies with bone marrow aspiration in burn patients, bone marrow suppression has not been seen, therefore thrombocytopenia is thought to be due more to increased consumption and platelet degradation than to bone marrow suppression.[23]

The incidence of thrombocytopenia in burn patients in different studies ranged from 23% to 41%, and in the Warner study prevalence of severe thrombocytopenia (platelet count less than 50,000) in critically ill patients was 10% to 17%. In previous studies, 26.9% of burn deaths were due to platelet depletion.[9] However, it is not clear whether the depletion of platelets caused the severity of the injury or was the cause. Thrombocytopenia has been associated with increased mortality and disability in critically ill patients.[4,24] In particular, platelet counts less than 50,000 in critically ill non-burn patients and less than 20,000 in critically ill burn patients have been associated with a sharp increase in mortality risk.[24] In burn patients, a decrease in platelet count occurs in the first 48 hours of hospitalization and ap-

pears to be due to the consumption of platelets due to heat damage, as well as the thinning of platelets as a result of resuscitation with high fluid volume. During the first week of hospitalization, the number of platelets decreases, which is thought to be secondary to the loss of circulating platelets, and eventually thrombocytosis develops in the next week. In the Warner study, except for patients with severe thrombocytopenia in the first week, all patients developed thrombocytosis in the second week. This thrombocytosis may theoretically be due to a reactive process due to temporary suppression of bone marrow or to the release of cytokines due to heat damage, anemia and tissue damage.[8]

In the present study, the prevalence of thrombocytopenia in the first week was 36% and was associated with older age (p=0.0001), male sex (p=0.003), percentage of burns (p=0.0001), and increased length of hospital stay. In the study by Crowther et al., thrombocytopenia was associated with increased length of hospital stay.[8] On the third to fifth day of hospitalization, platelet count was inversely related to percentage of burns. This is in line with Pavic's study finding that platelet count on the fourth day of hospitalization was inversely related to burn severity.[22] In the present study, the mortality rate was 14.9% in all patients, which was significantly higher in patients with higher burn rate and in thrombocytopenic patients. In the Mokhtari study, mortality rate was lower than in the present study, but the rate of patients with platelet deficiency was higher.[21] In Pavic's study, platelet count was inversely related to mortality.[22] In the Warner study, morbidity was 70% among patients with severe thrombocytopenia, with the lowest platelet count in the first week and the highest platelet count recovery length (9 days).[9]

In general, platelet counts decreased until the third day and then increased in both of the primary groups of this study. In comparison to the group without thrombocytopenia, the group with thrombocytopenia had significantly lower platelet counts on days one through seven (p=0.0001) and on the 14th day (p=0.004). However, on days 21 and 28 after burns, no significant difference in platelet count was observed between the two groups. It seems that after the fourteenth day, platelet count gradually returns to normal. The lowest platelet count was seen in the recent study on the third day and in the Mokhtari study on the fourth day.[21]

In patients who used silver sulfadiazine ointment in the first week, the prevalence of thrombocytopenia was significantly lower than in the group that did not use this ointment on their burn wound (p=0.0001). Due to the fact that silver has antimicrobial effects (by affecting the cell wall of bacteria),[25] in previous studies the use of silver-containing dressings (such as ColActive ointment with silver ions) has accelerated the healing of burn wounds,[26] and considering that thrombocytopenia in previous studies in most cases occurred with sepsis due to bacterial infection, it can be concluded that, most likely, silver sulfadiazine ointment, due to the silver compounds used in it, is associated with a lower incidence of thrombocytopenia in burn patients by reducing wound infection and the risk of sepsis due to bacterial infections.

Finally, it can be said that thrombocytopenia in burn patients is associated with increased mortality and worsening prognosis, and the use of dressings containing antibacterial agents can reduce the prevalence of thrombocytopenia and improve the prognosis of patients. However, it is still unclear whether thrombocytopenia is caused by the severity of inflammation and burn injury or is itself a contributing factor. In future studies, the effects of platelet count control on the prognosis of burn patients can be addressed.

Limitations

Access to the patients' information file, and the incompleteness and inaccuracy of the information contained in them was one of the limitations in this study. To help solve this limitation, the report of the nursing office was used to gather more accurate and complete information. Furthermore, there was a lack of previous studies in Iran, which was another limitation of this study, as less information regarding the setting of this type of experiment was available. Finally, this study focused on a limited list of variables, using a smaller sample size and a shorter follow-up period. It is suggested that studies with a larger sample size, a longer follow-up period, and more variables are conducted in order to find more possible confounding variables in the future which can achieve even more comprehensive, accurate and generalizable results.

Conclusion

Based on the results of this study, factors such as age, sex, use of silver sulfadiazine, burn percentage and the cause of burns all play a factor in the presence of thrombocytopenia in patients. In comparison with non-thrombocytopenic patients, patients in the group with thrombocytopenia were seemingly of an older age (the mean age being around 38 years), typically with a higher male population (about 80%), had not used silver sulfadiazine, had a higher percentage of burns, and were mostly burned by oil, gasoline and gas (while non-thrombocytopenic patients typically had most of their burns result from hot water). Further studies should be conducted on the extent of the effects of each of these factors on the causation of thrombocytopenia for more accurate results.

Furthermore, the results of this study show that in both groups of patients (with and without thrombocytopenia), there is a decrease in platelet count, starting on day one and ending on day 3 after burn injury. Moreover, in both groups, the platelet count started to increase after the third day. The difference in platelet count between the two groups was significant on days one through 7, and on the 14th day (with the thrombocytopenic group having a lower platelet count), however it became insignificant on days 21 and 28 (although the group with thrombocytopenia still had a lower platelet count). These results demonstrate that while the healing process, in terms of platelet count, for both groups, begins at around the same time, the recovery time for patients with thrombocytopenia, in terms of platelet count, after burn accidents seems to be higher.

Lastly, the results of this study clearly demonstrated that a thrombocytopenic condition plays an important factor in terms of hospitalization time and mortality rate of the patients. The patients with a thrombocytopenic condition had longer hospitalization periods, around four days longer than patients without thrombocytopenia, and higher mortality rates, around 27% higher than patients without thrombocytopenia. Furthermore, the platelet count of patients who passed away was lower than the platelet count of patients who survived. Therefore, it is important to further analyze the causes of thrombocytopenia in burn patients, and to reduce thrombocytopenia in order to better the prognosis of the patients.

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