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Seasonal Incidence of Acute Coronary Syndrome and Its Features

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ABSTRACT

Introduction: Acute coronary syndrome (ACS) is one of the most common health problems in the world and the leading cause of death. **Goal:** The goals of this study are to determine: ACS type, risk factors, incidence and the seasonal distribution of occurrence Spring/Summer, Autumn/Winter, ACS incidence by age and gender, and complications (post-infarction angina and heart failure) and fatal outcomes of ACS per season. **Material and methodology**: This study is designed as retrospective-prospective and analytical, which included 250 patients hospitalized in the Intensive Cardiac care unit of the Clinic for heart disease, blood vessels and rheumatism in the period from June 2013 to July 2014. It was assumed that there is the influence of the seasons on the incidence and characteristics of ACS. Material used were the medical records and data from the history of illness. **Results**: The most common type of ACS was ST elevation myocardial infarction (STEMI), without statistical significant difference between seasons. Presence of risk factors is not significantly different between seasons, with the hypertension as the most common risk factor for ACS during both seasons. The highest incidence of ACS was recorded in December during the winter season, while the lowest incidence was recorded in March. The occurrence of ACS during the Spring/Summer, Autumn/Winter was different according to age, with more frequent occurrence of ACS in older patients during the winter months. ACS complications (postinfaction angina and cardiac insufficiency) were also statistically different between seasons (p=0.048). Fatal ACS is more often recorded during the season Autumn/Winter compared to Spring/Summer season (p=0.001). **Conclusion**: The results suggest seasonal meteorological impact on the incidence, complications and outcomes of ACS, so there is a necessity that patients adapt their lifestyle and health professionals to improve the ACS treatment.

Keywords: ACS, season Spring/Summer, Autumn/Winter, complications, outcomes.

1. INTRODUCTION

ACS is one of the most common health problems in the world and the leading cause of death. It represents a clinical condition characterized by rapidly developing critical myocardial ischemia. Coronary heart disease nowadays represents the most important determinant of chronic heart failure–one of the most difficult and the most numerous chronic diseases, which causing permanent disability. Key diagnostic procedures for detection of patients with ACS are: ECG at rest and markers of myocardial necrosis. Troponin T and troponin I are specific cardiac markers for myocardial injury and are the „gold standard" for diagnosing the myocardial necrosis. In addition to the clinical, pathological and pathophysiological characteristics, therapeutic and diagnostic procedures which are established long-ago and well-known, in this paper we want to contribute by examination of the relationship between the incidence of ACS and seasons, the occurrence and the possible differences during cold (Autumn/Winter) and warm (Spring/Summer) period of the year. Also by investigating the possible differences in ACS type and the presence of risk factors for the its occurrence during the Spring/Summer and Autumn/Winter, relation between ACS incidence and the patient's age and sex, as well as complications and outcomes of ACS per season (1-3).

2. MATERIAL AND METHODS

This study is designed as retrospective-prospective analytical study, and included 255 subjects of both genders with ACS, according to the seasons Spring/Summer and Autumn/Winter. The subjects included in the study were admitted to the Clinic for heart disease, blood vessels and rheumatism, Clinical Center of the University of Sarajevo, in the period from June 2013 to July 2014. Inclusion criteria for the study were diagnosed ischemic heart disease in some form of the ACS: unstable angina pectoris, myocardial infarction without ST elevation (NSTEMI) and

myocardial infarction with ST segment elevation (STEMI). Exclusion criteria were other forms of ischemic heart disease, and also in the study were not included patients with STEMI referred for treatment by percutaneous coronary intervention in the other cardiac center. Patients with STEMI included in this study, in this period (2013-2014) were admitted during the time period of „golden hour", or during the first 90 minutes after the onset of pain were treated by percutaneous coronary intervention (PCI). Patients who were admitted during the first 6 hours after occurrence of STEMI and who were not treated with PCI were treated with fibrinolytic reperfusion therapy. We analyzed the following parameters: 1) The nature and frequency of the ACS according to the seasons; 2) Demographic parameters (age and gender); 3) Risk factors (hypertension, hyperlipidemia, diabetes mellitus, positive family history, tobacco smoking); 4) Employment status; 5) Troponin I values; 6) Complications–postinfaction angina and heart failure (Killip III and IV) and fatal outcomes of ACS.

Statistical analysis

Data analysis is presented in tables and charts by number of cases, percentage, arithmetic mean with standard deviation and range. To prove the hypothesis of particular goals the following test were used: Chi-square test with Yates correction due to the counts of the individual cells less than 5, Student's t test for independent samples and one-way analysis of variance (ANOVA). Results of all tests with $p<0.05$ or at the 95% confidence level was considered statistically significant. The analysis was conducted using statistical software IBM SPSS Statistics v22.0 (Chicago, Illinois, USA) and Excel 2010.

3. RESULTS

Analysis by months shows that the majority of patients with ACS was admitted during December–32 or 12,5% and the lowest during the March–14 or 5.5%.

Analysis of the ACS frequency by gender shows that men were significantly more represented in both the observed seasons in 80.8% of cases without statistically significant difference between seasons ($x2=0.0001$; $p=0.561$). Analysis of the mean age shows that patients with ACS were statistically significantly older during the period Autumn/Winter with an average age of 62.9±11.7 years (range 33-88 years) than patients hospitalized during the Spring/Summer with an mean age of 59.5±12.1 years (range 22-91 years) with $t=5.346$; $p=0.022$.

		Season		Total
		Spring/ Summer	Autumn/ Winter	
Gender	N	101	105	206
	%	80.8	80.8	80.8
	N	24	25	49
	%	19.2	19.2	19.2
Age by seasons				
	N	Mean	SD	SEM
Spring/Summer	22	91	12.056	1.078
Autumn/Winter	33	88	11.724	1.028

Table 1: Gender and age structure according to seasons

			Season		Total
			Spring / Summer	Autumn / Winter	
Type of ACS	STEMI	N	79	84	163
		%	63.2	64.6	63.9
	NSTEMI	N	27	25	52
		%	21.6	19.2	20.4
	Unstable angina	N	19	21	40
		%	15.2	16.2	15.7
Total		N	125	130	255
		%	100.0	100.0	100.0

Table 2: Type of ACS per season

		Season		Total
		Spring/ Summer	Autumn/ Winter	
Positive family history x2=0.289; p=0.340	N	59	57	116
	%	47.2	43.8	45.5
Smoking x2=0.057; p=0.456	N	73	74	147
	%	58.4	56.9	57.6
Hypertension x2=0.007; p=0.523	N	90	93	183
	%	72.0	71.5	71.8
Diabetes mellitus x2=0.614; p=0.260	N	32	39	71
	%	25.6	30.0	27.8
Hyperlipidemia x2=0.205; p=0.372	N	67	66	133
	%	53.6	50.8	52.2

Table 3: Risk factors for ACS according to seasons

		Season		Total
		Spring / Summer	Autumn/ Winter	
Employed	N	50	33	83
	%	40.0	25.4	32.5
Unemployed	N	18	18	36
	%	14.4	13.8	14.1
Retired	N	57	79	136
	%	45.6	60.8	53.3
	N	125	130	255
	%	100.0	100.0	100.0

Table 4. Employment status

	N	Mean	SD	SEM	Min	Max
Spring/ Summer	125	36,17191	59,985234	5,365242	,000	365,500
Autumn/ Winter	130	20,00941	39,064343	3,426170	,000	275,620
Total	255	27,93220	50,962548	3,191399	,000	365,500

Table 5. Mean value of troponin I per season

The most common type of ACS was STEMI in about 64% of cases during both seasons, without significant differences in the frequency by the seasons, $x2=0.232$; $p=0.890$.

Presence of risk factors was not statistically significantly different between seasons ($p>0.05$) including as the most hypertension, followed by hyperlipidemia, smoking, positive family history, and in the end as rarest among the risk factors the diabetes mellitus.

According to the employment status there was a significant difference between the observed subjects per season ($p<0.05$) in the sense that a larger number of retired persons was admitted due to the ACS during the season Autumn/Winter, and a larger number of employed during the season Spring/Summer, $x2=6.945$; $p=0.031$.

Analysis of the average value of troponin I shows that higher values are recorded during the season Spring/Sum-

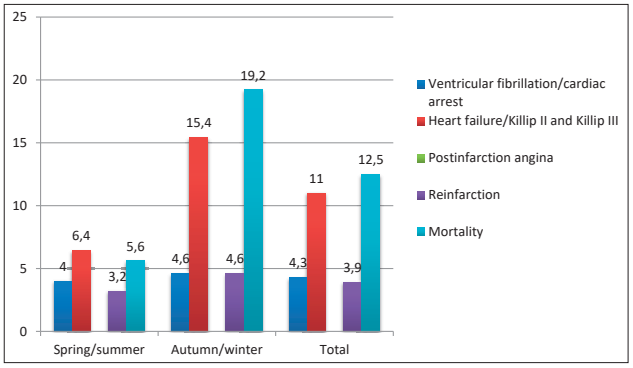

Figure 1. Percentage of complications and outcomes of ACS by seasons (x2 = 9.116; p = 0.048) outcomes were statistically signfikantno vary according to the seasons, and so in the spring / summer season is dominated by unfavorable outcomes types of post-infarction angina, and during the season autumn / winter heart failure (Killip III and IV), x2 = 9.116; p = 0.048. Mortality in this period statistically significantly more frequently recorded during the season autumn / winter and to 19.2% compared to 5.6% of the time during the season spring / summer, x2 = 10.789; p = 0.001, with an overall mortality rate of 12.5% in both seasons (2013/2014. old).

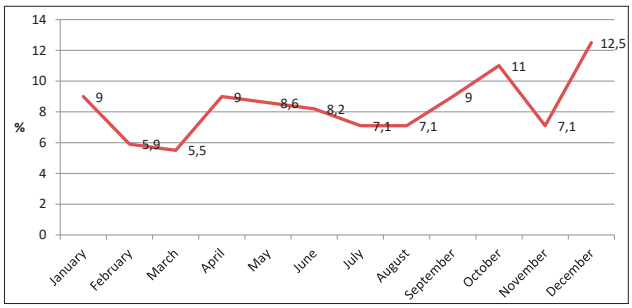

Figure 2. The flow and dynamics ASC Monthly

mer with a mean of 36.17 and SEM of 5.36 compared to the period Autumn/Winter with mean of 20.0 and SEM of 3.4265, with the statistically significant difference, t=6.550; p=0.011.

Outcomes significantly vary according to the seasons, so in the Spring/Summer season dominated unfavorable outcomes by types of post-infarction angina, and during the season Autumn/Winter as heart failure (Killip III and IV), x2=9.116; p=0.048. Mortality was statistically significantly more frequently recorded during the season Autumn/Winter–19.2% compared to 5.6% during the season Spring/Summer, x2=10.789; p=0.001, with an overall mortality rate of 12.5% during both seasons (2013/2014).

Analysis by months shows that the majority of patients with ACS was registered during the month of December–32 or 12.5% and the lowest during the month of March 14 or 5.5%.

4. DISCUSSION

The analysis of gender representation ACS according to the seasons in our study shows that men were significantly more represented in both seasons without significant difference (p=0.651) between the seasons which is largely coincides with the research by Douglas and associates (4). Clinical studies CARDIO2000 indicate greater representation of acute coronary syndrome in males than in females in the ratio of 4:1 in the total sample which fully corresponds with the results of this study (5).

Analysis of the mean age shows that patients with ACS were statistically significantly older during the period Autumn/winter with an average age of 62.9±11.7 years compared to patients during Spring/Summer with an mean age of 59.5±12.1 years (p=0.022).

The most common diagnosis was myocardial infarction in 215 or 84.3% of cases, of which STEMI 63.9% of cases, and without statistically significant differences between seasons (p=0.556). This result coincides with the results of CYPACS study (6).

Kass and Sewart in their study (7) showed that the most common risk factors for coronary heart disease are smoking, hypertension, hyperlipidemia, which are partly in line with our study but the incidence of risk factors has a slightly different sequence. In our study the presence of risk factors is not statistically significantly different according to the seasons with the most frequent hypertension (71.8%), followed by smoking, hyperlipidemia, family history, and finally as the rarest, in our sample, among the risk factors the diabetes mellitus. Hypertension is a leading factor of cardiovascular risk in the world. Approximately 27% of the world adult population has hypertension, which favors the formation of coronary ischemic disease (8). The Framingham study has shown that the risk of coronary heart disease in people with hypertension, aged 35-46 years, is two times higher compared to normotensive population of the same age (9). A small decrease in blood pressure significantly reduce cardiovascular risk. A meta analysis of prospective studies done on more than one million adults, showed that the reduction in systolic pressure of 2 mmHg leads to a 10% reduction of cardiovascular risk, or 7% decrease in the risk of coronary heart disease (10,11). One study from 2003 showed that hypertension is present in 55.9% of adult men and 38.4% women, which makes it a risk factor number one, which is in line with our research (7).

Smoking is an important cause of the increased incidence of atherosclerosis. In our total sample it was in second place, is represented with 57.6%. For male smokers, aged 40 years, ischemic heart disease occurs five times more often than among non-smokers, and the occurrence of myocardial infarction and sudden cardiac death is three times more common. It has been proven that tobacco use leads to endothelial dysfunction and induces platelet aggregation, lowers HDL levels, which also contributes to the development of atherosclerosis and placing smoking among the leading risk factors for ischemic heart disease (12). In our study the frequency of smoking, as risk factor did not differ according to the seasons (p=0.556). Lipids imbalance, such as high total cholesterol, triglycerides, low density lipoprotein (LDL) or a low high-density lipoprotein (HDL) leads to increased risk of ischemic heart disease.

Complications and outcomes of acute coronary syndrome in our study varied according to the seasons, and so during the season Spring/Summer dominate the post-infarction angina (10.4%), and during the season Autumn/Winter occurrence of heart failure of type Killip III and IV (15.4%). According to the type of coronary syndrome are the most common complications were myocardial infarction and of cardiac failure in 11.2% and postinfaction angina in 7.0% of cases (p = 0.048). Myocardial infarction affecting ≥40% of left ventricular myocardium usually results in cardiogenic shock and carries a high mortality rate. Respondents with STEMI in

our sample were treated with fibrinolytic therapy with streptokinase or alteplase. Cardiogenic shock and congestive heart failure in these cases does not constitute a contraindication for fibrinolysis, or for percutaneous coronary intervention which is necessary to be performed if the Cardiology Center provides such a possibility.

Decisive factor is the time from the onset of symptoms until the beginning of treatment in relation to the occurrence of ACS, primarily STEMI. After fibrinolytic therapy, reocclusion infarction of related artery occurs in about 5% to 10% of patients at the time of discharge, and in 25% to 30% of patients during one year. These patients also tend to have worse outcomes. Reinfarction is more common in patients with diabetes or previous myocardial infarction. With the advent of primary percutaneous coronary intervention (PCI) and stent, the risk of reinfarction has been decreased substantially, to around 3% during the first 90 days after myocardial infarction (17).

Higher incidence of post-infarction angina and reinfarction in the Spring/Summer season, in our work, can be explained by the more physical exercise and stress during this season, especially in those where after an episode of ACS is not performed coronary angiography and PCI, and with significant stenosis in the coronary arteries. Angina that occurs from a few hours to 30 days after acute MI is defined as postinfaction angina. The incidence of post-infarction angina is greatest in patients with NSTEMI (25%) and those who received fibrinolytic therapy have it more frequently than those treated with PCI. Patients with postinfaction angina have worse prognosis due to sudden death, reinfarction and an acute cardiac event, compared with those without such symptoms (18).

Analyzing the average values of markers of necrosis has been shown that the value of troponin was significantly higher during the Spring/Summer season compared to the season Autumn/Winter, with statistically significant difference (p=0.011), which was not in correlation with fatal outcomes by seasons. So, indirectly speaking, the value of troponin was not of prognostic significance for mortality.

As a result of ACS during hospitalization, mortality was more often recorded during the season Autumn/Winter in 19.2% of cases, compared to 5.6% during the season Spring/Summer (p=0.001), which can be explained by the older age of patients and employment status (more often retired), the regime of diet during the winter and the lack of sunlight, as such results in mortality of hospitalized patients agree also with studies conducted in North America, Asia and Europe (19-21).

It is interesting to notice that number of employed or patients of productive age reduces during the season Autumn/winter, with retired significantly more present in this season, and for the unemployed is the same, it can also be related to socioepidemiological status linked to the regime of diet and life style of this population.

Explanation for the higher mortality in season Autumn/Winter can be untimely contacting the doctor and inability for timely application of reperfusion therapy for STEMI, which is more pronounced in the winter months when transport of patients is not so convenient, especially in rural areas and untimely arrival of patients to hospital with more developed severe forms of heart failure, with developed clinical image of cardiogenic shock, which significantly worsen the prognosis and treatment outcome and greatly contribute lethal outcomes.

Highest incidence of ACS, in our study, was observed during the month of December, and the lowest during the month of March. The fact that the air temperature is associated with increased risk for ACS creates a presumption that the cold weather cause changes in blood pressure, as well as the traditional eating habits with a higher intake of salt and lipids of animal origin during the winter months, which can lead to changes in metabolism, and ultimately affect the mechanisms of atherogenesis, coagulation and thrombogenesis (13-16). It is also possible that the influence of days duration and lack of sunlight, or ultraviolet light (UV) in these months, in order to stimulate the synthesis of vitamin D3 in the skin and liposoluble cholesterol sulfate whose deficiency can influence the absence of metabolic sulfate also favor inflammation and atherosclerosis, and be the cause of higher incidence of acute coronary syndromes and increased mortality during winter (22-25). Less known is that under the influence of UV light, releases carbon monoxide in connection with hemoglobin that has a vasodilatory effect.

In fact, the greatest emphasis should be placed on prevention of coronary ischemic disease, through all levels which ultimately reduces the mortality from ischemic heart disease and acute coronary syndrome as its most severe form, in which as in this study proven influence of seasonal changes, and increases the influence of climatic factors during winter.

5. CONCLUSION

The incidence of acute coronary syndrome did not differ significantly by seasons Spring/Summer, Autumn/Winter, but the highest incidence of ACS was recorded in December during the winter season, while the lowest incidence was in March. The occurrence of acute coronary syndrome during the seasons Spring/Summer, Autumn/Winter was significantly different by age, but not gender, with more frequent occurrence of ACS in older age patients during the season Autumn/Winter, with lower socioepidemiological status, and therefore the diet regime. Complications and outcomes of ACS were also statistically different (p=0.048) according to the seasons, and so the season Spring/Summer dominated postinfaction angina pectoris, and during the season Autumn/Winter occurrence of heart failure (Killip III and IV). Fatal ACS was more often recorded during the season Autumn/Winter compared to Spring/Summer season (p=0.001). Obtained results suggest seasonal meteorological (weather) impact on the incidence, complications and outcomes of ACS, which leads to the need that patients adapt their lifestyle particularly during the winter months with the diet rich in organic sulfates and vitamin D3, and the need for greater, as possible, exposure to sunlight during the winter months.

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