Scientific Journal of
Nursing & Practice

Research Article

Pre-Hospital Symptoms, Actions and Delay Times-Does it Differ between Hypertensive and Non-Hypertensive ST-Elevation Myocardial Infarction Patients?

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Submitted: 26 October 2017; **Approved:** 08 November 2017; **Published:** 09 November 2017

Cite this Article: Ericsson M, Sederholm Lawesson S, Swahn E, Thylen I. Pre-Hospital Symptoms, Actions and Delay Times-Does it Differ between Hypertensive and Non-Hypertensive ST-Elevation Myocardial Infarction Patients? Sci J Nurs Pract. 2017; 1(1): 019-024.

INTRODUCTION

It is well established that early revascularization is crucial for the prognosis when an individual is stricken by an acute myocardial infarction [MI] [1,2]. For the most deadly form of MI - ST-Elevation Myocardial Infarction [STEMI] - the mortality rates are non-linear and increase for every 30 minutes that elapse before these patients are treated [2]. Both American and European guidelines stipulate that it is essential to make every effort to minimize all time delays, especially within the first 2 hours after onset of symptoms, by the implementation of a system of MI care network [1,3]. A variety of factors have been associated with prolonged care seeking behavior, such as different socio-demographic, clinical, situational and psychological factors [4-8]. The pre-hospital action also depends on the individual's knowledge, beliefs and attitudes to symptoms [9-11]. Therefore, it is crucial that patients interpret symptoms correctly; otherwise this will impact care seeking behavior; jeopardizing early revascularization [5-11]. Specifically, older age, female gender and co-morbidities such as a medical history of diabetes and hypertension often excels in prolonged pre-hospital delay times [5-7,12-16]. Furthermore, research has shown that a history of hypertension has an influence in the outcome for MI patients; both in-hospital and long term mortality has been shown to be associated with a greater risk for cardiac death both during the acute phase of the MI as well as post infarction when there is a history of hypertension [17-19]. However, no studies have primarily examined the influence of a medical history of hypertension and its impact on delay times from the patient's perspective. Since hypertension is prevalent in 31-59% of the patients in an MI population [17,20] it is important that healthcare professionals that meet these patients in the context of primary prevention, educate their patients about their increased risk of MI and how to recognize symptoms of an acute MI in order for them to act correctly. Therefore, this multicentre study was conducted with the purpose to examine pre-hospital symptoms, actions, and delay times in a STEMI population, and compare patients with or without a medical history of hypertension.

METHODS

Study design

This Swedish cross-sectional multicentre study (SymTime) used a descriptive and comparative design of self-reported data. We enrolled participants from five hospitals in Sweden: two university hospitals and three county hospitals. The hospitals were strategically selected based on a diverse geographic location and type of hospital. Data were collected in the Coronary Care Unit (CCU) in each participating hospital during November 2012 to January 2014.

Participants and procedures

Eligible patients were designed to be consecutively included within 24 hours after being admitted to the CCU. The following inclusion criteria were used: (1) diagnosed with a STEMI, defined as ST-elevation on admission Electrocardiogram (ECG) and a diagnosis of acute MI at discharge according to ESC guidelines [3]; (2) ability to fill in the questionnaire alone or with help from a healthcare professional; (3) willing to participate.

Data collection and instruments

The staff nurse in charge obtained clinical data (e.g., information on diagnosis, co-morbidities) and First Medical Contact (FMC) from the medical records.

Symptoms, actions and time-point measurements: A previously validated self-administered questionnaire developed and tested in a Swedish chest pain population was used [21], with small changes and clarifications. The questionnaire covers 35 items; including (1) baseline characteristics, (2) symptoms, (3) course of events including multiple time point measurements and (4) description of transport mode.

Study definition for pre-hospital delay: Patient´s pre-hospital delay was defined as the interval between "time-of-onset-of-symptom" until "time-of-first-medical-contact" [3]. The transport time to hospital was not included in this interval. The shorter the time from symptom onset to reperfusion, the greater the patient will benefit. In this study, a delayed time was defined as > 1 hour.

Statistical analysis

The material was analyzed both as a whole group and divided into two groups; hypertensive and non-hypertensive patients. The hypertensive diagnosis was assessed from medical records, documented prior to admittance. A descriptive analysis with frequencies and percentages was used to present patients' characteristics. Continuous variables were reported as mean ± Standard Deviation (SD) or median (Q_1; Q_3). Bivariate comparisons between groups were made by chi-square test and two-tailed Student's t-test or Mann Whitney´s U test for non-normally distributed variables. Logistic regression analyses were used to adjust for age and gender when comparing symptom presentation between groups. In addition, hierarchical logistic regression analyses were conducted in order to determine predictors of delay (i.e., < 1hour or > 1hour) in hypertensive and non-hypertensive patients separately. Predictors used were socio-demographic- (i.e., age, gender, co-habiting status, educational level), co-morbidities (i.e., previous MI, heart failure), clinical- (i.e., symptomatology, symptom burden, interpretation of symptoms, pain intensity) and contextual factors (i.e., time of symptom onset, at home or not when falling ill). Independent variables in the regression models were chosen based on theoretical relevance from the literature. A *p*-value <.05 indicated statistical significance. Statistical analyses were performed using SPSS software, version 22.0 (SPSS Inc, Chicago, Ill) for Windows.

Ethical aspects

Permission for the study was obtained from the regional Ethical Committee for Human Research in Linköping, Sweden (D-nr 2012/201-31), and complied with the Declaration of Helsinki [22]. Informed consent was obtained from the patients. They were informed about the study by the staff nurse both in writing and verbally. Patients were pain-free and hemodynamically stable when they were asked to participate.

RESULTS

Background Characteristics

In total, 532 STEMI patients were included in the study, with 76% of the participants being male. The mean age of the overall sample was 66 ± 11 years with a range of 31 to 95 years. We enrolled 265 hypertensive (50%) and 267 non-hypertensive patients (50%), with the groups differing on multiple characteristics. The hypertensive patients were significantly older than non-hypertensive patients, consisted of more women and they had a higher prevalence of a history of diabetes, angina pectoris, MI and atrial fibrillation, **Table 1.**

Symptoms

Bivariate comparison of symptom presentation and interpretation between hypertensive vs. non-hypertensive patients is presented in

Table 2. Hypertensive patients were less likely to experience pain/discomfort in the chest compared to non-hypertensive patients (86% vs. 92%, $p < .05$), but were more likely to experience pain/discomfort in the back (19% vs. 13%, $p < .05$). However, given the differences in background characteristics we performed a multiple logistic regression analysis adjusting for age and gender. After the adjustment, the differences were no longer statistical significant. No other differences in symptoms between groups were found. The patients experienced a symptom burden of 5.3 ± 2.5 symptoms. The majority of the overall sample described the characteristics of their pain as pressing (40%), grinding (16%), or squeezing (13%) with no significant differences between the two groups.

With no difference between the two groups more than a third expressed symptoms as weakness (40%), nausea (34%), tiredness (34%) and shortness of breath (32%). One fourth of the sample described pre-syncope (26%). The pain was rated as 6.8 ± 2.0 on a 0 - 10 point numeric rating scale (hypertensive 6.8 ± 2.1 vs. non-hypertensive patients 6.9 ± 1.9, $p = .038$). The most common description of the pain/discomfort experienced was uncomfortable (56%), worrying (43%) or tiresome (21%) feeling, with no significant differences between the two groups.

In total, 67% of the whole group interpreted the symptoms as originating from the heart with no significant differences between the two groups. Still with no significant statistical differences, the most common non-cardiac interpretation (n = 175) was that symptoms originated from the stomach (31%), muscles (31%) or lungs (22%), Figure 1. Of those believing the symptoms were not heart related, the hypertensive group was more convinced that the symptoms were not originating from the heart compared to the non-hypertensive group (57% vs. 36%, respectively, $p < .01$).

Table 1: Background characteristics for the total study group, and comparisons between the hypertensive and non-hypertensive group

Background Characteristics	Total group N = 532 %	Hypertensive group n = 265 %	Non-Hypertensive group n = 267 %	*p*-value
Demographics				
Mean age (years) ‡	66 ± 11	67 ± 11	64 ± 11	< .01
Gender, men	76.3	70.9	81.6	< .01
Marital status				
Single	22.9	24.2	21.9	.40
Educational level				
Compulsory school †	43.1	43.8	42.1	.26
Smoking habits				
Smoker	23.6	18.2	29.1	< .01
Clinical history				
Diabetes mellitus	14.0	24.5	3.4	< .001
Angina pectoris	13.4	21.2	5.7	< .001
Myocardial infarction	13.4	18.9	7.9	< .001
Heart failure	2.7	3.9	1.5	.11
Atrial fibrillation	5.0	7.7	2.3	< .01

‡ Data are presented as mean ± standard deviation (SD) † with a total education time ≤ 9 years.

Pre-hospital actions

The majority (71%) answered that they did not hesitate to seek medical care (hypertensive 69% vs. non-hypertensive patients 73%, $p = .36$). The most common reason for not seeking medical care immediately was that they thought the symptoms would disappear (27%), with no significant difference between the two groups (hypertensive 26% vs. non-hypertensive patients 27%, $p = .98$). Few patients, 8%, believed that the situation was not serious and therefore hesitated seeking medical care (hypertensive 8% vs. non-hypertensive patients 9%, $p = .64$). Only 19 patients performed self-care (e.g., medications) before their FMC. Approximately half of the patients (51%) chose to contact the emergency service center [EMS] as their FMC when falling ill, with no significant differences between hypertensive vs. non-hypertensive patients (52% vs. 50%, respectively, $p = .34$). The most common reasons for not contacting the EMS as a first action was "my way was quicker" (34%), "did not consider myself sick enough (28%), and "easier to take a taxi or be driven" (24%).

Symptom onset to First Medical Contact

Information on symptom onset to FMC was available in 445 patients, of those the median pre-hospital delay was 1:09 hours (Q_1 0:30; Q_3 2:51), with 56% delaying >1 hour from symptom-onset-to-FMC. The longest symptom-onset-to-FMC time was 90 hours. Symptom onset to FMC was 12 minutes longer for the hypertensive group compared to the non-hypertensive group; however this median difference was not significant. More specifically, the hypertensive group (*n = 237*) had a median decision time of 1:15 hours (Q_1 0:31; Q_3 3:19) with 59% delaying > 1 hour from symptom onset to FMC, and for the non-hypertensive group (n = 239) the median decision time was 1:03 hours (Q_1 0:30; Q_3 2:30) with 53% delaying > 1 hour

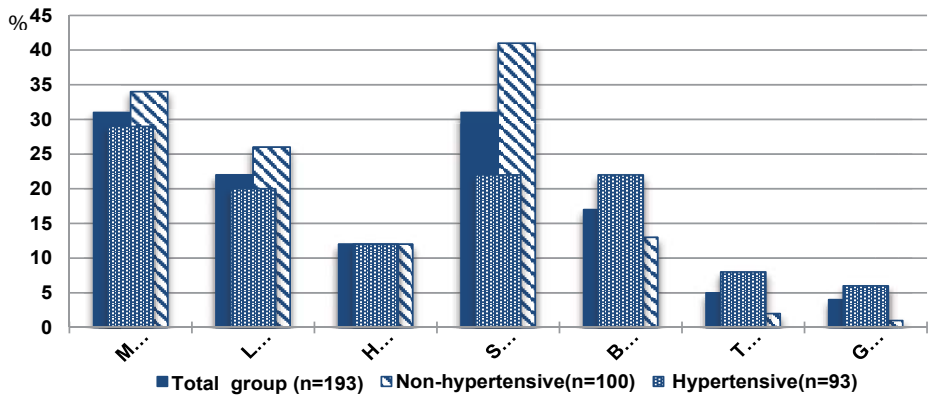

Figure 1: Symptom description when patients did not interpret them as coming from the heart, n = 193. There were no significant statistical differences between the groups.

from symptom onset to FMC (p = .24). In total, 94% of the patients answered that they had previous knowledge - or had heard about - fibrinolysis or primary PCI, with no statistically significant differences between the two groups (hypertensive 96% vs. non-hypertensive patients 92%, p = .11).

Among the hypertensive patients, symptom interpretation, experiencing cold sweat, or being at home when falling ill was the only significant predictors for delay in the regression model. More specifically, believing the symptoms were originating from the heart (OR .476, CI .261-.868, p < .01) and experiencing cold sweat (OR .458, CI .258-.814, p < .01) were associated with shorter delay times, while being at home when falling ill (OR 2.294, CI 1.170-4.117, p < .01) was associated with longer delay times. Among the non-hypertensive patients, educational level was the only significant predictor in the model. More specifically, a lower educational level (i.e., compulsory school) was associated with longer delay times (OR 2.099, CI 1.181-3.732, p < .01), Table 3.

Table 2: Symptom presentations and interpretations for the total study group, and comparisons between the hypertensive and non-hypertensive group.

Symptom presentation				
	Total group N = 532 (%)	Hypertensive group n = 265 (%)	Non-Hypertensive group n = 267 (%)	*p*-value
Pain, discomfort or pressure in the...				
Chest or thorax	88.7	85.7	91.8	<.05
Throat or neck	21.6	20.8	22.5	.67
Jaw or teeth	13.2	15.8	10.5	.07
Back	16.0	19.2	12.7	<.05
Stomach	8.1	7.2	9.0	.52
Shoulder	19.2	22.3	16.1	.08
Arm/hand	55.6	54.0	57.3	.48
left	43.7	45.8	41.7	.60
right	5.5	7.0	4.0	.60
both	50.9	47.2	54.3	.60
Numbness arm/hand	29.5	26.4	32.6	.13
Other symptoms				
Tiredness	33.5	34.7	32.2	.58
Weakness	39.7	40.4	39.0	.79
Shortness of breath	32.1	32.8	31.5	.78
Vertigo/pre-syncope	25.8	27.9	23.6	.28
Nausea	33.6	31.7	35.6	.36
Cold sweat	61.8	60.4	63.3	.53
Anxiety	11.8	12.8	10.9	.50
Fear	20.3	19.2	21.3	.59
General sick feeling	15.6	18.1	13.1	.12
Other	7.0	5.7	8.2	.31
Characteristics of the pain				
Squeezing	12.8	13.3	12.3	.78
Grinding	15.6	15.5	15.7	1.00
Burning	7.1	7.7	6.4	.59
Sharp	3.4	4.7	2.1	.14
Stinging	1.3	0.9	1.7	.68
Afflicting	3.6	3.4	3.8	1.00
Pressing	40.0	40.3	39.6	.92
Sore	2.1	2.6	3.0	.77
Cramping	10.7	9.9	11.5	.65
Diffuse	3.0	2.1	3.8	.42
Symptom burden [a]	5.3 ± 2.5	5.3 ± 2.5	5.3 ± 2.4	.85
Pain intensity, numeric rating scale [a]	6.8 ± 2.0	6.8 ± 2.1	6.9 ± 1.9	.38

Respondents had multiple choice alternatives a) mean and Standard Deviation (SD), the scale range from 0-10

Table 3: Hierarchical logistic regression performed to determine factors associated with pre-hospital delay > 1 hour in hypertensive and non-hypertensive patients separately. Predictors used were socio-demographics, co-morbidities and clinical- and contextual factors. The table presents the final significant model.

Predictors of prehospital delay > 1 hour	**OR**	**95% CI**	***p*-value**
Hypertensive patients, *n = 237*			
Symptoms originating from the heart, yes	.476	.261-.868	< .01
Experiencing cold sweat, yes	.458	.258-814	< .01
Being at home when falling ill, yes	2.294	1.170-4.117	< .01
Non-hypertensive patients, *n = 239*			
Compulsory school, yes	2.099	1.181-3.732	< .01

OR = Odds Ratio, CI = Confidence Interval.

DISCUSSION

In this multicentre study, we found no significant differences in symptom presentation, ambulance utilization, or pre-hospital delay times between hypertensive and non-hypertensive STEMI patients. This implies that other factors than an underlying chronic disease, such as hypertension, may have stronger impact in the pre-hospital phase than age and gender [14-16,21,23], symptom interpretation [6-10] and illness beliefs [24-26].

Even though we did not find any statistical differences in pre-hospital delay times between hypertensive and non-hypertensive patients in our STEMI population, the majority stated that they did not hesitate to seek medical attention immediately. Still, approximately half of the patients delayed more than one hour from symptom onset to their FMC, and though not statistically significant, we found that the hypertensive patients delayed 12 minutes longer compared with the non-hypertensive patients. Additionally, the patients delay time had a non-linear relation; the longer the patients delayed from onset of symptom to their FMC, the gap between the groups increased. Three quarters of the hypertensive group took their FMC within 3:19 hours while the analogous time window for the non-hypertensive patients was 2:30 hours. This is clinically important since every minute counts when it comes to saving heart muscle cells [1-3].

As well as in previous studies [4-8,21], and in clinical practice, we found that the predominant symptom was chest pain in the total group. The bivariate analyses showed that chest pain was less common in the hypertensive group. But when adjusted for age and gender the differences disappeared, which strengthen the fact that those characteristics are more important than the hypertensive diagnosis as such. The majority of the STEMI patients did also experience cold sweat and radiating pain to the arm(s) or hand(s), i.e., they had typical MI symptoms. However, only 67% interpreted the symptoms as originating from the heart, with the hypertensive patients being even more convinced that the symptoms were not heart related. We also found a high symptom burden in both the hypertensive as well as the non-hypertensive patients, describing more than five acute symptoms. Because it is a common misunderstanding that an MI should be presented with severe chest pain solely [6-10] the symptom burden found in our material may contribute to confuse the individual´s illness beliefs and contribute to prolonged patient delay.

These data implies that there is a mismatch in individuals' beliefs, attitudes [24-26] and interpretation of symptoms [6-8,10] when it comes to a pathophysiological understanding of an MI. Despite the known increased risk for cardiovascular disease in hypertensive patients, many hypertensive patients in our sample did not interpret the symptoms as originating from the heart; instead they believed that the symptoms came from the muscles, stomach, or lungs. Basic knowledge about how to decrease the muscle damage of the heart when falling ill in an acute MI was however high in our material, with 94% describing that they had heard about fibrinolysis or primary PCI. This is a promising finding, though an important limitation in the data is that the study did not describe the quality of this knowledge. One could believe that the hypertensive patients should have been even more knowledgeable because of their increased risk of suffering an MI, but our findings cannot support this assumption. However, awareness of MI as a hypertension complication has previously been described to be unsatisfactory recognized by about 85% of the participants in the 2014 Hypertension World day Campaign in Italy [27].

The majority of our patients stated that they took the symptoms seriously, but only half of the patients did contact the EMS as their first priority. The most common reason for not contacting the EMS as a first action was that "my way was quicker" with one third believing so. This statement was followed by that they did not consider themselves sick enough, and that it was easier to take a taxi or be driven. Similar findings were already presented a decade ago [28]. The low ambulance utilization as a first priority, and the reasons for not contacting the EMS found in our study, are still very alarming. This indicates the importance of continuously educating the public about when and why it is advisable and important to call for an ambulance One fifth of our STEMI patients also described fear when falling ill. Fear as a motivating factor has been previously discussed [26], but we did not find any shorter delay times in those experiencing fear.

Healthcare professionals need to better understand the patient's beliefs, feelings and coping strategies from a more in-depth perspective in order to guide the patient in taking a proper action if a recurrent MI occurs. A number of interventions in order to lessen the patients´ time delays and increase their use of ambulance transport have been tested, but with limited effect [29]. Despite these discouraging results, it is crucial to repeat those important efforts. A tailored education based on the patients pre-understanding and health literacy level should highlight the important and crucial facts that the acute risk in worsening the outcome when experiencing an MI is the patient him- or herself, with the acts and choices he or she performs. The patient must be taught that actions on health threat matters. Evidence-based patient education requires knowledgeable healthcare professionals with advanced communication skills and pedagogical competences [30]. Healthcare professionals meet hypertensive as well as non-hypertensive patients in different contexts in the healthcare system and this enables repeatedly face-to-face interventions over a long period of time. Appropriate knowledge in terms of long-time prognosis and the increased risk for coronary artery disease when suffering from hypertension, should be communicated to impact hypertensive patients in their decision making in a possible future MI event where every minute counts to reduce massive destruction of heart muscle cells.

STRENGTHS AND LIMITATIONS

This study offers new insights about symptoms and actions in the pre-hospital phase in patients with hypertension. The strength of this study is underscored by the inclusion of a large number of STEMI patients from five hospitals and from different areas of Sweden, adding to the external validity of our findings. Patients were included within 24 h after admission to hospital and the time limit was chosen to reduce the risk of recall bias. Using a validated questionnaire covering the most important aspects of patient delay was supplemented by a thorough analysis of objectively noted time points in the medical journals, including those from ambulance transports. This study also has several limitations. One limitation is that the questionnaire used is only validated in Swedish which can make it difficult to compare with other studies that have used other instruments. However, this was the only questionnaire available in Swedish at the time for the study. Although we aimed at including patients consecutively, some patients may have been missed due to heavy work load at the department etc. Unfortunately, log books were not kept at every hospital, which makes it difficult to retrospectively control for this. Lastly, this was a cross-sectional study and thus we can only report association rather than infer causation.

CONCLUSION

Hypertensive and non-hypertensive patients did not differ in symptom presentation, ambulance utilization, or pre-hospital delay times when experiencing a STEMI. Chest pain was the predominant symptom, usually in combination with cold sweat and a radiating pain to the arm(s). However, a high symptom burden and a diversity of symptoms might have an impact on symptom interpretation. The majority took the symptoms seriously and stated that they did not hesitate to seek medical attention immediately. Still, only half of the patients did contact the ambulance services as their first priority and delayed more than one hour from symptom onset to their first medical contact. Focusing on educating hypertensive patients as a high-risk population, might be one effective strategy for the early diagnosis of coronary artery disease and prevention of an MI.

Further prospective studies are necessary to investigate the impact of primary preventive education, even though results of previous interventional studies have been limited. Targeting risk groups would be essential when educating in the utilization of the ambulance services and a prompt decision process, when experiencing an acute MI.

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