



# Evaluation of MINOCA syndrome and HEART score in patients presenting to the emergency department with panic attack and chest pain complaints

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## Abstract

**Background** Patients presenting with chest pain may or may not be experiencing a panic attack. Is chest pain caused by a panic attack or myocardial infarction with non-obstructive coronary arteries (MINOCA) syndrome?

**Aim** In this study, we evaluated both MINOCA syndrome and HEART score in patients who presented to the emergency department with panic attacks and chest pain.

**Method** Patients who applied to the emergency department with panic disorder and chest pain complaints were included. Patients who met the MINOCA diagnostic criteria were identified. The study was completed with 143 eligible patients out of a total of 217 patients evaluated. The patients were divided into two groups. The first group was those whose symptoms and test results were consistent with MINOCA. The second group was composed of those whose chest pain was considered non-specific. The HEART score of all patients was calculated. The demographic characteristics, symptoms, and HEART scores were compared between the groups.

**Results** Of the 143 patients evaluated in the study, 62 (43.3%) were male and 81 (56.7%) were female. While the mean HEART score was  $4.7 \pm 1.5$  in the MINOCA group, it was  $2.0 \pm 1.0$  in the non-cardiac group, a statistically significant difference.

**Conclusion** Clinicians should pay attention to the patient's age, gender, number of attacks per week, HEART score, and which symptoms (palpitations, shortness of breath, and fear of death) are present in patients who meet the panic attack diagnostic criteria. Clinicians should be alert to the MINOCA syndrome in panic attack patients.

**Keywords** Cardiac · HEART score · MINOCA syndrome · Panic attack · Symptoms

## Introduction

Panic attacks are bouts of intense fear and anxiety lasting 5–10 min and accompanied by physical symptoms such as chest pain, hyperventilation, and tachycardia. Their prevalence, around 12%, has been increasing in recent years [1]. Panic disorder occurs more frequently in women than in men and is common under the age of 45 [2].

According to The Diagnostic and Statistical Manual of Mental Disorders (DSM-5), a panic attack is characterized by the presence of 4 or more of a total of 13 symptoms (Table 1) [3]. Some of these symptoms are also present in acute coronary syndrome (ACS) [4]. Symptoms such as palpitations, sensations of shortness of breath, sweating, and fear of death should be analyzed thoroughly. Chest pain can be seen in 78% of panic attack patients, while panic attack can be seen in 25% of patients presenting with chest pain [5]. Autonomic activation and hyperventilation that occur during a panic attack can lead to a coronary artery spasm. This situation presents with typical chest pain and myocardial ischemia findings in the clinic.

Myocardial infarction with non-obstructive coronary arteries (MINOCA) is a clinical syndrome whose prevalence is increasing [6]. It is characterized by ischemia finding on an ECG, elevated cardiac enzymes, and normal or < 50%

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**Table 1** DSM-5 criteria for panic disorder and HEART score

Panic attack	DSM-5 criteria	Point
≥ 4 symptoms	Palpitations, pounding heart, or accelerated heart rate	1
	Sweating	1
	Trembling or shaking	1
	Sensations of shortness of breath or smothering	1
	Feeling of choking	1
	Chest pain or discomfort	1
	Nausea or abdominal distress	1
	Feeling dizzy, unsteady, lightheaded, or faint	1
	Derealization (feelings of unreality)	1
	Fear of losing control or “going crazy”	1
	Fear of dying	1
	Paresthesias (numbness or tingling sensation)	1
	Chills or heat sensations	1
	<b>HEART score</b>	<b>Parameters</b>
History	Slightly suspicious	0
	Moderately suspicious	1
	Highly suspicious	2
EKG findings	Normal	0
	Non-specific repolarisation disturbance	1
	Significant ST depression	2
Age	< 45 years	0
	45–64 years	1
	≥ 65 years	2
Risk factors	None	0
	1–2	1
	≥ 3 or history of atherosclerosis	2
Troponin	≥ 3 × normal limit	2
	1–≥ 3 × normal limit	1
	< normal limit	0

occlusion in coronary angiography [7, 8]. Coronary artery spasm is a diagnostic factor or a probable outcome in this syndrome (50–90%) [9]. The HEART score is a scoring system developed to evaluate chest pain in the emergency department. It considers five parameters: age, angina type, electrocardiography (ECG) changes, number of risk factors, and troponin value (Table 1). The total score ranges from 0 to 10. Patients with a HEART score of 0–3 points are considered low, patients with a score from 4–6 are considered moderate, and patients with a score of 7–10 are considered high risk [10].

The relationship between panic attacks and chest pain has not been adequately studied. Is chest pain caused by a panic attack or MINOCA syndrome? In this study, we evaluated both MINOCA syndrome and HEART score in patients who presented to the emergency department with panic attacks and chest pain.

## Method

This study was conducted retrospectively on patients who applied to the emergency department between 1/06/2020 and 31/05/2021 with the approval of the ethics committee. Patients who applied to the emergency department with panic disorder and chest pain complaints were included, i.e., codes ICD F41, R07.3, and R07.4 in the hospital database. Patients who met the MINOCA diagnostic criteria were identified (chest pain, ischemia in ECG and troponin positivity, as well as normal or < 50% occlusion in CAG). All patients who presented to the emergency department with ACS symptoms as specified by the American Heart Association definition (chest/epigastric tightness, burning, a pressure sensation with radiating pain in the neck, jaw, or arms) were evaluated consecutively [11]. Those who were not diagnosed with a panic attack, had no chest pain at

presentation, had other psychosomatic disorders, had chronic diseases, had more than 50% stenosis in coronary angiography (to exclude panic attack due to myocardial infarction), those under 18 years of age, those lacking data, and those with other diagnoses (e.g., sepsis, heart failure, myocarditis, pulmonary embolism) were excluded from the study. The study was completed with 143 eligible patients out of a total of 217 patients evaluated (Fig. 1).

The symptoms of patients presenting with chest pain (hyperventilation, palpitations, sensations of shortness of breath, sweating, chills, abdominal pain, nausea, vomiting, heat sensations, paresthesia, fear of losing oneself, fear of death, derealization, and dizziness), the electrocardiography (ECG) results, cardiac enzymes measured (troponin/CK-MB), the number of attacks, and the results of primary angiography and routine blood tests were recorded. Blood samples for cTnI were collected at baseline (within 0–3 h). Acute coronary syndrome was not considered in patients with chronically high cTnI levels or those with cTnI levels  $< 35$  ng/L.

The patients were divided into two groups. The first group was those whose symptoms and test results were consistent with MINOCA. The second group was composed of those whose chest pain was considered non-specific (normal ECG, troponin in normal range, coronary angiography normal or absent).

The panic attack symptoms of the patients, which are specified in DSM-5, were recorded. The HEART score of all patients was calculated. Each of the raters had clinical experience. Two emergency physicians independently provided DSM-5 panic attack criteria, HEART score for each unique patient. Inter-rater reliability was found to be 100%. The demographic characteristics, symptoms, and HEART scores were compared between the groups. The threshold value of the prognostic markers (HEART score) investigated

in the study was calculated by receiver operating characteristic (ROC) curve analysis.

## Outcomes

### The primary study outcomes

Clinicians should be alert to the possibility of MINOCA syndrome in panic attack patients.

### Secondary outcomes

Clinicians should pay attention to the patient's age, gender, number of attacks per week, HEART score, and which symptoms (palpitations, sensations of shortness of breath, and fear of death) are present in patients who meet the panic attack diagnostic criteria.

## Statistics

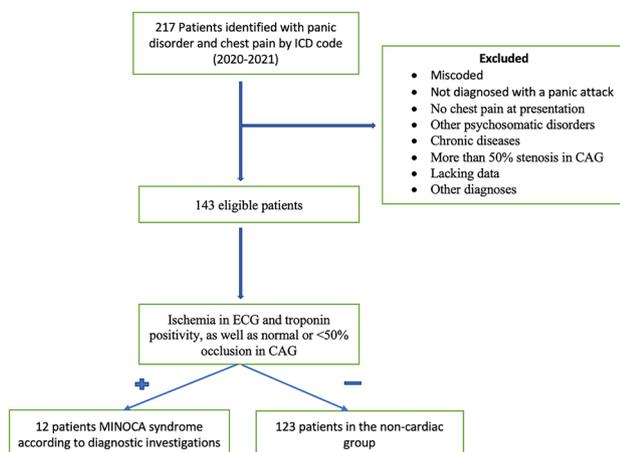
The behavior of quantitative variables was specified using centralization and measures of variance, i.e., mean  $\pm$  standard deviation. Fisher's exact test (where sample size was low) and chi-square tests were used to identify differences in ratios or relationships between categorical variables. The Mann–Whitney *U* test method was used to characterize the behavioral differences of the group averages when the assumptions of normality and homogeneity were met. Statistical significance was determined as  $p < 0.05$  for all cases. Statistical analysis was performed with the IBM SPSS package program (Statistics Package for Social Sciences for Windows, Version 21.0, Armonk, NY, IBM Corporation).

## Sample size determination

The study had between 50.9% and 100% power to produce a significant difference with  $N = 143$  with 0.05 type 1 error, and the mean of power is found as  $93.1 + 17.1$ .

## Results

Of the 143 patients evaluated in the study, 62 (43.3%) were male, and 81 (56.7%) were female. Of the 20 patients in the MINOCA group, 9 (44.4%) were female, and 11 (55.6%) were male, with a mean age of  $54.3 \pm 11.1$  years. Of the 123 patients in the non-cardiac group, 72 (58.5%) were female, and 51 (41.5%) were male, with a mean age of  $44.4 \pm 14.4$  years. The mean age of the patients in the



**Fig. 1** Study selection flow chart

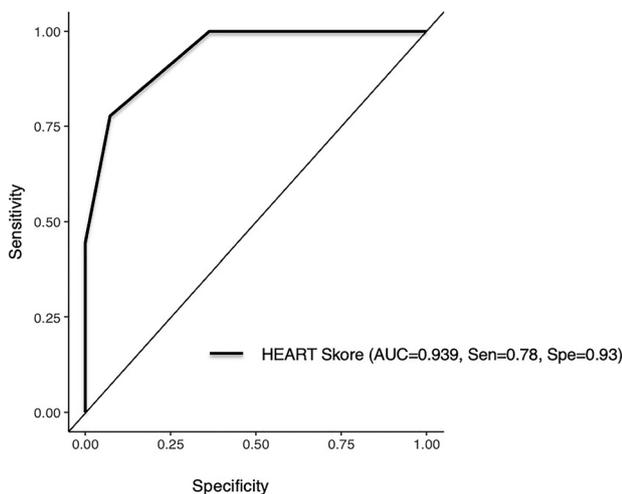
**Table 2** Age, sex, score, and cardiac enzyme comparison

		MINOCA Mean $\pm$ SD	Non-cardiac Mean $\pm$ SD	<i>p</i> value
<b>Gender</b>	Female 81 (56.7)	9 (44.4)	72 (58.5)	0.30**
<b><i>n</i> (%)</b>	Male 62 (43.3)	11 (55.6)	51 (41.5)	
<b>Age</b>	Year (46.9 $\pm$ 14.2)	54.3 $\pm$ 11.1	44.4 $\pm$ 14.4	< 0.01*
<b>HEART</b>	Score	4.7 $\pm$ 1.5	2.0 $\pm$ 1.0	< 0.01*
<b>Troponin</b>	ng/mL	41.9 $\pm$ 41.5	5.0 $\pm$ 8.7	< 0.01*
<b>CK-MB</b>	U/L	14.1 $\pm$ 16.3	3.1 $\pm$ 4.6	< 0.01*

\*Mann–Whitney *U* test

\*\*Pearson chi-squared test

study was 46.9  $\pm$  14.2 years. There was no significant difference between the groups in terms of gender ( $p=0.30$ ), but there was a statistically significant difference in terms of age ( $p<0.01$ ) (Table 2). While the mean HEART score was 4.7  $\pm$  1.5 in the MINOCA group, it was 2.0  $\pm$  1.0 in the non-cardiac group, a statistically significant difference ( $p<0.01$ ) (Table 2). Considering the area covered by the ROC curve, the HEART score is 3.5 in which sensitivity and specificity reached the highest level. AUC=0.939 (95% CI=0.89–0.989) (Fig. 2). There were 4 (20%) patients in the MINOCA group and 92 (74.8%) patients in the other group with a low-risk HEART classification. Ten (50%) patients in the MINOCA group and 22 (17.9%) in the non-cardiac group were classified as intermediate risk. Six patients (30%) in the MINOCA group and 9 patients (7.3%) in the non-cardiac group were classified as high risk ( $p=0.01$ ) (Table 3). The data and statistical results related to the complaints of the patients, as well as the number of attacks that were statistically significant between the groups and their

**Fig. 2** ROC curves for the HEART scores

symptoms (tachycardia, shortness of breath, fear of death), are presented in Table 3.

## Discussion

In this study, 20 (13.9%) of the 143 patients evaluated with panic attack and chest pain complaints were consistent with MINOCA syndrome according to diagnostic investigations evaluated by clinical history, ECG, cardiac enzymes, and coronary angiography. Its prevalence is about 3.5–15% [12]. As with panic attacks, MINOCA syndrome is more common in women and younger people [13]. In our study, women were in the majority in the noncardiac group and men in the MINOCA group (58.5% and 55.6%, respectively). Panic attacks are common between the ages of 25 and 39 [14], while MINOCA syndrome is common between the ages of 18 and 55 [15].

In our study, we found the mean age of all patients to be 46.9  $\pm$  14.2 years, while the mean age in the MINOCA group was 54.3  $\pm$  11.1 years. According to our results, men over 50 years of age with panic attacks and chest pain may be at risk.

In our study, the HEART score calculated in the MINOCA group was 4.7  $\pm$  1.5; this value is classified as medium risk. Some studies have shown the risk of major cardiac events to be 13% when the HEART score is between 4 and 6 [16]. We found that the mean HEART score in the non-cardiac group was 2.0  $\pm$  1.0. This value is low risk. The HEART score was found to be high risk in 30% of the patients in the MINOCA group and only 7.3% of the patients in the noncardiac group ( $p<0.01$ ) (Table 3). A high-risk HEART score in patients who present to emergency services with a panic attack and chest pain should be considered as an indicator of MINOCA syndrome.

The number of panic attacks can vary depending on the severity of the disease. While some individuals are exposed to such a situation once a month, other individuals may experience panic attacks several times a week [17]. In this study, the prevalence of those who had more than one panic attack per week in the MINOCA group was 90% ( $p<0.01$ ).

Clinicians should pay attention to what additional symptoms are present in panic attack patients beyond chest pain. Symptoms such as sweating, tremors, nausea-vomiting, abdominal pain, hot flashes, fear of losing oneself, derealization, and dizziness, which are among the diagnostic criteria of panic attack, were similar between the MINOCA and non-cardiac groups. In our study, patients with tachycardia, shortness of breath, and fear of death were the majority in the MINOCA group ( $p=0.03$ ,  $p=0.01$ ,  $p<0.01$ , respectively). Studies have shown that panic disorder is strongly linked to medical conditions due to its salient somatic symptoms, such as dyspnea, dizziness, numbness, chest pain, and heart palpitations [18]. Panic attacks resulting from heart-focused anxiety may increase the occurrence of angina attacks [19].

**Table 3** HEART risk classification and symptoms

		MINOCA n (%)	Non-cardiac n (%)	p value
<b>HEART risk classification</b>	Mild	4 (20)	92 (74.8)	<b>0.01**</b>
	Moderate	10 (50.0)	22 (17.9)	
	Severe	6 (30)	9 (7.3)	
<b>Hyperventilation</b>	F	6 (27.8)	62 (50.4)	0.15*
	M	14 (72.2)	61 (49.6)	
<b>Number of attacks</b>	< 1 per wk	2 (10)	72 (58.5)	<b>&lt; 0.01**</b>
	1–2 per wk	9 (45)	29 (23.6)	
	> 2 per wk	9 (45)	22 (17.9)	
<b>Recurrent emergency admissions</b>	F	8 (38.9)	43 (34.9)	0.96*
	M	12 (61.1)	80 (65.1)	
<b>Tachycardia</b>	F	5 (22.2)	64 (52)	<b>0.03*</b>
	M	15 (77.8)	59 (48)	
<b>Dyspnea</b>	F	3 (11.1)	60 (48.7)	<b>0.01*</b>
	M	17 (88.9)	63 (51.3)	
<b>Sweating</b>	F	8 (38.9)	62 (50.4)	0.53*
	M	12 (61.1)	61 (49.5)	
<b>Trembling or shaking</b>	F	11 (55.6)	75 (61)	0.84*
	M	9 (44.4)	48 (39)	
<b>Nausea/abdominal pain</b>	F	11 (55.6)	69 (56.1)	1.00*
	M	9 (44.4)	54 (43.9)	
<b>Chills or hot flushes</b>	F	12 (61.1)	88 (71.6)	0.12**
	M	8 (38.9)	35 (28.4)	
<b>Paresthesias</b>	F	15 (77.8)	86 (70)	1.00**
	M	5 (22.2)	37 (30)	
<b>Fear of losing control</b>	F	14 (72.2)	98 (79.7)	0.10**
	M	6 (27.8)	25 (20.3)	
<b>Fear of dying</b>	F	5 (22.2)	93 (75.7)	<b>&lt; 0.01*</b>
	M	15 (77.8)	30 (24.3)	
<b>Derealization</b>	F	18 (94.4)	111 (90.2)	1.00**
	M	2 (5.6)	12 (9.8)	
<b>Feeling dizzy</b>	F	12 (61.1)	73 (59.3)	1.00*
	M	8 (38.9)	50 (40.7)	

\*Pearson chi-squared test

\*\*Fisher exact test

F female, M male, Wk week

Hyperventilation during attacks was dominant in both groups and was not a distinctive symptom ( $p=0.15$ ). Studies on panic attacks and cardiac risk are scarce in the literature; this subject should be investigated further.

## Conclusion

Clinicians should pay attention to the patient's age, gender, number of attacks per week, HEART score, and which symptoms (tachycardia, shortness of breath, and fear of death) are present in patients who meet the panic attack

diagnostic criteria. Clinicians should be alert to the possibility of MINOCA syndrome in panic attack patients.

## Limitation

One of the most important limitations of our study is that patient data were obtained retrospectively. Another important limitation is that data belonging to only one center are included in the study.

All Authors have seen and approved the manuscript being submitted. We warrant that the article is the Authors' original work. We warrant that the article has not received prior

publication and is not under consideration for publication elsewhere. On behalf of all Co-Authors, the corresponding Author shall bear full responsibility for the submission.

**Author contribution** All authors contributed equally to all stages of the research.

## Declarations

**Competing interests** The authors declare no competing interests.

## References

- Chalmers JA, Quintana DS, Abbott MJ et al (2014) Anxiety disorders are associated with reduced heart rate variability: a meta-analysis. *Front Psychiatry* 5:80. <https://doi.org/10.3389/fpsy.2014.00080>
- Koefoed P, Woldbye DP, Hansen TO et al (2010) Gene variations in the cholecystokinin system in patients with panic disorder. *Psychiatr Genet* 20(2):59–64. <https://doi.org/10.1097/YPG.0b013e32833511a8>
- Asmundson GJ, Taylor S, Smits JA (2014) Panic disorder and agoraphobia: an overview and commentary on DSM-5 changes. *Depress Anxiety* 31(6):480–486. <https://doi.org/10.1002/da.22277>
- Perna G, Caldirola D (2017) Management of treatment-resistant panic disorder. *Curr Treat Options Psychiatry* 4(4):371–386. <https://doi.org/10.1007/s40501-017-0128-7>
- Huffman JC, Pollack MH, Theodore A (2002) Panic disorder and chest pain: mechanisms, morbidity, and management. *Prim Care Companion J Clin Psychiatry* 4(2):54–62. <https://doi.org/10.4088/pcc.v04n0203>
- Benamer H, Bouaouina MS, Masri A et al (2019) Vasospastic angina: an under-diagnosed pathology. *Ann Cardiol Angeiol (Paris)* 68(5):341–346. <https://doi.org/10.1016/j.ancard.2019.08.006>
- Pasupathy S, Air T, Dreyer RP et al (2015) Systematic review of patients presenting with suspected myocardial infarction and nonobstructive coronary arteries. *Circulation* 131(10):861–870. <https://doi.org/10.1161/CIRCULATIONAHA.114.011201>
- Agewall S, Beltrame JF, Reynolds HR et al (2017) ESC working group position paper on myocardial infarction with non-obstructive coronary arteries. *Eur Heart J* 38(3):143–153. <https://doi.org/10.1093/eurheartj/ehw149>
- Matta A, Bouisset F, Lhermusier T et al (2020) Coronary artery spasm: new insights. *J Interv Cardiol* 14(2020):5894586. <https://doi.org/10.1155/2020/5894586>
- Backus BE, Six AJ, Kelder JC et al (2013) A prospective validation of the HEART score for chest pain patients at the emergency department. *Int J Cardiol* 168(3):2153–2158. <https://doi.org/10.1016/j.ijcard.2013.01.255>
- Gulati M, Levy PD, Mukherjee D et al (2021) 2021 AHA/ACC/AASE/CHEST/SAEM/SCCT/SCMR Guideline for the evaluation and diagnosis of chest pain: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation* 144(22):368–454. <https://doi.org/10.1161/CIR.0000000000001029>
- Smilowitz NR, Mahajan AM, Roe MT et al (2017) Mortality of myocardial infarction by sex, age, and obstructive coronary artery disease status in the ACTION Registry-GWTG (Acute Coronary Treatment and Intervention Outcomes Network Registry-Get With the Guidelines). *Circ Cardiovasc Qual Outcomes* 10(12):003443. <https://doi.org/10.1161/CIRCOUTCOMES.116.003443>
- Safdar B, Spatz ES, Dreyer RP et al (2018) Presentation, clinical profile, and prognosis of young patients with myocardial infarction with nonobstructive coronary arteries (MINOCA): results from the VIRGO study. *J Am Heart Assoc* 7:009174. <https://doi.org/10.1161/JAHA.118.009174>
- Olaya B, Moneta MV, Miret M et al (2018) Epidemiology of panic attacks, panic disorder and the moderating role of age: Results from a population-based study. *J Affect Disord* 7(13):009174. <https://doi.org/10.1016/j.jad.2018.08.069>
- Kosmas N, Manolis AS, Dargès N et al (2020) Myocardial infarction or acute coronary syndrome with non-obstructive coronary arteries and sudden cardiac death: a missing connection. *Europace* 22(9):1303–1310. <https://doi.org/10.1093/europace/euaa156>
- Sandau KE, Funk M, Auerbach A et al (2017) Update to practice standards for electrocardiographic monitoring in hospital settings: a scientific statement from the American Heart Association. *Circulation* 136(19):273–344. <https://doi.org/10.1161/CIR.0000000000000527>
- Locke AB, Kirst N, Shultz CG (2015) Diagnosis and management of generalized anxiety disorder and panic disorder in adults. *Am Fam Physician* 91(9):617–624
- Allabadi H, Alkaiyat A, Alkhayyat A et al (2019) Depression and anxiety symptoms in cardiac patients: a cross-sectional hospital-based study in a Palestinian population. *BMC Public Health* 19(1):232
- Meuret A, Kroll J, Ritz T (2017) Panic disorder comorbidity with medical conditions and treatment implications. *Annu Rev Clin Psychol* 13(1):209–240

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