Relationship between characters of chest pain and pre-hospital delay in patients with acute myocardial infarction: a multicenter cross-sectional study

Youyang Zhang
Tongji Hospital of Tongji University
Shihao Wu
Tongji Hospital of Tongji University
Jiangqi Pan
Gongli Hospital, Navy Military Medical University
Sophia Hoschar
Helmholtz Zentrum München
Zhen Wang
Nanjing Medical University
Karl-Heinz Ladwig
Helmholtz Zentrum München
Wenlin Ma (mawenlin@tongji.edu.cn)
Tongji Hospital of Tongji University

Research Article

Keywords: pre-hospital delay time, patient decision time, chest pain, persistent, intermittent

Posted Date: March 9th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1417223/v1

Abstract

Objective

Atypical symptoms of patients with acute myocardial infarction (AMI) are associated with more delays in care-seeking. Still, patients with typical chest pain have not received enough attention. This study aimed to investigate the effect of pain characters on pre-hospital delays in AMI patients with chest pain.

Methods

Participants from the Multicenter Delay in Patients Experiencing AMI in Shanghai (MEDEA FAR-EAST) included 257 AMI patients (215 males). The data collection procedure consisted of three parts- basic epidemiological and medical information collection, bedside interview, and self-administered questionnaire. Patients were divided into two groups of persistent (n=171) or intermittent (including fluctuating, n=86) chest pain.

Results

Compared with patients with persistent pain, patients with intermittent pain have longer pre-hospital delay time (PHT) and patient decision time (DT) and DT/PHT, and they had a more positive response when symptoms occur. Further multiple regression analysis showed that intermittent pain was a risk factor for the delay. And in the analysis of different subgroups of chest pain, there was a significant negative correlation between the severity of pain and the impact of pain on daily life and the delay time.

Conclusions

In AMI patients, intermittent chest pain is an independent predictor of longer pre-hospital delays and should be given sufficient attention by patients and medical personnel.

Introduction

It has become a consensus that reperfusion or thrombolytic therapy as soon as possible after acute myocardial infarction (AMI) can reduce mortality and cardiovascular adverse events [1–3]. The total delay time is composed of the in-hospital delay time (“door-to-balloon” times) and the pre-hospital delay time (PHT). Many previous studies have been devoted to reducing in-hospital delays, but the in-hospital mortality rate has hardly improved [4]. In recent years, pre-hospital delay has gradually been taken seriously as the main source of delays, which may have more room for improvement [5]. However, targeted strategies have been implemented in most industrialized countries; data available suggest minimal change in median PHT [6, 7]. How to minimize pre-hospital delays remains a challenge.

The rapid response of patients to chest pain is essential to improve survival. Many previous studies focused on atypical symptoms, which have shown to be related to prolonged delay and poor prognosis in patients with AMI [8–10]. But patients with typical chest pain still have a high rate of delay. A study from Germany showed that the median PHT for AMI patients with no prodromal chest pain reached 217.5 minutes [11].

And Zhang et al. reported that patients with chest pain accounted for 66% of patients with a prehospital delay of more than 2 hours [12]. In addition, chest pain is still the most typical symptom of most AMI patients. Previous studies have reported only about 10–30% of patients with atypical chest pain [13–16].

Therefore, the objectives of our study are: (1) to assess the impact of chest pain characteristics (intermittent or persistent) on pre-hospital delay and patient’s decision delay, (2) to compare the behavioral response of patients with intermittent and continuous chest pain during AMI onset, (3) to evaluate further the relationship between chest pain subgroup classification and delay.

Methods

Study design

The Multicenter Delay in Patients Experiencing AMI in Shanghai (MEDEA FAR-EAST) study was a multicenter cross-sectional study aimed to assess the in-depth barriers contributing to the pre-hospital delay in Chinese AMI patients. The patients were recruited from

four hospitals with coronary care units in Shanghai (Tongji-Hospital, Tenth-Hospital, Yangpu-Hospital, and 455 People's Hospital). The conceptual framework and methods of the MEDEA FAR-EAST study have been described in detail previously [17].

Briefly, the major inclusion criterion was hospitalization with an AMI, which was confirmed by typical symptoms at onset and elevated cardiac biomarkers (troponin I or troponin T) as well as a corresponding ECG-diagnosis. The exclusion criteria were out-of-hospital cardiac arrest, cognitive impairment, and language barriers.

Standardized operation procedures (SOPs) were implemented to avoid reporting bias. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Commission of Tongji-University affiliated Tongji-Hospital (□□-KYSB- 2016-74) and informed consent was taken from all the patients. This approval is applicable to all participating centers.

Samples and Data collection

The study included a total of 257 AMI patients with atypical chest pain from April 2016 to January 2017 in the MEDEA FAR-EAST study. All patient information consisted of a three-part evaluation (a bedside interview conducted by trained study personnel, a self-administered questionnaire by patients, and basic epidemiological and medical information collected from the hospital's patient charts).

Measures

Pre-hospital delay time (PHT) and (patient’s decision delay time) DT

PHT was defined as the time interval between symptom onset and arrival at the hospital door. DT was defined as the elapsed time from symptom onset to seeking medical care or call EMS (emergency medicine service). PHT was composed of DT and transport time. Considering that the characteristics of the chest pain may be related to the choice of transportation, we took PHT as the primary outcome and DT as the secondary outcome. PHT and DT were expressed in minutes.

Asking patients to recall the time point when the acute symptoms began remained a challenge. Therefore, the onset-time was triangulated by trained personnel in the interview [18], using events from the patient’s daily routine to establish the chronology of symptom-onset to minimize recall bias.

Classification of chest pain

Patients were asked to answer whether the chest pain was intermittent or continuous and then were divided into intermittent chest pain group or persistent chest pain group by bedside interviews.

Similarly, patients were assigned to different subgroups based on the bedside interview questionnaire on the severity of pain and the impact on daily life (not at all, a little, medium, strong, very strong).

Psychological measures

Anxiety was assessed with the Generalized Anxiety Disorder scale (GAD-7) composed of 7 items, rated on a 4-point Likert scale ranging from 0-21. GAD-7 score≥10 points indicate anxious patients [19].

Depression was assessed using the Major depression inventory (MDI), which generates DSM-IV and ICD-10 diagnoses by the patients' self-reported symptoms. Depression is defined as at least five symptoms present in the MDI scale, of which at least one must be a “core” symptom (core symptoms including lack of energy, depressed mood, and lack of interest) [20].

Subjective wellbeing was evaluated through the WHO-5, rated on a 6-point Likert scale ranging from 0 to 25. Multiplication by 4 results in a total score of 0 to 100. WHO-5 score ≤ 50 indicates suboptimal well-being [21].

Denial regarding cardiac illness was assessed by the Cardiac Denial of Impact Scale (CDIS), ranging from 8 to 40. A score of ≥25 indicates cardiac denial [22].

The somatic symptom burden was captured by the somatic symptom scale (SSS-8) [23], which comprises 8 items, ranging from 0 to 32. 12 points or more (ranked as “high” and “very high”) was considered higher somatic symptom burden.

Fear of death and stress event were asked to answer “yes” or “no”.

Data analysis

The chi-square test was used to calculate the percentage of baseline characteristics and behavioral response of patients with persistent and intermittent chest pain, which was displayed as n (%). The independent sample t-test was used to calculate two groups of data following normal distribution, which was shown as mean ± SD. A Nonparametric Wilcoxon test was used to calculate the difference of PHT, DT, and DT/PHT among groups, which was shown as median (IQR). Spearman correlation analysis was used to explore the correlation between PHT, DT, and chest pain subgroups. A multiple linear regression model was used to evaluate the relationship between the characteristics of chest pain (persistent pain and intermittent pain) and PHT, DT.

SPSS 23.0 was used for all statistical analysis□p<0.05 was considered statistically significant. The analysis and description in this paper follow the STROBE guidelines for cross-sectional studies [24].

Results

The present study included 257 AMI patients, including 215(83.7%) men and 42(16.3%) women aged between 30 and 90 years (mean age 62.0 years, SD13.2).

Characteristics of participants with persistent and intermittent chest pain

As shown in Table 1, in the included population of our study, there were no statistically significant differences in socio-demographic factors, risk factors, psychological factors, and other symptoms in AMI patients with persistent and intermittent chest pain.

Differences in delay of AMI patients with persistent and intermittent chest pain

The median PHT and DT were 143 (425) minutes and 85(25,386.3) minutes, respectively, and DT accounted for 65.2% of PHT in the total sample. A total of 136(52.9%) patients had a pre-hospital delay of more than 120 minutes (Table 2).

As shown in Table 2, patients with intermittent chest pain are significantly longer than patients with persistent chest pain, in patient delay time, pre-hospital delay and DT/PHT (both p <0.01). We have further drawn the cumulative frequency of delays for the two groups, through which we can more intuitively see the shorter delays for patients with persistent chest pain (Figure 1).

Patients’ behavior responses during AMI

From Table 3, we can see that patients with intermittent chest pain were more likely to “wait for symptoms to pass” (p=0.016) and “tried to relax” (p=0.005) in the acute phase of AMI. However, patients with persistent chest pain were more likely to “called emergency department” (p=0.003). Moreover, there was a trend that patients with intermittent chest pain were more likely to choose public transportation (p=0.060).

The relationship between chest pain and delay in different subgroups

From the results of Spearman correlation analysis, we found that the severity of pain and the impact of pain on daily life were significantly negatively correlated with PHT (r=-0.176, p=0.005; r=-0.163, p=0.009 respectively) and DT (r=-0.225, p□0.001; r=-0.172, p=0.006 respectively) (Table 4).

In the severity of pain subgroup, the PHT of “not at all” was significantly longer than “medium”, “strong” and “very strong”. The difference between groups regarding DT was more significant. The DT of “not at all” and “a little” were both significantly longer than “strong” and “very strong”. PHT and DT showed the same trend in the impact of pain on daily life subgroup (Figure 2, the data was shown in Table S1-4).

Linear regression analysis of characteristics of chest pain and PHT, DT

As shown in Table 5, in the binary linear regression analysis, intermittent chest pain was significantly associated with longer PHT [adjusted R2 = 2.7%, F (1,255) = 8.012, p=0.005] and DT [adjusted R2 = 2.7%, F (1,255) = 8.014, p=0.005] And after adjusting for socio-demographic factors (age and sex), risk factors (STEMI, MI history, diabetes) and psychological factors (anxiety, cardiac denial and fear of death) in the multiple linear regression analysis (model 1-3), the significant differences still exist. Moreover, based on model 3, the

patient's behavioral responses with statistical differences were further adjusted (model 4), we found consistent results - intermittent chest pain was independently associated with longer pre-hospital delay [adjusted R2 = 5.3%, F (12,201) = 1.991, p=0.027] and patient's decision delay [adjusted R2 = 5.3%, F (12,199) = 1.980, p=0.028].

Discussion

To the best of our knowledge, this study is the first study to comprehensively assess the association between the characteristics, severity of chest pain, impact on daily life, and pre-hospital delay in the Chinese population. The significant finding of the present investigation is that intermittent chest pain was associated with longer pre-hospital delay and patient's decision time and was an independent risk factor for a longer delay. Moreover, the lower degree of chest pain and its impact on daily life related to longer PHT and DT.

The overall median PHT in this study was 143 minutes, which was similar to other related studies in the Chinese population [12, 25]. Not surprisingly, patients with intermittent chest pain had significantly longer PHT and DT than those with persistent chest pain. To understand the proportion of DT in the total prehospital delay, we compared the DT/PHT between the two groups. Interestingly, we also found that DT/PHT is greater in patients with intermittent chest pain (79.1 vs 59.9, p = 0.004). This indicated that patient delay time, as the most important part of pre-hospital delay, may have a great controllable improvement in reducing pre-hospital delay.

Although AMI patients with typical chest pain (intermittent or persistent chest pain) have not been the focus of previous studies, we could find evidence to support our results from the limited literature. A cross-sectional study [26] from Australia included 150 patients with undifferentiated, potentially ischemic chest pain, and they found that fluctuating symptoms were positively associated with decision time (p = 0.02). Mumford et al. [27] suggested that patients with crescendo angina have a longer delay. Linda et al. [28] reported that 64.0% of the patients who pre-hospital delayed 1–3 days described their symptoms as intermittent and/or of gradual onset. These studies were consistent with our research results, and our analyses were more in-depth and comprehensive, which may provide more meaningful evidence.

Previous studies have reported socio-demographic factors -age, gender [29–32], clinical symptoms [25, 26], risk factors - STEMI, MI history, diabetes [33, 34], psychological factors – anxiety [35], cardiac denial [36], and fear of death [37] and ambulance transfer [33] have an impact on pre-hospital delay. However, we found no statistical differences in these factors between the two groups of patients with intermittent and persistent chest pain (except for ambulance transfer). Therefore, in our further multiple linear regression analysis, we gradually adjusted these reported influencing factors by different models (Table 5, model 1–3). The results indicated that intermittent chest pain was an independent factor of delay.

To further explore the possible factors affecting the characteristics of chest pain on pre-hospital delay, we compared the behavioral responses of patients with persistent and intermittent chest pain during the onset of myocardial infarction. Patients with intermittent chest pain most likely assumed that their pain would resolve spontaneously or attempted to relieve it by relaxation, reported in previous studies to be associated with longer pre-hospital delays [38, 39]. However, patients with persistent chest pain may have to seek medical help more actively due to more obvious distress. These patients were more likely to choose ambulance transport, which shorten the PHT [40, 41].

Gao et al. [25] investigated 116 AMI patients; the result indicated that patients with pain scores > 6 had significantly shorter PHT than scores ≤ 6. Studies have shown that the intensity of chest pain at onset of symptoms was negatively correlated with patient delay and pre-hospital delays [25, 42]. A patient's subjective feeling of the severity of symptoms has been shown to be an important predictor of delay [42, 43].

In the subgroup classification of chest pain, we divided the severity of chest pain into 5 groups from "not at all" to "very strong" according to the patient's self-report. Through analysis, we obtained similar results as the above study. Ladwig et al. [44] reported that one-third of people believed that heart-attack is always accompanied by severe chest pain. Therefore, we had reason to believe that the delay of these patients was affected by the incorrect understanding of the symptoms of myocardial infarction. Also, the impact of chest pain on daily life was also significantly negatively correlated with PHT and DT. This suggested that the patient's degree of distress by chest pain was partly responsible for the delay.

The advantages of our research were that the participants of the study were recruited from the MEDEA FAR-EAST study, which based on multicenter data and a highly standardized evaluation system during hospital care. In addition, we focused on chest pain and

conducted a more comprehensive and systematic investigation. However, our study has some limitations: 1) All participants were recruited from China, and it has not been determined whether there are ethnic differences in this effect. 2) the PHT and DT were assessed retrospectively, giving room for a recall bias, although the onset-time was triangulated by trained and routinely supervised personnel. 3) Our study did not consider follow-up data. The impact of delay caused by chest pain on the prognosis requires further investigation.

Conclusions

Our research demonstrates that intermittent chest pain is an independent predictor of longer pre-hospital delays when facing an AMI. And patients with more severe distress by chest pain are more likely to have shorter pre-hospital delays. This suggested that the impact of the disease itself on delays in AMI patients with typical chest pain is still not to be ignored, which may provide information for future interventions to reduce delays.

Declarations

Acknowledgments

The authors would like to thank all MEDEA FAR-EAST interviewers for their work and all the patients who participated in the study.

Authors' contributions

Youyang Zhang: Conceptualization, Data Curation, Formal analysis, Writing- Original draft preparation. Shihao Wu: Data Curation, Visualization. Jiangqi Pan: Investigation. Sophia Hoschar: Supervision, Investigation. Zhen Wang: Investigation. Rongxiang Tu: Investigation. Karl-Heinz Ladwig: Writing - Review & Editing, Funding acquisition. Wenlin Ma: Conceptualization，Funding acquisition, Resources.

Funding

This work was supported by the National Key R&D Program of China (2018YFC1314700)，Shanghai Municipal Health Commission Foundation of Shanghai (2019ZB0202，2019SY026), Shanghai Tongji Hospital (ITJ[ZD]1809).

Availability of data and materials

The data that support the findings of this study are available from corresponding author, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of corresponding author.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The Ethics Commission of Tongji-University affiliated Tongji-Hospital approved the study on 16th of March 2016 (Reference Number: ⬜⬜-KYSB- 2016-74). This approval is applicable for all participating centers (Tongji-Hospital, Yangpu-Hospital, Tenth-Hospital and 455 Hospital). All patients with suspected AMI were asked for their permission to be interviewed and had to give written consent. Study participation was voluntary, patients were informed about the procedures of the study and they were assured that refusal would not affect their treatment. When written consent was not possible due to somatic weakness (e.g. poor eyesight), oral consent had to be given and was documented. This was also approved by the Ethics Commission of Tongji-University affiliated Tongji-Hospital.

Consent for publication

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

Author details

[1]Department of Cardiology, Shanghai Tongji Hospital, Tongji University School of Medicine, Shanghai, China. [2]Department of Geriatrics, Shanghai Tongji Hospital, Tongji University School of Medicine, Shanghai, China. [3]Department of Cardiology, Gongli Hospital, Navy Military Medical University, Shanghai, China. [4]Institute of Epidemiology, Mental Health Research Unit, Helmholtz Zentrum München, German Research Center for Environmental Health (HMGU), Ingolstädter Landstr 1, 85764 Neuherberg, Germany. [5]Department of Psychosomatic Medicine and Psychotherapy, Medical Center- University of Freiburg, Faculty of Medicine, Freiburg, Germany. [6]Department of General Practice, Jiangning Hospital, Nanjing Medical University, Jiangsu, China. [7]Department of Psychosomatic Medicine and Psychotherapy, University Hospital Rechts der Isar, Technische Univerität Munich (TUM)

References

1. De Luca G, Suryapranata H, Ottervanger JP, et al. Time delay to treatment and mortality in primary angioplasty for acute myocardial infarction: every minute of delay counts. Circulation 2004;109(10):1223-5. doi: 10.1161/01.CIR.0000121424.76486.20 [published Online First: 2004/03/10]
2. Guerchicoff A, Brener SJ, Maehara A, et al. Impact of delay to reperfusion on reperfusion success, infarct size, and clinical outcomes in patients with ST-segment elevation myocardial infarction: the INFUSE-AMI Trial (INFUSE-Anterior Myocardial Infarction). JACC Cardiovasc Interv 2014;7(7):733-40. doi: 10.1016/j.jcin.2014.01.166 [published Online First: 2014/07/26]
3. Koul S, Andell P, Martinsson A, et al. Delay from first medical contact to primary PCI and all-cause mortality: a nationwide study of patients with ST-elevation myocardial infarction. J Am Heart Assoc 2014;3(2):e000486. doi: 10.1161/JAHA.113.000486 [published Online First: 2014/03/07]
4. Bagai A, Dangas GD, Stone GW, et al. Reperfusion strategies in acute coronary syndromes. Circ Res 2014;114(12):1918-28. doi: 10.1161/CIRCRESAHA.114.302744 [published Online First: 2014/06/07]
5. Luepker RV. Delay in acute myocardial infarction: why don't they come to the hospital more quickly and what can we do to reduce delay? Am Heart J 2005;150(3):368-70. doi: 10.1016/j.ahj.2005.05.012 [published Online First: 2005/09/20]
6. McGinn AP, Rosamond WD, Goff DC, Jr., et al. Trends in prehospital delay time and use of emergency medical services for acute myocardial infarction: experience in 4 US communities from 1987-2000. Am Heart J 2005;150(3):392-400. doi: 10.1016/j.ahj.2005.03.064 [published Online First: 2005/09/20]
7. Gibler WB, Armstrong PW, Ohman EM, et al. Persistence of delays in presentation and treatment for patients with acute myocardial infarction: The GUSTO-I and GUSTO-III experience. Ann Emerg Med 2002;39(2):123-30. doi: 10.1067/mem.2002.121402 [published Online First: 2002/02/02]
8. Canto JG, Shlipak MG, Rogers WJ, et al. Prevalence, clinical characteristics, and mortality among patients with myocardial infarction presenting without chest pain. JAMA 2000;283(24):3223-9. doi: 10.1001/jama.283.24.3223 [published Online First: 2000/06/24]
9. Chau PH, Moe G, Lee SY, et al. Low level of knowledge of heart attack symptoms and inappropriate anticipated treatment-seeking behaviour among older Chinese: a cross-sectional survey. J Epidemiol Community Health 2018;72(7):645-52. doi: 10.1136/jech-2017-210157 [published Online First: 2018/03/28]
10. Lee JW, Moon JS, Kang DR, et al. Clinical Impact of Atypical Chest Pain and Diabetes Mellitus in Patients with Acute Myocardial Infarction from Prospective KAMIR-NIH Registry. J Clin Med 2020;9(2) doi: 10.3390/jcm9020505 [published Online First: 2020/02/16]
11. von Eisenhart Rothe AF, Albarqouni L, Gartner C, et al. Sex specific impact of prodromal chest pain on pre-hospital delay time during an acute myocardial infarction: Findings from the multicenter MEDEA Study with 619 STEMI patients. Int J Cardiol 2015;201:581-6. doi: 10.1016/j.ijcard.2015.01.067 [published Online First: 2015/09/04]
12. Zhang B, Zhang W, Huang R, et al. Gender and Age Differences Associated With Prehospital Delay in Chinese Patients Presenting With ST-Elevation Myocardial Infarction. J Cardiovasc Nurs 2016;31(2):142-50. doi: 10.1097/JCN.0000000000000219 [published Online First: 2014/11/25]
13. Bjorck L, Nielsen S, Jernberg T, et al. Absence of chest pain and long-term mortality in patients with acute myocardial infarction. Open Heart 2018;5(2):e000909. doi: 10.1136/openhrt-2018-000909 [published Online First: 2018/12/20]
14. Song CX, Fu R, Yang JG, et al. Angiographic characteristics and in-hospital mortality among patients with ST-segment elevation myocardial infarction presenting without typical chest pain: an analysis of China Acute Myocardial Infarction registry. Chin Med J (Engl) 2019;132(19):2286-91. doi: 10.1097/CM9.0000000000000432 [published Online First: 2019/10/01]

15. Tisminetzky M, Gurwitz JH, Miozzo R, et al. Age Differences in the Chief Complaint Associated With a First Acute Myocardial Infarction and Patient's Care-Seeking Behavior. Am J Med 2020;133(9):e501-e07. doi: 10.1016/j.amjmed.2020.02.018 [published Online First: 2020/03/23]
16. Brieger D, Eagle KA, Goodman SG, et al. Acute coronary syndromes without chest pain, an underdiagnosed and undertreated high-risk group: insights from the Global Registry of Acute Coronary Events. Chest 2004;126(2):461-9. doi: 10.1378/chest.126.2.461 [published Online First: 2004/08/11]
17. Hoschar S, Pan J, Wang Z, et al. The MEDEA FAR-EAST Study: Conceptual framework, methods and first findings of a multicenter cross-sectional observational study. BMC Emerg Med 2019;19(1):31. doi: 10.1186/s12873-019-0240-7 [published Online First: 2019/05/03]
18. Moser DK, McKinley S, Dracup K, et al. Gender differences in reasons patients delay in seeking treatment for acute myocardial infarction symptoms. Patient Educ Couns 2005;56(1):45-54. doi: 10.1016/j.pec.2003.11.011 [published Online First: 2004/12/14]
19. Spitzer RL, Kroenke K, Williams JB, et al. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med 2006;166(10):1092-7. doi: 10.1001/archinte.166.10.1092 [published Online First: 2006/05/24]
20. Bech P, Rasmussen NA, Olsen LR, et al. The sensitivity and specificity of the Major Depression Inventory, using the Present State Examination as the index of diagnostic validity. J Affect Disord 2001;66(2-3):159-64. doi: 10.1016/s0165-0327(00)00309-8 [published Online First: 2001/10/02]
21. Topp CW, Ostergaard SD, Sondergaard S, et al. The WHO-5 Well-Being Index: a systematic review of the literature. Psychother Psychosom 2015;84(3):167-76. doi: 10.1159/000376585 [published Online First: 2015/04/04]
22. Fowers BJ. The cardiac denial of impact scale: a brief, self-report research measure. J Psychosom Res 1992;36(5):469-75. doi: 10.1016/0022-3999(92)90007-o [published Online First: 1992/07/01]
23. Gierk B, Kohlmann S, Kroenke K, et al. The somatic symptom scale-8 (SSS-8): a brief measure of somatic symptom burden. JAMA Intern Med 2014;174(3):399-407. doi: 10.1001/jamainternmed.2013.12179 [published Online First: 2013/11/28]
24. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. Int J Surg 2014;12(12):1495-9. doi: 10.1016/j.ijsu.2014.07.013 [published Online First: 2014/07/22]
25. Gao Y, Zhang HJ. The effect of symptoms on prehospital delay time in patients with acute myocardial infarction. J Int Med Res 2013;41(5):1724-31. doi: 10.1177/0300060513488511 [published Online First: 2013/08/09]
26. Taylor DM, Garewal D, Carter M, et al. Factors that impact upon the time to hospital presentation following the onset of chest pain. Emerg Med Australas 2005;17(3):204-11. doi: 10.1111/j.1742-6723.2005.00724.x [published Online First: 2005/06/15]
27. Mumford AD, Warr KV, Owen SJ, et al. Delays by patients in seeking treatment for acute chest pain: implications for achieving earlier thrombolysis. Postgrad Med J 1999;75(880):90-5. doi: 10.1136/pgmj.75.880.90 [published Online First: 1999/08/17]
28. Coventry LL, Bremner AP, Williams TA, et al. The effect of presenting symptoms and patient characteristics on prehospital delay in MI patients presenting to emergency department by ambulance: a cohort study. Heart Lung Circ 2015;24(10):943-50. doi: 10.1016/j.hlc.2015.02.026 [published Online First: 2015/04/30]
29. Wang X, Hsu LL. Treatment-seeking delays in patients with acute myocardial infarction and use of the emergency medical service. J Int Med Res 2013;41(1):231-8. doi: 10.1177/0300060512474567 [published Online First: 2013/04/10]
30. Sheifer SE, Rathore SS, Gersh BJ, et al. Time to presentation with acute myocardial infarction in the elderly: associations with race, sex, and socioeconomic characteristics. Circulation 2000;102(14):1651-6. doi: 10.1161/01.cir.102.14.1651 [published Online First: 2000/10/04]
31. Nguyen HL, Saczynski JS, Gore JM, et al. Age and sex differences in duration of prehospital delay in patients with acute myocardial infarction: a systematic review. Circ Cardiovasc Qual Outcomes 2010;3(1):82-92. doi: 10.1161/CIRCOUTCOMES.109.884361 [published Online First: 2010/02/04]
32. Ladwig KH, Meisinger C, Hymer H, et al. Sex and age specific time patterns and long term time trends of pre-hospital delay of patients presenting with acute ST-segment elevation myocardial infarction. Int J Cardiol 2011;152(3):350-5. doi: 10.1016/j.ijcard.2010.08.003 [published Online First: 2010/09/04]
33. Mirzaei S, Steffen A, Vuckovic K, et al. The association between symptom onset characteristics and prehospital delay in women and men with acute coronary syndrome. Eur J Cardiovasc Nurs 2020;19(2):142-54. doi: 10.1177/1474515119871734 [published Online First: 2019/09/13]

34. Angerud KH, Thylen I, Sederholm Lawesson S, et al. Symptoms and delay times during myocardial infarction in 694 patients with and without diabetes; an explorative cross-sectional study. BMC Cardiovasc Disord 2016;16(1):108. doi: 10.1186/s12872-016-0282-7 [published Online First: 2016/07/09]
35. Fang XY, Spieler D, Albarqouni L, et al. Impact of generalized anxiety disorder (GAD) on prehospital delay of acute myocardial infarction patients. Findings from the multicenter MEDEA study. Clin Res Cardiol 2018;107(6):471-78. doi: 10.1007/s00392-018-1208-4 [published Online First: 2018/02/01]
36. Fang XY, Albarqouni L, von Eisenhart Rothe AF, et al. Is denial a maladaptive coping mechanism which prolongs pre-hospital delay in patients with ST-segment elevation myocardial infarction? J Psychosom Res 2016;91:68-74. doi: 10.1016/j.jpsychores.2016.10.008 [published Online First: 2016/11/30]
37. Albarqouni L, von Eisenhart Rothe A, Ronel J, et al. Frequency and covariates of fear of death during myocardial infarction and its impact on prehospital delay: findings from the multicentre MEDEA Study. Clin Res Cardiol 2016;105(2):135-44. doi: 10.1007/s00392-015-0895-3 [published Online First: 2015/07/27]
38. Khraim FM, Scherer YK, Dorn JM, et al. Predictors of decision delay to seeking health care among Jordanians with acute myocardial infarction. J Nurs Scholarsh 2009;41(3):260-7. doi: 10.1111/j.1547-5069.2009.01287.x [published Online First: 2009/09/03]
39. Noureddine S. Patterns of responses to cardiac events over time. J Cardiovasc Nurs 2009;24(5):390-7. doi: 10.1097/JCN.0b013e3181ae4f0e [published Online First: 2009/08/27]
40. Boothroyd LJ, Lambert LJ, Segal E, et al. Comparison of outcomes of ambulance users and nonusers in ST elevation myocardial infarction. Am J Cardiol 2014;114(9):1289-94. doi: 10.1016/j.amjcard.2014.07.060 [published Online First: 2014/09/10]
41. McKinley S, Aitken LM, Marshall AP, et al. Delays in presentation with acute coronary syndrome in people with coronary artery disease in Australia and New Zealand. Emerg Med Australas 2011;23(2):153-61. doi: 10.1111/j.1742-6723.2011.01385.x [published Online First: 2011/04/15]
42. Granot M, Dagul P, Darawsha W, et al. Pain modulation efficiency delays seeking medical help in patients with acute myocardial infarction. Pain 2015;156(1):192-8. doi: 10.1016/j.pain.0000000000000020 [published Online First: 2015/01/20]
43. Johansson I, Stromberg A, Swahn E. Factors related to delay times in patients with suspected acute myocardial infarction. Heart Lung 2004;33(5):291-300. doi: 10.1016/j.hrtlng.2004.04.002 [published Online First: 2004/09/30]
44. Albarqouni L, Smenes K, Meinertz T, et al. Patients' knowledge about symptoms and adequate behaviour during acute myocardial infarction and its impact on delay time: Findings from the multicentre MEDEA Study. Patient Educ Couns 2016;99(11):1845-51. doi: 10.1016/j.pec.2016.06.007 [published Online First: 2016/10/19]

Tables

Table 1. Sociodemographic and clinical characteristics of the study population stratified by persistent and intermittent chest pain.

	AMI patients with chest pain (n=257)			*p* value
	Missing (n)	Persistent	Intermittent	Overall
All patients		171(66.5%)	86(33.2%)	
Socio-demographic factors				
Age(year)	-	61.4±12.7	63.5±14.1	0.244
Sex (Female)	-	27(15.8%)	15(17.4%)	0.735
Sex (Male)	-	144(84.2%)	71(82.6%)	
Employed	-	65(38.0%)	33(38.4%)	0.955
Living alone	-	9(5.3%)	5(5.8%)	0.854
Lower educational level	-	87(50.9%)	43(50.0%)	0.894
Risk factors				
STEMI	-	105(61.4%)	46(53.5%)	0.224
LEVF<55%	4	61(36.5%)	23(26.7%)	0.118
Re-MI	-	14(8.2%)	9(10.5%)	0.546
Obesity	4	12(7.1%)	10(11.8%)	0.218
Hypertension	-	100(58.5%)	54(62.8%)	0.506
Hypercholesterolemia	4	45(26.8%)	22(25.9%)	0.878
Diabetes	-	62(36.3%)	25(29.1%)	0.251
smoking	-	79(46.2%)	37(43.0%)	0.629
Other symptoms				
Vomiting	-	51(29.8%)	24(27.9%)	0.750
Nausea	-	60(35.1%)	30(34.9%)	0.974
Apnea	-	58(33.9%)	30(34,.9%)	0.878
sweating	1	121(71.2%)	55(64.0%)	0.239
Feeling of dying	-	42(24.6%)	17(19.8%)	0.389
Dizziness	-	35(20.5%)	21(24.4%)	0.469
Fainting	1	18(10.6%)	8(9.3%)	0.748
Heartburn	-	22(12.9%)	12(14.0%)	0.808
Stomachache	-	16(9.4%)	12(14.0%)	0.264
Racing heart	-	39(22.8%)	17(19.8%)	0.578
None	1	17(9.9%)	13(15.3%)	0.210
Psychological factors				
Anxiety	31	20(13.2%)	9(12.0%)	0.792
Depression	31	15(10.1%)	9(11.7%)	0.708
Suboptimal wellbeing	54	30(22.4%)	12(17.4%)	0.405
Cardiac denial	33	86(57.7%)	45(60.0%)	0.744
Higher somatic symptom burden	41	25(17.2%)	12(16.9%)	0.950
Fear of death	10	33(20.1%)	16(19.3%)	0.875

Stress event	1	120(70.6%)	68(79.1%)	0.147

Data were shown as n (%), except age, shown as mean ± SD. MI: myocardial infarction; STEMI: ST-segment elevation myocardial infarction; LEVF: left ventricular ejection fraction. Low educational level is defined as junior high school and below.

Table2. Comparison of delays in patients with intermittent and persistent chest pain.

	Number	Total	Persistent pain	Intermittent pain	*p* value
PHT (min)	257	143.0(425.0)	110.0(278.0)	248.5(724.0)	**0.001**
PHT 120min	257	136(52.9%)	79(46.2%)	57(66.3%)	**0.001**
DT (min)	254	85.0(343.3)	60.0(276.3)	185(713.8)	**0.001**
DT 60min	254	137(53.9%)	80(41.7%)	57(67.9%)	**0.002**
DT/PHT (%)	254	65.2(55.7)	59.9(57.0)	79.1(46.1)	**0.004**

Bold significant *p* values at 0.05 level.

Table3. Behavioral response of patients with intermittent and persistent chest pain during the onset of AMI.

	AMI patients with chest discomfort (n=256)		*p* value
	Persistent	Intermittent	Overall
All patients	170(66.4%	86(33.6%)	
Wait for symptoms to pass	92(54.1%)	60(69.8%)	**0.016**
Tried to relax	69(40.6%)	51(59.3%)	**0.005**
Continuing activity	17(10.0%)	9(10.5%)	0.907
Called someone	24(14.1%)	8(9.3%)	0.271
Told someone nearby	102(60.0%)	54(62.8%)	0.666
Tried to help him/herself	28(16.5%)	14(16.3%)	0.969
Took medication	49(28.2%)	23(26.7%)	0.727
Called emergency department	48(28.2%)	10(11.6%)	**0.003**
Is driven/drives to the hospital	38(22.4%)	16(18.8%)	0.516
Public transportation	94(55.3%)	58(67.4%)	0.060

Bold significant *p* values at 0.05 level.

Table4. The correlation between different chest pain subgroups and PHT, DT in AMI patients.

	PHT		DT	
	r	p	r	p
The severity of the pain	-0.176	**0.005**	-0.225	**0.001**
The impact of pain on daily life	-0.163	**0.009**	-0.172	**0.006**

Bold significant *p* values at 0.05 level.

Table5. Linear regression analysis of the chest pain characteristics (intermittent chest pain) and PHT, DT in different models.

	dependent variable											
	PHT						DT					
	R^2	Adjusted R^2	B	SE	β	*p*	R^2	Adjusted R^2	B	SE	β	*p*
Unadjusted	0.030	0.027	288.56	101.94	0.175	**0.005**	0.031	0.027	288.58	101.94	0.176	**0.005**
Model 1	0.039	0.028	299.68	102.16	0.181	**0.004**	0.042	0.030	299.54	101.97	0.182	**0.004**
Model 2	0.066	0.043	287.43	102.09	0.174	**0.005**	0.068	0.045	289.87	102.17	0.176	**0.005**
Model 3	0.082	0.041	306.50	113.26	0.184	**0.007**	0.085	0.044	303.30	112.42	0.184	**0.008**
Model 4	0.106	0.053	247.34	116.43	0.148	**0.035**	0.107	0.053	251.17	115.54	0.152	**0.031**

Model 1: adjusted for age and sex;

Model 2: adjusted for model 1+ STEMI, MI history, diabetes;

Model 3: adjusted for model 2 + anxiety, cardiac denial and fear of death;

Model 4: adjusted for model 3+ wait for symptoms to pass, tried to relax, called emergency department (patient's behavioral response).

Bold significant *p* values at 0.05 level.

Figures

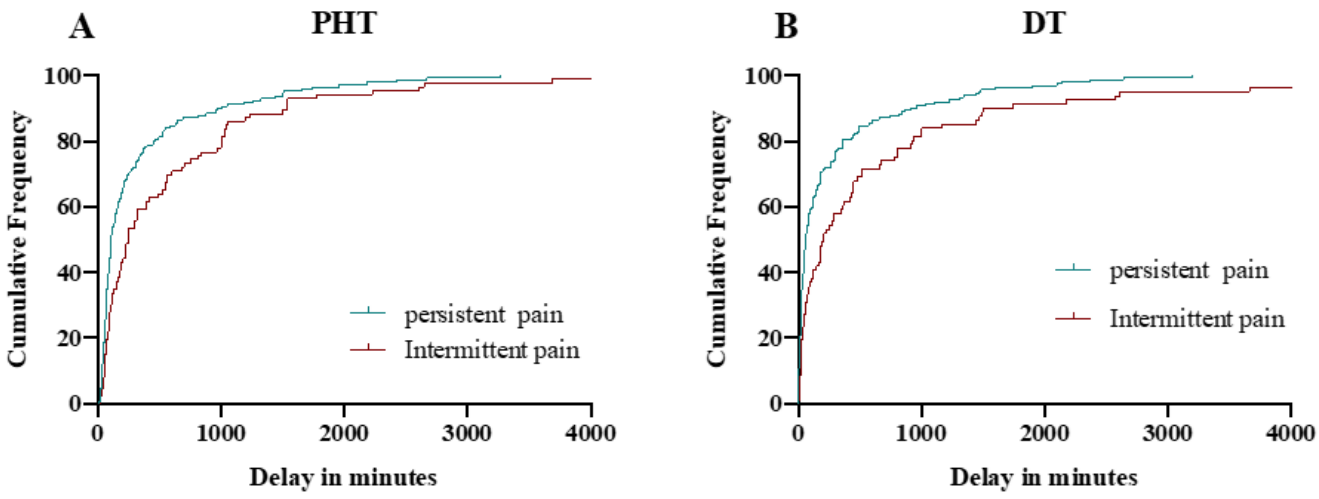

Figure 1

Sum-percent cumulative distribution plot of median PHT (in min) and DT (in min) of AMI patients with intermittent and persistent chest pain.

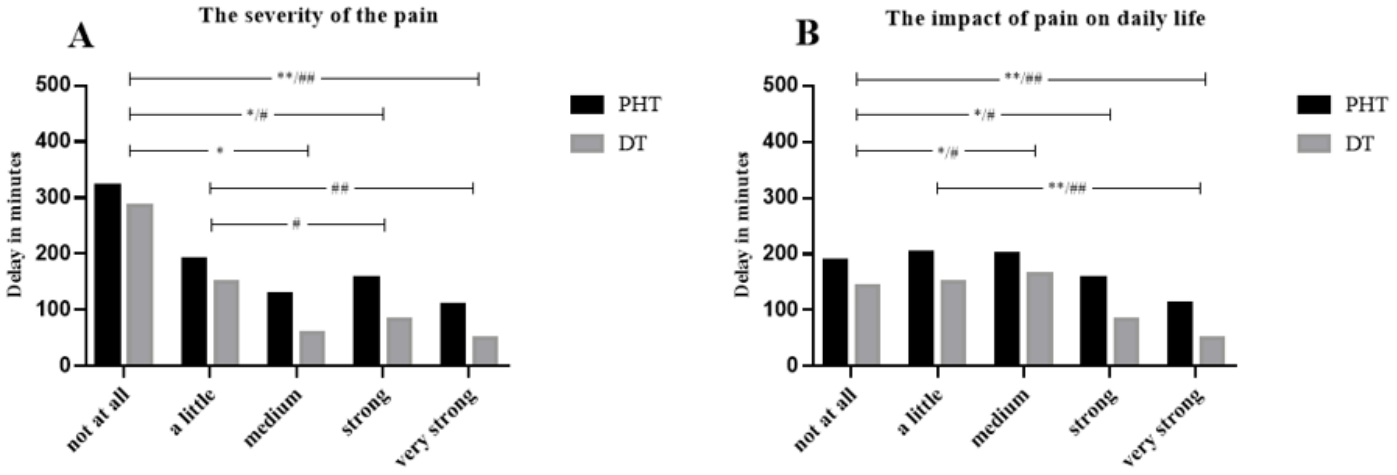

Figure 2

Non-parametric test for comparing PHT and DT in different chest pain subgroups. The punctuation '*' represented p <0.05 in PHT, '**' represented p <0.01 in PHT; '#' represented p <0.05 in DT, '##' represented p <0.01 in DT.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- TableS14.docx