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Comparison of Acute Coronary Syndromes in the Earthquake Zone Before and in the First Month After the Earthquake: A Single-Center Retrospective Analysis

Deprem Bölgesinde Deprem Öncesi ve Deprem Sonrası İlk Aydaki Akut Koroner Sendromların Karşılaştırılması: Tek Merkezli Retrospektif Bir Analiz

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ABSTRACT

Objective: Earthquakes can significantly impact both the occurrence and the management of acute coronary syndromes (ACS). This study aimed to investigate the effects of an earthquake on patients with ACS by comparing their clinical and angiographic features before and after the event.

Methods: We utilized a retrospective observational cohort design, involving 260 ACS patients who underwent coronary angiography. Data on patient characteristics, clinical variables, and procedural details were extracted from medical records. Statistical analyses were conducted to compare the ACS groups pre- and post-earthquake and to assess outcomes, which included in-hospital mortality and complications.

Results: After the earthquake, the ACS patients were older and predominantly male. The distribution of ACS subtypes remained similar between the groups. The use of anticoagulation before the procedure decreased after the earthquake, while the usage of other medications remained stable. The incidence of non-critical coronary arteries decreased post-earthquake, and there was a higher frequency of non-intervention in this group. Intervention in the left anterior descending coronary artery was more common after the earthquake. In-hospital mortality was associated with post-earthquake ACS, certain ACS subtypes, shock at admission, bifurcation stenting, and the no-reflow phenomenon. Complete revascularization was found to reduce mortality. The duration of intensive care unit stays was longer before the earthquake, while in-hospital mortality was higher after the earthquake. Gender differences were observed in coronary ectasia, with females being more affected post-earthquake.

Conclusion: Earthquakes significantly influence the clinical and angiographic features of ACS cases, thereby affecting mortality rates and revascularization outcomes.

Keywords: Acute coronary syndrome, earthquake, coronary angiography, clinical features

ÖZET

Amaç: Depremler, akut koroner sendromların (AKS) görülme sıklığını ve yönetimini önemli ölçüde etkileyebilir. Bu çalışmada AKS'li hastaların klinik ve anjiyografik özellikleri üzerine depremin etkilerinin incelenmesi amaçlandı. Bunun için deprem öncesi ve sonrasındaki AKS vakalarının klinik ve anjiyografik özelliklerini karşılaştıran bir geriye dönük gözlemsel kohort tasarımı kullanıldı.

Yöntem: Bu çalışmada koroner anjiyografi yapılan 260 AKS hastasını içeren retrospektif gözlemsel kohort tasarımı kullanıldı. Hasta özellikleri, klinik değişkenler ve prosedür ayrıntıları tıbbi kayıtlardan çıkarıldı. İstatistiksel analizler, hastane içi mortalite ve komplikasyonlar gibi sonuçları değerlendirerek deprem öncesi ve sonrası ACS gruplarını karşılaştırdı.

Bulgular: Deprem sonrasında AKS hastaları daha yaşlı ve çoğunlukla erkek cinsiyetteydi. AKS alt tiplerinin dağılımı gruplar arasında benzer kaldı. İşlem öncesi antikoagülan kullanımı deprem sonrasında azaldı, diğer ilaç kullanımları ise benzerdi. Deprem sonrası non-kritik koroner arter insidansı daha azdı ve bu grupta invaziv girişim daha az yapıldı. Sol ön inen koroner arter müdahalesi deprem sonrasında daha sık görüldü. Hastane içi ölüm, deprem sonrası AKS, belirli AKS alt tipleri, başlangıçta şok hali, bifurkasyon stentlemesi ve no-reflow fenomeni ile ilişkiliydi. Tam revaskülarizasyonun mortaliteyi azalttığı görüldü. Yoğun bakım ünitesi süresi deprem öncesi daha uzundu, ancak hastanede ölüm deprem sonrasında daha yüksekti. Koroner ektazi deprem sonrası kadın hastalarda daha sık izlendi.

Sonuçlar: Depremler, AKS vakalarının klinik ve anjiyografik özelliklerine etkilerinin yanısıra mortalite oranları ve revaskülarizasyon sonuçlarını da etkiler.

Anahtar Kelimeler: Akut koroner sendrom, deprem, koroner anjiyografi, klinik özellikler

ORIGINAL ARTICLE
KLİNİK ÇALIŞMA

Fuat Polat[1]
Ünal Öztürk[2]

[1]*Department of Cardiology, Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital, İstanbul, Türkiye*
[2]*Department of Cardiology, Kahramanmaraş Sütçü Imam University, Kahramanmaraş, Türkiye*

Corresponding author:
Fuat Polat
✉ fuatpolatsfl@gmail.com

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Natural disasters, including earthquakes, can have substantial impacts on both the occurrence and the management of acute coronary syndromes (ACS).[1] Emotional and physical stressors, ranging from anger, anxiety, and work-related stress to seismic events, war, sexual activity, hyperthermia, infections, and cocaine usage, have all been identified as contributors to plaque rupture.[2] Elevated blood pressure, compromised health, property damage, and the loss of loved ones can further burden patients who are already vulnerable. Research has consistently shown that earthquakes elevate the incidence of ACS during and after such events.[3-5] Additionally, post-traumatic stress disorder (PTSD) following earthquakes has been associated with increased occurrences of death, acute myocardial infarction, stroke, and heart failure.[6] Earthquakes are also linked to the rupture of vulnerable plaques, increased likelihood of ventricular tachyarrhythmias, and heightened rates of hospitalization related to implantable cardiac defibrillators.[2,7] Hence, understanding the post-earthquake changes in ACS incidence and manifestation is crucial. These observations highlight the potential variability in ACS occurrence and presentation following earthquakes, depending on factors such as earthquake severity, geographical location, and the demographic composition of the affected population.

This study was conducted to assess the impact of an earthquake on patients with ACS in the affected region. The primary objective was to compare the clinical and angiographic characteristics of ACS patients before and after the earthquake. In doing so, we aimed to ascertain whether the earthquake had a significant influence on the presentation, severity, and management of ACS cases.

Materials and Methods

The study adopted a retrospective observational cohort approach to investigate the ramifications of an earthquake on ACS patients who had undergone coronary angiography. Conducted in Kahramanmaraş, the city located at the epicenter of the earthquake, the site was chosen due to its designation as the government's earthquake center. This location provided a unique opportunity to study the effects of an earthquake on patients with acute coronary syndromes in an area significantly impacted by seismic activity. The study cohort comprised a total of 260 patients diagnosed with ACS and subjected to coronary angiography, divided into two groups for comparison: 130 patients who underwent coronary angiography prior to the earthquake, and 130 who did so afterward.

Patient attributes, clinical variables, and procedural details were meticulously extracted from electronic medical records and patient charts, focusing on variables such as age, gender, ACS subtype (ST-elevation myocardial infarction [STEMI], non-ST-elevation myocardial infarction [NSTEMI], unstable angina pectoris [UAP]), shock at presentation, pre-procedure medication usage (acetylsalicylic acid, P2Y12 inhibitors), anticoagulant utilization (pre-procedure and during the procedure), bail-out Gp2b3a usage, coronary artery status (presence of critical or non-critical lesions), coronary artery disease distribution, coronary interventions (including bifurcation stenting), coronary bypass decisions, complete revascularization, in-hospital mortality, peak troponin level, coronary ectasia, coronary thrombus, the no-reflow phenomenon, and length of stay in the intensive care unit (ICU).

ABBREVIATIONS

ACS	Acute Coronary Syndromes
CI	Confidence Interval
ICU	Intensive Care Unit
LAD	Left Anterior Descending Coronary Artery
NSTEMI	Non-ST-Elevation Myocardial Infarction
OR	Odds Ratio
STEMI	ST-Elevation Myocardial Infarction
UAP	Unstable Angina Pectoris

At our center, the femoral route was the standard for coronary angiography in managing acute coronary syndromes, barring any contraindications. Consequently, all study patients underwent coronary angiography via the femoral route. STEMI was defined based on new ST segment elevations in at least two anatomically contiguous leads, adhering to the following criteria:

- Men aged ≥ 40 years: ≥ 2 mm in V2-V3 and ≥ 1 mm in all other leads.
- Men aged < 40 years: ≥ 2.5 mm in V2-V3 and ≥ 1 mm in all other leads.
- Women (any age): ≥ 1.5 mm in V2-V3 and ≥ 1 mm in all other leads.
- Men and women in V4R and V3R: ≥ 0.5 mm, except for men < 30 years, where the criterion is ≥ 1 mm.
- Men and women in V7-V9: ≥ 0.5 mm.

Non-ST Elevation Acute Coronary Syndrome (NSTE-ACS) was defined for patients exhibiting typical chest pain but lacking ST-segment elevation on the ECG. If troponin levels were elevated, the condition was categorized as NSTEMI. In cases where cardiac troponin levels remained within normal limits, the diagnosis was unstable angina pectoris (UAP).

The definition of coronary artery ectasia involves dilation exceeding one-third of the coronary artery's length, with the diameter of the dilated segment measuring more than 1.5 times the diameter of a normal adjacent segment. No-reflow was characterized as inadequate myocardial perfusion through a given coronary segment in the absence of angiographic evidence of mechanical vessel obstruction. Angiographic no-reflow was defined as less than Thrombolysis In Myocardial Infarction (TIMI) 3 flow. A coronary thrombus was identified as TIMI thrombus grade 1 or higher. Complete revascularization referred to the achievement of optimal blood flow through all relevant coronary vessels via interventions such as angioplasty or stenting.

The inclusion criteria for patients consisted of a diagnosis of ACS, the necessity of undergoing coronary angiography for assessment, receiving treatment at the study site, and the availability of comprehensive medical records and necessary data for analysis. The exclusion criteria were implemented to ensure a focused and homogeneous study population. Exclusions encompassed patients with incomplete or absent medical records, hindering the precise assessment of study variables. Individuals with a history of prior cardiac interventions such as coronary artery

bypass grafting or percutaneous coronary intervention, patients exhibiting significant comorbidities that could confound study outcomes, individuals experiencing ACS due to factors other than coronary artery disease, and those unable to provide informed consent or lacking available legal representatives for consent were also excluded.

The principal outcomes of interest encompassed in-hospital mortality, peak troponin levels, coronary ectasia, coronary thrombus, the no-reflow phenomenon, and ICU length of stay. These outcomes were meticulously evaluated and compared between the pre-earthquake and post-earthquake ACS groups. Moreover, the study delved into the potential impacts of gender on these outcomes within each ACS group.

Ethical principles and guidelines were strictly adhered to during the study, including obtaining the requisite approvals from the Institutional Review Board or Ethics Committee. The study protocol aligned with the ethical principles enshrined in the Declaration of Helsinki. The Ethics Committee of Istanbul Yeni Yüzyıl University sanctioned the study protocol, with approval granted on 03/04/2023, documented as 2023/04-1062. Patient confidentiality and privacy remained inviolate throughout the study, with all data anonymized and securely maintained.

Statistical Analysis

Descriptive statistics were used to summarize patient characteristics and clinical variables. Continuous variables, such as age and ICU length of stay, were presented as mean ± standard deviation. Non-normally distributed continuous variables, like peak troponin level, were presented as mean and interquartile range. Categorical variables, including gender, ACS subtype, and coronary artery distribution, were reported as frequencies and percentages.

For normally distributed continuous variables (e.g., age and ICU length of stay), the independent t-test was utilized. The Mann-Whitney U test was applied to non-normally distributed continuous variables (e.g., peak troponin level). Chi-square tests were used to analyze categorical variables, such as gender, ACS subtype, shock at presentation, anticoagulation usage, bailout Gp2b3a utilization, presence of critical lesions, bifurcation stenting, coronary bypass decisions, and complete revascularization. The significance threshold was set at $p<0.05$.

Univariate and multinomial logistic regression analyses were conducted to assess the relationship between patient attributes and in-hospital mortality. These analyses helped examine the effects of individual variables on mortality and identify potential confounding factors. Odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were calculated. The regression models included variables such as post-earthquake ACS (as a binary variable), STEMI presence, shock at admission, bifurcation stenting, and the no-reflow phenomenon. The pre-earthquake ACS group served as the reference category.

To evaluate the influence of gender on coronary ectasia, coronary thrombus, no-reflow phenomenon, and in-hospital mortality within the pre- and post-earthquake ACS groups, chi-square tests were conducted. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software version 25.0 (SPSS, Inc, Chicago, IL).

Results

A total of 260 patients diagnosed with acute coronary syndrome and subjected to coronary angiography were enrolled in the study—130 prior to the earthquake and 130 subsequent to it. In the post-earthquake ACS cohort, patients were notably older (64.6 ± 13.0 vs. 57.2 ± 13.8, p=0.023), and there was a higher prevalence of male individuals (87 vs. 69, $P < 0.001$). The distribution of ACS subtypes was similar in both groups, with the largest proportion of patients representing non-ST-elevation ACS (48.5% vs. 50%). Although a trend towards increased shock at presentation was evident in the post-earthquake period, this difference did not achieve statistical significance (23.1% vs. 16.2%, $P = 0.16$). Loading doses of pre-procedure acetylsalicylic acid and P2Y12 inhibitors were administered at comparable rates, while anticoagulant use prior to the procedure decreased post-earthquake (64.6% vs. 86.2%, $P < 0.001$). Roughly one-third of the patients received anticoagulation only during the procedure post-earthquake (35.4%). The utilization of bailout Gp2b3a during procedures was similar (75.4% vs. 80%). The incidence of non-critical coronary arteries was reduced in the post-earthquake ACS group compared to the pre-earthquake ACS group (12.3% vs. 25.4%, $P = 0.023$). Nonetheless, the frequency of one or more critical lesions remained consistent between the groups. The distribution of critical lesions across coronary arteries was similar. Although the incidence of non-critical coronary artery cases was lower in the post-earthquake ACS group, patients who did not undergo coronary intervention were more prevalent within this subgroup (36.9% vs. 20.8%). The left anterior descending (LAD) coronary artery constituted the most intervened vessel within both ACS groups, both before and after the earthquake. Notably, intervention of the LAD artery was more frequent post-earthquake (54.6% vs. 33.8%). Although there was a slightly higher incidence of bifurcation stenting in the pre-earthquake group, this difference was not statistically significant (16.2% vs. 10.8%, $P = 0.20$). While coronary bypass decisions remained comparable between the groups, complete revascularization was more prevalent in the pre-earthquake ACS cohort (69.2% vs. 57.7%, $P = 0.05$) (Table 1).

A total of 26 in-hospital mortality cases were recorded. The association between patient characteristics and in-hospital mortality was explored through univariate and multinomial analyses. Post-earthquake ACS, STEMI presentation, shock at admission, bifurcation stenting, and the no-reflow phenomenon were all found to elevate in-hospital mortality risk in both univariate and multinomial logistic regression analyses (for multinomial analysis, $P = 0.043$, $P = 0.044$, $P < 0.001$, respectively). On the contrary, complete revascularization and an increased prehospital anticoagulation rate were identified as factors that decreased in-hospital mortality ($P < 0.001$ and $P = 0.03$, respectively) (Table 2).

The influence of ACS incidence before and after the earthquake on peak troponin levels, coronary ectasia, coronary thrombus, no-reflow phenomenon, ICU duration, and in-hospital mortality was assessed. Peak troponin levels, coronary ectasia, coronary thrombus, and the no-reflow phenomenon showed similar rates between the pre- and post-earthquake ACS groups ($P =$

Table 1. Baseline Clinical Characteristics of Patients with Acute Coronary Syndrome Before and After the Earthquake

Patient Characteristics	All Patients (n = 260)	Post-earthquake ACS (n = 130)	Pre-earthquake ACS (n = 130)	Overall *P*
Age (years)	60.9 ± 13.9	64.6 ± 13.0	57.2 ± 13.8	0.023*
Sex (Male)	156 (60)	87 (66.9)	69 (53.1)	<0.001*
ACS Type				
STEMI	100 (38.5)	51 (39.2)	49 (37.7)	0.96
NSTEMI	128 (49.2)	63 (48.5)	65 (50.0)	0.98
UAP	32 (12.3)	16 (12.3)	16 (12.3)	1.0
Shock at admission	51 (19.6)	30 (23.1)	21 (16.2)	0.16
Prehospital ASA	240 (92.3)	122 (93.8)	118 (90.8)	0.35
Prehospital P2Y12 inhibitor	160 (61.5)	78 (60)	82 (63.1)	0.61
Prehospital anticoagulation	196 (75.4)	84 (64.6)	112 (86.2)	<0.001*
GP IIb/IIIa inhibitors	57 (21.9)	104 (80)	98 (75.4)	0.18
Number of vessels with significant lesions				
0	49 (18.8)	16 (12.3)	33 (25.4)	0.023*
1	87 (33.5)	46 (35.4)	41 (31.5)	0.32
2	67 (25.8)	38 (29.2)	29 (22.3)	0.12
3	49 (18.8)	26 (20.0)	23 (17.7)	0.67
4	8 (3.1)	4 (3.1)	4 (3.1)	1.0
LMCA	12 (4.6)	7 (5.4)	5 (3.8)	0.55
LAD	175 (67.3)	82 (63.1)	93 (71.5)	0.15
CX	96 (36.9)	55 (42.3)	41 (31.5)	0.07
RCA	119 (45.8)	62 (47.7)	57 (43.8)	0.53
Number of treated vessels				
0	75 (28.8)	48 (36.9)	27 (20.8)	0.01*
1	149 (57.3)	69 (53.1)	80 (61.5)	0.03*
2	26 (10.0)	11 (8.5)	15 (11.5)	0.66
3	9 (3.5)	1 (0.8)	8 (6.2)	<0.001*
4	1 (0.4)	1 (0.8)	0 (0.0)	0.52
LMCA	2 (0.8)	2 (1.5)	0 (0.0)	0.50
LAD	115 (44.2)	44 (33.8)	71 (54.6)	0.001*
CX	55 (21.2)	26 (20)	29 (22.3)	0.65
RCA	60 (23.1)	26 (20)	34 (26.2)	0.24
Bifurcation stenting	35 (13.5)	14 (10.8)	21 (16.2)	0.20
CABG	22 (8.5)	11 (8.5)	11 (8.5)	1.0
Complete revascularization	165 (63.5)	75 (57.7)	90 (69.2)	0.50*

*Values are presented as mean ± SD, median (IQR) or n (%), Interquartile range [25% percentile-75% percentile]. ACS, acute coronary syndrome; ASA, Acetylsalicylic acid; CABG, coronary artery bypass graft; CX, circumflex artery; GP, glycoprotein; LAD, left anterior descending artery; LMCA, left main coronary artery; NSTEMI, non-ST segment elevation myocardial infarction; RCA, right coronary artery; STEMI, ST segment elevation myocardial infarction; UAP, unstable angina pectoris.

0.28, $P = 0.26$, $P = 0.11$, $P = 0.29$, respectively). While the pre-earthquake ACS group experienced a longer ICU stay (median 57 vs. 39 hours, $P < 0.001$), the post-earthquake ACS group had a higher frequency of in-hospital mortality (13.8% vs. 6.2%) (Table 3).

Gender-based disparities in coronary ectasia, coronary thrombus, no-reflow phenomenon, and in-hospital mortality within the pre- and post-earthquake ACS groups were investigated. No gender difference emerged within the pre-earthquake ACS group; however, females in the post-earthquake ACS group exhibited a higher prevalence of coronary ectasia ($P = 0.04$). Figure 1 illustrates a graphical representation of the results.

The effects of gender on intensive care unit length of stay and peak troponin levels within the ACS groups before and after the earthquake were compared. No gender-based distinctions were observed concerning intensive care unit length of stay and peak troponin levels in both pre- and post-earthquake ACS groups. Figure 2 provides a box-plot graphical representation of these outcomes.

Table 2. Effect of Patient Characteristics on In-Hospital Mortality: A Univariate and Multinomial Logistic Regression Analysis

Patient Characteristics	Univariate Analysis	Multinomial Analysis		
	P	OR	95% CI	*P*
Earthquake	0.039*	4.95	1.22-17.12	0.043*
Age	0.002*	1.03	0.97-1.09	0.35
Sex	0.80	3.63	0.68-19.28	0.13
ACS Type	0.014*	3.44	1.05-13.19	0.044*
Shock at admission	<0.001*	45.7	11.25-98.55	<0.001*
Bifurcation stenting	0.024*	11.6	1.23-19.09	0.032*
Complete revascularization	<0.001*	0.06	0.01-0.46	0.001*
Coronary ectasia	0.40	0.13	0.01-17.02	0.41
Coronary Thrombus	0.018*	3.26	0.62-17.14	0.16
No-reflow phenomenon	<0.001*	6.13	1.14-32.89	0.04*
Peak troponin	0.87	1.04	0.89-1.20	0.64
ICU duration	0.44	1.07	0.87-1.48	0.06
Prehospital anticoagulation	<0.001	4.38	0.02-0.52	0.03*

ACS, acute coronary syndrome; CI, confidence interval; OR, odds ratio; ICU, intensive care unit.

Table 3. The Impact of the Occurrence of Acute Coronary Syndrome Before or After an Earthquake on Clinical Endpoints

Clinical Endpoints	All Patients (n = 260)	Post-earthquake ACS (n = 130)	Pre-earthquake ACS (n = 130)	Overall *P*
Peak troponin (ng/mL)	1.9(0.47-7.2)	1.9 (0.37-7.2)	1.9 (0.60-7.2)	0.28
Coronary ectasia	21 (8.1)	13 (10.0)	8 (6.2)	0.26
Coronary Thrombus	86 (33.1)	49 (37.7)	37 (28.5)	0.11
No-reflow phenomenon	38 (14.6)	22 (16.9)	16 (12.3)	0.29
ICU duration (day)	2 (1-3)	2 (1-3)	2 (2-4)	<0.001*
In-hospital mortality	26 (10)	18 (13.8)	8 (6.2)	0.039*

*Values are presented as mean ± SD, median (IQR) or n (%), Interquartile range [25% percentile-75% percentile]. ACS, acute coronary syndrome; ICU, intensive care unit.

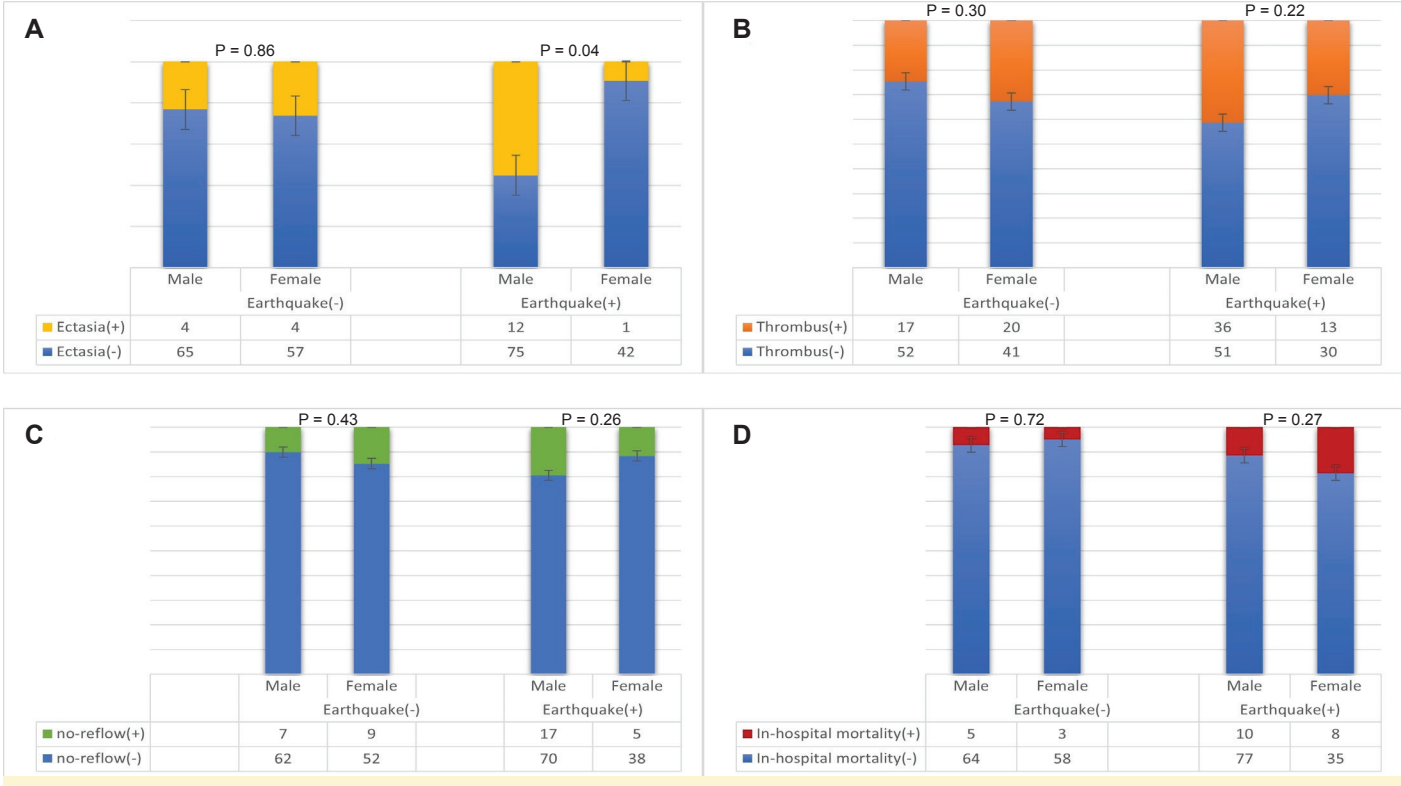

Figure 1 A-D. Bar graph representation of the impact of sex on ectasia (A), thrombus (B), no-reflow (C), and in-hospital mortality (D) in acute coronary syndrome cases occurring before or after an earthquake.

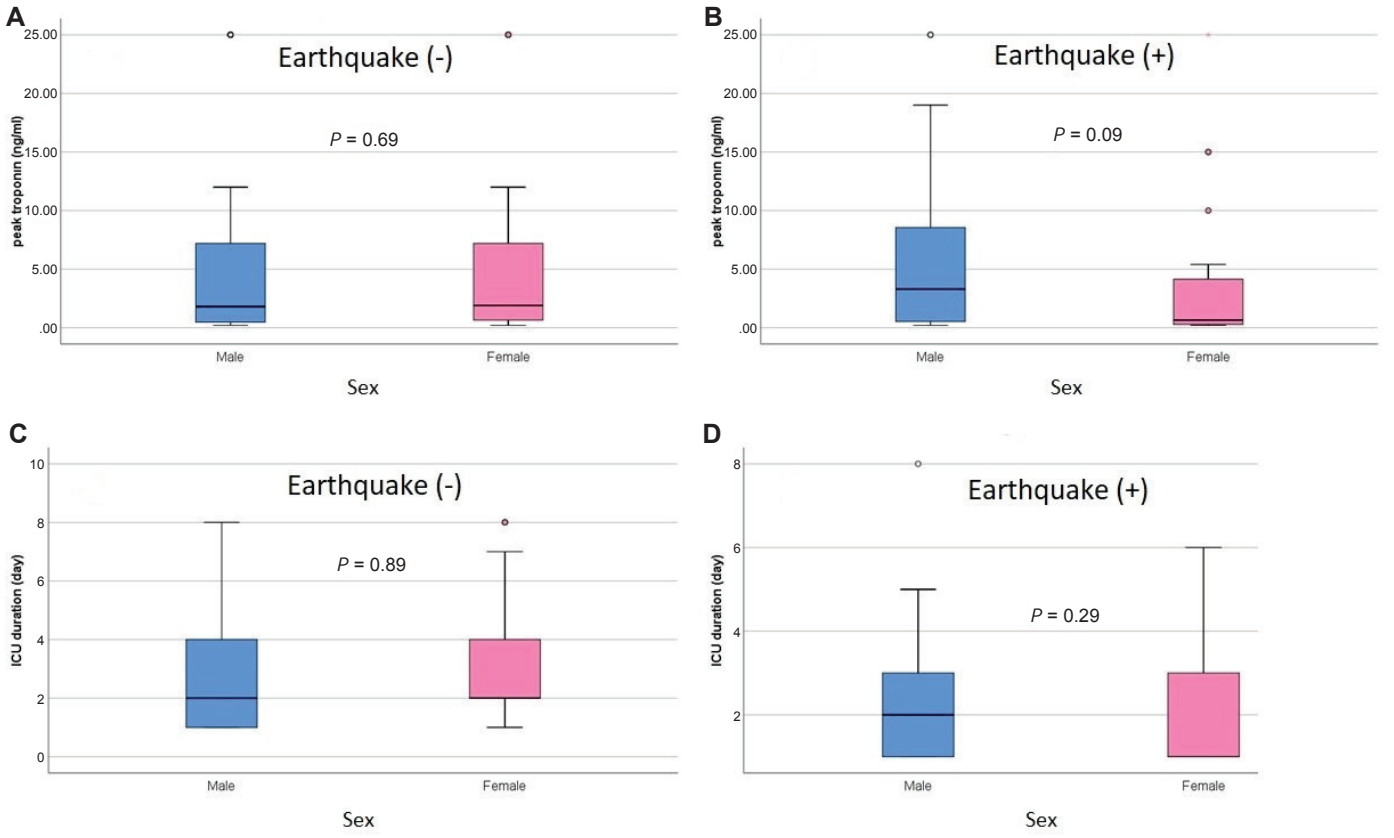

Figure 2 A-D. Box plot representation of the effect of gender on peak troponin levels in acute coronary syndrome cases occurring before (A) and after (B) the earthquake, and the effect of gender on the length of stay in the intensive care unit for acute coronary syndrome cases occurring before (C) and after (D) the earthquake.

Discussion

This retrospective analysis, conducted at a single center, sought to discern potential disparities in the occurrence, attributes, and outcomes of acute coronary syndrome (ACS) among patients residing within an earthquake-stricken zone, both before and within one month after the seismic event.

The findings of our investigation unveiled several significant revelations. Primarily, patients presenting with post-earthquake ACS displayed an advanced age, exhibiting a statistically significant variance in comparison to the pre-earthquake ACS cohort. This observation implies that the earthquake might exert a more pronounced influence on older individuals, potentially serving as a catalyst for ACS onset. Given that age has long been acknowledged as a cardiovascular disease risk factor, the augmented stress and trauma engendered by earthquakes could potentially increase the susceptibility of older persons to ACS.[8,9]

Moreover, within the post-earthquake ACS group, a higher prevalence of males was apparent. This observation aligns with earlier research, which underscores that males are prone to an increased risk of ACS development. The earthquake's impact could potentially exacerbate this risk for males, possibly due to heightened physical exertion during rescue and recovery efforts, increased levels of occupational stress, or differences in stress-responsive behaviors across genders.[10,11]

Nevertheless, it is imperative to critically examine the assumption that older individuals and males might be more predisposed to the adverse aftermath of the earthquake, potentially leading to plaque rupture. While this hypothesis is valid, its applicability could depend on any shifts occurring in the population demographics subsequent to the earthquake event. Variables such as population displacement or domestic migration might have induced alterations in the composition of the populace. The departure of younger, working-age individuals, or women from the earthquake-affected region could have influenced the demographic makeup of the observed patient cohort. As a result, the observed prevalence of elderly individuals and males within this cohort might stem from evolving population dynamics rather than being solely attributed to inherent age or gender-associated susceptibilities. This highlights the importance of a nuanced interpretation of our findings, acknowledging the intricate interplay between earthquake-induced demographic changes and their implications for patient demographics.

Despite similarities in the distribution of ACS subtypes between the pre- and post-earthquake groups, a discernible trend toward an elevated incidence of shock at presentation during the post-earthquake period was evident, albeit not achieving statistical significance. This emerging pattern suggests a possible linkage between the psychological and physiological strain caused by earthquakes and an increased likelihood of shock among ACS patients. However, it is crucial to recognize that alternative

factors might also contribute. Delays in admissions due to the consequences of the earthquake and potential obstacles in accessing timely medical care could potentially contribute to this observed trend. Thus, a comprehensive exploration of the elevated shock incidence necessitates a broader assessment beyond seismic stressors, encompassing a wider spectrum of contextual variables that influence patient care-seeking behaviors and access to healthcare services.

Regarding medication utilization, the study revealed a diminished frequency of anticoagulation administration before procedures within the post-earthquake timeframe. This reduction could potentially be attributed to logistical challenges and disturbances in healthcare infrastructure arising from the earthquake, potentially leading to delays or suboptimal medication dosing. Swift initiation of anticoagulation therapy plays a pivotal role in averting clot formation and mitigating complications among ACS patients. Consequently, concerted efforts must be undertaken to ensure consistent access to suitable medications and healthcare services during and in the aftermath of earthquakes, aiming to optimize patient outcomes.

Moreover, the prevalence of non-critical coronary artery disease was lower in the post-earthquake ACS cohort, potentially indicating increased disease severity within this demographic. This phenomenon might be linked to factors such as elevated stress levels, intensified physical exertion, and disruption of customary healthcare services during and post-earthquakes. Individuals afflicted with more severe coronary artery disease face an elevated risk of adverse events and may require more robust management approaches.

Remarkably, optical coherence tomography (OCT) investigations have provided illuminating insights into the landscape of coronary lesions. These studies have highlighted the tendency of thin fibrous cap fibroatheromas to be located in the proximal left anterior descending (LAD) artery domain, while fibrous plaques demonstrate a more even distribution across the coronary vasculature.[12,13] A significant observation arises from critical stenosis within the LAD artery, which co-occurs with an expanded myocardial area at risk, consequently amplifying the likelihood of symptomatic presentation. Additionally, the diagnostic efficacy of electrocardiogram (ECG) alterations is notably accentuated in cases related to LAD artery lesions.

Importantly, it is prudent to underline that infarctions stemming from the circumflex (Cx) artery may elude timely detection due to restricted or even absent ST segment modifications. In the context of the seismic event, a compelling consideration pertains to the potential synergy between the heightened physiological and emotional stress instigated by the earthquake and the predilection of LAD lesions for exacerbating acute coronary syndrome (ACS) incidents. The intrinsic vulnerability of LAD lesions could have been hastened by the formidable seismic stressor.

However, a nuanced evaluation of intertwined factors is warranted. Beyond the realm of physiological reactions, the post-earthquake environment encompasses variables such as a potential diminution in healthcare infrastructure and constrained medical resources within seismic zones. This complex landscape might have created a scenario wherein patients displaying overt symptoms and discernible clinical markers attributed to LAD lesions were more readily diagnosed with ACS or recommended for interventional procedures.

Regarding outcomes, in-hospital mortality was observed to be more common in the post-earthquake ACS group, while the ICU length of stay was longer in the pre-earthquake group. However, complete revascularization and an increased rate of prehospital anticoagulation were found to be effective factors in reducing in-hospital mortality. Furthermore, no significant differences were observed in peak troponin levels, coronary ectasia, or coronary thrombus between the pre- and post-earthquake ACS groups. Gender differences were also investigated, revealing that females had a higher incidence of coronary ectasia in the post-earthquake group. The higher mortality rate in the post-earthquake period may be attributed to a combination of factors, such as increased stress, limited access to healthcare services, and delays in receiving appropriate medical interventions. The longer ICU length of stay in the pre-earthquake group might be due to differences in baseline patient characteristics or other factors unrelated to the earthquake itself. These findings underscore the need for preparedness and resources to effectively manage ACS cases during and after earthquakes, to minimize the risk of adverse outcomes.

Several studies have reported an increase in ACS following earthquakes, which is supported by the findings of this study. A study conducted in Japan after the 2011 Great East Japan Earthquake found a significant rise in the number of patients with acute coronary syndrome during the subsequent three weeks, compared to previous years.[14] Another study involving 189 patients with ACS admitted before and after the earthquake that occurred on April 25, 2015, in Nepal, demonstrated a significant increase in the prevalence of multi-vessel disease and left main artery involvement following the earthquake. Additionally, post-earthquake ACS patients exhibited higher rates of heart failure, atrial fibrillation, and morbidity compared to pre-earthquake ACS patients.[15]

Similarly, a study conducted after the 2007 Noto Peninsula Earthquake also reported a higher incidence of acute coronary syndrome during the 35 days following the event, in comparison to the previous three-year period.[16] Additionally, the majority of acute coronary syndrome cases were diagnosed within seven days following the Noto Hanto Oki Earthquake, whereas an increase in arrhythmia and heart failure was observed following the Great East Japan Earthquake.[14,17] These findings suggest that the incidence and manifestation of acute coronary syndromes following an earthquake may vary depending on factors such as the severity of the earthquake, geographical location, and demographic characteristics of the affected population.

It is essential to consider the psychosocial impact of post-traumatic stress disorder on cardiovascular disease during natural disasters like earthquakes. This study's results align with previous research, showing a connection between natural disasters, including earthquakes, and a higher incidence of ACS. Additionally, this study sheds light on the specific complications associated with post-earthquake ACS and highlights the importance of complete revascularization and recognizing gender differences.

In conclusion, natural disasters such as earthquakes can significantly impact the incidence and manifestation of acute coronary syndromes. Comparing acute coronary syndromes in earthquake zones before and after these events provides valuable insights into how natural disasters can impact cardiovascular disease. These findings can inform future research aimed at uncovering the underlying mechanisms contributing to these changes and developing targeted interventions for individuals at higher risk. Consequently, healthcare providers must be equipped with the necessary resources for rapid diagnosis and management of these conditions in areas affected by disasters. Future studies could build upon this research by investigating additional risk factors and comorbidities that may contribute to increased complications in the post-earthquake ACS population.

Despite the valuable insights provided by this study, several limitations need acknowledgment. Firstly, the study's retrospective and observational design inherently carries the risk of bias and confounding factors. Although efforts were made to control for confounders through statistical analysis, the possibility of residual confounding cannot be completely ruled out. Secondly, the study was conducted at a single center, potentially limiting the generalizability of the findings to other settings or populations. The effects of earthquakes on ACS patients may vary depending on geographical location, infrastructure, and available healthcare resources in different regions. Therefore, caution should be exercised when extrapolating these results to other contexts.

Thirdly, the study's sample size was relatively small, particularly considering the low event rate for some outcomes. This limited sample size may have affected the statistical power of the study, potentially leading to an inability to detect significant differences in certain variables or outcomes. Future studies with larger sample sizes would yield more robust conclusions. Fourthly, the study primarily focused on short-term outcomes during the hospital stay and did not include long-term follow-up data. Important long-term outcomes, such as recurrent cardiovascular events or mortality beyond the hospital setting, were not assessed. Examining the long-term effects of earthquakes on ACS patients would provide a more comprehensive understanding of the impact and prognosis of this population.

Furthermore, this study did not explore the specific mechanisms underlying the observed associations between earthquakes and ACS. It was primarily descriptive in nature and did not investigate the physiological, psychological, or social factors contributing to the increased incidence and severity of ACS after earthquakes. It is important to highlight that due to the retrospective nature of our research, complete demographic data of patients were not available for analysis, including essential information such as hypertension, diabetes mellitus, and smoking status. These factors could potentially influence the occurrence and management of ACS. Given this limitation in data availability, our ability to thoroughly explore the role of these demographic factors within the scope of our study was constrained. As a result, the potential impact of these variables on the observed clinical and angiographic outcomes could not be adequately assessed.

Conclusion

This study conducted a comparative analysis of ACS patients' conditions before and after an earthquake. The patients from the post-earthquake period were predominantly older and male, and there was an increase in shock cases. Increased pre-hospital anticoagulation rates and complete revascularization were linked to reduced in-hospital mortality. Peak troponin levels, coronary ectasia, thrombus presence, and no-reflow phenomena were similar between the groups. Longer ICU stays were observed pre-earthquake, whereas in-hospital mortality rates were higher post-earthquake. These findings emphasize the importance of considering earthquake-related factors in ACS management and underscore the potential benefits of certain interventions.

Ethics Committee Approval: The Ethics Committee of Istanbul Yeni Yüzyıl University sanctioned the study protocol (Approval Number: 2023/04-1062, Date: 03.04.2023).

Informed Consent: Written informed consent was obtained from the patients.

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References

1. Huang KS, He DX, Huang DJ, et al. Changes in ischemic heart disease mortality at the global level and their associations with natural disasters: A 28-year ecological trend study in 193 countries. *PLoS One.* 2021;16(7):e0254459. [CrossRef]
2. Mittleman MA, Mostofsky E. Physical, psychological and chemical triggers of acute cardiovascular events: preventive strategies. *Circulation.* 2011;124(3):346-354. [CrossRef]
3. Zhang W, Ohira T, Yasumura S, et al. Fukushima Health Management Survey Group. Effects of socioeconomic factors on cardiovascular-related symptoms among residents in Fukushima after the Great East Japan Earthquake: a cross-sectional study using data from the Fukushima Health Management Survey. *BMJ Open.* 2017;7(6):e014077. [CrossRef]
4. Nozaki E, Nakamura A, Abe A, et al. Occurrence of cardiovascular events after the 2011 Great East Japan Earthquake and tsunami disaster. *Int Heart J.* 2013;54(5):247-253. [CrossRef]
5. Kario K, McEwen BS, Pickering TG. Disasters and the heart: a review of the effects of earthquake-induced stress on cardiovascular disease. *Hypertens Res.* 2003;26(5):355-367. [CrossRef]
6. Kario K, Matsuo T, Kayaba K, Soukejima S, Kagamimori S, Shimada K. Earthquake-induced cardiovascular disease and related risk factors in focusing on the Great Hanshin-Awaji Earthquake. *J Epidemiol.* 1998;8(3):131-139. [CrossRef]
7. Suzuki S, Sakamoto S, Miki T, Matsuo T. Hanshin-Awaji earthquake and acute myocardial infarction. *Lancet.* 1995;345(8955):981. [CrossRef]
8. Lagraauw HM, Kuiper J, Bot I. Acute and chronic psychological stress as risk factors for cardiovascular disease: Insights gained from epidemiological, clinical and experimental studies. *Brain Behav Immun.* 2015;50:18-30. [CrossRef]
9. Dhingra R, Vasan RS. Age as a risk factor. *Med Clin North Am.* 2012;96(1):87-91. [CrossRef]

10. Bazoukis G, Tse G, Naka KK, et al. Impact of major earthquakes on the incidence of acute coronary syndromes - A systematic review of the literature. *Hellenic J Cardiol.* 2018;59(5):262-267. [CrossRef]
11. Dakhil ZA, Farhan HA, Faraz F, et al. Impact of Earthquake on Cardiovascular Health: What Should Cardiovascular Healthcare Providers Anticipate After the Devastating Earthquakes in Turkey and Syria? *Curr Probl Cardiol.* 2023;48(9):101800. [CrossRef]
12. Fujii K, Kawasaki D, Masutani M, et al. OCT assessment of thin-cap fibroatheroma distribution in native coronary arteries. *JACC Cardiovasc Imaging.* 2010;3(2):168-175. [CrossRef]
13. Tearney GJ, Jang IK, Bouma BE. Optical coherence tomography for imaging the vulnerable plaque. *J Biomed Opt.* 2006;11(2):021002. [CrossRef]
14. Aoki T, Fukumoto Y, Yasuda S, et al. The Great East Japan Earthquake Disaster and cardiovascular diseases. *Eur Heart J.* 2012;33(22):2796-2803. [CrossRef]
15. Tembe M, Dhakal S, Shrestha A, Mugele J, House DR. Impact of Nepal Earthquake on Patients Presenting for Emergency Care at Patan Hospital. *Disaster Med Public Health Prep.* 2019;13(2):211-216. [CrossRef]
16. Tsuchida M, Kawashiri MA, Teramoto R, et al. Impact of severe earthquake on the occurrence of acute coronary syndrome and stroke in a rural area of Japan. *Circ J.* 2009;73(7):1243-1247. [CrossRef]
17. Onishi H, Yamamura O, Ueda S, et al. Ultrasound cardiography examinations detect victims' long-term realized and potential consequences after major disasters: a case-control study. *Environ Health Prev Med.* 2018;23(1):37. [CrossRef]