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INFARKT MIOKARDA SA NEOPSTRUKTIVNOM KORONARNOM BOLEŠĆU (MINOCA) - PRIKAZ SLUČAJA

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Sažetak: Uvod: Akutni koronarni sindrom tipa infarkta miokarda sa neopstruktivnom koronarnom bolešću (MINOCA) predstavlja infarkt miokarda bez stenoze koronarne arterije ili sa stenozom manjom od 50%. **Cilj rada** je ukazivanje na MINOCA-u kao relativno nov entitet u kardiologiji, na značaj rane dijagnoze i pravovremenog lečenja, kao i primena primarne i sekundarne prevencije kardiovaskularnih bolesti uz modifikaciju faktora rizika za iste. **Prikaz slučaja:** pacijent ženskog pola starosti 60 godina dolazi zbog bola u grudima po tipu stezanja i pritiska. Fizikalni nalaz uredan, dok na elektrokardiografskom zapisu registrujemo depresije ST segmenta u odvodima V4-V6 od 0,5 mm do 1 mm. Lečena po protokolu za infarkt miokarda bez perzistentne ST elevacije (NSTEMI). Odmah urađena koronarografija koja je bila uredna. Lečenje je nastavljeno medikalnom terapijom. **Zaključak:** MINOCA obuhvata heterogenu grupu pacijenata koji imaju infarkt miokarda, ali nemaju značajnu opstrukciju koronarne arterije na angiogramu. Naša pacijentkinja je imala tipičnu sliku infarkta bez ST elevacije i uvedena je medikalna terapija zbog redukcije kardiovaskularnog rizika za nove događaje i uticaj na povoljne ishode. Predloženo je pacijentkinji da se redovno kontroliše i upućena je na magnetnu rezonancu srca ispitivanje koje bi po algoritmu za MINOCA-u rasvetlilo uzrok infarkta.

Ključne reči: akutni koronarni sindrom, infarkt miokarda bez perzistentne ST elevacije (NSTEMI), prevencija, infarkt miokarda sa neopstruktivnom koronarnom bolešću MINOCA, tretman, prevencija

UVOD

Akutni koronarni sindrom (AKS) u Srbiji činio je 48,3% svih smrtnih ishoda od ishemijskih bolesti srca u 2022. godini. Prema podacima populacionog registra za AKS, u Srbiji je u 2022. godini dijagnoza akutnog koronarnog sindroma postavljena kod 19701 slučaja. Tokom 2022. godine od ovog sindroma u Srbiji su umrle 4564 osobe. Infarkt miokarda sa neokluzivnim koronarnim arterijama (MINOCA) odnosi se na kliničku situaciju u kojoj pacijent ima simptome koji upućuju na akutni koronarni sindrom (AKS), uz povišene vrednosti troponina, ali pri koronarografiji nema značajne opstrukcije koronarnih arterija (definisano kao stenozna <50% u bilo kojoj velikoj epikardnoj arteriji). Objavljena prevalencija MINOCA značajno varira u različitim studijama, krećući se od približno 1% do 14% pacijenata sa AKS-om koji su podvrgnuti angiografiji [1].

Akutni koronarni sindrom može da se ispolji kao nestabilna angina pectoris, akutni

infarkt miokarda sa ili bez ST elevacije ili de novo blok leve grane Hissovog snopa i kao iznenadna srčana smrt [2,3]. Definicija akutnog infarkta miokarda (IM) podrazumeva nekrozu kardiomiocita uz kliničku sliku u skladu sa akutnom ishemijom miokarda. Akutno oštećenje miokarda, povezano sa rastom i/ili padom vrednosti visoko senzitivnog troponina (hs-cTnI) i uzrokovano ishemijom miokarda, označava se kao akutni infarkt miokarda. Ako kod pacijenata postoje tegobe i novonastale elevacije ST segmenta u dva susedna odvoda ili novonastali blok grane govorimo o IM sa ST elevacijom (STEMI). Nasuprot tome, ukoliko nema uočenih perzistentnih elevacija ST segmenta govorimo o IM bez ST elevacije (NSTEMI) [4,5,6].

MINOCA se može smatrati ZAJEDNIČKIM terminom koji obuhvata heterogenu grupu osnovnih uzroka: koronarnih i nekoronarnih koji mogu biti srčani i vansrčani poremećaji (Slika 1.).

MYOCARDIAL INFARCTION WITH NON-OBSTRUCTIVE CORONARY ARTERY DISEASE (MINOCA) - CASE REPORT

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Summary:Introduction: Acute coronary syndrome type myocardial infarction with non-obstructive coronary artery disease (MINOCA) represents a myocardial infarction without coronary artery stenosis or with stenosis less than 50%. The aim of this paper is to highlight MINOCA as a relatively new entity in cardiology, the importance of early diagnosis and timely treatment, as well as the application of primary and secondary prevention of cardiovascular diseases along with the modification of risk factors for these conditions. Case presentation: A 60-year-old female patient presents with chest pain described as tightness and pressure. The physical examination is normal, while the electrocardiogram shows ST-segment depressions in leads V4-V6 ranging from 0.5 mm to 1 mm. The patient was treated according to the protocol for non-ST-elevation myocardial infarction (NSTEMI). Coronary angiography was immediately performed and found to be normal. Treatment was continued with medical therapy. Conclusion: MINOCA encompasses a heterogeneous group of patients who experience myocardial infarction but do not have significant coronary artery obstruction on angiogram. Our patient had a typical presentation of non-ST-elevation infarction and was treated with medical therapy to reduce cardiovascular risk for future events and improve outcomes.

Key words:Acute coronary syndrome (ACS), Myocardial infarction without persistent ST elevation (NSTEMI), Prevention, Myocardial infarction with non-obstructive coronary artery disease (MINOCA), Treatment, Prevention

INTRODUCTION

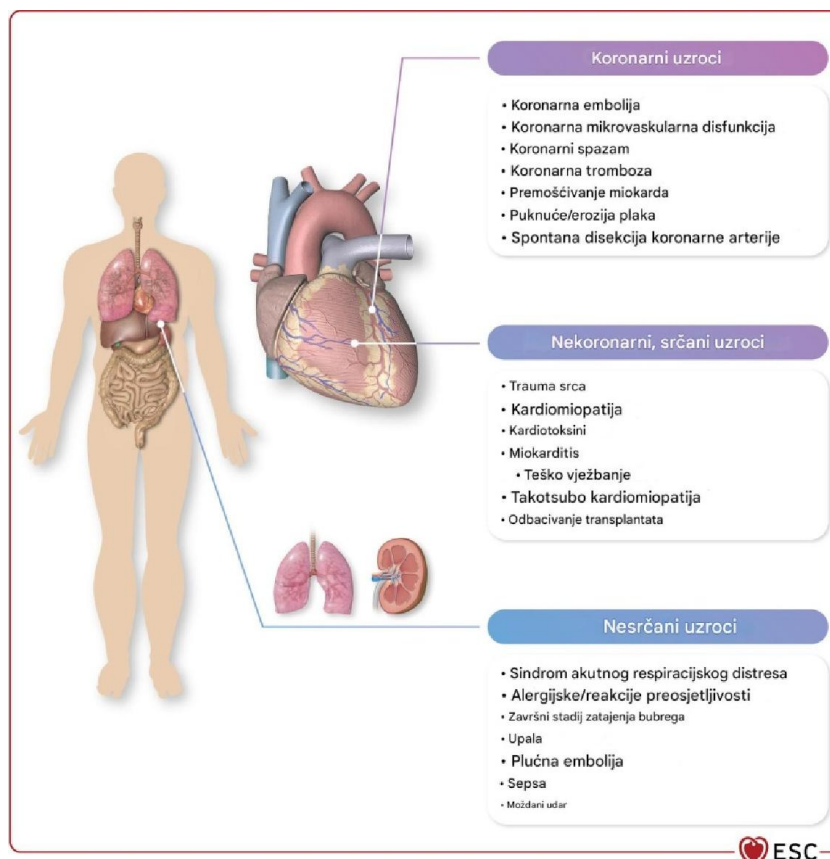
Acute coronary syndrome (ACS) accounted for 48.3% of all deaths from ischemic heart diseases in Serbia in 2022. According to data from the population registry for ACS, in 2022, the diagnosis of acute coronary syndrome was made in 19,701 cases in Serbia. During 2022, 4,564 people in Serbia died from this syndrome. Myocardial infarction with non-occlusive coronary arteries (MINOCA) refers to a clinical situation in which a patient exhibits symptoms suggestive of acute coronary syndrome (ACS), with elevated troponin levels, but coronary angiography shows no significant obstruction of the coronary arteries (defined as stenosis <50% in any major epicardial artery). The reported prevalence of MINOCA significantly varies in different studies, ranging from approximately 1% to 14% of ACS patients undergoing angiography [1].

Acute coronary syndrome can present as unstable angina pectoris, acute myocardial infarction with or without ST elevation, or de

novo left bundle branch block, as well as sudden cardiac death [2,3]. The definition of acute myocardial infarction (MI) involves myocardial cell necrosis with a clinical picture consistent with acute myocardial ischemia. Acute myocardial damage, associated with an increase and/or decrease in high-sensitivity troponin (hs-cTnI) levels and caused by myocardial ischemia, is referred to as acute myocardial infarction. If a patient experiences symptoms along with newly elevated ST segments in two contiguous leads or a newly developed bundle branch block, this is classified as STEMI (ST-Elevation Myocardial Infarction). In contrast, if no persistent ST segment elevation is observed, it is classified as NSTEMI (Non-ST-Elevation Myocardial Infarction) [4,5,6].

MINOCA can be considered a COMMON term that encompasses a heterogeneous group of underlying causes: coronary and non-coronary, which may include both cardiac and extracardiac disorders (Figure 1.).

Slika 1. MINOCA - zajednički termin koji obuhvata heterogenu grupu koronarnih i nekoronarnih uzroka.
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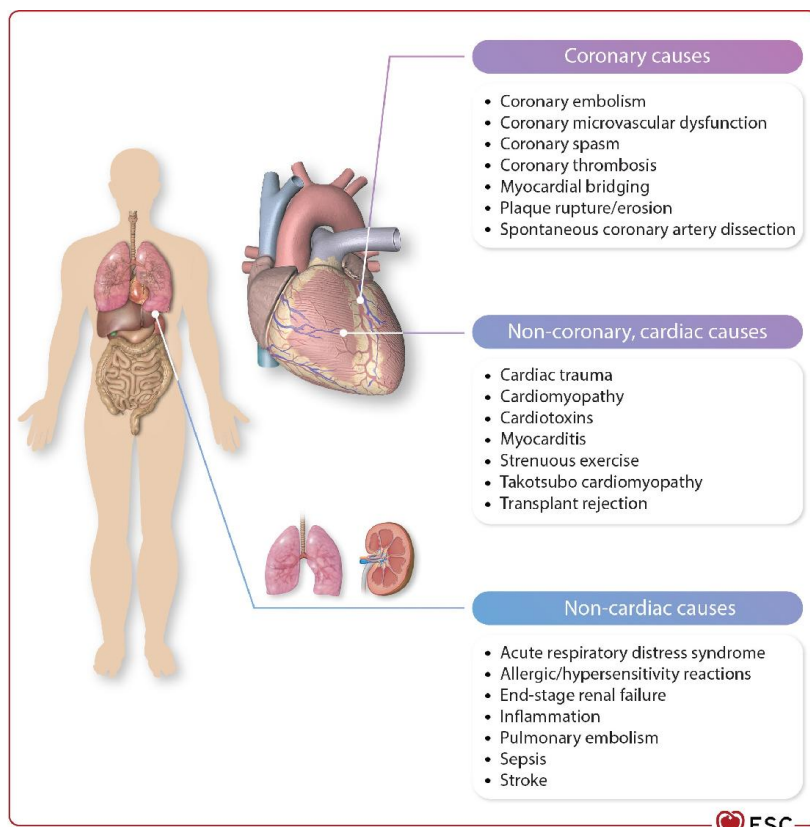


Kada dijagnoza nije jasno uspostavljena nakon koronarografije, MINOCA predstavlja radnu, a ne konačnu dijagnozu. Ključno je da kliničari sprovedu dodatne procene i ispitivanja kako bi identifikovali osnovni uzrok MINOCA, što će omogućiti postavljanje konačne dijagnoze i adekvatno lečenje pacijenata. Neuspeh u identifikaciji osnovnog uzroka MINOCA može dovesti do neodgovarajuće ili neadekvatne terapije [1]. Ako se osnovni uzrok MINOCA ne

može utvrditi samo primenom invazivne koronarografije (ICA), sledi procene mikrovaskularne funkcije i reaktivnosti koronarnih arterija, kao i intravaskularnog imidžinga. Pojam „funkcionalna koronarografija“ odnosi se na kombinaciju standardne koronarografije sa dodatnim testovima (npr. testiranje disfunkcije koronarne mikrocirkulacije i vazoreaktivnosti) (Slika 2.).

Figure 1. MINOCA - a common term encompassing a heterogeneous group of coronary and non-coronary causes.

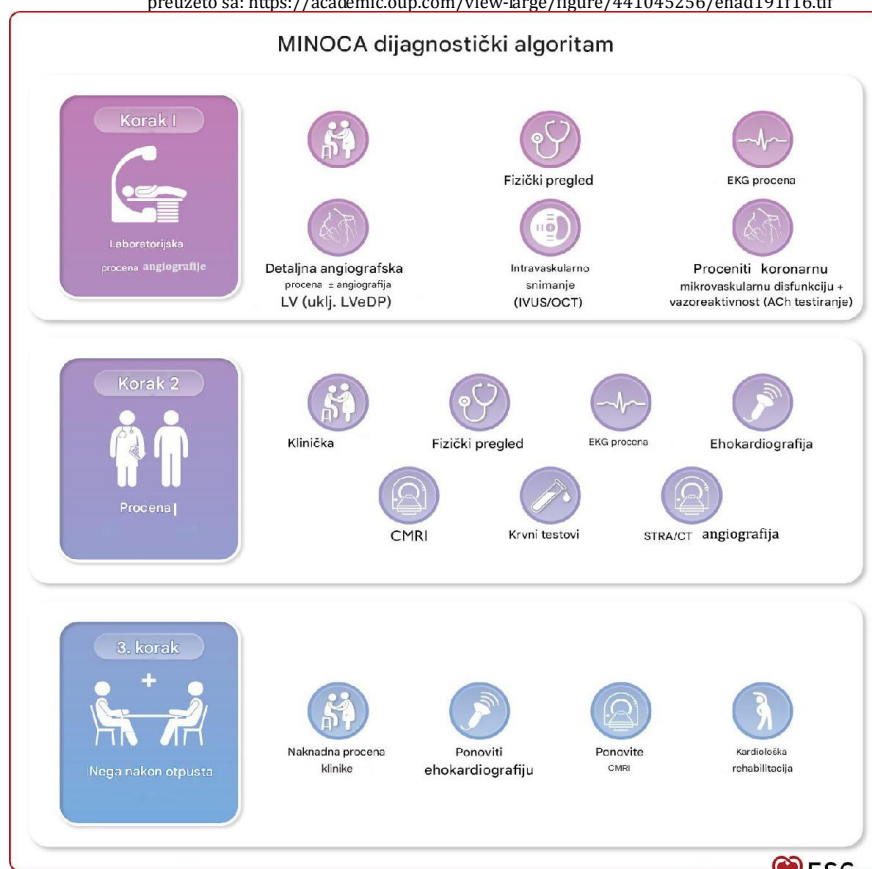
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When the diagnosis is not clearly established after coronary angiography, MINOCA represents a working, rather than a final, diagnosis. It is crucial that clinicians conduct additional assessments and investigations to identify the underlying cause of MINOCA, which will enable a definitive diagnosis and appropriate treatment for the patient. Failure to identify the underlying cause of MINOCA may lead to inadequate or inappropriate therapy [1]. If the underlying

cause of MINOCA cannot be determined solely through invasive coronary angiography (ICA), further assessments of microvascular function and coronary artery reactivity, as well as intravascular imaging, should follow. The term "functional coronary angiography" refers to the combination of standard coronary angiography with additional tests (e.g., testing for coronary microcirculation dysfunction and vasoreactivity) (Figure 2).

Slika 2. MINOCA dijagnostički algoritam. Evaluacija pacijenata sa radnom dijagnozom MINOCA
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Ukoliko se osnovni uzrok MINOCA ne može utvrditi funkcionalnom koronarografijom, preporučuje se neinvazivno snimanje (npr. ehokardiografija, CMR, CT angiografija, CT srca), u skladu sa kliničkom indikacijom. Magnetna rezonanca srca (CMR) je jedan od ključnih dijagnostičkih alata za određivanje osnovnog

uzroka MINOCA [7–11]. CMR može identifikovati osnovni uzrok kod čak 87% pacijenata sa radnom dijagnozom MINOCA i treba ga obaviti što je pre moguće nakon prijema pacijenta, idealno tokom inicijalne hospitalizacije [12] (Tabela 1.).

Tabela 1. Preporuke za infarkt miokarda sa neokluzivnim koronarnim artetijama (MINOCA)

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Preporuke	Klasa preporuke	Nivo dokaza
Kod pacijenata sa radnom dijagnozom MINOCA, preporučuje se CMR snimanje nakon invazivne angiografije ako konačna dijagnoza nije jasna.	I	B
Lečenje MINOCA u skladu sa konačno utvrđenom osnovnom dijagnozom je preporučeno, u skladu sa odgovarajućim vodičima specifičnim za bolest	I	B
Kod svih pacijenata sa početnom radnom dijagnozom MINOCA, preporučuje se primena dijagnostičkog algoritma radi utvrđivanja konačne dijagnoze.	I	C

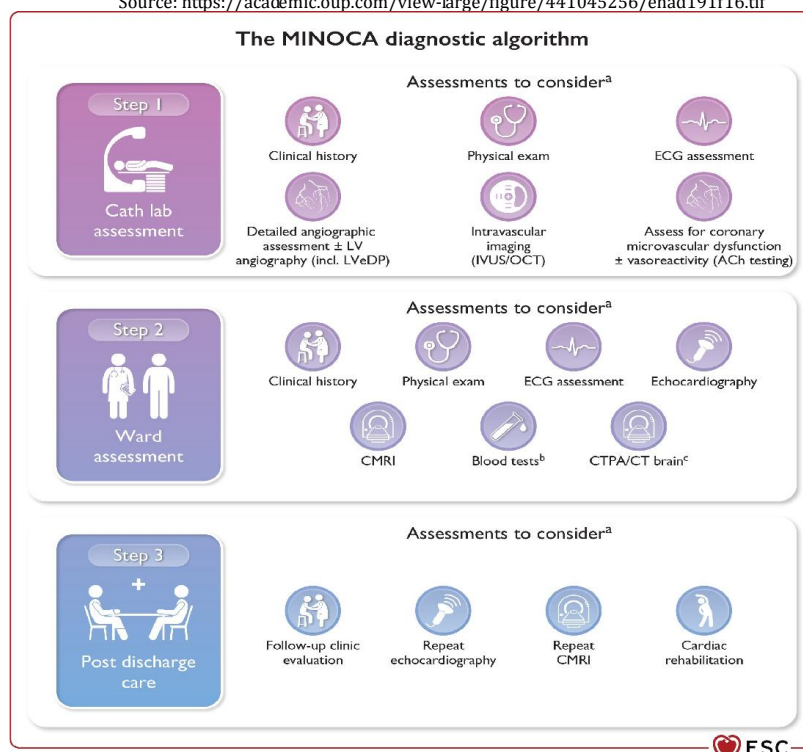
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CMR – kardijalna magnetna rezonanca; **MINOCA** – infarkt miokarda sa neokluzivnim koronarnim artetijama.

a Klasa preporuke.

b Nivo dokaza.

Figure 2. MINOCA diagnostic algorithm. Evaluation of patients with a working diagnosis of MINOCA.

Source: <https://academic.oup.com/view-large/figure/441045256/ehad191f16.tif>

If the underlying cause of MINOCA cannot be determined through functional coronary angiography, non-invasive imaging is recommended (e.g., echocardiography, CMR, CT angiography, CT heart), according to the clinical indication. Cardiac magnetic resonance (CMR) is one of the key diagnostic tools for determining

the underlying cause of MINOCA [7–11]. CMR can identify the underlying cause in up to 87% of patients with a working diagnosis of MINOCA and should be performed as soon as possible after patient admission, ideally during the initial hospitalization [12]. (Table 1)

Table 1. Recommendations for myocardial infarction with non-occlusive coronary arteries (MINOCA)

Source: <https://academic.oup.com/view-large/441045259>

Recommendations	Class ^a	Level ^b
In patients with a working diagnosis of MINOCA, CMR imaging is recommended after invasive angiography if the final diagnosis is not clear.	I	B
Management of MINOCA according to the final established underlying diagnosis is recommended, consistent with the appropriate disease-specific guidelines.	I	B
In all patients with an initial working diagnosis of MINOCA, it is recommended to follow a diagnostic algorithm to determine the underlying final diagnosis.	I	C

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CMR, cardiac magnetic resonance; MINOCA, myocardial infarction with non-obstructive coronary arteries.

^aClass of recommendation.

^bLevel of evidence.

Utvrđivanje osnovnog uzroka MINOCA omogućava započinjanje odgovarajuće terapije u skladu sa konačnom dijagnozom. Sekundarna preventivna terapija treba da se razmotri kod pacijenata sa dokazima koronarne aterosklerotske bolesti i za kontrolu faktora rizika.

Lečenje Takotsubo sindroma nije zasnovano na prospektivnim randomizovanim kontrolisanim studijama, te se terapija uglavnom zasniva na suportivnoj i empirijskoj strategiji [13,14]. Lečenje pacijenata sa miokarditisom se izvodi prema preporukama radne grupe za bolesti miokarda Evropskog udruženja kardiologa (ESC) [15,16].

Ishemija bez infarkta sa neokluzivnim koronarnim arterijama (INOCA) je opisana u kontekstu hroničnih koronarnih sindroma (CCS)[17,18].

PRIKAZ SLUČAJA

Pacijent ženskog pola starosti 60 godina dolazi zbog bola u grudima u vidu stezanja i pritiska u mirovanju. Navodi da je dan pre

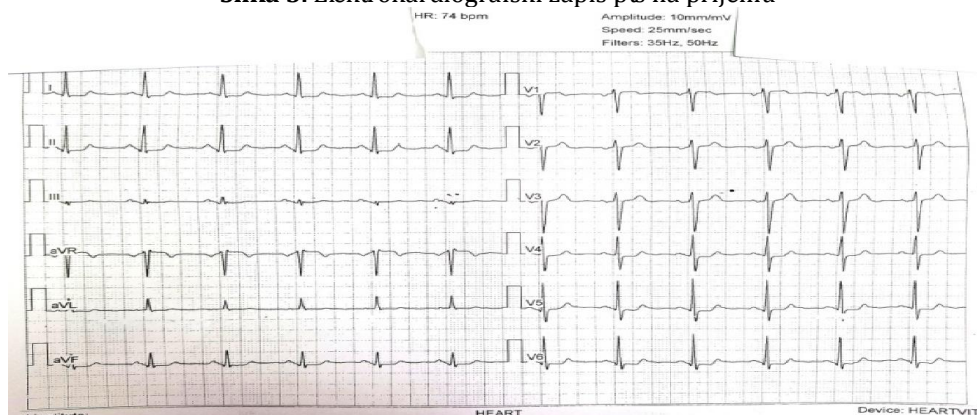
javljanja lekaru osetila bolove u grudima po tipu stezanja i pritiska. Bolovi se javljaju na napor, najčešće kad ide uzbrdo, traju duže od pola sata, šire se kroz levu polovinu grudnog koša, smanjuju se na prestanak napora što odgovara slici nestabilne angine pektoris. Ranije bila bez sličnih tegoba.

Porodična anamneza bila je uredna. Iz lične anamneze saznajemo da se leči od arterijske hipertenzije, dislipidemije i nije pušač.

Fizikalni pregled: inspekcijom je utvrđeno da je pacijentkinja svesna, orjentisana, pokretna, srednje osteomuskularne građe i uhranjenosti, afebrilna, eupnoična, eukardična. Odaje utisak srednje teškog bolesnika. Auskultatorni nalaz na srcu i plućima je uredan. Krvni pritisak 160/90 mmHg. Srčana frekvenca 75/min.

Na elektrokardiografskom zapisu registrujemo sinusni ritam, normogram, srčana frekvenca je 75/min, sa depresijom ST segmenta u anterolateralnim odvodima V4-V6 od 0,5 do 1mm (Slika 3).

Slika 3. Elektrokardiografski zapis pts na prijemu



Primljena pod slikom akutnog koronarnog sindroma tipa nestabilne angine i u toku hospitalizacije prvi srčani biomarker troponin **hs-cTnI 4,3 ng/l**, bio je normalan. Sutradan je ponovljen **hs-cTnI 79,2 ng/l** ali dolazi do porasta za oko 20 puta od prve vrednosti a 7 puta više od gornje granice referentne rednosti (referentna vrednost 0,0-11,6 ng/l), što daje definitivnu dijagnozu infarkta miokarda bez ST elevacije.

Laboratorijski je obrađena:

analiza	rezultat	komentar
glikemija	4,6 mmol/l	normalna
kreatinin	74,7 umol/l	normalan
holesterol	8,1 mmol/l	povišen
trigliceridi	1,3 mmol/l	normalni
CRP	4,4 mg/l	normalan
AST	45 IU/l	lako povišen
ALT	23 IU/l	normalan
CK	150 IU/l	normalan
LDH	921 IU/l	povišen
kompletna krvna slika u granicama referentnih vrednosti		
BNP	17 pg/l	Normalan (ref. vr. 0,0-100,0 pg/l)

Determining the underlying cause of MINOCA enables the initiation of appropriate therapy in accordance with the final diagnosis. Secondary preventive therapy should be considered for patients with evidence of coronary atherosclerotic disease and for the control of risk factors.

Treatment of Takotsubo syndrome is not based on prospective randomized controlled trials, so therapy is mainly based on supportive and empirical strategies [13,14]. Treatment of patients with myocarditis is carried out according to the recommendations of the working group for myocardial diseases of the European Society of Cardiology (ESC) [15,16].

Ischemia without infarction with non-occlusive coronary arteries (INOCA) has been described in the context of chronic coronary syndromes (CCS) [17,18].

CASE REPORT

A 60-year-old female patient presents with chest pain described as tightness and pressure at rest. She reports that the day before seeing the doctor, she felt chest pain resembling

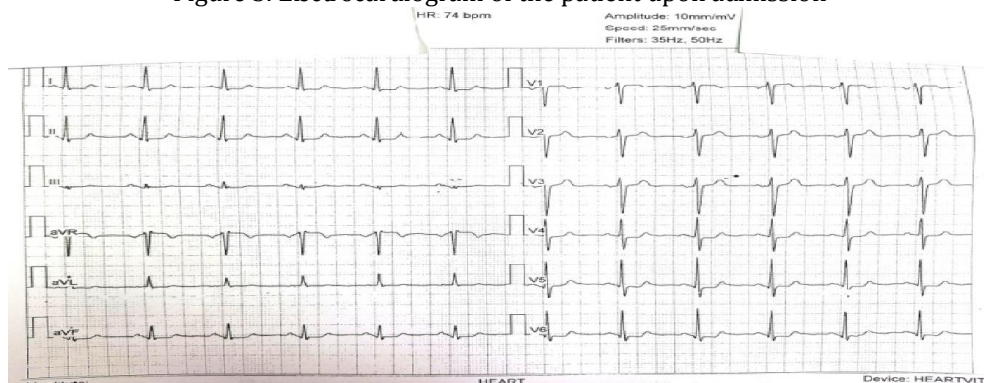
tightness and pressure. The pain occurs with exertion, most often when walking uphill, lasts longer than half an hour, radiates through the left side of the chest, and decreases with cessation of exertion, which corresponds to the clinical picture of unstable angina pectoris. She had no similar symptoms previously.

The family history was unremarkable. From the personal history, we learn that she is being treated for arterial hypertension and dyslipidemia and is a non-smoker.

Physical examination: Inspection revealed that the patient is conscious, oriented, mobile, of medium osteomuscular build and nutritional status, afebrile, eupneic, and with normal heart sounds. She appears to be moderately ill. The auscultatory findings on the heart and lungs are normal. Blood pressure is 160/90 mmHg. Heart rate is 75/min.

The electrocardiogram shows sinus rhythm, normal axis, a heart rate of 75/min, with ST segment depression in the anterolateral leads V4-V6 of 0.5 to 1 mm (Figure 3).

Figure 3. Electrocardiogram of the patient upon admission



The patient was admitted with a diagnosis of acute coronary syndrome type unstable angina, and during hospitalization, the first cardiac biomarker, high-sensitivity troponin (hs-cTnI), was 4.3 ng/l, which was normal. The following day, hs-cTnI was repeated and found to be 79.2 ng/l, showing an increase of approximately 20 times from the first value, and 7 times higher than the upper reference limit (reference range 0.0-11.6 ng/l), which led to the definitive diagnosis of non-ST-elevation myocardial infarction.

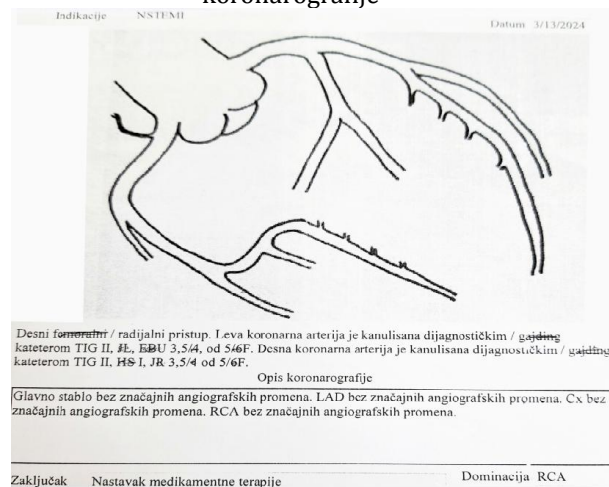
Laboratory tests were performed:

Analysis	Result	Comment
Glycemia	4,6 mmol/l	Normal
Creatinine	74,7 umol/l	Normal
Cholesterol	8,1 mmol/l	Elevated
Triglycerides	1,3 mmol/l	Normal
CRP	4,4 mg/l	Normal
AST	45 IU/l	Slightly elevated
ALT	23 IU/l	Normal
CK	150 IU/l	Normal
LDH	921 IU/l	Elevated
Complete blood count within reference range		
BNP	17 pg/l	Normal (ref. range 0,0-100,0 pg/l)

Lečena po protokolu za NSTEMI. U terapiji uveden niskomolekularni heparin, dvostruka antitrombotična terapija (DAPT), beta blokator nebivolol; ace inhibitor, blokator kalcijumskih kanala, diuretik i inhibitor protonske pumpe, nitroglicerina po potrebi.

Po kriterijumima za NSTEMI i velikog porasta vrednosti serumskog troponina urađena koronarografija koja je bila uredna, glavno stablo, LAD, Cx, RCA bez značajnih angiografskih promena (Slika 4).

Slika 4. Izveštaj sa koronarografije



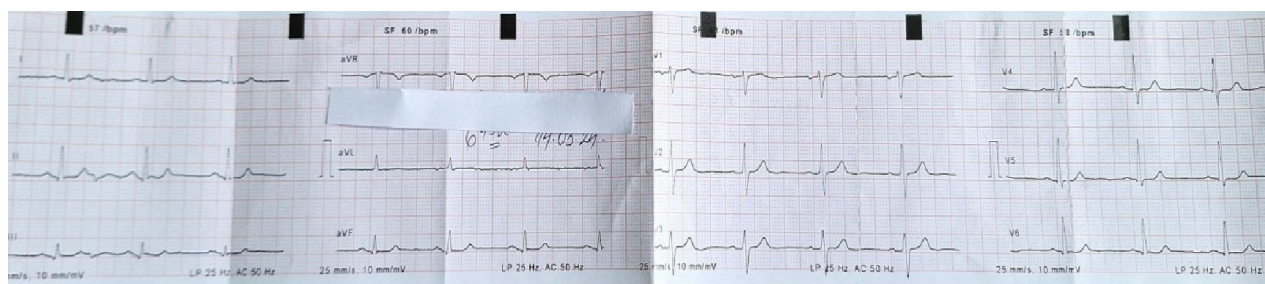
S obzirom da nema značajnih stenoza, nastavljena je medikalna i medikamentozna terapija. U daljem toku hospitalizacije radi otkrivanja uzroka MINOCA-e, urađena je ehokardiografija: koncentrična hipertrofija zidova leve komore, sa normalnom sistolnom funkcijom, ejeckiona frakcija je EF=60%, bez jasnih segmentnih ispada u kontraktilnosti što isključuje veliki infarkt a ide u prilog subendokardnog infarkta u prisustvu hipertrofije miokarda.

U daljem toku stabilna, kardijalno kompenzovana. Predlaže se dalje ispitivanje

definitivnog uzroka neokluzivnog infarkta po algoritmu za MINOCA-u: stres eho test i magnetna rezonanca srca (CMRI) a u slučaju pogoršanja tegoba u daljem toku funkcionalna koronarografija sa intravaskularnim ultrazvukom (IVUS) i optičkom koherentnom tomografijom (OCT) kao i testovima mikrovaskularne disfunkcije i koronarnog vazospazma [1].

Na otpustu, pacijentkinja bez bolova u grudima, normalna vrednost krvnog pritiska 130/90 mmHg, sa normalizovanim EKG zapisom EKG: sinusni ritam, normogram, sf 70/min, bez ST-T promena (Slika 5).

Slika 5. EKG pts na otpustu



Terapija na otpustu: DAPT, beta blokator nebivolol; ace inhibitor, blokator kalcijumskih kanala i diuretik kao fiksna kombinacija, inhibitor protonske pumpe i nitroglicerina po potrebi.

DISKUSIJA

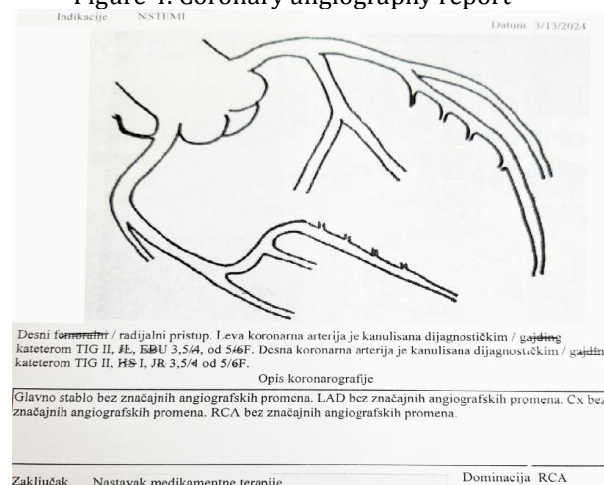
Prema četvrtoj univerzalnoj definiciji infarkta miokarda postoji više podtipova infarkta

miokarda. Postoji grupa pacijenata sa IM bez angiografski opstruktivne CAD (bez stenoze prečnika 50% i više, u velikom epikardnom sudu), a za ovaj entitet usvojen je termin infarkt miokarda bez opstrukcije koronarne arterije (MINOCA). Prevalenca se procenjuje na 6-8% [4], ali je heterogena pa varira od 1% do 14% pacijenata sa AKS-om [1]. Minoca je češća kod žena, kao i kod pacijenata koji se prezentuju kao

Treated according to the NSTEMI protocol. The therapy included low-molecular-weight heparin, dual antiplatelet therapy (DAPT), the beta-blocker nebivolol, ACE inhibitor, calcium channel blocker, diuretic, proton pump inhibitor, and nitroglycerin as needed.

According to the NSTEMI criteria and the significant increase in serum troponin levels, coronary angiography was performed, which showed no significant angiographic changes in the main stem, LAD, Cx, and RCA (Figure 4

Figure 4. Coronary angiography report

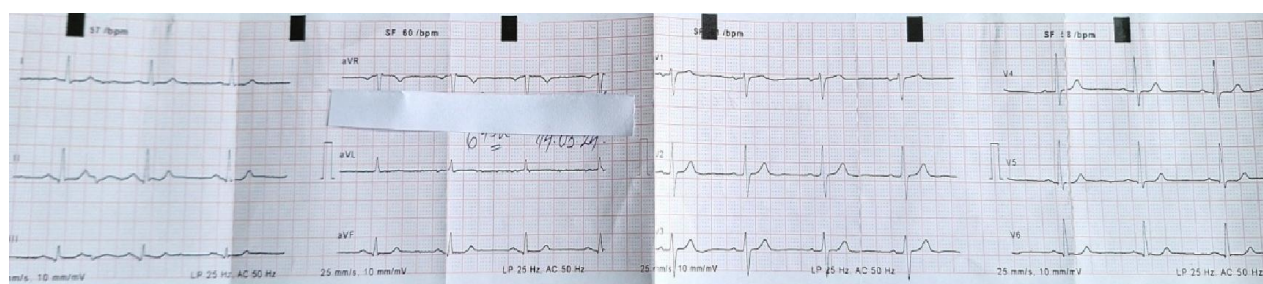


Given the absence of significant stenosis, medical and pharmacological therapy was continued. During the further course of hospitalization, to determine the cause of MINOCA, an echocardiogram was performed: concentric hypertrophy of the left ventricular walls, with normal systolic function, ejection fraction (EF) = 60%, without clear segmental abnormalities in contractility, which excludes a large infarction and supports the possibility of a subendocardial infarction in the presence of myocardial hypertrophy.

Throughout the course, the patient remained stable and cardially compensated. Further

investigation of the definitive cause of non-occlusive infarction is recommended according to the MINOCA algorithm: stress echo test and cardiac magnetic resonance imaging (CMRI), and in the event of worsening symptoms, functional coronary angiography with intravascular ultrasound (IVUS) and optical coherence tomography (OCT), as well as microvascular dysfunction and coronary vasospasm tests [1]. At discharge, the patient was without chest pain, with a normal blood pressure value of 130/90 mmHg, and a normalized ECG: sinus rhythm, normal axis, heart rate 70/min, without ST-T changes (Figure 5).

Figure 5. ECG of the patient at discharge



Therapy at Discharge: DAPT, beta blocker nebivolol; ACE inhibitor, calcium channel blocker and diuretic as a fixed combination, proton pump inhibitor, and nitroglycerin as needed.

DISCUSSION

According to the fourth universal definition of myocardial infarction, there are several subtypes of myocardial infarction. There

is a group of patients with MI without angiographically obstructive coronary artery disease (without stenosis of 50% or more in a large epicardial vessel), and the term myocardial infarction without coronary artery obstruction (MINOCA) has been adopted for this entity. Prevalence is estimated at 6-8% [4], but it is heterogeneous and varies from 1% to 14% of patients with ACS [1]. MINOCA is more common

NSTEMI [4]. Kriterijumi za postavljanje dijagnoze MINOCA su:

1. *Kriterijumi za dijagnozu akutnog infarkta miokarda*

a) Pozitivni srčani biomarkeri (po mogućnosti srčani troponin)

b) Klinički dokazi za infarkt miokarda, uključujući: simptome ishemije, nove ili pretpostavljene nove značajne ST-T promene ili novi blok leve grane Hisovog snopa (LBBB), razvoj patoloških Q zubaca, dokaz imidžing metodom novonastalog gubitka vijabilnosti miokarda i poremećaj regionalne pokretljivosti zida, identifikacija koronarnog tromba na angiografiji ili autopsiji,

2. *Odsustvo opstrukcije koronarnih arterija,*

3. *Odsustvo jasnog kliničkog uzroka za AMI prezentaciju [19,20].*

Uzroci porasta troponina, kao najsenzitivnijih markera, mogu biti različiti i svrstani na koronarne i nekoronarne uzroke. Koronarni uzroci su: vazospastična angina, koronarna mikrovaskularna disfunkcija, ruptura/erozija aterosklerotskog plaka, spontana koronarna tromboza ili embolija, previđena opstruktivna CAD. Nekoronarni uzroci mogu biti kardijalni poremećaji: Miokarditis, Takotsubo kardiomiopatija, druge kardiomiopatije (dilatativna, hipertrofična) i nekoronarni poremećaji kao što su embolija pluća, bubrežna insuficijencija i sepsa [21,22]. Neophodan je individualni pristup u terapiji.

Naša pacijentkinja se javila sa novonastalim bolom u grudima, uočenim plitkim ST depresijama na EKG zapisu. Hospitalizovana je u jedinici intenzivne nege, lečena po protokolu za non STEMI akutni koronarni sindrom. Urađena je koronarografija nakon koje je shvaćena kao MINOCA. Sve vreme je bez ponovljenih stenokardija i bez dinamičkih

elektrokardiografskih promena. Opuštena je sa predlogom mera higijensko-dijetetskog režima i medikamentoznom terapijom. Urađena je edukacija pacijenata o značaju održavanja idealnog indeksa telesne mase, pravilnoj ishrani bogatoj voćem i povrćem, značaju svakodnevne umerene fizičke aktivnosti, postizanju ciljnih vrednosti krvnog pritiska i holesterola.

ZAKLJUČAK

Infarkt miokarda sa neopstruktivnom koronarnom bolešću (MINOCA) predstavlja relativno nov entitet u kardiologiji i obuhvata heterogenu grupu pacijenata koji nemaju značajnu opstrukciju koronarne arterije na angiogramu. Cilj rada je ukazivanje na MINOCA-u kao relativno nov entitet u kardiologiji, na značaj rane dijagnoze i pravovremenog lečenja, kao i primena primarne i sekundarne prevencije kardiovaskularnih bolesti uz modifikaciju faktora rizika za iste. Prikazana pacijentkinja je na osnovu simptoma stenokardije i depresije ST segmenta na EKG shvaćena kao klasični akutni koronarni sindrom bez perzistentne ST elevacije a uz jako povišene vrednosti troponina, kao infarkt miokarda sa verovatnom teškom koronarnom stenozom ili okluzijom. Međutim, uredan nalaz na koronarografiji je uvrstio u relativno ređu grupu MINOCA. Pacijentkinja je lečena po protokolu za akutni koronarni sindrom i u daljem toku hospitalizacije nije bilo komplikacija. Opuštena je na dalje kućno lečenje uz medikamentoznu terapiju, uključujući dvojni anti-trombotičnu terapiju i savet o merama higijensko-dijetetskog režima, u cilju modifikacije faktora rizika. Predloženo je pacijentkinji da se redovno kontroliše i upućena je na magnetnu rezonancu srca ispitivanje koje bi po algoritmu za MINOCA-u rasvetlilo uzrok infarkta.

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in women, as well as in patients presenting as NSTEMI [4]. The criteria for diagnosing MINOCA are:

1. *Criteria for diagnosing acute myocardial infarction:*
 - a) Positive cardiac biomarkers (preferably cardiac troponin);
 - b) Clinical evidence of myocardial infarction, including: ischemic symptoms, new or presumed new significant ST-T changes or new left bundle branch block (LBBB), development of pathological Q waves, evidence by imaging method of newly developed myocardial viability loss and impaired regional wall motion, identification of coronary thrombus on angiography or autopsy,
2. *Absence of coronary artery obstruction,*
3. *Absence of a clear clinical cause for the AMI presentation [19, 20].*

The causes of troponin elevation, as the most sensitive markers, can be divided into coronary and non-coronary causes. Coronary causes include: vasospastic angina, coronary microvascular dysfunction, rupture/erosion of an atherosclerotic plaque, spontaneous coronary thrombosis or embolism, and overlooked obstructive CAD. Non-coronary causes can be cardiac disorders: myocarditis, Takotsubo cardiomyopathy, other cardiomyopathies (dilated, hypertrophic), and non-cardiac disorders such as pulmonary embolism, renal insufficiency, and sepsis [21, 22]. An individualized approach to therapy is essential.

Our patient presented with new-onset chest pain and was observed to have shallow ST depressions on the ECG. She was hospitalized in the intensive care unit and treated according to the non-STEMI acute coronary syndrome protocol. Coronary angiography was performed, after which she was diagnosed with MINOCA. Throughout the course, she had no recurrent

angina and no dynamic electrocardiographic changes. She was discharged with recommendations for hygiene-dietary regime measures and pharmacological therapy. Patient education was provided on the importance of maintaining an ideal body mass index, a diet rich in fruits and vegetables, the significance of daily moderate physical activity, and achieving target blood pressure and cholesterol levels.

CONCLUSION

Myocardial infarction with non-obstructive coronary artery disease (MINOCA) is a relatively new entity in cardiology and encompasses a heterogeneous group of patients who do not have significant coronary artery obstruction on angiography. The aim of this paper is to highlight MINOCA as a relatively new entity in cardiology, the importance of early diagnosis and timely treatment, as well as the application of primary and secondary prevention of cardiovascular diseases with modification of risk factors. The presented patient, based on the symptoms of angina and ST segment depression on the ECG, was initially diagnosed as a classic acute coronary syndrome without persistent ST elevation but with significantly elevated troponin levels, as a myocardial infarction with probable severe coronary stenosis or occlusion. However, the normal coronary angiography result classified her into the relatively rare MINOCA group. The patient was treated according to the acute coronary syndrome protocol, and during the course of hospitalization, there were no complications. She was discharged for further home treatment with pharmacological therapy, including dual antiplatelet therapy, and advice on hygiene-dietary measures to modify risk factors. The patient was advised to have regular check-ups and was referred for cardiac magnetic resonance imaging, which, according to the MINOCA algorithm, would clarify the cause of the infarction.

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