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Original article

First decade of cardiac catheterization laboratory at the Health Center Užice

Vuk Mijailović[1], Olivera Mićić[1], Katica Mraković[1], Branko Tomić[1], Milan A. Nedeljković[2]
[1]Health center Užice, General hospital Užice, Cardiology ward, [2]Clinical center of Serbia, Clinic of cardiology

Abstract

Introduction. Coronary artery disease is the most common cause of death in Serbia and worldwide. Percutaneous coronary intervention (PCI) is the optimal method of treating acute coronary syndrome in most cases. This method became available in the Health center Užice (HC) of Užice from 12.12.2011.

Objective. Presentation of work in cardiac catheterization laboratory in HC Užice.

Methods. This paper includes all patients who underwent coronarography, elective and primary PCI in cath lab in HC Užice in the period from 12.12.2011. to 01.07.2021. A total of 8245 patients were included, of which 1923 patients with ST elevation myocardial infarction (STEMI) and 713 patients with a non-ST elevation myocardial infarction (NSTEMI).

Results. Total of 8245 procedures were performed. Out of that were 5294 diagnostic coronarography, 1291 primary PCIs, 1652 elective PCIs. The number of procedures increases by 5% per year until year 2016 and after that it was stagnant. Out of 1923 patients with STEMI, a total of 1708 (88.82%) patients received reperfusion therapy. In 67.1% of STEMI patients in primary PCI was used, and 21.7% of patients received thrombolytic therapy. Total mortality in STEMI patients was 5.61%. 79.5% of patients with NSTEMI underwent coronarography during the same hospitalization.

Conclusion. Opening of cardiac catheterisation laboratory in GH Užice has improved the diagnosis and treatment of coronary disease. The introduction of primary PCI reduced the mortality of patients with STEMI. Organizing full 24/7 availability of primary PCI is still a goal that we are striving for.

Key words cardiac catheterization laboratory, primary PCI

Introduction

Cardiovascular diseases (CVD) are the most common cause of death in the world with 12.8% of total mortality[1]. In Europe, one in six men and one in seven women die from myocardial infarction[2].

Intrahospital mortality in patients with acute ST-segment elevation myocardial infarction (STEMI) ranges from 6% to 14%, and in Serbia it is 9.9%[2]. Of this number of deaths, 40% are patients younger than 75 years.[3]

Acknowledging the fact that CVD are the most common chronic diseases that have been the leading cause of death in developed countries since 1950, and in developing countries since 2001[4,5], we can conclude that cardiovascular disease, and especially acute coronary syndrome (ACS), currently represents the largest burden on health systems worldwide[6,7]).

According to official recommendations European and American Association of Cardiologists, based on a large number of clinical studies[8,9,10,11,12,13,14], for the treatment of acute coronary syndrome, percutaneous coronary intervention is the method of first choice.

In Serbia, in 2009, only 19% of patients with STEMI were treated with the primary PCI (Figure 1), according to which Serbia took one of the last places. In the same year, the "Stent for life" initiative was launched[15] with the task of improving the availability of primary PCI, thus reducing mortality and morbidity in patients with acute ST-elevation myocardial infarction (STEMI).

As one of the participants in this initiative, Serbia, with the support of the Association of Cardiologists of Serbia and the Ministry of Health, has started a program to create a network of cardiac catheterization labs throughout our country.

Cardiac catheterization lab in The Health Center (HC) in Užice started operating on 12.12.2011. All residents of the Zlatibor district, which according to the latest census has 335,826 in ten municipalities of this district (Table 1) and to some extent residents of the municipality of Ivanjica (35,445 inhabitants) gravitate to the heart catheterization lab of the HC in Užice.

Methods

This study included all elective coronary angiography and PCI procedures, as well as all procedures performed on patients diagnosed with acute coronary syndrome: myocardial infarction with ST elevation (STEMI), infarction without ST elevation (NSTEMI) and unstable angina pectoris (NAP) in the period from 12.12. 2011. to 01.07.2021. in the cath lab in HC Uzice. Elective coronary angiography was performed in patients who had signs

Address for correspondence: Vuk Mijailović, Kneginje Ljubice 1, Užice, +381642475760. E-mail: vuk.mijailovic@yahoo.com

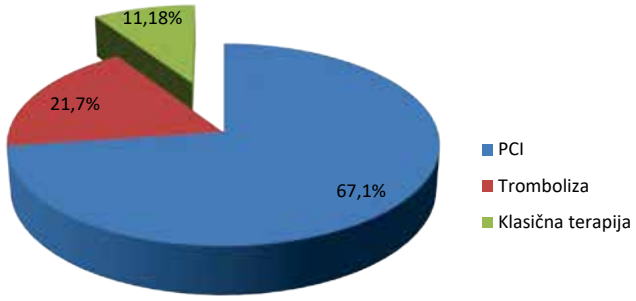

Figure 1. STEMI patients according to the method of treatment

of coronary artery disease on non-invasive cardiac diagnostics, as well as in the evaluation of heart failure, arrhythmias, preoperatively in valvular defects. 1923 patients with STEMI with a mean age of 66.4 ± 1158 years and 713 patients with NSTEMI with a mean age of 61.9 ± 10.8 years were included. The diagnosis of STEMI was made based on the presence of at least two of three criteria: symptoms of ischemia, ST elevation greater than 1mm in at least two ECG leads or a newly formed block of the left branch of the His bundle, elevated values of myocardial necrosis markers at least once (creatine kinase> double reference values, troponin I> 0.1 μg / L)[16]. The diagnosis of NSTEMI was made based on the presence of at least two of three criteria: symptoms of ischemia, ST-segment depression or T-wave negativity of 1 mm or more in at least two ECG leads, elevated myocardial necrosis marker values at least once (creatine kinase> double reference values, troponin I> 0.1 μg / L)[17]. Data were obtained from the medical documentation of HC Užice and Microsoft Exel database made in the angiosal of GH Užice, and were analyzed by descriptive statistics methods. The obtained results are presented graphically and tabelarly.

The primary goals of cath lab work in HC Užice are identical to the previously set ones: to increase the number of procedures, increase the number and percentage of patients with STEMI treated with the primary PCI, organize the availability of primary PCI 24 hours seven days a week.

Table 1. Number of inhabitants by municipalities of Zlatibor district

City	Number of citizens
Užice	78018
Prijepolje	36713
Požega	29488
Priboj	27127
Bajina Basta	26043
Sjenica	25248
Arilje	18725
Nova Varoš	16728
Čajetina	14726
Kosjerić	12083

These secondary goals are continuously current: gradual increase of complexity of interventions, increase of number of interventions performed by transradial approach, education of sufficient number of interventional cardiologists capable of independent work, establishment of cooperation with geographically close municipalities, education of medical staff on prehospital treatment of patients with ACS.

Results

Since the opening of the catheterization room on December 12, 2011, it has been in HC Uzice. to 01.07.2021. 8245 procedures were performed, of which 5294 diagnostic coronary angiographies, 1291 primary PCI, 1652 elective PCI. 3784 stents were implanted (Table 2).

In the period up to nine and a half years, 1923 patients with STEMI were treated in HC Uzice. A total of 1708 (88.82%) patients received reperfusion therapy (mechanical or pharmacological), and 215 patients (11.18%) received classical therapy. STEMI patients treated with reperfusion therapy were treated with mechanical reperfusion in the catheterization laboratory by primary PCI in 1291 cases (75.6% and 67.1% of the total number of STEMI) were treated, while in 417 (24.4% and 21.7% of the total number of STEMI) patients received thrombolytic therapy (Table 3, Figure 1).

Table 2. Number of procedures and stents used in Cath lab in HC Užice

Year	Total procedures	Diagnostic coronary angiography	Primary PCI	Elective PCI	Stents
12.2011	65	46	3	16	22
2012	899	595	139	165	331
2013	953	629	180	144	307
2014	1013	602	176	235	448
2015	1063	703	180	180	450
2016	652	447	105	100	270
2017	964	623	134	207	518
2018.	824	543	104	177	341
2019.	770	503	90	177	396
2020	674	395	120	169	475
07/01/2021	368	226	60	82	226
Total	8245	5294 (64,2%)	1.291 (15,7%)	1.652 (20,0%)	3784

Table 3. Division of STEMI according to the method of treatment

Year	STEMI	Primary PCI	Thrombolysis	Total reperfusion therapy	Classical therapy
2012	198	142 (71.71%)	36 (18.18%)	178 (89.90%)	20 (10.10%)
2013	242	180 (74.38%)	40 (16.52%)	220 (90.9%)	22 (9.10%)
2014	230	176 (76.52%)	34 (14.78%)	210 (91.3%)	20 (8.7%)
2015	250	180 (72%)	45 (18%)	225 (90%)	25 (10%)
2016	145	105 (72.41%)	25 (17.24%)	130 (89.60%)	15 (10.34%)
2017	224	134 (59.37%)	61 (26.79%)	195 (86.16%)	29 (13.4%)
2018.	186	104 (55.42%)	64 (35.54%)	168 (90.96%)	18 (9.03%)
2019.	190	90 (47.37%)	65 (34.21%)	155 (81.57%)	35 (18.42%)
2020	165	120 (72.72%)	31 (18.79%)	151 (91.52%)	14 (8.48%)
07.2021.	93	60 (64.51%)	16 (17.20%)	76 (81.7%)	17 (18.28%)
Total	1923	1291 (67.1%)	417 (21.7%)	1708 (88.82%)	215 (11.18%)

STEMI - myocardial infarction with ST elevation; PCI - percutaneous coronary intervention

Table 4. Number of NSTEMI that underwent coronarography each year

Year	NSTEMI	Coronary angiography
2012	60	55
2013	66	61
2014	65	55
2015	49	43
2016	53	23
2017	104	84
2018.	94	78
2019.	108	65
2020	78	70
07/01/2021	36	33
Total	713	567 (79.5%)

NSTEMI - myocardial infarction without ST elevation

Table 5. Total in-hospital mortality of patients with STEMI

Year	Total in-hospital mortality in patients with STEMI	Total STEMI
2012	12 (6.06%)	198
2013	18 (7.43%)	242
2014	14 (6.08%)	230
2015	13 (5.20%)	250
2016	8 (5.51%)	145
2017	9 (4.02%)	224
2018.	11 (5.91%)	186
2019.	14 (7.37%)	190
2020	13 (7.88%)	165
07/01/2021	4 (4.30%)	93
Total	108 (5.61%)	1923

STEMI-myocardial infarction with ST elevation

Of the 713 patients treated for non-ST elevation infarction (NSTEMI), in 567 cases (79.5%) coronary angiography was performed within 72 h. (Table 4). The method of further treatment of patients with NSTEMI is shown in Figure 2: most patients were treated by PCI (40%), about a third (35%) were referred to a cardiac surgeon consultation with a recommendation for surgical myocardial revascularization, and every fourth was advised to continue medication therapy without revascularization.

Total in-hospital mortality in patients with STEMI is shown in Table 5, and mortality according to the method of STEMI treatment in Table 6. Total mortality in patients with STEMI is 5.61%, the highest was during 2020 (7.88%). There is a significant difference in mortality between groups of patients divided according to the method of STEMI treatment. The lowest mortality is in the group of patients treated with mechanical reperfusion, while the highest is in the group of patients not treated with any form of reperfusion therapy.

In the initial years of cath lab operation in HC Užice, the primary vascular approach was the right femoral artery. Since 2017, the use of the transradial approach has gradually increased, and in 2020, the transradial approach is used in 90.2% of procedures (Table 7).

Currently four doctors-interventional cardiologists, six medical technicians and three X-ray technicians are employed.

Early administration of dual antiplatelet therapy (DAT) is recommended in the latest ESC guide. There is a consistently high percentage of patients given DAT prehospitally (Table 8).

Discussion

Cardiovascular diseases are a health problem of the highest priority for the Republic of Serbia as a group of diseases with the greatest impact on morbidity and mortality[18].

The recommendations of the European Society of Cardiology (ESC)[21] and the American Society of Cardiology (AHA)[22] summarize the results of a large number of publications on the role of PCI in the treatment of patients with ACS. According to these recommendations, patients with ACS without ST elevation should be treated with early PCI depending on their risk of developing ST elevation infarction or death. In STEMI, primary PCI is the recommended treatment if available within 120 minutes of first contact with medical staff, and patients

Table 6. Mortality by STEMI treatment

Year	Primary PCI	Thrombolysis	Classical therapy	Total
2012	5/142	2/36	5/20	12/198
2013	7/180	5/40	6/22	18/242
2014	7/176	3/34	4/20	14/230
2015	6/180	2/45	5/25	13/250
2016	3/105	2/25	3/15	8/145
2017	3/134	3/61	3/29	9/224
2018.	4/104	3/64	2/18	11/186
2019.	4/90	5/65	4/35	14/190
2020	5/120	4/31	2/14	13/165
07/01/2021	2/60	1/16	1/17	4/93
Total	46/1291 (3.56%)	30/417 (7.2%)	33/215 (15.35%)	108/1923 (5.61%)

STEMI - myocardial infarction with ST elevation; PCI - percutaneous coronary intervention

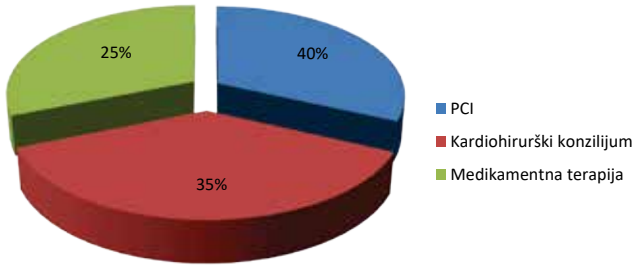

Figure 2. Further treatment of patients with NSTEMI after coronarography

treated with thrombolytic therapy should be transferred for coronary angiography within 24 hours to the nearest PCI center[20].

From the beginning of the operation of the cardiac catheterization room, the residents of the Zlatibor district and its surroundings, in accordance with the previously mentioned recommendations, were given the possibility of treatment with STEMI using the primary PCI method. From the beginning there is a hybrid treatment regimen for STEMI patients: primary PCI in HC Užice is available from Monday from 07h to Friday at 13h, and from Friday from 13h to Monday at 07h primary PCI is not available and then STEMI patients are treated with thrombolytic or classical therapy according to current recommendations[20].

The primary goal of increasing the number of interventions performed annually was achieved with a constant increase until 2016, with the desired increase in the number of procedures by 5% per year. The projected optimal number of all procedures for the coming years is 1200 per year, of which 200 are primary PCI, which would meet the needs of patients who gravitate to us. However, from 2016 to 2021, the number of procedures varies greatly with the trend of stagnation. This trend is mostly caused by frequent technical failures of the cath lab lasting from one to six months. In the period 12.07.2016. to 10.05.2019 the catheterization laboratory was out of order for a total of 15 months. During 2020, the total number of interventions was affected by the Covid19 pandemic, so we have data that during the five months of the pandemic, only 77 procedures were performed, of which 43 were primary PCI.

There is a significant variation in the number of elective PCI procedures, which in the first years of our work was mainly conditioned by the number of stents that were determined for our cath lab by national tender, and later the number of elective PCIs was also related to the technical correctness of cath lab (Table 2).

The number of primary PCIs quickly reached 180 procedures per year during 2015. After 2015, primary PCIs were less frequently performed for already mentioned reasons. During the previous nine and a half years, an average of 67.13% of patients with STEMI were treated with primary PCI. In this way, one of the goals of the "Stent for Life" initiative, to treat more than 70% of patients with STEMI with PCI, has been largely achieved.

Table 7. Frequency of transfemoral and transradial approach

Year	Total number of procedures	Transfemoral approach	Transradial approach
2012	964	941 (97,6%)	23 (2,4%)
2013	953	926 (96,1%)	37 (3,9%)
2014	1013	947 (93,5%)	66 (6,5%)
2015	1063	1005 (94,5%)	58 (5,5%)
2016	652	606 (92,9%)	46 (7,1%)
2017	964	673 (69,8%)	291 (30,2%)
2018.	824	425 (51,6%)	399 (48,4%)
2019.	770	153 (19,9%)	617 (80,1%)
2020	674	107 (15,6%)	567 (84,4%)
07/01/2021	368	36 (9,8%)	332 (90,2%)
Total	8245	5089 (70,5%)	2436 (29,5%)

Table 8. Prehospital administration of dual antiplatelet therapy in patients with STEMI

Year	Prehospital administration of dual antiplatelet therapy	Number of STEMI treated with primary PCI
2012	104 (73.23%)	142
2013	154 (85.55%)	180
2014	170 (96.6%)	176
2015	167 (92.77%)	180
2016	99 (93.4%)	105
2017	130 (97.01%)	134
2018.	99 (95.19%)	104
2019.	86 (95.55%)	90
2020	108 (90.0%)	120
07/01/2021	55 (91.67%)	60
Total	1172 (90.78%)	1291

STEMI - myocardial infarction with ST elevation

It should be noted that a number of patients were treated with thrombolytic therapy, so that 88.8% of all patients with STEMI received some form of reperfusion therapy. For further increase the number of primary PCI it is necessary to enable the availability of primary PCI during the weekend, as well as to improve cooperation with hospitals outside Užice in the Zlatibor region.

The last of the primary goals is the availability of cath lab 24 hours a day, seven days a week. To achieve this goal, it is necessary to increase the number of employees in the cath lab and constantly work on their further education while ensuring the long-term technical correctness of the cath lab.

The total intrahospital mortality in patients with STEMI in OB Užice is 5.61% (in the national registers of ESC mortality in STEMI varies from 6 to 14%)[18,22]. The efficacy of cath lab can best be demonstrated by the difference in mortality in patients with STEMI in relation to the method of their treatment. Patients treated with primary PCI had a mortality of 3.56%, those who received thrombolytic therapy 7.2%, while patients who did not receive reperfusion therapy had a mortality of 15.35%. Reperfusion therapy is usually not prescribed due to the late presentation of the patient to the doctor (more than 12 hours from the onset of symptoms), or the existence of some of the contraindications for thrombolytic therapy.

Patients with NSTEMI underwent coronary angiography within the same hospitalization in 79.5% of cases. According to current ESC recommendations and GRACE soon coronary angiography was performed in a period of one to three days. After coronary angiography, 35% of patients were referred for cardiac surgery to a tertiary institution, 40% were treated with PCI, and 25% were recommended to continue drug therapy without revascularization. In the treatment of NSTEMI patients, more frequent use of the PCI method is noticeable over the years.

The ESC recommendations for the treatment of ACS (20) give preference to the transradial vascular approach when performing PCI procedures. In the initial period, the primary access point in our cath lab was the right femoral artery. Since 2017, a significant increase in the number of transradial interventions has been noticed, which in 2021 reached the application in 90.2% of cases. The left radial artery is increasingly used as a secondary vascular approach.

There are currently four doctors, three X-ray technicians and six six medical technicians working in the cath lab. All doctors are interventional cardiologists capable for independent work. The plan is to have six interventional cardiologists capable of working independently in the cath lab, which would enable 24/7 readiness of the angio team. It is also necessary to train at least two more medical technicians and one X-ray technician to work in the cath lab.

Number of STEMI patients outside the territory of the city of Užice is growing from year to year. There is good cooperation with emergency services.

Prehospital antiplatelet drugs administration (Acetylsalicylic acid 300mg and Clopidogrel 600mg or Ticagrelor 180mg), immediately after the diagnosis of ACS, has been at a high level for several years. Thanks to the fact that we are always in direct telephone contact with the doctor who makes diagnose in the field, almost 100% prehospital administration of dual antiplatelet therapy in patients with STEMI has been achieved, in accordance with current ESC recommendations (16). Patients with STEMI are referred directly to the cath lab without delays in the emergency department or coronary care units.

Conclusion

The work of the cardiac catheterization room at the Uzice Health Center has improved and accelerated the diagnosis and treatment of all forms of coronary heart disease. The introduction of primary PCI reduced mortality in patients with STEMI. Organizing the non-stop availability of primary PCI is still the goal we need to achieve.

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Sažetak

Prva dekada rada sale za kateerizaciju u Zdravstvenom centru Užice

Vuk Mijailović[1], Olivera Mićić[1], Katica Mraković[1], Branko Tomić[1], Milan A. Nedeljković[2]

[1]Zdravstveni centar Užice, Opšta bolnica Užice, Kardiološko odeljenje [2]Univerzitetski Kliničcki centar Srbija, Klinika za kardiologiju

***Uvod**. Oboljenja srčanih krvnih sudova predstavljaju najčešći uzrok smrti u Srbiji i u svetu. Prekutana koronarna intervencija (PCI) je predstavlja optimalni načina lečenja akutnog koronarnog sindroma u većini slučajeva.Ova metoda je postala dostupna u Zdravstvenom centru (ZC) Užice od 12.12.2011. godine.*

***Cilj rada.** Prikazivanje rezultata u rada Angiosale u ZC Užice.*

***Metod**. U ovaj rad su uključeni svi bolesnici kod kojih je uradjena koronarografija, elektivna i primarna PCI u angiosali u ZC Užice u periodu od 12.12.2011. do 01.07.2021. godine. Uključen je ukupno 8245 bolesnika, od čega bolesnika sa infarktom sa ST elevacijom (STEMI) 1923 i 713 bolesnika sa infarktom bez ST elevacije (NSTEMI).*

***Rezultati.** Uradjeno je 8245 procedura. Od toga 5294 dijagnostičkih koronarografija, 1291 primarna PCI i 1652 elektivne PCI. Broj procedura raste za 5% godišnje do 2016. godine., zatim stagnira. Od 1923 bolesnika sa STEMI, reperfuzionu terapiju je dobilo 1708 (88,82 %) bolesnika, kod 67,1% je primenjena primarna PCI, a kod 21,7% bolesnika trombolitička terapija. Ukupni mortalitet kod pacijenata sa STEMI je 5,61%. Bolesnici sa NSTEMI su koronarografisani u okviru iste hospitalizacije u 79,5% slučajeva.*

***Zaključak.** Otvaranje angiosale u OB Užice je unapredilo dijagnostiku i lečenje koronarne bolesti. Uvođenje primarne PCI smanjilo je smrtnost bolesnika sa STEMI. Organizovanje non-stop dostupnosti primarne PCI je dalje cilj koje i dalje težimo.*

***Ključne reči:** sala za kateterizaciju srca, primarna PCI*