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Case report

# Interventional cardiology in Serbia during COVID-19 pandemic for the period of 2019-2022

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**Abstract**

**Background:** The aim of this study was to analyze the trends in catheterization laboratory procedures during COVID-19 pandemic for the 2019-2022 period.

**Methods**: Presentation of results in the interventional treatment of coronary artery disease and, to a lesser extent, structural heart diseases procedures in Cath Labs in Serbia in the 2019-2021 period.

**Results**: In 2019, in the territory of the Republic of Serbia, interventional cardiology practice was carried out in 17 centers (of which 10 tertiary and 7 secondary level health care centers within general hospitals) with a total of 28 cardiac catheterization labs. Meanwhile, general hospital Novi Pazar and Cuprija cath lab also started to work, so that there are currently 19 state owned centers in the territory of the Republic of Serbia where interventional cardiology procedures are carried out.

In 2019, a total of 47,522 procedures were performed in all Cath Labs, of which: 30,884 coronary angiographies, 16,658 PCI procedures, 1,601 emergency (without STEMI) procedures, 5,345 primary PCI procedures with 24,879 stents implanted, as well as 26 TAVR procedures and 68 percutaneous ASD closure procedures. A total of 96 specialist doctors worked in these labs, along with 38 fellows in training. During 2020, there were a total of 31,052 procedures in all Cath Labs, of which: 19,260 coronary angiographies, 11,792 PCI procedures, 1,299 emergency PCI (without STEMI), 4,807 primary PCI procedures, and 17,499 stents implanted, plus 10 TAVR procedures and 54 percutaneous ASD closures. 109 specialist doctors and 28 fellows in training worked in all labs. In 2021, a total of 37,042 procedures were performed in all labs, including: 24,055 coronary angiographies, 12,987 PCI procedures, 2,248 emergency (without STEMI) PCI procedures, and 5,006 primary PCIs, plus 23 TAVR procedures and 59 percutaneous ASD closures. 110 specialist doctors and 28 fellows in training worked in all labs. In the first 9 months of 2022, a total of 155 TAVR procedures were performed, of which 122 were performed at the ICVD "Dedinje", 17 at the ICVD "Vojvodina" and 16 at the University Clinical Center of Serbia.

**Conclusion**: The work results in the field of interventional cardiology in Serbia are comparable to European countries, in many segments even with the most economically developed among them. A significant drop in the number of procedures performed in 2020 at the expense of elective procedures is noted, as an unequivocal impact of the COVID19 pandemic and an increase after that with a tendency to return to the pre-pandemic level.

**Key words** PCI, TAVR, COVID-19, STEMI network

## Introduction

The era of development of interventional cardiology, which in addition to diagnostics involves therapeutic, percutaneous procedures on the heart and coronary arteries in the world, begins with the successful performance of the first balloon angioplasty by Andreas Gruntzing in Zurich on September 16, 1977[1]. Then percutaneous coronary balloon angioplasty was performed on an isolated lesion of the proximal LAD in a 38-year-old man with symptoms of stable coronary artery disease[1]. It is interesting that this patient was asymptomatic for the next 23 years and that when the symptoms reappeared in 2001, recoronarography was performed, which revealed that the previously treated coronary artery was patent[2]. However, initially the procedure itself was accompanied by frequent complications: 5-10% of patients had early stent thrombosis due to elastic recoil of the blood vessel, and up to 30% had clinically significant restenosis after 6 months of follow-up. With the later appearance of bare metal stents (FDA approved in 1987) and then drug-eluting

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stents (DES), which were first FDA approved in 2003, there was a significant reduction in the rate of stent thrombosis and restenosis, leading to increasing number of procedures performed all over the world[3]. The first coronary balloon angioplasty in Serbia was performed in December 1981 at IKVD "Dedinje", and in the decades that followed, these procedures became widespread and new Cath Labs started to work in all regions of Serbia. The procedure of transcatheter implantation of a biological aortic valve (TAVR) was first performed in the world by Alan Cribier in Rouen on April 16, 2003[4], and since 2014, this procedure has been successfully performed in Serbia, and the first case series were published in Vojnosanitetski pregled in 2014[5]. The aim of this study was to analyze Cath Lab procedure trends in Serbia in the period of 2019-2022, during COVID-19 pandemic.

## Methods

We presented the results of the invasive/interventional treatment of coronary artery disease and, to a lesser extent, structural heart diseases in the Cath Labs in Serbia in the period of 2019-2022. The presented data are indexed according to the size of the gravitating population and compared with the number and structure of procedures done in European countries.

## Results

In 2019, on the territory of the Republic of Serbia, interventional cardiology practice was carried out in 17 centers (of which 10 tertiary and 7 secondary level within general hospitals) with a total of 28 cardiac catheterization labs. In the following 2020, the practice took place in 17 centers (10 tertiary and 7 secondary level health care), with the difference that in this calendar year, for technical reasons, there was no work in the General hospital of Čačak, and unlike the previous year, the practice was carried out in General hospital of Leskovac. In 2021, the practice was carried out in all 18 available centers in the state owned health care system along with one hospital from the private health sector (Achi Badem - Bellmedic). Meanwhile, the General hospital of Novi Pazar and Cuprija Cath Lab also started working, so there are currently 22 centers in the territory of the Republic of Serbia where interventional cardiology procedures are performed (19 state owned and 3 private).

In 2019, a total of 47,522 procedures were performed in all Cath Labs, of which: 30,884 coronary angiographies, 16,658 PCI procedures, 1,601 emergency (without STEMI) procedures, 5,345 primary PCI procedures with 24,879 implanted stents, as well as 26 TAVR procedures and 68 percutaneous ASD closure procedures. A total of 96 specialist doctors worked in all labs, along with 38 fellows in training.

During 2020, there were a total of 31,052 procedures in all cath labs done, of which: 19,260 coronary angiographies, 11,792 PCI procedures, 1,299 emergency PCI (without STEMI), 4,807 primary PCI procedures, and 17,499 stents were used, plus 10 TAVI procedures and 54 percutaneous ASD closures were performed. 109 specialist doctors and 28 fellows in training worked in all labs.

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In the first 9 months of 2022, a total of 155 TAVR procedures were performed, of which 122 at the IKVD "Dedinje", 17 at the IKVD "Vojvodine" and 16 at the University Clinical Center of Serbia.

## Discussion

Data review on Cath Lab network in the Republic of Serbia shows a clear tendency to start new ones while continuing the work of existing centers. A look at the data shows that in 2020 there were 34.7% total procedures less, 29.2% fewer PCI procedures, 10.1% fewer primary PCI procedures, and 29.7% fewer stents implanted. This is a clear consequence of the COVID-19 pandemic outbreak, which led to a reduction in the number, especially of the elective procedures in the cath labs. The fact that the smallest reduction was in terms of primary PCI procedures indicates that, even in pandemic envioreement, the most severe patients with STEMI were optimally treated using mechanical reperfusion therapy in vast majority of cases. In the following 2021, fewer procedures were also recorded than in 2019: 22.1% fewer total procedures, 22.1% fewer coronary angiographies, 22% fewer PCI procedures and only 6.3% fewer primary PCIs. However, in 2021, there is a clear trend toward increase in the number of all procedures based on the year most affected by the COVID-19 pandemic and indicates a reorganization of the health system. The reduction in the procedural volume in the Cath Labs during the 2020 pandemic was a global phenomenon. European Association for Percutaneous Coronary Interventions organized the research through web questionnaire on the 1-15 of April 2020 period among its members, and found that 27% of responders admitted reduced number of coronary angiography/pPCI in STEMI patients, and 10% completely stopped performing interventions in STEMI patients. When it comes to NSTEMI, 38% reduced and 9% stopped work; in chronic coronary syndrome, 89% reduced and 51% of participants completely stopped working in the cath lab. As many as 48% of responders indicated that there was a delay in reperfusion time in STEMI patients, and 28% indicated that there was an increase in the number of patients with mechanical complications of myocardial infarction and cardiogenic shock, 22% indicated that there was an application of fibrinolytic therapy from logistic reasons dictated by the pandemic[6].

In order to assess the current state of interventional cardiology procedures in Serbia, the absolute number of interventions performed annually is best translated into a rate per million population. In 2020, the European Association for Interventional Cardiology published Atlas

Project - Mapping of Interventional Cardiology[7], a survey conducted at the level of 16 associations' member states with the data for 2016. We compared these data with the rates of procedures performed in our country for the (pre-pandemic) 2019 - in the year of 2019, there were 2.45 hospitals with Cath Lab per million population in Serbia. In the aforementioned survey, the average was 3.44 cath Labs/million population; going from 1 in Egypt to 4.9 in Greece. The total number of Cath Labs ranged from 1 in Egypt to 11.8/million in Germany, an average of 5/million inhabitants (in Serbia 4.03/million inhabitants). In Serbia, there are 1.58 hospitals with Cath Labs working 24/7 per million population, which is on average seen in the research (from 0.2 in Egypt to over 4 in Poland and Belgium; average 2/million population). In the countries covered by the survey, there were an average of 16.7/million population of interventional cardiologists; from 4.3 in Romania to 53.3 in Germany (13.8 in Serbia). 5 131/ million diagnostic coronary angiograms were performed; from 2,500 in Egypt to over 7,000 in Turkey and Germany (in Serbia 4,45/million people). On average, 2,5 PCI procedures were performed/million population; from under 1 in Egypt to over 3 in Switzerland, Poland and Germany (Serbia 2,4). Very heterogeneous data were obtained for primary PCI procedures - from 37 in Egypt to over 600/million in Slovenia, Germany, Netherlands and Poland. STEMI network in Republic of Serbia is well developed and functional which is indicated by the fact that in Serbia there were 770 primary PCI procedures per million population[7]. This number represents an excellent result because the age standardized incidence and prevalence of cardiovascular diseases in Serbia is comparable to countries that gravitate to the European Society of Cardiology (in Serbia 1,273 and 6,992 compared to 1,133 and 6,595 per 100,000 population in thes ESC region in 2017 age[8].

Although the authors of the ESC Atlas project emphasize a good correlation between the gross national income per capita as a surrogate of the economic power of a country and the achievements in the field of interventional cardiology; in the case of Serbia, the correlation is not so linear. With 5,700 USD per capita in 2016, it is among countries with a medium-high GBI, and among the countries included in the research, it would be in the penultimate place, above Egypt. Nevertheless, most of the parameters are around or above the average values, especially the number of primary PCIs, which speaks of the good organization of intereventional cardiology service and the dispersiveness of the national STEMI network.

There are also segments in which interventional cardiology in our country is below average of the countries of the ESC region. When it comes to the use of intracoronary imaging in Serbia, there were 52.27/million people of PCI procedures guided by OCT or IVUS. In the 16 countries of the ESC region, the average was 166/million PCIs guided by intracoronary imaging. In 2016, there were 48.2/million TAVR procedures in the mentioned countries, with over 100 in highly developed countries (Germany, France, Denmark, Switzerland). In the same year, 1 TAVI procedure was performed in Serbia (0.14/million population)[7]. However, the program of transcatheter implantation of the aortic valve in Serbia started in 2014, much later than in many European countries, and the first results were published in 2016 in Vojnosanitetski Pregled[5]. In the following years, the number increased so that in the first nine months of 2022, 155 of these procedures were performed in Serbia. If the proportional trend of the number of performed TAVR procedures were to continue until the end of the calendar year, the number would reach 29.76/million people per year, which brings our results closer to those of the ESC region. It can be expected that in the years to come, interventional treatment of structural heart diseases in Serbia will be equally represented as in the member countries of the European Society of Cardiology.

Another issue to consider is the number of procedures performed in an individual center with a Cath Lab. A larger volume means experience in the treatment of the clinicaly most serious patients and improves the outcome of the treatment[9]. According to the professional associations in Great Britain data, in the April 2019 - March 2018 period, there were 30% of centers with a Cath Lab that performed less than 400 procedures per year and 15.1% with less than 200 procedures[10]. In Serbia in 2019, 29.3% of centers performed less than 400 and 17.6% less than 200 procedures, which is comparable to one highly developed European country. Due to the impact of the COVID-19 pandemic and the entry of many centers with Cath Labs to work with COVID-19 patients in 2021, as many as 10 out of 19 hospitals with Cath Lab had less than 400 PCI procedures and 6 of them had less than 200.

## Conclusion

The results of the work in the field of interventional cardiology in Serbia are comparable to European countries, and in many segments with the most economically developed among them. A significant drop in the number of procedures performed in 2020 at the expense of elective procedures is noted, as an unequivocal impact of the COVID-19 pandemic and an increase after that with a tendency to return to the pre-pandemic levels.

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## Sažetak

***Interventna kardiologija u Srbiji za vreme COVID-19 pandemije za period 2019-2022***

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***Uvod:*** *Cilj rada je bio analiza trenda procedura u Sali za kateterizaciju u vremem COVID-19 pandemije za vreme 2019-2022 godina.*
***Metode:*** *Prikaz rezultata u interventnom lečenju koronarne arterijske bolesti i, u manjoj meri, strukturnih bolesti srca razgranate mreže angio sala u Srbiji u periodu 2019-2021. godine.*
***Rezultati:*** *U 2019. godini na teritoriji Republike Srbije interventna kardiološka praksa sprovođena je 17 centara (od toga 10 tercijernog i 7 sekundarnog nivoa zdravstvene zaštitite u sklopu opštih bolnica) sa ukupno 28 sala za kateterizaciju srca. U međuvremenu počela je sa radom i angio sala u OB Novi Pazar i OB Ćuprija tako da aktuelno na tertiriji Republike Srbije postoji 19 centara u vlasništvu države u kojima se sprovode interventno kardiološke procedure.*
*U 2019. godini u svim angio sala urađeno je ukupno 47 522 procedure od toga: 30 884 koronarografije, 16 658 PCI procedura, 1 601 hitna (bez STEMI) procedura, 5 345 primarnih PCI procedura uz 24 879 ugraađenih stentova. Urađeno je 26 TAVI procedura i 68 procedura perkutanog zatvaranja ASD-a. U svim salama radilo je ukupno 96 lekara specijalista uz 38 lekara na obuci. Tokom 2020. godine bilo je ukupno 31 052 procedure u svi angio salama a od toga: 19 260 koronarografija, 11 792 PCI procedure, 1 299 hitnih PCI (bez STEMI), 4 807 primarnih PCI procedura i pri tome utrošeno 17 499 stentova. Urađeno je 10 TAVI procedura i 54 perkutanih zatvaranja ASD-a. U svim salama radilo je 109 lekara specijalista i 28 lekara na obuci. U 2021. godini urađeno je u svim salama ukupno 37 042 procedure od toga: 24 055 koronarografija, 12 987 PCI procedura, 2 248 hitnih (bez STEMI) PCI procedura, 5 006 primarnih PCI. Urađeno je 23 TAVI procedura i 59 perkutanih zatvaranja ASD-a. U svim salama radilo je 110 lekara specijalista i 28 lekara na obuci.U prvih 9 meseci 2022. godine urađeno u ukupno 155 TAVI procedura od toga 122 na IKVB "Dedinje", 17 na IKVB "Vojvodine" i 16 u Univerzitetskom kliničkom centru Srbije.*
***Zaključak:*** *Rezultati rada u oblasti interventne kardiologije u Srbiji uporedivi su sa zemljama Evrope, u mnogim segmentima sa ekonomski najrazvijenijima među njima. Beleži se značajan pad broja izvedenih procedura u 2020. godini na račun elektivnih procedura, kao nedvosmislen uticaj COVID'19 pandemije i porast nakon toga sa tendencijom povratka na prepandemijski nivo.*

*Ključne reči: PCI, TAVI, COVID-19, STEMI mreža*