



## THE INFLUENCE OF THE PATIENT'S AGE ON THE DURATION OF THE PROCEDURE AND THE AMOUNT OF RADIATION DELIVERED WHEN PERFORMING DIAGNOSTIC CORONARY ANGIOGRAPHY

### UTICAJ DOBI PACIJENTA NA TRAJANJE PROCEDURE I KOLIČINU ISPORUČENOG ZRAČENJA PRI IZVOĐENJU DIJAGNOSTIČKE KORONARNE ANGIOGRAFIJE

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#### ABSTRACT

The aim of the research was to determine whether the age of the patient affects the duration of the procedure and the amount of ionized radiation delivered when performing diagnostic coronary angiography. The research was conducted at the Clinic for Invasive Cardiology of the Public Health Institution "University Clinical Center" Tuzla in the period from December 2018. to January 2020. The research included a total sample of 240 respondents, average chronological age of  $62.60 \pm 9.22$  years, ranging from 24 to 85 years. Out of a total of 240 respondents, in 121 respondents coronary angiography was performed using transradial arterial approach and 119 by performing a transfemoral arterial approach. The total sample was divided into two subsamples of respondents. The first sub-sample consists of respondents up to 65 years of age, and the second sub-sample consists of respondents over 65 years of age. During each performance of coronary angiography, the duration of the procedure (in minutes and seconds) and the amount of radiation delivered during the procedure (in mGy) were measured. The research data were processed using the method of parametric and non-parametric statistics. The Mann-Whitney U test was used to verify the research objective. Based on the obtained research results, it can be concluded that in patients over 65 years of age, the duration of the coronary angiography procedure is longer, and is at the limit of statistical significance ( $p= 0.057$ ). The amount of delivered radiation is higher in respondents over 65 years of age, but it is not statistically significant ( $p= 0.396$ ).

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**Keywords:** Coronary angiography, coronary disease, procedure duration, age, amount of delivered radiation.

## SAŽETAK

Cilj istraživanja je bio utvrditi da li dob pacijenta utiče na trajanje procedure i količinu isporučenog zračenja pri izvođenju dijagnostičke koronarne angiografije. Istraživanje je sprovedeno na Klinici za invazivnu kardiologiju JZU UKC Tuzla u periodu od decembra 2018. do januara 2020. godine. Istraživanjem je obuhvaćen ukupan uzorak od 240 ispitanika, prosječne hronološke dobi  $62,60 \pm 9,22$  godina raspona od 24 – 85 godina. Od 240 ispitanika 121 je urađen transradijalnim arterijskim pristupom a 119 transfemoralnim arterijskom pristupom. Ukupan uzorak je podijeljen na dva subuzorka ispitanika. Prvi subuzorak čine ispitanici do 65 godina starosti, a drugi iznad 65 godina starosti. Tokom svakog izvođenja koronarne angiografije mjerilo se vrijeme trajanja procedure (u minutama i sekundama) i količina isporučenog zračenja za vrijeme procedure (u mGy). Podaci istraživanja obrađeni su metodom parameterijske i neparametrijske statistike. Za provjeru postavljenog cilja istraživanja primjenio se Mann-Whitney U test. Na osnovu dobijenih rezultata istraživanja može se zaključiti da je kod pacijenata iznad 65 godina trajanje procedure koronarne angiografije duže, te je na granici statističke signifikantnosti ( $p= 0,057$ ). Količina isporučenog zračenja je veća kod ispitanika iznad 65 godina ali nije statistički signifikantna ( $p= 0,396$ ).

**Ključne riječi:** Koronarna angiografija, koronarna bolest, trajanje procedure, dob, količina isporučenog zračenja.

## INTRODUCTION

Coronary artery disease is a complex disease that reduces or completely stops blood flow through one or more arteries that supply the heart muscle, which leads to various clinical manifestations in the patient, including angina pectoris and acute coronary syndrome (ACS); (Williams, 2009).

Coronary angiography is the gold standard in the diagnosis of coronary artery disease. It is an invasive radiographic procedure in which a contrast agent (most often iodine) is injected through catheters placed at the ostia of the coronary arteries, which are visualized radiographically in order to detect stenosis or occlusions of the coronary arteries (Scanlon et al., 1999). Coronary angiography is an indisputable method for detecting significant flow-limiting stenosis, which can be revascularized by percutaneous interventions or surgically.

The rational use of coronary angiography as a diagnostic method implies a high percentage of finding critical stenosis on the coronary arteries, which is followed by percutaneous intervention.

In patients with severe symptoms or a clinical constellation suggesting a high risk condition, early invasive coronary angiography, without prior noninvasive assessment of the patient, may be a good strategy to identify potential lesions amenable to revascularization (Wijns et al., 2010). The methods used to perform invasive coronary angiography have improved significantly, resulting in lower complication rates and faster discharge of patients from the hospital. This is especially true if invasive coronary angiography is performed via the radial artery (Jolly et al., 2009).

Older people have more cardiovascular risk factors and a higher prevalence of ischemic disease than younger people, but due to age-related physiological changes, frailty and comorbidities, they are also more likely to experience procedural complications. Coronary angiography is generally safe to perform in the elderly. However, increased risks of bleeding, stroke, contrast-induced kidney injury, increased prevalence of peripheral arterial disease and tortuosity, chronic kidney disease, and decreased tolerance to sedatives and narcotics are factors that warrant attention. Despite certain risks and procedural difficulties, the elderly benefit from coronary angiography due to the higher prevalence of multi-vessel coronary disease and involvement of the left main, atypical presentations, and inconclusive noninvasive testing (Butany and Buja, 2016; Roberts and Shirani, 1998). Given that the need for coronary angiography in a patient is an adequate indication, regardless of age, previous studies focused more on the comparison of two arterial approaches (transfemoral and transradial) in the elderly population (Rouge et al., 2018; Alnasser et al., 2017). Currently, there are no studies that directly compare the duration of the coronary angiography procedure and the amount of delivered ionizing radiation, in relation to patient age, regardless of which arterial access was used.

Accordingly, the research question would be whether there is a difference in relation to the age of the patient and the duration of the coronary angiography procedure. Also, the goal is to determine whether there is a difference in relation to the amount of delivered radiation when performing diagnostic coronary angiography.

## **MATERIAL AND METHODS**

### **Sample of respondents**

The research was conducted at the Clinic for Invasive Cardiology of the Public Health Institution "University Clinical Center" Tuzla in the period from December 2018. to January 2020. The research included a total sample of 240 respondents, average chronological age  $62.60 \pm 9.22$  years, ranging from 24 to 85 years. Out of 240 patients, 137 (57.1%) respondents were male, and 103 (42.9%) respondents were female.

Out of a total of 240 respondents, in 121 coronary angiography was performed using transradial arterial approach and 119 by performing a transfemoral arterial approach.

Of the 121 respondents where transradial arterial approach was used, 69 (57%) were under the age of 65 and 52 (43%) were over 65 years old. Of the 119 respondents where transfemoral arterial approach was used, 65 (54.6%) were under the age of 65 and 54 (45.4%) were over 65 years old. Data were taken directly from the CATH lab. (catheterization laboratory) on a Phillips ALLURA XPER FD2 machine. All procedures were performed by one operator.

### **Measuring instruments**

During each coronary angiography, the duration of the procedure (in minutes and seconds) and the total amount of radiation delivered during the procedure (in mGy) were measured. The duration of the procedure is measured from the beginning of the palpation of the access artery on the prepared patient until the removal of the diagnostic catheter after the imaging is completed. For all coronary angiographies, six basic angiographic projections were made, and in case of need for better visualization of individual segments of arteries, one or two additional projections were made.

### **Data processing methods**

The research data was processed using the method of parametric and non-parametric statistics. The basic statistical parameters of the measure of central tendency, measure of dispersion were calculated, and the obtained results were presented in a table. Arithmetic mean, median and mode were calculated from measures of central tendency, and standard deviation, minimum and maximum results from measures of dispersion. The Mann-Whitney U test was used to verify the research objective. Research data were processed in the statistical package SPSS 20 for Windows.

## **RESULTS AND DISCUSSION**

The results in Table 1 show that the chronological age of the respondents is  $62.60 \pm 9.23$  years. The minimum and maximum age ranges from 24 to 85 years. The average total duration of the procedure is  $11.26 \pm 4.23$  minutes. The minimum and maximum duration of the procedure ranges from 4.58 to 32.19 minutes. The measures of symmetry (SK) are 1.55 and flatness (KU) is 4.58, which points to the conclusion that the data are positively asymmetric, and in terms of shape, the data distribution is elongated or leptokurtic.

The average amount of delivered radiation is  $217.07 \pm 83.61$  mGy, the minimum is 87.42 mGy, and the maximum is 502.11 mGy. The measures of symmetry and flatness are 0.75 and 0.34, which means that the data distribution is asymmetrical and flattened.

Given that the elderly population is generally burdened with more comorbidities, and especially due to the presence of generalized atherosclerosis, our results are somewhat expected. In practice, in elderly people, ensuring arterial access has proved to be more demanding, and due to the higher prevalence of generalized atherosclerosis and tortuosity in the arterial bed, the placement of the catheter to the ostia of the coronary arteries also proved to be more demanding. So far, we have not been able to find studies that directly compare the duration of the coronary angiography procedure and the amount of ionizing radiation delivered in relation to the age of the patients, regardless of which arterial approach was used. A large meta-analysis of nearly 20,000 patients from 2015. shows that the transradial arterial approach is associated with a small but significant increase in ionizing radiation exposure compared to the transfemoral arterial approach (Plourde et al., 2015). The same study also shows that the difference in radiation exposure decreases as years go past, which is probably related to the increase in the number of procedures due to greater acceptance of the transradial arterial approach, but also to technological progress.

Table 1. Measures of central tendency and measures of dispersion in relation to observed variables

Variables	AM	SE	MED	MOD	SD	SK	KU	MIN	MAX
Chronological age	62,60	0,60	64	70	9,23	-0,73	0,87	24	85
Total duration of the procedure (min.)	11,26	0,27	10,55	10,55	4,23	1,55	3,85	4,58	32,19
Amount of delivered radiation	217,07	5,40	205,63	110.11 <sup>a</sup>	83,61	0,75	0,34	87,42	502,11

Table 2 shows the results of descriptive statistics in relation to the age of the respondents and the variables related to "Total duration of the procedure" and "Amount of delivered radiation". The results show that the arithmetic values of both variables are higher in respondents over 65 years old in comparison to respondents up to 65 years of age. From the results, it can be concluded that the total duration of the procedure in respondents over 65 years old is longer and the amount of radiation is greater. In order to see if the differences are statistically significant, the results are shown in Table 3.

Table 2. The results of descriptive statistics in relation to the age of the respondents and the observed variables in the research

Variables	Age	N	M	SD	SE
Total duration of the procedure	up to 65 years old	135	10,71	3,57	0,31
	over 65 years old	105	11,96	4,88	0,48
Amount of delivered radiation	up to 65 years old	135	213,18	82,26	7,08
	over 65 years old	105	222,07	85,46	8,34

Based on the results shown in Table 3, it can be concluded that there is no statistically significant difference between respondents under 65 and over 65 years of age on the variables "Total duration of the procedure" and "Amount of delivered radiation". Although the results are not statistically significant, the results in relation to the variable "Total duration of the procedure" are at the limit of significance, which means that objectively it can be assumed that the performance of the coronary angiography procedure in patients over 65 years of age will take longer.

The fact that approximately the same percentage of patients in both age groups was operated with a transfemoral or transradial approach adds special significance to these results.

Table 3. Mann-Whitney U test results

Variables	Age	N	Average rank	Sum of ranks	Z	p
Total duration of the procedure	up to 65 years old	135	112.99	15253.50	-1.90	.057
	over 65 years old	105	130.16	13666.50		
Amount of delivered radiation	up to 65 years old	135	117.15	15815.00	-.84	.396
	over 65 years old	105	124.81	13105.00		

## CONCLUSION

Diagnostic coronary angiography is generally safe to perform in the elderly. However, increased risks of hemorrhage, stroke, contrast-induced renal injury, increased prevalence of peripheral arterial disease and tortuosity, chronic kidney disease, and decreased tolerance to sedatives and narcotics are factors that warrant attention.

Despite certain risks and procedural difficulties, the elderly benefit from coronary angiography because of the higher prevalence of multivessel coronary artery disease and left main coronary artery involvement, atypical presentations, and inconclusive noninvasive testing. From our research, it can be seen that at the level of statistical significance of 0.057, the total duration of the procedure increases as the age of the respondent increases.

That is to say that the procedure of coronary angiography in patients over 65 years of age takes longer, regardless of which arterial approach is used. The amount of delivered radiation is higher in respondents over 65 years of age, but it is not statistically significant ( $p= 0.396$ ).

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