

Physicians' acquaintance with a new procedure results in higher patient referral: experience of Kosovo in coronary angiography

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Abstract

The first coronary angiography in Kosovo was completed in 2003. We analyzed coronary angiographies performed in our center from October 2003 until October 2009 divided into two 3-year periods. The aims of our study were: to compare the number of coronary angiographies completed in the two periods; to evaluate the prevalence of normal coronary angiographies diagnosed in the first period compared to the second period; and to assess the prevalence of advanced coronary artery disease in the first three years compared to the last three years. This was a prospective angiography study that included 1,139 patients. The first group had 422 patients, who underwent the angiography procedure during the first three years, and the second group had 717 patients that went through the procedure during the last three years. In the first year, 109 coronary angiographies were completed, followed by 137, 176, 213, 218 and

286 ($P < 0.001$) procedures in the subsequent years. In the first period, a normal or near-normal coronary artery profile was found in 27% of patients, while this figure rose to approximately 39% in the second period ($P = 0.004$). Advanced coronary artery disease was found in 45% of the patients who underwent coronary angiography during the first three years, whereas this figure was only 24% of cases during the second period ($P < 0.001$). We believe that the availability of specialized resources and the physicians' familiarity with coronary angiography in our country influenced their decision to refer more patients for this procedure.

phy grew patients would be referred for this procedure at earlier stages of coronary artery disease.

Materials and Methods

We conducted a prospective angiography study from October 2003 until October 2009 on 1,139 patients. The study was completed in a private cardiology clinic in Vushtrri, Kosovo. We formed two groups; the first group included patients who underwent the procedure during the first three years and the second group included patients who underwent the procedure during the last three years.

Thorough histories were taken, and physical examination, laboratory tests and electrocardiogram (ECG) were performed on all patients included in the study. Informed consent was obtained from all the patients enrolled in the study.

Coronary angiography was performed using the standard Judkins technique with multiple orthogonal views. All angiograms were reported by two trained cardiologists. Angiography data included: location and severity of the coronary occlusion in the arterial tree. Vessels with a narrowing of 50% or greater were considered to have significant disease. In vessels that were occluded in multiple locations, the degree of narrowing was considered to be that of the most severe lesion. Only major coronary arteries, the left main (LM), right coronary (RCA), left anterior descending (LAD) and the circumflex arteries (Cx) were considered. Results were interpreted as: zero-vessel, one-vessel disease, two-vessel disease, and three-vessel or left main disease. Post-angiography recommendations were: no treatment, medical treatment, percutaneous coronary intervention (PCI) or CABG according to ACCF/SCAI/STS/AATS/AHA/ASNC criteria for appropriateness of revascularization.¹

Introduction

Coronary angiography was performed for the first time in Kosovo in 2003 in a small private clinic, some 30 km distant from the capital Prishtina. In the beginning, few patients underwent the procedure. As time passed, the number of procedures grew substantially.

We analyzed the coronary angiographies performed in our center from October 2003 until October 2009, divided into two 3-year periods. This was a prospective study and the data were collected for clinical and quality assurance purposes. Informed consent was obtained from each patient and the Internal Review Board approved the study.

The aims of our study were: i) to compare the number of coronary angiographies completed in the two periods; ii) to evaluate the prevalence of normal coronary angiographies diagnosed in the first period compared to the second period; iii) to assess the prevalence of advanced coronary artery disease the first three years compared to the last three years.

We hypothesized that the number of coronary angiographies would grow in the second period. On the other hand, we assumed that the number of patients requiring coronary artery by-pass grafting (CABG) would be higher in the first period and as physicians' awareness and familiarity with coronary angiogra-

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Statistical analysis

All values were expressed as mean±standard deviation (SD) or fractions. Comparison between parametric variables was performed using two-tailed unpaired t-test and the χ^2 test was used to evaluate categorical variables. For all tests, $P < 0.01$ was considered statistically significant. All statistical analyses were performed using statistical software (SSP, version 2.80, 2005).

Results

The study included 1,139 patients divided into two groups. The first group had 422 patients, who underwent the angiography procedure during the first three years and the second group had 717 patients who went through this procedure during the last three years. The two groups were similar with regard to gender, age, history of high blood pressure, diabetes mellitus, dyslipidemia, smoking, family history of myocardial infarction, prior history of myocardial infarction, and heart failure (Table 1). Male patients underwent coronary angiography more frequently than females, particularly during the first period (61.37% and 58.72%, respectively). Hypertension was the most prevalent cardiovascular risk factor, accounting for more than 60% in both groups, followed by smoking, dyslipidemia, family history of myocardial infarction and diabetes mellitus.

The number of procedures completed in the second period was clearly higher (63% vs 37%, $P < 0.001$). During this six year period, a significant increase in performed procedures was noted. In the first year, 109 coronary angiographies were completed, followed by 137, 176, 213, 218 and 286 ($P < 0.001$) procedures in the following years (Figure 1).

Normal or near-normal coronary artery findings were present in 27% of patients completed in the first period, while this finding significantly increased to around 39% in the second period ($P = 0.004$). As a result, patients who did not need treatment after the procedure were significantly more frequent in the second group compared to the first group (22.04% vs 34.31%, $P = 0.001$). Advanced coronary artery disease, affecting three major coronary vessels or left main coronary artery, was found in 45% of the patients who underwent coronary angiography during the first three years. Advanced coronary artery disease was diagnosed almost 2-fold less frequently in the second period, thus accounting for approximately 24% of cases ($P < 0.001$). At least 50% left main coronary artery stenosis was found in 29 (6.87%) patients of the first group as compared to 28 (3.91%) patients of the second group ($P = 0.03$). Recommendations for

PCI were around 2.5-fold higher in the second period (14.45% vs 34.03%, $P < 0.001$), whereas recommendations for CABG were as high as

40% during the first period. Other data of coronary angiography outcomes and further recommendations are shown in Table 2.

Table 1. Baseline demographic and clinical features. Data are presented as mean±SD or n. (%).

	Group 1 (n=422)	Group 2 (n=717)	P
Gender (males %)	259 (61.37)	421 (58.72)	0.66
Age	57.14±9.63	58.22±9.76	0.07
Hypertension (%)	272 (64.45)	451 (62.91)	0.81
Diabetes (%)	80 (18.96)	136 (18.97)	0.99
Dyslipidemia (%)	167 (39.57)	252 (35.15)	0.31
Smoking (%)	180 (42.65)	264 (36.82)	0.19
Family history of myocardial infarction (%)	142 (33.65)	249 (34.73)	0.79
Prior myocardial infarction (%)	169 (40.05)	246 (34.31)	0.19
Heart failure (%)	36 (8.53)	67 (9.34)	0.67

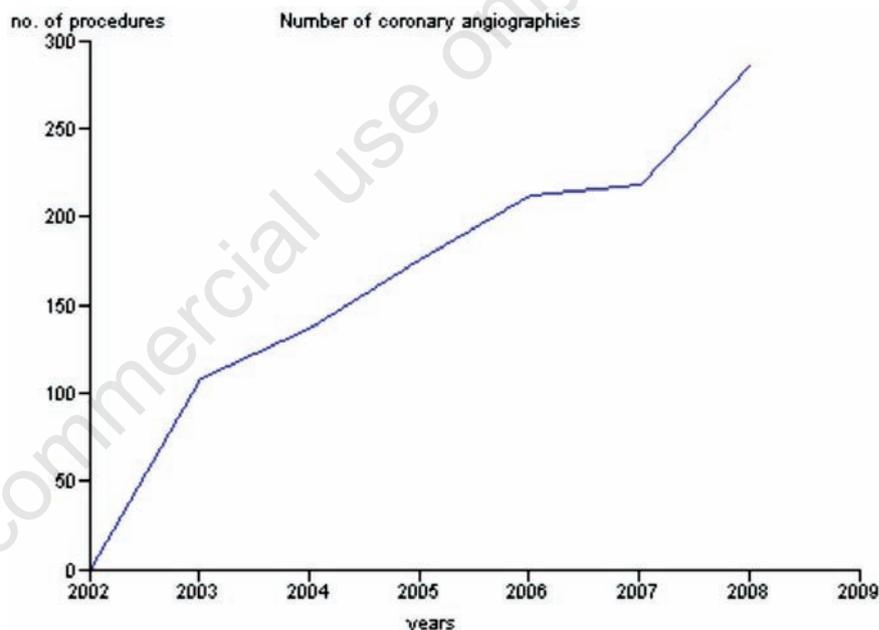


Figure 1. The graph shows the increase in the number of coronary angiographies performed during the 6-year period (2003-2009).

Table 2. Outcomes of coronary angiographies and recommendations. Data are presented as mean±SD or n. (%).

	Group 1 (n= 422)	Group 2 (n= 717)	P
Coronary angiography results			
Zero-vessel CAD (%)	114 (27.01)	279 (38.91)	0.004
One-vessel CAD (%)	63 (14.93)	138 (19.25)	0.1
Two-vessel CAD (%)	55 (13.03)	129 (17.99)	0.06
Three-vessel or LM CAD (%)	190 (45.02)	171 (23.85)	<0.001
Recommendations after coronary angiography			
No treatment (%)	93 (22.04)	246 (34.31)	0.001
Medical treatment (%)	102 (24.17)	54 (7.53)	<0.001
PCI (%)	61 (14.45)	244 (34.03)	<0.001
CABG (%)	166 (39.33)	173 (24.13)	<0.001

Cx, circumflex artery; CABG, coronary artery by-pass grafting; ECG, electrocardiogram; LAD, left anterior descending; LM, left main coronary artery; PCI, percutaneous coronary intervention; RCA, right coronary artery.

Discussion

Historical background of coronary angiography

Werner Frossmann performed the first heart catheterization in 1929. In a *self-experiment*, he introduced a bladder catheter into the right atrium from the antecubital vein approach.² This experiment was not recognized in medical circles and remained in the shadows for more than a decade until Cournand and Richards successfully repeated the procedure in 1941. Angiography developed rapidly during the 1930s. By 1942, they were able to push the catheter into the right ventricle.³ Mason Sones, after wrongly injecting contrast material into the right coronary artery instead of the aorta, was inspired to perform a selective coronary angiography. This technique became routine procedure in the Cleveland Clinic in 1959.⁴ In 1967, Melvin Judkins further simplified the procedure.

Lichtlen performed the first coronary angiography in Europe in 1965 at the University Hospital in Zurich, six years after its initial application in the USA.⁵ Yet several years were needed before the procedure was accepted. Coronary angiography had become a widely applied method of routine by the early 1970s, which means that it took around ten years for the procedure to be accepted.⁵ While it took six years for Europeans to perform the first coronary angiography, it took an additional period of approximately four decades for a small country in Europe, Kosovo, to perform the first coronary angiography. During the period when Kosovo belonged to the ex-Yugoslavia, patients were referred for coronary angiography to centers where the procedure could be performed.

Physicians' familiarity with coronary angiography

Pilote *et al.* compared the treatment after myocardial infarction between the United States and Canada, and came to the conclusion that American physicians recommend their patients for coronary angiography significantly more than their Canadian colleagues. Canadian physicians explained that the fewer cardiac catheterization facilities available influenced their clinical decision making.⁶ Among the reasons for higher referral for coronary angiography of American physicians compared to their Canadian or European counterparts is the abundance of facilities for coronary angiography, more physicians trained to perform the procedure, and financial compensation to the physicians and facilities.⁷ Cardiologists are more prone to recommend angiography than internists, and cardiologists

who perform the procedure are even more likely to recommend it than those who do not.^{7,8}

Referral for coronary angiography may vary among regions within the same country. In the United States, a regional variation was observed with regard to coronary angiography referral. A strong relationship was seen between the availability of an angiography facility in a certain area and the likelihood that this procedure would be recommended by the physician.⁹ Niemann *et al.* analyzed the clinical decisions taken after an exercise test suggesting angina pectoris in two Danish counties, one urban and one rural. Referral for coronary angiography in patients with an exercise test suggesting angina varied greatly according to the distance from the angiography facility. There were no financial barriers from any of the hospitals to refer their patients to the angiography center. The authors believe that lack of patient referral reflects local medical culture rather than difficulties in transporting the patient.¹⁰

Our data showed that the number of coronary angiographies performed in our center increased significantly. We believe that physicians' proximity to resources and familiarity with the procedure influenced the increase in patient referral for coronary angiography. In addition, during this period, new catheterization laboratories were established. Currently there are 6 angiography facilities, for a population of 2.4 million, hence there is one catheterization laboratory for 400,000 inhabitants. British Cardiac Society Guidelines suggest that one diagnostic cardiac catheterization and angiography laboratory is appropriate per 450,000-600,000 of the population.¹¹ France is known to have one of the highest numbers of catheterization laboratories in Europe, accounting for 2.9 per 1 million people,¹² whereas the number of catheterization centers in Kosovo is currently 2.5 per 1 million inhabitants.

Coronary angiography results from our center

The overall rate of normal or near-normal coronary angiographies recorded in our center was 34.5%, with a significantly higher rate during the second period (27.01% *vs* 38.91%, $P=0.004$). In general, 20 to 30% of patients undergoing coronary angiography have normal or near normal coronary arteries.¹³⁻¹⁵ The Euro Heart Survey reports that 24% of patients in their study had no coronary artery disease or stenosis of less than 50%.¹⁶ There appears to be an overuse of coronary angiography in our center in the second period, as the number of normal coronary angiographies increased to 38.91%.

As we anticipated, patients would be referred at earlier stages of coronary disease in the second period, thus advanced coronary

disease (three-vessel or left main coronary disease) was almost 2-fold lower in the second period (23.85% *vs* 45.02%, $P<0.001$). On the other hand, the number of patients referred for PCI during the second period was significantly higher than during the first period; however, this portion still remains small compared to European standards (34% *vs* 57%).¹⁶

Conclusions

We believe this to be the first study providing information on coronary angiography in Kosovo. Proximity of the physician to coronary angiography facilities and familiarity with the procedure influenced their decision to refer a higher number of patients for this procedure.

In our country, the early years saw a reluctance on the part of physicians to use coronary angiography, while recent years have seen signs of overuse of this procedure. Caution regarding its use is, therefore, needed in the future.

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