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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Cath lab costs in patients undergoing percutaneous coronary angioplasty — detailed analysis of consecutive procedures

Beata Dziki[1], Izabela Miechowicz[2], Piotr Iwachów[1], Michał Kuzemczak[2], Piotr Kałmucki[1, 2], Andrzej Szyszka[1, 2], Artur Baszko[1, 2], Tomasz Siminiak[1, 2]

[1]Interventional Cardiology, HCP Medical Centre, Poznan, Poland
[2]Medical University, Poznan, Poland

Abstract

Background: Costs of percutaneous coronary interventions (PCI) have an important impact on health care expenditures. Despite the present stress upon the cost-effectiveness issues in medicine, few comprehensive data exist on costs and resource use in different clinical settings.

Aim: To assess catheterisation laboratory costs related to use of drugs and single-use devices in patients undergoing PCI due to coronary artery disease.

Methods: Retrospective analysis of 1500 consecutive PCIs (radial approach, n = 1103; femoral approach, n = 397) performed due to ST segment elevation myocardial infarction (STEMI; n = 345) and non ST-segment elevation myocardial infarction (NSTEMI; n = 426) as well as unstable angina (UA; n = 489) and stable angina (SA; n = 241) was undertaken. Comparative cost analysis was performed and shown in local currency units (PLN).

Results: The cath lab costs were higher in STEMI (4295.01 ± 2384.54PLN, $p < 0.001$) compared to NSTEMI (3493.40 ± 1907.43 PLN, $p < 0.001$), UA (3206.31 ± 1692.82 PLN, $p < 0.001$) and SA patients (3138.91 ± 1427.62 PLN, $p < 0.001$). They were higher in males than in females (3668.9 ± 2095.2 vs. 3292.0 ± 1656.0 PLN, $p < 0.05$). In females PCIs performed via radial approach were more expensive than via femoral approach (3360.4 ± 1540.1 vs. 3135.5 ± 1890.3 PLN, $p < 0.01$). In all subgroups analysed, costs were positively correlated with X-ray dose, fluoroscopy, and total procedure times. Patients' age negatively correlated with cath lab costs in STEMI/NSTEMI patients.

Conclusions: Cath lab costs were higher in STEMI patients compared to other groups. In STEMI/NSTEMI they were lower in older patients. In all analysed groups costs were related to the level of procedural difficulty. In female patients, the costs of PCI performed via radial approach were higher compared to femoral approach. Despite younger age, male patients underwent more expensive procedures.

Key words: cost analysis, percutaneous coronary angioplasty, coronary artery disease

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INTRODUCTION

Coronary artery disease (CAD) is the leading cause of mortality and morbidity worldwide and is predicted to remain so for the next decades [1]. The rising incidence of cardiovascular diseases and population aging lead to increasing demand on hospital services and rising medical expenses. Thus, it is associated with an enormous economic burden [2].

Percutaneous coronary intervention (PCI) is the most widely used revascularisation strategy in various clinical scenarios as well as one of the most important drivers of hospital costs [3, 4]. Furthermore, with projected increasing demand for PCI, the large financial burden on contemporary health care systems that is placed by these procedures is expected to rise. Understanding the latter is critical for optimal resource allocation by health care decision makers.

Address for correspondence:
Tomasz Siminiak, MD, PhD, FESC, FACC, FSCAI, Professor of Cardiology, Poznan University of Medical Sciences, Interventional Cardiology, HCP Medical Centre, ul. 28 Czerwca 1956 roku Nr 194, 61–485 Poznań, Poland, e-mail: tomasz.siminiak@usoms.poznan.pl
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Despite the economic impact of PCI on health care expenditures in Western countries and the present stress upon the cost-effectiveness issues in medicine, few comparative data exist on cath lab costs and resource use in different clinical settings. Contrasting the costs associated with different clinical manifestations of CAD may help to optimise health care resource allocation in cardiology. To address this issue, we performed a study examining the cumulative cath lab costs and resource utilisation in patients with acute coronary syndromes (ACS) as well as stable CAD. We focused on costs of single-use devices (including catheters and stents) and drugs used in cath labs because other types of costs, including personnel, depreciation, and hospitalisation costs, are strongly dependent on the health care system and less on clinical and procedural issues.

The aim of the study was to assess determinants of cath lab costs related to use of single-use devices and drugs in real-life patients undergoing PCI due to ACS or stable CAD in a privately-run hospital providing emergency services in urban settings.

METHODS

Study population

Detailed retrospective analysis of data from 1500 consecutive PCI procedures performed at our institution due to ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), unstable angina (UA), and stable angina (SA) was undertaken. All patients were treated interventionally in accordance with clinical guidelines on treatment of the above-mentioned manifestations of CAD [3, 5–7]. The database included demographic, procedural, and clinical details of the consecutive cases as well as costs of all drugs and single-use devices needed to complete the PCI procedures.

Cath lab costs

Cardiac catheterisation laboratory costs were estimated as the costs of all supplies and drugs utilised in each PCI procedure. Resource utilisation, including vascular sheaths, diagnostic and guiding catheters, diagnostic and angioplasty wires, balloon catheters, coronary stents, inflation devices, syringes, contrast dye, and accessory materials, as well as costs of all drugs (including antiplatelet agents) administered in the cardiac catheterisation laboratory, was recorded for each PCI procedure. These procedural costs were assessed from the perspective of the hospital providing emergency services in urban settings by direct calculation using current manufacturers' charges to the hospital during the fiscal years 2013–2015. Total costs of single-use materials and devices as well as drugs used in the cath lab during the procedures were calculated and shown in local currency units (PLN; 1 Euro = approx. 4.2 PLN). Personnel costs, cath lab depreciation costs, ambulance transportation costs and all costs that occurred during the hospitalisation in the coronary care unit were not evaluated. Furthermore, procedural data such as total procedure time, fluoroscopy time, contrast medium volume, and X-ray dose received by patient were analysed. These data may indicate the level of procedural difficulty for PCI procedures.

Statistical analysis

Statistical analysis was performed using Statistica 12.0 software (Statsoft, Krakow, Poland). The results are expressed as the mean ± standard deviation for interval variables and n, per cent for categorical variables. A p value less than 0.05 was considered significant. The Lilliefors test was performed to determine whether a sample of values followed a normal distribution. The differences in distribution of values between the groups were assessed by the Mann-Whitney U test or the Kruskal-Wallis test, after meeting the assumptions and requirements for application of these statistical models. Furthermore, multiple comparison Dunn's test was performed. Due to lack of normal distribution, associations between continuous variables were evaluated using Spearman's rank correlation coefficient.

Ethical considerations

Informed consent was obtained from all individual participants included in the study. The study was conducted in accordance with the Declaration of Helsinki and approved by the local Ethics Committee.

RESULTS

The consecutive 1500 PCI procedures included those performed in both male (n = 950) and female (n = 550) patients, due to one of four clinical conditions: STEMI (n = 345), NSTEMI (n = 426), UA (n = 489), and SA (n = 241). They were performed both via radial (n = 1103) and femoral (n = 397) approaches. Significant demographic differences between groups of patients undergoing PCI due to different clinical indications were observed. Male patients were significantly younger (64.66 ± 11.35 vs. 70.65 ± 11.41 years; $p < 0.001$). NSTEMI patients were significantly ($p < 0.05$) older (69.1 ± 12.1 years) as compared to all other groups, including STEMI (65.9 ± 12.3 years), UA (66.3 ± 11.7 years), and SA patients (65.4 ± 9.6 years). In male patients, those presenting with NSTEMI were significantly ($p < 0.01$) older (66.3 ± 12.3 years) than those with STEMI (62.7 ± 11.1 years) or UA (64.9 ± 10.7 years). Such a difference was not observed in female patients (72.5 ± 10.7; 71.5 ± 12.4 and 69.1 ± 11.6 years, respectively, p = NS). However, female patients were older, as compared to males in all subgroups of patients ($p < 0.05$) (Table 1).

The costs of single use devices and drugs administered in the cath lab were significantly higher in STEMI group (4295.01 ± 2384.54 PLN, $p < 0.001$) as compared to NSTEMI (3493.40 ± 1907.43, $p < 0.001$), UA (3206.31 ± 1692.82, $p < 0.001$) and SA (3138.91 ± 1427.62 PLN, $p < 0.001$). No significant differences were found between the NSTEMI, UA, and SA groups (Fig. 1). The costs of single-use devices

Table 1. Summary of patient subgroups undergoing percutaneous coronary intervention due to non-ST elevation myocardial infarction (NSTEMI) or ST elevation myocardial infarction (STEMI), unstable angina (UA), or stable angina (SA)

	Number	Age [years]	Costs [PLN]	Proc. time [min]
NSTEMI:				
Females	188	72.5 ± 10.7*#	3220.1 ± 1541.9	43.8 ± 19.7
Males	238	66.3 ± 12.3#	3709.3 ± 2131.3	50.7 ± 36.6
STEMI:				
Females	125	71.5 ± 12.4*	3804.8 ± 2077.1#	49.6 ± 26.3
Males	218	62.7 ± 11.1	4572.0 ± 2510.9#	45.7 ± 25.6
UA:				
Females	165	69.1 ± 11.6*	3087.6 ± 1461.7	41.7 ± 20.9
Males	321	64.9 ± 10.7	3259.6 ± 1804.6	43.2 ± 24.4
SA:				
Females	71	67.6 ± 9.6*	3054.7 ± 1352.6	36.9 ± 17.5
Males	170	64.4 ± 9.5	3174.0 ± 1460.2	40.4 ± 24.3

Mean values ± standard deviation; *p < 0.05 vs. males; #p < 0.05 vs. all other clinical indications for percutaneous coronary intervention

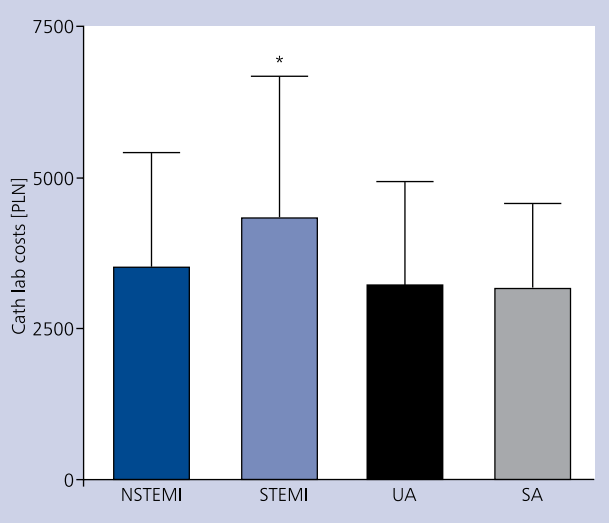

Figure 1. The costs of single-use devices and drugs used in the cath lab during percutaneous coronary intervention procedures performed due to ST elevation myocardial infarction (STEMI; n = 345), non-ST elevation myocardial infarction (NSTEMI; n = 426), unstable angina (UA; n = 489), and stable angina (SA; n = 241); *p < 0.05 vs. NSTEMI, UA, and SA

were significantly higher in male compared to female patients (3668.9 ± 2095.2 vs. 3292.0 ± 1656.0 PLN, p < 0.05), and negatively correlated with age in male (r = –0.117, p < 0.05) but not in female patients (r = –0.048, p = NS).

The costs of drugs and devices used in the cath lab were significantly (p < 0.05) higher in male NSTEMI (3709.3 ± 2131.3 PLN) and STEMI (4572.0 ± 2510.9 PLN) patients as compared to females (3220.1 ± 1541.9 and 3804.8 ± 2077.1 PLN, respectively), but the difference was not significant in UA patients (3259.6 ± 1804.6 and 3087.6 ± 1461.7 PLN, for males and females, respectively). The costs were lower in the UA group than in STEMI and NSTEMI in males, but only in the STEMI group in females.

The total duration of PCI performed in male NSTEMI patients (50.7 ± 36.6 min) was longer (p < 0.05) than in UA (43.2 ± 24.4 min) but not in STEMI patients (45.7 ± 25.6 min). The above-mentioned differences were not observed in female patients (43.8 ± 19.7; 49.6 ± 26.3 and 41.7 ± 20.9 min, respectively, p = NS). The patients' age significantly correlated with cath lab costs in STEMI (r = –0.181, p < 0.05) and NSTEMI patients (r = –0.095, p < 0.05), but not in UA (r = –0.068, p = NS) and SA patients (r = –0.061, p = NS).

In all analysed groups, the cath lab costs were correlated with fluoroscopy time — a surrogate marker of procedural difficulty (STEMI, r = 0.321, NSTEMI, r = 0.293, UA, r = 0.314, SA, r = 0.230; p < 0.05 in all). Similarly, X-ray dose received by patients (STEMI, r = 0.330, NSTEMI, r = 0.311, UA, r = 0.280, SA, r = 0.235; p < 0.05 in all) as well as total duration of the procedure (STEMI, r = 0.336, NSTEMI, r = 0.268, UA, r = 0.314, SA, r = 0.222; p < 0.05 in all) were correlated with the costs of devices and drugs used in the cath lab.

In female patients cath lab costs of procedures performed via radial approach were higher than via femoral approach (3360.4 ± 1540.1 vs. 3135.5 ± 1890.3 PLN, p < 0.01), but this difference was not observed in male patients (3659.7 ± 1996.3 vs. 3697.6 ± 2380.0 PLN, p = NS, Fig. 2).

DISCUSSION

Increasing demands on hospital services and high costs of revascularisation procedures are an important part of heated the debate on the reform of health care systems, in both the

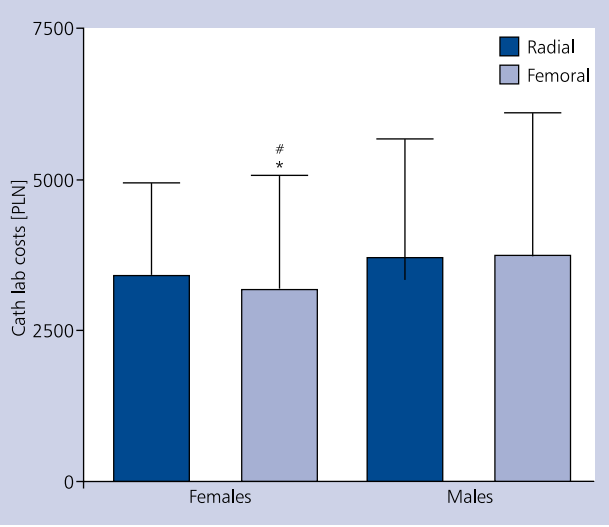

Figure 2. The costs of single use devices and drugs used in the cath lab during angioplasty procedures performed in male and female procedures via both femoral and radial approaches; *p < 0.05 vs. males; #p < 0.05 vs. radial

medical and economic literature. The associated annual costs of PCI (including the procedure itself, stents, and continued antiplatelet therapy) are enormous and have been estimated only in the United States at more than $12 billion annually [8]. These costs may further increase as a consequence of population aging, increasing prevalence of cardiovascular risk factors, and improved survival of patients after a cardiovascular event [9].

Interventional cardiology procedures, including PCI, are also an important part of health care budgets in European countries. Although over 120,000 PCI procedures are performed annually in cath labs in Poland, few comprehensive data exist on cath lab costs or resource use in different clinical settings [10, 11]. Most of them analyse the costs and effectiveness of PCI procedures over a longer period of time without detailed analysis of cath lab costs and resource utilisation in various clinical manifestations of CAD. Thus, increasing demand for information about comparative periprocedural resource use patterns in different clinical settings needs to be addressed.

The present study provides a contemporary description of cath lab costs and resource utilisation associated with PCI procedures in ACS as well as stable CAD patients. Not surprisingly, in the present study patients with NSTEMI were significantly older compared to other analysed groups. These results are consistent with available data indicating that NSTEMI patients are older and have more comorbidities as compared to patients with other manifestations of CAD [12]. However, in an analysis limited to women, no significant differences between the analysed groups with respect to age were observed. Furthermore, in the present study male patients were younger than female patients in all analysed groups, which is understandable, bearing in mind that cardiovascular disease develops 7-10 years later in women than in men [13].

The surprising finding was that periprocedural costs were higher in STEMI patients compared to other analysed groups, including NSTEMI patients. Although Wang et al. [14] reported higher hospitalisation costs in STEMI patients, their study included acute myocardial infarction patients treated interventionally as well as conservatively. Higher costs of STEMI hospitalisations were caused by differences in treatment approaches (80% of STEMI patients had a PCI, and only about 52% in the NSTEMI group). Soekhlal et al. [15] compared STEMI and NSTEMI patients treated interventionally and showed that treatment costs of NSTEMI patients receiving PCI were higher, as compared to interventionally treated STEMI patients. However, these costs included costs for inpatient days, intensive care unit days, day-care admissions, outpatient and emergency room visits, laboratory services, medical imaging services, surgical procedures, medical devices, diagnostic activities, microbiological and parasitological services, pathology, blood products, paramedical and supportive services, as well as rehabilitation services. Inpatient days, PCI procedures, and coronary stents were the greatest contributors to treatment costs. In the present study, in contrast to previously cited papers, analysis limited to cath lab costs was performed. Comparison of cath lab costs between groups must account for potential differences in the characteristics of patients receiving treatment. As mentioned earlier, patients with NSTEMI are older, with more comorbidities (including chronic illnesses like diabetes, chronic kidney disease, and peripheral artery disease) and very often more advanced atherosclerosis. Compared to younger subjects, a higher proportion of older patients have tortuous, calcified, and more atheromatous arteries, which make vascular access and PCI procedures much more challenging. We speculate that our results may be associated with increased rate of procedural failure, access site crossover, longer procedure times, greater use of contrast and medical equipment, as well as higher radiation exposure. Subgroup analysis of the TALENT study demonstrated age > 70 years as an independent predictor of subclavian tortuosity [16]. In the study by Le et al. [17], analysing patient and procedural characteristics associated with transradial to transfemoral approach crossover, the only patient characteristic found to correlate with access site crossover was age > 75 years [17]. It was also confirmed by multicentre prospective study, demonstrating that anomalous radial artery anatomy is associated with transradial failure and that the only independent predictor of this anomaly is age [18]. Taking all these facts into consideration, it would be expected that periprocedural costs in younger STEMI patients should not be higher compared to older subjects, especially the NSTEMI group. Thus, more expensive periprocedural

treatment of younger STEMI patients is astonishing and must be pointed out. It cannot be ruled out that the higher number of stents implanted and other devices used in the STEMI group could compensate for the possible difference and made PCI procedures in STEMI patients more expensive. Furthermore, in accordance with guidelines, in patients with cardiogenic shock, PCI procedure should be performed not only in infarct-related artery, but also in other stenotic lesions in the coronary tree [3]. In such a clinical scenario, more than one stent is implanted, and consequently cath lab costs are definitely higher. In the present study, the incidence of cardiogenic shock in the analysed groups of patients was not evaluated. However, the available data indicate that the prevalence of cardiogenic shock in STEMI patients is higher compared to NSTEMI patients [19]. Furthermore, in the study by Badheka et al. [20], cardiogenic shock was one of the significant predictors of increased cost of care. However, the factors that stand behind this association have not been clearly identified (i.e. higher number of implanted stents, cost of intra-aortic balloon pump, longer length of hospital stay, etc.). Other predictors of higher cost of care were acute myocardial infarction, increasing Charlson comorbidity index, and emergent/urgent admission.

What is even more surprising regarding the results of the present study is that patients' age was negatively correlated with cath lab costs in the STEMI and NSTEMI groups, which suggests that in both groups cath lab costs are lower in older patients. Similarly, in the analysis of all male patients, cath lab costs were negatively correlated with age. All the above correlations were significant but very weak. Thus, further studies are necessary to formulate conclusions.

The costs of drugs and single-use devices were significantly higher in male compared to female patients. As mentioned above, a weak but statistically significant negative correlation between cath lab costs and age in male patients was observed, in contrast to female patients. This suggests that male patients undergo more expensive coronary procedures despite younger age. In the present study, the majority of PCI procedures was performed via the radial route. Lower costs of drugs and single-use devices in female patients could be interpreted as surprising, considering the fact that women have higher risk of radial artery spasm, smaller arteries, and greater tortuosity [21]. Thus, the higher access site crossover is observed, which may translate into increased consumption of drugs and medical equipment. On the other hand, it is well recognised that male patients tend to have more advanced coronary atherosclerosis, which may need more cost-consuming treatment.

In the present study, surrogate markers of the procedural difficulty were defined. They included total procedure time, fluoroscopy time, and X-ray dose received by the patient. Assessing these factors as surrogate markers of technical difficulty, we found that all of them were correlated with costs of drugs and single-use devices. Importantly, these associations were observed in all analysed groups. Thus, it seems that they are not only reliable markers of procedural difficulty, but also markers of cost-consuming procedures, irrespective of indication for PCI. Of note, common sense suggests that it is reasonable to consider them as markers of operators' experience. Many studies revealed that the annual operator volume of PCI is associated with a decreased incidence of adverse outcomes, length of hospital stay, and cost of hospitalisation. A study by Badheka et al. [20] showed higher operator volume to be associated with a significant reduction in length of hospital stay and cost of hospitalisation. The latter, however, in contrast to the present study, was estimated by multiplying the total hospital charge with the cost-to-charge ratios. In our study, only periprocedural costs were taken into consideration. Furthermore, the annual operator volume of PCI has not been assessed. Beyond doubt, within institutions, as well as between different institutions, there can be a great variability among cardiac interventionalists in both resource use patterns and clinical outcomes. On the other hand, the operator volume data based on a single-centre registry can be misrepresented because many of them perform PCI procedures in more than one cath lab that makes such an analysis quite unreliable.

It is well recognised that PCI procedures performed via femoral approach are associated with the risk of vascular access site complications, which is higher in women than in men [21]. Furthermore, many studies indicate that bleeding complications are independently associated with the risk of death and ischaemic events [22]. Thus, the transradial PCI procedures have been increasingly adopted as a strategy for reducing the abovementioned complications. In the present study, the vast majority of PCI procedures were performed via radial approach. In female patients cath lab costs of PCI procedures performed via radial approach were higher than via femoral approach, but the difference was not observed in male patients. It must be pointed out that due to smaller radial arteries, increased risk of radial artery spasm, and greater tortuosity, PCI procedure via the radial route in women can be quite challenging. Thus, higher rates of access site crossover to femoral route as well as higher cath lab resource utilisation are observed. The available data suggests cost savings associated with a transradial approach. Jin et al. [23] reported that transradial interventions are associated with shorter length of stay and lower total hospital costs, defined as the total cost of an in-hospital stay from the day of admission through discharge. More than 80% of the cost differences were due to lower PCI-related costs. The differences in PCI-related costs were partially driven by the exclusive use of vascular closure devices in the transfemoral group. Cost-savings associated with transradial approach were also confirmed by Amin et al. [24] and Koltowski et al. [25]. However, it is hard to compare the cited papers with our findings, because they evaluated total hospital costs rather than costs of drugs and single-use

devices necessary to complete PCI procedure. Amin et al. [24] also analysed patient-level PCI costs, but these consisted not only of equipment and resources, but also personnel costs and other direct and indirect costs. Thus, comparisons with our findings could be misrepresented.

Limitations of the study

A few limitations of the present study need to be acknowledged. First, this is a single-centre study performed in a privately-run hospital providing emergency service in urban settings. Available data suggest that costs vary depending on hospital type and location [26]. Despite this limitation, and bearing in mind that data regarding cath lab costs in real-world practice are scarce, the study represents real-life patients and is free from potential selection bias associated with clinical trials. Second, the present study did not evaluate costs associated with the treatment of periprocedural complications such as bleeding, access-site complications etc. In addition, we analysed a fixed period of three consecutive years without considering changes of market prices within that time. We realise that from an economic perspective, true economic costs are best determined as costs of all resources in producing goods or services. The vast majority of available studies analyse them in a wider context by calculating all costs of hospitalisation or performing cost-effectiveness analysis over a longer period of time. Despite the benefits of such an approach, little attention is paid to detailed analysis of cath lab costs. Hence, a unique characteristic of the present study is the focus only on periprocedural cath lab costs. The third limitation raised by our cath lab cost analysis is whether its results can be applicable to other countries, because there are significant differences in prices of medical equipment across the world. In addition, even within the same country, the application of public tender procedures, needed to purchase drugs and single-use materials, may affect the costs.

Care should be taken when discussing our results with national reimbursement policy bodies. We did not analyse the hospitalisation costs, which are strongly related to individual characteristics of hospitals (e.g. percentage of personnel in training, involvement in emergency care system, depreciation and amortisation costs of the infrastructure), nor the cath lab personnel costs, which are strongly dependent on local availability of qualified staff, number of procedures per day (especially in 7/24 availability), etc.

The increasing number of interventional cardiology procedures has raised economic concerns for healthcare decision makers. Driven by these trends and in the context of heated debate regarding economic issues associated with PCI procedures, rigorous insight into the determinants of cath lab costs is imperative. The key issue in contemporary health care systems is to meet the challenge of reducing medical costs without jeopardising patients' clinical outcomes and prognosis. Obviously, this requires knowledge of the clinical effects of any cost reduction, because no substantial savings in expenditures on cardiac procedures should be offset by the further financial burden of cardiovascular morbidity and mortality. Understanding the clinical and financial effect of any cost reduction in cardiology as well as describing predictors of higher medical costs will not be possible without detailed analysis of their determinants, including determinants of costs in cardiac catheterisation laboratories.

CONCLUSIONS

The present study, which is an attempt to address above-mentioned issue, enable us to draw the following conclusions. First, in patients undergoing primary PCI due to STEMI, cath lab costs are higher than those in other indications. Second, in both STEMI and NSTEMI patients cath lab costs are lower in older patients. Third, cath lab costs are related to the level of procedural difficulty, as assessed by procedural and fluoroscopy times as well as X-ray dose received by patients, irrespective of indication for PCI. Our results furthermore indicate, that despite younger age, male patients require more expensive procedures. In addition, in female patients PCI procedures performed via radial approach required more single-use devices and drugs administered in the cath lab, as compared to femoral approach. Further investigations are needed to assess the influence of different clinical and demographic variables on periprocedural cath lab costs and to support health care decision makers regarding reimbursement policy.

Conflict of interest: *none declared*

References

1. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006; 3(11): e442, doi: 10.1371/journal.pmed.0030442, indexed in Pubmed: 17132052.
2. Bansilal S, Castellano JM, Fuster V. Global burden of CVD: focus on secondary prevention of cardiovascular disease. Int J Cardiol. 2015; 201 Suppl 1: S1–S7, doi: 10.1016/S0167-5273(15)31026-3, indexed in Pubmed: 26747389.
3. Windecker S, Kolh P, Alfonso F, et al. 2014 ESC/EACTS Guidelines on myocardial revascularization: The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)Developed with the special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAPCI). Eur Heart J. 2014; 35(37): 2541–2619, doi: 10.1093/eurheartj/ehu278, indexed in Pubmed: 25173339.
4. Ben-Yehuda O, Kazi DS, Bonafede M, et al. Angina and associated healthcare costs following percutaneous coronary intervention: A real-world analysis from a multi-payer database. Catheter Cardiovasc Interv. 2016; 88(7): 1017–1024, doi: 10.1002/ccd.26365, indexed in Pubmed: 26774951.
5. Roffi M, Patrono C, Collet JP, et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). Eur Heart J. 2016; 37(3): 267–315, doi: 10.1093/eurheartj/ehv320, indexed in Pubmed: 26320110.

6. Montalescot G, Sechtem U, Achenbach S, et al. 2013 ESC guidelines on the management of stable coronary artery disease: the Task Force on the management of stable coronary artery disease of the European Society of Cardiology. Eur Heart J. 2013; 34(38): 2949–3003, doi: 10.1093/eurheartj/eht296, indexed in Pubmed: 23996286.
7. Steg PhG, James SK, Atar D, et al. et al.. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. The Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology (ESC). Eur Heart J. 2012; 33: 2569–2619.
8. Dharmarajan K, Lampropulos J, Bikdeli B, et al. Most important papers in health costs, cost-effectiveness, and resource utilization. Circ Cardiovasc Qual Outcomes. 2012; 5(2): e9–15, doi: 10.1161/CIRCOUTCOMES.112.965830, indexed in Pubmed: 22438466.
9. Bansilal S, Castellano JM, Fuster V. Global burden of CVD: focus on secondary prevention of cardiovascular disease. Int J Cardiol. 2015; 201 Suppl 1: S1–S7, doi: 10.1016/S0167-5273(15)31026-3, indexed in Pubmed: 26747389.
10. Jaworski R, Jankowska EA, Ponikowski P, et al. Costs of management of patients with coronary artery disease in Poland: the multicenter RECENT study. Pol Arch Med Wewn. 2012; 122(12): 599–607, indexed in Pubmed: 23160000.
11. Gąsior M, Gierlotka M, Gąsior U, et al. Koszt i efektywność zabiegów angioplastyki wieńcowej. Kardiol Pol. 2004; 61: 43–47.
12. Cohen M. Long-term outcomes in high-risk patients with non-ST-segment elevation myocardial infarction. J Thromb Thrombolysis. 2016; 41(3): 464–474, doi: 10.1007/s11239-015-1227-1, indexed in Pubmed: 26001907.
13. Mass AH, Appelman YEA. Gender differences in coronary heart disease. Neth Heart J. 2010; 18: 598–602.
14. Wang G, Zhang Z, Ayala C, et al. Costs of Hospitalizations with a Primary Diagnosis of Acute Myocardial Infarction Among Patients Aged 18-64 Years in the United States. Ischemic Heart Disease. InTechOpen. 2013: 77–90, doi: 10.5772/53499.
15. Soekhlal RR, Burgers LT, Redekop WK, et al. Treatment costs of acute myocardial infarction in the Netherlands. Neth Heart J. 2013; 21(5): 230–235, doi: 10.1007/s12471-013-0386-y, indexed in Pubmed: 23456884.
16. Sciahbasi A, Romagnoli E, Burzotta F, et al. Transradial approach (left vs right) and procedural times during percutaneous coronary procedures: TALENT study. Am Heart J. 2011; 161(1): 172–179, doi: 10.1016/j.ahj.2010.10.003, indexed in Pubmed: 21167351.
17. Le J, Bangalore S, Guo Yu, et al. Predictors of Access Site Crossover in Patients Who Underwent Transradial Coronary Angiography. Am J Cardiol. 2015; 116(3): 379–383, doi: 10.1016/j.amjcard.2015.04.051, indexed in Pubmed: 26026865.
18. Lo TS, Nolan J, Fountzopoulos E, et al. Radial artery anomaly and its influence on transradial coronary procedural outcome. Heart. 2009; 95(5): 410–415, doi: 10.1136/hrt.2008.150474, indexed in Pubmed: 18977799.
19. Khalid L, Dhakam SH. A review of cardiogenic shock in acute myocardial infarction. Curr Cardiol Rev. 2008; 4(1): 34–40, doi: 10.2174/157340308783565456, indexed in Pubmed: 19924275.
20. Badheka AO, Patel NJ, Grover P, et al. Impact of annual operator and institutional volume on percutaneous coronary intervention outcomes: a 5-year United States experience (2005-2009). Circulation. 2014; 130(16): 1392–1406, doi: 10.1161/CIRCULATIONAHA.114.009281, indexed in Pubmed: 25189214.
21. Pandie S, Mehta SR, Cantor WJ, et al. Radial Versus Femoral Access for Coronary Angiography/Intervention in Women With Acute Coronary Syndromes: Insights From the RIVAL Trial (Radial Vs femorAL access for coronary intervention). JACC Cardiovasc Interv. 2015; 8(4): 505–512, doi: 10.1016/j.jcin.2014.11.017, indexed in Pubmed: 25907080.
22. Jolly SS, Amlani S, Hamon M, et al. Radial versus femoral access for coronary angiography or intervention and the impact on major bleeding and ischemic events: a systematic review and meta-analysis of randomized trials. Am Heart J. 2009; 157(1): 132–140, doi: 10.1016/j.ahj.2008.08.023, indexed in Pubmed: 19081409.
23. Jin C, Li W, Qiao SB, et al. Costs and Benefits Associated With Transradial Versus Transfemoral Percutaneous Coronary Intervention in China. J Am Heart Assoc. 2016; 5(4), doi: 10.1161/JAHA.115.002684, indexed in Pubmed: 27107136.
24. Amin AP, House JA, Safley DM, et al. Costs of transradial percutaneous coronary intervention. JACC Cardiovasc Interv. 2013; 6(8): 827–834, doi: 10.1016/j.jcin.2013.04.014, indexed in Pubmed: 23871512.
25. Kołtowski Ł, Filipiak KJ, Kochman J, et al. Cost-effectiveness of radial vs. femoral approach in primary percutaneous coronary intervention in STEMI - Randomized, control trial. Hellenic J Cardiol. 2016; 57(3): 198–202, doi: 10.1016/j.hjc.2016.06.005, indexed in Pubmed: 27497806.
26. Topol EJ, Ellis SG, Cosgrove DM, et al. Analysis of coronary angioplasty practice in the United States with an insurance-claims data base. Circulation. 1993; 87(5): 1489–1497, indexed in Pubmed: 8141866.

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Koszty powstałe w pracowni hemodynamiki podczas wykonywania procedur przezskórnych angioplastyk wieńcowych — szczegółowa analiza kolejnych zabiegów

Beata Dziki[1], Izabela Miechowicz[2], Piotr Iwachów[1], Michał Kuzemczak[2], Piotr Kałmucki[1, 2], Andrzej Szyszka[1, 2], Artur Baszko[1, 2], Tomasz Siminiak[1, 2]

[1]Pracownia Kardiologii Inwazyjnej, Centrum Medyczne HCP, Poznań

[2]Uniwersytet Medyczny, Poznań

Streszczenie

Wstęp: Koszt przezskórnych interwencji wieńcowych (PCI) jest istotną składową wydatków systemów ochrony zdrowia. Mimo znacznego nacisku na zagadnienia efektywnego wydawania środków przeznaczonych na świadczenia medyczne niewiele jest opublikowanych danych dotyczących rzeczywistych kosztów procedur wykonywanych w poszczególnych wskazaniach klinicznych.

Cel: Celem niniejszej pracy była szczegółowa analiza porównawcza kosztów materiałów medycznych i leków zużytych w pracowni hemodynamiki podczas przeprowadzania PCI u pacjentów z poszczególnymi postaciami klinicznymi choroby niedokrwiennej serca.

Metody: Retrospektywnej ocenie poddano kolejnych 1500 zabiegów PCI (dostęp promieniowy: n = 1103 lub udowy: n = 379) wykonanych z powodu zawału serca z uniesieniem odcinka ST (STEMI; n = 345) i zawału serca bez uniesienia odcinka ST (NSTEMI; n = 426) oraz dławicy piersiowej niestabilnej (UA; n = 489) i stabilnej (SA; n = 241). Po dokonaniu szczegółowej analizy porównawczej wyniki przedstawiono w złotych polskich (PLN).

Wyniki: Koszty leków i materiałów medycznych zużytych podczas PCI wykonanych z powodu STEMI (4295,01 ± 2384,54 PLN; $p < 0,001$) były wyższe niż u pacjentów z NSTEMI (3493,40 ± 1907,43 PLN; $p < 0,001$), UA (3206,31 ± 1692,82 PLN; $p < 0,001$) i SA (3138,91 ± 1427,62 PLN; $p < 0,001$), Procedury były droższe u mężczyzn niż u kobiet (3668,9 ± 2095,2 vs. 3292,0 ± 1656,0 PLN; $p < 0,05$), U kobiet zabiegi wykonane z dostępu promieniowego były droższe niż z dostępu udowego (3360,4 ± 1540,1 vs. 3135,5 ± 1890,3 PLN; $p < 0,01$). We wszystkich ocenianych podgrupach zabiegów koszty korelowały dodatnio z pochłoniętą dawką promieni X, czasem fluoroskopii i całkowitym czasem trwania PCI. Wiek pacjentów ujemnie korelował z kosztami zabiegów wykonanych u osób ze STEMI i NSTEMI.

Wnioski: Powstające w pracowni hemodynamiki koszty PCI są wyższe u pacjentów ze STEMI w porównaniu z innymi wskazaniami klinicznymi. We wszystkich badanych grupach zabiegów PCI koszt leków i materiałów medycznych zależy od stopnia trudności zabiegu ocenianego za pomocą analizy czasu jego trwania, czasu fluoroskopii i pochłoniętej dawki promieniowania X. U kobiet średni koszt PCI wykonanego z dostępu promieniowego jest wyższy niż z dostępu udowego. Mężczyźni, mimo młodszego wieku, są poddawani droższym zabiegom PCI niż kobiety.

Słowa kluczowe: angioplastyka wieńcowa, analiza kosztów, choroba niedokrwienna serca

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Adres do korespondencji:
prof. dr hab. n. med. Tomasz Siminiak, Uniwersytet Medyczny im. Karola Marcinkowskiego, Pracownia Kardiologii Inwazyjnej, Centrum Medyczne HCP, ul. 28 Czerwca 1956 roku Nr 194, 61–485 Poznań, e-mail: tomasz.siminiak@usoms.poznan.pl
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