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Original Article

Comparison of the Economic Burden Between Coronary Artery Bypass Grafting and Percutaneous Coronary Intervention at a One-Year Follow-up

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ABSTRACT

Background: Cardiovascular disease is one of the leading causes of death and disability in the world. There is limited information about the economic burden of this disease in Iran. This study aimed to compare the economic burden between coronary artery bypass grafting surgery (CABG) and percutaneous coronary intervention (PCI) from 2018 through 2019.

Methods: The cost of cardiovascular disease was calculated from a sociological perspective based on a top-down approach. The study samples were 379 cardiac patients with venous congestion above 70% who were sampled at Tehran Heart Center by simple random sampling. The cost information was collected in 3 different periods using the hospital information system and interviewing patients.

Results: The direct medical cost of CABG was higher than that of PCI (183 907 460 rials vs 122 508 920 rials). The direct nonmedical cost and the indirect cost of CABG were 15 848 570 rials and 79 420 960 rials, respectively, while these costs were 7 951 900 rials and 26 315 170 rials, respectively, for PCI.

Conclusions: At 1 year's postoperative follow-up, CABG had a higher cost than PCI for the patients and, thus, the country's healthcare system. ***(Iranian Heart Journal 2022; 23(1): 106-111)***

KEYWORDS: Economic burden, Cost, Open-heart surgery, Angioplasty, CABG, PCI

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Cardiovascular disease is one of the leading causes of male and female mortality in the world. It is estimated that 31% of global mortality (17.9 million deaths) is related to cardiovascular disease. [1] In Iran, cardiovascular disease is the leading cause of premature death. [2] The most common treatments for coronary heart disease are coronary artery bypass grafting surgery (CABG) and percutaneous coronary intervention (PCI). PCI is an invasive procedure and is considered a better choice for patients because, unlike open-heart surgery, it does not require a sternotomy. [3] In South Korea, between 2006 and 2013, the number of hospitals performing PCI

doubled, while the rate of CABG rose only by 15%. [4] In the United States, between 2001 and 2008, the annual rate of CABG dropped significantly. [5] There was also a decline in the number of PCI procedures performed in the United States in recent years, from 559 000 in 2010 to 519 000 in 2013. [6] The global burden of cardiovascular disease in 2010 was $863 billion, and it is projected to reach $1044 billion by 2030. [7] In Iran, the economic burden of coronary artery disease in 2014 was estimated at $4.8 billion, [8] imposing back-breaking costs on up to 55% of patients. [9] Several clinical trials have reported that CABG is more expensive than PCI. Nonetheless, a 5-year follow-up study showed that the risk of the recurrence of vascular occlusion in PCI was higher than that in CABG. Various studies have shown no significant differences between PCI and CABG in cardiovascular patients with lesser and moderate complexity in terms of myocardial infarction and death. [10, 11] Nevertheless, in more complex and long-term cases, the incidence rates of myocardial infarction and mortality in CABG appear to be significantly lower than those in PCI. [12] Given the prevalence and mortality rates of cardiovascular disease in Iran and the lack of studies on the economic aspects and costs of this disease, we sought to compare the costs for patients treated with either CABG or PCI at a 1-year follow-up.

METHODS

This observational, prospective cohort study compared the costs of CABG and PCI in 381 patients from 2018 through 2019 in Tehran Heart Center. CABG was performed in 184 patients and PCI in 197. The study population was followed up for up to 1 year. The study protocol was approved by the Ethics Committee of Tehran University of Medical Sciences.

Data Collection and Costs

As is demonstrated in Table 1, data were collected over 1 year and in 3 different periods. With the aid of a researcher-made form, the study population's demographic information, direct nonmedical costs, days of absence from work, and lost income were collected. This information was then completed in 2 periods of 6 months and 1 year after either CABG or PCI. Clinical information regarding the studied patients and hospital costs (outpatient, inpatient, surgical, and pharmacological) was collected from the hospital's information system. Data were completed and updated up to 1 year after either CABG or PCI. Treatment costs were calculated in terms of state tariffs.

Direct Treatment Costs

These costs are directly related to the disease. The diagnostic costs of the disease include treatment and care. [13] For the calculation of the diagnostic costs of the disease (eg, the exercise test, electrocardiography, echocardiography, and angiography), the hospital's information system and the researcher-made form were utilized. This information was collected up to 1 year after the treatment procedure. The treatment and hospitalization costs of the patients were also calculated from the hospital's information system. The main drugs of the CABG and PCI groups were identified over 1 year by examining the information of 10 000 patients from the pharmacy information system of Tehran Heart Center, and their costs were calculated based on state tariffs.

Direct Nonmedical Costs

These costs comprise a combination of the costs imposed on patients and their families and include travel expenses for the treatment of the disease, as well as the costs of food and accommodation. [13] Information pertaining to these costs was gathered using the researcher-made form and interviews

with the patients in 3 different periods over 1 year.

Indirect Costs

Indirect costs are caused by the loss of opportunities and economic resources due to disease, and they include lost production costs owing to premature death and lost production costs due to disease. [13] In this study, information regarding the number of days of absence from work and the lost income of the patients and their companions was collected in 3 different periods over 1 year.

RESULTS

PCI interventions are associated with stents and balloons, both of which account for 60% of the costs of consumables in the catheterization laboratory. In patients undergoing CABG, the length of stay from admission to discharge is the average hospital stay in the general ward, the intensive care unit, and the post-coronary care unit, which are 10, 3, and 3 days, respectively. On average, patients undergoing CABG stay in the hospital for 16 days, whereas patients undergoing PCI stay in the hospital for 2 days.

As is illustrated in Figure 1, the average cost of the PCI group increased with a rise in the number of clogged arteries and, thus, the increased use of stents and balloons.

Fifty-seven percent of the patients in the CABG group were admitted to Tehran Heart Center from outside Tehran Province, as opposed to about 42% of the patients in the PCI group. The direct nonmedical cost in the CABG group was on average about twice that in the PCI group. Additionally, absenteeism from work in the CABG and PCI groups was 109 and 36 days, respectively. Given the heavier nature of open-heart surgery, the CABG group patients needed more rest, which affected their income.

Finally, a summary of hospital and follow-up costs over 1 year is presented in Table 2. Table 2 generally shows that CABG costs were higher than PCI costs in most cases. Only in terms of drug costs did the PCI group patients incur heavier costs (13 997 480 rials per year in the PCI group vs 10 814740 rials in the CABG group).

Overall, at the 1-year follow-up, the costs were higher in the CABG group than in the PCI group.

Δ(CABG-PCI)	95% CI
60620130	54863120 to 66225290
67207340	52710110 to 82369610
43996010	30202670 to 58012220
34200670	21347450 to 46246050

Table 1. Variables used to compare the economic burden between coronary artery bypass grafting and percutaneous coronary intervention

Variables	Sources	Time Interval for Receiving Information
Demographic Information	Interviews with the patients and a researcher-made form	First visit
Direct medical costs	Hospital information and interviews with the patients	First visit, followed by 6 months and 12 months postprocedurally
Direct nonmedical costs	Interviews with the patients and a researcher-made form	First visit, followed by 6 months and 12 months postprocedurally
Indirect costs	Interviews with the patients, a researcher-made form, and the Statistical Center of Iran	First visit, followed by 6 months and 12 months postprocedurally

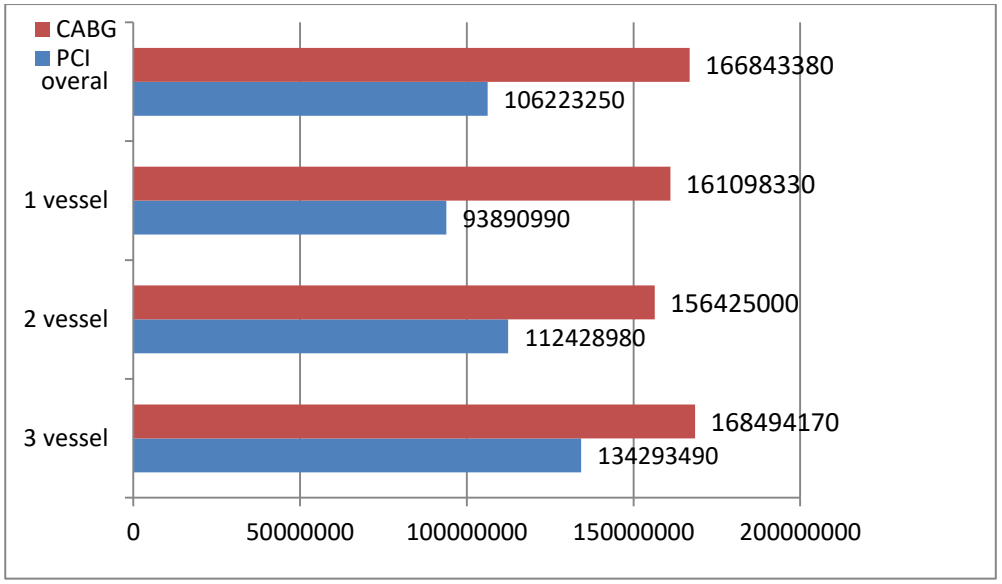

Figure 1. The figure depicts the initial hospitalization costs for the PCI and CABG arms in the study.

*Numbers are in rials.

PCI, Percutaneous coronary intervention; CABG, Coronary artery bypass grafting

Table 2. Costs collected during the 1-year follow-up

Average Costs	PCI(n=195)	CABG(n=184)	(CABG-PCI)Δ	95% CI
Direct medical expenses	122/508/920	183/907/460	61398540	
Hospital and hospitalization costs	106/223/250	166/843/380	60620130	54941230 to 66141430
Postoperative outpatient costs	2/288/190	6/249/340	3961150	2791920 to 5161270
Drug costs	13/997/480	10/814/740	-3182740	
Nonmedical direct costs	7/951/900	15/848/570	7896660	
Travel expenses	4/731/220	10/167/540	5436310	3734140 to 7419250
Accommodation and food expenses	2/148/520	4/362/840	2214320	1232730 to 3301780
Indirect costs	26/315/170	79/420/960	53105790	
Lost income of the patients	21/493/820	69/651/850	48158020	33577940 to 63486460
Lost income of the patients' companions	4/821/350	9/769/110	4947750	1566780 to 8332830
Total cost per patient	156/775/990	279/176/990	122401000	94932420 to 142511990

*Numbers are in rials.

PCI, Percutaneous coronary intervention; CABG, Coronary artery bypass grafting

DISCUSSION

The incidence of coronary artery disease in Iran is 1027 per 100 000 people. [14] In 2016, out of a total of 360 000 registered deaths in Iran, heart disease accounted for 150 000 deaths, of which 59 000 occurred in individuals under the age of 70, making heart disease the number one cause of death in Iran. [15]

The results of the current study showed that in CABG, direct medical costs, direct nonmedical costs, and indirect costs accounted for 65%, 5.6%, and 29.4% of the total costs, respectively, while in PCI, these figures were 78%, 5%, and 17%, respectively. In CABG,

patients are absent from work for more than a year, and the share of the indirect costs of total costs is higher in CABG than in PCI.

In line with the present study, in another study that estimated the economic burden of coronary heart disease in Iran, the combination of costs was almost the same (73%, 3%, and 21%). [8] In another study in Iran, the amount of out-of-pocket payments for cardiovascular patients in 2015 was calculated to be about 16 million rials per year, which is not concordant with our findings. [9]

In the present study, in both PCI and CABG groups, costs related to absenteeism from work due to disability, after direct medical expenses, comprised the largest share of the total cost. In a study in South Korea, direct costs due to heart disease accounted for 53.3% of the treatment cost, and the lost production cost was estimated to be 33.6% due to disability and mortality. [16]

In the present study, the total cost of 1 year in the CABG group was about 279 176 990 million rials. It should be noted that the minimum wage in 1998 in Iran was about 20 million rials per month and 24 million rials per year. A study in Iran showed that 25% of cardiac patients with a stable job faced excessive costs, with the costs being more than double in self-employed and retired patients.[9] In addition to incurring high costs, patients also face absenteeism from work. In the present study, the patients in the CABG and PCI groups were absent from work for an average of 109 days and 36 days over 1 year, respectively. The impact assumes even greater significance among patients who do not meet the conditions for receiving insurance benefits.

As is shown in Figure 1, the average cost of the PCI group increased with a rise in the number of clogged arteries and, thus, the increased use of stents and balloons. In patients with triple-vessel disease, several studies have shown that, at a 5-year follow-up, CABG appears to be more cost-effective than PCI. [17, 18]

Our 1-year follow-up period may not be enough to examine the effects of the 2 interventions more accurately, and this is one of the limitations of the current study. Furthermore, the conversion of costs into dollars due to severe fluctuations in the exchange rate in Iran can be deemed another shortcoming of this investigation.

Overall, CABG costs more than PCI in the first year. Basic insurance and supplementary insurance have a favorable role in hospital costs, but their role in postoperative services is less pronounced. Patients have difficulty paying for medications, especially Plavix, as well as costs related to cardiac rehabilitation. Long queues at public hospitals and the lack of patient visits by treating physicians are some of the reasons why patients are regularly removed from postoperative checkups at public hospitals. What further aggravates the situation is that some patients are not sufficiently insured. Moreover, private centers fail to perform postoperative checkups regularly.

CONCLUSIONS

Cardiovascular disease imposes high costs on the healthcare system. It is, therefore, advisable to control and limit the consequences of this disease with self-care and screening programs.

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