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Original Article

An Observational Study for Cost Analysis in Post-angioplasty Acute Coronary Syndrome Patients in Tertiary Care Hospital

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Abstract

Introduction: Acute coronary syndrome (ACS) is an emerging epidemic in our country and is adding economic burden to the existing health-care system. Long duration prescriptions and cost of drugs are making treatment a luxury. This study aims to analyze the cost-effectiveness of the prescription pattern in post-angioplasty ACS patients treated in the intensive care unit (ICU) at a tertiary care hospital.

Purpose: The purpose of the study was to carry out the cost analysis to study the economic burden of prescriptions for the treatment of ACS after angioplasty.

Materials and Methods: A cross-sectional observational study was performed on prescriptions of 600 patients of ACS treated with angioplasty at cardiac ICUs at J. J. Hospital Mumbai from September to October 2018 and analysis was carried out to find out cost-effectiveness.

Results: Maximum incidence was found in the 7th decade (31%) followed by the 6th decade (30.5%). 74.5% were males. A total of 5972 drugs were analyzed which also included drugs incorporated in drug-eluting stents. An average number of drugs prescribed per prescription was 9.95 (minimum 9 and maximum 17). Nearly 56.29% of total drugs were exclusively prescribed for ACS and 41.27% drugs were used as supportive treatment. Only 15.75% of total drugs were prescribed by generic name. Only 1/3rd of the prescribed drugs were available in hospital pharmacy. Cost analysis revealed the cost per prescription being 4,422.58 Indian National Rupee (INR) of which 2,148.62 INR was borne by the patient.

Conclusion: Most drugs are not prescribed by generic names and thus are unavailable in hospital pharmacy which increases the treatment cost. Studying the prescription pattern and making appropriate amendments in treatment policies will reduce the financial burden and lead to better health care.

Key words: Acute coronary syndrome, Angioplasty, Cost analysis, Generic, Prescription

INTRODUCTION

Acute coronary syndrome (ACS) encompasses a continuum of conditions ranging from ST-segment elevation myocardial infarction (STEMI) to non-STEMI and unstable angina.[1] The most common cause of mortality in patients with coronary artery disease (CAD) is ACS. Due to the introduction of both invasive and non-invasive therapeutic strategies, the mortality caused by ACS has been significantly reduced in the world. Although mortality from ACS has declined substantially, it is still estimated that 40% of the patients who experience a coronary event will die within 5 years with the risk of death being 5–6 times higher in individuals who experience a recurrent event.[2,3] Compared with other populations around the world, CAD occurs in Indians 5–10 years earlier and the major effect of this peculiar phenomenon is on the productive workforce of the country aged 35–65 years.[4] The highest burden of ACS in the world is found to be in India, both

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the prevalence and incidence are high among Indians.[4,5] India is undergoing an epidemiological transition and is on the threshold of an epidemic of cardiovascular disease.[6] Over the past 40 years, the prevalence has increased by 300% or more in India and is increasing now at a rate of 5–6% per year and has increased from 1.6% to 7.4% in rural populations and from 1% to 13.2% in urban populations.[7] Thus, ACS has become the new emerging epidemic in our country and is adding economic burden to the already existing health-care system. With current trends in health-care development, mortality generally declines the causes of death shifts, and all this leads to an increase in average life expectancy. Rapid changes in lifestyle which includes improved nutrition, better hygiene, sedentary lifestyle, and increased tobacco use result in obesity, dyslipidemia, high blood pressure, and heart disease. These changes are collectively known as epidemiological transition.[8] As a result of the epidemiological transition, the cause-specific deaths from cardiac diseases have doubled to 36% of all deaths over the past two decades in India.[9] Rapid development and the resulting changes in the social fabric and physical environment are driving these chronic diseases epidemic in India. Considering the above statistics, it becomes evident, the impact these diseases have, both physically and economically, not only on the patients but also on the nation as a whole. Even though few centers do provide world-class medical facilities in India, they are available only to the minority who can afford it and the focus on high-tech interventions may be distracting from the goal of providing evidence-based, safe, effective, and relatively inexpensive drugs on a much wider scale among the affected population. Management has evolved considerably over the past decade and long duration prescriptions and cost of drugs is making affordable treatment a luxury. With international trends of rising health-care costs and increasing rates of cardiovascular disease, the efficient use of limited health-care funds through the promotion of appropriate therapies with favorable indices of cost-effectiveness is of particular importance, especially given the large number of patients to whom these therapies might be applied. The prescribing behavior varies with different physicians prescribing the prescription depending on their knowledge and the guidelines they follow. The quality of medical care requires prescribing to be judicious, appropriate, safe, effective, and economic. "Good" prescribing requires to maintain balance between numerous factors which can be conflicting at times. The ultimate aim is achieving maximum clinical benefit for the patient and at the same time reducing the risk of complications and the economic burden on the patient while respecting their choice.[10] Inappropriate prescribing habits lead to ineffective and unsafe treatment, prolongation of illness, distress, and unnecessary economic burden to the patient. Countries spend 30–40% of their total health budget on drugs, some of which are useless and expensive.[11] The economic implications of treatments for cardiovascular diseases are increasingly important worldwide, as the direct and indirect annual costs associated with cardiovascular disease are enormous. There is increasing importance of prescription pattern monitoring studies due to rise in the marketing of new drugs and products, variations in the prescribing pattern and consumption of drugs, growing concern about various drug interactions, the cost of drugs, and the pattern of prescription.[12] As a researcher, we have a unique responsibility to study these aspects and communicate the price variation between brands and to better understand the effect of prices on prescription behavior**.** It is important that physicians should be familiar with the cost of drugs used in the treatment of ACS and thus it becomes necessary to ascertain the degree of price variation among brands of the same generic to understand the market and marketing dynamics of the Indian pharmaceutical market.[13] Very few studies are currently available that covers this aspect in post-angioplasty patients. Considering the economic implications the disease has, this study aims to study the pattern and number of the drugs that are prescribed especially in their generic and branded names and to carry out the drug cost analysis of some of the drugs prescribed in post-angioplasty ACS patients treated to find out the price variation among some branded drugs and generic drugs. This will help bridge the gap that exists regarding the knowledge and information about drug prescription and cost of various drugs used for the better and efficient use of limited health-care funds and resources.

MATERIALS AND METHODS

The present study entitled an observational study for cost analysis in post-angioplasty ACS patients in tertiary care hospital was a cross-sectional, observational, descriptive study conducted in the cardiac intensive care unit (ICU) unit of the department of cardiology in collaboration with the department of pharmacology in a tertiary health care hospital. This study was conducted for a period of 6 months (May 2018–November 2018). A sample size of 600 patients was included. Post-angioplasty, hemodynamically stable patients of either gender aged 18 years and above and admitted in cardiac ICU were included in the study. Post-angioplasty patients not satisfying the above criteria were excluded. The present study was started after submitting protocol and getting approval from the Institutional Ethics Committee and cardiology department. Patients were given information about the study and after taking written consent from them; the data were collected during the said period from patient's prescriptions and the electronic medical record database and were recorded in a

structured case record form, while taking the data above given inclusion and exclusion criteria were followed. The data were compiled into Microsoft Office Excel worksheet 2013 Version, and a descriptive statistical analysis was carried out. The results on continuous measurement scale were presented as Mean ± standard deviation (SD), and results on categorical measurement type were presented as simple percentages (%). Results were prepared in tabular and graphical form. The following data were collected: Patient demographic details such as patients initial, age, gender, address, and occupation prescription details such as number of drugs, names of individual drugs, dosing schedule, and the duration for which it is prescribed, cost of drugs prescribed from the hospital schedule which was calculated on the basis of rate contract (RC) available in hospital drug store and cost of drugs prescribed from pharmacies outside the hospital which was obtained from the CIMS. Both the generic cost and the branded drug costs were calculated for the common drugs that were prescribed. Cost included in the analysis was direct medical care costs for prescriptions given after angioplasty.

Table 1: Gender distribution in study population (*n*=600)

Gender	Frequency (%)
Male	447 (74.5)
Female	153 (25.5)
Total	600 (100)

Table 2: Drugs prescribed by generic name in the study population

Drug	Number of prescriptions (%)
Heparin	600 (63.76)
Ranitidine	174 (18.49)
Atorvastatin	35 (3.72)
Enalapril	16 (1.7)
ISDN	16 (1.7)
Others*	101 (10.63)
Total	942 (100)

*Others includes amlodipine, atenolol, digoxin, dabigatran, clopidogrel, warfarin, metoprolol, levofloxacin, and metformin

Table 3: Cost analysis of the prescription among the study participants (*n*=600)

Parameter	Amount (INR)
Total cost for all 600 prescriptions	2,653,550
Average cost per prescription	4422.58
Total cost borne by the patient	1,289,172 (48.59%)
Average cost per prescription borne by the patient	2148.62
Total cost borne by the hospital	1,364,378 (51.41%)
Average cost per prescription borne by the hospital	2273.96

INR: Indian national rupee

RESULTS

Demographic Details

The patients in the study were above the age of 18 years. The minimum age was 25 years and the maximum age was 87 years. Mean age was 57.6 years with SD of 11.37. Majority of the patients, 186 (31%) were in the age group of 61–70 years and 183 (30.5%) were between 51 and 60 years of age [Figure 1]. Table 1 shows that Out of the total 600 patients enrolled, there were 447 (74.5%) males and 153 (25.5%) females [Table 1]. The approximate ratio of male: female was 2.84. Considering the occupational status of patients, 311 (51.84%) were employed and 289 (48.16%) were unemployed.

Prescription Analysis

A total of 600 prescriptions of patients who underwent angioplasty and admitted in cardiac ICU were analyzed, which had a total of 5972 drugs. This included the fixed drug combination (FDC) formulation as a single drug. An average number of drugs prescribed per prescription was 9.95 ± 20.49. The minimum drugs per prescription were 7 (1) and maximum drugs were 17 (2). Majority of patients were prescribed with nine drugs per prescription, 193 (32.16%), followed by 10 drugs per prescription in 191 (31.84%) patients [Figure 2].

In total, 40 classes were prescribed in 600 prescriptions (n = 600). The various classes of drugs were divided as drugs used exclusively for the treatment of ACS after angioplasty (3596 [55.90%]) of the total drugs prescribed, drugs used as supportive treatment (2655 [41.27%]) and concomitant medications (181 [2.81%]). The maximum number of drugs belonged to the antiplatelet class of drugs making it the most

Table 4: Imapact of the quantity of drug prescription on overall cost difference for the patients

Drug	Generic cost	Branded cost	Number of brands prescribed	Quantity prescribed	Cost difference	Total cost
Aspirin	0.2	0.33	5	473	0.13	61.49
Atorvastatin	0.38	5.82	15	392	5.44	2132.48
Cefotaxime	16.2	33.44	1	598	17.24	10309.52
Clopidogrel	3.5	5.95	8	71	2.45	173.95
Enalapril	2.29	2.91	2	48	0.62	29.76
Heparin	98.35	70.16	1	600	−28.19	−16914
Pantoprazole	0.51	9.44	3	405	8.93	3616.65
Ranitidine	0.39	0.77	2	174	0.38	66.12

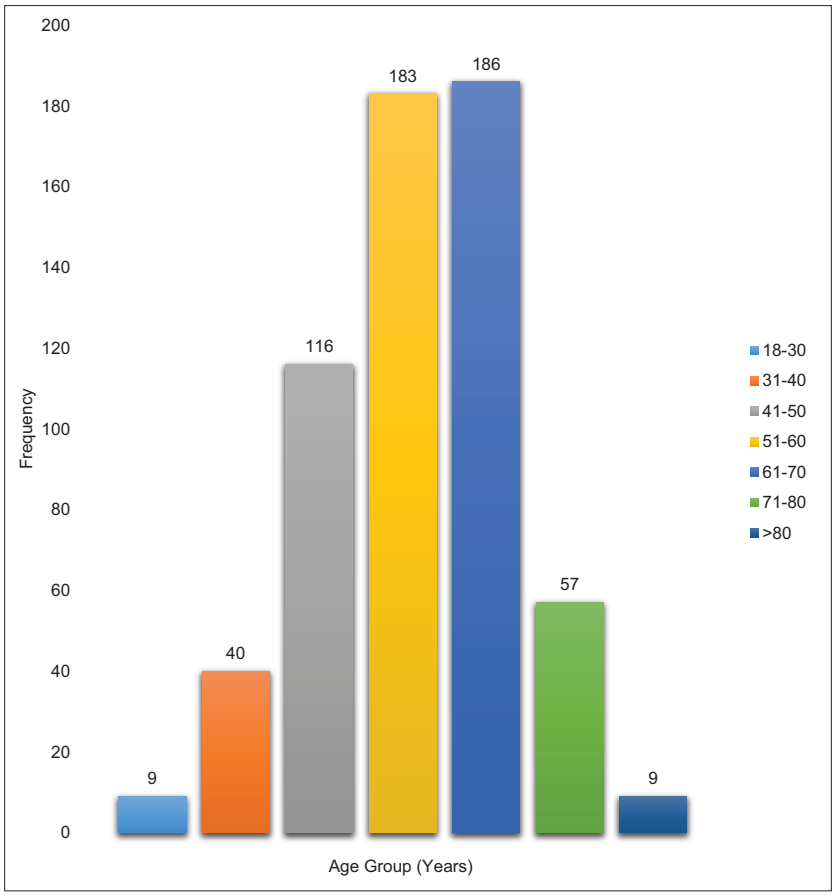

Figure 1: Age distribution in the study population (*n* = 600)

commonly prescribed drug class with 1187 (33%) of the total drugs used for ACS treatment post-angioplasty. This was followed by anticoagulants having 606 drugs (16.85%). The angiotensin receptor blockers had a minimum number of drugs being prescribed which was 94 (2.6%).

Analysis of Drugs Prescribed by Generic and Branded Names

Of all the total of 5972 drugs prescribed among the study population, only 942 drugs (15.75%) were prescribed by generic name [Figure 3]. Out of 103 different drugs of various classes prescribed, 30 drugs (29.12%) were prescribed by generic name. Heparin was the most common drug prescribed by generic name, with a total of 600 prescriptions. This was followed by ranitidine with 174 prescriptions [Table 2]. Furthermore, drugs prescribed by their branded names were calculated for brand prescription of five or more brands. This also includes FDCs which are prescribed as branded drugs. In total, nine drugs had prescriptions in five or more brand names. Atorvastatin had been prescribed with 15 branded names in total followed by metoprolol having 12 branded names being prescribed. Other drugs were rosuvastatin, telmisartan, clopidogrel, and metformin.

Analysis of Drugs Prescribed Included in Hospital Pharmacy

A total of 103 different types of drugs, 36 drugs (34.95%) were available and dispensed from hospital pharmacy. Of all the total drugs, 53.54% were dispensed from hospital pharmacy, and the remaining 46.46% of drugs were purchased from the outside medical store [Figure 4].

Cost Analysis of Prescription

For calculation of total cost of drugs prescribed post-angioplasty, the factors considered were the cost per tablet, frequency of administration, duration of treatment, and the number of prescriptions where the drug was prescribed. Here, the cost was calculated for a maximum duration of treatment of 30 days for all the drugs except anticoagulants, sedatives, antibiotics, laxatives, analgesics, and muscle relaxants for which the duration of treatment was taken as 5 days post-angioplasty.

The average cost per prescription was 4,422.58 Indian National Rupee (INR), out of which, the cost borne by the hospital was 2273.96 INR (51.41%), and the cost borne by the patient was 2148.62 INR (48.59%) [Table 3].

Cost Difference between Generic and Branded Drug

The cost difference between the generic and branded prescription of a few of the drugs was calculated that was dispensed from our hospital. All the generic drugs were cheaper than their branded counterparts except for unfractionated heparin for which the branded cost

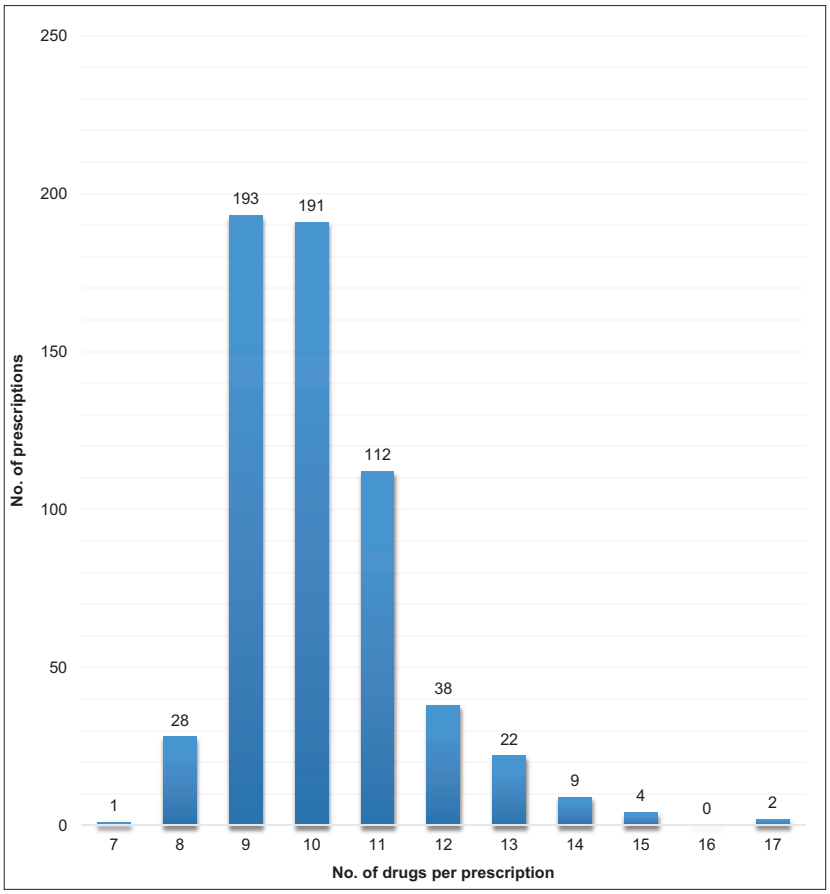

Figure 2: Number of drugs prescribed per prescription in the study population

was cheaper as compared to its generic counterpart. The maximum cost difference was found for low molecular weight heparin (Enoxaparin) and minimum for clopidogrel [Figure 5]. Considering the quantity of drug prescribed, the maximum difference in cost was observed for unfractionated heparin followed by cefotaxime. The minimum difference was observed for enalapril [Table 4].

DISCUSSION

The present study was an observational, descriptive type of study conducted in cardiac ICU unit of the department of cardiology in collaboration with the department of pharmacology in a tertiary care hospital. In this study, prescriptions of 600 patients of ACS, who were admitted in cardiac ICU after they had undergone angioplasty, were assessed.

In the present study, all the patients were above the age of 18 years with a range of 25–87 years, with the average age being 57.6 ± 11.37 years. Majority of patients, i.e., 186 (31%) were in the age group of 61–70 years followed by 183 (30.5%) patients in the age group of 51–60 years making a combined 61.5% of the total study population. This finding was in accordance with the finding of another study conducted by Naveen *et al.* having a mean age of 57.61 ± 11.09 years.[14] Another study conducted by Patel *et al.* had a mean age 57.05 ± 11.92 years.[15] Mean age of the patients was 56.94 ± 11.98 years in a study conducted by Narwane *et al.*[16] The most common age group found in our study was found in accordance with 51–60 years (36.76%) of the study conducted by Naveen *et al.*, whereas another study observed that a maximum number of patients, i.e., 39% were in the age group of 51–60 years.[14] This supports the fact that ACS or CAD affects most commonly the people from the middle to old age group. This may be due to the presence of various risk factors that may have developed in people over a period of time. Furthermore, ACS is now occurring in young age as early as in 20–30 years age group as well, stating the impact of lifestyle changes and addictions such as smoking and alcohol consumption which are common in the young age group population.

The present study had 447 (74.5%) males and 153 (25.5%) females. The approximate ratio of male: female was 2.84. A study conducted by Dawalji *et al.* had 72.94% males and 27.06% females.[10] In a study conducted by Kamath *et al.*, of the 349 patients, 81% were males and 19% were

females.[17] In a retrospective study conducted by Tasneem and Fouzia, of the 140 patients was studied, 96 of these patients were men and 44 of them were women.[18] The present study findings were consistent with the findings of these studies and indicated that males are more prone to CAD as compared to female may be due to the sedentary habits and addictions. The maximum number of males (128) was in the age group 61–70 years and maximum number of females (55) was in the age group of 51–60 years indicating that the females were affected by ACS in their post-menopausal age which may be due to the loss of cardioprotective effects of estrogen.

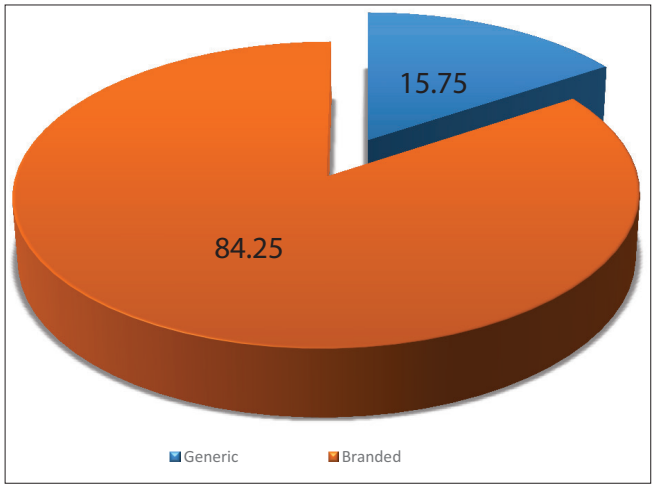

Figure 3: Generic versus branded prescription

Considering the occupational status of patients, the present study had 311 (51.84%) as employed and 289 (48.16%) patients were unemployed. This may be attributed to the finding that the majority of the patients fall in the age group of their retirement from their occupation. Second, employment has been known as a risk factor for the development of ACS by affecting the lifestyle of the people.[19]

The present study had a total of 5972 drugs being prescribed in the 600 prescriptions of patients who underwent angioplasty. The minimum drugs per prescription were 7 (1) and maximum drugs per prescription were 17 (2). An average number of drugs prescribed per prescription was 9.95. This was more than that found in a study conducted by Naveen *et al.*, which was 7.73.[14] Another study conducted by Choudhari *et al.* showed an average number of drugs per encounter as 7.96 which was again less than that found in our study.[20] A study conducted by Dawalji *et al.* showed the average number of drugs per patient as 9.68[10] which

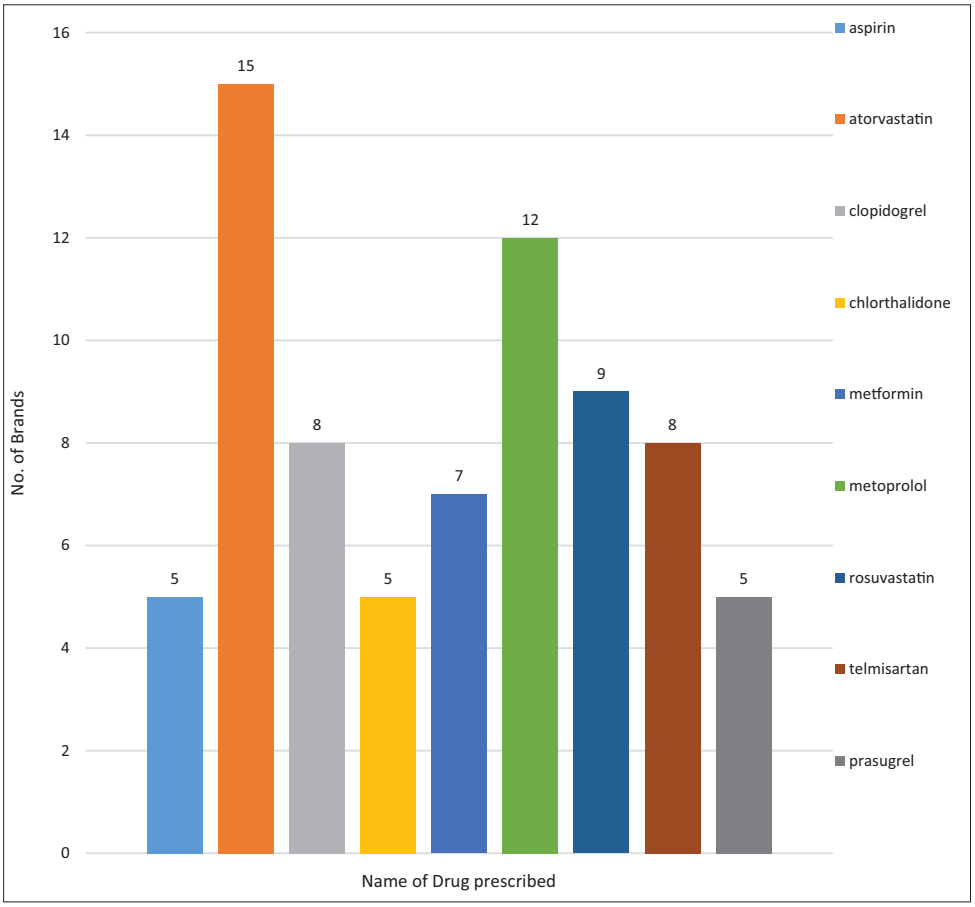

Figure 4: Number of brands of a single drug prescribed

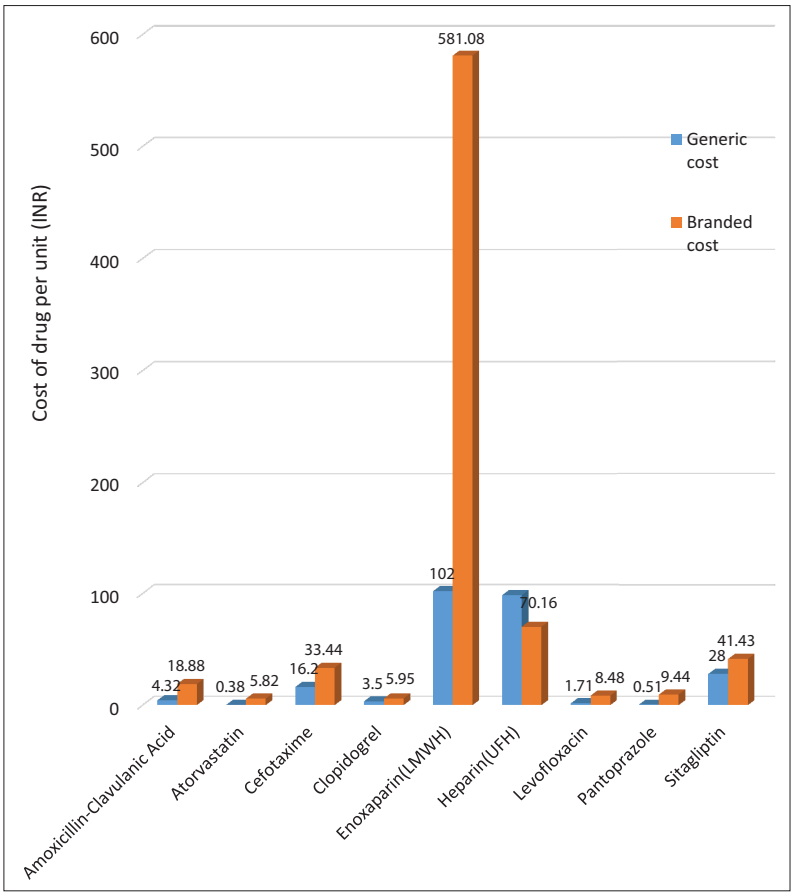

Figure 5: Cost difference between genric and branded drugs

was close to the finding of our study. In a study conducted by Tasneem and Fouzia, the average number of drugs used per patient was 9.93.[18] It is, thus, seen that a combination of various drugs is often prescribed for the treatment of ACS, especially after angioplasty, to improve the success rate of the procedure done. However, this may lead to polypharmacy and if unchecked, can ultimately lead to the development of complications due to it. This may lead to an increase in the mortality and morbidity among the diseased population.

In the present study, out of 5972 drugs, only 15.75% of the drugs were prescribed by generic name and 84.25% were prescribed as branded drugs which were in accordance with a study conducted by Naveen *et al.* showed 89.73% of drugs being prescribed by branded name and only 10.26% of drugs with generic name[14] and with the study conducted by Tasneem and Fouzia that had percentage of drugs prescribed by generic names only up to 6.00%.[18] Another study showed only 16.28% of drugs being prescribed with the generic name, which was in accordance to the present study.[20] In a study conducted by Narwane *et al.*, the percentage of drugs prescribed by generic name was 61.08%. The present study finding was way below than that found in this study.[16] The percentage of drugs used by generic name varied from the previous studies. The present study showed a lower rate of prescribing of drugs by their generic name. This may indicate more inclination of the prescribing doctors to prescribe branded drugs, and this may lead to the promotion of any specific brands. This may also create confusion and prescribing errors among the pharmacists dispensing these drugs. Generic drug prescription can be beneficial provided; adequate quality control can be maintained and good quality of generic drugs being made available in the pharmacy shops. Increasing generic prescribing would rationalize the use and reduce the cost of drugs and make the treatment more cost effective and economical.

In the present study, out of a total of 103 different types of drugs, 36 drugs (34.95%) were available and dispensed from the hospital pharmacy. Of all the drugs prescribed among the study population, 53.54% of drugs were dispensed from hospital pharmacy and the remaining 46.46% of drugs were purchased from the outside medical store. 51.94% of drugs prescribed exclusively for the treatment of ACS post-angioplasty were dispensed from hospital pharmacy making the treatment less costly to the patients, as more than half of the drugs were provided from the hospital store itself. The remaining drugs had to be purchased from outside. The reason for this may be

less number of generic prescriptions or unavailability of some of the drugs in the hospital pharmacy or absence of some of the drugs in the RC list of the state government. The drugs that were available and dispensed from the hospital pharmacy included generic drugs as well as few of the branded drugs that were dispensed from the generic drug stock of the hospital pharmacy at the level of the pharmacist. This in a way reduced a little expenditure on drugs that the patient had to bear for purchasing the drugs from outside medical stores. Prescribing generic drugs for long-term treatment thus would significantly reduce the economic burden on the patient.

In the present study, the average cost per prescription was 4,422.58 INR, out of which, the cost borne by the hospital was 2273.96 INR (51.41%) and the cost borne by the patient was 2148.62 INR (48.59%). The cost calculated was for a maximum period of 1 month for all the drugs that were prescribed in a single consultation by the physician and were dispensed from the hospital pharmacy in a single visit. Considering the difference in the cost of generic and branded prescriptions and the quantity of drugs that the patient has to take for treatment post angioplasty over months to years, multiple branded prescriptions can thus increase the total cost of treatment which can be difficult for low income population to sustain over such long periods. This can lead to a decrease in the compliance of treatment significantly. However, in the present study, along with drugs prescribed by generic names, many branded drugs were also dispensed from the hospital pharmacy. These drugs were provided free of cost to the patients that reduced the overall economic burden on the patient. This being a government hospital, the majority of the patients that come here are of low socialeconomic background, thus receiving medicine free of cost can help improve the compliance of the treatment and encourage them for regular follow-up to refill their prescriptions. There were no similar studies that were published with whom we could compare our cost parameters. It is important to keep in mind the expenditure on travel and the time and money spent on consulting also adds to the total health-care cost. In a developing country like India, the cost is an important factor that determines compliance.[21]

CONCLUSION

The present study provides valuable insight into the pattern of drugs prescribed in ACS especially post-angioplasty. Antiplatelets, anticoagulants, statins, and beta-blockers were the most common drugs that were prescribed in the majority of the prescriptions. Not only the number of generic prescriptions is needed to be increased by the prescribing doctors but also the number and type of drugs available in the hospital pharmacy are needed to be made more available to the patients. Since the treatment has to be continued over a long period of time ranging from months to years, the treatment should be monitored and individualized according to the response that the patient shows. All these will help to reduce the financial burden and lead to better health care and resource utilization. The study of prescribing pattern is a component of a medical audit that does monitoring and evaluation of the prescribers as well as recommends necessary modifications to achieve rational and cost-effective medical care. The prescribing doctors should be familiar with the cost of drugs used in the ACS post-angioplasty to help them improve patient management by rationalizing prescribing practices and carry out the necessary interventions to improve rational drug usage. The study results showed that the inappropriate use of drugs in CAD increases the cost of treatment and in the long term this may even contribute to drug-related problems and interventions are necessary to improve rational drug use of drugs. The results of this study on drug prescribing pattern can provide a framework for continuous prescription audit in a hospital inpatient setting and appropriate amendments in treatment policies will reduce the financial burden and lead to better health care.

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