Research Article

Cost analysis of ACE inhibitors and ARBs used in essential Hypertension

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Abstract

Objective: Hypertension is a chronic disorder requiring lifelong treatment. This study is done to find out the percentage variation of cost among different brands of angiotensin converting enzyme inhibitors (ACE inhibitors) and angiotensin receptor blockers (ARBs) used in hypertension. **Materials and methods**: The cost of a particular drug being manufactured by different companies, in the same strength and dosage forms, was referred from "Indian Drug Today (January - March 2017)". The difference between the maximum and minimum prices of same drug was analyzed and percentage variation in the prices and cost ratio were calculated. **Results**: In Single drug therapy, among ACE inhibitors, Enalapril (5 mg) shows maximum price variation of 4748% and among ARBs, Valsartan (80 mg), has the price variation of 494.2%. In combination therapies, Irbesartan + Hydrochlorothiazide (150 mg +12.5 mg) combination showed the maximum variation of 289.85 %. **Conclusion**: This study shows a wide variation in the prices of ACE inhibitors and ARBs. Prescribers should be aware of these variations and select cost effective drug to decrease the economic burden on population.

Keywords: Hypertension, cost analysis, price variation, cost ratio

Introduction

Hypertension is a long term medical condition resulting in high morbidity and mortality. It is an important risk factor for various diseases like coronary heart disease, stroke, congestive heart failure and impaired renal function (Kokiwar et al., 2012). WHO rates hypertension as one of the most important cause of premature death worldwide. Prevalence of hypertension in India is reported to vary from 4-15% in urban and 2-8% in rural population (Sandozi and Emani, 2010). The situation is more alarming as hypertension attributes for nearly 10% of all deaths (Patel V et al., 2011). Antihypertensive therapy reduces the risk of morbidity and mortality. According to eighth Joint National Committee (JNC 8) (James et al., 2014), Angiotensin converting enzyme (ACE) inhibitors and Angiotensin receptor blockers (ARBs) are the initial drugs of choice along with calcium channel blockers and thiazide diuretics for hypertension. ACE inhibitors are also recommended in patients with diabetes, cardiovascular disease (American Diabetes Association, 2010) as they have nephroprotective (Fioretto and Solini, 2005) and cardio protective properties.

There are many brands of the same drug available in Indian market with large difference in prices. The cost of medicines is a hurdle in treating the condition effectively. Due to lack of information on comparative drug prices and quality it becomes difficult for physicians to prescribe most economical treatment (*Paunikar and Bhave, 2015)*. This affects the compliance and adherence to the treatment by the patients. Information generated from cost analysis studies will be helpful for both the doctors in choosing the correct medicine for their patients and for policy makers in successfully utilizing the available resources (Adama et al., 2003). So the present study was done to analyze the variation of cost among different brands of ACE inhibitors and ARBs available in the Indian market.

Materials and methods

The study was done in the department of pharmacology of a teaching hospital in south India. Indian Drug Today (January - March 2017) was used to analyze the prices of ACE inhibitors and ARBs. The cost of a particular drug in the same dose and dosage forms being manufactured by different

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companies was compared. The cost of drugs in Indian rupee (INR) for 10 tablets was calculated for each brand. The difference between the maximum and minimum costs of the same drug manufactured by different pharmaceutical companies was calculated. The percentage cost variation and cost ratio were then calculated for each drug. The percentage variation in the cost of the drugs was calculated using the following formula (Jadhav et al., 2013).

$$\text{Percentage cost variation} = \frac{\text{Price of most expensive brand} - \text{Price of least expensive brand}}{\text{Price of least expensive brand}} \times 10($$

Cost ratio is calculated by the ratio of most expensive brand to least expensive brand of the same drug (Singh, 2016). It helps to know how many times the most expensive formulation is costlier than the least expensive formulation of the same drug.

Exclusion criteria: The drugs manufactured by only one company; drugs with no cost information were excluded. Fixed dose combinations of more than two agents were also excluded.

Statistical analysis

The data collected was entered in Microsoft Excel 2007. Cost ratio and percentage cost variation were calculated. The data is represented in the form of tables and charts.

Results

The prices of total of 21 drugs (11 single and 10 combination preparations) belonging to ACE inhibitors and ARBs were analyzed. Percentage cost variation increases with increase in the no. of manufacturing companies.

Table 1 shows the price variation among ACE inhibitors. Maximum cost variation was seen with Enalapril 5mg (4748%) while Perindopril 4mg showed minimum cost variation of 44.2% (Figure 1). The cost ratio ranged from 1.44 for perindopril 4mg to 48.48 for Enalapril 5mg.

Table 1. Price variation among ACE inhibitors

Drugs	Dose (mg)	Min. price (INR)	Max. price (INR)	Cost ratio	Cost variation (%)
Captopril	25	9.07	35	3.85	285.88
Enalapril	2.5	0.51	20	39.21	3821.56
	5	0.66	32	48.48	4748.5
	10	12	48	4	300
Lisinopril	2.5	13.5	50	3.7	270.37
	5	25	100	4	300
	10	39	114	2.92	192.3
Perindopril	2	56.25	94	1.67	67.11
	4	85	123	1.44	44.9
Ramipril	1.25	14.91	44.3	2.97	197.11
	2.5	26.5	79.8	3.01	201.13
	5	38.57	128.8	3.32	233.93
	10	63.5	179.3	2.82	182.36

Table 2 shows price variation in ARBs. Maximum cost variation

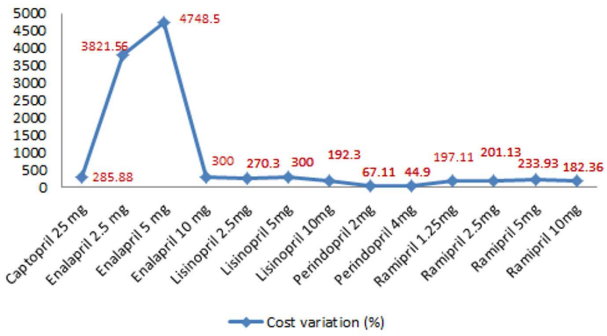

Figure 1. Percentage cost variation in ACE inhibitors

was seen with Valsartan 80 mg (494.2 %) while Candesartan 4mg showed minimum cost variation of 3% (figure 2). The cost ratio ranged from 1.03 for Candesartan 4mg to 5.94 for Valsartan 80 mg.

Table 2. Price variations among ARBs

Drugs	Dose (mg)	Min. price (INR)	Max. price (INR)	Cost ratio	Cost variation (%)
Losartan	25	10	38	3.8	280
	50	19	62.5	3.28	228.94
Irbesartan	150	78.56	240	3.05	205.49
	300	168	199.65	1.18	18.83
Candesartan	4	27	27.81	1.03	3
	8	45.27	48	1.06	6.03
Valsartan	80	69	410	5.94	494.2
	160	130	500	3.84	284.61
Olmesartan	20	70.5	90.1	1.27	27.8
	40	109	161	1.47	47.7
Telmisartan	20	12	50.66	4.22	322.16
	40	18	85	4.72	372.22

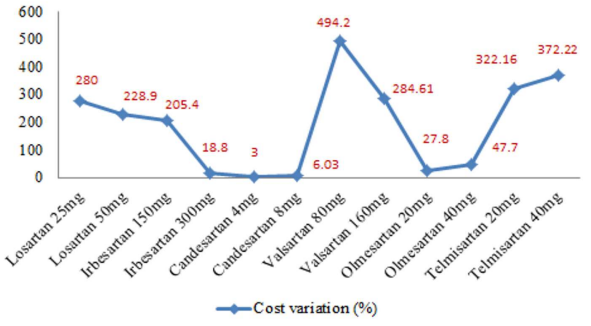

Figure 2. Percentage cost variation in ARBs

Table 3 shows price variation in combination therapy. A total of 10 combinations were analyzed. In this Irbesartan + Hydrochlorothiazide (150 mg +12.5 mg) combination showed the maximum variation of 289.85 %, while Losartan + Ramipril (50 mg +2.5 mg) showed minimum variation of 4.12% (figure 3). Cost ratios of ACE inhibitors and ARBs as single therapy and combination therapy were given in figure 4, 5, 6 respectively.

Discussion

Hypertension is a chronic illness requiring long term

Table 3. Price variations among combination therapy

Drugs	Dose (mg)	Min. price (INR)	Max. price (INR)	Cost ratio	Cost variation (%)
Enalapril + Hydrochlorothiazide	10 +25	27.75	52.33	1.88	88.57
Lisinopril + Hydrochlorothiazide	5 +12.5	42.5	52.1	1.22	22.58
Ramipril + Hydrochlorothiazide	2.5 + 12.5	34.11	84.1	2.46	146.55
	5 + 12.5	43.13	93	2.16	115.62
Losartan + Hydrochlorothiazide	50 + 12.5	29	89	3.06	206.89
Losartan + Ramipril	50 + 2.5	56.8	59.14	1.04	4.12
Losartan + Amlodepine	25 + 5	32	53	1.65	65.625
	50 +5	30	88.47	2.95	194.9
Irbesartan + Hydrochlorothiazide	150 + 12.5	69	269	3.89	289.85
Olmesartan + Hydrochlorothiazide	40 + 12.5	125	145	1.16	16
Telmisartan + Hydrochlorothiazide	40 + 12.5	55	105	1.91	90.9
	80 + 12.5	110	125	1.13	13.63
Telmisartan + Amlodepine	40 + 5	55	101	1.83	83.63

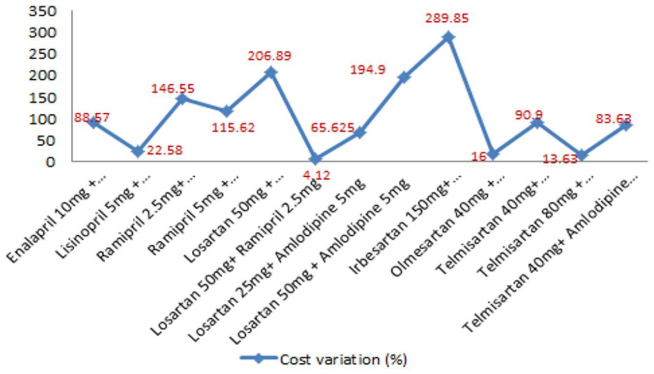

Figure 3. Percentage cost variation in combination therapy

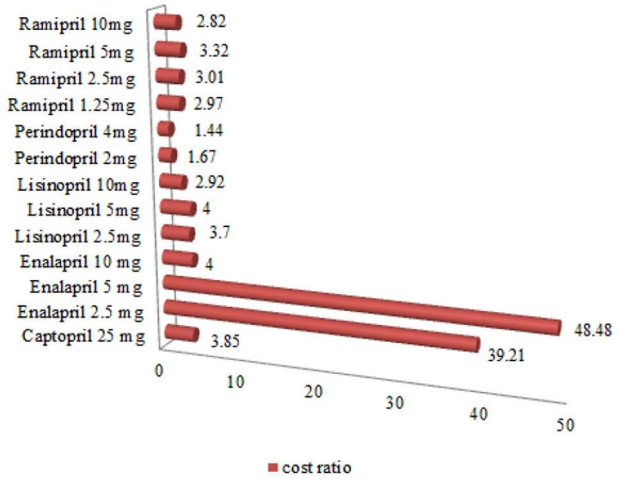

Figure 4. Cost ratio of ACE inhibitors

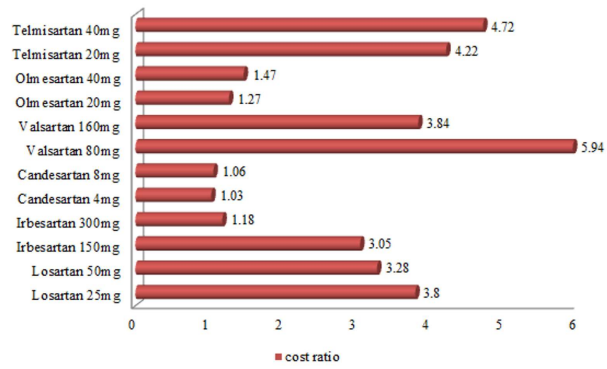

Figure 5. Cost ratio of ARBs

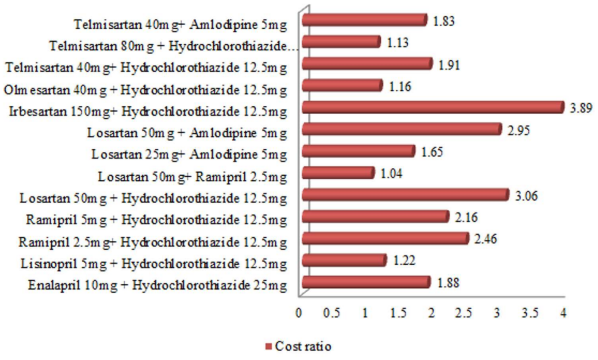

Figure 6. Cost ratio of combined therapy

treatment. The compliance of patient is significantly dependent on the cost of the prescribed medicines and higher cost means the compliance will be less (Rao, 2005). Selection of cost effective brand will improve the compliance and the consequence of the treatment.

There is a high fluctuation in the minimum and maximum price of ACE inhibitors and ARBs. The cost variation was above 100%. Among ACE inhibitors, Enalapril (5 mg) shows maximum price variation of 4748% and among ARBs, Valsartan (80 mg) has the price variation of 494.2 %. Other similar studies in oral antidiabetic drugs (Rajesh and Hima Bindu, 2017), antibiotics (Zubin, 2015), antihistamines (Singh, 2016) found similar results. These

wide variations in the prices have severe economic implications. Unlike developed countries, more than 80% health financing is borne by patients in India (Creese et al., 2004, Mahal et al., 2010). Studies have shown that providing a manual of comparative drug prices annotated with prescribing advice to physicians reduced their patients' drug expense especially in a disease like hypertension which needs long term treatment (Reichert et al., 2000).

The National pharmaceutical pricing authority (NPPA), of Government of India controls drug prices in Indian market. It fixes the ceiling price of a drug based on essentiality of a drug and the pharmaceutical companies fix the price for their products equal to or below the ceiling price for that formulation; however, they cannot sell any medicine given in the drugs prices control order (DPCO) list at a cost higher than that fixed under this order (Drugs Prices Control Order. 2017). The DPCO, 2017 list of price-controlled drugs includes Enalapril, Ramipril and Telmisartan. In our study the price variation even with the above drugs is high. Only 2 drugs out of the total 11 drugs i.e. Enalapril (2.5/5 mg) and Losartan (25/ 50/ 100 mg) were included in the WHO model list of essential Medicines (WHO model list of Essential Medicines 2017) while other drugs were not included in the list. There is a huge price variation of 4748% with Enalapril 5mg even though it is mentioned in WHO model list and DPCO.

Physicians should thus prescribe the low cost drugs and should not be influenced by pharmaceutical industries. Even though Medical Council of India have insisted on prescribing generic drugs as far as possible, doctors are not writing prescriptions containing only generic or unbranded chemical name of drugs. Often, the physicians and the patients prefer the expensive brand name drugs because they believe that the generic equivalent is inferior. The costly brand of same generic drug is scientifically proved to be in no way superior to its economically cheaper counterpart (Das et al., 2007). Comparative evaluation on quality of branded drug and its generic counterpart must be made mandatory for generic manufacturer. It is essential to take action by the government in regulating the prices which can be affordable by a common man.

Conclusion

There is a wide variation in the prices of different brands of ACE inhibitors and ARBs. They have an important role in management of hypertension especially associated with co-morbidities like diabetes, heart failure. The health care providers must be aware of the availability of low cost drugs and can select the cost effective ones based on the economic status of the patient. This reduces the economic burden on the patient and health care system.

Conflict of interest

The authors have no conflict of interest.

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