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## Cost Effectiveness Analysis of Streptokinase and Tenecteplase in the Treatment of Coronary Thrombosis in a Tertiary Care Teaching Hospital



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### ABSTRACT

To Analyse the costs and outcomes of the Streptokinase (STK) and Tenecteplase (TNP) for the Coronary Thrombotic patients and to provide the finer Therapeutic outcome. A Prospective Observational Study was carried out in a Narayana Superspeciality and Tertiary care teaching hospital (Dept. of Cardiology) and Narayana Pharmacy College for a period of 6 months among 123 patients. The data was collected by the patient data forms and specialized questionnaire and the costs and outcome for STK and TNP were evaluated. Pregnant women were excluded from the study. In this study out of 180 patients 123 patients were willing to provide information. Demographics like age, gender, marital status, educational status, employment status were evaluated. Males are more effected compare with females. 50 -60 age people are more prone to get coronary thrombosis. The cost of the STK is 2270 rs/- and TNP is 34500 rs/- and the cost difference is 32230 rs/-. The ICER for the STK was 56.75 and TNP was to be 522.7 were evaluated with the use of statistical formula. This study shows that the STK is more cost effective drug than the TNP. As compared to the cost of STK with TNP, STK is of less cost and easily bearable to the patients. So instead of giving other, STK is cost effective as per Incremental cost effectiveness ratio (ICER).

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### Introduction

Coronary thrombosis is the formation of a blood clot inside blood vessel of the heart i.e. coronary arteries. This clot may restrict the blood flow to the heart tissue leads to damage or myocardial infarction. In India, among the deaths, cardiac diseases reported by the Registrar General of India [1, 2]. The treatment for the Coronary Thrombosis is much expensive in the Indian Health Care Settings. Normally Coronary Thrombosis is Treated with the tissue plasminogen activators and Anti-Thrombotic i.e. Streptokinase, reteplase and Tenecteplase etc.

**Coronary Artery:** The coronary arteries are the arterial blood vessels of coronary circulation, which transport oxygenated blood to the heart muscle [3-7]. These arteries wrap around the entire heart. The word coronary comes from the Latin corona and Greek koron meaning crown. The coronary arteries are mainly composed of left and right coronary arteries and give several branches they,

Left Coronary Artery {arises from the aorta within the left cusp of aortic valve and feeds blood to the left side of the heart}

- Left anterior descending artery
- Left circumflex artery
- Posterior descending artery
- Ramos or intermediate artery (sometimes a third branch is formed at the fork between left anterior descending and left circumflex arteries)

Right Coronary Artery {arises from the aorta within the right cusp of aortic valve and feeds blood to the right side of the heart}

Pharmacoeconomics has been stated as the interpretation and analysis of cost of drug therapy to the health care system and society [8, 9]. It identifies, calculates and compares the cost and effective of drug therapy and drug products and services. Cost Effective Analysis is defined as a set of analytical and mathematical procedures that support the choice of approaches in various alternative approaches. CEA evaluates only different drugs treatments for same conditions. In CEA the cost of drugs are compared against the outcomes of the drugs [10-14]. The cost of drugs include, Physician cost, Nursing cost, medication cost, ambulance services, drug administration cost, hospitalization cost and travelling costs. Effectiveness are outcomes can measured in duration of treatment, symptom free days (SMP) and mortality rate etc., the results of CEA shown as cost/outcome for both treatment options [15, 16].

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**Cost Effectiveness Ratios**

Average cost effectiveness ratio (ACER):

This one of the method of presenting results includes calculating the average costs effectiveness ratio (ACER) foe each alternative [17].

$$\text{Average cost effectiveness ratio} = \frac{\text{health care costs}}{\text{clinical outcomes}}$$

Incremental cost effectiveness ratio (ICER):

ICER is the key measure of the cost- effective analysis. Based on ICER results can be analyzed.

$$\text{Incremental cost effectiveness Ratio} = \frac{\text{cost of drug A-cost of drug B}}{\text{Effect of drug A-Effect of drug B}}$$

Streptokinase creates an active complex which promotes the cleavage of the Arg/Val bond in plasminogen to form the proteolytic enzyme plasmin. Plasmin in turn degrades the fibrin matrix of the thrombus, thereby exerting its thrombolytic action [18, 19]. This product names available in the market were tabulated in Table 01.

| Product             | Company             | Cost(Rs)       | Dose       |
|---------------------|---------------------|----------------|------------|
| Lupiflo Injection   | <b>Lupin</b>        | <b>1818.74</b> | 1500000 IU |
| Myokinase Inj       | <b>Biocon Ltd</b>   | <b>2135.70</b> | 15Lac IU   |
| Icikinase Injection | <b>Abbott India</b> | <b>2270.00</b> | 1.5 MIU    |

**Table 1:** Streptokinase product names, dose and their costs.

A single dose of 1.5 million IU streptokinase should be infused intravenously over one hour.

Tenecteplase binds to the fibrin component of the thrombus (blood clot) and selectively converts thrombus-bound plasminogen to plasmin, which degrades the fibrin matrix of the thrombus. Tenecteplase has a higher fibrin specificity and greater resistance to inactivation by its endogenous inhibitor (compared to native t-PA) [20-23]. This product names available in the market were tabulated in Table 02.

| Product  | Company           | Cost(Rs)        | Dose  |
|----------|-------------------|-----------------|-------|
| Elaxim   | <b>Emcure</b>     | <b>34500.00</b> | 40 mg |
| Metalyse | <b>Boehringer</b> | <b>39899.00</b> | 40mg  |
| Velix    | <b>Emcure</b>     | <b>34500.00</b> | 40 mg |

**Table 2:** Tenecteplase product names, dose and their costs.

Tenecteplase is supplied as a sterile, lyophilized powder for example each 50 mg vial of TNKase is packaged with one 10 mL vial of Sterile Water for Injection, USP for reconstitution, 10mL syringe with TwinPak Dual Cannula Device, and three alcohol prep pads. Tenecteplase) is for intravenous administration only. A single bolus dose should be administered over 5 seconds based on patient weight [24-26].

**Research Methodology:**

**Study Design:** Prospective observational study.

**Study Site:** Study Was Conducted In Narayana Medical College And Hospital (NMCH), in the Department of Cardiology.

**Study Duration:** 6 Months.

**Study Population:** 123 Patients.

**Study Materials:**

- Patient Data Collection Proforma.
- Questionnaire.

**Study Criteria:**

**a) Inclusion Criteria:**

- Patients both Male and Females are included in the study.

- Patients with age 19 to 75 are included in the study.
- Only coronary thrombosis patients are taken in to consideration.
- Only streptokinase and Tenecteplase prescriptions are taken in the study.
- Only medication cost considered in the study.

**b) Exclusion Criteria:**

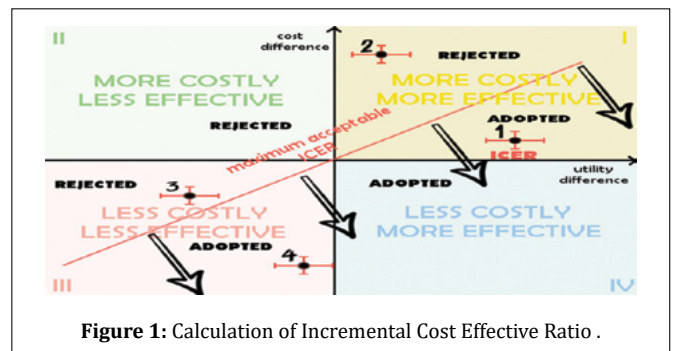
- Less than 19 years and above 75 years population are excluded.
- Pregnant Women are excluded in the study.
- Direct cost (laboratory Charges) were Excluded and indirect costs were not taken in to the study.

**Method of Data Collection:**

- The Enrolment of patients will be done on the basis of Inclusion and Exclusion Criteria.
- The data for the present study will be collected by Chart Review Method, which will be collected on a specially designed patient data collection Proforma.
- Patient data collection Proforma includes patient’s demographics like age, gender, employment status, marital status, investigation data, physician medication order form and nurses medication administration record.
- We informed them about the confidentiality of the data and the voluntary nature of their participation.

Calculation of INCREMENTAL COST EFFECTIVE RATIO:

$$ICER = \frac{\text{Cost of drug A-Cost of drug B}}{\text{Effect of drug A-Effect of drug B}}$$



**Figure 1:** Calculation of Incremental Cost Effective Ratio .

**RESULTS**

A total of 123 Coronary thrombosis Patients were recruited under inclusion criteria and were followed for the present study. Among them 55 were Streptokinase users and 68 were Tenecteplase users. The data was collected and analyzed based upon the following parameters;

- Based on Age.
- Based on Gender wise distribution.
- Based on Literacy.
- Based on Employment.
- Based on Marital Status.
- Based on Residence.
- Based on Income.

| Age(yrs.) | Total Number of Patients(N=123) | Total Percentage of Patients | Streptokinase Users   |               | Tenecteplase Users    |               |
|-----------|---------------------------------|------------------------------|-----------------------|---------------|-----------------------|---------------|
|           |                                 |                              | No. of Patients(n=55) | Percentage(%) | No. of Patients(n=68) | Percentage(%) |
| 20- 29    | 10                              | 8.13                         | 4                     | 3.25          | 6                     | 4.87          |
| 30- 39    | 11                              | 8.94                         | 5                     | 4.06          | 6                     | 4.87          |
| 40- 49    | 22                              | 17.88                        | 9                     | 7.31          | 13                    | 10.56         |
| 50- 59    | 34                              | 27.64                        | 16                    | 13.01         | 18                    | 14.63         |
| 60- 69    | 36                              | 29.26                        | 16                    | 13.01         | 20                    | 16.26         |
| > 70      | 10                              | 8.13                         | 5                     | 4.06          | 5                     | 4.06          |

Table 03: Classification of Patients Based on Age.

| Gender | Total Number of Patients (N=123) | Total Percentage of Patients | Streptokinase Users   |               | Tenecteplase Users    |               |
|--------|----------------------------------|------------------------------|-----------------------|---------------|-----------------------|---------------|
|        |                                  |                              | No. of Patients(n=55) | Percentage(%) | No. of Patients(n=68) | Percentage(%) |
| Male   | 72                               | 58.53                        | 32                    | 26.01         | 40                    | 32.52         |
| Female | 51                               | 41.47                        | 23                    | 18.69         | 28                    | 22.76         |

Table 4: Classification of Patients Based on Gender.

| Literacy      | Total Number of Patients(N=123) | Total Percentage of Patients | Streptokinase Users   |               | Tenecteplase Users    |               |
|---------------|---------------------------------|------------------------------|-----------------------|---------------|-----------------------|---------------|
|               |                                 |                              | No. of Patients(n=55) | Percentage(%) | No. of Patients(n=68) | Percentage(%) |
| Uneducated    | 7                               | 5.69                         | 3                     | 2.43          | 4                     | 3.25          |
| Primary       | 26                              | 21.13                        | 11                    | 8.94          | 15                    | 12.19         |
| Secondary     | 35                              | 28.45                        | 14                    | 11.38         | 21                    | 17.07         |
| Graduate      | 34                              | 27.64                        | 18                    | 14.63         | 16                    | 13.01         |
| Undergraduate | 12                              | 9.75                         | 5                     | 4.06          | 7                     | 5.69          |
| Postgraduate  | 9                               | 7.31                         | 4                     | 3.25          | 5                     | 4.06          |

Table 5: Classification of Patients Based on Literacy.

| Employment | Total No. Of Patients(N=123) | Total Percentage of Patients | Streptokinase Users   |               | Tenecteplase Users    |               |
|------------|------------------------------|------------------------------|-----------------------|---------------|-----------------------|---------------|
|            |                              |                              | No. of Patients(n=55) | Percentage(%) | No. of Patients(n=68) | Percentage(%) |
| Yes        | 65                           | 52.84                        | 29                    | 23.57         | 36                    | 29.26         |
| No         | 58                           | 47.15                        | 26                    | 21.13         | 32                    | 26.01         |

Table 6: Classification of Patients Based on Employment Status.

| Marital Status | Total No. of Patients(N=123) | Total Percentage of Patients | Streptokinase Users   |               | Tenecteplase Users    |               |
|----------------|------------------------------|------------------------------|-----------------------|---------------|-----------------------|---------------|
|                |                              |                              | No. of Patients(n=55) | Percentage(%) | No. of Patients(n=68) | Percentage(%) |
| Married        | 88                           | 71.54                        | 40                    | 32.52         | 48                    | 39.09         |
| Unmarried      | 35                           | 28.45                        | 15                    | 12.19         | 20                    | 16.26         |

Table 7: Classification of Patients Based on Marital Status.

| Residence | Total No. of Patients (N=123) | Total Percentage of Patients | Streptokinase Users   |               | Tenecteplase Users    |               |
|-----------|-------------------------------|------------------------------|-----------------------|---------------|-----------------------|---------------|
|           |                               |                              | No. of Patients(n=55) | Percentage(%) | No. of Patients(n=68) | Percentage(%) |
| Urban     | 60                            | 48.78                        | 28                    | 22.76         | 32                    | 26.01         |
| Rural     | 63                            | 51.21                        | 27                    | 21.95         | 36                    | 29.26         |

Table 8: Classification of Patients based on Residence.

| Income Per year                       | Total Number of Patients(N=123) | Total Percentage of Patients | Streptokinase Users   |               | Tenecteplase Users    |               |
|---------------------------------------|---------------------------------|------------------------------|-----------------------|---------------|-----------------------|---------------|
|                                       |                                 |                              | No. of Patients(n=55) | Percentage(%) | No. of Patients(n=68) | Percentage(%) |
| High Class                            | 0                               | 0                            | 0                     | 0             | 0                     | 0             |
| Upper Middle Class (5.4-8.4lakhs)     | 31                              | 25.20                        | 14                    | 11.38         | 17                    | 13.82         |
| Middle Class (1.2-5.4lakhs)           | 65                              | 52.84                        | 23                    | 18.69         | 42                    | 34.14         |
| Below Middle Class (72,000-1.2 lakhs) | 22                              | 17.88                        | 16                    | 13.01         | 6                     | 4.87          |
| Lower Class (<72,000)                 | 5                               | 4.06                         | 2                     | 1.62          | 3                     | 2.43          |

Table 9: Classification of Patients Based on Income.

| Cost parameter |                 | Total cost in Rs | Mean cost |
|----------------|-----------------|------------------|-----------|
| Direct cost    | Medication cost | 1,24,850         | 2,270     |
| Total cost     |                 | 1,24,850         | 2,270     |

Table 10: Overall Cost of Streptokinase.

| Cost parameter |                 | Total cost in Rs | Mean cost |
|----------------|-----------------|------------------|-----------|
| Direct cost    | Medication cost | 23,46,000        | 34,500    |
| Total cost     |                 | 23,46,000        | 34,500    |

Table 11: Overall Cost of Tenecteplase.

| Name of the drug | Unit cost | Average cost or cost difference |
|------------------|-----------|---------------------------------|
| Streptokinase    | 2270      | 32230                           |
| Tenecteplase     | 34500     |                                 |

Table 12: Comparison of Streptokinase & Tenecteplase cost.

| Drug name     | No. Of patients | Effective | Ineffective |
|---------------|-----------------|-----------|-------------|
| Streptokinase | 55              | 40        | 15          |
| Tenecteplase  | 68              | 66        | 2           |

Table 13: Effectiveness of Streptokinase & Tenecteplase cost .

| Drug name     | Unit cost | Effectiveness of cost |
|---------------|-----------|-----------------------|
| Streptokinase | 2270      | Cost effective        |
| Tenecteplase  | 34500     | Cost non effective    |

Table 14: Effectiveness based on cost.

| Drug name     | No. Of patients | Outcome             |
|---------------|-----------------|---------------------|
| Streptokinase | 55              | Average             |
| Tenecteplase  | 68              | Effective or better |

Table 15: Comparison of Streptokinase & Tenecteplase outcome.

**Outcome ( Effectiveness ) :**

⇒ STREPTOKINASE EFECTIVENESS

Out of 55 patients treated with streptokinase 40 patients with reduced occlusion(TIMI SCORE 3 )and symptoms.

⇒ TENECTEPLASE EFFECTIVENESS

Out of 68 patients treated with streptokinase 66 patients with reduced occlusion(TIMI SCORE 3 ) and symptoms.

$$ACER = \frac{\text{health care costs}}{\text{clinical outcomes}}$$

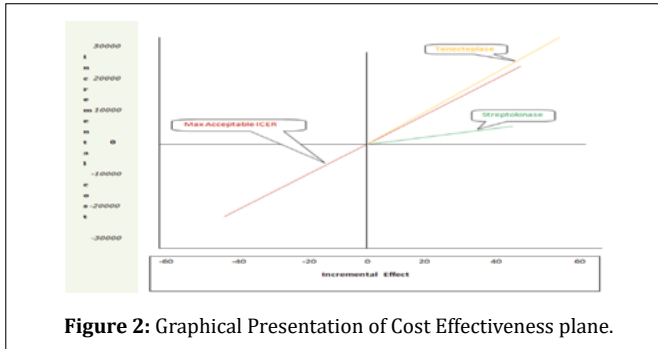
$$ICER = \frac{\text{cost of drug A} - \text{cost of drug B}}{\text{Effect of drug A} - \text{Effect of drug B}}$$

**Discussion**

In our study out of 180 patients 123 patients are willing to provide information with age groups of 20-70 are considered for the study. Out of which the people depended upon antiplatelet drug like Streptokinase and Tenecteplase the mostly used patients age group of 50 to 69 are mostly used. Based on the gender males are most suffered with coronary thrombosis compared to females. Based on employment, based on literacy secondary grade and graduates mostly used Streptokinase and Tenecteplase. Martial status of the patients tenectaplase used mostly in married. Based on residence rural and urban people used these drugs .Based on income Middle class people,

| Treatment     | Cost{mean} | Effect | Average Cost Effectiveness Ratio(ACER) |
|---------------|------------|--------|--|
| Streptokinase | 2,270      | 40     | 56.75                                  |
| Tenecteplase  | 34,500     | 66     | 522.7                                  |

**Table 16:** Calculation Of Average Cost-Effectiveness Ratio (ACER).



**Figure 2:** Graphical Presentation of Cost Effectiveness plane.

upper class people used this drugs the cost of Streptokinase 2270 rs /- and tenecteplase is 34500 rs/- and cost difference is 32230 rs/-. out of which streptokinase is used in 55 patients and tenecteplase in 68 patients mostly Streptokinase is effective in 40 patients and ineffective in 15 patients,tenecteplase is effective in 66patients and ineffective in only 2 patients. Based on the effectiveness Streptokinase is cost effective due to its low cost and tenecteplase is of cost effective due to its high cost. So our study findings shows that streptokinase is cost effective with less treatment outcome but tenectaplase is highly effective but cost is more. So cost effectiveness as per average cost effectiveness ratio (ACER) streptokinase is organises effective.

**Conclusion**

This study shows that the Streptokinase is more cost effective drug than the Tenecteplase . In cost effective analysis, it is useful to you bring out the best alternative for the treatment to the patients who are suffering with coronary thrombosis . Study concluded that most of the patients who are using a streptokinase which is a cost effective beneficial for the patients.As compared to the cost of streptokinase with Tenecteplase, streptokinase is of less cost and easily bearable to the patients. so instead of giving other, streptokinase is cost effective as per Incremental cost effectiveness ratio . So the physicians and the clinical pharmacist should have the knowledge by giving the drug to the patients. Government has to take measures to reduce the cost of Tenecteplase and also distribution by government schemes main beneficial to the patients.

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