Benefits of Intra Aortic Balloon Pump (IABP) in Acute Coronary Syndrome

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Abstract

IABP (Intra Aortic Balloon Pump) is a device which improves diastolic coronary and systemic flow and reduces afterload and myocardial work. ACC/AHA guidelines list IABP therapy in cardiogenic shock as Class 1b recommendation. European society also recommends the same.

Recent studies published in European Heart Journal has raised doubts about the outcome, clinical efficacy, and therapeutic benefits of IABP. We conducted a record based descriptive study on the in hospital outcome (death or survival) of 72 patients who underwent emergency IABP insertion for Acute coronary syndrome (ACS). Data was collected from medical records using a structured questionnaire.

It was observed that 62.5% of patients survived with IABP. Its use was observed mostly in Anterior wall MI followed by Inferior wall MI & NSTEMI. Survival rates were significantly more for multi vessel than single vessel disease (p value- 0.02). Comparison of each indication for insertion was done with the overall survival rate. In Cardiogenic shock, survival rates were low even with IABP support (57.8% vs 62.5 %), but statistically significant increase in survival rates were observed in cases of Arrhythmia (91.6% vs 62.5% p value-0.02) and Inferior wall MI (92.6% vs 62.5% p value- 0.024).

Key Words: Acute Coronary Syndrome, Intra-Aortic Balloon Pump

Introduction

Unstable Angina Pectoris (UA) or acute myocardial infarction (AMI) which constitute Acute Coronary Syndrome (ACS) is one of the main killers in the developing and developed world. The main tools to determine the likelihood of ACS are the symptom history, the ECG and blood markers of myocardial injury such as troponin T (TnT). Mortality data from Global Burden of Diseases studies have revealed that cardiovascular diseases especially coronary heart disease are important causes of death in India. Worldwide, of the 17.5 million deaths from cardiovascular diseases, 20% deaths occurred in high income countries, 8% in middle income countries, 37% in lower-middle income countries, and 35% in low income countries including India.

IABP (Intra Aortic Balloon Pump) was introduced in 1968 by Dr Adrian Kantrowitz to improve diastolic coronary and systemic blood flow, and reduce afterload and myocardial work. It is an inflatable 32-40 cc balloon, triggered to inflate with helium immediately after aortic valve closure at dicrotic notch and triggered to deflate with isovolumetric contraction.

The benefits of Inflation include increased coronary blood flow, increased diastolic pressure, increased systemic perfusion and potential for increased coronary collateral circulation.

Benefits of deflation include decreased afterload, shortened isovolumetric phase, increased stroke volume and enhanced forward cardiac output. IABP is suggested to act as a stabilizing measure or to prevent catheterization laboratory events. The SHOCK trial, Should we emergently revascularize Occluded Coronaries in cardiogenic shock (SHOCK), in 1999 – supported the use of IABP for initial stabilisation in Cardiogenic shock.

ACC/AHA supports IABP therapy in Cardiogenic shock as Class 1b recommendation. Recent study conducted by Krischan et al (Eur heart journal), in 2009, raised doubts regarding the efficacy of IABP in STEMI & LV dysfunction.

Objectives

• To compare survival rates for various indications of IABP insertion
• To study factors that determine survival in IABP insertion

Materials and Methods

Clinical records of all patients irrespective of age, gender, and co-morbidities who presented to the Emergency department of Amala Institute with Acute coronary syndrome and in whom emergency IABP was inserted during the period from 1/8/2011 -1/8/2013 were analysed. A total of 72 patients were studied.

The data was analysed using the standard statistical technique of Student ‘t’ test for interval data and chi square for nominal data.
Indications for IABP Insertion include:

1. Cardiogenic shock – Persistent hypotension despite adequate filling pressures.
2. Slow fill of the Coronaries which occurs during or after the coronary angiogram/angioplasty
3. Critical lesion: in high grade stenosis or multivessel involvement
4. Mechanical defects including Ventricular septal defects, Mitral regurgitation, Ventricular rupture
5. Arrhythmia refractory to medical treatment

Results

Out of 72 patients, 45 survived (62.5%) with IABP. Maximum survival rate was seen in the age group of <60 yrs. Survival rate was reduced after the age of 60 yrs. Majority patients were males (p value – 0.4). 64.9% of males and 53.3% of females survived. Survival rate in females was less when compared to males. Majority of patients had multi-vessel disease. Survival rates were better in multi-vessel disease than single vessel involvement (p value-0.020). Survival rate with LT MAIN vessel involvement is low even with IABP support (p value-0.019). Survival rates were maximum for IWI followed by AWMI. Mortality rate was highest for NSTEMI (p value-0.024) (Table 1).

<table>
<thead>
<tr>
<th>ACS</th>
<th>Total Patients</th>
<th>Survived</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWMI</td>
<td>46</td>
<td>28 (60.8%)</td>
<td>19 (41.3%)</td>
</tr>
<tr>
<td>IWMI</td>
<td>13</td>
<td>12 (92.3%)</td>
<td>1 (7.6%)</td>
</tr>
<tr>
<td>NSTEMI</td>
<td>13</td>
<td>5 (38.4%)</td>
<td>7 (53.8%)</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>45</td>
<td>27</td>
</tr>
</tbody>
</table>

Mortality rate with IABP in patients with shock is 42.2% (p value-0.39). In case of arrhythmia, the survival rate with IABP was 91.6 % when compared with overall survival rate of 56.6% (p value-0.02). Survival rate was 76.9% in cases of slow flow when compared to 59.3% overall survival rate with IABP (p value-0.23). Survival rate was 66.6% in cases of critical lesion when compared to 61.6% overall survival rate with IABP (p value-0.7) (Table 2).

Discussion

IABP insertion can increase survival rate in Acute Coronary Syndrome. The survival rate was more in males and in those less than 60 yrs. IABP had statistically significant better outcome with multi vessel than single vessel involvement. This could be due to the ischemic preconditioning in multi vessel involvement, ie myocardium will be exposed to slow ischemia for long time in case of multivessel disease, and will adapt better than single vessel disease.

Table 2. Comparison of Various Indications for IABP Insertion

<table>
<thead>
<tr>
<th>Indications of IABP Insertion</th>
<th>Survival Rate(%)</th>
<th>Mortality Rate(%)</th>
<th>p.Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Vessel</td>
<td>46.4</td>
<td>56.7</td>
<td></td>
</tr>
<tr>
<td>Multi Vessel</td>
<td>74.4</td>
<td>25.5</td>
<td>0.02</td>
</tr>
<tr>
<td>LT Main</td>
<td>40</td>
<td>60</td>
<td>0.019</td>
</tr>
<tr>
<td>AWMI</td>
<td>60.8</td>
<td>41.3</td>
<td></td>
</tr>
<tr>
<td>IWMI</td>
<td>92.3</td>
<td>7.6</td>
<td>0.024</td>
</tr>
<tr>
<td>NSTEMI</td>
<td>38.4</td>
<td>53.8</td>
<td></td>
</tr>
<tr>
<td>LV Dysfunction</td>
<td>62.9</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Cardiogenic Shock</td>
<td>57.8</td>
<td>42.2</td>
<td></td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>91.6</td>
<td>8.3</td>
<td>0.02</td>
</tr>
<tr>
<td>Slow Flow</td>
<td>76.9</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Critical Lesion</td>
<td>66.6</td>
<td>33.3</td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td>25</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>

There was no significant difference in survival rate in terms of gender (64.9% of males and 53.3% of females survived). It was also seen that even though men had a higher incidence of Acute coronary syndrome, their survival was better than females. This could be due to their better ability to withstand stress. Left main vessel involvement had statistically significant low survival rate even with IABP. This could be because of the extensive area of infarct involving the left ventricle which is supplied by the vessel.  

Mortality rate after IABP insertion in patients with Cardiogenic shock was 42.2% and survival rate 57.8%. This was comparable to the SHOCK trial mortality rate of 46.7% (in the early revascularization group). Similar study conducted by Abdul Waheb etal supported IABP use before angioplasty in Myocardial infarction with Cardiogenic shock.

The maximum survival rates were seen in IWMI, Arrhythmia & Multi vessel disease. The highest survival rate was seen with IWMI followed by AWMI (statistically significant). NSTEMI had high mortality rate even with IABP support. IABP was found to significantly increase survival rates in cases of IWMI and refractory arrhythmias.

Conclusion

IABP improves survival rates in ACS. Maximum survival rates were seen in IWMI, Arrhythmia & Multi vessel disease. Mortality rates are still high in ACS even with IABP insertion, hence research should be done in developing other mechanical devices and management protocols that will further improve the survival rate.

Limitations of this study are its small sample size, lack of comparison to a group without IABP and its predominant male sample.
End Note

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Abbreviations
• IABP- Intra Aortic Balloon Pump
• ACS- Acute Coronary Syndrome
• NSTEMI- Non ST segment Elevation Myocardial Infarction
• STEMI- ST segment Elevation Myocardial Infarction
• LV- Left Ventricle
• AWMI- Anterior Wall Myocardial Infarction
• IWM- Inferior Wall Myocardial Infarction
• ACC- American college of Cardiology
• AHA- American Heart Association

Conflicts of Interest:
None declared

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