Quality of Life in Patients with Multivessel Coronary Artery Disease: Ten-year Follow-up of a Comparison of Surgical, Angioplasty or Medical Strategies - MASS II Trial

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Abstract

Aims: We assessed quality of life (QoL) in patients with symptomatic multivessel coronary disease who randomly underwent surgery, angioplasty, or medical treatment. Although the clinical benefits of coronary interventions seem to be confirmed, their effects on QoL are still scarcely studied.

Methods and Results: The Short-Form Health Survey (SF-36) questionnaire was applied in patients at baseline, 6 months, and annually until the end of the study. At five years of follow-up, SF-36 had been completed by 483 patients and at 10 years by 334 patients.

Of these, 110 underwent surgical revascularization, 126 underwent angioplasty, and 98 were medically treated. All three therapeutic strategies resulted in significant improvement in all dimensions (P<0.001). The improvement reached similar levels in the three treatment groups. However, this increase did not reveal differences between the physical and mental components between the three therapeutic groups. Medical Treatment: In this group, the mental component improved in 83.7% of patients, whereas in relation to the physical component there was an improvement in 84.7% of them. Surgery: Regarding the mental component, there was an improvement in 85.4% of patients, whereas in relation to the physical component there was an improvement in 92.7% of them. Angioplasty: In this group, the mental component improved in 77.8% of patients, whereas in relation to the physical component there was an improvement in 73.0% of them.

Conclusion: Improvement was observed in all domains and in the three therapeutic modalities. Regarding the beginning of the study and compared with medical therapy or angioplasty, surgery provided better quality of life after 5 years of follow-up and that remained in up to ten years of follow-up.

Keywords: Quality of life; Coronary; Coronary artery disease; Surgery; Angioplasty; Medical Therapy

Introduction

In a recent Scientific Statement, the American Heart Association set national targets for health promotion and disease reduction with consequent improvement in quality of life [1]. In this scenario, it is considered that Coronary Artery Bypass Grafting (CABG) and Percutaneous Coronary Intervention (PCI) have been accepted therapies for stable angina for more than three decades as alternatives to Medical Treatment (MT) [2].

However, regardless of the treatment option, it is assumed that the progression of coronary atherosclerosis is inevitable. In part, because of the presence of modifiable risk factors such as dyslipidemia, smoking, diabetes mellitus and hypertension, and also because of non-modifiable risk factors like genetic determinants.

Moreover, patients with CAD may undergo coronary interventions in the course of disease progression. Thus, after an intervention they may benefit from the reduction in the risk of a coronary event, and, therefore, they may improve quality of life (QoL) [3].

Most reports of the benefit of interventions have focused on survival rates, cardiac events, and other clinical markers of disease [4,5]. Recent studies have been directed at evaluating the ability of activities of daily life, as a way to assess the operative success. Among them are assessments of exercise capacity and return to employment [6,7].

However, studies designed to evaluate QoL after mechanical interventions have only compared two treatment modalities: surgery, angioplasty or medical treatment and resulted in conflicting conclusions [8,9]. These differences were mainly due to the different times the studies were conducted, therapeutic resources available, and the different tools used to assess patients’ quality of life.

With the purpose of comparing the three therapeutic modalities available for the control of CAD symptoms and their respective effects on patients’ quality of life, MASS II (The Medicine, Angioplasty or Surgery Study II) was developed to evaluate outcomes of the major clinical events, long-term survival, and quality of life of patients undergoing medical treatment, surgery, or angioplasty [10].

Methods

Details of the MASS II study design, protocol, patient selection and...
inclusion criteria have been previously published (10). Briefly, patients with symptomatic multivessel CAD documented with angiograms, and myocardial ischemia identified by symptoms or exercise test were considered eligible for inclusion. Angina pectoris was classified according to the Canadian Cardiovascular Society (CCS) (class II or III) [11]. This study was conducted in the Department of Coronary Artery Disease of the Heart Institute (InCor) of the School of Medicine, University of São Paulo (USP). The Ethics Committee of the Heart Institute approved the trial, and all procedures were performed in accordance with the Helsinki Declaration.

**Patient selection**

From May 1995 to May 2000, 2076 subjects were eligible for the three usual treatment modalities. From this, 1465 patients were excluded because they did not consent to participate in a randomized study. Thus, the present study sample was composed of the remaining 611 patients. Patients would be included and randomized if surgeons, interventional cardiologists, and clinicians agreed on the possibility of any of the treatment modalities. Thus, 203 patients were assigned to surgical myocardial revascularization, 205 to angioplasty, and 203 to medical treatment. A written informed consent was obtained from all patients after they received detailed information on the study and had their questions answered.

**Sample**

Of the 611 patients randomized, 483 of them completed the assessment of quality of life and demographic profile questionnaire at 60 months.

Of these, 161 patients underwent CABG, 166 PCI, and 156 MT. After 10 years of follow-up, 334 participants were able to answer the quality of life instrument, 110 patients in CABG, 126 in PCI, and 98 patients in MT group.

**Instruments**

We used the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), a generic questionnaire for quality of life assessment conceived by Ware and Sherbourne [12]. The questionnaire consists of 36 questions addressing eight domains (or dimensions) in two major components: The physical component that includes physical functioning, bodily pain, general health, and physical capacity; and the mental component that encompasses mental health, emotional health, social functioning, and vitality, and is assessed through 35 questions. Also, there is one additional question comparing their current health with that of the previous year. The purpose of the questions was to turn subjective measures into objective data that could be analyzed in a specific, global, and reproducible manner as well as to analyze the different tools used to assess the patients quality of life (Figure 1).

Assessment of quality of life was achieved by the analysis component obtained through the medium of a cluster of four fields forming each component as previously described [8]. A specific score for each question was used to analyze the results. A low numeric score reflected a poor perception of health, loss of function, and presence of bodily pain, whereas a high numeric score reflected a favorable perception of health, preserved functioning, and absence of bodily pain.

SF-36 was developed to be a self-administered instrument; however, it can also be administered in an interview format, which was used in our study with the purpose of standardizing the management, since a variation in the educational level of our patients was detected.

Previous studies comparing different ways to administer SF-36 (calls, interviews, or self-administered) resulted in no differences [13].

The interviews were administered at baseline and at 6, 12, 24, 36, 48, 60 and 120 months of follow-up.

At all times of evaluation, the instrument was administered by trained nurses and done interpersonally. They were blinded with respect to treatment at baseline and during the whole time of follow-up. The components of SF-36 are summarized in Figure 1.

The demographic profile investigation questionnaire included questions on educational attainment, marital status, professional life, and relationship with work. We also sought to evaluate the occurrence of changes in the work environment related to the disease; of the professional prospects of the economic situation; and also of the influence of these changes from the patient’s point of view.

**Statistical analysis**

Data were initially analyzed descriptively which resulted in the construction of tables and graphs, and calculations of statistical measures for the study variables. For categorical variables, we used the chi-square test and, for continuous variables we used ANOVA. Friedman’s nonparametric test was used to assess group behavior. The nonparametric Kruskal-Wallis test was used to compare the groups, and the Dunn test was used for multiple comparisons. The significance level was set at 5%. The quality of life of the study groups by time variable were evaluated by repeated measures ANOVA and multiple comparisons. P values <0.05 were considered significant.

**Results**

Of the 483 patients in the 5-year follow-up, 334 patients have completed 10-year follow-up. These subjects were distributed among groups: 98 patients in the MT, 126 in the PCI, and 110 in the CABG group. The other 149 patients did not complete the study for various reasons that include death, refusal to answer the questionnaire, or inability to understand the questions. These reasons are shown in Figure 2. Most baseline characteristics were similar in the 3 groups and are summarized in Table 1. The mean age was 65.6 years old, 68.6%
were men, 36.2% were smokers, and 28.2% had diabetes. Furthermore, 53.6% had hypertension, 44.9% had previous myocardial infarction, and 87.7% of patients reported angina at baseline.

We considered the following events for analysis: Acute Myocardial Infarction (AMI), Cerebrovascular Accident (CVA), and additional surgical or percutaneous interventions. Thus, during 10 years of follow-up, 57.1% of patients in the MT group had some kind of event (AMI or CVA), whereas for PCI or CABG groups, 41.3% and 22.7%, respectively, had an event. There was a significant difference in the occurrence between the three treatment groups ($P<0.01$).

Revascularization procedures occurred during follow-up in 43.8% of patients in the MT group, 34.9% in the PCI group, and in only 9.0% of patients in the CABG group. Thus, there was significant difference in additional revascularization procedure rates among the three treatment options ($P<0.01$).

**Quality of life**

**Medical treatment:** Mean values for the physical component at baseline, 5-year and 10-year follow-up are $53.8 \pm 19.6$, $72.7 \pm 22.4$, and $72.0 \pm 19.8$, respectively. Variation delta between groups are 18.8 for baseline versus 5 years and 0.7 for 5 years versus 10-year. For this component, 84.7% of subjects improved and 15.3% worsened in a follow-up of 10 years. Regarding mental components, mean values are $63.1 \pm 21.9$, $74.6 \pm 21.7$, and $78.4 \pm 20.3$ for baseline, 5-year and 10-year follow-up, respectively. Variation delta between groups are 11.5 for baseline versus 5 years and 3.8 for 5 years versus 10 years. For this component, 83.7% improved and 16.3% worsened in a 10-year follow-up (Table 2).

**Percutaneous intervention:** Mean values for the physical component at baseline, 5-year and 10-year follow-up are $75.0 \pm 21.9$, $71.4 \pm 20.8$, and $68.4 \pm 22.8$, respectively. Variation delta between groups are 10.8 for baseline versus 5 years and 2.9 for 5 years versus 10-year. For this component, 73.0% of subjects improved and 27.0% worsened in a follow-up of 10 years. Regarding mental components, mean values are $63.8 \pm 22.7$, $76.8 \pm 23.2$, and $75.7 \pm 23.9$ for baseline, 5-year and 10-year follow-up, respectively. Variation delta between

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**Table 1:** Baseline Characteristics Demographic and Clinical Profile.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>MT n=98</th>
<th>PCI n=126</th>
<th>CABG n=110</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>64.3</td>
<td>65.3</td>
<td>67.3</td>
<td>0.063</td>
</tr>
<tr>
<td>Female</td>
<td>28</td>
<td>44</td>
<td>33</td>
<td>0.539</td>
</tr>
<tr>
<td>Clinical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>31.6</td>
<td>23.0</td>
<td>30.9</td>
<td>0.268</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>45.9</td>
<td>58.7</td>
<td>54.5</td>
<td>0.157</td>
</tr>
<tr>
<td>Smokers (%)</td>
<td>38.8</td>
<td>32.5</td>
<td>38.2</td>
<td>0.549</td>
</tr>
<tr>
<td>Prior AMI (%)</td>
<td>39.8</td>
<td>48.4</td>
<td>45.4</td>
<td>0.433</td>
</tr>
<tr>
<td>Angina (%)</td>
<td>80.6</td>
<td>92.0</td>
<td>89.0</td>
<td>0.057</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>7.1</td>
<td>3.9</td>
<td>3.6</td>
<td>0.428</td>
</tr>
</tbody>
</table>

MT: Medical Treatment; PCI: Percutaneous Coronary Intervention; CABG: Coronary Artery Bypass Grafting; AMI: Acute Myocardial Infarction.
groups are 12.9 for baseline versus 5 years and 1.0 for 5 years versus 10 years. For this component, 77.8% improved and 22.2% worsened in a 10-year follow-up (Table 2).

Surgery - Mean values for the physical component at baseline, 5-year and 10-year follow-up are 45.9 ± 16.4, 77.4 ± 21.2, and 68.9 ± 20.8, respectively. Variation deltas between groups are 31.5 for baseline versus 5 years and 8.5 for 5 years versus 10-year. For this component, 92.7% of subjects improved and 7.3% worsened in a follow-up of 10 years. Regarding mental components, mean values are 58.7 ± 20.4, 78.7 ± 22.4, and 74.5 ± 21.7 for baseline, 5-year and 10-year follow-up, respectively. Variation deltas between groups are 20.1 for baseline versus 5 years and 4.3 for 5 years versus 10 years. For this component, 85.4% improved and 14.6% worsened in a 10-year follow-up (Table 2).

Comparing treatment groups in respect to the physical component at baseline, there was a significant difference between the treatment groups (P<0.001) when the CABG group had a lower mean perceived quality of life. For 5 and 10 years of follow-up, there were no differences between groups (Figure 3).

Comparisons of the physical component in the three times of investigation irrespective of treatment performed revealed differences between baseline and 5-year follow-up (P<0.001); between baseline and 10-year follow-up (P<0.001); and between 5-year and 10-year follow-up (P=0.106).

Comparisons among treatment groups regarding the mental component in the three times of investigation showed that there was no statistically significant difference among treatment groups for any of the three periods of investigation (Figure 4).

However, differences are present in this component among the three times of investigation irrespective of treatment: baseline versus 5-year follow-up (P<0.001) and baseline versus 10-year follow-up (P<0.001). There is no difference regarding this component between 5 and 10-year follow-up (P=1.00).

Table 2: Mean value of the components relating to treatment.
The CABG group had a better perception in the areas of functional capacity ($P<0.001$, $P=0.004$) and Social Aspect ($P=0.035$, $P<0.001$) when compared with the PCI group and MT, respectively. This group had a better perception at the end of the study as to the state of their Physical Appearance and General Health in relation to the PCI group (Figure 5).

The MT group had a better perception of their vitality compared to the other groups, and better general state of health when compared to the PCI group (Figure 5).

### Discussion

Progress in treatment modalities for several chronic diseases, including CAD, has lead to an increase in life expectancy among patients with these diseases. However, this increase in life expectancy is not necessarily accompanied by an improvement in quality of life.

Moreover, some characteristics of the clinical manifestations of these diseases, and also the own aging, have an impact not only on physical but on mental aspects of patients. Because of this, patients adapt themselves, their daily activities and even emotionally to overcome the problems. It is in this scenario that we observe the emergence of the perception of quality of life by the patients.

However, even considering all aspects of this issue, the main finding of the present trial was the perception of improved Qol in symptomatic CAD patients irrespective of the treatment performed.

Our study is singular because there are few studies that have assessed quality of life of patients with CAD undergoing the three usual treatment strategies for this disease. Moreover, studies directed to assess the Qol have some limitations. They usually compared only two types of interventional treatments with a short follow-up time. Furthermore, when assessing quality of life, they used different tools and end points for this investigation. Among these studies are CABRI [14], AWESOME [15], and ARTS [16], which compared the interventional treatments, PCI and CABG at 1-year, 6 months, and 1-year follow-up, respectively.

To our knowledge, no randomized studies exist that have compared the quality of life for symptomatic CAD patients assigned to three therapeutic strategies in a 10-year follow-up.

**Figure 4:** Box Plot mental component in the three periods of investigation.
Using the instrument "Medical Outcomes Study 36-Item Short-Form Health Survey" (SF-36), we observed that in the first five years of monitoring, there was an improvement in the perceived quality of life in all aspects for all study participants in the three treatment groups. This improvement was sustained until the end of the analysis. We emphasize that in the 10-year follow-up, the positive perception of QoL was maintained, with no significant difference among groups until the end of the study.

In the baseline, CABG group had worse averages for the perception of quality of life in some areas like physical function and role physical.

Because of this, they began with lower scores. After surgical intervention, patients achieved significant improvement in the sequential evaluation. The greatest variation was observed in the physical component. However the perception of improvement was also observed in other components.

The significant superiority in quality of life, in its two major components, and also in various fields, observed in patients undergoing CABG compared to other therapeutic strategies deserves some reflection.

These differences may be a consequence of clinical variability, comorbidities, physical and emotional expectations before the intervention, and also by expectations with the therapeutic procedure and its variable perception as effective and definitive treatment. Also the higher frequency of angina observed at baseline in CABG patients can be explained by the expectation of waiting for the interventional treatment.

Nonetheless, although medical and also percutaneous groups had higher rates of clinical events compared to surgical group, this fact did not interfere in the difference in QoL reported by patients at the end of 10 years of follow-up.

Noteworthy is the fact that patients in MT arm improved QoL in a similar way as those who underwent revascularization procedures, despite the high rates of clinical events for this group. Furthermore, the massive and individualized treatment used in this group and crossovers for CABG or PCI in the follow-up could explain this result.

Studies conducted in the CASS trial comparing clinical and surgical treatments achieved better results for quality of life in the surgical group at five years and similarly after 10 years of follow-up. Although these results were similar after 10 years of follow-up, authors applied different measurement descriptors, such as length of hospitalization and drug therapy [11].

In order to compare percutaneous and surgical treatments in 5-year follow-up, the BARI trial found that patients in the PCI group returned to work earlier in the first year of the evaluation. However, this difference was not statistically significant [17].

Similarly, the RITA trial compared the results of quality of life of patients undergoing percutaneous and surgical treatments. In this study, the authors used the Nottingham Health Profile (NHP) and observed a higher percentage of freedom from angina in the surgical group, but noted earlier return to work in the PCI group. Moreover, the authors found that the benefits of both treatments over time were similar [18].

Using the Medical Outcomes Study 36-Item (SF-36), the RITA-2 trial compared the results of QoL of clinical and percutaneous treatments. In this study, they observed improvement in vitality, physical wellness, and general health in PCI patients at 3 months and one-year follow-up. After three years, the results were similar in
both groups. This similarity of results was attributed to the increased number of interventions in the clinical group [8].

Limitations of our study include the fact that it is valid for a specific population of symptomatic multivessel CAD patients with normal ventricle function. As a long-term follow-up study, procedures were performed using standard techniques from the beginning of the study. Thus, only on-pump CABG and angioplasty with bare-metal stents were used. In the same way, and by the fact of being a long-term study, with a relatively elderly population, it is reasonable to expect a decline in study population due to death or mental incapacitation. Even with this limitation, we achieve a number of patients with similar characteristics in three therapeutic options at the end of the study. Moreover, this long period has imposed losses due to deaths of patients for cardiac causes and from any cause, physical or mental inability to answer the questionnaires and also the occurrence of crossover during follow-up.

Conclusion

Results achieved in this study show that there was an improvement in quality of life in coronary artery disease patients, regardless of the treatment option. Moreover, this improvement was observed in the first five years and was sustained until 10-year follow-up. Compared with medical or percutaneous treatment, surgery provided a better quality of life after five years of follow-up and that remained up to ten years of follow-up.

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