Hybrid CABG: An alternative for perfusion time decrease

Revascularização híbrida do miocárdio: uma alternativa para reduzir o tempo de perfusão

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Abstract
Objective: To evaluate the reduction of the cardiopulmonary bypass (CPB) time and its related complications in Coronary artery bypass surgery (CABG) using an hybrid alternative method.

Methods: Ninety patients had been retrospectively analyzed, between March/2000 and August/2006. All had been treated with 3 or more grafts and split into 2 groups: hybrid group - 45 patients who had been operated by the hybrid technique; total group - 45 patients operated in on-pump.

Results: In the hybrid group the CPB time varied from 20 to 81 min. while in the total group from 60 to 210 min. (p<0.001). The aorta cross-clamping time varied in the first group from 7 to 70 min. and in the second from 34 to 100 min. (p<0.001). A statistically significant difference was found between those two groups when was comparing the incidence of postoperative atrium fibrillation and renal dysfunction.

Conclusion: Using a hybrid technique can reduce the CPB time and the incidence of some postoperative complications. Probably, this reduction in atrium fibrillation and renal dysfunction incidences could be explained by a less significant inflammatory activation evoked by a shorter CPB time.

Resumo

Objetivo: Avaliar a possibilidade da redução do tempo de circulação extracorpórea (CEC) e das complicações relacionadas a esta variável na revascularização do miocárdio (RM), utilizando o método híbrido como alternativa.

Métodos: Noventa pacientes foram analisados, retrospectivamente, entre março/2000 e agosto/2006. Todos foram revascularizados com três ou mais enxertos e divididos em dois grupos: híbrido - 45 pacientes que foram operados pela técnica híbrida; total - 45 pacientes operados com CEC.

Resultados: No grupo híbrido, o tempo de CEC variou de 20 a 81 minutos e, no grupo total, de 60 a 210 minutos (p<0,001). O tempo de pinçamento aórtico variou de 7 a 70 minutos no primeiro grupo e de 34 a 100 minutos (p<0,001). Foi encontrada diferença estatisticamente significativa entre os grupos em relação à incidência de fibrilação atrial e à disfunção renal.

Conclusão: Utilizando-se a técnica híbrida é possível reduzir o tempo de CEC e a incidência de algumas complicações pós-operatórias. Provavelmente, esta redução nas incidências de fibrilação atrial e disfunção renal podem ser explicadas por uma redução na resposta da inflamatória consequente a um tempo de CEC menor.

α-error was set at 5%. The nominal variables were analyzed using Fisher’s exact test or the Chi-Square test. The continuous parametric variables were analyzed using Student’s t-test and the non-parametric continuous variables with the Mann-Whitney test.

In the Hybrid Group, the CPB time was 41.5 ± 17.7 min., and in the Total Group, 85.2 ± 24.2 min (p<0.001). The aortic clamping time was 24.4 ± 13.1 min. in the first group and 55.8 ± 14.4 in the second (p<0.001) (Table 3). The mean number of grafts for each patient in the Hybrid Group was 3.31 and was 3.35 in the Total Group. The proportion of arterial grafts was 56% in the first group and 52% in the second.

Renal dysfunction, which was defined as plasmatic creatinine ≥ 2mg/dl or an increase of 1mg/dl in preoperative values, was observed in 6.6% of the patients of the Hybrid Group and in 22.2% of the patients of the Total Group (p=0.03). Atrium fibrillation occurred in 4 patients from the Hybrid Group and in 12 patients from the Total Group (p=0.02). A statistically significant difference was not observed when comparing the quantity of blood collected by drains, incidence of surgical infection, trans-operative infarction, stroke and hospital mortality between the two groups (Table 4).

Table 1. Preoperative characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hybrid</th>
<th>CPB</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman, %</td>
<td>16 (n = 45)</td>
<td>24 (n = 45)</td>
<td>0.29</td>
</tr>
<tr>
<td>Age*</td>
<td>61 (11)</td>
<td>62 (8.1)</td>
<td>0.6</td>
</tr>
<tr>
<td>Smoking</td>
<td>31.1</td>
<td>31.1</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>38</td>
<td>48</td>
<td>0.34</td>
</tr>
<tr>
<td>Systemic arterial hypertension , %</td>
<td>82</td>
<td>71</td>
<td>0.21</td>
</tr>
<tr>
<td>Heart failure (NYHA III/VI) , %</td>
<td>26.6</td>
<td>2.2</td>
<td>0.001</td>
</tr>
<tr>
<td>Left ventricle aneurysm ,</td>
<td>6.6</td>
<td>2.2</td>
<td>0.6</td>
</tr>
<tr>
<td>Chronic obstructive lung disease , %</td>
<td>15.5</td>
<td>4.4</td>
<td>0.15</td>
</tr>
<tr>
<td>Severe pulmonary arterial hypertension, %</td>
<td>4.4</td>
<td>4.4</td>
<td>1</td>
</tr>
<tr>
<td>Left coronary artery trunk lesion , %</td>
<td>15.5</td>
<td>8.8</td>
<td>0.33</td>
</tr>
<tr>
<td>Morbid obesity, %</td>
<td>8.9</td>
<td>0</td>
<td>0.11</td>
</tr>
<tr>
<td>Previous myocardium infarction , %</td>
<td>44.4</td>
<td>33.3</td>
<td>0.28</td>
</tr>
<tr>
<td>Peripheral vascular insufficiency , %</td>
<td>15.5</td>
<td>6.6</td>
<td>0.18</td>
</tr>
<tr>
<td>Stroke , %</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Renal Failure , %</td>
<td>8.8</td>
<td>2.2</td>
<td>0.36</td>
</tr>
<tr>
<td>Hepatic failure , %</td>
<td>4.4</td>
<td>0</td>
<td>0.49</td>
</tr>
<tr>
<td>Chronic atrial fibrillation , %</td>
<td>2.2</td>
<td>2.2</td>
<td>1</td>
</tr>
</tbody>
</table>

*pThe values are mean (deviation)*

Table 2. Preoperative mortality risk estimation

<table>
<thead>
<tr>
<th>Score*</th>
<th>Hybrid</th>
<th>CPB</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.59 (6.27)</td>
<td>7.6 (5.18)</td>
<td>0.001</td>
<td></td>
</tr>
</tbody>
</table>

Estimated risk, % 9 5

*pThe values are mean (deviation)*

RESULTS

The groups were similar in age, gender and risk factors for coronary disease (p>0.05) (Table 1). The incidence of NYHA III/IV cardiac insufficiency was higher in the Hybrid Group (p<0.001). The mean of preoperative mortality risk estimation score (Parsonnet index) was 14.59 ± 6.27 in the Hybrid Group, and 7.6 ± 5.18 in the Total Group (p<0.001) (Table 2).
DISCUSSION

CPB supported the development of intracardiac surgeries and complex procedures where a clean and static field is necessary, thus allowing for great advances in cardiac surgery. However, its harmlessness is questioned because of problems related with its use, which are mainly associated with prolonged perfusion time [9-11].

Perfusion time is related to a systemic inflammatory response that leads to changes at cellular and humoral levels [12,13], such as the activation of complement system and coagulation cascade, causing alterations in vascular permeability and reactivity. Neurologic dysfunctions are related to on-pump CABG [8,14], especially with a prolonged CPB time [15]. Because of its adverse effects, alternatives that could diminish the morbidity of CPB have been investigated. The use of antifibrinolytic agents [16,17], hemofiltration [18,19] and off-pump CABG [20,21] are technological advents in this procedure. In this way, the off-pump CABG is undoubtedly a great advance; however, the application of this technique has technical and planning limitations. The cardiac manipulation to expose the coronary branches brings hemodynamic complications that can limit the procedure. Major alterations in the ventricular filling pressures have already been described [1,3].

Soltoski et al. [22] described a conversion rate of 25% in CABG procedures without CPB and suggested one selective behavior. The insistence on continuing the procedure without CPB in less-than-ideal hemodynamic conditions is not uncommon, but it should be discouraged because its serious consequences. In this study, we considered an alternative method, which may reduce morbidity from CPB in three-vessel disease.

This study showed that perfusion time, the most common factor in the development of complications after CPB, could be reduced using a hybrid method (Table 3). Aortic clamping time also presented a statistically significant reduction.

The use of CPB and perfusion time can affect the occurrence of postoperative renal dysfunction [9,23]. We have shown that the group with the shortest perfusion time was the Hybrid Group, which also presented a statically significant reduction in postoperative renal dysfunction.

A reduction in the incidence of postoperative atrial fibrillation (AF) was also found in this study when both groups were compared. It is known that incidences of atrial fibrillation are lower in the off-pump CABG series [24]. Many factors are related to postoperative atrial fibrillation. The reduction in perfusion time and most likely in inflammatory response could explain the decrease in the incidence of AF in the hybrid group.

In a 2,630-patient on-pump CABG study, Lahtinen et al. described that atrial fibrillation was a major determinant in the occurrence of postoperative strokes [25]. From these cases, the authors reported a 2% incidence of stroke and previous atrial fibrillation of 36.7%. The mortality in this neurologically damaged group was 23.1%. In our sample, there were no strokes in either group. This could be explained by the relatively small number of cases that underwent MR in our study when compared with the Lahtinen’s study [25]. Perhaps in another study with stronger statistical power, a difference in postoperative stroke occurrence in Hybrid Group would be found.

The number of postoperative infarcts, deaths, surgical infections and strokes, as well as the bleeding volume, were similar between the groups. These data show that it is possible and safe to reduce the CPB time without decreasing of the quality of the procedure.

CONCLUSION

The use of hybrid technique can reduce CPB and aortic clamping time in the MR of patients with multiple coronary artery diseases without compromising the quality of the procedure. Although this study presents some limitations inherent to a retrospective study, our data show that the incidences of postoperative atrial fibrillation and renal dysfunction can be reduced using the hybrid technique.

REFERENCES


