Myocardial Protection During Cabg Procedures: "The Optimal Flow For Bloodcardioplegia During Aortic Occlusion Is Regulated By The Heart Itself"

C Maas

Citation


Abstract

Myocardial protection remains an important, much discussed subject in cardiac surgical practice. Literature describes different methods. A minimal haemodilutional method of arresting and protecting the heart using "warm" oxygenated patient blood directly from the oxygenator is described by Calafiore et.al. The bloodcardioplegiaflow (BCF) during aortic occlusion is regulated by a rollerpump. Following a defined protocol, a syringe pump is set to deliver the highly concentrated potassiumsolution in the bloodcardioplegia line.

Figure 1

Table 3: Blood cardioplegia intervals

<table>
<thead>
<tr>
<th>Qo rollerpump</th>
<th>Qs syringe pump</th>
<th>Time (minutes)</th>
<th>total K+ (mmol)</th>
<th>[K+] (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 mll/min</td>
<td>120 ml/h</td>
<td>2</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>200 mll/min</td>
<td>120 ml/h</td>
<td>2</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>200 mll/min</td>
<td>90 ml/h</td>
<td>2</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>200 mll/min</td>
<td>60 ml/h</td>
<td>3</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>200 mll/min</td>
<td>40 ml/h</td>
<td>5</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

This method of protecting the heart during aortic crossclamping appears to be more effective than cold crystalloid cardioplegia. However, using a defined BCF can be at a disadvantage because this method does not take into consideration the myocardial mass and functional status of the heart. To overcome these limitations we modified the Calafiore-method in the “Isala”-method to provide pressure/afterload regulated cardioplegia flow delivery. The BCF is generated by the centrifugal pump which is integrated in our extra corporeal circuit and situated before the oxygenator. Oxygenated blood derived from the recirculation port of the oxygenator is supplemented with concentrated potassium solution (2 mmol/ml) and delivered directly to the myocardium through an aortic-root cannula (figure 1 and table 1).
The BCF is measured with an ultrasonic flowmeter (HT311, Transonic Systems). The value of the BCF depends on the pressure at the outlet port, which equals arterial line pressure, the length of the cardioplegia line, the pressure drop over the aortic-root cannula or saphenous vein cannula (figure 2) and, most important, the functional status of the heart and the resistance of the myocardial vasculature.

To achieve a potassium concentration of either 20 mmol/l (initial dose) or 10 mmol/l (maintenance dose) the settings of the potassium syringepump are based on the measured flow rate and the patient's systemic potassium concentration. This 'Isala'-technique results in a selfregulated BCF with the advantages of a centrifugal pump such as an automatic pressure limitation in the blood cardioplegia system and the heart itself.

The BCF gives additional information about the presence and degree of aortic insufficiency and also about the quality of the anastomoses.

This pilot-study compares the 'Isala' technique with the Calafiore technique and with the use of cold St. Thomas Hospital II cardioplegia. 60 consecutive patients (20 in each group) scheduled for first time coronary bypass surgery were enrolled in this study. All patients were operated on by the same cardiac surgeon. There were no significant differences between the groups regarding to ECC time, aortic crossclamping time and number of anastomoses (table 2). We observed that the BCF was higher with the 'Isala' technique (figure 3).
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In conclusion we find the 'Isala'-technique a safe and easy method of delivering an optimal BCF during aortic occlusion and that it can be used safely for any cardiac surgical procedure requiring myocardial arrest. The selfregulating characteristics of the 'Isala'-technique showed that the flow for bloodcardioplegia depends on the (metabolic) demands of the heart itself and that it varies between 100 and 550 ml/min. We observed a better myocardial protection during CABG procedures. The optimal and/or maximal duration of the ischaemic intervals and the duration of the bloodcardioplegia delivery has to be investigated. Further research is necessary to determine the clinical improvement using this technique.

CORRESPONDENCE TO

Last name: Maas Fist name: Cees Middle Initial: M
Degree: Clinical Perfusionist (EKP) Department: Extra
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Corporeal Circulation Institution: Isala Clinics City: Zwolle State: Overijssel Postal Code: 8000 GM PO Box: 10500 Country: The Netherlands Phone: 01131384242852 Email Clinic: c.m.maas@isala.nl Private: Cees_maas@planet.nl

References
Author Information

Cees Maas, EKP
Department of Extra Corporeal Circulation, Isala Clinics