

## Complete, Incomplete or No Myocardial Revascularization

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Encouraging results in the short- or long-term prognosis of myocardial revascularization surgery (MRS) may be attributed to the use of a larger number of grafts in coronary arteries<sup>1</sup>. To reach this goal, native arteries need to have an adequate diameter to receive the graft, the atherosclerotic plaque has to be proximal and the distal arterial bed should allow good blood flow. Furthermore, in surgical strategy, options to revascularize arterial branches and occluded arteries should also be considered. Surgery done under such conditions is named complete anatomical revascularization, where every blood vessel to be treated should have a diameter over 1.5mm and lumen stenosis over 50%, regardless of downstream myocardial viability. Complete functional revascularization is also the situation in which only arteries that irrigate viable myocardium are surgically approached. When the surgical procedure does not treat every artery with stenosis over 50% in a viable myocardium, the operation is named incomplete but still functional revascularization<sup>2</sup>.

The hypothetical superiority of surgery has not resulted in true benefits for a specific group of patients<sup>3</sup>. Recent developments in the use of arterial grafts for MRS and stents for coronary angioplasty (PCI) have led to improved results in both strategies. Widespread pharmacological use of statins and antiplatelet drugs have improved the outcome in candidate patients for MRS or PCI, with little difference between both procedures except for more favorable results in non-fatal myocardial infarction prevention surgery and when a second intervention is required<sup>4,5</sup>.

On the other hand, in current medical practice, physicians have a variety of options available in most cases. However, there is a lack of consistent results to support the choice of the best procedure to revascularize the myocardium. Current available guidelines for the treatment of coronary multivessel disease do not formally address this issue<sup>6,7</sup>. In this context, the decision to apply complete or incomplete myocardial revascularization depends on the clinical condition of each patient and is made almost always during the surgical procedure. The interventionist cardiologist also faces the same dilemma in procedures on patients with stable coronary artery disease (CAD) or when acute ischemic syndrome is also present. In this situation the preference of the surgeon is almost always focused on the blood vessel related to the clinical event. Thus, the strategy of complete percutaneous revascularization depends on the patient's clinical condition, the site of stenosis, and the quality and diameter of the blood vessel. Hence, the

probability that incomplete percutaneous revascularization will be done is higher in PCI when compared to MRS.

Randomized studies comparing the relative efficacy of MRS over PCI concluded that percutaneous angioplasty did not reduce the mortality rate of surgery; furthermore, the study disclosed a significant need for further percutaneous angioplasty<sup>8-12</sup>. In these studies the number of percutaneous angioplasty was significantly lower compared to the number of graft surgeries. It should be emphasized that, except for the MASS II trial, all other studies used predominantly double artery samples, which have a good clinical prognosis (Tab.1).

Given that a lower number of percutaneous angioplasty did not affect immediate or late mortality in these comparative studies, it is fair to inquire whether more grafts have a true effect on the prognosis. There is still significant uncertainty in the decision for each of the procedures (PCI or MRS), as well as for the most adequate form of myocardial revascularization. Theoretically, any strategy of complete myocardial revascularization should add extra benefits to myocardial function recovery or protection against future events, which could increase survival rates. However, this could also increase the procedure time and the risk of short-term complications. Therefore the best decision to revascularize the myocardium still depends on correct individualized medical assessment.

Advances in myocardial revascularization surgery techniques have allowed patients to receive arterial or venous grafts with no need for extra-corporeal circulation. This option, however, has technical limits when grafts are applied to the left ventricle posterior wall, which means fewer bypasses and more frequent incomplete myocardial revascularization. Apparently, however, this does not worsen the short-term prognosis for these patients as compared to those that received more grafts with help from extra-corporeal circulation<sup>13,14</sup> (Tab. 2).

A further point is that even with fewer perioperative events, revascularization surgery without extra-corporeal circulation resulted in significantly decreased short term graft patency (88% vs. 98%,  $p=0.002$ ) without compromising the prognosis for these patients<sup>14</sup>.

### Medical treatment

Previous trials and other recent studies compared medical treatment with usual revascularization methods, and revealed

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## Point of View

	Number of vessels affected		Number of vessels treated	
	Two arteries (%)	Three arteries (%)	MRS	PCI
MASS II <sup>8</sup>	42	58	3,3	2,1
BARI <sup>9</sup>	59	41	3,1	2,4
CABRI <sup>10</sup>	57	43	2,8	2,1
SoS <sup>11</sup>	58	42	2,8	2,0
GABRI <sup>12</sup>	57	43	2,2	1,9

MRS = myocardial revascularization surgery (MRS). PCI = coronary angioplasty.

**Table 1 - Arterial involvement**

that, based on a strict control of risk factors and appropriate medication, medical treatment has similar efficacy in reducing death compared to MRS or PCI regardless of the number of percutaneous angioplasties or the number of grafts applied to specific patient subgroups<sup>8,15</sup> (Fig. 1).

### Diabetes

Diabetic patients admitted as potentially having an increased risk for worse prognosis were assessed in a number of trials comparing MRS and PCI<sup>9,16</sup>. The best 10-year survival prognosis in patients undergoing MRS compared to PCI (60% vs. 46%,  $p < 0.001$ ) was seen in 1938 diabetic patients. In this trial, incomplete revascularization was the most significant factor leading to post-PCI adverse effects<sup>17</sup>. The high rate of adverse effects seen in diabetic patients following PCI was due to an increased rate of recurring stenosis and rapid disease progression in this group<sup>18</sup>.

### Elderly patients

There are still controversies about whether complete or incomplete revascularization offers better results in elderly patients, particularly as this group has a higher procedure-related mortality<sup>19</sup>. In a group of 5.003 patients aged over 70 years, incomplete revascularization was recognized as an independent risk factor for early death and death six months after the procedure<sup>20</sup>. In patients with reduced survival expectancy, complete revascularization can increase immediate procedure-related risks, which should be weighed strongly in the hypothetical possibility of prolonged survival.

### Final comments

Theoretically, the size of the revascularized area using MRS or PCI is the main survival determining factor for patients with coronary artery disease. Based on available evidence, revascularization by MRS or PCI offers similar survival benefits; the intervention, however, should be at least functionally complete in patients who are non-diabetic, and have preserved left ventricle function, multivessel, and stable coronary artery disease. Coronary angioplasty is currently more popular among

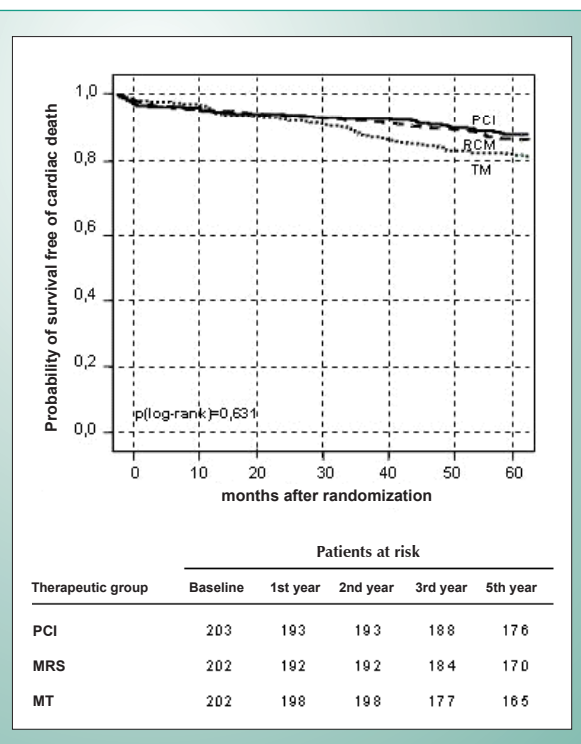
	Number of vessels treated		
	Without ECC	With ECC	p
STRAKA <sup>13</sup>	2.3	2.7	<0.001
VIDIMINKI <sup>14</sup>	2.2	2.8	<0.001
HUEB <sup>15</sup>	2.1	2.8	<0.001

ECC = extra-corporeal circulation. p = statistical significance level

**Table 2**

physicians due to increased patient acceptance and reduced hospital stay. Although current data shows that PCI tends to require further interventions due to recurring stenosis, new endo-arterial stents promise a reduction of this risk.

Clinical conditions should guide the choice of complete or incomplete revascularization in specific patient groups. Diabetic patients enjoy greater benefits with complete revascularization by MRS. On the other hand, acute coronary syndrome patients tend to benefit more from timely incomplete revascularization of the event-related artery through PCI. As PCI potentially requires further interventions, and MRS is usually reserved for symptomatic patients, medical treatment including strict control of risk factors may be a reasonable first choice of treatment for patients with few symptoms, preserved left ventricular function, stable coronary artery disease, and who refuse invasive treatment such as PCI or MRS.



**Fig. 1** - Probability of survival free of cardiac death among three therapeutic options: medical treatment (MT), myocardial revascularization surgery (MRS), and coronary angioplasty (PCI).

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