Histological aspects of the saphenous vein damage with the use of the symmetry® aortic connector system

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Received 4 November 2003; received in revised form 4 January 2004; accepted 28 January 2004

Abstract

The purpose of the present study was to analyze the histological aspects of the saphenous veins after the use of the Symmetry® aortic connector in off pump coronary artery bypass surgery (OPCAB). Nineteen consecutive patients who underwent OPCAB surgery and who received one proximal saphenous vein anastomosis using the St Jude aortic Symmetry® connector system were evaluated. In each patient one small segment of the saphenous vein was cut before the use of the Symmetry® connector (V0), then another segment after (V1). All segments were stored in an acetone–formaldehyde–alcohol solution before examination. Examination of the V0 segments showed non-specific media fibrosis. In V1, 11 segments presented with a complete alteration of the endothelial layer (58%) and 8 with severe lesions (more than 80%). Among all the V1 segments, 8 had a dissection of the media (42%) and 1 presented with a wall thrombus. These results suggest that the use of the aortic connector can be associated with different types of lesions of the venous wall. Thus, further investigation and especially long-term follow-up are mandatory to evaluate the consequences of such lesions upon the grafts' patency.

Keywords: Symmetry® aortic connector; Saphenous vein; Histology

1. Introduction

The Symmetry® mechanical anastomotic nitinol device (St Jude Medical, Minneapolis, MN) has been recently developed for vein graft-to-aorta anastomoses in off-pump coronary artery bypass (OPCAB) [1]. It procures the advantage of an atraumatic proximal suture lowering the risks relative to lateral aortic clamping, which can be associated with severe complications such as cerebral atheromatous microembolisms or aortic dissections [2]. This automatic suturing technique was recognized to be safe, quick and reliable. Nevertheless, the consequences of the introduction of a metallic device into the vein upon its anatomical structure have not been described [1]. Yet, venous dilatation before implantation is known to alter the media and induce apoptosis that promotes subsequent mid-term stenosis.

The purpose of the present study was to analyze the consequences upon the venous structure of the use of the Symmetry® mechanical anastomotic device.

2. Patients and methods

Nineteen consecutive patients who underwent OPCAB surgery from November 2002 to January 2003 and who received one proximal saphenous vein anastomosis using the St Jude aortic Symmetry® connector system were evaluated. Mean age was 68 ± 5 years. After its harvesting, the saphenous vein was flushed with saline solution. A small distal segment of 7–8 mm was cut and stored in an acetone–formaldehyde–alcohol (AFA) solution (V0). The external diameter of the vein graft was assessed in 0.25 mm increments to match with the most adequate size of the different connecting systems (4.5–6.5 mm). The vein was then introduced into a transfer sheath and guided over the implantation system. The proximal tip was secured into...
the hooks of the connector with a forceps. The delivery tube was placed into the handle that allows delivery inside the aortic wall. An aortic cutter was used to make a perfect circular hole into the aorta. The connection system was inserted into the aorta and the vein connected by pushing a button on the handle. Before the vein was inflated by the blood flow, another distal segment was cut and stored in an AFA solution (V1). Both parts of the vein were examined. Two paraffin-embedded blocks of formalin-fixed tissue from each patient were identified (V0 and V1). Histological sections for light microscopy were stained with the classic HES technique (hematoxylin, eosin, safran) to detect endothelial cell and media damage, as well as fibrosis and wall lesions. A complete damage of the endothelial layer was defined, in comparison to the V0 segments, as an absence of any endothelial cell over three different microscope fields.

3. Results

All the patients had intra-operative flow measurement with an ultrasonic probe (Cardiomed flowmeter, Medi-Stim®, Oslo, Norway). All the venous grafts were patent with a diastolic perfusion index (IP) below 2 (according to the manufacturer’s indication). No additional stitches were used after implantation of the veins on the aortic wall.

Histological examination was possible in each case. Each patient was his own control. The V0 segments, examination revealed diffuse media fibrosis compatible with the patients’ age. The endothelial cells were present in all patients. The V1 segments showed a complete damage of the endothelial cells in eight cases (Fig. 1). In 11 patients, the V1 segments had lesions of more than 80% of the endothelial cells (defined as a loss of at least 80% of the endothelial cells over three different microscope fields in comparison to V0). Among all the V1 segments, eight presented with dissection of the media layer (Fig. 2), and one showed a wall thrombosis (Table 1).

We did not notice any thrombosis of the vein graft in the early post-operative period. None of the patients developed postoperative myocardial infarction or neurological complications.

4. Discussion

The manual suturing technique between the aorta and venous grafts remains the gold standard in coronary surgery, because of its price effectiveness and reproducibility. Yet, in case of OPCAB surgery, the venous implantation on the aorta needs side clamping. With the use of CPB, this maneuver reveals to be very often safe because of the aortic pressure that can be lowered as needed, but can be risky in case of a full flow aorta with atheromatous lesions or calcifications. In some cases, this side clamping is associated with aortic dissections or emboli migrations that lead to stroke [2].

The Symmetry device was developed by St Jude medical to provide a bloodless end-to-side venous suture to the aorta without side clamping [1]. This system seems to be reliable [3] even if some cases of early graft thrombosis have been described, especially in patients who presented

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Aspects of the venous grafts after the insertion of the Symmetry® aortic connector (V1)</th>
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<tbody>
<tr>
<td>V0</td>
<td>V1</td>
</tr>
<tr>
<td>Total endothelial lesions</td>
<td>0</td>
</tr>
<tr>
<td>Partial endothelial lesions (&gt;80%)</td>
<td>0</td>
</tr>
<tr>
<td>Wall dissection</td>
<td>0</td>
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<tr>
<td>Thrombosis</td>
<td>0</td>
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</tbody>
</table>

V0 represents the veins after harvesting. Wall dissections were not in correlation with the severity of the endothelial layer.
before surgery with coronary re-stenosis after endoluminal treatment and nitinol-stents insertion [4].

In our series, all the veins after the connector use presented with major or total endothelial damage. This is known to contribute to a greater response to injury than undamaged grafts. Nevertheless, conclusions about endothelial lesions remain questionable since vein storage in a saline solution alters the endothelium [5]. Furthermore, eight veins (42%) showed important dissection of the media. We did not have any mismatch between the vein size and the connectors. Yet, the lesions produced by the device seem to be severe. We did not have a long-term follow-up and consequently we cannot estimate the risk of thrombosis or stenosis consecutive to the graft damage. Thus, it remains unclear for us if the histological changes could have an impact upon the graft’s patency. Traverse et al. [4] have recently reported in a prospective study that 15% of the analyzed patients who received aortic connectors in a CABG procedure developed significant stenosis or occlusion at the connector site shortly after CABG (mean time to recurrence of chest pain: 173 ± 39 days). These early stenosis were attributed to the 90° angle of the anastomosis that may facilitate king–king in some cases.

Further investigations, especially experimental, are mandatory to define the long-term evolution of such graft lesions to evaluate their implication in early graft occlusions. Therefore, the use of the Symmetry® aortic anastomotic device can be questionable in routine off-pump coronary artery surgery. The introduction of the new generation of the Symmetry® connectors could resolve this problem by excluding the aggressed part of the vein from circulation.

References