Detection of a Twisted Saphenous Vein Graft During Coronary Artery Bypass Surgery

J. van der Meulen*MD, I. E. Eijsman MD, Prof.
Division of Cardiopulmonary Surgery Academic Medical Center, University of Amsterdam, The Netherlands

During a coronary artery bypass procedure, graft blood volume flow was measured using the CardioMed transit time flowmeter. Blood volume flow in the saphenous vein graft to the ramus descendens posterior was found to be zero. After untwisting, graft blood volume flow was clearly detectable.

CASE
A 67 year old male undergoing routine coronary artery bypass grafting (CABG).

HISTORY
Six months prior to hospital admission the patient experienced an episode of impending myocardial infarction in the anteroseptal and lateral regions. This was successfully treated with thrombolyses. Hereafter, the patient suffered from angina pectoris New York Heart Association (NYHA) class III/IV. Cardiac catheterization revealed significant stenoses of the ramus descendens anterior, the right coronary artery and the ramus circumflexes. The patient was subsequently admitted to our hospital for CABG.

PROCEDURE
The patient underwent a routine CABG operation. Via a midsternotomy incision, the left internal thoracic artery (ITA) was dissected out from its surrounding structures. Saphenous vein was taken from both lower legs. Extracorporeal circulation was installed using PVC tubing and a membrane oxygenator. The left ventricle was vented via the right upper pulmonary vein. The blood was cooled to 28 °C and the aorta was cross-clamped. One litre of St. Thomas’ cardioplegia was given via the aortic root. The ramus descendens posterior (RDP) was identified and opened. It was found to be atherosclerotic with an inner diameter of little more than 1 mm. Using saphenous vein, an end-to-side anastomosis was constructed with Prolene 7.0. A jump graft was then constructed using a venous graft from the first diagonal branch a small atherosclerotic vessel with a diameter of 1 mm, to the obtuse marginal branch, which had a diameter of 1.5 mm and no significant atherosclerosis. Finally, an end-to-side anastomosis was made between the left internal thoracic artery and the ramus descendens anterior, a vessel with a lumen of 2 mm and no significant atherosclerosis. The aortic cross-clamp was released and with two proximal anastomoses onto the ascending aorta, the revascularization was complete.

FLOW MEASUREMENT
During the operation, we were able to measure the blood flow through the grafts using a Flowmeter (Medi-Stim AS, Oslo, Norway, two channel transit time flowmeter). The transit time probes were placed around the vessel giving the true volume flow in ml/min without the need of any zero-line calibration. The flow curves as well as the mean flow values are shown on the monitor of the flowmeter. This was our first experience with this equipment. We took several measurements from all the grafts we had constructed, including that of the internal thoracic artery.
FLOW MEASUREMENT PROCEDURE

In order to improve the acoustical contact between the flat front face of the probes and the vessel wall, it is recommended to immerse the probe head in saline solution for two minutes before the measurement. The degree of the acoustical coupling is registered on the monitor of the flowmeter by means of a color indicator. If, after placing the probe around the vessel, the acoustical coupling remains poor, it may be improved by moistening the probe again using saline, blood or sterile gel.

When taking the measurements, it is important to ensure that the probe is of a larger size than the outer diameter of the vessel. This is in order to avoid partial or complete occlusion of the vessel which would yield a false flow value. The transit time probes for coronary application are supplied in sizes 2, 3, 4 and 5 mm, with or without handle. We found the 3 mm probe with handle to be the right size for measuring the internal thoracic artery graft and the 4 mm probe with handle to be suitable for the saphenous vein measurements.

FLOW MEASUREMENT RESULTS

In order to measure the internal thoracic artery flow, a 15 mm mid-portion of the graft was dissected out. This is a necessary procedure as any surrounding fatty tissue attenuates ultrasound making transit time flow measurements difficult or even impossible. However, a thin pedicle may be left in place if free-dissection should be avoided. After wetting the probe head in a saline solution and immersing it in sterile gel, we applied the probe to the graft giving the flow curve shown in figure 1.

The curve shows the characteristic shape of flow in an internal thoracic artery graft to the ramus descendens anterior, with a small back flow during early systole and the main forward flow during diastole. ITA flow was measured to 25 ml/min, falling within the value of 49.8 ± 32.9 documented by Walpoth et. al.1. The accuracy of the CardioMed Flowmeter measuring ITA flow has earlier been documented by Laustsen et. al.2.

Using a 4 mm probe with handle, we went on to measure the vein graft going to the obtuse marginal branch. A mean flow value of 66 ml/min was recorded as shown in figure 2.

Finally using the same 4 mm probe, we measured the flow in the saphenous vein graft to the RDP. This was recorded as virtually zero (figure 3). Taking into account the poor quality of the vessel we did not expect a high rate of flow, but the 2 ml/min value we measured is within the nominal zero offset of the flowmeter and should therefore be regarded as an indication of minimal or no flow in the graft.
Figure 3. Flow in the twisted saphenous vein graft to the RDP.

The graft was inspected several times but no obstruction could be seen. The flow was measured again, yielding the same result. After further very careful inspection there was seen to be a full twist in the graft, which rolled easily from side to side. This meant that the twist was visible only when the graft could be observed over its full length.

The graft was disconnected from the aorta and after untwisting reanastamosed. The measuring procedure was carried out again, this time recording a clean pulsatile flow with a mean value of 24 ml/min (figure 4).

Figure 4. Flow in the saphenous vein graft to the RDP after untwisting.

DISCUSSION
Initial inspection of the graft to the RDP did not reveal the torsion. Hemodynamic instability or at least ECG changes are to be expected in cases of non-functioning grafts. In this case there were no such signs at all.

The Medi-Stim flowmeter has proved itself to be a useful tool in intraoperative problem detection and helpful in preventing a potential accident in the postoperative period.

References

*Please address all correspondence to: Dr. J. van der Meulen, Division of Cardiopulmonary Surgery, Academic Medical Center, University of Amsterdam, NL-1101 AZ Amsterdam, The Netherlands.

Correspondence related to the Flowmeter should be forwarded to: Medi-Stim ASA, Marketing Dept., PB 4744 Nydalen, N-0421 Oslo, Norway, or by using e-mail: medistim@medistim.com.