Wide sternal retraction may impede internal mammary artery graft flow and reduce myocardial function during off-pump coronary artery bypass grafting: presentation of two cases

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INTRODUCTION

The left internal mammary artery (IMA) is routinely used for grafting of the left anterior descending coronary artery (LAD), providing good flow to the anterior left ventricle (LV) wall. Impeded IMA-to-LAD flow may result in myocardial ischaemia and haemodynamic deterioration. From a study population, we describe two incidents where myocardial ischaemia was observed during off-pump coronary artery bypass surgery (CABG), with a confirmed reduction in the IMA-to-LAD flow in one patient. In patient no. 1, normal IMA flow was assessed by transit-time flow measurement after a complete IMA-to-LAD anastomosis. The anterior LV wall thickening was monitored continuously by epicardial ultrasonic transducers. Normal wall thickening was confirmed after IMA grafting. During a wide sternal opening for circumflex grafting the anterior wall motion displayed an ischaemic pattern, with reduced systolic and increased post-systolic wall thickening. IMA flow was reduced simultaneously. When easing the sternal opening, IMA flow normalized, as did the motion pattern in the anterior LV wall. In patient no. 2, similar changes in wall thickening occurred during a wide sternal opening after IMA-to-LAD grafting. When easing the retractor, the wall thickening normalized. It is important for the surgeon to be aware of this possible cause of myocardial ischaemia, with a risk of subsequent haemodynamic deterioration. This may not only be of great importance during off-pump CABG, but can also be significant for successful weaning from the cardiopulmonary bypass machine.

Keywords: Coronary artery bypass surgery • Left ventricular dysfunction • Intraoperative monitoring
wall-thickening velocity and emergence of post-systolic thickening, usually caused by ischaemia [4]. Repeat of the TTFM demonstrated an arrested flow in LIMA (Fig. 1A). When the opening of the sternal retractor was reduced, IMA flow increased immediately and the M-mode image and the wall-thickening velocity pattern normalized (Fig. 1B). The Cx anastomosis was completed with the eased opening of the retractor, and the postoperative course was uneventful.

Patient 2 (a 70-year old male) underwent OPCAB grafting of the LAD, 2nd diagonal and the posterior descending coronary artery (PDA). As in the first patient, two ultrasound transducers were fixed to the epicardium, measuring contractility in the LAD and the Cx areas, respectively. After completion of the LAD and diagonal anastomosis the sternal retractor was opened widely in order to perform the bypass to the PDA. The signal from the transducer in the LAD region developed an abnormal, ischaemic ultrasonic M-mode pattern, which normalized after reducing the opening of the retractor. The patient then remained stable with normal patterns on the M-mode recordings, and had an uneventful postoperative course.

### DISCUSSION

A majority of patients undergoing OPCAB have a multi-vessel disease including significant lesions in the LAD. Although the circulation of the myocardium may be supplied by the LAD, a well-functioning LIMA-to-LAD graft is important when the heart is positioned for grafting of the Cx and right coronary arteries. This positioning imposes a stress on the haemodynamic state and may require administration of vasopressors, which in turn may increase oxygen demand. This consideration is the main reason for recommending bypassing the LAD first in OPCAB [5]. Cessation of flow in the LIMA may therefore be detrimental and cause circulatory deterioration. During OPCAB haemodynamic instability is reported as the most frequent cause of conversion to cardiopulmonary bypass (CPB) [6], and this in turn increases the risk of major complications [2, 7]. In both the reported cases continuous M-mode monitoring demonstrated reduced function of the anterior LV wall, although ECG remained normal. In the first case, this resulted in haemodynamic instability, while the second patient remained stable. The demonstrated ischaemia...
was a serious concern and also demonstrated the importance of maintaining flow in the LIMA during grafting of the lateral and inferior wall of the myocardium.

When a wide retraction of the sternum is necessary, the IMA flow may be compromised as shown in case 1 and as previously reported in a single patient operated with CPB [8]. It is important for the surgeon to be aware of this possible mechanism for the myocardial dysfunction when the myocardium is supplied by the IMA graft. If possible, a wide opening of the retractor during CABG surgery should be avoided. If the TTFM technology is available, the LIMA flow is easily measured when increasing the retractor opening. Although impairment of the IMA graft flow due to sternal retraction may be more serious in OPCAB, it may also be of importance in CABG performed with CPB. A wide opening of the sternum could reduce flow in the LIMA, which may result in ischaemia and thereby impede weaning from CPB. These mechanisms could cause similar challenges after weaning from CPB.

The TTFM represents an easy and reproducible technique for the demonstration of inadequate flow in coronary grafts, and should always be considered in CABG surgery [9, 10]. The ultrasound methodology used for monitoring of the regional myocardial contractility provides a sensitive tool for detecting ischaemia. In conclusion, we believe that the TTFM, transoesophageal echocardiography [11, 12] and miniaturized ultrasonic monitors placed directly on the epicardium [3, 13] may be useful instruments in the prevention of ischaemic complications during CABG.

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REFERENCES


eComment. Extended sternal retraction and internal mammary artery flow

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We read with interest the manuscript by Espinoza et al. [1] in which the authors presented two patients in whom internal mammary artery (IMA) flow was compromised with extended sternal retraction during off-pump coronary artery bypass grafting (CABG). We would like to comment on the authors’ paper with similar incidents that we have encountered in our practice.

We had 3 patients in whom the left IMA flow was decreased when we widely opened the sternum retractor during CABG. The first patient had cerebrovascular disease (left vertebral artery occlusion and insignificant left internal carotid artery stenosis) in addition to coronary lesions. We detected an accessory ascending collateral branch from the IMA after careful exploration of the proximal part of the artery. Flow reduction was overcome with clipping of this vessel and freeing of the IMA. The procedure did not affect the neurological status of the patient in the postoperative period. In the second patient, the IMA divided into two branches after the middle segment, measuring 1 mm in diameter. Left anterior descending artery was bypassed with the suitable middle portion of the IMA. Sternal over-retraction caused flow reduction, which was overcome with the approximation of the sternal edges. In both patients, we proposed that the reason for the reduction in the flow of IMA was due to distention of the graft. In the third patient, there was no identifiable cause for the decrease in IMA flow, other than sternal retraction. Since IMA was the last anastomosed graft before the proximal anastomosis in our procedures, decrease in IMA flow was detected with simple palpation of the vessel and managed accordingly.

IMA is still the gold standard graft for myocardial revascularization. We believe, it should be kept in mind that there may be various reasons which may lead to compromised IMA flow, either of the most common distention or sometimes of an idiopathic nature. Although flow compromise may be evaluated by transit-time flow measurement, simple palpation of the graft is also simple and effective method.

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References