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Efficacy of High-Resolution Epicardial Ultrasonography in Cardiovascular Surgery

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Abstract

In cardiovascular surgery, it is important to identify the target vessel and to assess the quality of vascular structure. Preoperative enhanced computed tomography (CT) and angiography give us that information; however, we sometimes encounter difficulties due to limitation of those preoperative examinations. Intraoperative use of 15-MHz high-frequency epicardial ultrasound with small probe has a great potential to detect small vessels and it will give us benefits in cardiovascular operations, especially coronary artery bypass surgery.

Introduction

In cardiovascular surgery, it is important not only to identify the target vessels but also to assess the vascular lumen before we incise the vessel. Though preoperative enhanced CT or angiography will help us, however, we sometimes encounter difficulties due to limitation of those preoperative examinations and we frequently miss it especially in emergent cases. Previous reports have showed the efficacy of high-frequency epicardial ultrasound (ECUS) in coronary bypass surgery [1,2,3].

Since 2013, we introduced 15-MHz high-frequency epicardial ultrasound (VeriQ C system; MediStim, Oslo, Norway) in our institute. It combines ultrasound imaging and proven transit time flow measurement (TTFM) in a single system that is specifically designed for cardiovascular procedures and its small probe can detect vessels in narrow surgical field, like the circumflex artery.

Technique

We routinely use the ECUS to detect and assess the target vessels in all cardiovascular surgery, and following are our typical uses.

First, the ascending aorta is fully examined. Of course, old probes can assess the ascending aorta, the ECUS can easily assess lateral side of the aorta including minor curvature; the debris or the thickness of aortic wall in wider area are clearly demonstrated.

Second, the target coronary artery is identified. Intrafat or intramuscular coronary artery can be easily found, and detail structure can be assessed for the target vessel. The diseased area would be detected and the diameter of target vessel can be measured. If coronary plaque is located in posterior side, it is difficult to realize before incise the coronary artery without ultrasonic imaging. Using ECUS, dissection for the exposure of the target coronary artery can be minimized, and we can avoid unnecessary dissection and bleeding.

Third, we can also assess the grafts. For example, if dissection of internal thoracic artery is suspected, we can diagnose and detect the damaged area [3].

Fourth, after anastomosis, we can assess it with not only transit time flow measurement but also ultrasound imaging. And we can check the shape of anastomosis. And if flow pattern is bad, ECUS will be helpful for understanding of the cause.

ECUS are versatile in other cardiovascular surgery. For instance, we can search for the grafts in redo surgery after CABG. In cases with coronary AV fistulae, detection of abnormal vessels and the flow measurement of fistulae are feasible. We have experienced one case with coronary AV fistulae which was suspected by preoperative CT, and identified by ECUS intraoperatively. After ligation of fistulae under heartbeat, we verified that the blood flow of aneurysm has vanished by ultrasonic imaging. In cases with aortic surgery, assessment of the cervical branches, abdominal aorta, and the vessels of the lower limb are assessed by ECUS. In our experience in patients who underwent total de branch operation for aortic arch aneurysm, use of ECUS avoided neurological event. Observation of the brachiocephalic artery was easy, but space for the observation of left common carotid artery and left subclavian artery was very limited. We suppose, old proves were not able to observe them in this limited space. Intraoperative examination of cervical vessels, we could find mobile plaque on the posterior wall of left subclavian artery before the anastomosis (Figure 1). The left subclavian artery was ligated and reconstructed at more distal site from this lesion, and there was no neurological complication postoperatively. Preoperative thin-sliced enhanced CT examination did not demonstrate this pathology. Moreover, intraoperative transesophageal echocardiography couldn't evaluate these areas.

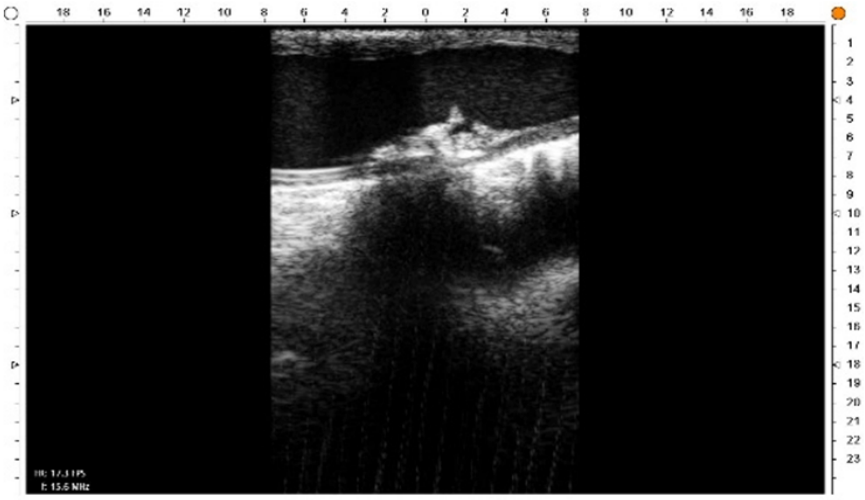

Figure 1:

Discussion

Although ECUS is very useful non-invasive intraoperative examination, the costs of all these VeriQ C system have been concerned. In an early stage, MediStim limited the number of probe uses to 50 cases. After using 50 cases, we had to use a new probe. Then, the limitation increased up to 100 cases, and finally, there is no limit since 2013. This revision is economically very meaningful and promoted us use in various kinds of cardiovascular operation. Now, we routinely use it for checking the target vessel in all cardiovascular surgery.

Epicardial ultrasonography can give great contributions to CABG and there are potential benefits in widely applications in all cardiovascular surgery.

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