Minimized extracorporeal circulation for the robotic totally endoscopic coronary artery bypass grafting hybrid procedure

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Robotically assisted totally endoscopic coronary artery bypass grafting (TECAB) can be performed on the beating heart with cardiopulmonary bypass support in high-risk patients or patients for whom technical difficulties are expected with a complete off-pump approach. To minimize the inflammatory response and reduce the requirement for transfusion, minimized extracorporeal circulation is an attractive option for robotic TECAB procedures. The present report describes a case for which minimized extracorporeal circulation was used for the first time in TECAB performed using the da Vinci telemanipulation system.

Key Words: *Cardiopulmonary bypass; Coronary artery bypass graft surgery; Inflammation; Robotic surgery*

A 60-year-old woman with diabetes, hypertension and hyperlipidemia presented with a three-day history of chest pain. Cardiac troponin I was negative, but a nuclear stress test demonstrated reversible ischemia in the apex and apical septum. Coronary angiography revealed diffuse left anterior descending coronary artery (LAD) disease requiring surgical intervention, whereas, the obtuse marginal branch was suitable for percutaneous coronary intervention.

An 8 mm INTERGARD graft (MAQUET Cardiovascular LLC, USA) was sewn onto the left axillary artery, as previously described (1), and left femoral venous cannulation was achieved percutaneously. After left lung isolation, the robot was deployed through ports in the third, fifth and seventh intercostal spaces, the pericardial fat pad was removed and the left internal mammary artery (LIMA) was harvested in a skeletonized fashion. With an activated clotting time of 300 s, cardiopulmonary bypass (CPB) was established with the minimized extracorporeal circulation (MECC) system using arterial and venous retrograde priming. The intraoperative setup is demonstrated in Figure 1. After deploying the endostabilizer, and with the heart beating, an end-to-side anastomosis of the LIMA to the LAD was constructed with 7-0 Prolene (Ethicon Inc, USA) in a running technique. The patient was weaned from CPB and was recovered in the intensive care unit. After an uneventful postoperative course, she underwent planned percutaneous coronary intervention of the first obtuse marginal artery with a 2.25 mm × 16 mm Taxus Atom stent (Boston Scientific Corporation, USA). The postoperative angiogram of the LIMA to LAD graft is shown in Figure 2. The patient was discharged from hospital on postoperative day 7 with a hemoglobin concentration of 1.14 g/L and hematocrit at 32.7%. The patient did not receive a transfusion of packed red blood cells.

DISCUSSION

Off-pump beating heart totally endoscopic coronary artery bypass grafting (TECAB) is considered to be the least invasive method of surgical coronary revascularization, but may not be applicable to all

Diminution du recours à la circulation extracorporelle lors d'une intervention hybride de pontage coronarien totalement endoscopique

Le pontage coronarien totalement endoscopique (ou TECAB pour *totally endoscopic coronary artery bypass*) peut être effectué à cœur battant avec l'aide de la circulation extracorporelle (CEC) chez les patients à haut risque ou chez les patients où des difficultés techniques sont à prévoir si l'approche se fait entièrement sans l'aide de la CEC. Pour atténuer la réponse inflammatoire et les besoins transfusionnels, la CEC réduite est une option attrayante dans les cas de TECAB. Le présent rapport décrit la première utilisation de CEC réduite dans un cas de TECAB réalisé à l'aide d'un télémanipulateur da Vinci.

Figure 1) Intraoperative setup

patients; a recent series (2) reported a high rate of intraoperative exclusion. Pump assistance may permit wider applicability of robotic TECAB to patients who are otherwise not suitable for a TECAB procedure. By unloading the heart, reducing target vessel backflow and deflating the lungs, cardiopulmonary support reduces the technical complexity of robotic TECAB. In addition, CPB serves as a safety net in TECAB, allowing immediate cardiocirculatory support should ischemia or hemodynamic problems occur, thereby increasing the comfort level of the operating team and improving patient safety. Consequently, prophylactic cannulation has become part of our beating heart TECAB protocol. CPB is then instituted if required during the course of the procedure. In the described case, unloading the

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heart allowed more space for suturing and enabled bringing the target vessel into a more suitable location for suturing without hemodynamic compromise.

MECC was developed to reduce systemic inflammation associated with CPB and to reduce its deleterious effects. Patients in whom MECC was used required fewer transfusions (related to more stable hemoglobin levels on pump [3]), which may be attributable to smaller priming volumes and the use of retrograde autologous priming. In addition, CPB with a lower activated clotting time can be achieved, which may limit perioperative blood loss.

Certain characteristics make the MECC more challenging than standard CPB. Because of the closed system, it is important that specific care be taken in preventing air entrainment in the venous line. This risk is minimized with percutaneous venous drainage as used in the present case. Because the system has no venous reservoir, volume shifts are often managed by altering the position of the patient during the procedure. When the robot is connected to the patient, it is difficult to safely manoeuvre the patient. We have found that pharmacological agents can alter the preload of the patient adequately during CPB-assisted beating heart TECAB.

Robotic TECAB is a technically demanding procedure that is simplified by cardiopulmonary support. Pump assistance may also extend this minimally invasive technique to patients who are, otherwise, not candidates for robotic TECAB. The described technique allows the expansion of TECAB to higher risk patients. We conclude that MECC is a suitable method of cardiopulmonary support for robotic TECAB.

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Figure 2) Postoperative angiogram of the left internal mammary artery to left anterior descending coronary artery graft

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