

Robotic Dissection of the Right Internal Thoracic Artery through Median Sternotomy

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The use of robotic systems in cardiac surgeries aims at decreasing the surgical trauma. The totally endoscopic myocardial revascularization, assisted by the DaVinci robot (Intuitive Surgical, Sunnyvale, California) is feasible and the learning process must be carried out in steps. The first step is the preparation of the left internal thoracic artery, through the totally endoscopic approach.

The case presented here proposes the dissection of the right internal thoracic artery through complete sternotomy. It proposes a new step directed at the totally endoscopic procedure, aiming at decreasing the injuries caused by the learning curve.

Introduction

The development of new equipment and technologies has contributed to the decrease in surgical trauma in the area of cardiovascular surgery¹. The decreased hospitalization time, less frequent use of blood derivatives and better esthetic results are examples of important benefits resulting from minimally invasive procedures.

The thoracoscopic procedures in cardiovascular surgery started to be published in the beginning of the 1990s. Initially, they were video-assisted without robotic help^{2,3}. Progressively, the computed technology started to be incorporated by surgeons and robotic help became a reality. From a single mechanical arm controlled by voice and that supported only video, the telesurgery became available, completely assisted by a robot equipped with a three-dimensional console and four mechanical arms (DaVinci Intuitive Surgical, Sunnyvale, California) (Figure 1).

Key words

Robotics; cardiac surgical procedures/methods; surgical procedures, minimally invasive; mammary arteries.

There are several cardiovascular procedures that can be performed with robotic assistance. The atrial communication and mitral valve repair, the myocardial revascularization are the procedures with the highest number of publications⁴⁻⁶.

The learning curve for the use of robotic assistance consists of steps⁷⁻¹⁰. The exhausting training in experimental models is crucial and establishes the beginning of the team's experience^{9,10}. The dissection of the left internal thoracic artery is the first step to perform the robot-assisted totally endoscopic revascularization^{7,8}. Usually, one starts directly with the endoscopic dissection; however, difficulties in handling the equipment can happen, resulting in trauma and injury to the main graft used for the myocardial revascularization.

The present study proposes a former step when preparing the totally endoscopic left internal thoracic artery. We report the complete dissection of the right internal thoracic artery using the median sternotomy approach.

Case Report

In December 2008, a 54-year-old male patient with chronic coronary insufficiency, stable angina and candidate to myocardial revascularization was assessed. He had a history of arterial hypertension and dyslipidemia. The coronary angiography disclosed severe lesions in the anterior interventricular branch, diagonal branch and left marginal branch. The left ventricular function was normal.

The proposed surgery was the revascularization of the anterior interventricular branch to the left internal thoracic artery; of the diagonal branch to the right internal thoracic artery and an aortic bypass surgery to the left marginal branch, in retro-aortic position. The dissection of the right internal thoracic artery was totally robot-assisted. The anesthesia preparation did not differ from the one routinely used for on-pump myocardial revascularization surgery. Mechanical ventilation was established without the need for selective orotracheal intubation. At the operating room, the robot was positioned to the patient's right, aiming at establishing the access of the arms and the video to the right internal thoracic artery (Figure 2).

The median sternotomy was the chosen approach. The preparation of the right magna saphenous vein, removed from the right thigh, was carried out through mini-incisions. After the opening of the pericardial sac and exploration of the cavity, the left internal thoracic artery was prepared, through a skeletonized approach, without pleural opening. After the retractor was positioned, now to the right internal thoracic

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Figure 1 - DaVinci Intuitive Surgical robot operation console, Sunnyvale, California.

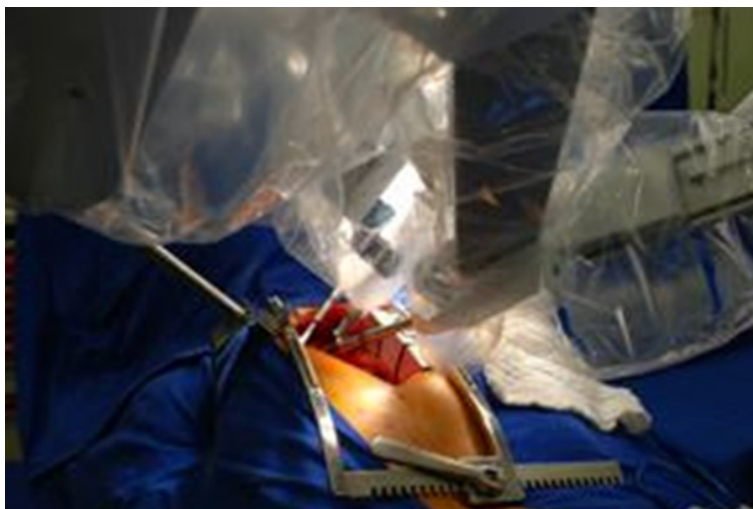


Figure 2 - Robot set in position for the right internal thoracic artery preparation through median sternotomy. The robot is positioned to the patient's right and three arms are working: video, forceps and electrocauterizer.

artery, the robot was brought closer. The operating table was placed in a 30-degree right lateral decubitus position.

Three mechanical arms were employed, as follows: the video, the electrocauterizer (EndoWrist - Intuitive Surgical) and forceps (EndoWrist deBakey - Intuitive Surgical) (Figure 2). The fourth arm remained inactive. The dissection was carried out under the same principles employed in the preparation of the left internal thoracic artery: skeletonized approach and with no opening of the pleural cavity. The electrocauterizer (Valleylab Force II) was kept at very low voltage throughout the entire procedure.

The robot-assisted right internal thoracic artery preparation time through the sternotomy was 50 minutes. The artery was dissected from its subclavian artery emergence to its bifurcation. The smaller branches were cauterized and the larger ones were clipped under direct vision. At the end of the preparation, no hematomas or lesions caused by traction or pinching were observed. The complete heparinization was carried out and the artery was cut. The flow was considered to be excellent.

Subsequently, the extracorporeal circulation circuit was installed. The surgery was uneventful and the proposed

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revascularization was carried out. The total surgical time was 5 hours. The hospital discharge occurred seven days after the surgery, under excellent clinical conditions.

Discussion

The equipment used in the present case (DaVinci Intuitive Surgical, Sunnyvale, California) (Figure 1) presents high image resolution, satisfactory three-dimensional visualization, control for vibration decrease and allows free maneuvers with a broad range of movements. These are advantages that encourage and stimulate its use in minimally invasive procedures.

There are several reports on the preparation of internal thoracic arteries for totally endoscopic myocardial revascularization. However, the learning curve can be long and injuries can eventually occur^{7,8}.

Several experimental models have been proposed for the training in robotic surgery^{9,10}. Simulations with non-living models present the robotic technology to the surgeon. Experimental animal models allow a closer approach to reality and are crucial before surgical procedures are performed in humans. The robot-assisted dissection of the right internal thoracic artery through median sternotomy can be the first step. When the median sternotomy is employed, the robotic arm access to the artery is facilitated, compared to the closed thorax. The possibility of immediate intervention in case of bleeding provides the surgeon with reassurance and tranquility, in adaptation to the technique. An assistant surgeon remains opposite the robot arms and has prompt access to the surgical field. The surgeon's activity is identical to that performed when the totally endoscopic left internal thoracic artery preparation is carried out. The visual field is the same and the arms' movements are also the same. The progress to the totally endoscopic preparation becomes natural.

tranquilidade The anesthesia control of the patient did not differ from the routine anesthesia used for myocardial

revascularization. There was no need for selective orotracheal intubation or decrease in ventilatory volume. Bleeding was negligible.

The time of preparation was satisfactory, considering the learning curve. Definitely, it would have been longer if the chosen preparation had been the totally endoscopic procedure.

No injuries caused by the robot-assisted dissection were observed. The incidence of lesions during the learning phase is estimated at 6% and 2% is considered acceptable after long training^{7,8}. The learning process using the conventional sternotomy can decrease these figures, especially at the initial phase.

The learning curve must be considered in all surgical areas, mainly when the technological innovations are incorporated. We believe that the preparation of the right internal thoracic artery through median sternotomy can be an important initial step. It is a safe way to start the robot-assisted totally endoscopic cardiac surgery.

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Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any post-graduation program.

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