Work in progress report

Total robotic-enhanced pericardiectomy for effusive pericarditis

O. Reuthebuch, E. Ecknauer, G. Zünd, M. Turina

Clinic for Cardiovascular Surgery, University Hospital Zurich, Ramistrasse 100, CH-8091 Zurich, Switzerland
Institute for Anesthesiology, University Hospital Zurich, Ramistrasse 100, CH-8091 Zurich, Switzerland

Received 30 April 2002; received in revised form 2 August 2002; accepted 21 August 2002

Abstract

With the DaVinci® Robot only recently in clinical use, limitations of video-assisted thoracoscopy could disappear due to Endo-Wrist® features, tremor cancellation and three-dimensional view. This report describes the total endoscopic pericardiectomy successfully achieved with robotic assistance in a 50-year-old man suffering from effusive pericarditis. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Minimally invasive surgery; Robotics; Pericardiectomy

1. Introduction and method

Progress in robotic technology permitted the development of instruments with multiple degrees of freedom (DOF), three-dimensional view of the operative field, and tremor cancellation. The following report documents the safe and precise total robotic pericardiectomy in a patient suffering from effusive pericarditis succeeding thoracic empyema.

A 50-year-old man was hospitalized for left-sided empyema which finally resolved in thoracic drainage, consecutive thoracoscopic debridement and successive open debridement. Antibiotic treatment was resumed and patient was discharged in stable condition.

Two months later, the patient was readmitted in reduced general condition, with enlarged heart shadow associated with fever up to 39.1°C. Initial transthoracic echocardiography (TTE) revealed a circular, hemodynamically relevant pericardial effusion with 600 ml of fibrinous fluid, mainly compromising the right ventricle (Fig. 1).

Due to the expected bilateral pleural adhesions, a thoracoscopic pericardial fenestration was rejected. Patient’s general condition made an open pericardiectomy a potentially high-risk procedure; therefore it was decided to use the DaVinci® telemanipulator (Intuitive Surgical, Mountain View, CA) to resect the pericardium. To minimize risk of lung injury when inserting optics and instruments, a right thoracic approach and double-lumen single-lung ventilation was chosen. First trocar was placed in the fifth intercostal space in the anterior axillary line. Via this trocar, CO2 was insufflated to a maximal intrathoracic pressure of 8 mmHg. Under three-dimensional (3D) optical control, two additional instrument-carrying trocars were placed in the third and seventh intercostal space in the mid-clavicular line. To gain complete visualization of the right heart, pleural adhesions were divided with scissors and cautery blade. Pericardium was then grasped and transected from sternum until left thoracic cavity was reached. Pericardium was carefully opened with the scissors at the diaphragmatic edge. Pericardial effusion was drained into right pleural cavity. Cautery energy was reduced to a minimum to prevent ventricular fibrillation, and pericardium was resected along sternal edge-superior vena cava-phrenic nerve-diaphragm with the cautery knife. Pericardium was cut into pieces and removed via the lower trocar (Fig. 2).

As a next step, further pericardium was resected beyond the left anterior descending (LAD) and removed. At the end of the procedure, chest tubes were placed via trocar incisions.

Procedure duration was 51 min. Patient was extubated in the operating room (OR) and transferred to intensive care unit (ICU). Postoperative course was uneventful and patient was discharged on the tenth day after initial antibiotic treatment. Histologic and microbiologic examinations showed no infection, indicating a parainfectious process as the underlying disease. Postoperative transthoracic echocardiography (TTE) showed no residual pericardial effusion with normal wall-motion.
2. Discussion

Poor instrument steering and difficulties in simultaneous access to the left and right heart via an unilateral thoracic approach are the main limitations of video-assisted thoracoscopic surgery (VATS) when used for cardiac procedures. Thoracoscopic pericardiectomy therefore ended often as a mere pericardial fenestration, with possible recurrence of the underlying disease [1].

The only reliable technique to prevent recurrence of pericardial effusion is the resection of a large part of pericardium [2]. Therefore it seems to be mandatory to access the heart via a median sternotomy, since subxiphoid resection as well as lateral thoracotomy show a recurrence rate of up to 18% [3]. Though VATS approach reduces surgical trauma, it is still unknown if the amount of resected pericardium is sufficient to prevent recurrence of the disease [4]. Furthermore pleural adhesions in the area of trocar placement can challenge the approach [5]. To combine benefits of conventional and minimal invasive techniques, Ohtsuka et al. proposed a hybrid approach, where parts of the pericardium are resected via small thoracotomy under video-assisted control [5].

However, with the introduction of the wrist-enhanced DaVinci® telemanipulator in 1999 (Intuitive Surgical, Mountain View, CA), even closed chest coronary artery bypass grafting became reality. Due to the Endo-Wrist® feature of the DaVinci system, with six DOF of its end-effectors, practically the entire pericardium between the phrenic nerves can be excised via three little incisions (1.5 cm), either through the left or right chest. The built-in tremor cancellation allows precise guidance of all kinds of instruments such as microforceps, de Bakey forceps, scissors, electro-cautery and even clip-applicators. Three-dimensional view, already described by Luison and Boyd as an important factor to increase precision and efficiency in VATS procedures [6], in combination with a ten-fold magnification, facilitates not only the identification of structures, but also the navigation of instruments.

In conclusion, pericardiectomy can be safely performed with the DaVinci® telemanipulator. The technique, because of reduced trauma, appears superior to other techniques.

Acknowledgements

We thank Stefan Schwyter for his contribution in the preparation of the figures.

References


