Heart, Lung and Circulation (2019) **28,** e79–e82
1443-9506/04/$36.00
https://doi.org/10.1016/j.hlc.2018.04.307

Minimally Invasive Surgery for Coronary-Pulmonary Artery Fistula Via Parasternal Minithoracotomy

Hao Liu, MD, PhD, Ju Mei, MD, PhD, Yi He, PhD, Zhaolei Jiang, MD, PhD, Min Tang, MD, PhD *

Cardiothoracic Surgery Department, Xinhua Hospital, Shanghai Jiao Tong University, School of Medicine, Shanghai, China

Received 1 March 2018; accepted 17 April 2018; online published-ahead-of-print 29 September 2018

Epicardial surgical repair has been proven to be effective for patients with coronary- pulmonary artery fistula (CPAF). However, most of the surgery has been performed through a median sternotomy under cardiopulmonary bypass. In this report, we describe a novel technique of performing minimally invasive surgery for CPAF patients without extracorporeal circulation via a parasternal minithoracotomy. This technique has proved to be safe and effective and may be worthy of use for patients with CPAF.

Keywords Minimally invasive cardiac surgery • Congenital heart disease

Introduction

Coronary artery fistula (CAF) is defined as an anomalous connection between a coronary artery and other cardiovascular structures [1]. At present, multiple studies have revealed the main pulmonary artery (PA) as the most common termination site for CAF, with the prevalence rates of coronary-pulmonary artery fistula (CPAF) ranging from 36% to 77% in all CAF [2]. To date, most surgery for repairing the CPAF has been performed through a median sternotomy under cardiopulmonary bypass (CPB), which is invasive. In recent years, we have performed minimally invasive surgery for CPAF patients without CPB. Here, we explore the feasibility, effectiveness, and safety of performing minimally invasive surgery for CPAF patients through a left parasternal minithoracotomy.

Technique

The minimally invasive surgical procedure of repairing CPAF was performed under general anaesthesia via a small left parasternal minithoracotomy incision (4–6 cm) in the third intercostal space without rib resection.

The CPAFs were identified using transoesophageal echocardiography (TEE) and blood flow was measured before surgical separation of the fistula. The CPAF was partially visualised on the ME AV short-axis (SAX) view (Figure 1A, B), and fully visualised by tracing the vessel during transition from the ME AV SAX view to the ME AV LAX view. After distraction of the thoracic wall with a tissue retractor and dissection of the pericardium, pericardial stay sutures can then be used for appropriate positioning. Subsequently, a sequential tortuous anomalous vessel can be revealed posterior to or around the PA. The drainage of the abnormal vessel into the posterior wall of the pulmonary artery was documented, which was consistent with the views based on the multiple detector computed tomography (MDCT, Figure 2A, B), coronary angiography and echocardiography (Figure 2C, D). After confirming the precise location of the CPAF, we used tweezers to temporarily clamp the CPAF and imitate ligating the CPAF. Then, TEE was performed again to examine whether the blood flow of CPAF had disappeared or reduced, and to determine the place for ligation. If the blood flow of the CPAF had completely disappeared, the clamping position will be the ligating position (Figure 3A–D). Finally, the CPAF was ligated with prolene suture under the monitoring of TEE.

*Corresponding author. Tel.: +86 21 25078037. Email: tangmin@xinhuamed.com.cn

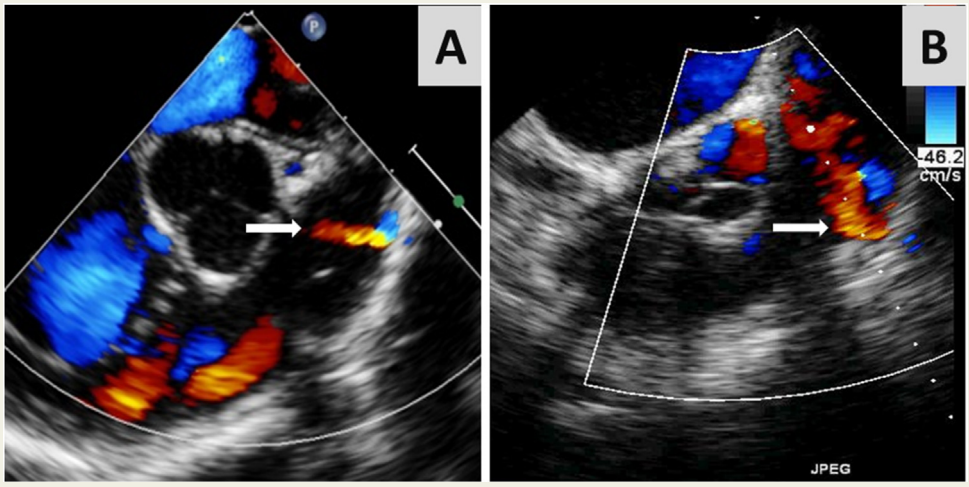

Figure 1 From the transoesophageal echocardiography view. The coronary-pulmonary artery fistula can be easily seen (A, B white arrow). A: Right coronary artery to pulmonary artery fistula; B: Left anterior descending artery to pulmonary artery fistula.

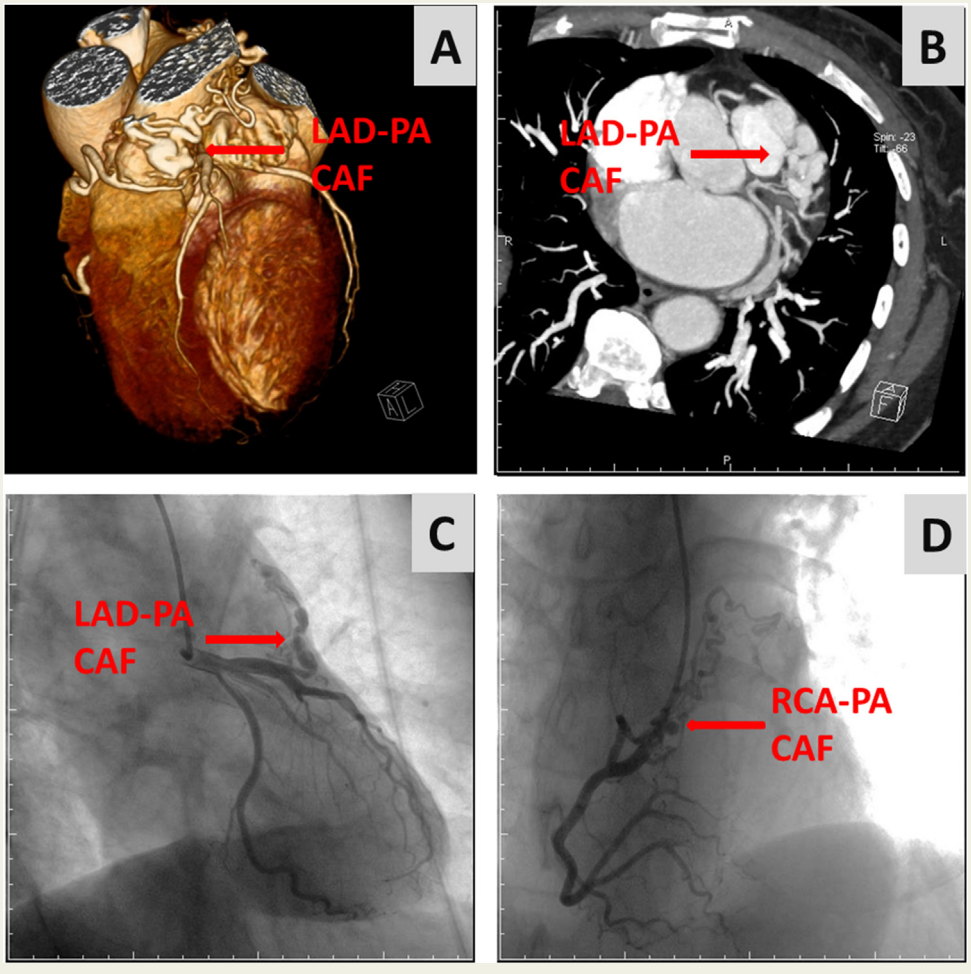

Figure 2 The diagnoses of coronary-pulmonary artery fistula (Red arrow). A,B: The images from multiple detector computed tomography; C,D: The images from coronary angiography.
Abbreviations: LAD, left anterior descending artery; PA, pulmonary artery; CAF, coronary artery fistula; RCA, right coronary artery.

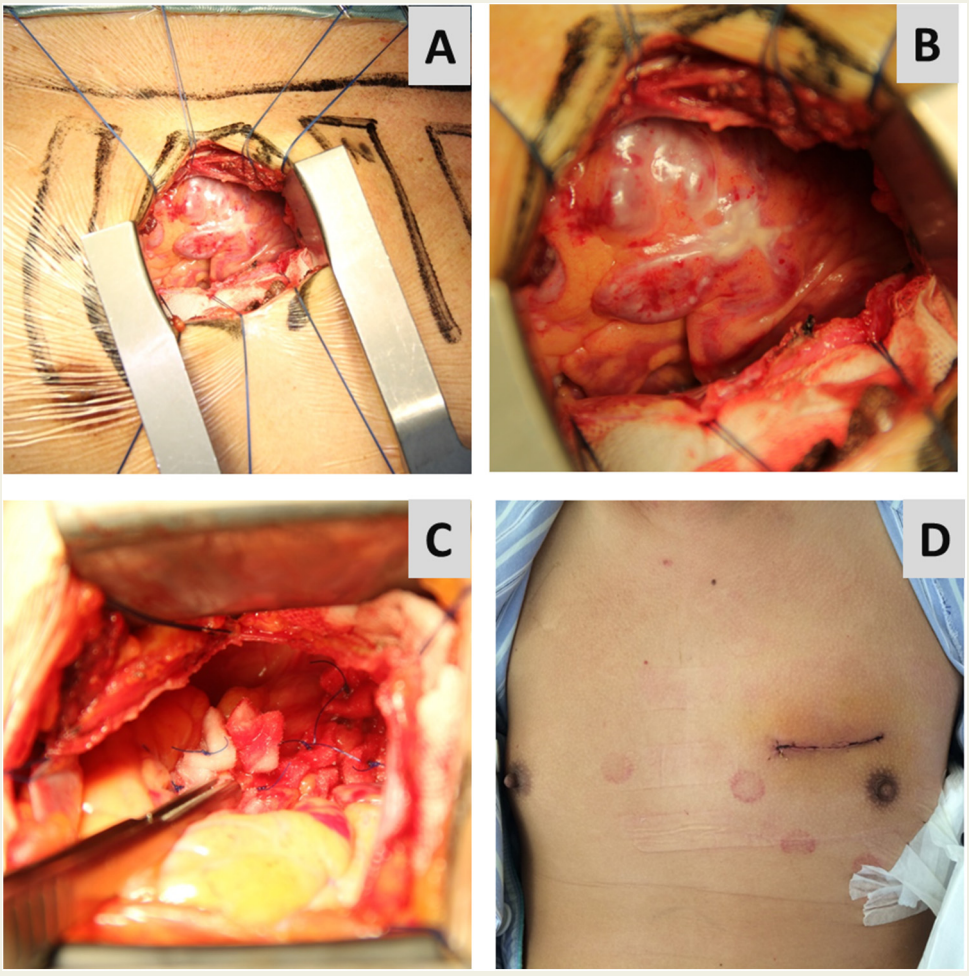

Figure 3 The graphics of minimally invasive surgery in coronary-pulmonary artery fistula. A, Left parasternal minithoracotomy incision on the third intercostal space; B, The coronary-pulmonary artery fistula was be revealed posterior or around to PA after dissection of pericardium; C, The image after ligation of the coronary-pulmonary artery fistula; D, Skin incision.

After ligating the CPAF, all patients were observed for 15 minutes before closing the incision. If the patient meets the following conditions, the ligation of CPAF will be considered to be successful: (1) No changes in the ST-T wave pattern or arrhythmia was found by the electrocardiograph monitoring. (2) The heart wall motion was normal by the evaluation of TEE through different views (ME 4-chamber, ME 2-chamber, and transgastric SAX views). (3) The fistula blood flow completely disappeared under TEE.

After the surgery, the patient recovered in the surgical intensive care unit. All the patients were extubated on the first postoperative day. No patient needed any inotropes or blood transfusion in the perioperative period. The postoperative course of the patient was uneventful. All patients were discharged from the hospital about 1 week after the surgery.

Postoperative echo Doppler showed the disappearance of the jet flow over the pulmonary artery. Postoperative CT angiography showed no remnant of the fistula after the ligation.

Comments

Minimally invasive cardiac surgical techniques have been used more and more for cardiac diseases. Current data has demonstrated that minimally invasive cardiac surgery provides several advantages for patients compared with conventional cardiac surgery [3]. However, as we know, the minimally invasive techniques have been used rarely in CAF. Here, we report our method of minimally invasive surgery for repairing CPAF.

The pulmonary trunk can be easily exposed by a parasternal minithoracotomy, because it is horizontal and centred around the third left chondro-sternal joint. Based on these anatomic landmarks, almost all of the coronary artery fistula would be repaired through this incision as long as the fistula drains into the pulmonary artery.

Transcatheter closure of CPAFs may be an alternative method to surgical closure, but some complications have been reported, such as device migration, thrombosis and

recanalisation. Moreover, fistulas with multiple communications were considered to be contraindications to transcatheter closure. Therefore, in our view, for quicker recovery and to be minimally invasive, this technique has an edge on conventional surgery. It can be an alternative to traditional surgical closure in some specific patients [4].

We performed the minimally invasive surgical procedure for repairing CPAFs through left parasternal minithoracotomy for 17 patients from July 2006 to June 2015. The median age was 19 years (range, 4 to 77 years) with 11 males (64.7%). Almost all of the patients had a history of dyspnoea, palpitation or dizziness and weakness. Sinus rhythm was shown in all patients' electrocardiograms, some with first-degree AV block and Q waves in leads V1-V2. Echocardiogram showed normal left ventricular function in 10 patients; meanwhile seven patients had low left ventricular ejection fraction with less than 60% at the time of operation. All the patients were diagnosed by TEE, CT angiography or cardiac catheterisation. There was no conversion to sternotomy and mortality.

The mean follow-up duration was 18.7 ± 5.8 months. No patient showed remnants of the fistula during the follow-up. All patients were asymptomatic. No complications of myocardial ischaemia and left ventricular dysfunction were detected as of last follow-up. Thence, our technique may be a safe, feasible, and effective method that may deserve further use for patients with CPAFs.

References

[1] Said SM, Dearani JA, Burkhart HM, Schaff HV. Surgical management of congenital coronary arterial anomalies in adults. Cardiol Young 2010;20 (Suppl. 3):68–85.

[2] Verdini D, Vargas D, Kuo A, Ghoshhajra B, Kim P, Murillo H, et al. Coronary-pulmonary artery fistulas: a systematic review. J Thorac Imaging 2016;31:380–90.

[3] Downs EA, Johnston LE, LaPar DJ, Ghanta RK, Kron IL, Speir AM, et al. Minimally invasive mitral valve surgery provides excellent outcomes without increased cost: a multi-institutional analysis. Ann Thorac Surg 2016;102(July (1)):14–21.

[4] Zhang Wen, Hu Renjie, Zhang Lei, Zhu Hongbin, Zhang Haibo. Outcomes of surgical repair of pediatric coronary artery fistulas. J Thorac Cardiovasc Surg 2016;152:1123–30.