

Application of Endovascular Occlusion of Both Caval Veins in Minimally Invasive Isolated Redo Tricuspid Surgery through Right Thoracotomy



Zhaolei Jiang^a, Ju Mei^{a*}, Fangbao Ding^a, Saie Shen^b, Jiaquan Zhu^a, Junwen Zhang^a, Hao Liu^a, Hang Yin^a

^aDepartment of Cardiothoracic Surgery, Xinhua Hospital, Shanghai Jiaotong University School of Medicine, Shanghai 200092, China

^bDepartment of Anesthesiology, Xinhua Hospital, School of Medicine, Shanghai Jiaotong University, Shanghai 200092, China

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Objective

To summarise the experiences of applying vena cava endovascular occlusion technique in minimally invasive isolated redo tricuspid surgery.

Methods

Forty-six consecutive patients received minimally invasive redo tricuspid surgery through right thoracotomy at our institute. All the patients had isolated significant tricuspid regurgitation after previous cardiac surgeries. Preoperative chest computed tomography showed high risk of conventional median sternotomy and vena cava exposure. A right anterolateral thoracotomy incision was made from the fourth intercostal space. The arterial cannula was placed in femoral artery, and balloon cannulas were used for bicaval cannulation. The venous cannulation was guided by transoesophageal echocardiography. Tricuspid valve operation was performed with heart beating after both venous cannulas were endovascularly occluded by inflating the balloons.

Results

There were no complications related to this cannulation technique. Two patients needed position adjustment or re-inflation of the balloon to obtain complete occlusion. The average time of cardiopulmonary bypass establishment was 55 ± 15 min and pump time was 58 ± 23 min. The length of stay was 8 ± 7 days. There was no early death in hospital.

Conclusion

Endovascular occlusion of both vena cava in isolated redo tricuspid surgery was safe, effective and reliable. This approach significantly simplified the complexity of the surgery.

Keywords

Endovascular occlusion • Minimally invasive surgery • Tricuspid regurgitation • Transoesophageal echocardiography • Cardiopulmonary bypass

Introduction

Some patients developed severe tricuspid regurgitation (TR) after previous cardiac surgeries. A redo tricuspid surgery was necessary for these patients [1–3]. However, dense adhesions underneath the sternum and around the caval veins increased

the risk of conventional sternotomy and caval veins exposure. In order to overcome these difficulties, we used a right anterolateral thoracotomy, and cannulated bicaval veins by endovascular occluder (Tyco™ tracheal tube) with the guidance of transoesophageal echocardiography (TEE). Here, we present our experience of this minimally invasive surgery.

*Corresponding author at: Department of Cardiothoracic Surgery, Xinhua Hospital, Shanghai Jiaotong University School of Medicine, 1665 Kongjiang Road, Shanghai 200092, China. Tel.: +86 021 25078031; fax: +86 021 25078042., Emails: ju_mei63@126.com, meiju003@163.com

Materials and Methods

Clinical Data

From 2002 to 2012, 46 consecutive isolated redo tricuspid valve operations were performed through a minimally invasive approach from right fourth intercostal space without aortic cross-clamping. All patients had isolated significant TR. The patients' clinical profile is shown in Table 1. Preoperative chest computed tomography manifestations showed that there were dense adhesions underneath the sternum and around the caval veins, which increased the risk of conventional redo sternotomy and cardiopulmonary bypass (CPB) establishment.

Surgical Technique

All patients were positioned supine with the right side elevated at 30°. A right anterolateral thoracotomy was performed through the fourth intercostal space. Arterial cannula was inserted from femoral artery. Under TEE guidance, the balloon cannulas (Tyco™ tracheal tube, Table 2)

Table 1 Clinical Profile.

No.	46
Age (year)	47.3 ± 15.1 (13–67)
Female	19 (41.3%)
Weight (kg)	59.2 ± 11.2 (39–75)
TR grade	
Severe	46
NYHA class	
I	0
II	15 (32.6%)
III	30 (65.2%)
IV	1 (2.2%)
Previous cardiac operation	
Once surgery	39 (84.8%)
MVR	11 (23.9%)
MVR + TVP	6 (13.0%)
MVR + AVR	3 (6.5%)
MVR + AVR + TVP	2 (4.3%)
TVP (Ebstein)	8 (17.4%)
TVP (isolated TR)	2 (4.3%)
VSD closure	6 (13.0%)
TOF correction	1 (2.2%)
Twice surgery	7 (15.2%)
(1) MVR; (2) TVP	2 (4.3%)
(1) VSD closure; (2) TVP	3 (6.5%)
(1) Blalock–Taussig shunt; (2) radical correction of tetralogy of fallot	2 (4.3%)

NYHA, New York Heart Association; MVR, mitral valve replacement; TVP, tricuspid valvuloplasty; AVR, aortic valve replacement; VSD, ventricular septal defect; TOF, tetralogy of fallot.

Table 2 Size of Tyco™ Tracheal Tube.

	Inside Diameter (mm)	Outside Diameter (mm)	Maximum Balloon Diameter (mm)
7Fr	7	9.6	36
7.5Fr	7.5	10.2	38
8Fr	8	10.9	40

were inserted through the surface both SVC and IVC without dissecting the adhesions around the vena cava. The size of cannula was selected according to the diameter of the vena cava and the weight of patient. When the weight was less than 60 kg, SVC selected 7Fr cannula and IVC selected 7.5Fr cannula. When the weight was more than 60 kg, SVC selected 7Fr cannula and IVC selected 8Fr cannula. The balloons of cannulas were inflated with normal saline to obtain the occlusion of SVC and IVC when nasopharyngeal temperature was about 32–33 °C. TEE was used to monitor the position or size of the intubation balloon and estimate the effect of endovascular occlusion (Fig. 1). Occasionally, we needed adjustment of the position or size of the balloon to make sure that the vena cava were occluded completely. When endovascular occlusion had been achieved, right atrium was opened and tricuspid valve surgery was performed with heart beating. After valve manipulation was finished, the balloons of venous cannulas were deflated and right atrium was closed.

Results

All the patients successfully underwent this minimally invasive redo tricuspid surgery. No patient needed to transit to conventional sternotomy. The tricuspid valve was repaired in 12 patients (annuloplasty ring) and replaced in 34 patients (27–31 mm mechanical valves). There were no CPB accidents or complications related to this technique during the operation. Two patients needed adjustment of the position or size of balloon with TEE guidance. The average time of operation was 161 ± 52 min. The average time for CPB establishment was 55 ± 15 min and the average pump time was 58 ± 23 min. Intraoperative TEE showed that all patients had only none to mild TR and there was no paravalvular leakage. The average length of stay was 8 ± 7 days. There was no in-hospital death. Postoperative complications included pleural effusion ($n = 3$) and acute renal dysfunction ($n = 2$).

Discussion

Minimally invasive approaches through a right thoracotomy have been used increasingly, which are mainly suitable for severe tricuspid valve lesions after previous cardiac surgery

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