

# An Unexpected Case of Difficulty in Weaning from Cardiopulmonary Bypass

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**Abstract:** Cardiopulmonary bypass is typically required for coronary artery bypass surgery, valve repair or replacement, congenital heart defect correction and cardiovascular operation. However, difficulty in weaning from cardiopulmonary bypass can increase mortality, which makes difficulties for the physicians. The cause of difficult weaning should be found, but sometimes it is difficult. The assessment by transesophageal echocardiography plays a central role in diagnosing and managing the cardiac operations patients. The early principal goal is the assessment of any findings that indicate a structural problem, which may require immediate surgical intervention. Herein, we presented a case of difficulty in weaning from cardiopulmonary bypass. A 53-year-old woman was admitted to our hospital due to fatigue and lower limb edema. The patient planned to undergo tricuspid bioprosthetic valve replacement under cardiopulmonary bypass due to the dysfunction of the tricuspid mechanical valve and the anticoagulant drugs being ineffective. During the cardiopulmonary bypass weaning process, hemodynamic instability occurred. Abnormal tricuspid regurgitation displayed by transesophageal echocardiography. After reopening the right atrium for testing, it was found that the mitral valve was occluded by gauze. Removing the gauze from the right atrium, it was successfully separated from cardiopulmonary bypass. Transesophageal echocardiography is important to accurately understand the clinical course of such complications.

**Keywords:** Cardiopulmonary Bypass, Transesophageal Echocardiography, Tricuspid Valve

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## 1. Introduction

Cardiopulmonary bypass (CPB) is usually required for coronary artery bypass surgery, valve repair and replacement, congenital heart defect correction and cardiovascular operation [1]. Due to abnormal cardiac structure or function, vasoplegic syndrome or ventricular dysfunction, a considerable number of cardiac surgery patients are often accompanied by difficulties in weaning from CPB, which can also increase perioperative complications and mortality [2-4]. In these cases, therapeutic decisions have to be taken quickly for successful separation from CPB. Various crisis management scenarios can be anticipated which emphasizes the importance of basic knowledge in applied cardiovascular physiology, knowledge of pathophysiology of the surgical lesions as well as leadership, and communication between multiple team members in a high-stakes environment. Since

the mid-90s, transesophageal echocardiography (TEE) has provided an opportunity to assess the completeness of surgery, to identify abnormal circulatory conditions, and to guide specific medical and surgical interventions. TEE is a visualization technique that can evaluate the circulatory system structurally and functionally, providing a basis for intraoperative cardiac diagnosis and treatment decisions, and effectively improving the safety of anesthesia and surgery [5-7].

In terms of pathophysiology and surgical management, the tricuspid valve has always received less attention than any other cardiac valve. The tricuspid valve is a part of the complex functional apparatus including the right atrium, right ventricle and pulmonary circulation [8]. Tricuspid regurgitation is a common and serious condition, but tricuspid valve surgery, that may be a valve replacement when a repair is not feasible, is rarely performed [9]. Herein, we present a case of redo-tricuspid valve replacement, difficulty in

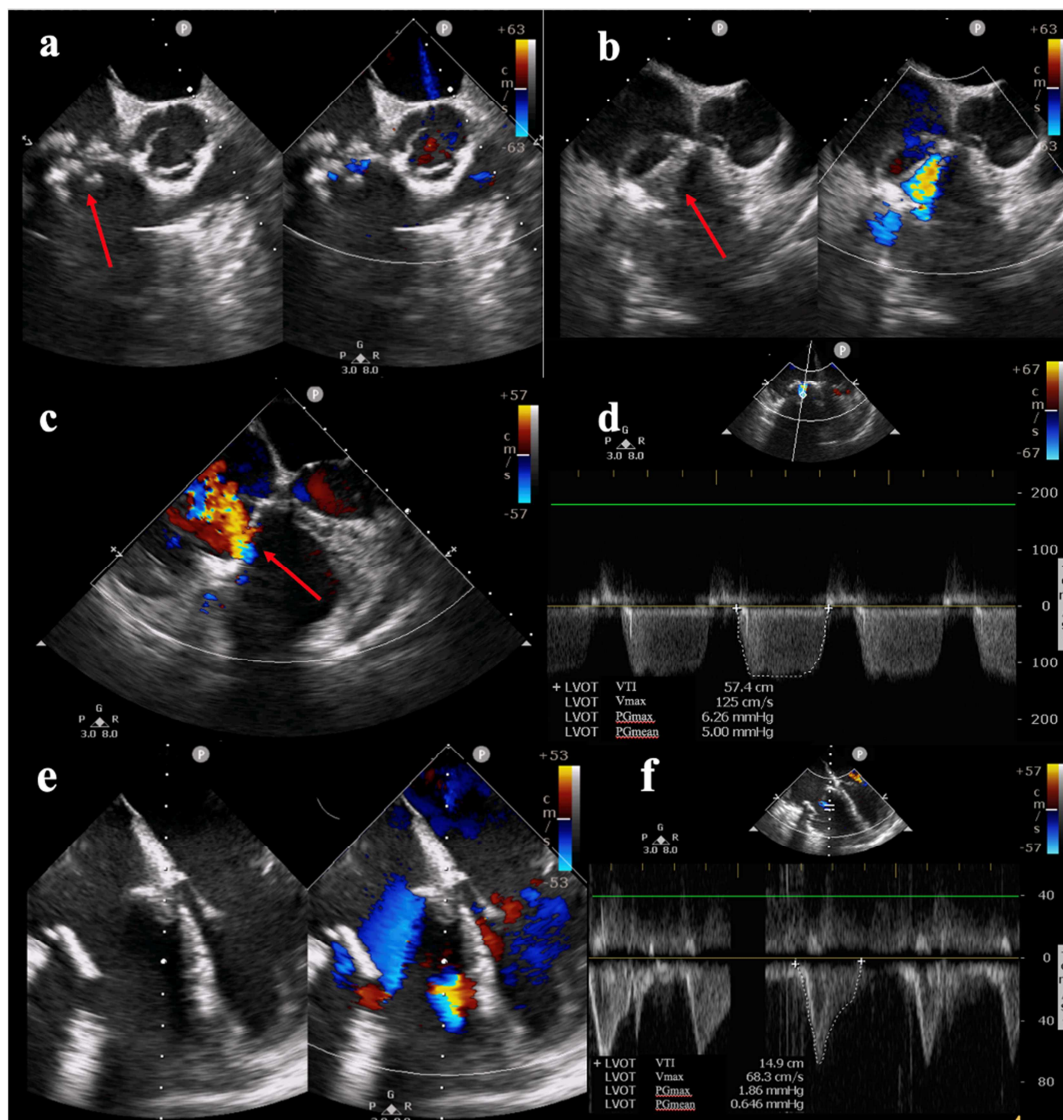
weaning from CPB. The assessment by TEE plays a central role in diagnosing and managing the clinical course of such complications.

## 2. Case Presentation

A 53-year-old woman was transferred to our institution with fatigue and lower extremity edema. She underwent mechanical tricuspid valve replacement 4 years ago for primary tricuspid valve disease. Echocardiography showed mechanical tricuspid valve dysfunction, with an anterior tricuspid valve velocity of 2 m/s and a mean pressure gradient is 9 mmHg. Due to the dysfunction of the tricuspid mechanical valve and the anticoagulant drugs being ineffective, the patient planned to undergo tricuspid bioprosthetic valve replacement under CPB. The original mechanical valve was removed and the tricuspid bioprosthetic valve was replaced. Intraoperative

exploration revealed extensive fibrous tissue proliferation around the mechanical tricuspid valve.

After tricuspid valve replacement, TEE showed the abnormal function of the prosthetic tricuspid valve (Figure 1a). Abnormal tricuspid regurgitation was found in the mid-esophageal four-chamber view (Figure 1b). The anterior blood flow velocity of the tricuspid valve was measured at 125 cm/s in the mid-esophageal RV inflow-outflow view (Figure 1c), and the mean pressure gradient was 5 mmHg (Figure 1d). After reopening the right atrium for detection, it turned out to be a piece of gauze left in the right atrium blocking the tricuspid orifice. After removing the gauze from the right atrium, the mid-esophageal four-chamber view showed that the tricuspid valve prosthetic valve functioned well, and no tricuspid valve regurgitation was found (Figure 1e), while the mean pressure gradient was 0.646 mmHg (Figure 1f).



**Figure 1.** a: TEE shows an abnormal image (red arrow) of the tricuspid valve position, and the prosthetic biological tricuspid valve is not clearly displayed. b: The forward flow velocity of the tricuspid valve is 125cm/s, and the opening of the tricuspid valve is unclear (red arrow). c: The blood flow spectrum shows the regurgitation of the tricuspid bioprosthetic valve. d: The maximum transvalvular pressure gradient of the tricuspid valve was measured to be 6.26 mmHg, and the mean pressure gradient was 5 mmHg. e: TEE shows the abnormal sound shadow of the tricuspid valve disappeared after removing the gauze. f: The maximum transvalvular pressure gradient of the tricuspid valve after the obstruction was 1.86 mmHg, and the mean pressure gradient was 0.646 mmHg.

### 3. Discussion

TEE is a relatively new imaging development. The main innovations of TEE occurred in 1970. Early staff had both Doppler technology and M-mode technology, which could be used through the esophageal pathway, but the most important development was the rigid, mechanical, two-dimensional echocardiography esophagoscopy in 1977. The establishment of TEE in perioperative cardiac anesthetic care has resulted in a significant change in the role of the anesthetist who, using TEE can provide new information which may change the course and the outcome of surgical procedures [3]. The accuracy of perioperative TEE in diagnosing structural abnormalities is quite high, producing reliable and reproducible results.

Separation from CPB after cardiac surgery is a gradual transition from complete mechanical circulation and respiratory support to spontaneous mechanical activity of the lungs and heart. During the separation phase, TEE provides a basis for the diagnosis and treatment decision-making process by measuring cardiac performance. The early principal goal is the assessment of any findings that indicate a structural problem, which may require immediate surgical intervention. Since 2010, both European and American Task Forces have recommended that TEE should be used in all elective and emergency cardiac operations unless contraindicated [10, 11]. In many cases, complex separation from CPB can be predicted, such as preoperative known left or right ventricle dysfunction, bleeding, hypovolemia, vascular paralysis, pulmonary hypertension, or due to surgical related technical complications. Prompt diagnosis and treatment decisions regarding mechanical or pharmacologic support have to be made within a few minutes. The assessment by TEE plays a central role in diagnosing and managing the patients [12, 13].

We summarized four contextual scenarios of weaning from CPB: (i) Structural abnormalities such as intracardiac shunt, valvular regurgitation, para-prosthetic leaks, or vascular bypass graft obstruction and occlusion [13]. (ii) Dynamic abnormalities such as left (or right) ventricular outflow tract obstruction [14]. (iii) Ventricular systolic dysfunction is characterized by depressed contractility, impairment in ventricular diastolic relaxation, or restrictive filling pattern, relatively insufficient and absolutely insufficient capacity. (iv) Vascular paralysis syndrome requires a normal or elevated cardiac output company to maintain ventricular function due to low blood pressure and systemic vascular resistance [15, 16]. Every year, over 1 million patients worldwide undergo cardiac surgery. Due to the aging population, cardiac surgery will increasingly be provided to patients with a higher risk of complications. These issues will have a significant impact on future healthcare costs, as the population undergoing cardiac surgery is older and more prone to postoperative complications. Real time monitoring of TEE is crucial for intraoperative management [17, 18]. A critical component of the intraoperative exam is clear communication of the echocardiographic findings to the surgical team. Advances in

intraoperative monitoring techniques aid the cardiovascular surgeon in patient management and, possibly, contribute to improved outcomes.

### 4. Conclusion

TEE is an essential component in the evaluation of surgical repair and its potential associated complications. We demonstrate a case of difficulty in weaning from CPB. It is due to gauze occlusion of the tricuspid valve. Intraoperative TEE has the potential to influence clinical decision making for cardiac surgical patients significantly. It is useful in surgical planning, guiding various hemodynamic interventions, and assessing the immediate results of surgery. Thus, TEE should be used routinely in patients undergoing cardiac surgeries.

### Conflict of Interest

The authors declare that there is no conflict of interest.

### Informed Consent

Informed consent was obtained from the patient for being included in the study.

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