Inverted Left Atrial Appendage during Minimally Invasive Mitral Valve Repair

Abstract

Inverted left atrial appendage (LAA) is a rare complication in cardiac surgery. The echocardiographic appearance often leads to misdiagnosis of thrombus or some other cardiac mass. Patients misdiagnosed in this way often undergo unnecessary anticoagulation or surgical treatment. Recently, minimally invasive mitral valve surgery (MIMVS) has become more widespread. However, as the incision for MIMVS through the right thoracotomy is very small, the inverted LAA is not within the surgical field of the cardiac surgeon. We present a case of inverted LAA during MIMVS and provide images from transesophageal echocardiography.

Keywords: *Inverted left atrial appendage, minimally invasive mitral valve repair, transesophageal echocardiography*

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Introduction

Inverted left atrial appendage (LAA) is an infrequent complication in cardiac surgery. The echocardiographic appearance often misleads anesthesiologists to diagnose thrombus or some other cardiac mass.

In minimally invasive mitral valve surgery (MIMVS) with small right thoracotomy, an inverted LAA cannot be directly confirmed by cardiac surgeon. In the present case, transesophageal echocardiography (TEE) revealed a hyperechoic structure in the left atrium during de-airing. However, after weaning from cardiopulmonary bypass (CPB), the hyperechoic structure disappeared. We thus finally diagnosed inverted LAA. Inverted LAA has been reported to be caused by excessive negative pressure through the ventricular vent tube. However, in this case, since no negative pressure was applied, we speculated that the etiology of inverted LAA could have involved expansion of the left lung due to high continuous positive airway pressure (CPAP), which facilitated visualization of the mitral valve, squeezing on the LAA. In the MIMVS, the risk of inverted LAA might need to be considered much more often than with median full-sternotomy cardiac surgery alone. Written consent for publication was obtained from the patient.

Case Report

A 51-year-old man (158 cm, 68 kg) with mitral regurgitation (MR) was scheduled for elective, minimally invasive mitral valve repair. Preoperative TEE showed severe MR due to prominent prolapse of the middle scallop of the posterior leaflet (P2) with torn chordae. The left atrium was dilated (left atrial diameter 36 mm). Left ventricular ejection fraction was 63%.

General anesthesia was induced with 5 mg of midazolam, 100 μg of fentanyl, 50 mg of rocuronium, and 0.2 μg/kg/min of remifentanil intravenously. A left-sided 35-Fr double-lumen tube was intubated, and the proper position was confirmed by bronchoscopy. After intubation, a TEE probe was inserted.

We placed a central venous catheter and pulmonary artery through the left internal jugular vein and a 16-Fr venous cannula through the right internal jugular vein for the superior vena cava drainage. Anesthesia was maintained with 1%–1.5% sevoflurane in oxygen and air and continuous infusions of remifentanil at 0.2–0.5 μg/kg/min and propofol at 3–4 mg/kg/h.

Right thoracotomy was made at the level of the fourth intercostal space in the left semi-lateral position. The femoral arteries were cannulated with a 20-Fr arterial cannula. Another 24-Fr venous cannula was placed inferior vena cava. The vent tube

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was inserted through the right superior pulmonary vein into the left ventricle. We confirmed that the tip of 24-Fr venous cannula and the vent tube was proper potion on TEE.

After establishing CPB, an antegrade cardioplegia cannula was inserted into the ascending aorta, and a flexible cross-clamp was subsequently applied. Myocardial protection was provided using mild systemic hypothermia (34°C), and antegrade cold blood cardioplegia was provided at 30-min intervals throughout the procedure.

After transseptal atrial approach, the plication of the posterior leaflet (P2) and reinforcement mitral annuloplasty with a 30-mm MEMO 3D mitral ring (Sorin Biomedica Cardio S.r.L., Saluggia, Italy) were performed. After declamping the aorta, dopamine infusion was started at 3 μg/kg/min. De-airing was performed by standard maneuver including manual cardiac agitation and conventional aspiration of the aortic root vent and left ventricular vent. During de-airing, TEE revealed a hyperechoic mass in the left atrium, which seemed to be adhering to the mitral ring, suggestive of atrial thrombus [Figure 1]. However, during CPB, activated coagulation time was maintained over 500 s and atrial thrombus seemed unlikely to have arisen under such conditions. Weaning from CPB was attempted, and as left atrial pressure increased, the hyperechoic mass disappeared from TEE [Figure 2]. We thus finally diagnosed this structure as an inverted LAA. Weaning from CPB was very smooth. After weaning, TEE showed no abnormal mass in the left atrium. The postoperative course has been uneventful, and the patient was discharged 7 days after surgery.

Discussion

The formation of a new left atrial mass postoperatively may be attributed to thrombosis or vegetation. Although vegetation is less likely in a patient immediately postoperatively, thrombus is a possibility. An inverted LAA is a rare cause of left atrial mass and is often misdiagnosed as pathologies such as left atrial thrombus or neoplasm.[1] Although inverted LAA appears to be a relatively benign surgical phenomenon, potential seems to exist for complications such as necrosis and rupture to lead to pericardial tamponade.[2]

An unusual area of blood clot formation and the absence of a long, tubular, pyramidal LAA shadow on echocardiography raise the index of suspicion for inverted LAA.[3] However, as accurate diagnosis is difficult to establish from echocardiography, surgery remains the gold standard for diagnosis in this region. In median full-sternotomy cardiac surgery, the cardiac surgeon can easily find that the LAA has become intussuscepted and inverted inside the left atrium. However, MIMVS uses a small right anterolateral incision. This approach allows easy access to the mitral valve because the mitral valve lies in an annular plane approximately in the sagittal plane of the body. However, the left ventricular apex, LAA, and other such structures on the left side of the heart cannot be observed in this small surgical field.

Inverted LAA may be caused by excess negative pressure created by the left ventricular vent or during evacuation of air performed by digital insertion intraoperatively.[4] In MIMVS, manual digital procedures by the cardiac surgeon to evacuate air cannot be performed due to the small surgical filed. In the present case, since the tips of the left ventricular vent were located in the left ventricular apex and excessive negative pressure was not applied, the mechanisms leading to inverted LAA remain unclear. However, in MIMVS, one technique is left lung continuous expansion, usually involving the delivery of high CPAP, pressing the heart in a rightward direction to enhance exposure of the mitral valve. As a result, we speculated that the etiology of the inverted LAA in this case could have involved expansion of the left lung due to high

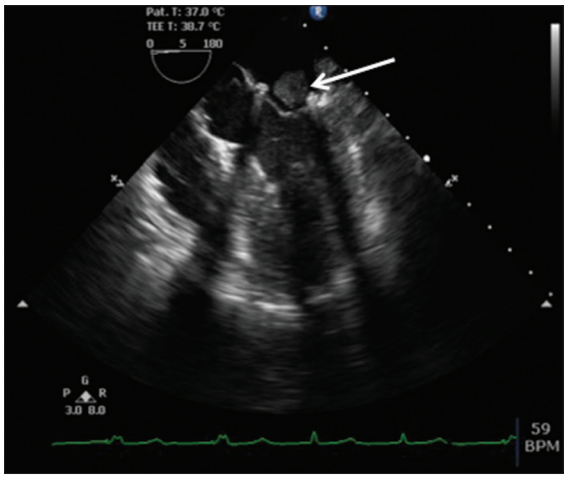

Figure 1: Intraoperative transesophageal echocardiography shows a hyperechoic structure adhering to the mitral annulus (white arrow)

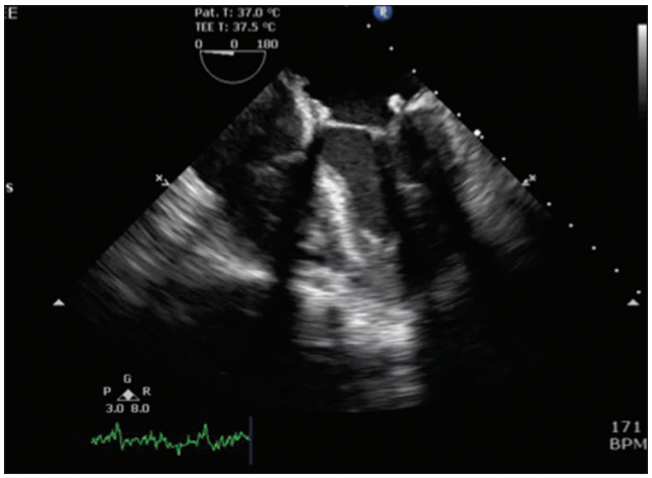

Figure 2: Intraoperative transesophageal echocardiography shows a disappearance of hyperechoic structure after left atrium filling

CPAP squeezing on the LAA. Only one case report has described inverted LAA induced by external pressure due to massive pericardial effusion.[5] Similarly, in the present case, compression of the LAA by the left lung expanded under high CPAP could have provided the mechanism for inversion.

The optimal treatment of inverted LAA remains unclear, given the scarcity of this pathology. During the cardiac surgery, after weaning from CPB, the blood volume returned from the CPB circuit to the heart, and LA pressure subsequently increased gradually to normal levels, and the LAA reverted to the normal position. If this attempt had proven unsuccessful, the valsalva maneuver would have been applied to transiently increase LA pressure markedly beyond normal LA pressure. Sustained intussusception of the LAA even after Valsalva maneuver might have warranted further surgical intervention.

Conclusion

Inverted LAA is a rare phenomenon but should be considered in cases in which a cardiac mass is newly identified postoperatively. In the MIMVS, the cardiac surgeon will not see the intussusception of the LAA directly through the surgical field. Moreover, delivery of CPAP to the left lung as a means of obtaining better visualization of the mitral valve could lead to inverted LAA. Intraoperative TEE is useful to detect inverted LAA and facilitate rapid correction of this complication.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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