# Ultrasound Visualization of the Left Circumflex Artery by Direct Endocardial Scanning of the Mitral Annulus during Surgery

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The left circumflex coronary artery is susceptible to injury during mitral valve surgery because of its proximity to the mitral annulus[1]. Recent studies showed that the circumflex artery can be visualized in most patients by transesophageal echocardiography (TEE)[2]. Even so, prevention of iatrogenic injury seems difficult with this modality[2]. We describe our experience of visualization of the circumflex artery by direct endocardial scanning of the mitral annulus with a high frequency ultrasound probe during surgery. This technique may facilitate safe surgery in cases anatomically susceptible to iatrogenic injury.

Clinical Presentation

The patient was a 57-year-old man who had severe mitral regurgitation caused by anterior leaflet prolapse. In the operating room, a transesophageal echo probe (X7-2t transducer, EPIQ 7 ultrasound system; Philips, Amsterdam) was inserted, and an L-shaped high frequency linear-array ultrasound probe (L15-7io transducer, EPIQ 7 ultrasound system; Philips) was prepared in a clean probe cover on the surgical field for direct epiaortic ultrasound scanning. This procedure was routine.

During pre-pump evaluation by TEE, the echo-cardiographer realized that the circumflex artery appeared to be running close to the mitral annulus in a part (Figure

1). The surgeons were notified, and blindly placing sutures for annuloplasty was felt to be dangerous. We had experience in visualizing epicardial coronary arteries using the probe for epiaortic ultrasonography[3]; therefore, we thought it would be possible to visualize the artery by direct scanning of the mitral annulus. We decided to do that before placing sutures. The surgery was performed via median sternotomy. After opening the left atrium by left atriotomy, cold saline was infused. The depth was set at 2.5cm, and the dynamic range was set at 60; the probe was inserted into the left atrium (Figure 2A). The mitral annulus was scanned from the anterolateral commissure to P2, perpendicular to the annulus. The circumflex artery was visualized at higher resolution (Figure 2B). Identification of the circumflex artery was confirmed by administrating an additional dose of cardioplegia from the aortic root. The left ventricular cavity was identified as a cavity filled with fluid. The posterior mitral valve leaflet was identified as a floating thin structure (Video). The mitral annulus was identified as the attachment part of the mitral leaflet to the left ventricular myocardium. We measured the distance between the artery and the mitral annulus. The distance at the narrowest point was 3 mm; thus we believed that annuloplasty could be performed safely if the sutures were carefully placed.

The mitral valve was repaired by chordal replacement to the anterior leaflet and ring annuloplasty with a semi-rigid ring (Physio 2, Edwards Life Science; Irvine, CA). 2-0

mattress sutures for ring implantation were carefully placed just at the mitral annulus where the circumflex artery was close. Special care was taken to place the needle perpendicular to the atrial surface towards the left ventricular apex. The patient did not have any clinical problems thereafter, and post-repair TEE evaluation revealed the circumflex artery to be intact.

## Discussion

The left circumflex coronary artery is susceptible to injury during mitral valve surgery [1]. Its risk of being damaged during the Cox maze procedure has also been pointed out[4]. Ender et al. reported that the circumflex artery could be visualized in 99% of patients by TEE[2]. Although TEE was useful for early detection of injury in mitral valve repair patients[2], three cases of iatrogenic injury among 110 patients were reported, suggesting that injury prevention was difficult even when using TEE[2].

We have successfully visualized the left circumflex artery by direct endocardial scanning of the mitral annulus in cases in which TEE showed the circumflex artery to lie in close proximity to the annulus. Uncomplicated mitral valve repair had been completed. Images of higher resolution can be obtained by this method than by TEE, and the artery can be located while directly watching the position of the ultrasonographic probe on the

mitral annulus. This technique may be helpful to facilitate safe surgery in patients with susceptible anatomy to iatrogenic injury at the time of mitral valve surgery and the Cox maze procedure. We are now conducting a feasibility study to confirm the reproducibility of this technique. One limitation of this technique is a definite learning curve, which we realized as we gained experience.

To the best of our knowledge, this is the first report of ultrasound visualization of the circumflex artery by direct endocardial scanning of the mitral annulus.

Conclusion

We described ultrasound visualization of the left circumflex artery by direct endocardial scanning of the mitral annulus during surgery.

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Figure 1

Image of intra-operative transesophageal echocardiography before repair.

The left circumflex artery runs close to the mitral annulus. LCx, left circumflex artery; CS, coronary sinus; LA, left atrium; LV, left ventricle.

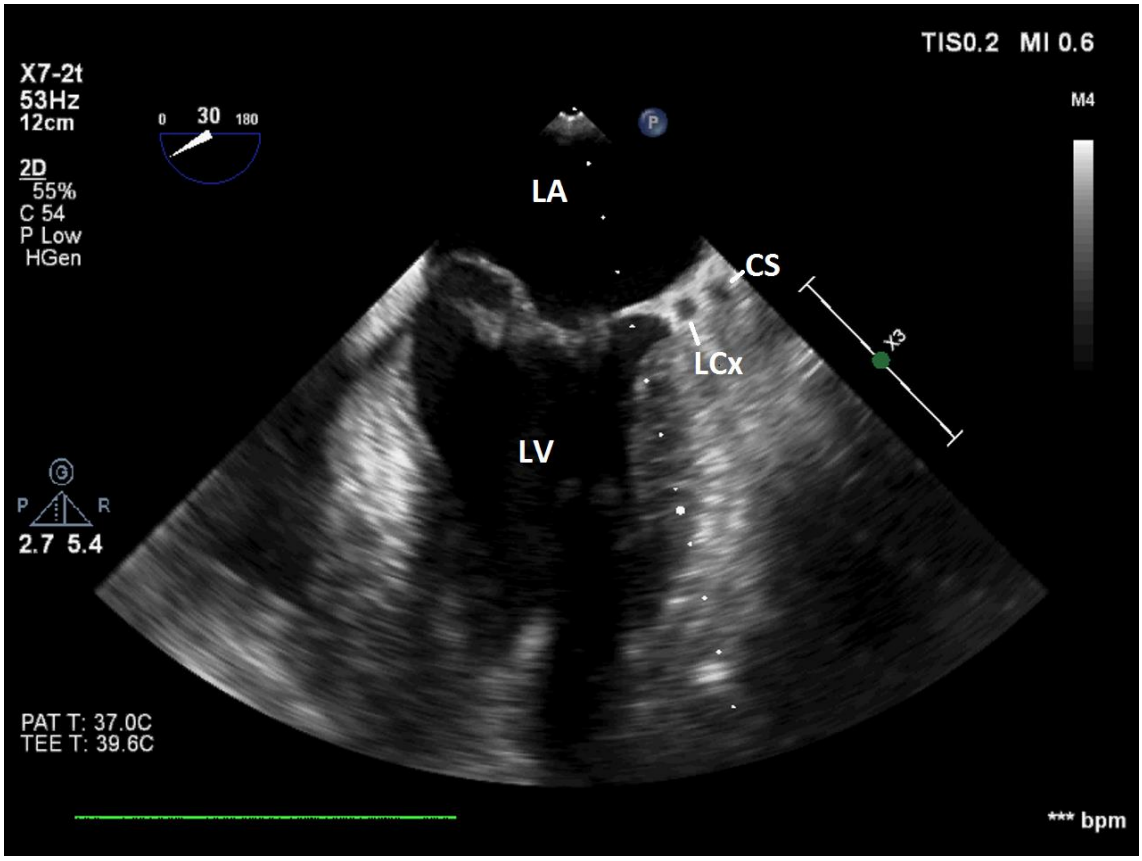


Figure 2A

Intraoperative picture. An L-shaped high frequency linear-array ultrasound probe (black arrow) was inserted in to the left atrium, and the mitral annulus was scanned.

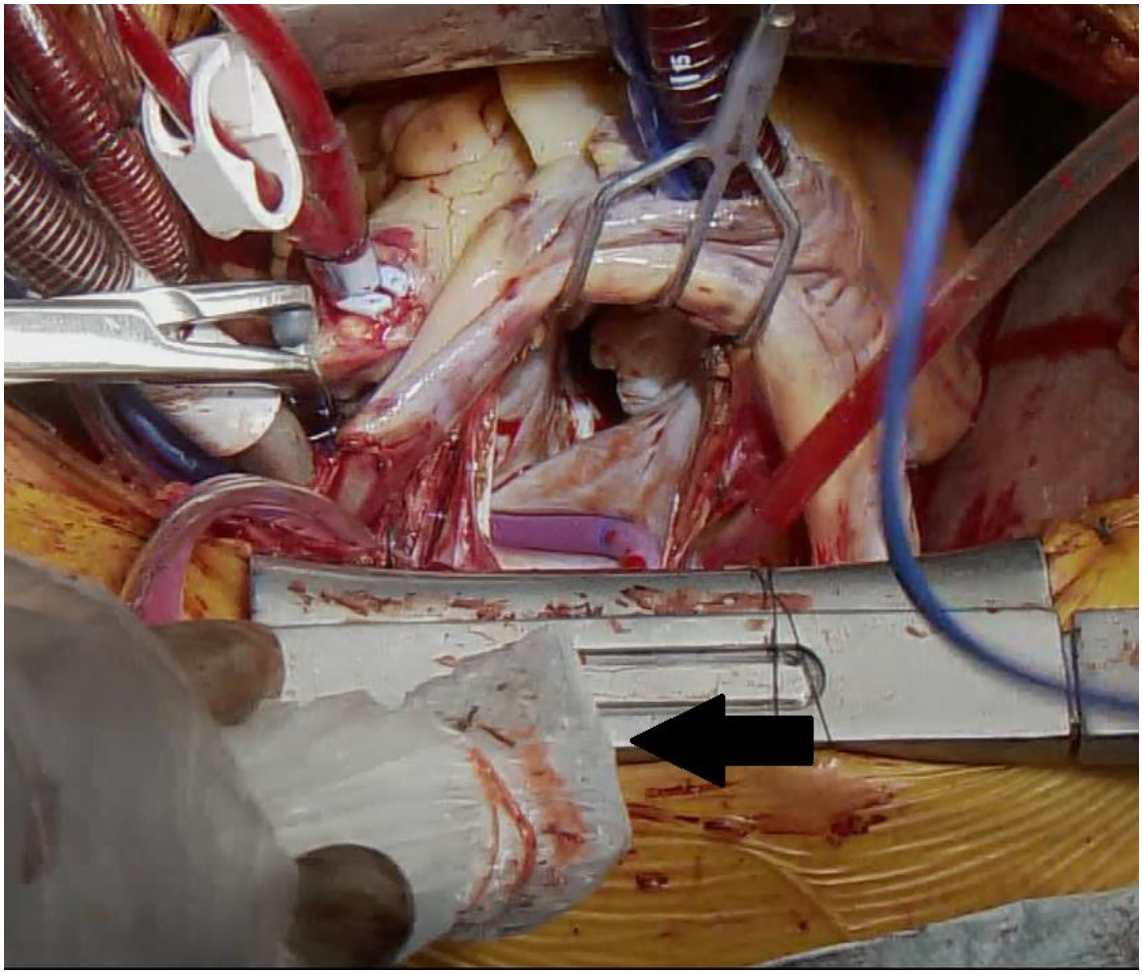
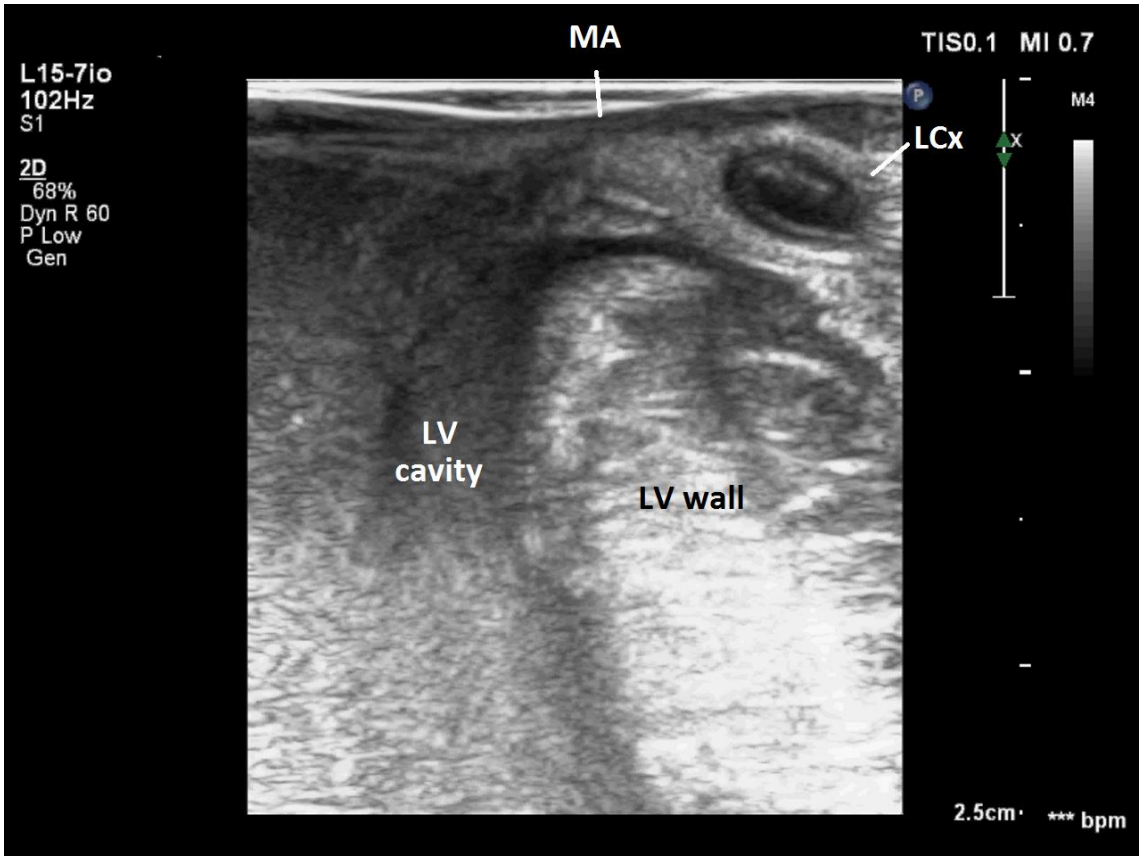


Figure 2B

Intra-operative image of endocardial ultrasonography by direct scanning of the mitral annulus.

The left circumflex artery is clearly visible. The distance between the mitral annulus and the circumflex artery was 3mm at the narrowest point. LCx, left circumflex artery; LV, left ventricular cavity; LV wall, left ventricular wall; MA, mitral annulus.




Video

An intraoperative video clip showing direct endocardial ultrasonography of the mitral annulus. The posterior mitral leaflet is the floating structure in the left ventricular cavity.