Hyperdynamic Left Atrial Appendage May Increase the Risk of Perforation During Left Atrial Appendage Closure– A Case Series

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Abstract

Introduction: Delayed pericardial effusion following WATCHMAN FLX implantation is not well understood. We present a case series of two patients with hyperdynamic left atrial appendages (LAA) who developed delayed pericardial effusions following WATCHMAN FLX implantation. Methods: Successful left atrial appendage closure was performed in 2 patients with paroxysmal atrial fibrillation using the WATCHMAN FLX device. Both patients had hyperdynamic left atrial appendages noted during their procedures. Intra-procedure course was uncomplicated. Results: Delayed pericardial effusion occurred necessitating drainage in both cases. Conclusion: While exact mechanisms remain unclear, sinus rhythm and the presence of a hyperdynamic LAA may play a role. Understanding the interaction of the appendage and the delivery system may help to reduce the likelihood of this rare, but serious, complication. Keywords: Atrial fibrillation; Left Atrial Appendage Closure; Pericardial Effusion; Pericardiocentesis.

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Introduction

Left atrial appendage closure (LAAC) is increasingly utilized to mitigate stroke risk in patients unable to tolerate anticoagulation. Serious complications from LAAC with the WATCHMAN device are rare. According to the NCDR registry, major in-hospital adverse events occur in only 2.16% of cases and 1.39% of these events were due to pericardial effusion requiring intervention (1). To date, there have been no reported risk factors for pericardial effusion development following LAAC. In the PINNACLE FLX trial, there were no acute pericardial effusions requiring drainage within the first 7 days from WATCHMAN FLX device implant; however, 3 patients required pericardiocentesis between 7 and 45 days (2). We present a case series of two patients with hyperdynamic left atrial appendages who developed pericardial effusions following WATCHMAN FLX implantation.

Case Series

Case Report 1

The first patient was a 90 year-old female with multiple medical issues including recent transcatheter aortic valve replacement (TAVR) and paroxysmal atrial fibrillation (AF) on Warfarin and Aspirin, who had recent gastrointestinal bleeding and was referred for LAAC. Her CHA_2DS_2-VASc score was 4. Cardiac CTA indicated LAA ostial dimensions of 2.0 x 2.4 cm with an ostial area of 3.88 cm^2. With the use of WATCHMAN TruPlan simulation software (Boston Scientific) a 27 mm WATCHMAN FLX device was chosen with a double curve delivery sheath.

The patient was in sinus rhythm at the time of the procedure and contrast injection into the appendage was notable for hyperdynamic contractile function (Figure 1). Intracardiac echocardiography (ICE) was used for successful deployment of a 27 mm WATCHMAN FLX with 20% compression. No device recapture was performed. Post-procedure TTE displayed a small pericardial effusion that appeared unchanged from pre-procedural imaging. Transthoracic echocardiogram (TTE) performed 6 hours post-procedure showed the size of the effusion to be unchanged (Figure 2). Warfarin was not restarted, but the patient was continued on Aspirin.

On post-operative day 1, the patient developed AF with rapid ventricular response and reported severe pleuritic chest pain. Repeat TTE demonstrated interval increase in the size of the effusion (now moderate-sized) without tamponade physiology. She was managed with amiodarone and colchicine. Surveillance echocardiograms performed over the ensuing days demonstrated slow continued expansion of the pericardial effusion, and decision was made for drainage. Due to the posterior location of the effusion, the patient underwent a surgical approach with removal of 500cc of dark bloody fluid on post-operative day 7. Follow-up echocardiogram did not demonstrate significant fluid re-accumulation. The patient was restarted on Warfarin and discharged three days after her surgical window. Repeat CTA at 45 days post-implant demonstrated no

evidence of device-related thrombus (DRT) and no leak through the device. The patient was transitioned to aspirin and clopidogrel and has done well upon clinical follow up.

Case Report 2

The second patient was a 62 year-old female with persistent AF despite prior radiofrequency pulmonary vein isolation ablation, hypertension, thoracic ascending aortic aneurysm, transient ischemic attack, morbid obesity, hypercholesterolemia, and peptic ulcer disease. Her CHA_2DS_2-VASc score was 4. She had suffered a fall as well as severe uvular bleeding following a transesophageal echocardiogram (TEE) necessitating discontinuation of rivaroxaban. She was thus referred for LAAC.

Pre-procedural TEE imaging was notable for a LAA emptying velocity of approximately 90cm/s (Figure 3). Cardiac CTA indicated LAA ostial dimensions of 2.9 x 1.5 cm with an ostial area of 3.07 cm^2. With the use of WATCHMAN TruPlan simulation software, a 20 mm WATCHMAN FLX device was chosen with a double curve delivery sheath. Transseptal puncture was obtained with ICE as well TEE imaging under general anesthesia. Contrast imaging revealed a hyperdynamic LAA. The device was implanted with a single deployment and with 18% compression. No pericardial effusion was noted on post-implant TEE or ICE. Following the procedure, the patient underwent a bedside point-of-care TTE, which also did not show a pericardial effusion.

Approximately 12 hours following the procedure, the patient developed shortness of breath and chest pain and presented to a local emergency department for further evaluation. She was found to have inferior ST-segment elevation and a troponin of 0.11 ng/mL. Coronary angiography was unremarkable but chest CTA demonstrated a large pericardial effusion. She was started on intravenous fluids and norepinephrine due to hypotension and transferred to our institution where TTE confirmed cardiac tamponade (Figure 6). Emergent pericardiocentesis removed 400 mL of bloody fluid, resulting in improvement in her systolic blood pressure from 110 mmHg to 150 mmHg. Her pericardial drain was removed after 3 days. The patient was treated with colchicine and restarted on rivaroxaban which she had not resumed. The pericardial effusion did not recur, and she has been able to resume her normal baseline activities.

Discussion

Acute pericardial effusion and tamponade during deployment is a recognized though uncommon complication of LAAC. The incidence of pericardial effusion in both the EWOLUTION registry and the Boston Scientific manufacturer-compiled registry is less than 1%, significantly lower than reported in the original trials (3,4). Delayed pericardial effusion after LAAC is even less common (5). Regardless of timing, such effusions can lead to cardiac tamponade and even death. Avoidance and recognition of procedurally-related pericardial effusion are imperative to the LAAC operator.

As far as we know, this is the first case series to report delayed pericardial effusion following LAAC with WATCHMAN FLX. The mechanism in both of these cases was likely microperforation during implantation. One plausible explanation would be that the J-shaped fixation anchors of the WATCHMAN FLX device caused appendage microperforations during the procedure, an etiology that has been theorized in the PINNACLE FLX trial (2). In both cases presented, the patient was in sinus rhythm at the time of the procedure and noted to have a hyperdynamic left atrial appendage on contrast injection. We hypothesize that this hyperdynamic state may have caused increased anchor tissue engagement leading to appendage microperforation.

The appearance of "auto-tug"—where the core wire moves automatically back and forth within a loosened hemostatic valve—is not an uncommon finding noted prior to WATCHMAN release. Tightening the hemostatic valve on the core wire in this situation may put strain upon the appendage, especially in the setting of a hypermobile or hyperdynamic appendage, causing the anchors to repeatedly pull upon appendage tissue. Therefore, we recommend loosening the hemostatic valve from the core wire, allowing the core wire to move freely in these situations until device release. When the "tug test" is performed, it should be performed very gently. Though the exact mechanism of microperforation is not well understood, attention to the inter-

action of the WATCHMAN device, delivery system, and the appendage may help to reduce the chance of inadvertent appendage perforation.

Conclusion

We report a small case series of delayed pericardial effusion following LAAC. While mechanisms are still unclear, sinus rhythm and in particular the presence of a hyperdynamic LAA may play a role. Understanding the interaction of the appendage and the delivery system may help to reduce the likelihood of this rare, but serious, complication.

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FIGURE LEGEND

Figure 1: Panels A and B. Left atrial appendage angiography demonstrating hyperdynamic appendage contractility.

Figure 2: Panel A. Transthoracic echocardiogram (TTE) prior to the procedure displaying small pericardial effusion.**Panel B.** Transthoracic echocardiogram (TTE) after the procedure displaying the effusion unchanged. **Panel C.** Transthoracic echocardiogram (TTE) 1 day after the procedure displaying moderate-sized effusion. **Panel D.** Transthoracic echocardiogram (TTE) 7 days after the procedure displaying large posterior pericardial effusion.

Figure 3: Left atrial appendage emptying velocity

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