

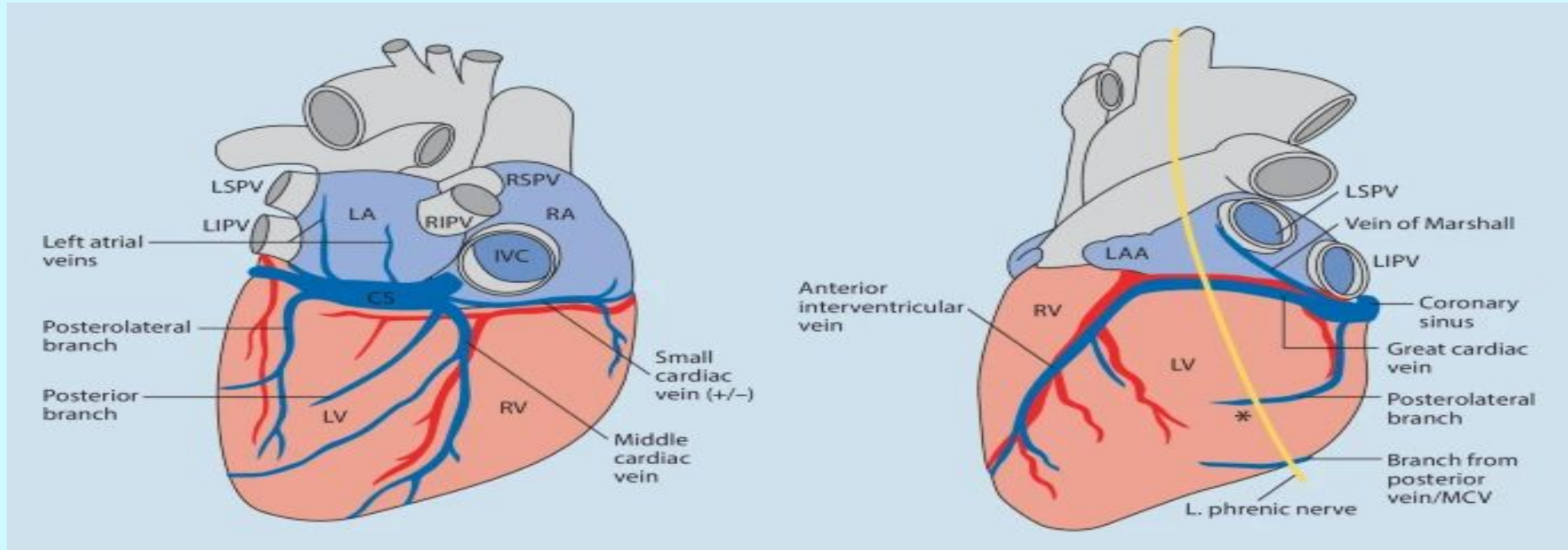
Sounding the Alarm: Anesthetic Recognition of Coronary Sinus Perforation in the Electrophysiology (EP) Lab
Diamond Clough MD, Vlad Frenk MD, FASA

Department of Anesthesiology, F.H.Netter MD School of Medicine, Quinnipiac University, St.Vincent’s Medical Center



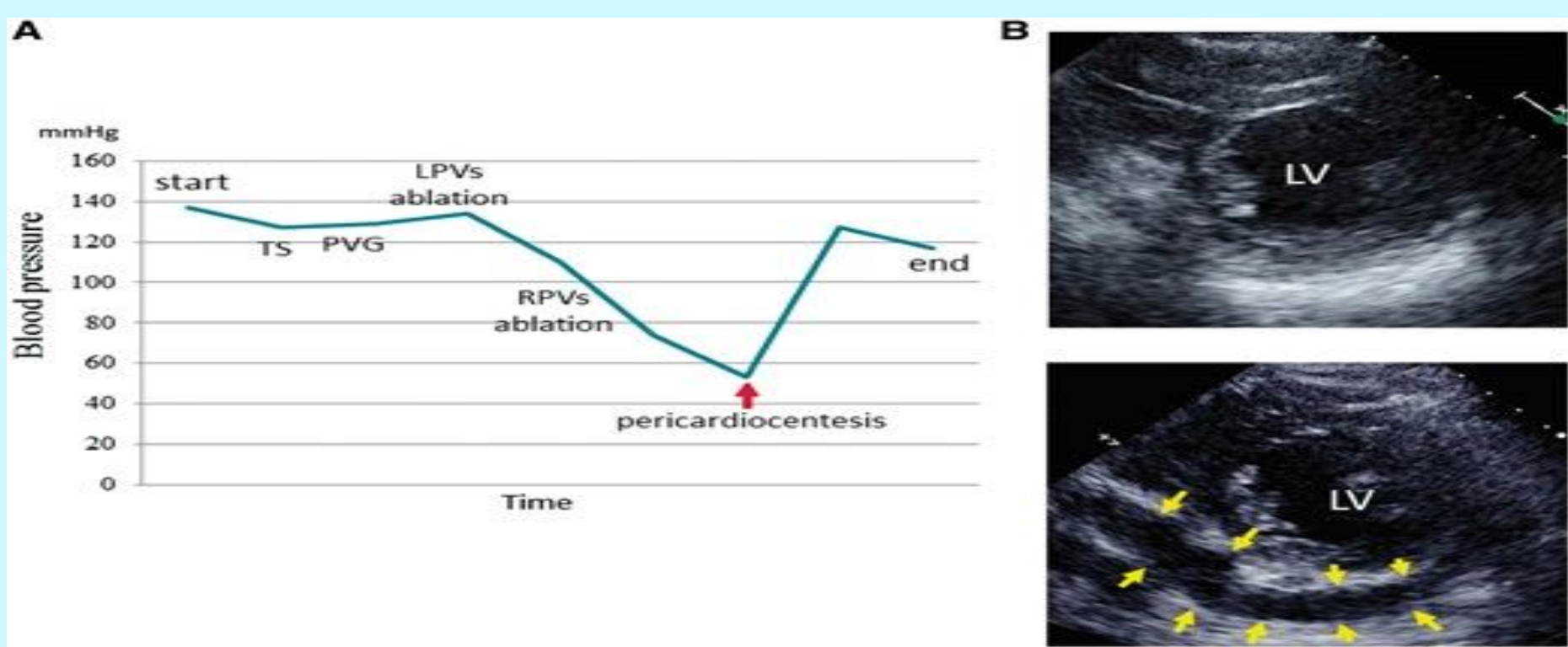
CASE DESCRIPTION

37 year old man was undergoing atrial fibrillation and supraventricular tachycardia ablation in the electrophysiology lab. During the case, there was a sudden desaturation with drop in end-tidal CO2 and difficulty ventilating, followed by profound hypotension on the arterial-line tracing. The anesthesia team communicated a request for CPR. CPR initiation was delayed due to cardiology-related factors. The EP team identified pericardial blood and planned for pericardiocentesis, which was prolonged secondary to difficulty finding equipment and difficulty with access, necessitating the presence of a second provider. The patient was eventually placed on ECMO and transferred to a higher level of care facility. A coronary sinus perforation was identified in the operating room and repaired. Unfortunately, the patient sustained an anoxic brain injury and did not survive despite aggressive resuscitation and surgical efforts.



Coronary sinus perforation					
Location	Main vessel		Bifurcation		Distal
Causes	– Overstretch during device deployment – Scaffold manipulation – Guidewire tip perforation		– Overstretch during device deployment – Scaffold manipulation – Guidewire tip perforation		– Guidewire tip perforation
Treatment	Perforation		Perforation		Perforation
	Small	Large	Small	Large	Small
	– Balloon inflation – Protamine – Repeat angiogram If haemostasis is not achieved: – PTFE-covered stent – Surgery	– PTFE-covered stent – Surgery	– If haemostasis with balloon inflation is feasible consider percutaneous management – If haemostasis with balloon inflation is not feasible consider surgery	– Surgery	– Protamine – If haemostasis is not feasible consider surgery
					Large
					– Surgery

Proposed algorithm for coronary sinus perforation management.



DISCUSSION

Surgical Procedure: Atrial fibrillation and supraventricular tachycardia ablation

Cardiac perforation with rapid hemopericardium and tamponade is a feared acute complication of catheter ablation procedures because it can progress from a subtle physiologic change to cardiovascular collapse in minutes. Early recognition, which is often signaled by sudden unexplained drop in end-tidal CO2, difficulty ventilating, rapid hypotension (arterial line), rising airway pressures, or new desaturation, must trigger a specific, rehearsed team response to avoid delayed resuscitation and escalation. In multidisciplinary EP environments, the margin for error is small and delays in communication, locating equipment (in this case, pericardiocentesis kit and lines for central access) or initiating cardiopulmonary resuscitation (CPR) and pericardial decompression directly increase the risk of persistent low cerebral perfusion, need for cardiopulmonary bypass (CPB)/ECMO, and poor neurologic and survival outcomes.

SUCCESSFUL RESCUE HINGES ON THREE PARALLEL ACTIONS PERFORMED QUICKLY AND IN COORDINATION:

- 1. Immediate recognition and clear announcement of the emergency (e.g., “tamponade — pericardial effusion — need pericardiocentesis and surgical backup”) so the whole room shares the same mental model.
- 2. Rapid temporizing maneuvers to restore perfusion (CPR per ACLS if indicated, high-flow IV access, vasopressors, reversal of anticoagulation when appropriate) while preparing for decompression. Most centers report routine use of protamine to reverse heparin if tamponade with active bleeding is suspected; this must be balanced against thrombotic risks and the procedural context.
- 3. Definitive pericardial decompression under imaging guidance (echo/fluoroscopy is optimal) using micro-puncture technique, guidewire, and pigtail drain for ongoing drainage ± autotransfusion. If pericardiocentesis is difficult or bleeding is uncontrolled, early activation of cardiothoracic surgery and escalation to CPB or ECMO is lifesaving. Delaying surgical involvement because of attempts to keep the case in-lab can cost precious minutes.

WHAT SHOULD BE DONE IN THE EP LAB WHEN PERFORATION/TAMPONADE IS SUSPECTED — PRACTICAL CHECKLIST

Immediate (first 60–90 seconds):
Verbally announce the diagnosis loudly and clearly: “Suspected cardiac perforation/tamponade”. If ventilating is difficult / ETCO2 drops and BP falls, begin high-quality CPR immediately per ACLS if pulseless — don’t delay compressions awaiting other tasks. Early CPR preserves cerebral perfusion.

Pericardial decompression
Prepare pericardiocentesis tray (micro-puncture needle, echogenic needle, guidewire, peel-away sheath, pigtail catheter, 3-way stopcocks, suction/collection and autotransfusion set). If pericardiocentesis not rapidly successful or bleeding is ongoing/large, call cardiothoracic surgery and consider immediate transfer to OR or initiation of CPB/ECMO. Do not delay surgical involvement.

Systems-level recommendations (to prevent delays)
Maintain a dedicated, labeled pericardiocentesis/emergency kit in every EP lab (micro-puncture set, pigtails, long needles, drainage bags, sterile ultrasound probe cover). Staff should confirm kit presence on daily startup checklist.

Predefine and rehearse escalation triggers (when to call CT surgery, when to move to OR/activate CPB/ECMO). Run periodic multidisciplinary simulation drills that include rare catastrophic complications (perforation/tamponade with arrest), and debrief to capture latent safety threats (equipment location, communication gaps).

References

- Metzner A, et al. Management of pericardial tamponade in the electrophysiology laboratory (review). *Europace/ Springer reviews* (2022–2024). — overview on recognition, reversal of anticoagulation, echo/fluoro guidance, and need for surgical backup.
- Tokuda M, et al. Outcomes of cardiac perforation complicating catheter ablation. *Circ Arrhythm Electrophysiol* 2011 — epidemiology and outcomes after perforation during AF ablation.
- Hamaya R, et al. Management of cardiac tamponade in catheter ablation (large series). *Europace* 2018 — incidence, institutional management patterns, outcomes.
- IAC / EP lab standards (Inter-societal Accreditation Commission & HRS / Heart Rhythm Society guidance), requirements for personnel competency, emergency equipment, surgical backup.