

Endocardial biventricular defibrillator implantation in a patient with superior vena cava obstruction

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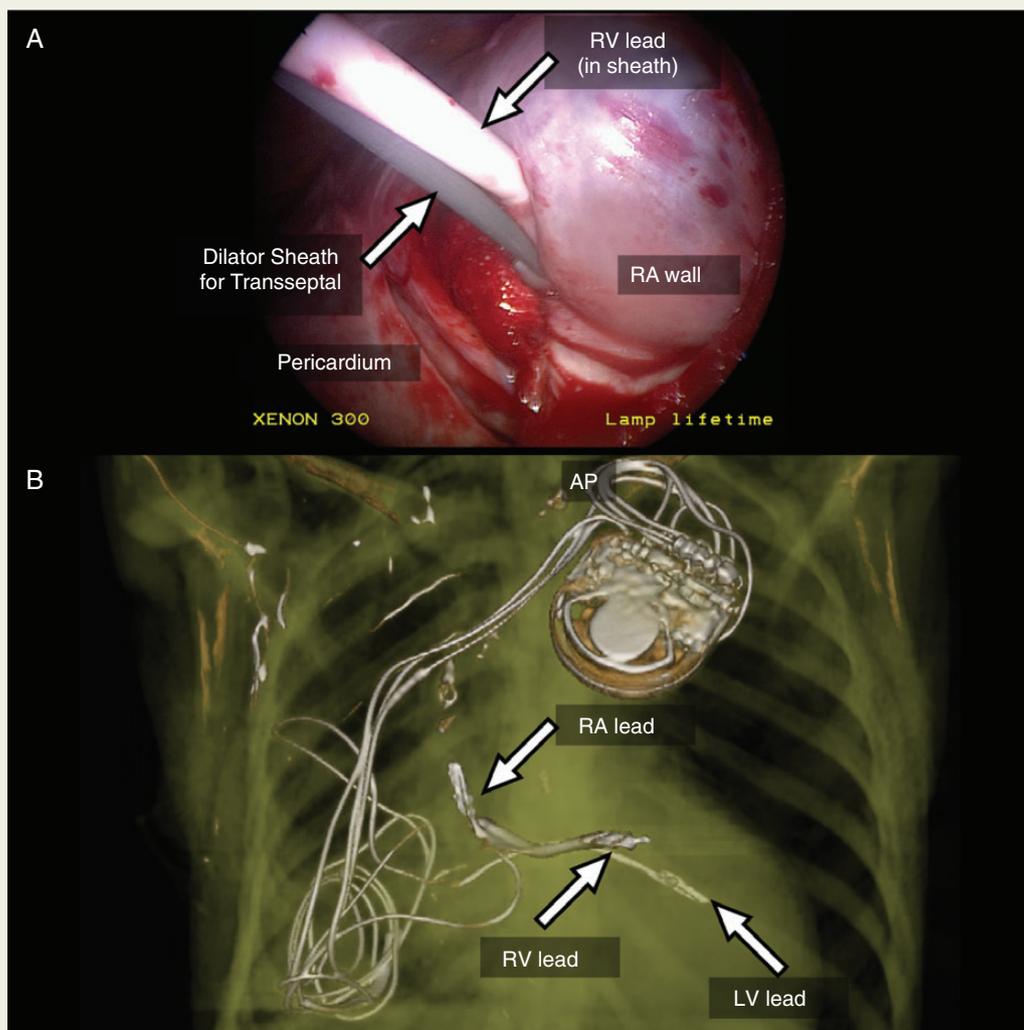
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Options for cardiac device implantation in patients with central venous obstruction are limited. We describe a novel method of device implantation of an entirely endocardial biventricular defibrillator system using video thoracoscopy in a patient with superior vena cava obstruction. Direct right atrial access was used for all leads and an endocardial left ventricular lead was delivered via atrial transseptal puncture.

A 41-year-old female with previous embolic myocardial infarction and subsequent late cardiac arrest presented with serial biventricular defibrillator generator site infections. Following system extractions, intrinsic QRS duration was 140 ms, LV ejection fraction was 14%, NYHA was class III. Superior vena cava obstruction was confirmed with venography, a long-occluded segment extending into both sub-clavian veins was deemed unsuitable for stenting and dilatation.

A novel direct transatrial endocardial approach for reimplant was undertaken, using thoracoscopic, transoesophageal echocardiographic and fluoroscopic guidance, with right-sided thoracic working ports (see also Supplementary material, video).

INR was 2.4 on the day of procedure, which was conducted under general anaesthetic. Warfarin was continued throughout the perioperative period. Heparin was avoided in the intra- and perioperative period. Following right lung deflation, three ports were inserted into the right thorax, a sixth intercostal space mid-axillary line 15 mm 'working' port, a fourth intercostal space anterior axillary line 'camera' port, and a fifth intercostal space 'grasping' port.



Pericardial access was achieved using an electrocautery hook. Right atrial access was obtained using an Endry's coaxial needle (Cook Cardiology) through an 8 French SafeSheath peel-away introducer.

This sheath was exchanged over-the-wire for an 8.5 French steerable sheath (Medtronic, MN, USA) and an active fixation dual coil right ventricular lead (6947M, Medtronic) was placed on the RV septum. Atrial access was repeated and atrial septal puncture performed under video and transoesophageal echocardiographic guidance (*Panel A*). A second steerable sheath was passed into the left ventricle and used to deliver an active bipolar lead to the lateral wall of the left ventricle (Medtronic, 5076). Lead position was confirmed by transoesophageal echocardiography fluoroscopy and observing pacing complexes. A third right atrial puncture was used to place an endocardial right atrial lead (5076, Medtronic). Good lead parameters were obtained on all leads. Final ventricular lead positions are illustrated in a post-operative CT scan reconstruction (*Panel B*). Atrial haemostasis was achieved using PerClot. The three leads were secured to the thoracic wall and brought out the thoracic cavity via the 'grasping' port. Leads were secured on the chest wall and were tunnelled subcutaneously and connected to a left prepectoral generator (Protecta XT CRT-D, Medtronic). Access ports were closed and a standard surgical chest drain was placed on the right side.

The CRT-D was programmed in DDD mode with a lower rate limit of 50 bpm and upper tracking rate of 120 bpm. Outputs were 2.25 at 0.4 mV (LV lead), 2 V at 0.4 ms (RV lead), and 1.5 V at 0.4 ms (RA lead). The device was programmed with a 'VF' zone above 222 bpm and ATP during charging, and a monitor zone above 165 bpm. The SVC coil was inactivated.

Postoperatively, paroxysms of atrial fibrillation responded to amiodarone, bilateral pericardial effusions were drained. A postoperative echocardiogram during biventricular pacing estimated her ejection fraction at 25%. She was discharged 2 weeks following implant. Eleven months hence, the patient has had no further hospital admissions or arrhythmic events.

Patients with limited venous access present severe problems for device implantation. The presented hybrid approach is a minimally invasive development of direct atrial access technique for pacemaker implantation.^{1–3} Limited therapeutic options exist for similar patients with severe heart failure, but alternatives would include a mini-thoracotomy to provide atriotomy access and either an endocardial or epicardial LV lead placement. Conceivably, a tunnelled system from the femoral venous system would be possible.

The dual-coil lead was selected to prospectively maximize defibrillation vector options, lead extraction would be a major surgical undertaking whether a single or dual coil device was used. Given the final position of the SVC coil (*Panel B*), it is unlikely that vectors incorporating it in the defibrillation circuit would be superior to an RV Coil to Generator configuration. The presented VATS technique is modifiable for other venous access difficulties, and adds to options available for cardiac device implantation.

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