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Alternate method for endocardial pacemaker lead implantation: A hybrid mini-thoracotomy approach

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ABSTRACT

Although the conventional methods for endo-cardial pacemaker lead implantation via subclavian or cephalic or axillary vein routes is common, but sometimes due to anatomical variations it is not feasible to access these veins Emergence of newer techniques are useful for lead implantation. This case report focuses on a hybrid approach of combined mini-thoracotomy for endocardial pacemaker lead implantation. This fluoroscopy guided minimal thoracotomy approach with endocardial MRI compatible lead placement had the benefits of simple procedural, minimal hospital stay, low early complication rates and economically viable to the patient.

1. Introduction

The conventional method of permanent pacemaker lead implantation via the axillary, subclavian, or cephalic vein is not feasible in some cases of occlusion or stenosis of the venous system. The majority of upper body venous occlusions (superior vena cava and its branches) is caused by previous insertion of central venous catheters [1,2]. In such cases, implantation of pacing leads via a transthoracic approach with epicardial leads, or transiliac approach, is possible, although both are associated with an increased complication rate and pacing via the transiliac approach has a high incidence of lead displacement and infection. Before 1979, cephalic cut down was usually used for transvenous pacing [3]. At present, commonly used venous access approaches are axillary, cephalic cut down, and subclavian puncture [3,4]. However, there are situations when these approaches cannot be employed because cannulation is not possible due to small size, spasm, absence or occlusion of the usual described veins. However, total venous occlusion in unilateral/bilateral upper limbs is more challenging so alternate method of endocardial lead implantation should be opted which is demonstrated in this case report.

The conventional method of gaining access for endocardial lead implantation are: a) *access medially to the occlusion:* this may require a medial subclavian puncture, with added risk of pneumothorax, collateral damage (e.g. puncture of the trachea or non-compressible arteries) and future lead crush. As an alternative to subclavian puncture, a supraclavicular approach has been described with a puncture lateral to the head of the sternocleidomastoid muscle [5]. However, this approach, with internal jugular venous puncture, requires tunnelling the lead over the clavicle. b) *Inside out access:* This involves puncturing the occluded venous segment anteriorly in the subclavicular region through the skin using a transeptal kit. This is a relatively new approach which requires more clinical evaluation [6]. c) *Surgical access:* This most commonly involves implantation of an epicardial lead, but could

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also involve placing standard pacing leads endocardially, e.g. via a *trans*-atrial access. d) *Leadless pacemaker:* These devices have been recently introduced for pacing the right ventricle [7]. e) *Transilliac access:* This approach has been used in case a superior access is impossible (e.g. in case of B/L sub-clavian occlusion), It requires use of long leads and has been reported in studies with lead instability, pocket erosion, deep vein thrombosis and high risk of pulmonary embolism [8,9].

2. Case report

65 year old male presented with a medical history of hypertension, type 2 diabetes mellitus and chronic kidney disease. The patient had a history of multiple pre-syncopal episodes with generalised weakness. ECG done in triage showed complete heart block with ventricular rate of 30/m. Patient was immediately admitted for urgent temporary pacemaker implantation (TPI) and further evaluations for permanent pacemaker implantation Patient had previous history of thrombophlebitis of left hand which was managed conservatively. Clinical evaluation revealed that he had engorged superficial veins on left hemithorax. Permanent pacemaker implantation was planned Before the procedure patency of bilateral subclavian vein was confirmed by contrast injection. Contrast imaging revealed a bilateral subclavian vein occlusion proximally with long segment occlusion and collaterals filling posterior paraspinal veins draining into superior vena cava (SVC) through azygous vein (Fig. 1). As obstruction was long from proximal subclavian vein to innominate and SVC bilaterally. Considering the pattern of vessel occlusion tranvenous approach was aborted. Venoplasty and inside out approach using LASER was avoided in view of its success outcomes and cost effectiveness.

Epicardial lead option was also ruled out owing to their complication rates and non MRI compatibility. Transatrial lead placement was also not indicated [10,11]. Cardiopulmonary bypass was not used in this case. Transilliac approach was also not feasible secondary to the technical issues related to the approach and its associated co-morbidities. Leadless pacemaker option was advised, however financial constraints were the deterring. Considering the limitations in the case a transthoracic approach by minimal thoracotomy with endocardial lead implantation was planned. The procedure involved leads tunnelled to connect implanted pulse generator (IPG) kept inside a pocket in infraclavicular area. This hybrid procedure was planned in CTVS set up with fluoroscope facility.

Medtronic Attesta MRI conditional, passive fixation leads with length 58cm/53 cm was placed in this case. After obtaining written informed consent from the patient procedure was performed under general anesthesia. A right thoracotomy approach was adopted through 3rd intercostal space (Fig. 2) Right pectoralis muscle was incised and purse string suture was taken into superior vena cava right atrium (RA). Pacemaker right ventricle lead was inserted through right slit in SVC close to right atrium junction and placed in right ventricle (RV) endocardial surface under fluoroscopic guidance. RA lead was inserted through a slit hole opening at the

Fig. 1. Bilateral upper limbs subclavian vein occlusion with extensive collaterals and reformation in superior vena cava.

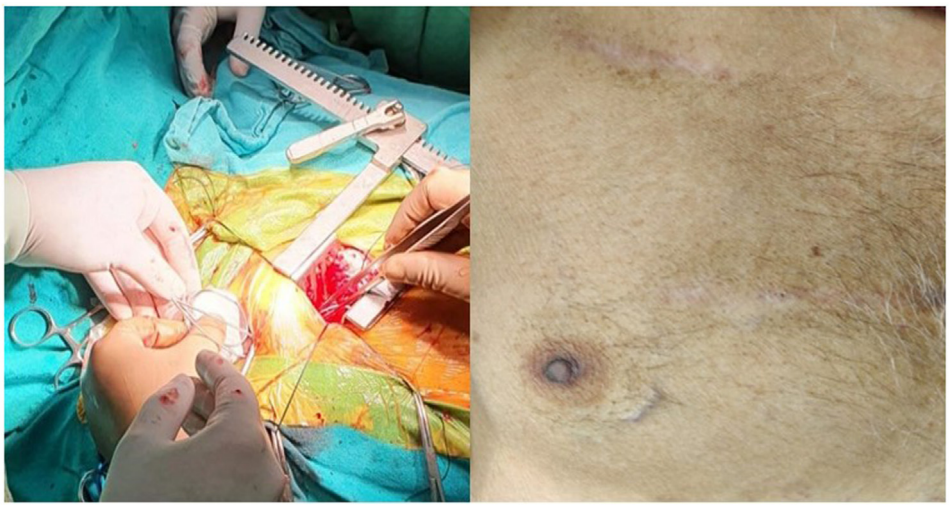

Fig. 2. a)Thoracotomy with endocardial lead placement using hybrid approach b) incision site post healing.

junction between SVC and RA to be placed endocardially inside RA appendage. Leads was directly advanced through SVC and RA. Leads were fixed directly to SVC and RA and sleeves were fixed outside in the tunnel. Both lead positions were confirmed via fluoroscopy and secured subsequently in place. Leads were then tunnelled above to the sub clavicular pocket where IPG was connected to the leads and pocket was closed in triple suture layers. Minimal inotropic support was administered which was tapered subsequently and patient was extubated. There were no procedural complications and chest x-ray confirmed the leads position. Lead parameters were within normal

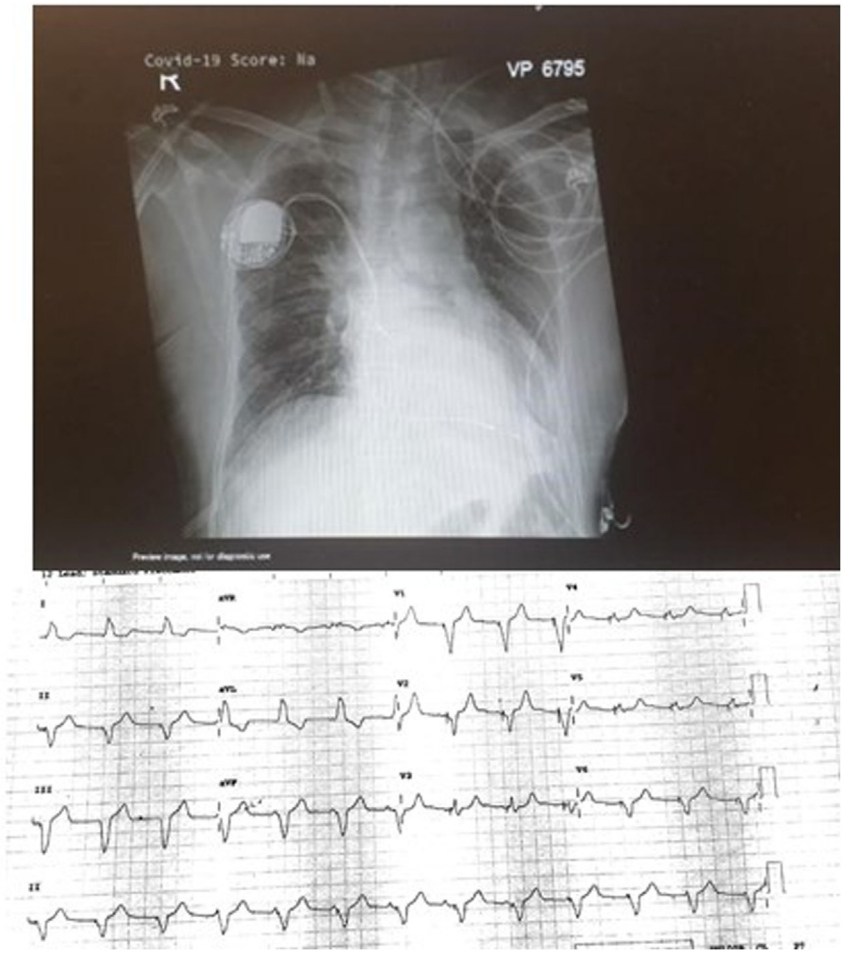

Fig. 3. Post procedural chest x-ray with endocardial lead positions, ECG showing normal lead parameters.

limits as checked with the programmer. The ECG parameters were also normal. Duration of hospitalization was 5 days and the patient was discharged under stable conditions and is being followed up (Fig. 3).

3. Discussion

Central venous stenosis/occlusion is common in patients who have undergone previous pacemaker implantation or have a history of central venous cannulation due to inflammation and fibrosis. Venous obstruction following pacemaker insertion occurs in 23% patients within 6 years of device placement [12]. Transiliac or transthoracic approaches are alternative options in such cases. Studies involving transiliac implants report high complication rates with a significant number of lead dislodgment (7–21%). An increased incidence of lead fractures is expected but not reported in the literature [13]. Pacing via transiliac approach appears to have a higher incidence of deep vein thrombosis (34%) and risk of subsequent pulmonary embolism based on data from temporary pacing wire studies [14]. Surgical epicardial lead insertion with either video assisted thoracoscopic surgery (VATS) or mini thoracotomy requires a prolonged hospital stay and has greater perioperative complications including arrhythmias, acute kidney injury, and infection, compared to transvenous implantation [15,16]. The choice of one or the other strategy depends on individual anatomical considerations, on the tools available, and on the physician's experience with the specific technique.

In this approach we tried to avoid complications related to epicardial lead placement and reduce financial constraint of MICRA (VVI) implant and more of hardware usage with venoplasty or inside out laser technique with its subsequent unpredictable success rates. Minimal thoracotomy approach with endocardial MRI compatible leads placement under fluoroscopy guidance made this procedure simple, short hospital stay, low complication rates and also financially beneficial to patient [17–19].

We have herein presented a hybrid technique of minimal thoracotomy and endocardial dual chamber lead placement for a case with limitations to other surgical approaches. This adopted surgical technique also reduced early complication and added advantage of short hospital stay. However there is a need for documentation of more cases on this surgical approach for evaluating effectiveness and long term successful outcomes.

Credit author statements

Viveka Kumar: conceptualizing, methodology, investigation, supervision, formal analysis, validation, review of draft.

Pradipta Nayak: methodology, investigation, preliminary draft.

Mitendra Singh Yadav: Investigation, project administration.

Vanita Arora: methodology, supervision.

Sangeeta Dhir: Roles/Writing – final draft; Writing - review & editing.

Vivek Kumar: Supervision, review of draft.

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