Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 01, 2024

Original research article

RARE VASCULAR COMPLICATIONS IN CARDIAC IMPLANTABLE ELECTRONIC DEVICE PROCEDURES: A CASE SERIES AND OVERVIEW OF MANAGEMENT

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Abstract

Obtaining Vascular access is one of the blind things during implantation of cardiac implantable electronic device (CIED) which may be associated with various access-related complications ranging from Pneumothorax, Haemothorax and Pacemaker Pocket hematoma. We describe a series of morbid vascular complications which are acute to subacute in presentation and management strategies. The vascular complications include acute vascular bleeding managed with vascular intervention using coil closure in the same sitting and, subacute vascular complication presenting as pacemaker pocket hematoma due to arteriovenous fistula and late arterial bleed managed by vascular coil closure. The other access-related complication included alveolar injury presenting as acute haemoptysis managed conservatively.

Keywords: pacemaker pocket hematoma, arterio-venous fistula, alveolar haemorrhage, coil closure, Cardiac implantable electronic devices (CIED)

Introduction

Obtaining vascular access during the implantation of cardiac implantable electronic devices (CIED) is a procedure fraught with potential complications, including but not limited to pneumothorax, haemothorax, and pacemaker pocket hematoma. Although some of these complications have been well-documented, carrying a risk of less than 1%, others such as arteriovenous (AV) fistula and alveolar haemorrhage lack comprehensive understanding due to the scarcity of reported cases in the existing

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 01, 2024

literature. This article seeks to address this knowledge gap by presenting a series of acute to subacute vascular complications encountered during implantation and elucidating their corresponding management strategies.

Case 1

A 64-year-old man with coronary artery disease and recurrent scar-related ventricular tachycardia underwent a defibrillator implantation. He developed cough and haemoptysis 2 hours after the procedure, but no pain or dyspnoea. A chest radiograph showed infiltrates in the right upper zone and the possibility of alveolar haemorrhage was considered (Fig 1). He was managed conservatively and his haemoptysis subsided in 3 days, with resolution of the X ray findings in a radiogram repeated after 2 weeks. He recovered uneventfully.

Case 2

A 48-year-old gentleman developed sudden haemoptysis soon after attempted venous access while undergoing a PPM implantation for CHB. A venogram was done which showed the contrast staining the lung tissue (Fig 1). A separate venous access was taken and the implantation completed. The haemoptysis persisted for 2 days after which it subsided spontaneously. There was no evidence of haemothorax /pneumothorax, nor any desaturation, and he recovered uneventfully.

Fig 1: Shows the chest radiograph of case: 1 at admission (A), and 3 hours after the ICD implantation (B). Note the left upper zones infiltrates due to alveolar haemorrhage. Panel C shows the fluoroscopic still-frame of a venogram showing the contrast staining the lung parenchyma (arrow) with suggesting needle injury to the lung (case 2)

Case 3

A 62-year hypertensive male underwent dual chamber permanent pacemaker (PPM) implantation presented on day 10, with acute onset painful increase in the size of the CIED pocket accompanied by a postural hypotension and a drop-in haemoglobin levels by 4grams/dl. An urgent non-contrast CT revealed a large hematoma at the site of the CIED implant, with no fluid collection within the pleural spaces (Fig 2A). Suspecting an arterial bleed, left sub-clavian arteriogram obtained using the 6F Judkins right coronary artery catheter via the right femoral arterial access. It revealed free pulsatile extravasation of blood originating from the thoraco-acromial (TA) branch of left axillary artery (Fig 2B). Selective cannulation of culprit artery done by 4F LIMA coronary catheter with 7F cook shuttle sheath support was done. 2 Coils the first one (0.018 inch, 3x3 mm, Nester, Cook Medical) were deployed into the bleeding TA

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 01, 2024

branch distally with care taken that their proximal end did not protrude into the lumen of the main subclavian artery, and the second one (0.035, 2x3, Reye, Cook medical) was also deployed within the same branch to completely occlude the culprit vessel (Fig 2C). After 2 days the patient was discharged without event and no infection at 2 months of follow-up.

Fig 2: (From Case: 3) Panel A shows the CT scan showing large haematoma (16x8cm) at pacemaker site with no intrathoracic extension. Panel B shows Subclavian angiogram showing free pulsatile flow from a branch of subclavian artery Panel C shows Post coil occlusion showing complete cessation of flow

Case 4

A 63-year-old man underwent a left sided dual chamber PPM for complete heart block, after explanation of a previous right sided device infection. Three weeks after the implant he presented with a tense swelling of the left infraclavicular region extending to the pectoral region. An ultrasound done showed a collection in the region, and a

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 01, 2024

doppler confirmed a large pseudo- aneurysm and AV fistula arising from left axillary artery branch. Endovascular balloon assisted coiling of left axillary artery branch with complete obliteration of pseudoaneurysm and the AV fistula was done with preservation of the distal flow (Fig 3).

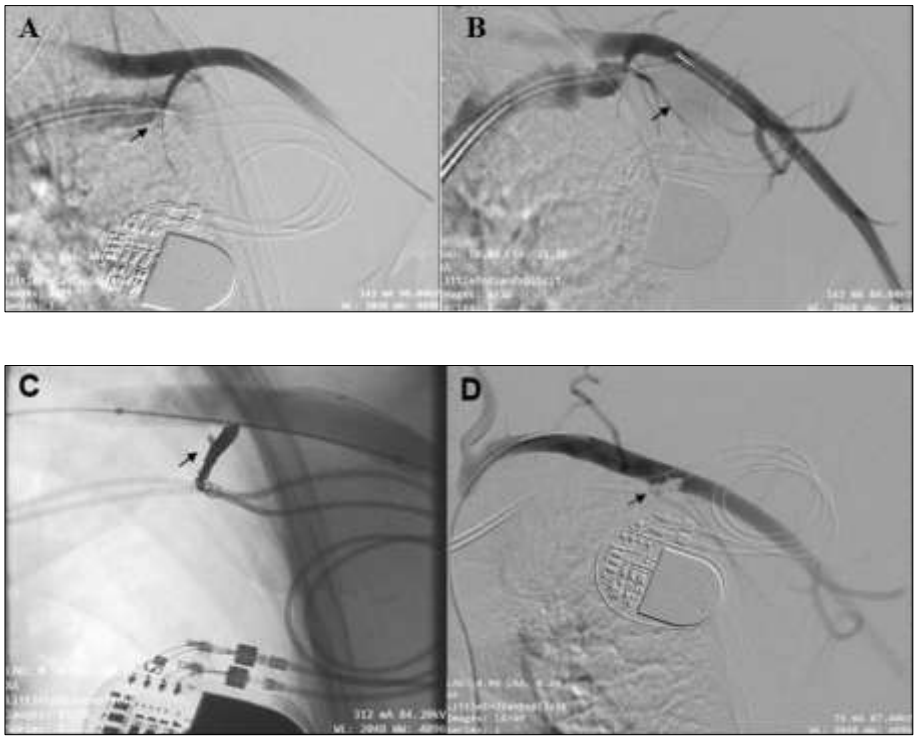

Fig 3: Angiographic still frames from Case: 4. Panel A shows subclavian artery feeding the fistula and opacifying the subclavian vein (arrow). Panel B shows the faint filling of the pseudoaneurysm in the arterial phase (arrow). Panel C shows 8 x 60 mm balloon inflation of the artery while coiling and the compact coil in the fistulous tract (arrow). Panel D shows post procedure left subclavian, axillary artery angiogram showing no filling of pseudoaneurysm or the AV fistula and preserved distal flow

Case 5

A 50-year-old diabetic and hypertensive man with complete heart block, was considered for dual chamber PPM. During the procedure, there was inadvertent arterial puncture twice. Afterwards venous access was secured and the pocket created. There was significant swelling of the area and arterial type of back bleed form the puncture site that was continuously oozing out. A femoral artery access was obtained immediately and a subclavian artery angiogram obtained using a 5F JR catheter, which confirmed the oozing out of the contrast in to the surrounding soft tissue. The arterial rent was closed using 2 coils (Cook medical) thus securing haemostasis. Subsequently PPM implantation was completed.

Discussion

This case series underscores the rarity and potential dangers associated with two complications of PPM implantation - alveolar hemorrhage and arteriovenous fistula. The preference for the axillary vein as the access site has significantly reduced the

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 01, 2024

incidence of complications such as pneumothorax and haemothorax [1].

The occurrence of alveolar haemorrhage is exceptionally rare with less than 10 reports published in the literature [1, 4]. The hypothesised mechanism includes inadvertent puncture of the lung tissue with creation of a fistulous communication between the bronchiole and a small blood vessel of the bronchial or pulmonary vasculature. In all but one of the reported cases, conservative management was successful and the haemoptysis was self-limiting. However, in one instance the haemorrhage was massive enough to warrant a trans arterial embolization procedure. In most of the cases difficulty in obtaining the venous access with aspiration of air bubbles, or arterial puncture was reported. Limited data is available to draw generalisations regarding management, which should be tailored to the individual case scenario. This might include, transfusion, intubation and ventilation, endobronchial balloon blockade of the haemorrhagic segment, embolization of the culprit feeding artery are potential useful measures [1, 2]. Fluoroscopic guidance with care not to cross the medical border of the first rib helps the needle to remain extrathoracic, and minimize the risk of injury to the pleura and lung parenchyma.

Arteriovenous fistula after subclavian venous access has been reported after central venous catheter insertion, pacemaker lead extraction and rarely after venous access for pacemaker [5]. It may be accompanied by hematoma formation, and pseudoaneurysm. Clinical manifestation of pseudoaneurysm can be expanding painful swelling due to hematoma, whereas AV fistula can present as a bruit or even high output cardiac failure. Haematoma presentation is usually sub-acute and gradual and not as an acute presentation requiring immediate care. The rapidity of presentation as in our case directed us to consider arterial bleed as our cause of morbidity. Common cause of the same include rupture of arterial pseudo-aneurysm, dislodgement of arterial clot, or free rupture. All of these are potential complications which arise from trauma to the artery at the time of taking access. The thoraco-acromial artery, branch of axillary artery runs normally posterior to the pectoralis major muscle. Embolization material to seal similar perforations include polyvinyl alcohol foam, microcoils, gelfoam, clotted autologous blood, intracoronary thrombin, microfibrillary collagen and subcutaneous tissue. The more distal the site of bleed from the lumen of the major vessel, higher the chances that a coil may be of use without dislocation from its target site. The more proximal to the lumen of the main vessel that the site of rupture is and if the rent extends onto the lumen of the main vessel a covered stent-graft may be of use with sacrifice of the side branch. Surgical repair is yet another option albeit much more invasive. Of note, small AV fistulas without any hemodynamically significant shunt may be closely monitored as they can close spontaneously with time [6]. Interestingly, AV fistula can occur acutely as a direct result of the needle-trauma or manifest after a variable longer period after the procedure probably due to chronic venous occlusion and angiogenetic response [7, 8].

A common thread among the reported complications in these cases is the challenge associated with obtaining venous access, often necessitating multiple attempts, inadvertent arterial punctures, and air aspiration. To mitigate the risk of these rare yet potentially dangerous complications, it is imperative to prioritize strategies that enhance the ease and accuracy of venous access during cardiac implantable electronic device (CIED) procedures.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 01, 2024

Maintaining optimal patient hydration emerges as a crucial factor in preventing complications. Adequate hydration facilitates vascular accessibility, reducing the likelihood of multiple access attempts and inadvertent arterial hits. Furthermore, meticulous attention to procedural details, such as using venogram or ultrasound guidance, proves instrumental in enhancing the precision of venous access.

The incorporation of imaging modalities, such as venogram or ultrasound, not only aids in visualizing the axillary vein during the procedure but also serves to identify potential pitfalls, thereby minimizing the risk of inadvertent arterial puncture or lung parenchymal injury. Utilizing fluoroscopic guidance, while ensuring the needle remains extra-thoracic, contributes to the overall safety of the procedure by preventing injury to the pleura and lung parenchyma.

Moreover, these preventative measures align with broader efforts to reduce the incidence of complications associated with CIED procedures. By addressing challenges related to venous access through proactive strategies, clinicians can contribute to a safer and more streamlined implantation process, thereby mitigating the occurrence of these rare and perilous complications.

Conclusion: Alveolar haemorrhage as well as arteriovenous fistula are potentially dangerous complications of transvenous PCIED procedures which may have acute or a subacute presentation. Management must be individualised to the clinical scenario, and percutaneous intervention closure or embolization of the bleeding vessel when appropriate, without exploration of the pocket may be one of the methods to manage the same apart from the more invasive surgical repair.

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