2021

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Recommended Citation

Khazi, Fayaz Mohammed; Alhashimi, Samer Badr Eddin; Majthoob, Motaz Yousef; Saleh, Ayman; Al-Sibaie, Ayman; and Aljassim, Obaid (2021) "Multiple migrated superior vena cava stents with cardiac injury - A stepwise open cardiectomy strategy to mitigate potential fatality," *Journal of the Saudi Heart Association*: Vol. 33 : Iss. 4 , Article 13.

Available at: <https://doi.org/10.37616/2212-5043.1281>

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Multiple Migrated Superior Vena Cava Stents With Cardiac Injury - A Stepwise Open Cardiotomy Strategy to Mitigate Potential Fatality

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Abstract

Iatrogenic injuries with migrated interventional stents can sometimes be life-threatening. The interventional retrieval management is generally the treatment of choice, as surgical procedures carry a high mortality risk with only a few cases reported. We report a patient with two stents migrated into the right atrium from superior vena cava resulting in cardiac perforation. She was successfully treated using pericardiocentesis followed by surgical intervention with rapid post-operative resolution of symptoms. The technique presented here substantiates the steps for a safe and effective removal of these multiple displaced stents with minimal postprocedural complications.

Keywords: Balloon angioplasty/stent, Cardiopulmonary bypass, Pericardial tamponade, Hemodialysis, Superior vena cava syndrome, Angioplasty complication

1. Introduction

Interventional therapy is believed to be a well-established treatment for benign central venous stenosis [1]. Cardiac tamponade is a relatively rare consequence of superior vena cava (SVC) stenting, but it is associated with high mortality.

2. Case report

A 37-year-old female on regular dialysis with previous right subclavian vein stent and SVC angioplasty was admitted with SVC syndrome (Fig. 1A). A self-expandable stent implanted within the SVC was noted to protrude into the right atrium. A second stent was deployed superiorly to stabilize the first stent and third stent was placed to bridge the overlap. Final angiogram showed a stable upper stent with good flow within the SVC. Four hours after deployment, the patient felt shortness of breath

with central chest pain, which improved the next day after dialysis, but experienced a drop in haemoglobin. Transthoracic echocardiography showed a 1.9 cm circumferential pericardial effusion with a foreign body projecting into the right atrial wall (Fig. 1B). Subsequent contrast tomography demonstrated migrated stents in the right atrium (Fig. 1C), a patent stent in the SVC with contrast extravasation into the pericardial cavity (Fig. 1D) and pleural effusion. She was discussed in a multidisciplinary meeting and decided to perform preoperative pericardiocentesis to achieve hemodynamic stabilisation and scheduled her later for emergency cardiac surgery. It was felt that the interventional procedure carries a high risk of vessel wall perforation and worsening of pericardial haemorrhage and shock.

In the operating room, a subxiphoid pericardial catheter was inserted under continuous echocardiographic guidance. There was a rapid improvement in haemodynamics and ventilation following

Received 23 August 2021; revised 13 September 2021; accepted 2 October 2021.
Available online 29 October 2021.

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Fig. 1A. Preoperative right venogram showing stenosis of right subclavian and mid superior Ven cava.

Fig. 1B. Preoperative transthoracic echocardiography demonstrating the presence of entrapped stent in right atrium with pericardial effusion. 1B¹ Preoperative transthoracic echocardiography demonstrating the presence of entrapped stent in right atrium (broad white arrow). 1B² Preoperative transthoracic echocardiography demonstrating the pericardial effusion with compression of right heart.

Fig. 1C. preoperative CT demonstrating the presence of stent.

the aspiration of 200 ml bloody fluid from the pericardial cavity. Patient underwent an uneventful anaesthesia induction using remifentanyl and propofol. Furthermore 500 ml of haemorrhagic fluid with fibrin clots were evacuated following sternotomy. The innominate vein, along with its confluence with the inferior vena cava, was dissected out. Heparin 300 IU/kg was administered, and arterial cannulation was established via the ascending aorta. On close inspection, a small piece of migrated stent tip (size 4/0 needle) was found to penetrate the right atrial wall near inferior vena cava. Initial attempt to go on Cardiopulmonary bypass (CPB) was difficult with no return flow. Subsequently, 80% of CPB flow was achieved with ascending aorta and a double-staged venous cannulation into the inferior vena cava and another directly into the right atrium. Her temperature was brought down to 28° in

Fig. 1D. After primary balloon angioplasty and deployments of all three stents the contrast agent extravasation into the pericardial sac suggesting a right heart perforation and bloody pericardial effusion and clear flow across the upper SVC stent.

Fig. 2. Intraoperative photograph showing the two stents retrieved from the right atrium during open heart surgery.

anticipation of hypothermic circulatory arrest. The stent tip that was visible penetrating right atrial wall was taken out safely. The initial attempt to remove the lower SVC stent was unsuccessful due to poor access which made direct removal too risky. The incision was extended towards the lateral wall of the SVC and the second stent could now be visualised easily along the incision following gentle suction. The stent was crushed out of the SVC opening into the right atrium to prevent the possibility of airlock during CPB (Fig. 2). Further inspection of the SVC did not reveal any stent remnants, and the third stent was felt higher up in the SVC. Subsequently, the right atrial cannula was inserted into the SVC to establish full flow on CPB. The patient received antegrade cardioplegia every 20 min. The right atrial and SVC incisions were closed with a running 4-0 polypropylene suture following deairing. The aorta clamp time was 68 min, The CPB lasted 143 min. She was decannulated successfully and extubated four hours following surgery. Her post-operative chest X-ray showed a well-positioned stent in the SVC. During her three-month follow up, the stent was still patent, and symptoms of SVC syndrome had not reappeared.

3. Discussion

SVC stents are particularly at risk for migration because of their large size and diameter changes associated with changes in venous return. They can migrate into the innominate vein, right atrium, right ventricle [2] and pulmonary artery with incidence being 2%–3% [3]. These migrated stents must be removed to prevent thrombosis, arrhythmias, perforation with injury to valves and papillary

muscles. Despite its favourable risk profile, risk of SVC rupture and cardiac tamponade is associated with up to 1.8% of cases with interventional procedures [4]. Even open-heart surgery experienced significant postoperative complications including stroke, atrial fibrillation, tamponade, and leaflet damage requiring valve replacement [5]. The management options are percutaneous retrieval, repositioning it to another site, watchful waiting, or open surgery. However, the stent could migrate into the right atrium with consequent aortic–right atrial shunt [6].

Most cardiac stent migrations occurred within a few days following stent placement. Delayed migrations will be mostly over a short distance because of reendothelialization. Few patients are best to leave to be managed through conservative approaches because of their comorbidities. A migrating stent reaching the right ventricle with myocardial injury should be managed by surgical methods, as these patients are associated with a higher success rate compared to percutaneous approaches [7]. We considered hypothermia and backup circulatory arrest due to the nature of the procedure, high risk of air locking and possible neurological complications.

Several case reports have exhibited that minimally invasive techniques are relatively safe in these patients [8]. However, there is a lack of a large multi-centre data to support one surgical technique over another. We believe that the high SVC and inferior venous cannulation with longer cannulas would have avoided above problems, but we opted for an open procedure with double staged cannulation and cardioplegic arrest as a safer option because of her preoperative critical state with the possibility of

worsening the venous or cardiac rupture as the site of initial rupture was not clear on angiography. Our approach even though more invasive, allows complete visualisation of all the stents including those remaining in the upper SVC, helps in the safe placement of cannula and proper inspection and repair of adjacent valves.

Our case was unusual because multiple stents migrated during the intervention procedure to treat SVC stenosis into the right heart with subsequent cardiac injury, and a stepwise approach has been taken to retrieve these stents using CPB due to their precarious position. Future studies should therefore compare practices and provide strategies regarding techniques and efficacies associated with CPB in the context of managing these patients. Multidisciplinary collaboration among interventional radiology, cardiology, anaesthesia, critical care, and cardiothoracic surgery is essential to develop a care plan. We feel a well prepared and planned emergent open-heart surgery might be a safer and less harmful strategy compared to blind interventional procedures to retrieve these intracardiac stents. Moreover, follow-up intervals after the stent procedure need to be shortened to enable faster diagnosis.

Consent for publication

Patient consented for publication.

Conflict of interest

The authors declare that they have no conflicts of interest.

Author contributions

Conception and design of Study: Fayaz Mohammed Khazi. Literature review: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Acquisition of data: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Analysis and interpretation of data: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Research investigation and analysis: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Data

collection: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Drafting of manuscript: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Revising and editing the manuscript critically for important intellectual contents: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Data preparation and presentation: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Supervision of the research: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim. Research coordination and management: Fayaz Mohammed Khazi, Samer Badr Eddin Alhashimi, Motaz Yousef Majthoob, Ayman Saleh, Ayman Al-Sibaie, Obaid Aljassim.

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