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Journal of Clinical & Experimental Cardiology

Case Report

Atrioventricular Block Unveiled during Ventricular Septal Defect Closure-A Serial Case Report

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ABSTRACT

Background: The transcatheter ventricular septal defect procedure is a complex intervention that poses potential complications, including complete heart block. We present here two cases of patients who developed AV block during the closure of VSD and recovered with steroids and atropine.

Case presentation: Peri membranous VSD was found in a 19-year-old military recruit. A baseline 12-lead EKG showed sinus rhythm and no conduction delays. Echocardiography revealed a 6 mm-9 mm peri membranous VSD. Then the VSD was closed with a VSD occluder no 10-8. ECG monitor and echocardiography showed a complete atrioventricular block during the procedure. Fortunately, atropine and methylprednisolone overcame this. Recurrent atrioventricular block and VSD were not found after the procedure.

Routine screening revealed peri membranous VSD in a 33-year-old man. His 12-lead EKG was normal, but an echocardiogram showed a 3 mm-5 mm peri membranous VSD. Using VSD occluder no 10-8 closed the VSD trans catheterally. The hemodynamic monitor and echocardiography showed a total atrioventricular block during the procedure. Luckily, atropine and methylprednisolone solved his heart rhythm. The device was put in despite this issue. The procedure left no residual VSD or atrioventricular block.

Conclusion: During the transcatheter closure of ventricular septal defects, there is a potential risk of atrioventricular block. This can occur due to mechanical trauma or compression caused by the delivery system or device. It is crucial to choose the appropriate device size to minimize the risk of this complication. Close heart rhythm monitoring is necessary during short-term and long-term follow-up periods.

Keywords: Ventricular septal defect; Atrioventricular block; Trans catheter device closure; Case report

Abbreviations: VSD: Ventricular Septal Defect; EKG: Electrocardiography; TTE: Trans Thoracal Echocardiography; TEE: Trans Esophageal Echocardiography; AVB: Atrioventricular Block

INTRODUCTION

VSD is responsible for over 20% of all CHDs, making it the most common congenital heart defect. Peri membranous VSDs are the usual culprit behind hemodynamically significant VSDs in newborns and young children. It is now possible to carry out trans catheter closure of Ventricular Septal Defects (VSDs) with the aid of fluoroscopy and trans esophageal echocardiography under general anesthesia. In several countries, trans catheter closure is now the preferred treatment over open surgery for certain types of ventricular septal defect. However, there is controversy around this treatment due to the potential for short-term and long-term complications, such as heart valve injury, thromboembolic events and complete Atrioventricular Block (cAVB), despite the high success rates achieved after 6-12 months. It has been observed that complete Atrioventricular Block (cAVB) is a rare complication that may arise in association with trans catheter closure for Ventricular Septal Defect (VSD). However, this serious event appears to be under recognized and is worth further investigation [1].

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Received: 20-Feb-2024, Manuscript No. jcec-24-29673; **Editor assigned:** 23-Feb-2024, PreQC No. jcec-24-29673 (PQ); **Reviewed:** 08-Mar-2024, QC No. jcec-24-29673; **Revised:** 13-May-2025, Manuscript No. jcec-24-29673 (R); **Published:** 20-May-2025, DOI: 10.35248/2155-9880.25.16.950

Citation: Indrihapsari P, Yogibuana V (2025) Atrioventricular Block Unveiled during Ventricular Septal Defect Closure-A Serial Case Report. J Clin Exp Cardiolog. 16:950.

CASE PRESENTATION

Case 1

A 19-year-old male presented with an incidental finding of peri membranous VSD during a military selection. He was 170 cm tall and weighed 60 kg. He had good energy levels and no symptoms of left ventricular failure. Baseline 12-lead Electrocardiogram (ECG) showed normal sinus rhythm. Transthoracic 2D echocardiography showed 6-9 mm, left to right shunt peri membranous VSD with normal pulmonary arterial diameter and cardiac chambers. All pulmonary veins were draining into the left atrium trans esophageal echocardiography revealed a 6 mm-7 mm peri membranous VSD suitable for trans catheter device closure. The Qp:Qs at cardiac catheterization was 1.1 and the mean pulmonary artery pressure measured 21 mmHg [2].

Under general anesthesia, the application of a KONAR-MF VSD occluder no. 10 mm-8 mm from lifetech was executed with guidance from trans esophageal echocardiography and fluoroscopy. This device was soft, flexible and offers a hybrid design between single and double-disc devices, designed to conform to ventricular septal defect. It can be delivered through a small sheath, can be screwed together at both sides which allows it to be placed in ante grade or retrograde way. In addition to that, its slim cable and flexible waist are expected to minimise damage to adjacent structures and reduce complications like complete heart block. During the procedure, there was a complete atrioventricular block with a ventricular rate of 40 bpm seen on both the monitoring and echocardiography screens [3]. To resolve this, 1 mg of sulfas atropine and 125 mg of methylprednisolone was administered intravenously, resulting in the AVB resolving shortly and converting to sinus rhythm with stable hemodynamics. After this, the procedure resumed and the device was placed with no evidence of residual VSD from the trans esophageal echocardiography, nor was there any recurrent atrioventricular block after the procedure (Figures 1-7) [4].

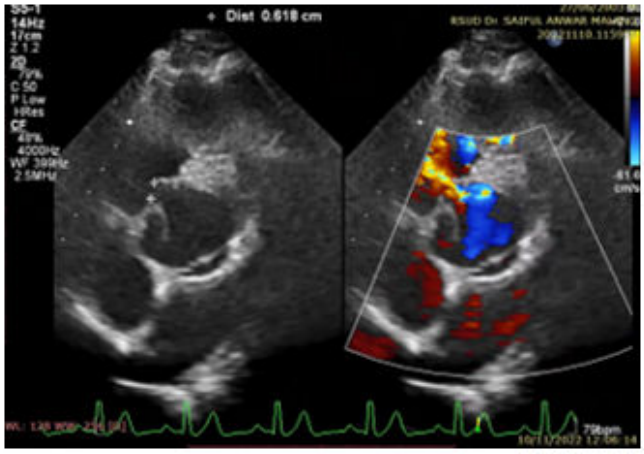

Figure 1: Transthoracal echocardiography revealed 0.6 cm peri membranous VSD.

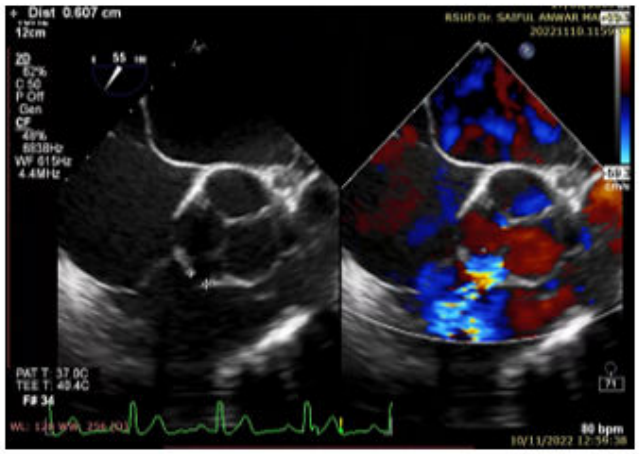

Figure 2: Transesophageal echocardiography confirmed the peri membranous VSD.

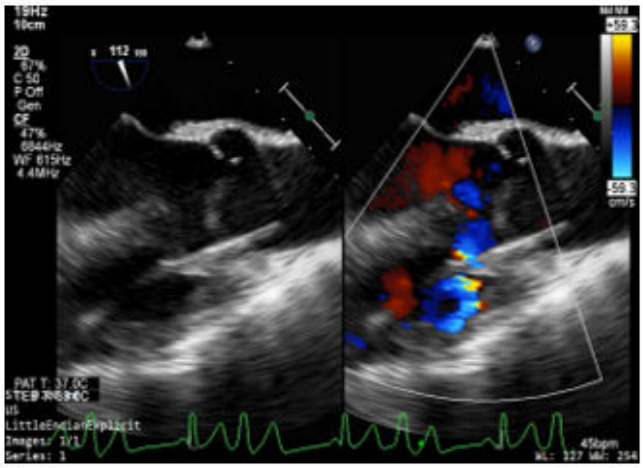

Figure 3: Total AV block occurred during wire crossing.

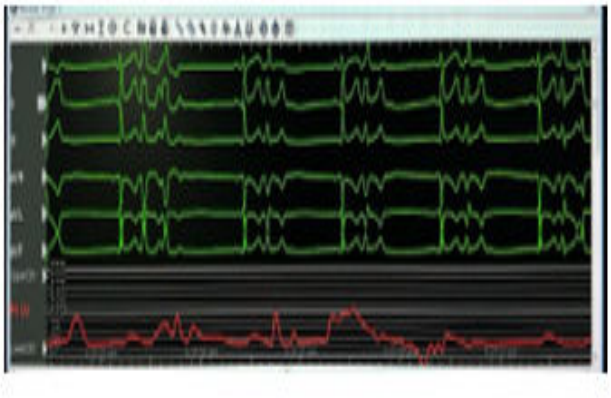

Figure 4: Monitor ECG showed TAVB.

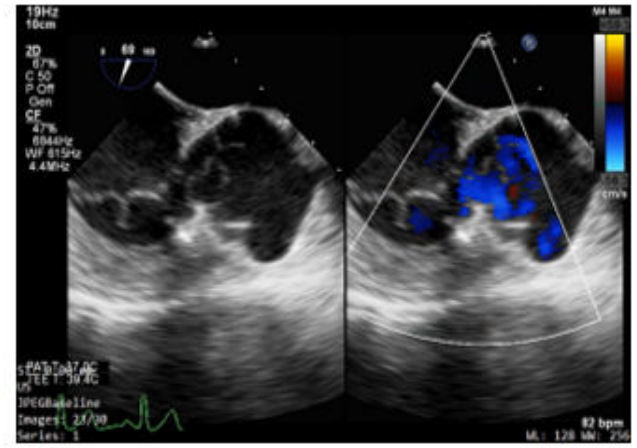

Figure 5: TEE after device was placed.

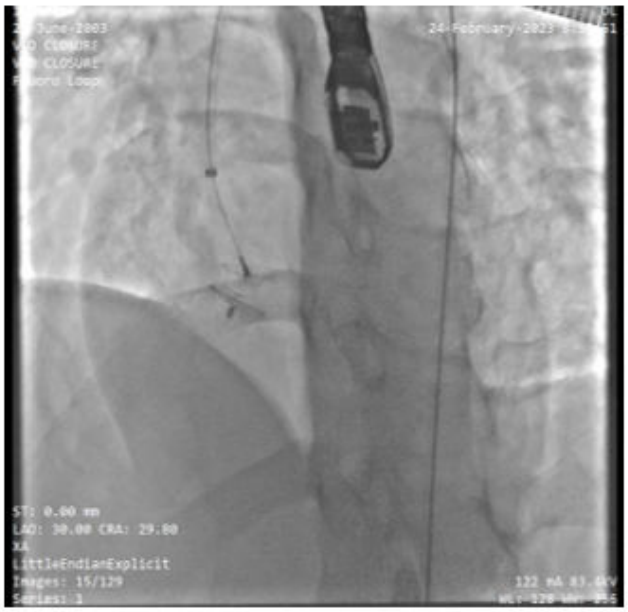

Figure 6: Fluoroscopy after device was placed.

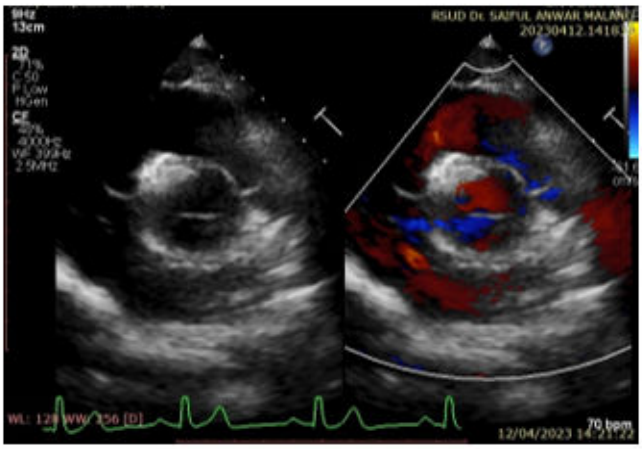

Figure 7: TTE evaluation 1 month after closure, no residual shunt nor TAVB.

Case 2

During a routine health check, a 33-year-old man was diagnosed with a peri membranous VSD. He is 160 cm tall, weighs 80 kg and does not show any symptoms of left ventricular failure. A 12-lead ECG showed normal PR interval and QRS complexes, while a transthoracic echocardiogram revealed a 4 mm-6 mm left to right shunt peri membranous VSD, with normal pulmonary artery diameter and cardiac chambers. Further confirmation from a trans esophageal echocardiography revealed a 3 mm-5 mm peri membranous VSD that can be closed using a trans catheter device. At cardiac catheterization, the Qp:Qs was 1.3 and the mean pulmonary artery pressure was measured at 22 mmHg [5].

During the procedure, a KONAR-MF VSD occluder no. 10 mm-8 mm from lifetech was applied while the patient was under general anesthesia. The procedure was guided by trans esophageal echocardiography and fluoroscopy. Hemodynamic monitor and echocardiography screens revealed a junctional rhythm, followed by a complete atrioventricular block with a ventricular rate of 38 bpm. To address this issue, intravenous administration of 0.5 mg of sulfas atropine and 125 mg of methylprednisolone were given, which quickly assisted in the subsiding of the atrioventricular block. As a result, the heart converted to sinus rhythm with stable hemodynamics. Following this, the procedure continued and the device was successfully placed. Trans esophageal echocardiography revealed no residual VSD and there was no recurrence of atrioventricular block post-procedure (Figures 8-13) [6].

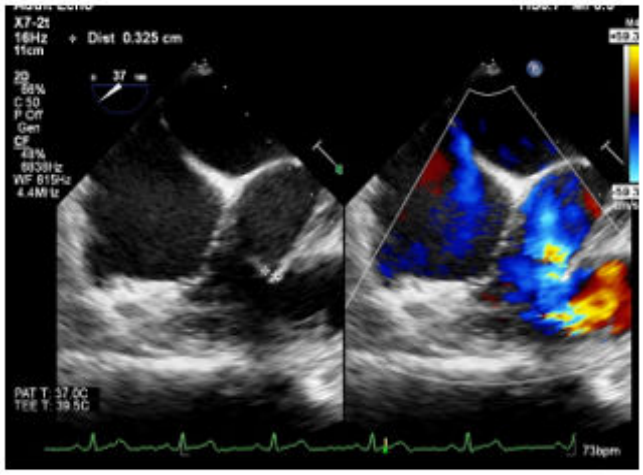

Figure 8: TEE revealed a 3 mm peri membranous VSD.

Figure 9: TEE during VSD closure, while TAVB occurred.

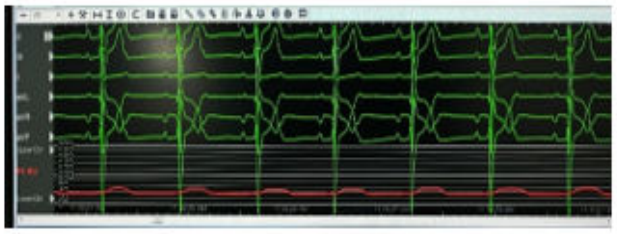

Figure 10: Monitor ECG showed TAVB.

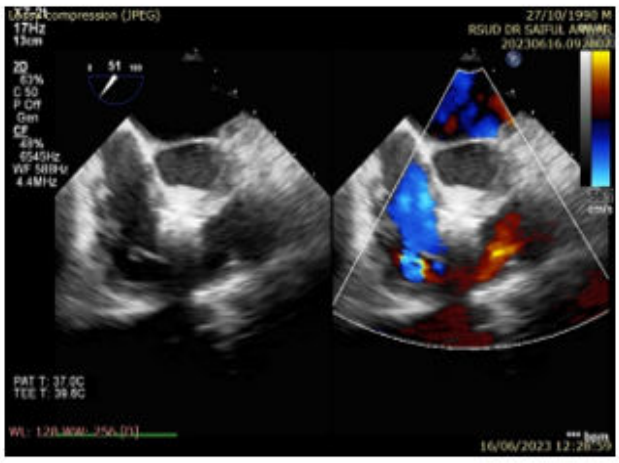

Figure 11: TEE after device was placed.

Figure 12: Fluoroscopy after closure.

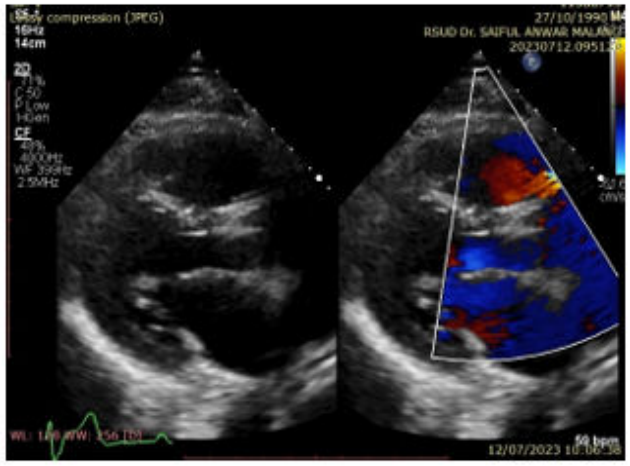

Figure 13: TTE evaluation in the following month.

RESULTS AND DISCUSSION

According to reports, a small percentage of patients (between 1% to 5%) may experience temporary complete AVBs after undergoing trans catheter device closure of a peri membranous VSD. The peri membranous region of a VSD is difficult to categorize due to its varying shapes. However, these defects exhibit certain commonalities, such as the presence of fibrous continuity between the leaflets of the tricuspid and aortic valves that form some of the defect's borders, as well as conduction tissue that runs poster inferiorly [7].

Although the exact cause of an AVB is not fully understood, it is believed that the conduction system may be affected during the creation of an arteriovenous loop or deployment of a septal occluder. If an AVB occurs immediately during the procedure, it may be due to mechanical injury caused by a catheter or device. It may occur as a result of mechanical rubbing of the left and right ventricular retention disks on the proximal conduction

system, resulting in a localized area of edema and inflammation. It can often be resolved quickly through medical intervention such as temporary pacing, corticosteroid or high-dose acetylsalicylic acid therapy or device removal. It is worth noting that some cases of early AVB may resolve on their own. High-dose steroid and aspirin were effective in our patient in reversing early post procedural cAVB, demonstrating that the inflammatory process probably plays a significant role in the early phase.

VSD sizing is challenging because the complexity of peri membranous VSD geometry cannot be captured by measuring 1 or 2 dimensions available by means of standard echocardiographic and angiographic imaging. Echocardiographic analysis can overestimate VSD diameter by 21%. AVB must be taken into consideration due to the increasing number of peri membranous VSDs that are closed with the device. If AVB occurs after device placement, it is highly probable that device expansion against the conducting tissue played a significant role; therefore, the use of oversized devices should be avoided. Another study suggested a farther distance from the aortic valve and closer distance to the tricuspid valve as risk factors. For various reasons, oversized devices should not be used and only those 1 mm-2 mm larger than the defect diameter have been recommended [8].

Preventing total heart block remains a challenging task, and selecting an appropriately sized device is crucial. Walsh et al. have recommended using devices that are 0.5 mm-1 mm larger in diameter than the peri membranous VSD (as determined by TEE) [9]. However, it is important to note that the device itself could potentially trigger inflammation or scar formation in the conduction tissue region, resulting in AV conduction abnormalities. Further research is necessary to fully understand the impacts of arrhythmias on such patients.

CONCLUSION

Before performing trans catheter VSD closure, it's important to consider the potential risk of atrioventricular block. TEE is a useful tool for imaging the VSD anatomy and its relationship with surrounding structures. During the procedure, there is a possibility of conduction system injury from mechanical trauma or compression caused by the delivery system or device, which could result in acute intra procedural atrioventricular block. Patients and their family should be made aware of the symptoms and seek immediate medical attention if necessary. Follow-up care is also important for patients with implanted devices both immediately and in the long-term. Future device modification (softer and less traumatic occluders) could probably help to avoid the occurrence of cAVB.

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