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Case Report

Hemodynamic Monitoring of Transcatheter Closure in Patients with Patent Foramen Ovale: A Case Study

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ABSTRACT

Patent Foramen Ovale (PFO) is a congenital cardiac anomaly characterized by the persistent opening of the foramen ovale, resulting in a right-to-left shunt due to incomplete closure of the interatrial septum after birth. Incidences of PFO is about 25% or 1 in 4 people in the world's population. Methods: this case study aimed to assess hemodynamic changes during transcatheter closure of PFO in an adult patient. The procedure was monitored for changes in ECG, pulse rate, and blood pressure, highlighting potential risks such as puncture wounds. Findings suggest that comprehensive hemodynamic monitoring is essential during PFO closure procedures. A 66 years old man with a history of symptoms of slurred speech symptoms staggering and then fainting then the PFO closure that is taken during disease management during January - May 2024 at RSUPN Dr. Cipto Mangunkusumo (RSCM). Results: during the PFO Closure procedure, there were changes in the ECG rhythm from Sinus Rhythm to PVC Rythm, decrease pulse rate, decrease in the patient's blood pressure from 176/89 to 118/78 mmHg, as well as risks such as puncture wounds. Conclusion: hemodynamic monitoring during transcatheter closure of Patent Foramen Ovale (PFO) is crucial to detect potential changes and complications. Close surveillance is necessary to identify and promptly manage procedural risks.

Keywords: hemodynamics, patent foramen ovale, slurred speech, transcatheter closure

INTRODUCTION

Patent Foramen Ovale (PFO) is the most common congenital heart defect of fetal origin and occurs in approximately 25% of the population worldwide. PFO results from the failure of closure of the foramen ovale, a normal structure present in the fetus to direct blood flow directly from the right to left atrium bypassing the pulmonary circulation (1). Foramen Ovale is a gap or shortcut in the inter-atrial septum that allows blood to flow from the right atrium to the left atrium during fetal development. Gradually the septum primum and septum secundum grow by overlapping at the foramen secundum to form an incomplete septum as an oval-shaped gap (2). Most patients with PFO are asymptomatic, but some patients may experience symptoms such as migraines with aura, risk of ischemic stroke, transient ischemic attack due to a thrombus or embolism flowing from the right side of the atrium to the left atrium through the open PFO gap (3).

The prevalence of PFO was significantly higher in the cryptogenic stroke group compared to the known-cause stroke group (59% vs 19%) (4). The prevalence of PFO incidence in Indonesia is not known for certain because the cases are rare and there has been no further research on PFO Closure. Clinically significant PFOs produce adverse consequences through two mechanisms: they serve as paradoxical embolization conduits from the venous side to the systemic circulation and because of their hole-like structure they can be a site for in situ thrombus formation (3). PFO's are classified into large (4 mm), medium (3.9-2mm), small (<2mm) the specific characteristics of PFOs require detailed assessment during the management of cryptogenic stroke patients considering the size, risk, and volume of right-to-left flow across the PFO (5). Adult patients with PFO usually have no symptoms or complaints, but the most important potential is the occurrence of migraine and the risk of ischemic stroke due to paradoxical embolism (2). Various symptoms are usually found by patients with PFO such as ischemic stroke (6), migraine with aura (7), decompression sickness (8), systemic arterial embolism (9). PFO may be found to be associated with the presence of Atrial septal aneurysm (thickening of the interatrial septum), Eustachian Valve (residual sinus venosus valve), Chiari Tissue (filamentous strands in the right atrium) (3). To diagnose Patent Foramen Ovale, several diagnostic modalities such as Transthoracic Echocardiography (TTE) and Bubble Test, as well as Transesophageal Echocardiography (TEE) can be performed (5).

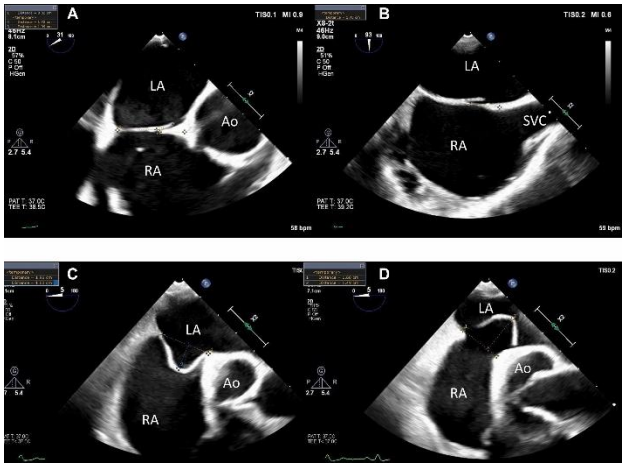

Figure 1. Transesophageal Echocardiography Patent Foramen Ovale

In the pediatric population, PFO does not require further treatment. Whereas in adults, treatment of PFO is indicated in patients with symptoms such as migraine and cryptogenic stroke. After the diagnostic examination, the next step is to determine the management of PFO such as treatment and prevention of recurrent stroke. In the treatment, antiplatelet and anticoagulant drugs can be administered, while for invasive measures, Patent Foramen Ovale Closure can be performed with a PFO occluder device that will be implanted in the PFO gap in the inter atrial septum primum (10,11). Hemodynamic monitoring aims to learn about problems that have not been identified before the procedure to anticipate problems that may occur during the procedure. Most problems have early signs and symptoms that can be recognized and then given appropriate action before serious problems occur in the patient. There are two types of hemodynamic monitoring: non-invasive consisting of level of

consciousness, blood pressure, oxygen saturation, and ECG, while invasive consists of arterial pressure, pulmonary artery pressure, and central venous pressure (12).

Risk of Paradoxical Embolism (ROPE Score)

Paradoxical embolism is one of the mechanisms of PFO occurrence in cryptogenic stroke at a young age. Paradoxical embolism can cause thromboembolic events originating from veins flowing through the PFO gap in the heart (13). To predict the association between stroke and PFO, a Risk of Paradoxical Embolism (RoPE) Score calculator can be used. By combining several factors such as age, history of hypertension, history of diabetes, history of smoking, history of stroke or transient ischemic attack, as well as the image of infarction on imaging with the result of points that must be assessed with a maximum score of 10 (14).

Table 4 RoPE score calculator

Characteristic	Points	RoPE score
No history of hypertension	1	
No history of diabetes	1	
No history of stroke or TIA	1	
Nonsmoker	1	
Cortical infarct on imaging	1	
Age, y		
18-29	5	
30-39	4	
40-49	3	
50-59	2	
60-69	1	
≥70	0	
Total score (sum of individual points)		
Maximum score (a patient <30 y with no hypertension, no diabetes, no history of stroke or TIA, nonsmoker, and cortical infarct)		10
Minimum score (a patient ≥70 y with hypertension, diabetes, prior stroke, current smoker, and no cortical infarct)		0

Abbreviation: RoPE = Risk of Paradoxical Embolism.

Figure 2. RoPE Score Calculator (15)

CASE DESCRIPTION

This research is a case study of an adult patient diagnosed with Patent Foramen Ovale with a history of symptoms of slurred speech and staggering and then fainting who was performed transcatheter closure at Dr. Cipto Mangunkusumo Hospital (RSCM). The research data was taken from secondary data from January - May 2024.

Male patient, age 66 years, weight 56 kg, height 156 cm, history of symptoms of heavier left extremities, slurred speech, staggering until fainting, has a diagnosis of patent foramen ovale and recurrent non-hemorrhagic stroke, performed PFO Closure Action on May 13, 2024.

After the patient entered the PJT cathlab ward, vital signs were obtained with blood pressure (BP) 176/89 mmHg, pulse 88 times per minute, temperature 36 degrees Celsius, oxygen saturation 98%, respiration 16 times per minute. Mr. M has no history of diabetes = 1 point, has a history of hypertension = 0 points, has no history of ischemic stroke = 1 point, has a history of smoking = 0 points, infarction on CT scan results = 1 point, and began experiencing a history of stroke at the age of 30-39 = 4 points, the total number of scores obtained by Mr. M

is 7/10 points. Mr. M's total RoPE score is 7/10 points. The patient was diagnosed with Moderate Patent Foramen Ovale diameter 2.45 mm after TEE examination.

Before the PFO closure procedure, the patient was advised to fast for 4-8 hours and wear an action suit before the patient is moved to the table and then the installation is carried out with sphygmomanometer, oximetry, and ECG electrodes. The procedure log and patient identity are entered into the hemodynamic monitor by a technician. The anesthetist performs general anesthesia with ETT No. 7.5 Cuff level 20, Fraction 50%, RR 12 times per minute.

Before TEE procedure was carried out, obtained PFO tunnel was 2.84 mm with a distance from the aorta to the PFO of 8.28 mm.

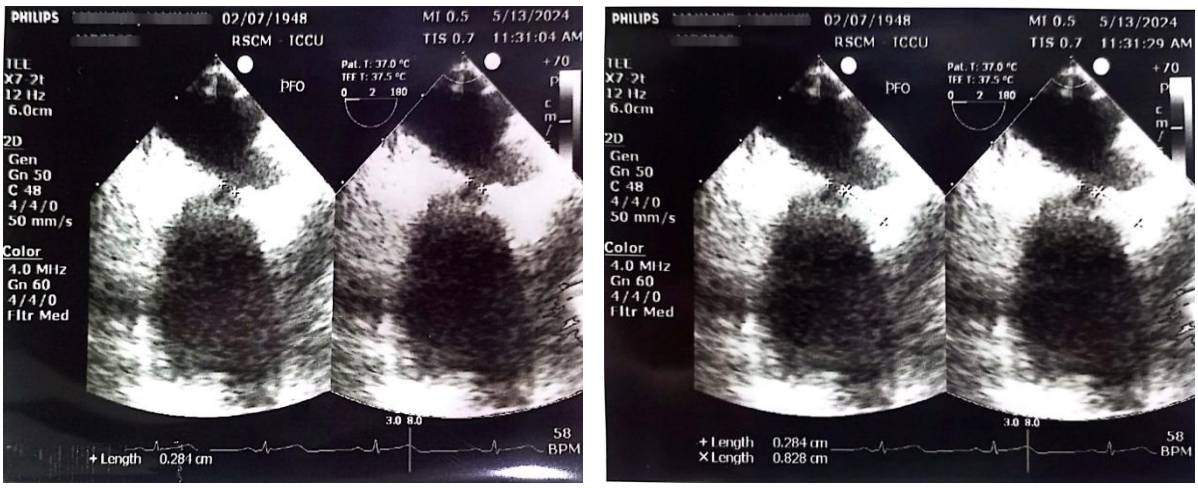

Figure 3. Measurements of PFO before Action (16)

During the PFO closure, BP when the patient started anesthesia ranged from 103-121/69-78 mmHg and pulse 74-80 bpm. When the PFO procedure is performed, a 6 Fr access sheath into the right femoral vein is inserted JR 3.5/6 Fr diagnostic catheter and 150 cm aqualiner wire changed the patient's ECG rhythm becomes a PVC rhythm appearing over a few seconds due to the position of the catheter which is difficult to pass through the PFO gap. Heparin was given 5000 units intravenously to prevent thrombus occurs during the procedure. Because the JR 3.5 diagnostic catheter had not succeeded in passing the PFO, it was replaced with a 6 Fr MPA II catheter, then add a dose of heparin as much as possible 2000 intravenous units. The MPA II catheter had not been successfully inserted, so it was replaced with a dilator transseptal long sheath, then insert the transeptal needle and managed to penetrate the PFO to the left atrium. The 6 Fr MPA II catheter is reinserted with the wire and then inserted from right atrium to left atrium through the PFO inserted into the vein pulmonalis to ensure the position is correct. The distance between the PFO and the aorta was measured, and it was found to be 13.9 mm, and it was decided to use a PFO occluder tool with OCCLUTECH measures 23 mm x 25 mm. Next enter the 9 Fr delivery sheath, after that the PFO occluder device measuring 23 mm x 25 mm is inserted and released in the inter-atrial septum heart. The tool was installed successfully via guiding TEE, A push-pull test was carried out, the position of the occluder remained fixed and did not change. Finally, the delivery sheath is removed, after the delivery sheath is removed the wound. The puncture is fixed with 2-0 silk and covered with compression gauze. Evaluation with TEE after installation of the PFO occluder device installed well and there is no residue.

Vital signs after needle entry were 132/83 mmHg and pulse 69 bpm, when the delivery sheath entered the blood pressure was 113/73 mmHg and the pulse 65 bpm. After the procedure was completed, BP was 126/79 mmHg, and the pulse was 79 bpm.

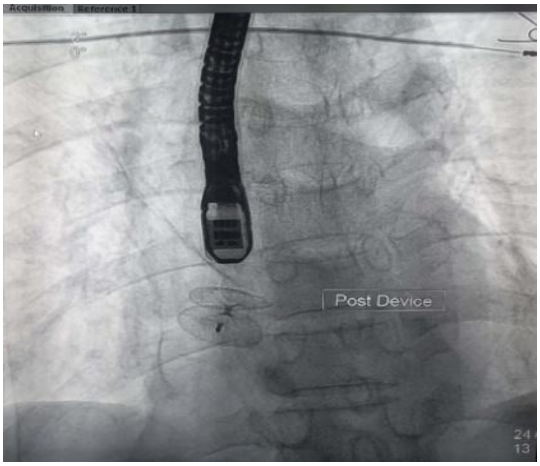

Figure 4. Post Device PFO Occluder (16)

DISCUSSION

Patient Mr. M aged 66 years, in December 2023 had complaints of heavier left extremities, slurred speech, and sudden migraines and then fainted while on the move then was taken to a hospital and a CT-Scan examination was performed on the head and the results were found to have blockages in the brain, then given antiplatelet drugs and vitamins. Because he felt that he had not improved enough, the patient asked to be referred to RSCM for further management.

Mr. M has no history of diabetes = 1 point, has a history of hypertension = 0 points, has no history of ischemic stroke = 1 point, has a history of smoking = 0 points, infarction on CT scan results = 1 point, and began experiencing a history of stroke at the age of 30-39 = 4 points, the total number of scores obtained by Mr. M is 7/10 points. Mr. M's total RoPE score is 7/10. Patients with cryptogenic stroke and at least one clinical risk factor may consider PFO closure (17).

The patient had undergone several supporting examinations such as electrocardiogram, holter monitoring, bubble test echo, and transesophageal echocardiography (TEE). The TEE examination resulted in a diagnosis of Patent Foramen Ovale with a PFO diameter of 2.45 mm and negative thrombus. The patient was admitted to the hospital on May 12, 2024, and scheduled for PFO Closure and TEE on May 13, 2024. This action is included in the secondary indication to prevent recurrent ischemic stroke (18).

After handing over the patient between the room nurse and the nurse in the cathlab, the patient was moved to the action table, using noninvasive monitoring hemodynamic shows BP 176/89 mmHg, pulse 88 times per minute, temperature 36 degrees Celsius, oxygen saturation 98%, respiration 16 times per minute. Furthermore, general anesthesia was carried out followed by a pre-treatment TEE procedure, obtained a PFO tunnel size of 2.84 mm with a distance from the aorta to the PFO of 8.28 mm, then determined the size of the PFO occluder device to be used, namely the 23 mm x 25 mm OCCLUTECH device. Based on Vitarelli's research (19), transesophageal echocardiography (TEE) has a major role in the diagnostic evaluation of PFO

in post-procedure assessment after transcatheter closure to focus TEE indications on the device closure procedure.

During the TEE procedure, there was a change in the ECG picture from Sinus rhythm to Bradycardia with HR 56 bpm, and a tension drops to 94/61 mmHg. Based on research conducted by (20) shows that bradycardia and hypotension during TEE with intra-procedural sedation can occur and cause hemodynamic changes due to the administration of anesthetic drugs, one of which is propofol.

After the access is installed, the wire and catheter are inserted, there is a change in the patient's ECG picture to a PVC rhythm appearing for a few seconds due to the difficult position of the catheter passing through the PFO, whereas BP 132/83 mmHg and pulse 69 bpm. The onset of catheter-induced ECG arrhythmias during cardiac catheterization procedures can occur when the catheter tip enters the heart chambers and hits part of the heart wall (21), or the gap is too small to pass through the delivery sheath, the inner core should be used for a certain auxiliary expansion. Because the tip of the inner core is sharp, the cooperation between the sonographer and the operator is very important during this process (22).

After the delivery sheath is removed, BP was 126/79 mmHg, and the pulse was 79 bpm, the puncture wound is fixed with 2-0 silk and covered with pressure dressing. This can happen and is included in the risk during the catheterization procedure because the catheter goes in and out of the sheath and it is difficult to penetrate the PFO gap and the sheath size changes, so the puncture incision becomes elongated. The PFO Closure procedure usually lasts for one to two hours, but in this case for 5 hours. This is also related to the risks and complications during the procedure based on several factors in each patient such as the anatomy of the blood vessels, the level of difficulty, and the operator's experience in the procedure (23).

The action was completed, the patient's consciousness was still under the influence of anesthetic drugs. In addition, it is necessary to pay attention to several observation plans such as monitoring the patient's hemodynamics after the action, the patient's consciousness condition, signs of bleeding at the puncture site, and immobilization of the right leg for 2 hours after the action. Patients are recommended to take acetosal for 6 months. Research (24) reported that transcatheter closure of PFO accompanied by antiplatelet treatment for at least 6 months is superior to antiplatelet therapy alone for secondary stroke prevention.

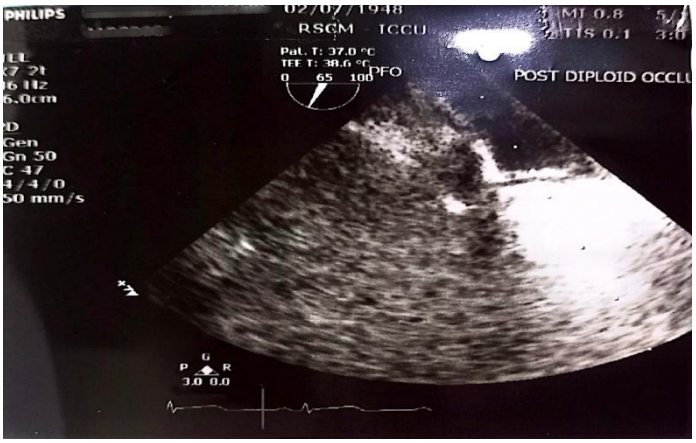

Figure 5. Post PFO Occluder

CONCLUSION

Hemodynamic monitoring during transcatheter closure of PFO patients in the Cipto Mangunkusumo Hospital cathlab room using monitoring superficial and it is in accordance with the procedure. The patient's hemodynamic monitoring picture before device insertion or during the TEE procedure changes the ECG picture to sinus bradycardia and decreases blood pressure (hypotension) due to anaesthesia drugs. It became normotension after the procedure. Hemodynamic monitoring during the installation of the PFO occluder device did not significantly change the patient's blood pressure, pulse rate, saturation, ECG. It depends on selecting the number and type of wire, cooperation between the sonographer and the operator's expertise so as not to touch the part of the heart wall where the device/occluder will be inserted. The hemodynamic picture after the PFO occluder device was installed, the patient's hemodynamic condition returned to normal with the results of blood pressure 126/79 mmHg, HR 70 bpm, SpO2 100%, and RR 12.

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CONFLICT OF INTEREST

The author confirms there is no conflict of interest to disclose about the subject matter of the publication.

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