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CASE PRESENTATION

The role of imaging in percutaneous interventional occlusion of the left atrial appendage. Case report. Thrombotic material formation on watchman device due to antithrombin-III deficiency

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Abstract: On patients with non-valvular atrial fibrillation, permanent anticoagulation at a score of CHA2DS2-VASc ≥1 is recommended. In relation to this, the risk of hemorrhage represented by HAS-BLED score increases. The concept of percutaneous interventional occlusion of the left atrial appendage is established more and more during the last years as an alternative to permanent therapy with anticoagulants on patients with non-valvular atrial fibrillation and with an increased risk of hemorrhage. Imaging, through transesophageal echocardiograghy (TEE), has the main role in performing the percutaneous interventional occlusion of the left atrial appendage. Thus, pre-interventional, there should be established the patient's selection, atria anatomy, left atrial appendage anatomy, procedures planning, optimum sizes for the device and the contraindications for the procedure should be excluded. Intra-procedural, in combination with fluoroscopy under angiographic control, the following are assured: transseptal puncture guidance, placing and anchoring the device, excluding residual flux, viewing intra-procedural complications such as, in our case, the formation of thrombotic material on the tip of Watchman device due to antithrombin-III deficiency and on this way, the procedural success of the intervention is being assured. Post-interventional, the complications assessment and occluder efficiency on short and long term shall be assured.
Keywords: atrial fibrillation - transesophageal echocardiograghy (TEE) - Watchman device - antithrombin-III deficiency.

Rezumat: La pacienții cu fibrilație atrială non-valvulară este recomandată anticoagularea permanentă la un scor CHA-2DS2-VASc ≥1. În raport cu acesta crește și riscul de hemoragie reprezentat prin scorul HAS-BLED. Conceptul de ocluzie intervențională percutanată a apendicelui stâng atrial se etablează din ce în ce mai mult în ultimii ani ca alternativă la terapia permanentă cu anticoagulante la pacienții cu fibrilație atrială non-valvulară și risc crescut de hemoragie. Imagistica, prin intermediul ecocardiografiei transesofagiene (ETE), are rolul principal în efectuarea ocluziei intervenționale percutanate a apendicelui stâng atrial. Astfel preintervențional se stabilește selecția pacientul, anatomia atriilor, anatomia apendicelui stâng atrial, planificarea procedurilor, dimensiunile optime ale dispozitivului și se exclud contraindicațiile pentru realizarea procedurii. Intraprocedural în combinație cu fluoroscopia sub control angiografic se asigură ghidarea puncției transseptale, plasarea și ancorarea dispozitivului, excluderea fluxului residual, vizualizarea complicațiilor intraprocedurale, precum în cazul nostru formarea de material trombotic la nivelui vârfului dispozitivului Watchman datorită deficitului de antitrombină III, astfel asigurânduse succesul procedural al intervenției. Postintervențional se asigură evaluarea complicațiilor și eficacității ocluderului pe timp scurt și lung.
Cuvinte cheie: fibrilație atrială – ecografie transesofagiană (TEE) - Dispozitiv Watchman - deficit de antitrombină-III.

INTRODUCTION

On patients with atrial fibrillation without anticoagulants treatment, the global risk of stoke is 5 times higher. Thus, this arrhythmia remains one of the major causes for stroke, sudden death and cardiovascular morbidity in the world. For this reason, permanent anticoagulation is recommended on patients with atrial fibrillation and a score of CHA2DS2-VASc ≥1 accor-

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ding to the current guide for atrial fibrillation treatment and management developed by the *European Society of Cardiology* (ESC)[1]. Drug therapy with non-vitamin K anticoagulants is very efficient in preventing the stroke and reduces the risk of brain hemorrhage in comparison with vitamin K antagonist therapy (VKA)[2]. The bleeding risk represented by HAS-BLED score is partially congruent with CHA2DS2-VASc score. According to the European Society of Cardiology (ESC), the relative contraindication regarding oral anticoagulants is represented for atrial fibrillation not only by HAS-BLED score, but also by the clinical assessment made by the attending physician, as well as by patient's tendency of falling, for example, due to a posture and walking disorder[3]. Patients with contraindication for permanent anticoagulation and with non-valvular fibrillation are represented in Garfield Registry (GARFIELD-AF Registry) by 3.2% of patients with CHA2DS2-VASc score between 0 and 1, as well as by 9.6 % of patients with a CHA2DS2-VASc score between 2 and 6[4].

Transesophageal echocardiograghy (TEE) is useful for additional assessment of valvulopathies and also for excluding intracardiac thrombi, especially on left atrial appendage (LAA) in order to facilitate early cardioversion or catheter ablation[5]. Once it was observed that approximately 90% of thrombi have been produced on non-valvular atrial fibrillation on the left atrial appendage (LAA), systems for its occlusion and closure have been developed by means of interventional occlusion[6-9]. One of these devices is represented by the Watchman device (Boston Scientific), which represents one of the best devices scientifically studied. Through transesophageal echocardiograghy (TEE), more measurements of the left atrial appendage (LAA) are performed, on at least 4 angles of echocardiographic views which are: at 0, 45, 90 and 135°. Through that, one can precisely determine the opening of the left atrial appendage (LAA) respectively the size of the Watchman device. Additionally 3D transesophageal echocardiograghy can be used in order to quantify the opening surface of the left atrial appendage (LAA). The anatomical morphologies of the left atrial appendage (LAA) most commonly encountered are: the windsock, the broccoli, the cactus and the chicken wing.

From these different morphologies, the chicken wing is the most frequent one[10]. In case of a complex anatomy of the left atrial appendage (LAA), preinterventional measurements can be made through computerized tomography (CT) or through magnetic resonance tomography (MRT).

Watchman device implantation technique

On most facilities, this procedure takes about 30-45 minutes and is minimally invasive. This procedure is performed under sedation; general anesthesia is not required. Before beginning the procedure, intracardiac thrombi and pericardial effusion are excluded and optimum sizes of the device are determined in accordance with the left atrial appendage (LAA) anatomy using transesophageal echocardiograghy (TEE). After the device implantation, this should present a compression of about 72% up to 90% from its nominal diameter, according to the manufacturer´s instructions.

After the right femoral vein puncture and after placing the catheter into the right atrium, transseptal puncture is performed at the proper height of the septum, posterior on the inferior septal area, under fluoroscopic guidance by means of Pigtail catheter, respectively echographic control by means of intraprocedural transesophageal echocardiograghy (TEE) (Figure A - image 1 and 2).

Through the transseptal guide wire, the guiding catheter with a thickness of 12-14 French is being introduced for the occlusion system. Once the air from the occlusion system is being eliminated by means of saline NaCl injection, its inclusion into the transseptal guiding catheter follows. Under fluoroscopic and echographic control, the device is being placed and anchored into the left atrial appendage (LAA). After that, Tug test is being performed in order to verify optimal

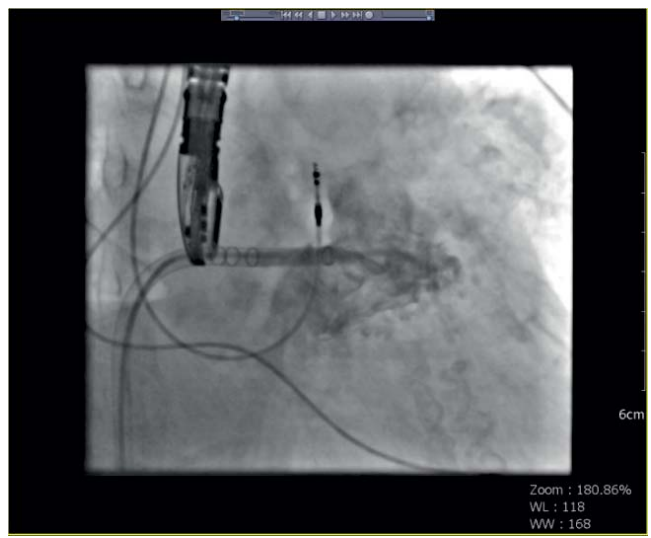

Figure A. Interventional occlusion of the left atrial appendage by means of a 27 mm Watchman device guided by angiographic control and intraprocedural TEE. **Image 1.** After transseptal puncture the Watchman device is guided inside the left atrial appendage (LAA), highlighting its anatomy through fluoroscopy after administrating the contrast agent by means of the Pigtail catheter.

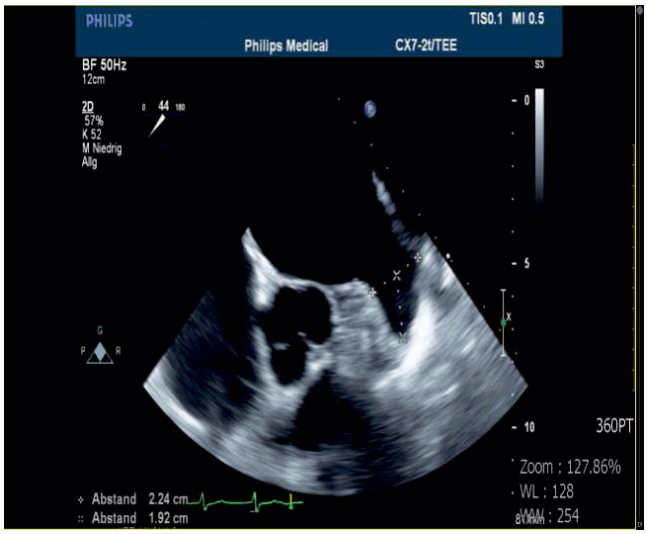

Image 2. Establishing optimal sizes of the device depending on the anatomy of the left atrial appendage (LAA) through transesophageal echocardiograghy (TEE) on an echocardiographic view angle of 44°.

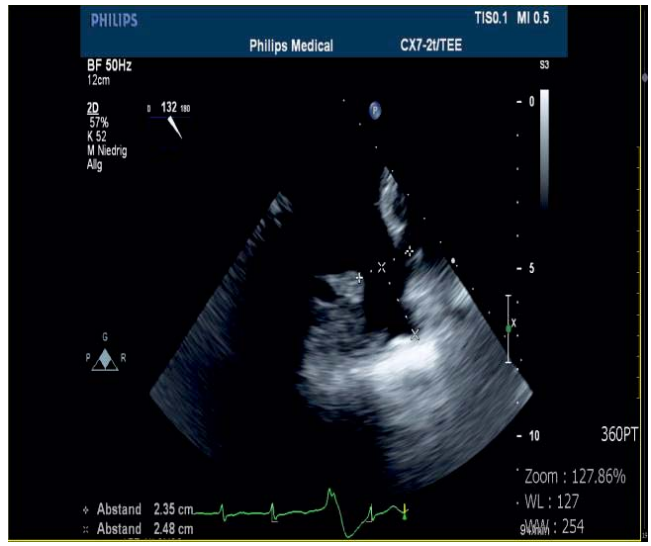

Image 3. Respectively on an echocardiographic view angle of 132°.

placement and stability of the Watchman device. In case of a suboptimal placement of the device, this will be retraced into the occluder system and then, its optimal placement will follow. After its final placement, a contrast agent fluoroscopic representation respectively a test for the presence of residual flux are performed. This will be done on the side part of the device through transesophageal echocardiograghy (TEE) as well as through 3D transesophageal echocardiograghy. Once the Watchman device is correctly placed, its release from the screw connection of the occluder system will be the next step. On the day following the device implantation, the presence of pericardial effusion must be excluded.

This procedure is made under the control of activated coagulation time (ACT), anticoagulation being performed with unfractionated heparin (UFH).

CASE PRESENTATION

The 84 years old patient came in for elective hospitalization, respectively for the left atrial appendage interventional occlusion with a Watchman device due to bleeding complications occurred under new anticoagulants treatment. According to the patient's medical history the following are known: transient ischemic attack (TIA) with transitory aphasia, symptomatic epilepsy with complex focal seizures, decompensated heart failure with pleural fluid on the left side, medium tricuspid insufficiency, mild aortic insufficiency, mild mitral insufficiency, atrial fibrillation with a 7 points CHA2DS2-VASc score and a risk for stroke of 10% per year, a 5 points HAS-BLED score and thus having a very high hemorrhagic risk, cardiovascular risk - hypertension (HT), repeated upper digestive hemorrhage with iron deficiency under anticoagulant therapy with rivaroxaban within GAVE syndrome (gastric antral vascular ectasia) with folate deficiency.

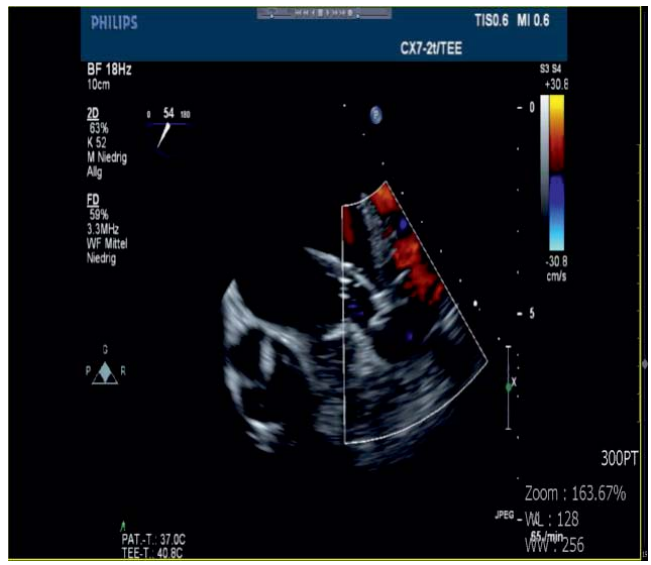

Image 4. Device placement and anchorage into the left atrial appendage (LAA).

On admission, the patient's health condition was generally good: from the cardiovascular point of view – stable; with normal clinical, local and neurological examination, without significant information. Medication: Bisoprolol 2.5 mg, Ramipril 2.5 mg, Torasemide 10 mg, Nitrendipine 5 mg, Levetiracetam 250 mg, Oxycodone 30 mg, Omeprazole 20 mg, Folsäure 5 mg, Ferro Sanol 50 mg, Calcium D osteo, Lactulose 10 ml.

Pre-interventional transesophageal echocardiograghy (TEE) was ambulatory performed into the cardiology office of the medical care centre.

Interventional occlusion of the left atrial appendage

During the intervention, once the right femoral puncture respectively the transseptal puncture were performed without any complications, the guiding catheter and Watchman device were introduced. Thrombotic material was formed on the tip of the Watchman device viewed on transesophageal echocardiograghy.

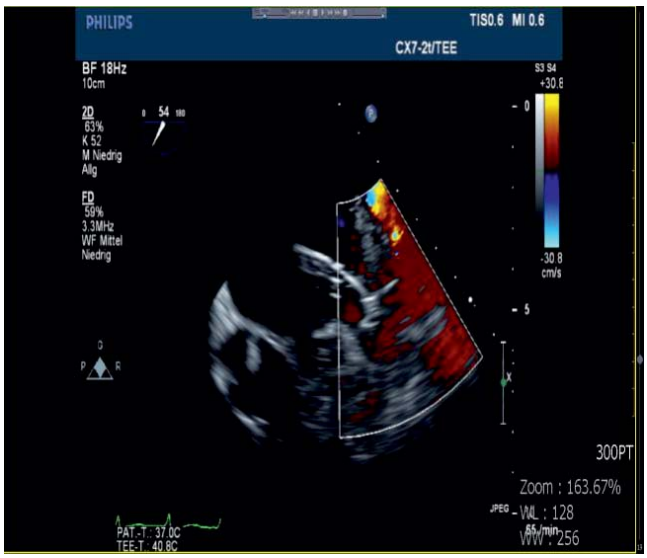

Image 5. Tug test in order to verify optimal placement and stability of the Watchman device.

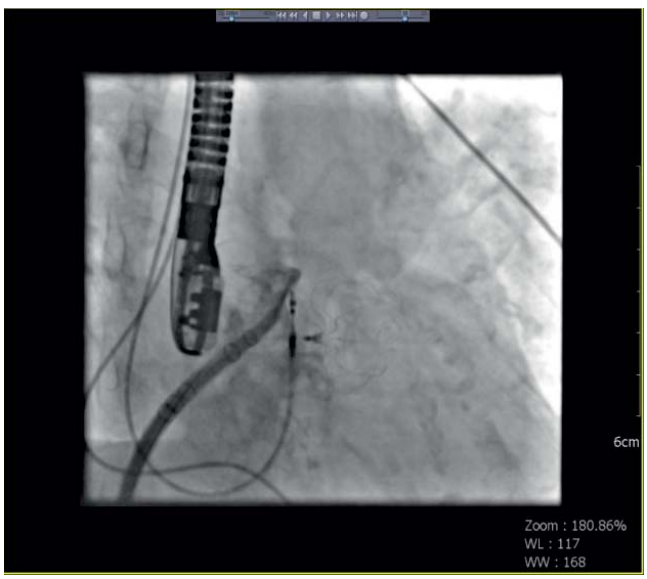

Image 6. Fluoroscopy performance. The Watchman device nitinol structure is being revealed in occlusion position, after its release from the screw connection of the occlusion system.

Then, the device was replaced by a multifunctional 8 F catheter in order to suck out over and over again the biggest parts of the thrombotic material. Because of some small residual parts of the thrombotic material on the guiding catheter, the decision to stop the intervention was made. Thus, an 8 F catheter has been reintroduced and, under continuous suction the guiding catheter from the sept is being withdrawn. That way, all residual parts of the thrombotic material could be eliminated. When the control of activated clotting time (ACT) was made, only therapeutic values were determined, the anticoagulation being made with unfractionated heparin (UFH).

During laboratory examination in hemostasis, antithrombin-III deficiency was found. This caused the thrombotic material formation during the intervention. Post-interventional, no other complication was found, both imaging and clinically.

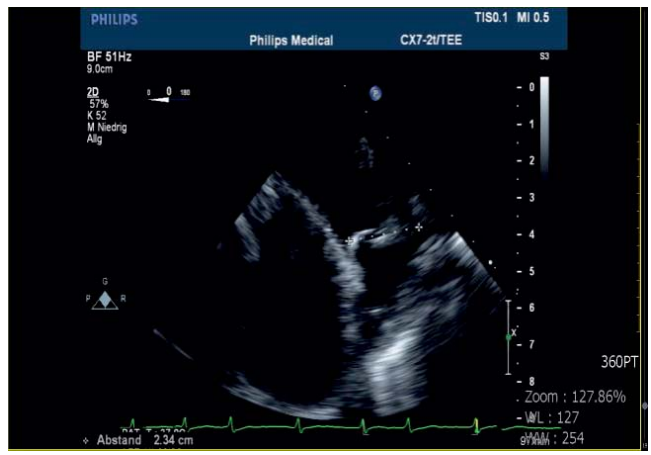

Image 7. Echocardiographic control by means of device size measurement after implant at a 0° view angle.

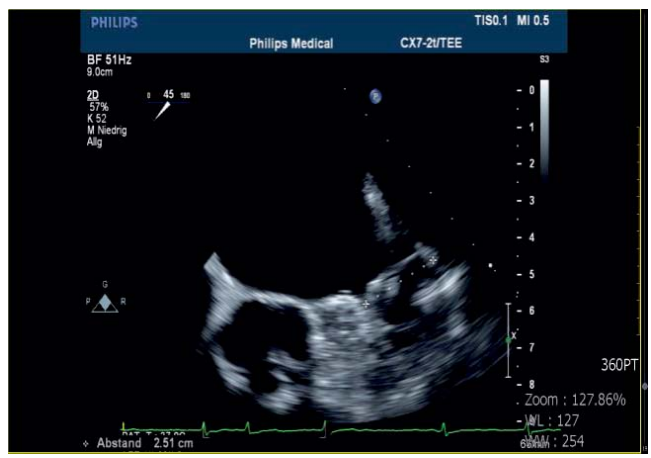

Image 8. Respectively a 45° view angle.

Antithrombin (antithrombin-III)

Antithrombin represents the main inhibitor of blood clotting. This mainly inactivates factors Xa, IXa and IIa (thrombin) enzymes ans also performs inactivation actions over factors XIIa, XIa, VIIa complex and tissue factor. In adults, concentrations below 40-70% are associated with a tendency to thrombosis[11]. Congenital antithrombin deficiency is very rare. The reduction of acquired antithrombin concentration is to be differentially considered depending on clinic signs, therefore, this is less significant on hepatic diseases than on consumptive coagulopathy[12]. Causes for antithrombin deficiency can be represented: by synthesis disorders (very rarely congenital, liver diseases, asparaginase treatment), in increased consumption (consumptive coagulopathy - disseminated intravascular coagulation (DIC)), in inflammatory processes (systemic inflammatory response syndrome, sepsis, systemic hyperfibrinolysis), in loses (nephrotic syndrome, ascites, wounds with large surface, massive blood transfusions) or on newborn babies (physiological).

After 4 weeks, a 27 mm Watchman device has been implanted under antithrombin-III substitution, without any complication.Therapy with Clopidogrel 75 mg has been recommended for 6 months and Aspirin 100 mg for the rest of her life. A control should be made through transesophageal echocardiograghy after a period of 3 and 6 months from the intervention.

Transesophageal echocardiograghy (TEE)

The role of imaging in percutaneous interventional occlusion of the left atrial appendage is extremely essential and irreplaceable, having a pre-interventional, intra-procedural and post-interventional role.

By using pre-interventional transesophageal echocardiograghy we can establish patient´s selection, atria anatomy, fossa ovalis identification, left atrial appendage anatomy, procedures planning, optimum sizes of the device and we can exclude the contraindications in performing this procedure. Contraindications are represented by the pre-existence of: an interatrial shunt, atrial septal aneurysm, intracardiac thrombi or left atrial appendage thrombi, pericardial effusion, mitral stenosis with orifice area smaller than 1.5 cm^2, a cardiac masses or tumours, complex aterom with mobile plate in the aortic arch or descendent aorta, as well as by placing the device, interference with any intracardiac or intravascular structure.

By using intra-procedural transesophageal echocardiograghy in combination with fluoroscopy we can assure the guidance of septal puncture, device placement and anchorage and we can exclude residual flux. In our case, we could visualize the formation of thrombotic material on Watchman device due to antithrombin-III deficiency and this way we could immediately and totally remove the thrombotic material without any other interventional complications.

By means of post-interventional transesophageal echocardiograghy we can assure complications assessment, such as exclusion of an iatrogenic shunt in the interatrial septum, of pericardial effusion, of residual flux or the appearance of a new paraprotetic flux or the appearance of thrombi on the device. We can also assess the efficiency, stability and the position of the occluder on short and long term.

CONCLUSION

The Watchman device, through endotelialisation, permanently eliminates the possibility of thrombi formation on the left atrial appendage (LAA) and so, the risk of stroke on non-valvular atrial fibrillation is being considerably reduced. It represents an alternative to anticoagulant treatment. Anticoagulant treatment interruption on long term, after performing interventional occlusion of the left atrial appendage, can eliminate or visible reduce the hemorrhagic risk. This way, the Watchman device can represent a cheaper alternative, as an unique procedure that eliminates the risk of a stroke, from which a specific group of patients could benefit. As a result, percutaneous interventional occlusion of the left atrial appendage is the only procedure that could considerably reduce hemorrhagic risk on patients with triple therapy (antiplatelet double therapy and anticoagulant). The success rate of this procedure rises above 95%, depending on the left atrial appendage (LAA) anatomy as well as on the experience of the team that performs the procedure.

Echocardiography represents imaging examination as main role, through which percutaneous interventional occlusion of the left atrial appendage is performed. That way, the thickness of the device could be determined based on the left atrial appendage (LAA) anatomy, intra-procedural complications could be viewed in real time - as in our case, thrombotic material formation on Watchman device due to antithrombin-III deficiency - and major complications could be avoid.

Conflict of interest: none declared.

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