

Endoprosthesis Implantation at the Entry Pathway of the Right Atrium Monitored by Intracardiac Ultrasound

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Obstructions of the upper venous system may be due to spontaneous thrombosis or the presence of hemodialysis or chemotherapy catheters, or even the presence of extrinsic compression due to intra-thoracic tumors. The use of endoprosthesis for the treatment of these obstructions has become common practice, and its indications include situations of risk for pulmonary embolism, superior vena cava syndrome, and loss of vascular access. Within this context, the use of intracardiac ultrasound may be useful in evaluating the extension and severity of the obstructive lesion, besides providing important information about the mural and intraluminal morphology of the venous system. The authors report the case of a patient with superior vena cava syndrome caused by thrombosis at the entry pathway of the right atrium, besides discussing the subject by means of literature review.

Introduction

Obstructions of the upper venous system have a varied physiopathogenesis, including the occurrence of spontaneous thrombosis (1 to 4% of all venous thromboses, the presence of hemodialysis or chemotherapy catheters, and even extrinsic compression caused by intrathoracic tumors¹⁻³). The use of endoprosthesis for the treatment of obstructions in the venous system has become common practice, and it has been indicated for situations of risk of pulmonary embolism, superior vena cava syndrome, and loss of vascular access⁴. Within this context, the use of intravascular/intracardiac ultrasound may be useful in evaluating the extension and severity of the obstructive lesion, besides providing important information about the mural and intraluminal morphology of the venous system. The authors report the case of a patient with obstruction of the superior vena cava secondary to thrombosis of totally implantable catheter, which was impairing the right atrium. The patient had a polytetrafluoroethylene (PTFE)-covered endoprosthesis implanted in the superior vena cava/right atrium system, which was monitored by intravascular/intracardiac ultrasound.

Key words

Superior vena cava syndrome; endoprosthesis; ultrasonography, interventional.

Case Report

The case of a 61-year-old female patient with previous radical mastectomy due to infiltrating ductal carcinoma and a totally implantable catheter implanted for chemotherapy is described. Eleven months after catheter implantation, the patient began to experience edema of the face and upper limbs, as well as cyanosis of the face. Computed tomography of the chest showed the presence of thrombosis in the superior vena cava and upper portion of the right atrium, confirming the diagnosis of superior vena cava syndrome (SVCS). No extrinsic compression was observed.

Twenty days after the onset of symptoms, the implantable catheter was removed, and no remission of the symptoms was observed. Patient was referred to venography and right cardiac catheterization. An injection into the right subclavian vein and right femoral vein allowed visualization of the complete occlusion in the upper portion of the right atrium, immediately after the origin of the azygous system up to the tricuspid valve region. The upper venous system drained into the azygous system. Pressures in the right ventricle and pulmonary artery were within normal ranges (mean pulmonary arterial pressure = 20 mmHg) (Figure 1).

Due to the severe clinical impairment, surgical risk and guarded prognosis, surgery was contraindicated. The percutaneous procedure was indicated for implantation of the PTFE-covered endoprosthesis through the femoral artery, without predilation in order to prevent thrombi displacement to the pulmonary system. The right femoral and right subclavian veins were punctured, and the right atrium was injected with contrast material, confirming the obstruction of the entry pathway. Non-fractionated heparin (10,000 UI) was administered endovenously. A 0.014" Shinobi wire (Cordis, FL, USA) was used to move past the occlusion; recanalization was performed by dilation with a 3mm x 20mm balloon. A 0.035", 300cm DAIG guidewire (St. Jude Medical, MN, USA) was positioned through the femoral vein. A 9F sheath was introduced over the guidewire to the right internal jugular vein, and a 9Mhz intravascular/intracardiac ultrasound catheter (Boston Scientifics, MN, USA) was positioned.

Using the Galaxy system (Boston Scientifics, MN, USA), ultrasound images were obtained which, combined with the angiographic images, enabled assessment of the presence and distribution of the thrombus, its relationship with the azygous system and with the tricuspid valve (figures 2 to 5), as well as the dimensions of the endoprosthesis to be used. Balloon predilation remained a non-viable option due to the ultrasonographic findings showing a large thrombus. A 17 x 27 mm (16F) Apolo endoprosthesis (Nano Endovascular, SC,

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Fig. 1 - Occlusion of the upper portion of the right atrium up to the proximity of the tricuspid valve. Drainage through the azygous system is seen.

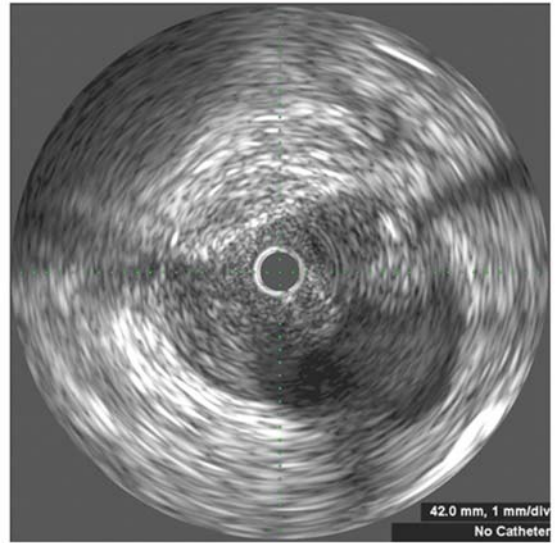


Fig. 3 - Intravascular/intracardiac ultrasound after recanalization of the entry pathway of the right atrium showing thrombosis and deceleration of the blood flow.

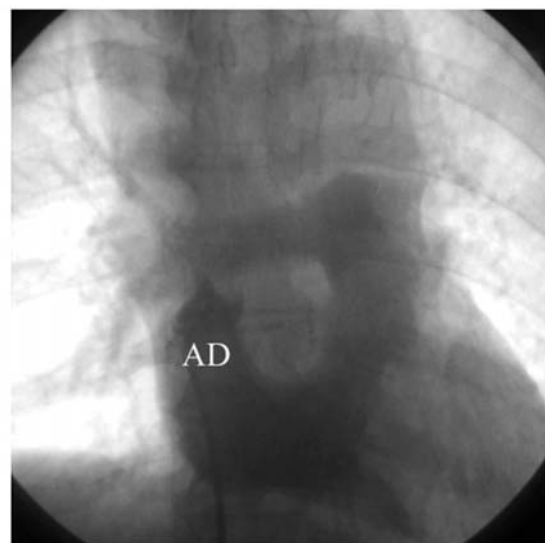


Fig. 2 - Occlusion of the upper portion of the right atrium (RA).

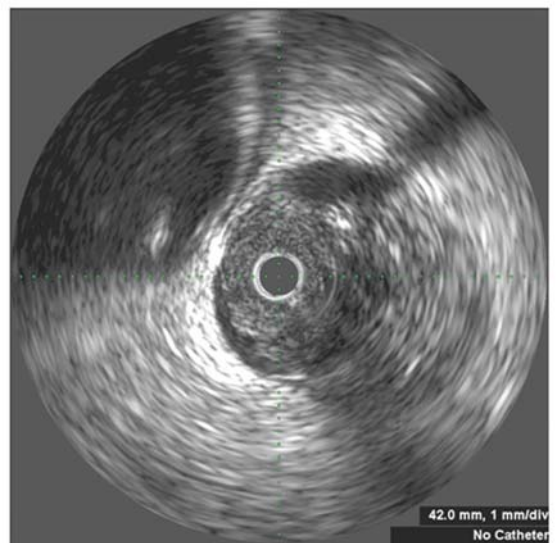


Fig. 4 - Intravascular/intracardiac ultrasound after recanalization of the entry pathway of the right atrium showing thrombosis and deceleration of the blood flow. Left atrium and the inter-atrium septum are seen between 9 o'clock and 12 o'clock positions.

BR) was implanted through the femoral puncture access, followed by balloon postdilation (a Multitrack 18x50mm balloon, Numed, NY, USA). At the end of the procedure, new angiographic images (figure 6) and ultrasonographic images (figure 7) were obtained. Despite the reestablishment of an adequate blood flow to the right atrium entry pathway, as well as flow maintenance in the azygous system, a thrombus was detected at the proximal rim of the endoprosthesis.

Follow-up pulmonary arteriography did not show any thrombi images, and the pulmonary artery pressures remained within normal ranges. While still in the hemodynamics

room, the patient experienced a considerable improvement of cyanosis and noticeable reduction of facial edema. She was discharged two days after the procedure, and was on acetylsalicylic acid (200mg) and anticoagulation with oral warfarin 5mg for 6 months, with a target INR (International Normalized Ratio) between 2.0 and 3.0.

At the 4th and 10th months of follow-up, the patient underwent a hemodynamic study with catheterization of the right chambers plus angiography associated with intravascular/

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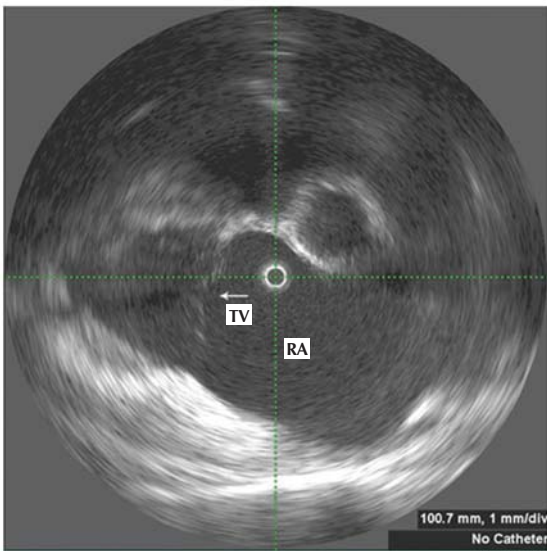


Fig. 5 - Intravascular/intracardiac ultrasound after recanalization of the entry pathway of the right atrium (RA) showing the tricuspid valve (TV) free of the thrombus.

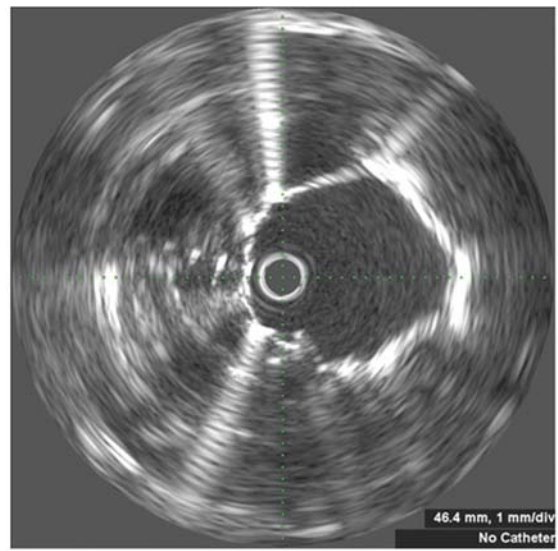


Fig. 7 - Intravascular/intracardiac ultrasound showing adequate apposition of the endoprosthesis.



Fig. 6 - Venous angiography showing recanalization of the superior vena cava/right atrium and the image of a thrombus at the upper portion of the endoprosthesis.



Fig. 8 - Follow-up venous angiography made at 10 months showing maintenance of recanalization of the superior vena cava/right atrium and no image of a thrombus in this portion.

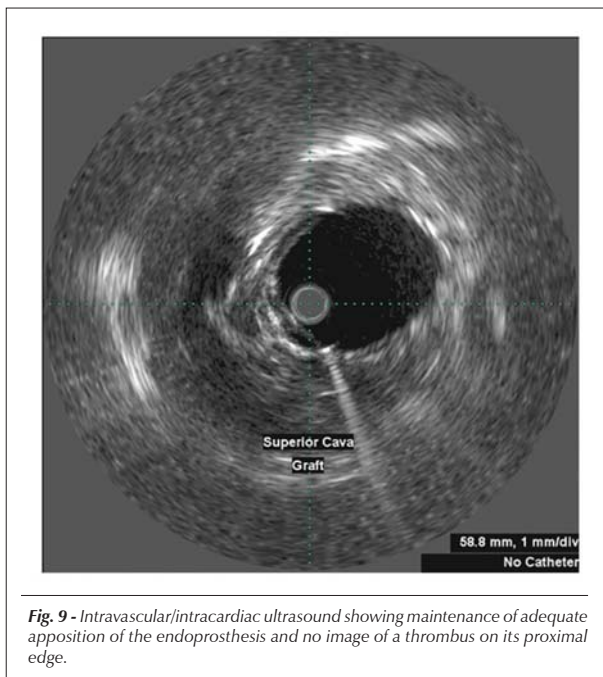
intracardiac ultrasound, which showed that the initial results had been maintained and that the thrombus at the proximal rim of the endoprosthesis had disappeared (figures 8 and 9). After two years, the patient was on 200mg of ASA, asymptomatic and performed routine daily activities. Chest X-ray does not show displacement of the endoprosthesis.

Discussion

Thrombosis in the upper venous system is a rare occurrence,

and is usually associated with the presence of catheters implanted in the venous system either for chemotherapy or hemodialysis; thrombi may also occur in certain situations after radiotherapy¹. There are also reports of superior vena cava syndrome in patients with pacemakers^{2,3}. The diagnosis of this syndrome may be difficult when the symptoms are mild and associated with minor obstructions or caused by extensive collateral circulation. The presence of edema helps to make most diagnoses.

Treatment in these cases includes thrombolysis, balloon



dilation, stenting, surgery, or a combination of these procedures. However, the best strategy has not yet been established. Chemical thrombolysis performed with thrombolytic agents (rTPa, streptokinase) does not provide assurance as to recanalization, has poor success rates, and may pose a risk of bleeding. Surgery in these cases is considered a major procedure which demands extracorporeal circulation, thus raising the morbidity-mortality risk in a group of patients with non-established diagnoses and high comorbidities, mainly those with neoplasms or chronic renal insufficiency that are undergoing hemodialysis. Current trends consist of employing the percutaneous technique, whose superiority has been described in literature, both for recanalization of occlusions and superior vena cava stenosis without involvement of the right atrium and/or tricuspid valve⁴. Balloon angioplasty for the treatment of superior vena cava obstructions provides immediate adequate results⁵. On the long run, however, its efficacy is compromised by elastic retraction. On the other hand, the use of self-expandable stents or balloon-expandable stents significantly reduces the occurrence of elastic retraction, thus eliminating one of the factors responsible for restenosis. Self-expandable stents, in particular, adapt better to the anatomy of overlying structures by determining a type of negative elastic retraction, as they continue to expand over time⁶ besides adapting to sites subjected to an ample range of movements, such as joints or angulations. The use of PTFE-covered endoprosthesis for the treatment of superior vena cava syndrome with the involvement of the right atrium has not yet been described in literature, and in the case reported, the initial success was maintained throughout the two-year follow-up. The considerable clinical experience with aortic endoprostheses without oral anticoagulation leads us to the discussion of high and low pressure territories, and the need for anticoagulation. Presumably,

until reendothelialization is achieved in the venous system, oral anticoagulation is essential mainly to avoid pulmonary embolism. It is not known if the endoprosthesis coating poses any risk for embolic events. Therefore, prolonged oral anticoagulation therapy was administered for six months. Oral anticoagulation was interrupted after this period, and the reduced risk of thrombosis was attributed to the endothelialization of the endoprosthesis. Besides the images obtained by angiography and intravascular ultrasound, the maintenance of normal pressure levels within the pulmonary artery indicated absence of significant embolism episodes. One should consider, however, the possibility of microembolism in the pulmonary territory, which is known to have intense fibrinolytic action.

Another application of percutaneous intervention in the venous system includes the palliative treatment of the superior vena cava syndrome of neoplastic origin. Several case reports are described in literature and, as such, the technique has been shown to be safe, easily-performed, with high rates of success, and providing rapid relief of symptoms when compared to conventional treatment, chemotherapy, or radiotherapy alone, and it may become the procedure of choice for these situations⁷⁻¹⁰. The use of endovascular biopsy could be associated with stenting to allow a definite diagnosis to guide anti-tumoral therapy¹¹.

The use of intravascular/intracardiac ultrasound for the percutaneous treatment of venous system obstructions has been studied, providing details not visible on venography. With this technique, the formation of collaterals proximal to a venous obstruction may be differentiated from intraluminal trabeculations¹². The extrinsic compression and resulting deformity of the venous lumen, on the other hand, may be directly visualized. Ultrasound seems to be better than venography for assessing the grade of the obstruction, as venography would underestimate the grade of the lesion, particularly in cases of extensive occlusions¹². Moreover, ultrasound provides data on the morphology of the luminal wall, presence of thrombi or debris and, in case of stenosis secondary to multiple punctures, the fibrous component may also be visualized¹²⁻¹³. It also enables determination of the extension and grade of the obstructive lesion, mainly to define the extension and the diameter of the balloons and/or stents to be employed, besides providing data on the proximal and distal edges of the stent and its adequate apposition¹²⁻¹³. The use of intravascular/intracardiac ultrasound helps to establish the adequate positioning of the prosthesis without compromising the valve.

Conclusion

The knowledge acquired through the use of intravascular and intracardiac ultrasound in coronary percutaneous interventions and cardiopathies enables us to use it as an important ancillary tool in treating total or incomplete obstructions of the venous system, mainly in the group of patients at risk and low rates of success with other therapies. Percutaneous treatment associated with intravascular and intracardiac ultrasound may become the method of choice in the treatment of obstructive lesions of the venous system.

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