

ENETS Consensus Guidelines for the Standards of Care in Neuroendocrine Tumors: Echocardiography

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Introduction

Carcinoid heart disease is observed in 3–4% of all patients with a neuroendocrine tumor and in 40–50% of those with a carcinoid syndrome [1, 2]. Details on well-differentiated neuroendocrine jejunal-ileal tumors have already been discussed in the ENETS Consensus Guidelines and the reader is referred to these Guidelines [3]. Here technical questions and quality management for the diagnosis and follow-up of carcinoid heart disease will be discussed.

Involvement of the tricuspid leaflets grade 2–3 occurs in 90%, a stenosis of the pulmonary leaflets in 50%, while regurgitation is seen in 81% of the patients during the course of the disease [4, 5]. Carcinoid heart disease is a relatively late manifestation of neuroendocrine tumors; however, it has an important impact on the prognosis of these patients. Thus, early diagnosis and treatment is mandatory in each patient with a carcinoid syndrome. Echocardiography is the gold standard for detection of carcinoid heart disease. This article will concentrate on technical details for echocardiography. The information provided should help those not experienced with this disease to diagnose carcinoid heart disease and provide high-quality information of echocardiographic investi-

gations. The information provided by echocardiography will be the basis for clinical decisions and may well influence the prognosis and outcome of the patient.

What Are the Characteristics of Carcinoid Heart Disease?

There are specific characteristic features of carcinoid heart disease, such as thickening of valvular leaflets, valvular cups and chordae. Due to these changes, there is reduced excursion of the valvular leaflets, cups and chordae. In addition, retracted, shortened and fixed leaflets or cups can be observed. These changes may subsequently lead to valvular regurgitation and/or stenosis, resulting in right ventricular dilatation and reduced function, as well as right atrial dilatation.

Technological Requirements for Echocardiography and Documentation

As a basic standard equipment for high-quality echocardiography, a midrange platform with the ability to perform two-dimensional, color-coded pulsed-wave and

continuous-wave Doppler investigations is needed. The optimal recommended equipment could be a high-end platform with the ability to perform stress echocardiography, transoesophageal echocardiography, three-dimensional echocardiography, tissue Doppler echocardiography and investigations with transpulmonary contrast agents. Visualization should be electrocardiographically triggered. Multiple frequency imaging technology is recommended for the transducers. Digital documentation of all images, as well as computerized documentation of images and reports, is recommended.

Patient Information for Optimal Cooperation

For optimal cooperation, adequate information should be provided to the patient. Thus, the patient should be informed that:

(1) Transthoracic echocardiography is a painless investigation in which three leads are attached to the chest of the patient for ECG and a probe is placed on the chest to scan the heart with ultrasound.

(2) In order to detect the possibility of a patent foramen ovale which would allow for vasoactive substances to be transferred from the right side of the heart to the left side and cause damage to left-sided valves, a 'bubble' study should be performed. During the study, saline – 'salt water' – mixed with a very small amount of the patient's blood is injected into the left antecubital vein and the patient should then be asked to perform 'cough' and 'Valsalva' manoeuvres.

In addition, in those patients who are considered candidates for surgical therapy, transoesophageal echocardiography and possibly cardiac catheterization should be performed. Transoesophageal echocardiography is an investigation of the valves and pumping chambers of the heart performed with an ultrasound transducer placed at the tip of the thin tube. The tube is swallowed by the patient and is located in the gullet during the procedure. The investigation could be performed with or without light sedation.

Necessary Information to Be Provided before Echocardiographic Investigations

The interpretation of results as well as the estimation of disease progress may be influenced by previous therapies, i.e. thoracic surgery, as well as by previous echocardiographic results. Thus, detailed information on previous therapies and echocardiographic results should be provided.

How Should the Investigation Be Performed?

Routine standards of echocardiographic investigations should be followed. Thus, the patient is placed in a left decubitus position. Echocardiographic views are acquired as per recommendation of the respective societies (for example according to the recommendations of the American Society for Echocardiography or the British Society for Echocardiography) [6–8]. For better assessment of pulmonary and tricuspid valves, a high long-axis parasternal view of the pulmonary valve and modified parasternal view of the right ventricular inflow are useful. In addition, assessment of the left ventricular size and function are an integral part of the echocardiographic investigation of patients with neuroendocrine tumors.

As the assessment of patency of the foramen ovale is a necessary part of the initial evaluation of the patient with confirmed diagnosis of carcinoid heart disease, the recommended procedure is described in detail as follows:

A 20- to 22-gauge Abbocath is placed into the antecubital vein and connected to a three-way tap. Two Luer lock 10-ml syringes are attached to the three-way tap. One of the syringes is filled with 8 ml of saline; 0.3 ml of blood is withdrawn from the vein into the syringe; 0.2 ml of air is added to the 'mixture'. Saline, blood and 0.2 ml of air are mixed between 2 Luer lock syringes attached to the three-way tap on the arm of the patient. 3–4 ml of the agitated mixture is injected as a bolus into the vein under ultrasound control and with continuous recording of images. The injection should be repeated under cough and Valsalva manoeuvre (release phase). A patent foramen ovale is considered present when there is a transfer of microbubbles from the right atrium to the left atrium within 3–5 cardiac cycles.

Echocardiographic Report

The echocardiographic report should give details on special features of the valves, like thickening of the leaflets, reduction of mobility of the leaflets, retraction of the leaflets, maximal degree of the reduction of mobility. The report should indicate if the leaflets are fixed. In addition, the following special features of the endocardium should be mentioned:

- Occasional visualization of fibrous plaques of the endocardium, together with functional data like wall motion and overall function of the right as well as the left ventricle.

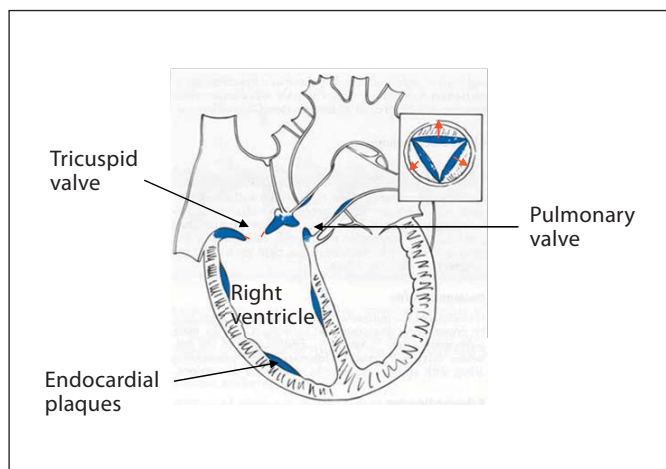


Fig. 1. Carcinoid heart disease.

- Wall thickness assessment is an integral part of conventional echocardiographic investigation. Right ventricular size should be assessed in a four-chamber view as per ASE recommendation.
- Ejection fraction of the right ventricle is difficult to assess due to the complex geometry of the right ventricle. If available, three-dimensional echocardiography is a promising tool. Meanwhile, right ventricular function assessment is semiquantitative. Fractional shortening could also be used as per ASE recommendation.

To allow for 'proper' follow-up echocardiography, description of thickness, mobility, 'shape' of the valve leaflets, presence and degree of shortening and retraction, assessment of degree of regurgitation as well as of degree of stenosis, size and function of the ventricles have to be provided and digital storage of all examinations is mandatory (fig. 1).

To avoid pitfalls in the echocardiographic evaluation of neuroendocrine tumors, utmost attention to the degree of 'brightness' of different parts of the valvular apparatus and to the degree of mobility of the leaflets/cusps of the valves is necessary, as a minor degree of involvement is very easy to miss.

Personal experience in echocardiography with at least 200 examinations per year is recommended for those evaluating patients with carcinoid heart disease.

List of Participants

List of Participants of the Consensus Conference on the ENETS Guidelines for the Standard of Care for the Diagnosis and Treatment of Neuroendocrine Tumors, Held in Palma de Mallorca (Spain), November 28 to December 1, 2007

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