

## Challenges in the diagnosis of atrioventricular nodal reentrant tachycardia: a bibliographic review

### *Desafios no diagnóstico da taquicardia por reentrada nodal: revisão bibliográfica*

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**ABSTRACT:** Atrioventricular nodal reentrant tachycardia (AVNRT) is characterized by the reentry of the electrical impulse in the area of the AV node area. It is usually benign and is twice as frequent in women than in men. The diagnosis is based on the patient's clinical presentation and the 12-lead ECG and is characterized by pseudo r' in lead V1 or pseudo S' deflection in lower leads. Possible obstacles for the diagnosis are related to the time elapsed in the patient's trip to the hospital, the short duration of the crises and the interval between them, and the absence of previous cardiovascular diseases in these patients. This review aims to analyze the diagnostic strategies for AVNRT, based on scientific publications in the following databases: National Library of Medicine (PubMed), Scientific Electronic Library On-line (SciELO) and US National Library of Medicine (NCBI). Due to the nonspecific symptoms and the occurrence of short-termed crises with long gaps between them, AVNRT can be mistakenly diagnosed as an anxiety disorder. It was observed that the 24-hour Holter is the most used exam in clinical practice, but one of the least effective. Despite the high cost and restricted access, diagnostic tests such as the external loop recorder, the EP study and even the 48-hour Holter monitor have significantly higher diagnostic yield, making the diagnosis of AVNRT easier.

**Keywords:** Atrioventricular nodal reentrant tachycardia; Arrhythmia; Tachycardia; Diagnosis; Challenges.

**RESUMO:** A taquicardia por reentrada nodal (TRN) é caracterizada pela reentrada do impulso elétrico na área do nó atrioventricular (NAV). Geralmente, apresenta-se de forma benigna, sendo duas vezes mais frequente em mulheres do que em homens. O diagnóstico se baseia na apresentação clínica do paciente e no ECG de 12 derivações e caracteriza-se por pseudo r' na derivação V1 ou deflexão pseudo S' nas derivações inferiores. Possíveis dificuldades no diagnóstico podem ser relacionadas com o tempo decorrido de deslocamento do paciente até o hospital, a curta duração das crises e intervalo entre elas e a ausência de doenças cardiovasculares prévias. Esta revisão objetiva analisar as estratégias diagnósticas da TRN, tendo como base produções científicas publicadas nas seguintes bases de dados: National Library of Medicine (PubMed), Scientific Electronic Library On-line (SciELO) e US National Library of Medicine (NCBI). Devido à inespecífica gama de sintomas e à ocorrência de crises espaçadas e de curta duração, a TRN pode ser erroneamente diagnosticada como quadro ansioso. Observou-se que o Holter de 24 horas é o exame mais utilizado na prática clínica, porém um dos menos eficazes. Apesar do custo elevados e do acesso restrito, exames diagnósticos como o loop externo, o EEF e, até mesmo, o Holter de 48 horas apresentam taxas de detecção significativamente maiores, tornando o diagnóstico da TRN facilitado.

**Palavras-chave:** Taquicardia reentrante nodal; Arritmia; Taquicardia; Diagnóstico; Desafios.

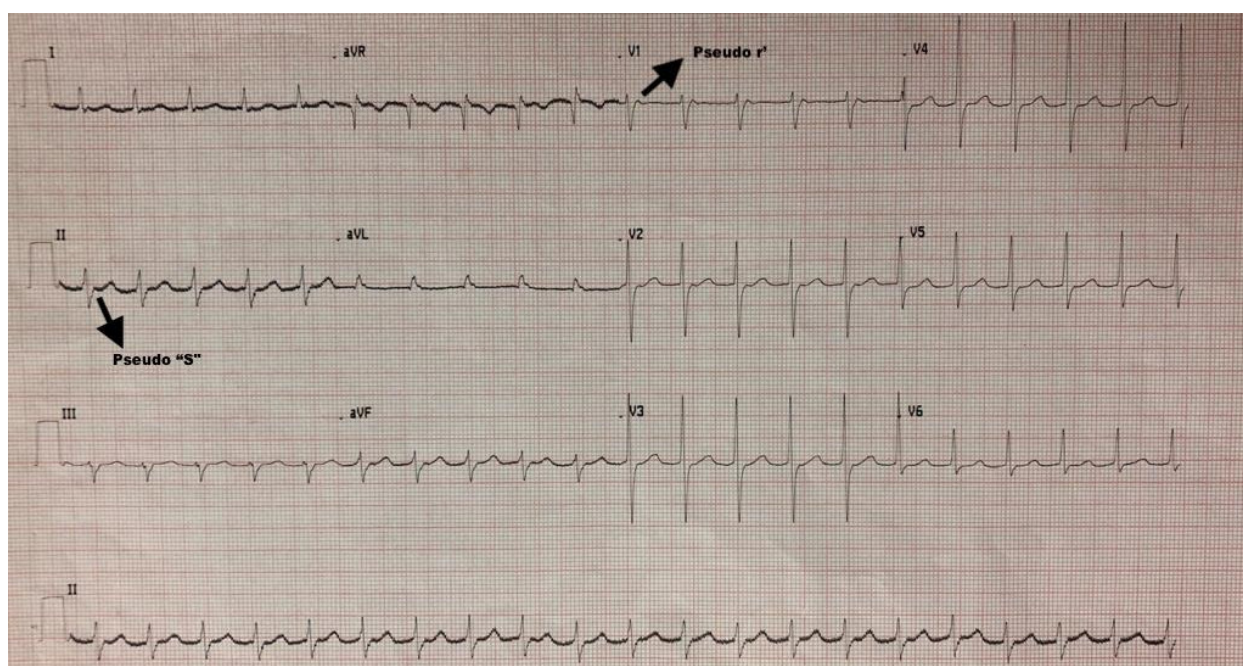
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## INTRODUCTION

In patients with dual AV nodal pathways, atrioventricular (AV) conduction can go through two pathways with different physiological properties before reaching the AV node, which are the alpha pathway, of slow conduction and short refractory period, and the beta pathway, of fast conduction and long refractory period<sup>1</sup>. Thus, AVNRT is characterized by the reentry of the electrical impulse in the area of the AV node area<sup>2</sup>. AVNRT is usually benign, occurs in patients without structural heart disease, and is twice as frequent in women than in men<sup>3</sup>.

The most common form of AVNRT is called typical or slow-fast, as conduction occurs anterogradely by the slow pathway and retrogradely by the fast pathway. The electrocardiogram (ECG) presents heart rates from 140 to 220 bpm, narrow QRS and no record of atrial activity, as it occurs almost simultaneously with ventricular activity, and ST segment depression. Therefore, the P wave may be absent (covered by the QRS complex) or posterior to the QRS, deforming it<sup>4</sup>. The diagnosis is based on the patient's clinical presentation and the 12-lead ECG and is characterized by pseudo r' in lead V1 or pseudo S' deflection in lower leads. Comparison of the QRS complex in sinus rhythm with the ECG during tachycardia can help in the identification of the P wave (Figure 1).



**Figure 1** – 12-lead ECG of AVNRT with regular narrow QRS complex tachycardia, pseudo r' in lead V1 and pseudo "S" in D2 (image from personal archive)

The main symptoms include abrupt onset and termination of palpitations, dyspnea, angina and syncope<sup>2,4</sup>. In about 50% of patients, palpitations are felt in the neck due to the jugular venous reflux caused by the simultaneous contraction of the atria and ventricles. It is also possible to observe bulging of the jugular vein<sup>5</sup>.

Due to nonspecific symptoms and the difficulty of obtaining an ECG during the crisis, recurrent episodes can be confused with dysautonomia or psychosomatic diseases. Possible obstacles for the diagnosis are related to the time elapsed in the patient's trip to the hospital, the short duration of the crises and the interval between them, and the absence of previous cardiovascular diseases in these patients<sup>11,12,14,28</sup>.

## OBJECTIVE

As this is a challenging diagnosis, this review aims to analyze the diagnostic strategies for AVNRT.

## METHODS

This study is a Bibliographic Review based on the scientific literature published from 2010-2020, giving preference to studies published in the last 5 years, in Portuguese and English, in the following databases: National Library of Medicine (PubMed), Scientific Electronic Library On-line (SciELO) and US National Library of Medicine (NCBI). Scientifically relevant studies that addressed clinical aspects and ways of diagnosing AVNRT or electronic monitoring devices and their effectiveness, were included.

After selecting the articles according to previously defined criteria, the following steps were followed consecutively: selective reading and choice of appropriate material to meet the objective of the study; analytical reading and analysis of texts; interpretative reading and writing of the text.

As this is a bibliographic review, approval of an Ethics and Research Committee was not required. In the search conducted in the databases, 335 studies related to the “nodal reentry tachycardia diagnosis” descriptor were found, 6 of them in the Scientific Electronic Library Online (SciELO) and 329 in the National Library of Medicine (PubMed). Searches carried out in the US National Library of Medicine (NCBI) were conducted through Pubmed Central (PMC). Among the studies found, 27 were used and the others were excluded during selective reading for not addressing the theme. In order to add knowledge that is already consolidated in the clinical setting, two relevant books were included in the elaboration of the article.

## RESULTS

There are several obstacles to the diagnosis of AVNRT in clinical practice. Due to the peculiar characteristics of the crises, which begin and end abruptly, it is hard to capture them in the ECG. Furthermore, the ECG in sinus rhythm, in most cases, does not present abnormalities or suggestive features. The monitoring test most used in clinical practice for arrhythmias is the 24-hour Holter monitoring, which is also inefficient in these cases. More advanced tests, such as the loop monitor, and the electrophysiological study (EP study) are highly expensive and are not available in all diagnostic centers. The absence of abnormalities in laboratory tests further restricts the means of detecting possible abnormalities. Sinus tachycardia in patients who seek emergency care, and the presence of anxiety disorder can lead to diagnostic errors. It is common to find patients with AVNRT who

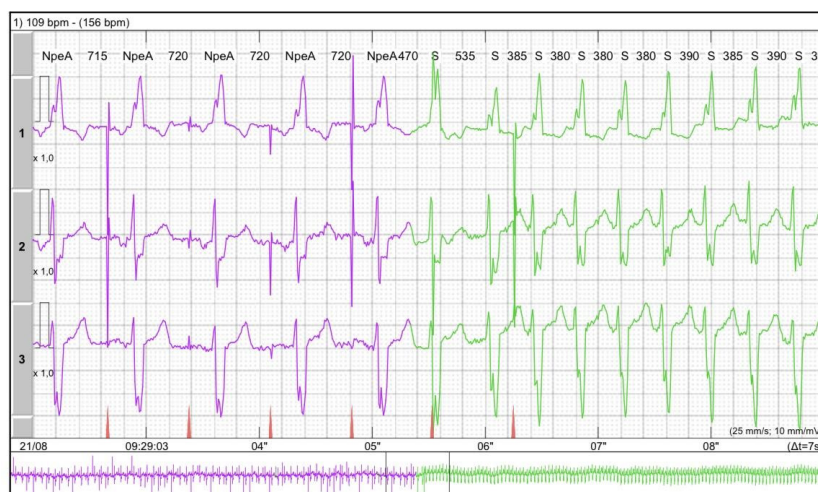
were treated with anxiolytics for decades<sup>6-12</sup>.

It is believed that, in some cases, there is a genetic component involved in AVNRT, and the most common mode of inheritance is autosomal dominant with incomplete penetrance. The risk of a first-degree relative developing AVNRT is 3.6 times greater than that of the general population<sup>13</sup>.

The most commonly reported symptoms are palpitation, presyncope and syncope, vertigo, dizziness, chest and/or neck pain, nervousness and anxiety<sup>14</sup>. Patients tend to be more anxious, pessimistic, and extroverted, and it is even possible to characterize them as having a “typical AVNRT personality”. A study indicates that this typical personality, associated with dysfunctional regulation of the hypothalamic-pituitary-adrenocortical system, could favor AVNRT physiology<sup>12</sup>. Polyuria may be a symptom related to the release of atrial natriuretic peptide in response to increased atrial pressure<sup>15</sup>. The events tend to be short-termed and disappear before the electrocardiogram is performed. Thus, different external or implantable devices can be used, such as Holter monitoring, external loop monitors and implantable loop recorders<sup>7</sup>.

### Laboratory tests

A retrospective analysis tried to suggest inflammation as a potential mechanism in the pathogenesis of arrhythmia. For this, 196 patients who underwent electrophysiological study due to palpitation or paroxysmal supraventricular tachycardia (PSVT), including AVNRT, underwent the following laboratory tests: monocyte count to high-density lipoprotein cholesterol ratio (MHR), neutrophil/lymphocyte ratio (NLR), and monocyte/lymphocyte ratio (MLR). However, it was found that patients with PSVT did not show any significant difference in these inflammatory markers<sup>10</sup>. Hence, it is not possible to diagnose AVNRT through laboratory tests.



**Figure 2** – 24-hour Holter monitoring with extrasystole leading to the start of AVNRT

*Holter*

A 24 to 48-hour Holter monitor in patients with frequent symptoms can be useful and avoid invasive electrophysiological studies (Figure 3). In a study with patients from 5 to 18 years old, with intermittent palpitations, normal ECG and no underlying structural heart disease, 37% had positive Holter findings with the 48-hour Holter. In patients with positive Holter, 72.5% had diagnostic findings in the first 24-hour and 28% only in the later 24 hours. Therefore, it was found that the 48-hour Holter monitoring increased yield by 10% when compared to conventional 24-hour monitoring.<sup>7</sup> Nevertheless, if the gaps between crises are longer, this monitor will not be useful to detect them.<sup>8</sup>

*External cardiac event recorders*

External patient-activated cardiac event recorders are recommended for patients who experience palpitations without hemodynamic impairment and nondiagnostic Holter-ECG<sup>9</sup>. Patch ECG monitors are small wireless adhesive devices affixed over the patient's left pectoral region for up to 14 days and are not available in Brazil. As they are water-resistant, they can remain on the patient during showering and exercise. Diagnostic yield of relevant arrhythmias with Holter monitoring is 6%, while for those using 14-day ECG patch monitors it is 66%<sup>16-17</sup>.

Unlike ECG patch monitors, external loop recorders are used for longer periods, ranging from weeks to months. The recorders are activated by the patients themselves in symptomatic events and can record tracings lasting from few seconds to 1 hour. They are also available in the implantable version<sup>16</sup>.

The external event recorder is presented as a portable device with built-in electrodes placed on the chest during symptomatic periods. Due to its way of use, part of the arrhythmia may not be recorded. The great benefit of this modality lies in the fact that the data is sent to the monitoring center (hospital, doctor or caregiver) in real time<sup>8,16</sup>. Its use and system are similar to Holter monitoring, but it has the benefit of being analyzed almost instantly<sup>16</sup>.

However, while Holter monitoring can diagnose 10 to 15% of patients with palpitations, external cardiac event recorders reach 66 to 83%. Some studies indicate that the ideal time of use is between 2 and 4 weeks, while others point to 2 months of follow-up as the ideal. The electrophysiological study and/or the implantable loop recorder were proved useful for patients with longer gaps between crises or with low tolerance to external monitors<sup>8,9</sup>.

In view of the limited number and the high cost of

the implantable event recorders and its invasive character, this alternative is not available for most patients<sup>9,18</sup>.

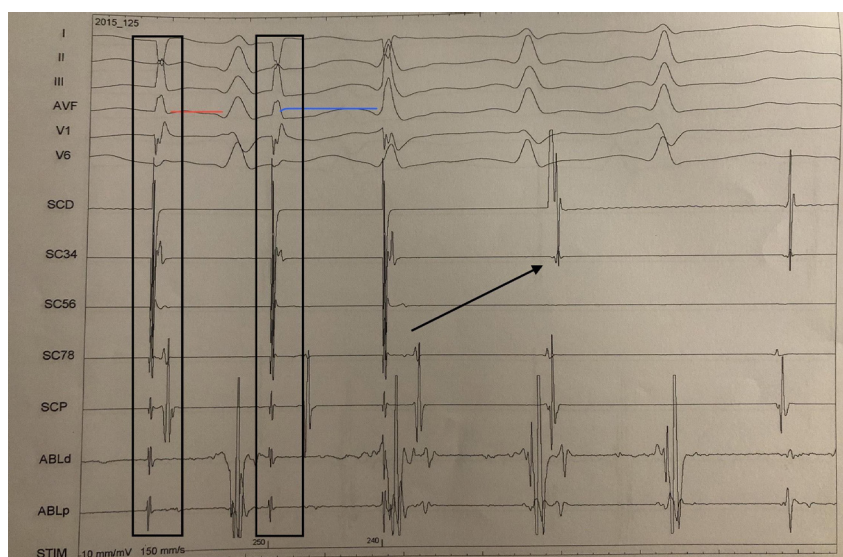
*Implantable cardiac event monitors*

The implantable loop recorder is a subcutaneous device used for continuous heart rhythm monitoring for up to 3 years. This device can diagnose episodes of arrhythmia and syncope that occur sporadically. It does not depend on activation by the patient, which can be useful for patients who collapse, for example, and it is not affected by other electrical devices. This device has a high yield, with up to a 75% detection rate for the cause of syncope at 3 years. Because it is well tolerated by patients and has a high rate of diagnostic efficacy, it is seen as a strategy to reduce costs in the health system<sup>19-20</sup>.

*Electrophysiological study of the heart*

The electrophysiological study of the heart is an invasive procedure that stimulates the heart by introducing two catheters in the femoral vein. These catheters are equipped with a mechanism for electrical stimulation, which can reveal the refractory periods, conduction and activation changes and diagnostic for diseases such as AVNRT. Incremental stimulation helps for observing and measuring the impulse conduction during stress conditions and evaluates the recovery time of normal function at the cessation of stimulation (Figure 3). The occurrence of undiagnosed narrow QRS complex supraventricular tachycardia in symptomatic patients or patients refractory to drug treatment patient is one of the indications for the electrophysiological study of the heart. This procedure is even capable of eliminating the accessory pathway, in the case of AVNRT, by means of radiofrequency ablation.<sup>21</sup> Due to its benefits, this technique has become the main treatment for AVNRT<sup>22</sup>. However, studies indicate that there was an increase in the number of complications after radiofrequency catheter ablation in patients including adult patients with AVNRT, with complications in about 3% of patients<sup>15</sup>. AVNRT accounts for over 60% of patients undergoing invasive cardiac electrophysiology study<sup>23</sup>.

Since chronic administration of antiarrhythmic drugs, such as beta blockers, is ineffective in up to 70% of cases<sup>24</sup>, the EP study, in addition to being a diagnostic method, is also useful in the treatment of AVNRT. The most used technique in recent decades was radiofrequency, but cryoablation can reduce the risk of the procedure without changing its effectiveness. It is particularly useful on anatomical substrates whose ablation has a high risk of damaging the conduction system<sup>25</sup>.



**Figure 3** – Programmed stimulation with the presence of dual AV nodal physiology (jump) and double echo. After the first atrial stimulation (black rectangle), it is possible to observe the fast pathway (in red) and, after the second, the slow pathway (in blue), thus composing the dual AV nodal physiology. The echo is related to the fact that the ventricular activity (captured by the catheter positioned in the coronary sinus) occurs before the atrial activity (captured by the ablation catheter) (arrow)

#### *Late diagnosis*

A retrospective analysis found that 12 patients aged  $88 \text{ years} \pm 3.7 \text{ years}$  who presented cases of palpitations were given medications for anxiety and panic attacks for decades. After detailed examinations, they were actually diagnosed with AVNRT and underwent successful radiofrequency ablation. All patients undergoing EP study had already been to an emergency room at least five times and, in all visits, the episodes of AVNRT were not documented on the ECG, as they were found to be in sinus tachycardia<sup>11</sup>.

In this study, two extremely relevant points were addressed: the fact that all patients arrived at the hospital in sinus tachycardia, after the end of the AVNRT crises, generating the false diagnosis of anxiety; and the female predominance of AVNRT in older age<sup>11</sup>. These results diverge from other studies that indicate a reduction in the prevalence of PSVT mediated by an accessory pathway with age<sup>15</sup>. Therefore, considering that advanced age is not a contraindication for slow pathway ablation<sup>22</sup>, symptomatic older patients deserve more advanced tests for diagnosis of possible AVNRT.

#### *Interference of anxiety*

AVNRT includes a series of debilitating symptoms that compromise the patient's quality of life, including anxiety, which is present more frequently in this PSVT when compared to the others. The uncertain and sporadic characteristic of the crises causes anxiety and leads the patient to search for curative treatment instead of symptomatic palliative treatment<sup>26-28</sup>.

AVNRT diagnosis can be confused with generalized anxiety, as the crises are difficult to monitor and require

several electrocardiographic exams to obtain an ECG with an alteration. The difficulty lies in the distinction between an anxiety episode resulting from uncertain symptoms and an anxiety patient<sup>28</sup>.

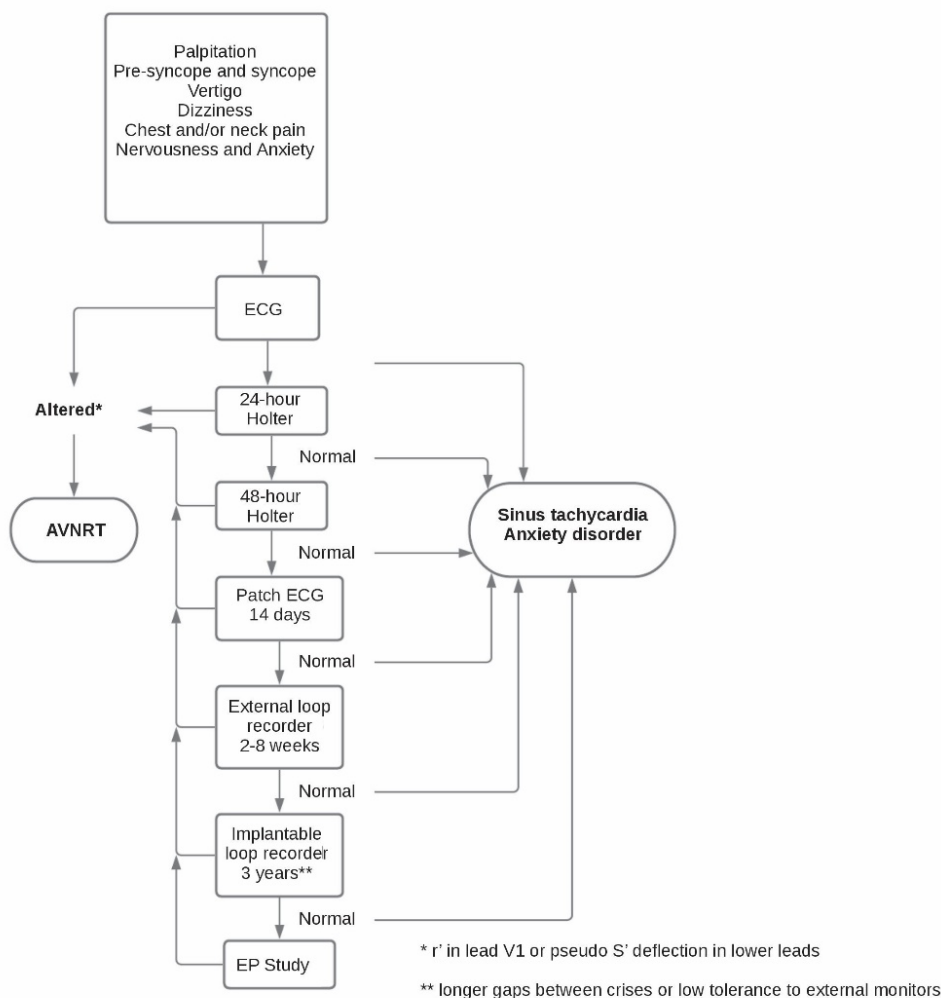
It is interesting to highlight that the group of patients with AVNRT who underwent ablation and were cured had a significant decrease in generalized anxiety and anxiety disorder<sup>29</sup>.

#### *Flowchart for the diagnosis of AVNRT*

In view of the vast number of symptoms and their implication in daily activities, it is important that the disease is diagnosed in the shortest time possible and with less costs in order to solve the problem and minimize any damage to the cardiovascular system (Figure 4). After the AVNRT diagnosis, the patient can be treated with antiarrhythmic drugs, such as beta blockers, or with ablation in an EP study<sup>21,22,24</sup>.

## CONCLUSION

Due to the nonspecific symptoms and the occurrence of short-termed crises with long gaps between them, AVNRT can be mistakenly diagnosed as an anxiety disorder. It was observed that the 24-hour Holter is the most used exam in clinical practice, but one of the least effective. Despite the high cost and restricted access, diagnostic tests such as the external loop recorder, the EP study and even the 48-hour Holter monitor have significantly higher detection rates, facilitating the diagnosis of AVNRT.



**Authors' participation:** *Carmo AB* - Responsible for research and preparation of the original text; *Sobral MLP* – Responsible for revising the original text and guiding the work.

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