

## Contribution of the Electrophysiological and Anatomical Analysis of the Atypical Atrioventricular Nodal Tachycardia Circuit

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### Summary

**Objective:** To analyze retrograde conduction during junctional ectopic tachycardia (JET) episodes and investigate the existence of a relationship between the presence of a retrograde block and the risk of atrioventricular block (AVB) development during radiofrequency ablation procedures in patients with nodal atrioventricular tachycardia (NAVT).

**Methods:** 145 male and female patients aged 16-84 years, with NAVT who had undergone radiofrequency catheter ablation in the posteroseptal region of the right atrium were studied. Evaluation criteria were anatomical location and electrophysiological behavior of retrograde conduction during NAVT, in order to understand the nodal reentrant circuit (classifying the tachycardia as typical or atypical), and monitoring of retrograde conduction during JET episodes for risk-predicting AVB events.

**Results:** Of the 145 patients studied, 132 (91%) met electrophysiological and anatomical criteria of the typical form of NAVT, and 13 (9%) of atypical form. During the ablation, 5.3% with the typical form and 30.8% of the atypical form presented risk events for AVB. After the ablation, complications were a total AVB episode in one patient and a first-degree AVB episode in another in the typical group, and one first-degree AVB in the atypical group. All three episodes were preceded by risk events and resulted in permanent nodal injury.

**Conclusion:** Patients with atypical NAVT presented higher percentages of risk events for atrioventricular block than did patients with the typical form ( $p=0.021$ ). A careful observation of retrograde conduction during JET episodes is vital in order to avoid permanent damage in AV nodal conduction, such as TAVB, after the ablation procedure.

**Key words:** Arrhythmia, nodal atrioventricular tachycardia, ablation.

### Introduction

Paroxysmal supraventricular tachycardia (PSVT) is a relatively common disturbance of cardiac electrical activation with an incidence of 0.5% in the general population, in the absence of structural cardiac disease<sup>1</sup>. Within this group, nodal atrioventricular tachycardia (NAVT) is responsible for about 60% of PSVT cases<sup>1</sup>. There is a 3:1 predominance of females over males<sup>2</sup>.

Characteristically, NAVT occurs in sustained paroxysmal surges, especially from the second decade of life on<sup>3</sup>. In the great majority of cases, it produces uncomfortable symptoms that may require medical intervention, whether in a situation of a sustained episode or for secondary prevention in order to avoid new episodes<sup>4</sup>.

Previous studies<sup>2-5</sup> have demonstrated that patients with NAVT classically have two anatomically and

electrophysiologically distinct conduction pathways. Presently, there is electrophysiological proof that the dual nodal pathway is commonly composed of a circuit that encompasses a slow conduction pathway with a short refractory period (the "alpha" route in old nomenclature) and another route with fast conduction and a long refractory period (the "beta" route in old nomenclature) that determine the substrate for the reentry mechanism<sup>5</sup>. In typical NAVT, anterograde conduction occurs by the slow pathway, whereas retrograde conduction occurs by the fast route with an earlier recording of retrograde atrial activation during the electrophysiological (EPS) study in the anterior region of the tricuspid ring (bundle of His area). All other NAVT types that show any variation in the electrophysiological and/or anatomical circuit during tachycardia are considered atypical.

The classical electrophysiological definition of the dual nodal pathway represents an abrupt increase of nodal A-V conduction of at least 50 ms between the atrial and His (AH) potential intervals, with an anterograde block in the fast pathway conduction and selective conduction by the slow pathway in response to a 10 ms decrease during atrial or ventricular

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stimulation; this phenomenon is known as a "JUMP"<sup>1-5</sup>.

Over the last decades, therefore, electrocardiographic and electrophysiological criteria of the different forms of PSVT have been better clarified, allowing optimization of therapeutic techniques that initially included surgical curative treatment<sup>6</sup>, and later, radiofrequency catheter ablation<sup>1-5</sup>. More specifically, in NAVT, the posteroseptal region of the right atrium has become the ablation target of choice<sup>7</sup>. This procedure has shown a high rate of success<sup>2</sup> considering the established locations of both pathways<sup>7</sup>, especially in typical NAVT. Nevertheless, atypical forms may present unique electrophysiological characteristics and uncommon pathways, making it difficult to determine the target anatomical site for ablation by radiofrequency catheter (RF), whether it is an anterograde or retrograde conduction route.

During application of the RF energy, the appearance of an accelerated automatic junctional ectopic rhythm (JET) is common, and its occurrence is related to the success of the procedure<sup>2,3,5</sup>. The emergence of a block of the retrograde conduction to the atria during JET was associated with a concomitant lesion of the fast pathway and imminent risk of total atrioventricular block (TAVB) after the procedure<sup>3,5,8</sup>.

The objective of this study was to first classify the NAVT according to the electrophysiological performance of the anterograde and retrograde pathways, and then to accurately identify the anatomical location of the retrograde pathway (by analysis of the earliest retrograde conduction site during nodal tachycardia). Secondly, the objective was to observe retrograde conduction during episodes of JET in the ablative procedure, in order to appraise the existence of an association between a retrograde block and the risk of an atrioventricular block developing during ablation procedures with a radiofrequency catheter in patients with NAVT.

## Methods

Our selected patients had a history of symptomatic and frequent tachycardia, with sudden onset and termination, with or without electrocardiographic documentation of PSVT. The baseline electrocardiogram in sinus rhythm showed a normal or slightly shortened P-R interval and an absence of an evident anomalous pathway. Between 1999 and July of 2005, 145 patients were selected, both male and female, with ages ranging between 16 and 84 years.

During the electrophysiological study (EPS), catheters were positioned in the right atrium at the A-V junction (the bundle of His electrogram recording), inside the coronary sinus, and at the apex of the right ventricle. The EPS protocol included artificial stimulation (by an EMS™ electrophysiology polygraph) of the right atrium and ventricle, both with a basic cycle of 8 to 10 stimuli followed by an extra stimulus with progressively shorter coupling (with 10 ms decrements) until the effective refractory period of the stimulated site or induction of NAVT was attained. Two or three basic cycles with up to three extra stimuli were used in order to induce NAVT. The programmed atrial stimulation was performed and the following points were determined: sino-atrial conduction time, sinus node recovery time, Wenckebach point, and refractory periods of the atrium and AV node, besides the presence or absence of a longitudinal

dissociation or "JUMP" before tachycardia induction.

Atrial stimulation as per the protocol with extra stimuli in 10 ms decrements was carried out under concomitant observation of nodal conduction (AH interval) up to the induction of NAVT (with or without a "JUMP" preceding the tachycardia). NAVT induction with the extra stimulus technique proved to be possible in all patients. However, in some patients with the typical form (32 patients = 24.24% of typical cases) prior infusion of isoproterenol (1 to 4 mcg/min) was necessary for tachycardia induction.

Diagnosis of NAVT was determined by electrophysiological criteria previously established by Josephson et al<sup>9</sup>, excluding patients with tachycardia mediated by an anomalous pathway (A - ventricular pre-excitation during atrial stimulation; B - lengthening of V-A interval during tachycardia with the concomitant development of a bundle branch block; C - advancement of atrial activation during ventricular stimulation at the moment of bundle of His refractoriness; D - elimination of tachycardia with the release of radiofrequency in a site other than the lower septal region of the right atrium), and including those in whom the criteria met all the requisites for a NAVT (A - exclusion of a participating anomalous pathway; B - induction of tachycardia with a narrow QRS using the atrial extra stimuli or rapid atrial stimulus technique; C - dissociation of the atrium from the tachycardia circuit during stimulation in the right atrium (RA), coronary sinus (CS) or His (H); D - ablation via the slow pathway prevents re-induction of tachycardia; E - a "JUMP" was not considered necessary for diagnosis).

Tachycardia was classified as typical or atypical according to conduction velocity, electrophysiological properties of anterograde and retrograde pathways and anatomical location of the retrograde pathway by analysis of the intracavitary electrogram record (see Tabs. 1, 2, and 3), where "slow-fast" NAVT is typical of an earlier recording of retrograde atrial activation in the anterior region (near the bundle of His). All other forms of NAVT were considered atypical.

Ablation was performed in sinus rhythm in the posteroseptal region of the right atrium and with no recording of His potential in the ablation catheter. The electrophysiological criteria included obtaining a small atrial potential and an ample ventricular potential, with a 1:4 ratio<sup>5,7,9</sup>, i.e., at the level of the tricuspid ring (in the posteroseptal region of the right atrium), near the coronary sinus ostium, as well as an A/V ratio on the electrogram of  $\leq 0.5$ <sup>2,5,9,10</sup>.

JET occurred in 100% of patients (of the typical and atypical groups) during emission of RF, with a variation of 1 to 30 ectopic beats. Events considered risk-predictors for AVB during JET were a lengthening of the P-R interval ( $\uparrow$  P-R), an atrioventricular block (AVB) or an atrioventricular dissociation (AVD).

According to medical literature<sup>2,5</sup>, when "isorhythmic dissociation" events arise during JET (a phenomenon in which the sinus frequency is very similar to the junctional ectopy frequency, making it difficult to assess the integrity of ventriculo-atrial conduction), RF should be immediately interrupted, since the criterion for evaluating nodal conduction integrity is the observation of any P-R interval prolongation through atrial stimulation in a frequency higher than that of the junctional rhythm (JET) during the ablation procedure.

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## ANTEROGRADE CONDUCTION DURING NAVT

TYPE	AH:HA
Fast	<1
Slow	>1

**Table 1 - Classificação da via anterógrada segundo suas propriedades eletrofisiológicas de condução rápida e lenta. É realizada por meio de AH:HA ratio (2, 5, 9, 11)**

## EARLIEST RETROGRADE ATRIAL CONDUCTION

TYPE	HA
Fast	<100
Intermediate	100-200
Slow	>200

**Table 2 - Electrophysiological properties of conduction velocity in the retrograde pathway during NAVT, which was divided according to its conduction velocity. Retrograde conduction was classified as fast, intermediate and slow (2, 5, 9, 11)**

## RETROGRADE PATHWAY – LOCATION

TYPE	Earliest retrograde atrial activation
Anterior	His (His - CS <sub>os</sub> ≥ 10ms)
Middle	CS <sub>os</sub> = His (SC <sub>os</sub> - His ≤ 5ms)
Posterior	CS <sub>os</sub> (SC <sub>os</sub> - His > 10ms)

**Table 3 - Anatomical criteria to locate the retrograde pathway during NAVT based on the record of the earliest retrograde atrial activation (9, 11, 16). His – bundle of His; CSos – coronary sinus ostium. When the retrograde pathway is anteriorly located, the activation of the bundle of His precedes that of the coronary sinus ostium by at least 10 ms; in average, the retrograde activation is equally distant between the bundle of His and the CS; when posteriorly located, the CS activation precedes that of the bundle of His by at least 10 ms**

In our project, however, there was no evidence of isorhythmic dissociation events, although during the ablation procedure sometimes the JET beats were intercalated with sinus capture beats (enabling analysis of the P-R interval in these beats); also, when there was any lengthening of the P-R interval ( $\uparrow$  P-R) in sinus capture beats during RF, this was immediately interrupted, since a prolonged P-R interval is also considered a risk-predicting event for nodal injury<sup>2,5</sup>. Therefore, in our study it was not necessary for any patient to undergo atrial stimulation during ablation, since there were no isorhythmic dissociation events.

All patients analyzed had previously signed a consent form for the electrophysiological study. Anti-arrhythmic drugs were discontinued before the study for a period equivalent to five half-lives. Patients were taken to the electrophysiology laboratory in fasting state (for about 12 hours) and sedation was

given by an anesthesiologist.

A 7F (“French”) decapolar or quadripolar catheter was introduced through the right internal jugular vein into the coronary sinus in order to record its potentials. Three catheters were introduced via the right femoral vein: 1) one 7F quadripolar catheter, positioned in the tricuspid ring to record the electrogram of the bundle of His; 2) one 7F quadripolar catheter to record the upper right atrium potential and provide atrial stimulation, or to perform ventricular stimulation, if necessary; 3) one EPT™ 8F ablation catheter with temperature control and distal 5 mm electrode used for mapping the target site and for the radiofrequency ablation.

After identifying the target site, radiofrequency (RF) energy was released with temperature control at 65°C, for a period of 60 seconds. During the RF application, JET episodes were carefully monitored in order to analyze the integrity of the V-A conduction. During such episodes, the presence of a V-A block or of one or more dissociated beats led to an automatic and immediate interruption of RF supply.

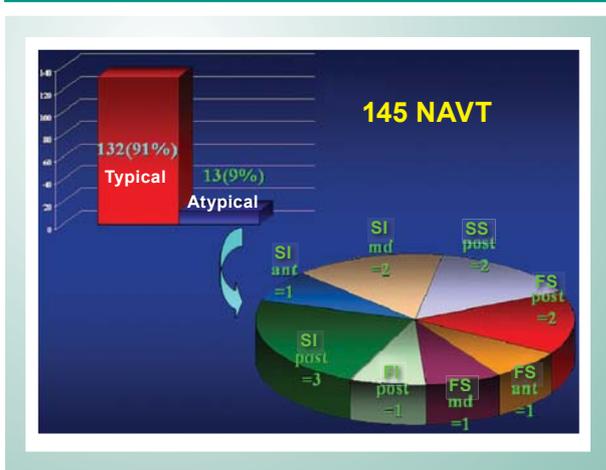
After the RF application, a new atrial and ventricular stimulation was used to evaluate the success of the procedure. A successful procedure was considered as the non-induction of new tachycardia and absence of atrial echoes. The presence of a wave leap (JUMP), but with no atrial echo, was considered a sign of ablation success.

As to the catheter positioned inside the CS, it is also important to point out that the region that corresponds to the ostium of the coronary sinus (where the proximal electrodes of the catheter are located) is considered the proximal (pxCS) location, and the region more than two centimeters away from the interior of the ostium is considered the distal (dCS) or eccentric location.

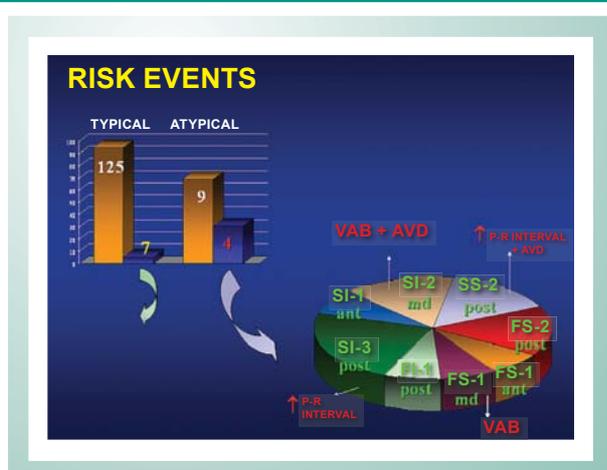
## Results

In all, 145 patients with NAVT were analyzed. One hundred and thirty-two (91%) of them met electrophysiological criteria of the typical form (slow-fast with the earliest recording of retrograde activation in the anterior region of the right septum, near the bundle of His), and 13 (9%) met criteria for atypical forms (other cases of NAVT or NAVT with circuits other than the well-defined circuit of the typical form) (Tabs. 1, 2, 3, and 4). Hence, in this study we observed a significant difference between the numbers of patients with typical and atypical forms. According to what had been noted in previous studies<sup>9,11-15</sup>, atypical NAVT is infrequent, and even in light of modern electrophysiology knowledge, varied and/or multiple circuits of the atypical forms are still poorly understood, unlike the typical tachycardia circuit which is already well-established<sup>1,2,5</sup>.

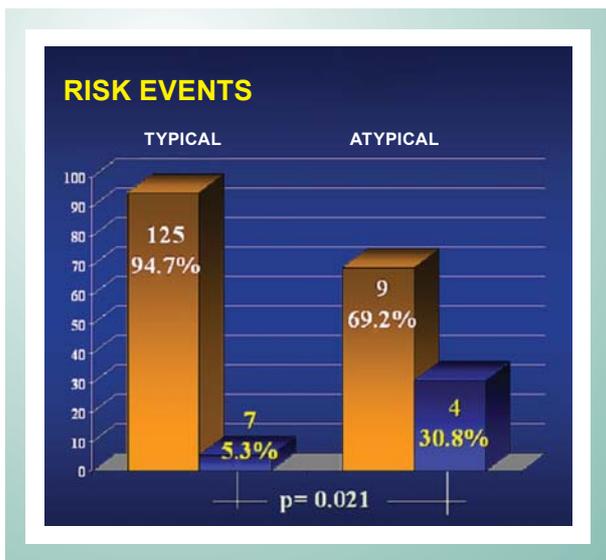
After the electrophysiological diagnosis of NAVT (typical or atypical), all patients were submitted to ablation with a radiofrequency catheter in the posteroseptal region of the right atrium. During JET, if any risk-prediction event was detected (increased P-R interval, V-A block and/or A-V dissociation) radiofrequency was immediately interrupted. V-A conduction monitoring during JET was performed by means of the signals obtained by the catheters positioned in the coronary sinus and upper right atrium.



**Table 4** - Classification of 13 patients with the atypical forms according to electrophysiological properties of conduction velocity in the anterograde (S – slow or F – fast) and retrograde (I – intermediate, L – slow and R – fast) pathways and to anatomical location of the retrograde pathway (ant – anterior, md – middle and post – posterior; Example: SI post = 3 – the anterograde pathway has slow conduction and the retrograde pathway, fast conduction, and the retrograde is posteriorly located; three patients presented this electrophysiological behavior).



**Table 6** - Table 6 – Observe the risk-predicting events in both groups (7 in typical and 4 in atypical forms). In atypical forms there were 4 risk-predicting events as follows: SI md, SS post, FS md e SI post.



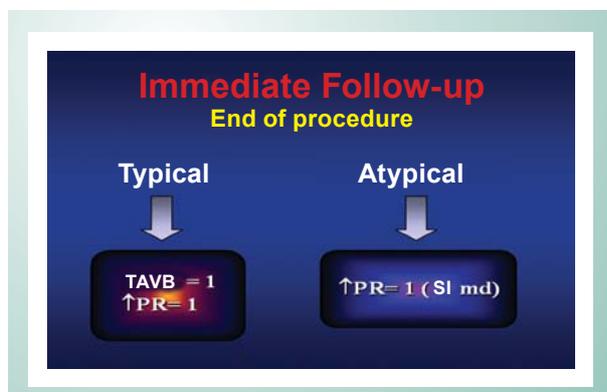
**Table 5** - Observe in this table the higher incidence of risk-predicting events during JET in the group of atypical forms, with  $p = 0.021$ . See explanations in the text.

Out of the 132 patients in the group of typical cases submitted to ablation, seven progressed with risk-predicting events (5.3%) during this procedure; one patient experienced a ventriculo-atrial (V-A) block and 6 patients had a V-A block followed by atrioventricular (A-V) dissociation. (Fig. 2 and Tabs. 6 and 7).

In the group of atypical cases (13 patients), four (30.8%) experienced risk-predicting events during radiofrequency application. These included lengthening of the P-R interval, V-A block, V-A block (or V without A) followed by A-V dissociation, and lengthening of the P-R interval followed by A-V dissociation; in these cases radiofrequency was immediately stopped (Tabs. 4, 5, 6, and 7).

CASE	SEX	AGE	AH	HA	AH/HA	A + EARLY	AVB RF	FINAL	NAVT
1	F	35	176	160	1,10				SS post
2	F	55	73	190	0,38	pxCS			FI post
3	F	63	134	281	0,48	pxCS			FS post
4	F	38	88	256	0,34	pxCS = HIIS	V with no A	1:1	FS post
5	F	48	234	110	2,13	pxCS = HIIS	V with no A/AVD	1:1 (PR>)	SI md
6	F	44	213	160	1,33	dCS			SI post
7	F	42	246	130	1,89	pxCS = HIIS			SI md
8	M	74	346	125	2,77	HIS			SI ant
9	M	53	230	222	1,04	pxCS	PR>/ AVD	1:1	SS post
10	M	60	100	324	0,31	HIS			FS ant
11	M	63	104	201	0,52	dCS			FS post
12	F	54	164	160	1,03	pxCS	PR>	1:1	SI post
13	F	79	200	182	1,10	pxCS			SI post

**Table 7** - Table 7. Risk-predicting events were observed in 4 patients of the atypical form during RF catheter ablation. Observe that the risk-predicting events occurred in patients who presented circuits in which the retrograde pathway was located in the middle (pxCS=His) and posterior (pxCS) regions of the atrial septum; therefore, closer to the RA posteroseptal region, where the ablation-catheter is placed. pxCS – proximal coronary sinus; dCS – distal coronary sinus.



**Table 8** - Immediate follow-up (during hospital stay) of patients upon conclusion of the ablative procedure.

Atypical cases were classified as eight subtypes, with four risk events in four different patients (out of 13 patients who

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underwent ablation) (Tabs. 4, 6, and 7).

During JET, if risk-predicting events emerged, RF was rapidly interrupted in order to prevent permanent A-V conduction damage.

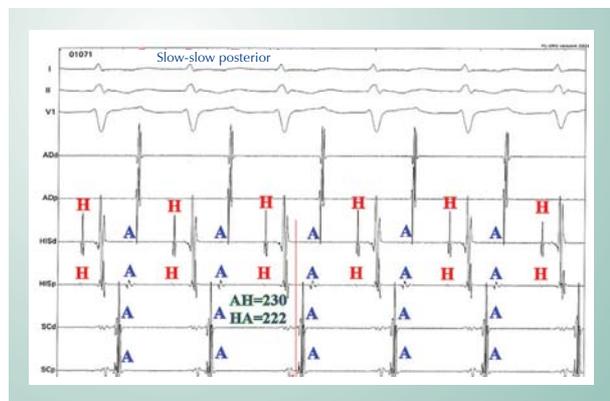
After RF interruption in the atypical group, the A-V conduction that was dissociated gradually recovered but in one case (SI med), one patient remained in first-degree atrioventricular block. In the typical group, one patient remained in first-degree atrioventricular block and another in total AVB. Consequently, in both groups, typical and atypical, there were patients who experienced permanent damage in A-V nodal conduction (Figs. 1, 2, 3, and 4 and Tabs. 7 and 8).

According to Table 8, permanent complications in the typical cases were one episode of TAVB and one episode of first-degree AVB. In the atypical cases, there was one episode of first-degree AVB as a permanent consequence of nodal damage following ablation.

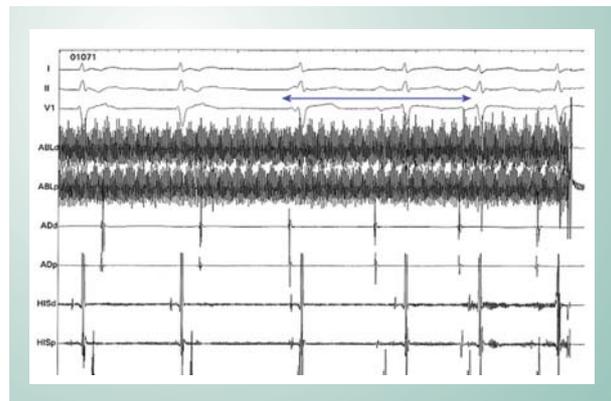
During follow-up for up to six months, patients remained asymptomatic (with no recurrences of NAVT) and did not experience late complications inherent to the ablation procedure, such as late atrioventricular blocks<sup>1-5</sup>.

## Discussion

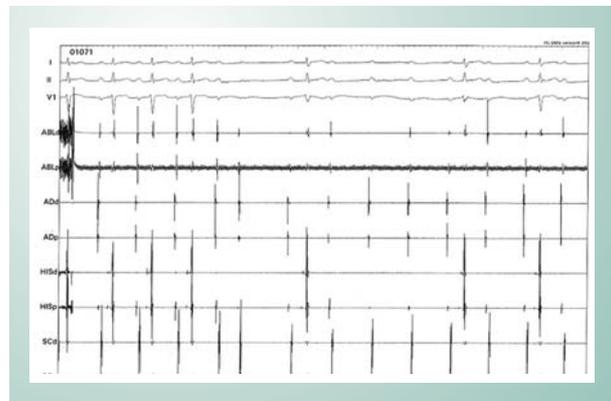
Third-degree AVB or total A-V block (TAVB) is considered the most significant complication associated with ablation of an NAVT<sup>1,2,5,10</sup>. The incidence of this complication is considered low, with less than 1% in published studies<sup>1,5,16-18</sup>. For that reason, in order to prevent complications such as TAVB during the ablation procedure, it is extremely important to observe the integrity of ventriculoatrial (V-A) conduction or the lengthening of the P-R interval<sup>8,10,19,20</sup> during JET. It is known that an A-V block, both transient and permanent, rarely occurs when V-A conduction remains intact during the entire period when JET occurs. Furthermore, loss of V-A conduction (V-A block) during JET has been suggested as an imminent risk for TAVB during an ablative procedure<sup>8</sup>. Therefore, radiofrequency should be immediately discontinued<sup>2,5,10,21</sup> if a V-A block does occur, since the positive predictive value of a V-A block during JET for the occurrence of TAVB is approximately 20%<sup>8,10</sup>.



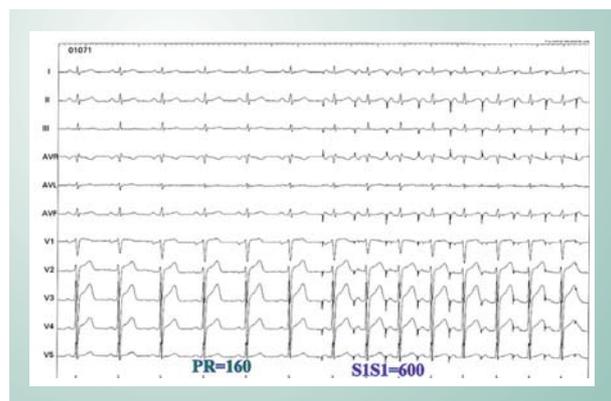
**Fig. 1** - Slow-slow posterior atypical NAVT. The earliest retrograde atrial record was observed in the proximal CS. RA (distal and proximal), His (distal and proximal), CS (distal and proximal) – intracavitary records. I, II, V1 – intracavitary surface records. I, II, V1 – surface records.



**Fig. 2** - The same patient during RF-catheter ablation in the posteroseptal region of RA. The risk-predicting event during JET was AV dissociation. ABL (distal and proximal ablation catheter), RA (distal and proximal), HIS (distal and proximal), CS (distal and proximal) – intracavitary records. I, II and V1 – surface records.



**Fig. 3** - The same patient (slow-slow posterior) after AV dissociation during RF presented high-degree AV block, followed by first-degree AVB, but presented normal atrioventricular conduction limits after the end of the procedure. ABL (distal and proximal ablation catheter), RA (distal and proximal), His (distal and proximal), CS (distal and proximal) – intracavitary records. I, II, V1 – surface records.



**Fig. 4** - The same patient with transient first-degree AVB after RF-catheter ablation. Observe the PR interval = 160 ms in sinus rhythm. However, when the patient underwent programmed atrial stimulus with fixed cycles of 600 ms (S1S1), that is, of only 100 bpm, the PR interval increased considerably to 250 ms, leading to nodal injury, by a first-degree AV block, with PR interval = 250 ms. In this tracing see all EKG surface leads.

We also highlight the fact that V-A conduction during JET occurs even in patients who do not experience retrograde V-A conduction with programmed ventricular stimulation

prior to ablation<sup>2,5,10</sup>, and this reinforces even further the importance of an early abortion of radiofrequency emission in the presence of a V-A block.

Over the last decade, selective ablation of the posteroseptal region of the right atrium (RA) has become the approach of choice<sup>7</sup>. This procedure has shown a high rate of success<sup>2</sup>, considering the established locations of the anterograde and retrograde pathways of a typical NAVT. Nevertheless, in atypical forms, including multiple pathway circuits, unique electrophysiological features and paths with uncommon locations may appear in mappings made during the electrophysiological study, making it difficult to determine the target anatomical site for ablation. Actually, atypical behavior routes represent an additional risk in atrioventricular blocks<sup>5,10,11,13</sup> (Fig. 1).

Studies carried out with atypical forms also suggest that in these cases ablation should be approached with greater caution<sup>11,14,22</sup>. In some of these studies, patients with the atypical form presented a higher incidence of some degree of nodal damage after RF emission (detected by analysis of A-H interval lengthening, increase of the A-V node refractory period or of Wenckebach point) resulting from RF catheter ablation in the posteroseptal region of the RA<sup>11,14,15</sup>. In any case, in every NAVT (typical or atypical) the presence of risk-predicting events during JET is considered an important marker for a permanent A-V block<sup>3, 8-12,14</sup>, much more than for transient TAVB.

Our objective in this study was to try to characterize the anatomical variants and electrophysiological behavior of atypical forms of NAVT (since they are still poorly explained by the specialized literature) and to correlate them with risk-predicting events for AVB during ablation with a radiofrequency catheter.

As to the anatomical location of the retrograde pathway in the atypical forms in this study, the earliest atrial retrograde conduction was observed in a more anterior position (near the bundle of His) in two patients, in the medial region (pxCS = His) in three patients, in the proximal coronary sinus in 6 patients, and in the distal coronary sinus (dCS) in two patients (Tabs. 4, 6, and 7).

The electrophysiological behavior of the anterograde and retrograde pathways in atypical forms was manifold (Tabs. 4, 6, and 7).

Based on the data above, we can see that risk-predicting events occurred in both forms of NAVT (atypical with 30.8% versus 5.3% in typical forms) with a higher and statistically significant percentage ( $p=0.021$ ) in atypical forms (Tab. 5). Analyzing the anatomical location of the retrograde pathway of atypical forms in which risk events were seen (with their respective SI md, SS post, FS md, and SI post circuits), we can see that this location was medial or posterior, and therefore, closer to the target region for the ablation catheter in the posteroseptal region of the RA. On the other hand, this may have contributed to the appearance of risk-predicting events for nodal damage and even permanent damage of nodal A-V

conduction, through the permanent first-degree A-V block present in one patient (who had the atypical SI med form).

In spite of the fact that risk-predicting events have been observed more frequently (in terms of percentages) in atypical forms ( $p=0.021$ ), there was also permanent damage in nodal conduction after RF emission in typical forms preceded by these risk events. These were, respectively, one with a first-degree A-V block and another with a permanent TAVB (both preceded by a V-A block during JET) (Tabs. 4, 5, and 6).

From data analysis, we can conclude that in both types of NAVT risk-predicting events can cause permanent nodal injury.

In spite of higher percentages of risk-predicting events in atypical forms, more patients with typical forms (two to one with atypical forms) experienced permanent lesions in nodal A-V conduction. This may have occurred as a result of several factors, including the large difference in numbers of patients with typical versus atypical forms (132 versus 13, respectively), inadvertent risk of TAVB despite rapid interruption of RF in the presence of an V-A block during JET (as per Hintringer et al<sup>8</sup>), and, at the same time, the fact that patients with risk-predicting factors during JET had the RF emission immediately stopped, which in most cases avoided permanent nodal lesions, such as TAVB, in many patients.

The greatest limitation of this study was the large numerical difference between patients with typical NAVT and those with atypical NAVT (132 versus 13 patients, respectively), probably as a result of a lower rate of atypical forms among the total cases of NAVT, a phenomenon already noted in previous studies<sup>3,10,11, 19,22,23</sup>. In spite of this significant numerical difference between both variants, there was a statistical significance ( $p = 0.021$ ) during RF emission and an accelerated junctional rhythm of more risk-predicting events in patients with atypical forms, especially those with earlier retrograde V-A conduction during NAVT in the medial and posterior regions of the septum, near the target position of the ablation catheter. None of the atypical cases that presented an earlier retrograde V-A conduction during tachycardia in the anterior region of the septum or at the distal site of the catheter positioned inside the coronary sinus (30.7% of atypical forms), had risk-predicting events (Tabs. 4, 5, 6, and 7).

## Conclusion

Atypical forms represent 9% of the incidence of nodal reentry atrioventricular tachycardia cases studied. The possibilities of anatomical and electrophysiological variations within the atypical forms of nodal reentry atrioventricular tachycardia are multiple. The medial and posterior position retrograde pathways show a larger number of risk-predicting events for atrioventricular block. Characterization of the anatomical type allows for a wiser approach in preventing complications.

## Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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