

Supraventricular Tachycardia: Experience of the Sheikh Khalifa Hospital

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Abstract

Original Research Article

Introduction: Supraventricular tachycardias represent a fairly common condition, often encountered in emergencies but which remains underestimated due to the rarity of seizures or their atypical manifestations. **Methods:** We report the results of a retrospective and descriptive single-center study of 32 cases of supraventricular tachycardia carried out in the cardiology department of the Cheikh Khalifa University Hospital over a period of 2 years: from January 2020 to January 2022. We studied in this work the epidemiological, clinical, paraclinical and therapeutic characteristics of these tachycardias. The results of our series are compared with those of the literature. **Results:** The age of the patients varies between 27 and 80 years with an average age of 58.1 years with a sex ratio M/F=1.6. All patients were symptomatic with the presence of palpitations in 87.5% of cases accompanied by dyspnea in 40.62% of cases, Chest pain and lipothymia were present in 15.62% and Syncope was found in 2 patients 6.25% of cases. Endocavitary electrophysiological exploration has proven to be important in defining the mechanism of these tachycardias, in this case tachycardias with one-to-one conduction; In our series, it confirmed the presence of a typical atrial flutter in 53% of cases, and objectified tachycardia by intranodal reentry in 28.12% of cases and less frequently reentry by accessory route, identified in 18.75% of cases. In this series, radiofrequency represents the energy most used in the management of these supraventricular tachycardias. **Conclusion:** Conventional fluoroscopy was the most widely used given the typical nature of these SVTs (84.6% of cases) while three-dimensional mapping was only used in 12.5% of patients who were admitted for recurrences. The low risk of complications and the high success rates revealed in our series make ablation a reference treatment, which has made it possible to change the prognosis of supraventricular tachycardias.

Keywords: Three-dimensional mapping, conventional fluoroscopy, electrophysiological exploration, radiofrequency ablation, supraventricular tachycardia.

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INTRODUCTION

Supraventricular tachycardia (SVT) represents a heterogeneous group of arrhythmias used to describe tachycardias whose origin is above the bifurcation of the His bundle: left or right atrium, atrioventricular junction, accessory pathways. Tachycardias can be of atrial origin (micro or macro re-entry: flutter or atrial fibrillation) or junctional (by intra-nodal re-entry or by an accessory or exceptionally focal pathway). In the acute setting and depending on the mechanism of the tachycardia, vagal maneuvers, drug cardioversion, or, very rarely, electrical cardioversion may be necessary and effective to terminate the tachycardia. Endo-cavity radiofrequency (RF) ablation preceded by electrophysiological exploration has revolutionized the treatment of many supraventricular tachycardias. It constitutes a non-surgical curative therapeutic approach allowing the

transformation of the arrhythmogenic substrate into a fibrous scar, which constitutes a definitive treatment of the arrhythmia. The aim of our study is to describe the epidemiological, clinical, electrocardiographic, and electrophysiological characteristics of patients admitted for supraventricular tachycardia (apart from atrial fibrillation, which represents a group of its own) and to evaluate the activity and results of radiofrequency ablation in the treatment of these SVTs.

MATERIALS AND METHODS

This is a retrospective and descriptive monocentric study, carried out in the cardiology department of the Sheikh Khalifa University Hospital (HUCK) over a two-year period from January 2020 to January 2022.

The study included a series of 32 cases of supraventricular tachycardias all treated by RF ablation procedures.

All symptomatic patients with electrophysiological findings of supraventricular tachycardia who received ablative therapy during their hospitalization or programmed after discharge will be included. All patients who are candidates for radiofrequency ablation of atrial fibrillation will be excluded, considered as a separate group.

Patients In our series, the average age was 58.1 years. All patients underwent a complete history regarding the onset and frequency of palpitations, syncope, chest pain, dyspnea, etc. They also underwent a 12-lead surface electrocardiogram at rest and a transthoracic echocardiography.

All patients in our series underwent electrophysiological exploration before ablation to confirm the reentry circuit and trigger tachycardia in patients in sinus rhythm performed in the cardiac catheterization room under local anesthesia. After a right femoral venous approach or right venous and left arterial approach, 3 intracavity electrophysiology leads (2 6F leads and 1 7F lead) were introduced and positioned under scopy. Intracardiac lead positions may vary depending on the arrhythmia to be ablated, but most often the leads are positioned as follows: A decapolar, octa, or hexapolar lead in the coronary sinus; a quadripolar lead at the nodo-hissian junction; and the 3rd quadripolar lead successively placed in the right atrium and then in the right ventricle for a study of anterograde and retrograde properties.

When the indication for ablation is retained, clear information is provided to patients on the modalities, the expected benefits and the risks of the procedure. Thus, a written consent was signed by the patients before the ablation.

2 types of ablation catheters are generally used: non-irrigated catheter and irrigated catheter. The determination of the ablation site is dependent on the rhythm disorder to be ablated.

Radiofrequency energy is delivered by a generator that allows monitoring of temperature, impedance and power. The procedure can be aided by a three-dimensional mapping system that allows the position of the different leads in the heart cavities to be visualized in real time.

Intravenous heparin is essential for left-sided surgery to reduce the risk of thromboembolic events. Analgesics may also be used in case of pain.

Throughout the procedure, functional signs, vital parameters including blood pressure, heart rate,

oxygen saturation and electrocardiographic recording should be monitored.

In the immediate post-procedure period, all patients are placed in a cardiac intensive care unit for 24 hours of close monitoring. All patients are then reviewed 15 days after the ablation procedure and, if successful, at 1 month, 6 months, and following a recurrence of the symptomatology. In case of failure, a redux ablation can be proposed to the patient using a more advanced technology such as 3D reconstruction and then they will be followed up regularly in consultation.

The short-term success of the procedure is defined by the combination of the disappearance of the rhythm disorder during or after radiofrequency pacing and the absence of arrhythmia triggering by the various pacing maneuvers even after drug sensitization.

RESULTS

In our series, the average age was 58.1 years with extremes ranging from 24 to 80 years. The sex ratio was 1.6 males to females, i.e. 20 males to 12 females, the mean age for males was 60.95 years, and for females 53.36 years.

According to the type of supraventricular tachycardia, there was A male predominance with a ratio of 14 men to 3 women for atrial flutter. A female predominance with a ratio of 7 women to 2 men for intranodal reentrant tachycardia. A discrete male predominance with a ratio of 4 men for 2 women for the accessory pathway.

In our series, 31 patients were of Moroccan origin and one patient of Congolese origin.

No history of sudden death in the family or personally recovered, nor of known OSA was identified in the study population. Dysthyroidism such as hypothyroidism under replacement therapy was found in 2 patients, i.e. 6.25% of cases.

5 patients, or 15.62% of cases, were followed up for ischemic heart disease revascularized by coronary angioplasty with placement of active stents. In the study population, all cardiovascular risk factors were present, although at different rates. The most frequent risk factor was chronic smoking in 12 patients (37.5%); a sedentary lifestyle was second with a rate of 34.37%. Obesity was found in 7 patients (21.87%). 7 patients (21.8%) were known to have hypertension. Type 2 diabetes on oral antidiabetics was also found in 6 patients, i.e. 18.75% of cases. Dyslipidemia was found in 3 patients and thus represents the least frequent CV risk factor with a percentage of 9.3%.

Only one patient or 3.125% of cases had a history of enolism. In our study, 2 patients had no cardiovascular risk factor.

Palpitations were the most frequent symptomatology, present in 28 patients or 87.5% of cases. Dyspnea was present in 13 patients or 40.62% of

cases. Chest pain and lipothymia were present in 5 patients (15.62%). Syncope was found in 2 patients (6.25% of cases) (Table 1).

Table 1: Clinical signs of TSV

Clinical signs	Number of patients	Percentage
Palpitations	28	87,5%
Dyspnea	13	40,62%
Lipothymia	5	15,625%
Chest pain	5	15,625%
Syncope	2	6,25%

On clinical examination, 30 patients or 93.75% of the cases were hemodynamically stable and only 2 patients or 6.25% had signs of IVD such as crepitus rales at the basithoracic level, one of which also had signs of IVD such as IMO arriving at mid-leg.

Electrocardiographic Data

30 patients, or 93.75% of cases, had a percritical electrocardiographic recording; the data from this recording were not found in 2 patients: The latter showed a fine QRS tachycardia in 29 patients, i.e., 90.6% of the

cases, and a wide QRS tachycardia in only one patient, i.e., 3.125%, related to an aberration. The tachycardias were regular in 15 patients, i.e., 50% of cases, and irregular in the other half (Figure 1).

The ECG showed atrial flutter in 15 patients (50% of cases) and INR in 8 patients (26% of cases). The ECG analysis was not clear in the rest of the patients, hence the interest of electrophysiological exploration to determine the exact mechanism of the tachycardia.

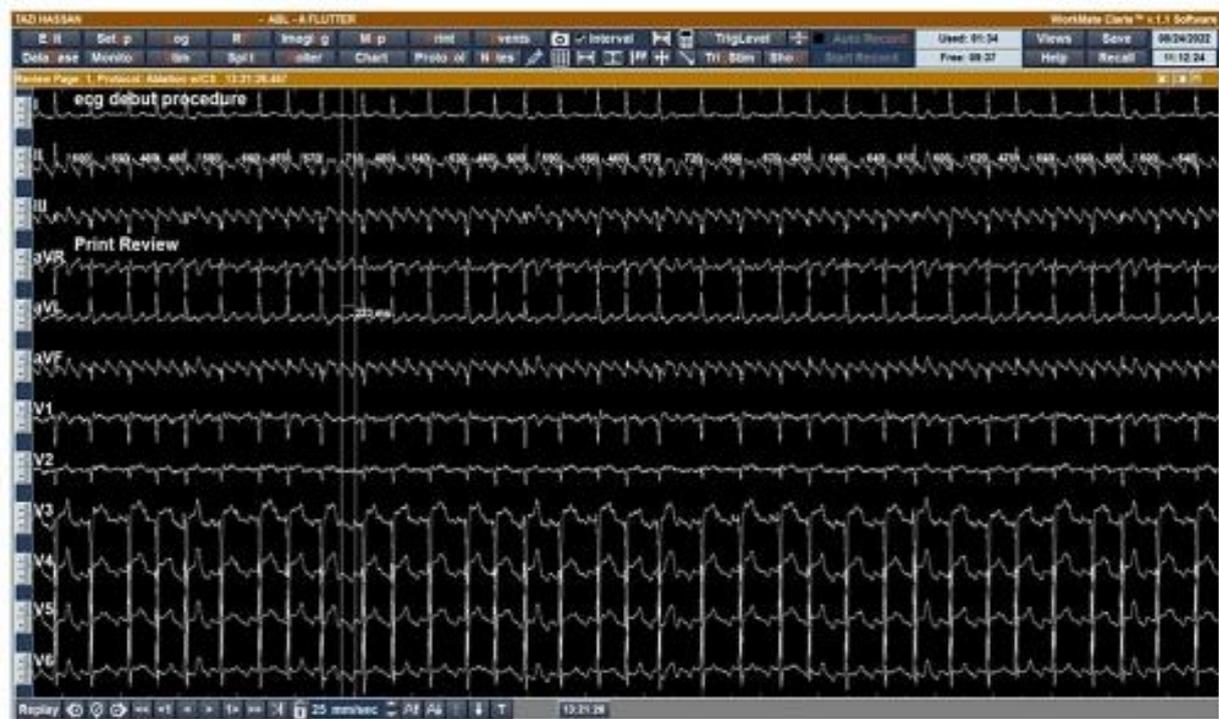


Figure 1: ECG at the start of the ablation procedure for variable conduction counterclockwise atrial flutter

All patients in our series underwent trans-thoracic echocardiography. In 8 patients (25% of cases), we found an aspect of ischemic heart disease with

moderate diastolic ventricular dysfunction in 4 patients (50%). The TTE was without abnormalities in the other patients (75% of cases).

Only 1 patient, i.e. 3.8% of cases, had an ECG holter showing an intermittent Wolff Parkinson White syndrome with a very probable super Wolff.

Paraclinical data

Electrophysiological exploration

All patients in our series underwent electrophysiological exploration before ablation to confirm the reentry circuit and trigger tachycardia in patients in sinus rhythm. The results were as follows:

An aspect of isthmo-dependent anti-clockwise atrial flutter in 17 patients, i.e. 53% of the cases, a typical slow-fast intranodal reentrant tachycardia (TRIN) in 9 patients, i.e. 28.12% of the cases, and an accessory pathway of the WPW syndrome type in 6 patients, i.e. 18.75% of the cases: There were more left (Nb= 5) than right (Nb=1) locations: A left lateral Kent was found in 4 patients, a left midseptal pathway in 1 patient, and a right posteroseptal Kent was identified in 1 patient (Table 2).

Table 2: Electrophysiological Exploration Results

electrophysiological exploration results	Number of patients	Percentage (%)
typical counterclockwise atrial flutter	17	53
typical TRIN	9	28,12
acesory pathway	6	18,75

All patients were on antiarrhythmic therapy: 19 patients on monotherapy (13 cases on beta-blocker, 2 cases on amiodarone), 13 patients on dual therapy (8 cases on beta-blocker and amiodarone, 3 cases on betablocker and flecaïnide), and received curative treatment by radiofrequency ablation.

Conventional fluoroscopy with EGM was used in 28 patients or 87.5% of the cases while the Abbot Ensité precision mapping system was used in 4 patients or 12.5% (figure 3). 24 patients or 75% of the cases had a primary ablation procedure while 6 patients or 18.75% of the cases had a redux ablation procedure: 4 patients had a recurrence of typical atrial flutter and 2 patients had a recurrence of accessory pathway.

For the patients with NRTI, the procedure was conducted with immediate success for all patients, i.e. 100% of the cases. An average of 13.2 shots was performed for patients with TRIN for an average shot duration of 367.5 ms allowing to deliver an average energy of 35.7 W.

For patients with WPW syndrome (n=5), the procedure was conducted with immediate success in 4 patients, i.e., 80% of cases (Figure 2). Ablation was partially successful in only 1 patient (most likely related to the existence of an epicardial extension of the accessory pathway). The accessory pathway ablation procedure required an average of 5.6 radiofrequency pulses with an average firing time of 408 ms and an average energy of 37.8 watts (Table 3).

Table 3: The differents carracteristics of radiofrequency ablation

Radiofrequency Ablation	Average Number of Shots	Average Power (W)	Average Temperature (°C)	Average Shots Duration (ms)	Succes	Partiel succes / Failure
WPW	5,6	37,8	47	408	66,6%	33,3%
TRIN	13,2	35,7	47,75	367,5	100%	0%
Atrial Flutter	8,2	42,6	46,2	414,6	76,4%	23,5%



Figure 2: Radiofrequency shots in atrial flutter objectifying tachycardia arrest after tachycardia cycle lengthening

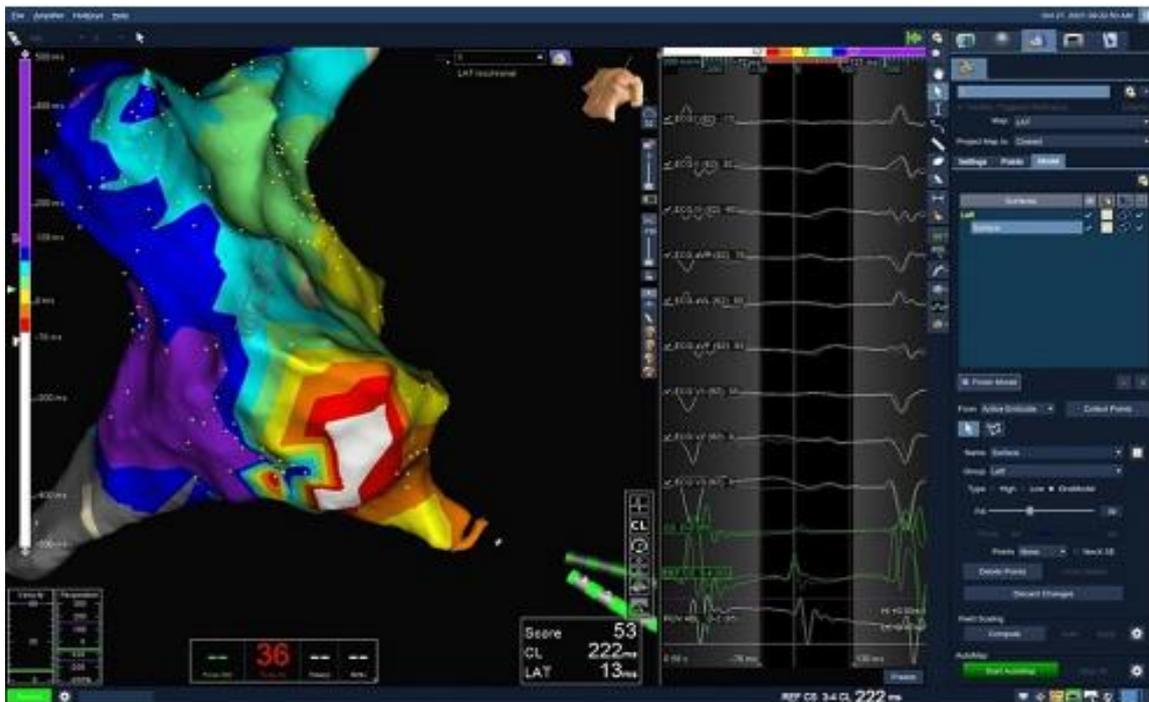


Figure 3: activation map with Abbot's Ensite precision system representing counterclockwise atrial flutter the oil spot spread of the impulse includes a primoactivation at the cavotricuspid isthmus (red area) and a counterclock

During the accessory pathway ablation procedure, we noted the occurrence in 2 patients of atrial fibrillation in immediate post-radiofrequency: poorly tolerated hemodynamically reduced by external electric shock in one patient and well tolerated having been reduced spontaneously in the other. In addition, no post procedural complications were noted, including AVB,

hematoma at the puncture site, arteriovenous fistula, tamponade, MI, recurrence or death.

Follow-up 6 months after the ablation procedure found 100% of patients asymptomatic with a regular sinus rhythm on ECG (Figure 4).



Figure 4: ECG at the end of typical atrial flutter ablation procedure showing return to sinus rhythm

DISCUSSION

Epidemiological studies of supraventricular tachycardia remain limited in our country. In the US health care system, the prevalence of SVT at the general population level is 2.25/1000 persons and the incidence is 35/100 000 person-years [1]. Women are twice as likely to develop SVT as men, and persons aged 65 years or older are more than five times as likely to develop SVT as younger persons [1]. In the study by Orejarena *et al.*, [2] the mean age of onset of supraventricular tachycardia was 57 years with extremes ranging from childhood to 80 years. This is consistent with the mean age of 57.4 years found in our study [3-6]. Some studies [3-6], including the prospective multicenter study by Calkins *et al.*, have shown that women are more likely to be affected by intranodal reentrant tachycardias than men, and vice versa for reciprocal tachycardias.

With regard to clinical data Episodes of supraventricular tachycardias are often manifested by palpitations. They may be associated with dizziness, chest tightness, dyspnea, lipothymia or even syncope [7]. The frequency of occurrence of the episodes varies according to the patient, ranging from several attacks per week to a few per year or even less.

The results of our study are consistent with the literature, all patients were symptomatic with palpitations in 87.5% of cases as well as dyspnea in 40.625% of cases, lipothymia in 15.625% of cases. Syncope was the least frequent symptom, found in 6.25% of cases.

For electrocardiographic data, a per-critical ECG is very useful in the effective diagnosis of SVT, although it may not lead to a specific diagnosis [8]. It may not be available in patients with very short or infrequent periods of palpitations.

Although the per and intercritical ECG can help in the diagnosis of supraventricular tachycardias, it is the electro-physiological study that allows, thanks to several specific maneuvers, to identify the mechanism of the tachycardia and thus to make the definitive diagnosis. It is often necessary to determine the mechanism of the tachycardia and in some cases to trigger the crisis; the ablation of the arrhythmogenic focus can be performed during this exploration. It is most often performed by endocavitary approach. It can also be performed by transesophageal approach, especially in the pediatric population [9, 10]. In our study population, PEE was performed by endocavitary approach in all our patients and the results showed a predominance of typical counterclockwise atrial flutter in 50% of cases, typical slow/fast TRIN was found in 30.7% of cases and accessory pathways were identified in 19.2% of cases. In our series, in the 6 patients with an accessory pathway, the most frequent location was in the left lateral area (in 5 patients) followed by the right posteroseptal and left midseptal areas. These results are in agreement with the data found in the literature, in particular in a study carried out in the Netherlands in 2002 on 157 patients: It found a predominance of the left lateral zone (47 patients) followed by the right lateral (31 patients), right posteroseptal (26 patients) and left posteroseptal (14 patients) zones. The left midseptal location was rarer,

found in 13 patients [11]. This agrees with another study performed in 2016 in Portugal confirming the slightly higher frequency of accessory pathways around the mitral annulus (53.15% of cases) compared with those distributed around the tricuspid annulus (46.85%) [12].

Long-term management depends on the underlying mechanism, frequency of symptoms, patient safety, and patient preference. However, the potential for substantial improvements in quality of life, reduction in hospital attendance, and financial burden make catheter ablation a particularly desirable option as first-line treatment for all SVTs, especially in junctional tachycardias.

Catheter ablation is now widely used for most varieties of VSD, and patient-reported outcome measures have shown that patients experience significant improvements in quality of life after ablation.

Radiofrequency ablation is classically performed under fluoroscopy. Recent technological advances have led to the development of nonfluoroscopic three-dimensional (3D) mapping systems to guide ablation in prolonged electrophysiological procedures, such as mapping of atypical atrial flutter [13].

In our study, the conventional fluoroscopy technique with EGM tracking was used in 84.6% of cases while the Abbot Ensite precision mapping system was used in 15.4%.

Radiofrequency ablation of accessory pathways is based on destruction of the accessory pathway after pinpointing its precise location, thereby interrupting the electrical connection at the accessory bundle. The immediate success of the procedure is defined by the disappearance of conduction through the VA in the anterograde and retrograde directions.

The most common location of the accessory pathway is the left lateral zone. This area can be accessed either from the ventricular side of the atrioventricular groove via the femoral artery and the aortic valve [14] or from the atrial part of the atrioventricular groove via the femoral vein with trans-septal puncture to access the left atrium [15]. In some cases, the presence of a patent foramen ovale allows the ablation probe to be positioned in the left cavities by an anterograde approach without resorting to a trans-septal puncture. In our study, the most commonly used vascular approach is right femoral vein

The NASPE prospective ablation registry, published in 1998, including 3357 patients, 654 of whom had an accessory pathway, found a success rate of 94% and a recurrence rate of 4.6%.

The prospective multicenter clinical trial of Calkins et al, published in 1999, including 1136 patients, 500 of whom had an accessory route, found a success rate of 93%, similar to the previous registry, with a recurrence rate of 7.8%.

Limitations of our study

Small number of patients in our series but short duration of the study (2 years)
Procedures performed during the COVID period
High cost of procedures with low health coverage
Retrospective study

CONCLUSIONS

Radiofrequency ablation has revolutionized the treatment of most supraventricular tachycardias and is now the first-line curative treatment thanks to its high success rate and the low incidence of serious complications related to the procedure.

It avoids the use of anti-arrhythmic drugs that are sometimes ineffective, poorly tolerated, with potential side effects, reduces hospital attendance and improves the quality of life of patients. However, this technique is costly and depends essentially on the experience of the operators.

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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