

# Paroxysmal Supraventricular Tachycardia: Highlighting Unmet Needs in Emergency Care

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## Interview Summary

The clinical syndrome of paroxysmal supraventricular tachycardia (PSVT) is characterised by recurrent, acute episodes of rapid heart rate. PSVT is a common condition, affecting patients' daily lives through the unpredictable onset of symptoms such as palpitations, breathlessness, chest pain, and associated anxiety. However, its transient nature can impede diagnosis and the acute management of PSVT episodes often requires emergency hospital care. During interviews conducted with the EMJ in July 2021, two leading cardiologists specialising in the treatment of arrhythmias, John Camm, St George's University Hospitals NHS Foundation Trust, London, UK, and Felix Sogade, Georgia Arrhythmia Consultants, Macon, Georgia, USA, discussed PSVT, focusing on current unmet needs in emergency care. Topics covered included the challenges of diagnosis and key concerns around both the acute and long-term management of PSVT attacks. The burden PSVT presents to patients and the healthcare system was also examined, with consideration of how the emergence of home-based approaches and improved patient and caregiver education may help to address current unmet needs.

## INTRODUCTION

### Paroxysmal Supraventricular Tachycardia: Prevalence and Patient Impact

Supraventricular tachycardias (SVTs) are a group of conditions that produce elevated heart rates of >100 bpm at rest due to altered electrical activity in or above the His bundle.<sup>1,2</sup> As a subgroup of SVT, PSVTs are characterised by sporadic episodes of regular tachycardia that start and

stop abruptly. The most common types of PSVT are atrioventricular nodal re-entrant tachycardia and atrioventricular reciprocating tachycardia, which are both linked to the abnormal re-entry of propagating impulses. Focal atrial tachycardias are less common PSVTs caused by abnormalities in the automaticity of the heart.<sup>3,4</sup>

Camm explained that overall prevalence estimates for PSVT vary depending on source and means of data collection. Epidemiological studies are limited, but the estimated prevalence of SVT in the general USA population is cited

as 2.25 per 1,000 persons, with an incidence of 35 per 100,000 person-years.<sup>2,5</sup> This estimate from the 1990s reflects the acute burden of PSVT in the healthcare setting, given patients were required to have documented PSVT on ECG during the specific encounter.<sup>5</sup> The study likely underestimates PSVT prevalence due to the episodic nature of the disease, variability in duration of SVT episodes, and the fact that the majority of SVT episodes are experienced outside of the healthcare setting.<sup>4</sup> A 2021 study used a longitudinal claims-based approach and estimated PSVT prevalence to be 2–3 times larger than prior estimates (1.2–2.1 million treated prevalence). Regardless of epidemiologic approach, the risk of PSVT is higher in females and in those aged  $\geq 65$  years.<sup>2</sup> Reflecting on his experience in the USA, Sogade noted: “PSVT is a very prevalent disorder, but it is often underdiagnosed or misdiagnosed. We know that approximately 1–2 million people per year suffer from this condition in the USA alone, and one can only project that this is a disease of significant impact both in the USA and globally.”

From case to case, PSVT differs in terms of the frequency of episodes (weekly, monthly, or yearly) and symptom severity or impact. However, the experts agreed that the patient experience of PSVT mainly centres on the effects of a rapid heart rate and associated anxiety. “The majority of patients sense PSVT immediately because of a rapid thumping in the chest, usually between 140 and 240 bpm,” said Camm. “That, of course, can provoke other symptoms like breathlessness, chest pain, light-headedness, and particularly anxiety. For patients who are suffering their first attack, for example, anxiety is a very prominent feature because they think they’re having a heart attack and want to seek help immediately.” Sogade further described the association between anxiety and PSVT: “Because the palpitations cause a level of discomfort and restlessness, PSVT also results in social anxiety whereby people are afraid to travel on vacation, or are afraid to go out.” According to Camm, the overall impact of PSVT depends very much on the frequency of the attacks. “Obviously the more frequently it happens, and the more unpredictable, the more the patients’ quality of life will be disturbed by the arrhythmia,” he concluded.

## Diagnosis of Paroxysmal Supraventricular Tachycardia

The unpredictable, transient nature of PSVT means that the condition is frequently diagnosed when the patient seeks help for acute attacks, and an ECG is pivotal to this diagnosis. As outlined by Sogade: “Clinical history is very important for the diagnosis of PSVT, whereby the patient presents with palpitations and other symptoms, but the most important factor is the ECG.” Camm reinforced this point: “In order to make a definitive diagnosis of PSVT, you must see it on an ECG and be capable of interpreting the ECG, or accessing an expert opinion about an ECG if you are in the emergency room (ER), for example. Many patients will go to their general practitioner, who can also make the diagnosis if they have the means to record and interpret an ECG.”

However, diagnosis may be impeded for reasons other than ECG interpretation. “Most episodes of PSVT are self-terminating, so by the time somebody seeks medical attention the episode may have ended, and the healthcare provider observes a normal heart rate,” said Sogade. He also described how, for this reason, females tend to be misdiagnosed with anxiety disorder on clinical presentation of PSVT.<sup>6</sup> Camm noted that there may still be clues on an apparently normal-looking ECG such as the classical pattern of Wolff-Parkinson-White ventricular pre-excitation but accepted that “in most instances, you have to try to document the arrhythmia when it happens.” To this end, the use of Holter or event monitors or wearable devices was discussed. According to Camm: “If the arrhythmia occurs every few days, you can use a Holter ambulatory monitor with chest electrodes attached to a solid-state recorder to pick up an attack. Even in people who think they only have rare attacks, over 24 or 48 hours you may be able to make a diagnosis based on a very brief asymptomatic event on a Holter ECG. If, however, the patient is having attacks every 6–9 months, then you have to think about event recorders. Nowadays, smartphones and watches allow ready acquisition of an ECG, and patients can be trained in their use. It’s a quick way of finding out about the rhythm disturbance, and is a very good system that I often suggest to patients.” Sogade shared this view: “I find the wearable devices that are currently entering the

market very interesting. Patients are coming in with their own ECG rhythm strips documenting their episode, and I think that is going to lead to a larger population of diagnosed patients who we will be able to treat,” he said. “There are a number of reasons why people may complain of palpitations that may be mistaken for PSVT, e.g., a quickening of the pulse if they are fearful or worried, but misdiagnosis doesn’t usually occur once there is an ECG,” concluded Camm.

## Unmet Needs in the Diagnosis of Paroxysmal Supraventricular Tachycardia

Summarising unmet needs in the diagnosis of PSVT, Sogade re-emphasised that the emergence of mobile monitoring is beginning to address the problem of under-diagnosis. In addition, Camm noted the potential benefits of advanced techniques and the increased use of invasive cardiac electrophysiology studies to pinpoint diagnoses: “By putting catheters with electrodes into the heart you can identify abnormal pathways, which allows you to make a very accurate diagnosis and in practical terms allows you to actually destroy the abnormal part of the heart so that the palpitations will not continue.” However, at the opposite end of the spectrum Sogade raised the issue of access to any form of care as a notable unmet need: “I live in the USA, and while it’s easier if you live near to medical resources, imagine living in a place that is far away from medical facilities. Some patients, a mixed bag of diagnosed and non-diagnosed, have had PSVT for 40 years with no specific treatment. Furthermore, access to care during the COVID-19 pandemic has been very restricted, and these patients have fallen into a lower priority for ER treatment,” he stressed.

## TREATMENT OF PAROXYSMAL SUPRAVENTRICULAR TACHYCARDIA

### Acute Treatment

In terms of acute treatment, it was discussed how, at present, there are limited home-based therapies for PSVT and no approved pharmacological options for patients to self-administer. According to Camm, the initial advice given to a patient who experiences an attack at home is to sit or lie down and relax. “They can

also do a vagal manoeuvre, aiming to intensify the activity of the vagus nerve to act as a brake and literally stop the tachycardia. This can be done in a variety of ways, for example, by massaging the carotid sinus in the neck, but this is very uncomfortable. It also has some dangers as it could dislodge plaques from the carotid artery and cause strokes. Alternative methods include the Valsalva manoeuvre (activating the vagal nerve by increasing pressure in the chest) or employing the diving reflex to slow the heart rate (covering the nose with water to activate the autonomic vagal nervous system). However, if these don’t work and you’re at home, there’s nothing much else you can do but rest and wait or take yourself to the doctor,” said Camm.

“Once in the ER, the standard of care is intravenous adenosine for classically recognised PSVT,” said Sogade. “This results in termination of the episode, but requires you to obtain an intravenous line, connect the patient to a monitor, and have trained medical personnel available. In addition, medical personnel may be uncomfortable/anxious giving intravenous adenosine because of the sudden or awful effect it can create in the patient,” he cautioned. Camm explained further: “A quick and simple injection of a few milligrams of adenosine breaks the tachycardia within seconds, but during these few seconds the patient often feels as though they are going to die, although this sensation doesn’t last for more than a few moments.” Verapamil and diltiazem (non-dihydropyridine calcium antagonists [calcium-channel blockers]) or  $\beta$ -blockers like bisoprolol or esmolol were cited as other intravenous treatment options, although both experts highlighted adenosine as the classical approach to the acute treatment of PSVT. Yet Camm also pointed out that these treatment options are not appropriate for all PSVTs: “Atrial tachycardias, which have a relatively small occurrence compared to the other forms of PSVT, don’t respond in the same way to a Valsalva manoeuvre or to drugs such as adenosine, but do respond well to ion channel inhibitors like fast sodium channel blockers etc.,” he said.

### Long-Term Treatment

The experts went on to describe the treatments available for PSVT beyond acute care. “Going forward, there are a number of drugs to

prevent the recurrence of PSVT. There are also electrophysiology studies followed by ablation where you can identify and essentially destroy the critical areas and interrupt these tachycardias. Ablation in particular is very effective, but anti-arrhythmic drugs can also be effective,” said Camm. Sogade agreed that ablation was an effective treatment, although noted that the technique is “costly, and not widely available” in the USA. Sogade also outlined some of the disadvantages of long-term medical therapy: “Most of the long-term management of PSVT involves the patient being prescribed medications,  $\beta$ -blockers, and calcium-channel blockers to reduce the heart rate and the frequency of PSVT. The most common side effects with  $\beta$ -blockers are a sense of fatigue, weight gain, insomnia, and poor sleep. The alternative, calcium-channel blockers, cause constipation and can also lower blood pressure too far.” Furthermore, Sogade stressed that taking medication every day to help prevent these attacks is a considerable undertaking across a lifetime, especially if diagnosis is in the teenage years.

### Unmet Needs in the Treatment of Paroxysmal Supraventricular Tachycardia

After considering the current treatment situation in PSVT, alternative options for patient self-administration at home was the chief unmet need identified by both Camm and Sogade. “If, eventually, we have a home therapy by which patients use their medication only during an attack, it would be another item in our armamentarium, and this is an area that I believe is going to be revolutionary,” said Sogade. Camm agreed: “It would be of value if the patient could do something more at home, and this is where new developments come in.” The experts described the study drug etripamil (Milestone Pharmaceuticals, Montreal, Canada), a rapidly acting, non-dihydropyridine calcium-channel blocker in the same class as verapamil, that is being developed as an intra-nasal spray for patient self-administration.<sup>7</sup> Described by Sogade as “the first of its kind,” the nasal administration was said to allow rapid absorption of the drug and so terminate the tachycardia within a few minutes.<sup>7</sup> Camm explained that a self-administered treatment such as this would

benefit both patients and the healthcare system by reducing the number of patient visits to the ER with mild attacks of PSVT. “Generally, emergency physicians want to reassure patients and tell them how to deal with PSVT at home as far as possible,” commented Camm.

## HEALTHCARE BURDEN

Treating patients with PSVT is associated with a notable healthcare burden that, as discussed above, predominantly centres on the provision of care in a hospital setting. Moreover, this burden alters markedly at the point of diagnosis. “We know there is definitely a doubling or tripling of the cost of healthcare resource utilisation when the patient is diagnosed with PSVT,”<sup>8,9</sup> said Sogade. “Pre-diagnosis, the patient has been utilising medical care and going to the ER during an episode, and there is a cost related to that. Yet once patients are diagnosed, they are on medical therapy, visiting for check-ups with their healthcare provider, and they may also be offered invasive therapy with catheter ablation,” he said. Camm noted that the burden of PSVT depends on the treatment received, and that if the patient is in a healthcare system in which ablation is readily available then the problem may be solved quite rapidly with no further needs. Sogade agreed that a successful ablation procedure is considered curative for most PSVTs. However, although it is associated with a high success rate (>90%), and the risks of recurrence (2.0–8.0%) and complications (0.3–1.5%) are relatively low in atrioventricular nodal re-entrant tachycardia or atrioventricular reciprocating tachycardia.<sup>2,10</sup> Sogade observed that any recurrence with a need for repeat ablation, or complications requiring hospitalisation or additional procedures, would notably increase treatment costs. “You always have to balance the risks and benefits,” he added. Further to this, Camm explained that while the true cost of an ablation procedure is not considerable, health insurance considerations mean that in some countries it costs a lot more due to it being an interventional approach requiring hospital admission. “For the average person, in the USA, the cost would be 5,000 USD before diagnosis and this would jump to a range of around 10,000–40,000 USD after diagnosis,” said Sogade.

The experts also discussed how PSVTs and associated healthcare resource use vary by gender due to the combined influence of differences in prevalence, diagnosis, and treatment. “PSVTs are more common in females than in males,”<sup>4,11</sup> said Camm. “Data [from a USA medical care survey] show that female patients aged <65 years account for the largest percentage of ER visits for PSVT, although the annual visit rate is higher in those aged ≥65 years. Overall, the annual visit rate per 100,000 individuals was 26 for females and only 11 for males,”<sup>4,12</sup> he stated. “As in most aspects of cardiovascular medicine, we see the issue of gender difference in terms of PSVT diagnosis and treatment,” said Sogade. “Definitely there are more females who are diagnosed with PSVT; two-thirds of patients are female.<sup>13</sup> Perhaps more female patients seek healthcare or engage the healthcare system when they experience symptoms. However, when it comes to therapy, females are not offered invasive options as often as males.”<sup>13</sup> Camm agreed that ablation is less often applied to females than to males: “I think it’s a general rule that compared to males, females have fewer major interventional approaches offered to them in any setting. Otherwise, males and females respond to ablation and drugs in a very similar fashion.” As would be expected, the gender differences in diagnosis and treatment are reflected in healthcare resource use and expenditure.<sup>13</sup> Sogade suggested that increased awareness from both healthcare providers and patients is key to addressing this sex disparity and overcoming any issues in care provision.

### **Addressing the Healthcare Burden in Paroxysmal Supraventricular Tachycardia**

The experts moved on to discuss how addressing unmet needs in diagnosis and treatment could help reduce the healthcare burden of PSVT. Home monitoring was seen as an advance that could bring marked patient and health economic benefits by facilitating the diagnosis of PSVT. “There are so many self-monitoring devices that are accurate in terms of recording an event when it’s happening,” commented Sogade. The experts concurred that greater supply and use of home monitoring devices would give patients the ability to

record and share ECGs with their healthcare provider, and so help to accelerate an accurate diagnosis.

Regarding treatment, improved technology and home-based approaches were described as pivotal to the future of PSVT management. According to Camm: “Better ablation technology will mean we are able to do these procedures more quickly and more safely, which will be an advantage. In addition, new drug targets will be identified and there are options for developing brand new medications. As already discussed, there are also different formulations being developed so that patients can administer drugs to themselves when appropriate.” Sogade underscored the value of a home therapy option. “If people don’t want to take medications every day and they don’t/can’t have an ablation, then the ability to treat themselves at home with an agent that can terminate the episode would, I think, be useful.”

In addition, Sogade reiterated the message of better education around PSVT to expedite both diagnosis and treatment. “I think the biggest unmet need is in the education of the public and we have to find a way of delivering information, maybe online or using the different social media platforms. We need to raise awareness of the PSVT conditions, how they present symptoms, the different means of diagnosis, and all the therapeutic alternatives that are available, especially the agent under investigation, etripamil, as an alternative option for intermittent therapy. We don’t want patients to make decisions on their own, but do want them to have sufficient information to enable the best healthcare decisions,” he concluded.

### **SUMMARY**

Camm and Sogade discussed the impact of PSVT as a common arrhythmia that presents a notable burden to patients and to providers of emergency healthcare. The nature of PSVT with its unpredictable, transient episodes was said to present challenges in diagnosis, and greater use of patient home monitoring devices to facilitate diagnosis was endorsed. The experts were encouraged by the ongoing development of self-administered drug formulations to enable patients to treat

mild attacks at home. As well as bringing meaningful benefits to patients, it was predicted that home-delivered treatments would also lessen the impact of PSVT on healthcare resources by reducing the burden

on the ER and giving an alternative to long-term, preventive medication use. Prioritising patient and physician education to generate greater awareness of PSVT, its diagnosis, and treatment, was also highlighted as valuable.

## Biographies

### John Camm

St George's University Hospitals NHS Foundation Trust, London, UK

John Camm is emeritus Professor of Clinical Cardiology at St George's Hospital Medical School, University of London, UK. He graduated from Guy's Hospital, London, UK, and pursued a career in cardiology at St Bartholomew's Hospital, London, UK, before moving to St George's as British Heart Foundation Professor of Clinical Cardiology in 1986. Camm is a Fellow of many professional societies, including the European Society of Cardiology (ESC). He is President and Trustee of the Arrhythmia Alliance (AA), and founder of the Atrial Fibrillation Association (AFA), past Editor-in-chief of *EP Europace*, current Editor-in-chief of *European Heart Journal - Case Reports* and Editor of the *European Society of Cardiology Textbook of Cardiovascular Medicine* and its digital version *ESC CardioMed*. He has been involved in the production of numerous guidelines, including the ESC Guidelines for the management of atrial fibrillation. Camm was awarded the ESC Gold Medal in 2005 and the British Cardiovascular Society Mackenzie Medal in 2008. He has authored or co-authored over 1,250 papers and 35 books.

### Felix Sogade

Georgia Arrhythmia Consultants, Macon, Georgia, USA

Founding physician of Georgia Arrhythmia Consultants (GACRI), Felix Sogade completed his Cardiac Electrophysiology Fellowship at Duke University, Durham, North Carolina, USA; Cardiology Fellowship at the State University of New York (SUNY) at Stony Brook, New York, USA; and MBBS at the University of Ibadan, College of Medicine, Ibadan, Nigeria. He is an Associate Professor at Mercer University School of Medicine, Macon, Georgia, USA, and Director of Cardiac Electrophysiology at Atrium Health Navicent, Macon, Georgia, USA. He serves as an editor for *Circulation: Arrhythmia and Electrophysiology*. He is a Fellow of the American College of Cardiology (ACC) and the Heart Rhythm Society (HRS). He serves as an HRS Ambassador to Africa and helped create the Africa Heart Rhythm Association (AFHRA). He was former Board Chairman of the Association of Black Cardiologists.

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