Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia, with a prevalence of over 50 million cases currently and ≥ 25% lifetime risk across races.1 Surprisingly, the disease is only classified by broad strokes into paroxysmal, persistent, or permanent. Treatment strategies, which are limited to antiarrhythmic drugs or catheter ablation, are applied with a similar lack of granularity to the stage of the disease,2,3 regardless of mechanism.4 Our overly simplistic clinical approach to AF disallows us from understanding the disease and matching interventions with the specific stage of progression, even though there is growing evidence that early intervention is critical.3 Moreover, current attempts at reclassifying AF have been limited to cross-sectional, comorbidity-based heuristics, which considered AF to be a consequence instead of a precursor of other conditions.5,6 A paradigm shift is needed – differentiation of the underlying spectrum of paroxysmal AF will allow us to tailor therapies that target the underlying pathophysiology and identify those at risk for progression.

To overcome this lack of specificity in the diagnosis of paroxysmal AF, we need to identify specific mechanisms in AF pathognesis, before prescribing therapies. For example, vagal nerve stimulation and cardioneural ablations have shown promise in AF, but are underutilized and not individually tailored.4,7 In the earlier stages of AF, triggered activity from atrial tissue, such as ectopic beats, are the underlying *first-mover* in the onset of an episode of AF. Longer, sustained episodes of AF are accompanied by increased atrial scarring and fibrosis, as part of the disease progression. This supports the understanding that earlier phases of paroxysmal AF are driven by electrical triggers, which is ultimately mediated by a maladaptive response of the autonomic nervous system (ANS), such as increased sympathetic activity and acute parasympathetic withdrawal.8,9 Our overarching hypothesis is that sympathetic activity drives triggered atrial activity that leads to and sustains episodes of AF in those with structurally normal atria

To test this, we will leverage a pre-existing, well-established cohort: the UIC Multi-Ethnic Atrial Fibrillation Registry (AF Registry),10 which is enriched for paroxysmal AF. This cohort have extensive follow-up data, genetic sequencing, EP signals, and are led by members of the mentorship committee. During my TL1, T32, and F32 scholarship, I have worked extensively to collect clinical data in multiple ongoing NIH-sponsored investigations involving my mentorship and advisory team,10,11 developing critical skills in signal processing and biostatistics. I found supporting evidence that vagolysis lead to abnormal cardiac perfusion and increased cardiovascular mortality.12–15 These abnormalities were identified through electrocardiography-based (ECG) markers, including heart rate variability (HRV), and associated with ANS function and cardiac physiology.16 As a fellow in clinical cardiac electrophysiology (EP), I am positioned to also obtain highly-granular data from EP studies performed during AF ablation, including cardiac-specific blood samples, intracardiac electrograms, and electroanatomical mapping. I will integrate these features into clinical data from the AF Registry to identify phenotypes of paroxysmal AF with structurally normal hearts, which are likely driven by atrial triggered activity. I will evaluate the molecular mechanisms underlying sympathetically-mediated AF by direct measurement of cardiovagal neurohormones, such as neuropeptide Y (NPY) and galanin (GAL), and indirect measurement of receptor function through assessment of common genetic variants in NPY2R and GALR1.17–19 This mentored research with the appropriate, rigorous training will extend my background in signal processing and biostatistics to computational approaches in epidemiology and genmoics. To this end, I have the following aims:

**Aim 1: Identify electrocardiographic phenotypes of paroxysmal AF with structurally normal atria.** We will generate electrocardiographic parameters in sinus rhythm (atrial and ventricular activation and repolarization indices) and in atrial fibrillation (amplitude of fibrillatory waves, atrial frequency). We will assess the relationship of these parameters to groups of paroxysmal AF with normal left atrial size and structure. *Hypothesis*: Increased amplitude of fibrillatory waves during atrial fibrillation and increased variability in P wave indices will identify paroxysmal AF with structurally normal atria.

**Aim 2: Determine the electrophysiological characteristics of sympathetically-mediated paroxysmal AF.** In a prospective subgroup in the AF Registry with paroxysmal AF, we will measure biomarkers of increased sympathetic activity during electrophysiology study including cardiac-specific levels of NPY and Gal. *Hypothesis*: Elevated levels of NPY and Gal will be associated with increased risk of AF recurrence.

**Aim 3: Evaluate the role of genetic variants in cardiovagal receptors in sympathetically-mediated paroxysmal AF.** We will identify if common genetic variants in the cardiovagal receptors, including GAL1R and NPY2R, are associated with abnormalities in ECG markers. *Hypothesis*: Variants associated with sympathetically-mediated paroxysmal AF will be associated with increased risk of paroxysmal AF in structurally normal atria.

The current paradigm in the management of AF is superficial, focusing on therapies that are aimed at pharmacological and ablative modification of cardiac ion channels, instead of specific mechanisms, such as the underlying maladaptive autonomic response. Identifying upstream mechanistic, autonomic pathways could lead to targeted therapies that not only decrease the risk of AF, but may also provide benefit in a number of other triggered atrial arrhythmias.7

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