

Arrhythmia: Understanding Heart Palpitations & Irregular Beats

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Defining Arrhythmia Perception

Arrhythmia perception refers to the subjective awareness of abnormal cardiac rhythms, a phenomenon that sits at the critical intersection of physiology, neurology, and psychology. While the heart's function is typically regulated automatically and unconsciously, certain alterations in rate, rhythm, or force of contraction can break through the threshold of awareness, resulting in the experience commonly termed **palpitations**. This perception is not merely a passive registration of internal stimuli; rather, it is an active cognitive and emotional interpretation of afferent cardiac signals. A core challenge in understanding arrhythmia perception lies in the frequent dissociation between objective physiological reality and subjective experience: some individuals experience intense, distressing palpitations despite minimal or benign cardiac abnormalities, while others remain entirely unaware of severe, life-threatening arrhythmias, a condition known as **silent ischemia** or asymptomatic atrial fibrillation. Thus, arrhythmia perception is a complex construct influenced equally by the magnitude of the cardiac event and the individual's psychological state, attentional focus, and baseline interoceptive capacity.

The psychological significance of perceiving an abnormal heart rhythm is profound because the heart is intrinsically linked to notions of life, stress, and emotional vitality. When an individual perceives a missed beat, a sudden acceleration, or an irregular flutter, this sensation often triggers a cascade of cognitive appraisals, frequently leading to the catastrophic misinterpretation that the event signifies imminent death or severe cardiac disease. This interpretation amplifies the emotional response, primarily fear and anxiety, which in turn can exacerbate the perceived symptom intensity through autonomic nervous system activation. For instance, the fear response itself induces sympathetic overdrive, leading to sinus tachycardia or increased force of contraction, which validates the initial perception of abnormality, creating a potent and often debilitating **symptom-anxiety feedback loop**. Understanding this perceptual process is crucial not only for cardiologists diagnosing rhythm disorders but also for psychologists treating anxiety, panic disorder, and somatic symptom disorder, where cardiac complaints are often central to the clinical presentation.

Distinguishing between genuine arrhythmia perception and functional cardiac awareness is a foundational step in clinical assessment. Functional palpitations, often related to stress, caffeine intake, or hyperventilation, may involve physiologically normal, yet highly perceived, changes in heart rate or output. True arrhythmia perception involves the awareness of pathologically irregular rhythms, such as premature ventricular contractions (PVCs), supraventricular tachycardia (SVT), or atrial fibrillation (AF). The characteristics of the perceived sensation--whether described as a 'flip-flop,' a 'pounding,' or a 'racing' sensation--can sometimes offer clues to the underlying rhythm, but patient descriptors are notoriously unreliable due to the high degree of psychological overlay. Researchers utilize specialized tasks, such as the **Heartbeat Detection Task (HBDT)**, to objectively measure an individual's interoceptive accuracy regarding their cardiac activity, providing

a quantifiable measure of their perceptual ability independent of their self-reported distress or anxiety levels.

The Physiological Mechanisms of Cardiac Signaling

The perception of cardiac activity relies on intricate afferent neural pathways that transmit information regarding the mechanical and chemical state of the heart to the central nervous system. The heart is richly innervated by both the autonomic nervous system and specialized sensory fibers. Mechanoreceptors, located primarily within the walls of the atria and ventricles, are crucial for signaling changes in cardiac volume and pressure. These receptors respond to stretching or distension of the myocardial tissue. When an arrhythmia occurs, such as a premature contraction followed by a compensatory pause and a forceful post-pause beat, the resulting sudden changes in chamber filling and pressure strongly activate these mechanoreceptors. The signals generated by these receptors travel primarily via the vagus nerve (Cranial Nerve X) and sympathetic afferent fibers that ascend through the spinal cord, ultimately reaching central processing centers in the brainstem and forebrain.

Central processing of these cardiac signals occurs across a network of brain regions collectively known as the **interoceptive network**. Key among these regions is the insular cortex, particularly the anterior insula, which is widely recognized as the primary cortical area responsible for mapping and integrating afferent visceral signals. The insula integrates signals from the heart, lungs, and gut, translating raw physiological data into subjective feelings and awareness. Alongside the insula, the anterior cingulate cortex (ACC), the somatosensory cortex, and parts of the prefrontal cortex are involved in modulating the attention paid to these signals and applying cognitive and emotional context. For an arrhythmia to be consciously perceived, the intensity of the incoming cardiac signal must be sufficient to cross a perceptual threshold, and the central nervous system must allocate sufficient attentional resources to register and interpret the signal, a process heavily mediated by the functional connectivity between the brainstem nuclei and the cortical interoceptive map.

Furthermore, the perception of arrhythmias is often mediated not just by the irregularity itself, but by the associated hemodynamics. For instance, a rapid tachycardia or an episode of atrial fibrillation can lead to a transient reduction in cardiac output, resulting in secondary symptoms such as dizziness, lightheadedness, or shortness of breath. These secondary somatic symptoms provide additional sensory input that reinforces the perception of cardiac distress. The brain integrates these diverse sensory inputs--the mechanical sensation from the heart, the chemosensory changes related to potential hypoxia, and the vestibular input related to lightheadedness--into a unified, often alarming, experience. Individual differences in the sensitivity and responsiveness of these afferent pathways, possibly due to genetic factors or chronic stress exposure, may explain why some individuals are **cardiac hyper-aware** while others remain

insensitive to significant physiological shifts.

The Interplay of Interoception and Cardiac Awareness

Interoception is the overarching psychological construct referring to the sense of the physiological condition of the body, encompassing signals arising from internal organs. Cardiac awareness is a specific facet of interoception focused exclusively on the heartbeat. Research distinguishes between three primary dimensions of interoception: **interoceptive accuracy**, which is the objective ability to detect internal bodily signals; **interoceptive sensibility**, which is the self-reported belief and confidence in one's ability to detect internal signals; and **interoceptive awareness**, which is the metacognitive matching of accuracy and sensibility. In the context of arrhythmia perception, these distinctions are crucial. Individuals with high interoceptive accuracy are genuinely better at detecting subtle cardiac irregularities, which can be advantageous but also potentially distressing if coupled with high anxiety.

Conversely, many individuals who report severe palpitations and high interoceptive sensibility (they are highly confident in their ability to feel their heart) often demonstrate poor interoceptive accuracy when objectively tested. This mismatch suggests a reliance on cognitive and emotional inference rather than true physiological detection. For these individuals, the perception of irregularity is likely driven by generalized autonomic arousal, muscular tension in the chest wall, or hypervigilance stemming from past traumatic health experiences or underlying anxiety disorders. They are not detecting an arrhythmia; they are detecting the somatic manifestations of emotional distress, which they catastrophically misattribute to a cardiac problem. This concept helps explain conditions like **cardiac neurosis** or health anxiety focused on the heart, where the subjective experience of cardiac distress is disproportionate to any objective findings.

Furthermore, the relationship between interoception and emotion is bidirectional. Emotional states, particularly anxiety and fear, significantly modulate interoceptive accuracy. High anxiety can lead to a narrowing of attention, focusing intense scrutiny on ambiguous bodily sensations. This heightened focus lowers the perceptual threshold for cardiac signals, making even normal fluctuations in heart rhythm or force seem salient and alarming. Conversely, individuals experiencing high levels of psychological distress often exhibit a reduced ability to accurately track their heartbeats in objective tasks, suggesting that intense emotional processing may interfere with the precise, objective mapping of visceral signals, replacing accuracy with generalized somatic noise and misinterpretation. Effective treatment often involves interventions designed to recalibrate this disturbed interoceptive balance, moving the individual away from catastrophic interpretation toward a more neutral and accurate appraisal of their internal state.

Psychological Modulators and Cognitive Bias

Psychological factors are arguably the most significant modulators of arrhythmia perception severity and distress. Cognitive biases, particularly **catastrophic misinterpretation**, play a central role. When an individual feels a momentary flutter, a non-anxious person might dismiss it as a side effect of caffeine, whereas an individual prone to anxiety might immediately interpret it as evidence of a massive heart attack or cardiac arrest. This catastrophic appraisal immediately triggers a fear response, activating the fight-or-flight mechanism, leading to further physiological symptoms (e.g., hyperventilation, muscle tension, increased heart rate), thereby intensifying the perceived cardiac distress and confirming the initial fearful thought. This self-perpetuating cycle is the hallmark of panic disorder and health anxiety related to cardiac symptoms.

Another key psychological factor is **attentional bias**. Individuals with high levels of health anxiety or panic disorder often exhibit an attentional bias towards somatic symptoms. Their cognitive resources are disproportionately allocated to monitoring internal bodily sensations, especially those emanating from the chest. This constant monitoring ensures that even mild, non-pathological variations in heart rhythm are registered and processed consciously, whereas these same events would be ignored by an individual without such a bias. This hypervigilance effectively lowers the detection threshold for cardiac signals, increasing the frequency and intensity of reported palpitations, even when the actual underlying cardiac rhythm load remains low or benign. This bias is often exacerbated in quiet or resting states when external distractions are minimized, forcing internal focus.

The concept of **learned association** also contributes significantly. If an initial cardiac event (even a benign one) occurred during a period of high stress or was followed by a frightening experience, the individual may form a strong associative link between the cardiac sensation and danger. Subsequent similar sensations, regardless of their physiological origin or severity, automatically retrieve the fear response. This classical conditioning process ensures that the mere perception of an irregular beat serves as a potent conditioned stimulus for anxiety. Therapeutic approaches often target these maladaptive cognitive biases and learned associations through techniques like cognitive restructuring, which aims to challenge and replace catastrophic thoughts with more balanced and realistic appraisals of cardiac sensations.

Clinical Relevance and Diagnostic Dilemmas

Arrhythmia perception holds immense clinical relevance, impacting both diagnostic efficiency and patient quality of life. In cardiology, the primary diagnostic challenge revolves around distinguishing between symptoms caused by serious, treatable arrhythmias and those driven primarily by heightened perception and anxiety. Over-perception leads to frequent, often unnecessary, emergency room visits, extensive and costly diagnostic testing (e.g., repeated ECGs, Holter monitors, stress tests), and significant patient distress. Patients often insist that their symptoms are cardiac in origin, sometimes resisting psychological referrals, thereby creating a complex clinical

dilemma where the treating physician must address both the remote possibility of occult cardiac disease and the immediate certainty of severe psychological distress.

Conversely, under-perception, or the failure to perceive significant arrhythmias, poses a different, potentially life-threatening risk. Conditions such as asymptomatic atrial fibrillation (AF) are notorious for being silent, yet they carry a high risk of stroke due to the formation of blood clots. Similarly, some patients with severe ventricular arrhythmias or profound bradycardia may experience minimal or vague symptoms, delaying necessary intervention. The lack of perception in these cases underscores the fact that the severity of the physiological event does not always correlate with the subjective experience. Screening programs and technological advancements, such as wearable monitoring devices, are increasingly important in identifying these silent arrhythmias, bypassing the inherent unreliability of self-reported symptoms in high-risk populations.

The clinical management of patients presenting with palpitations thus requires a highly integrated approach. After ruling out serious cardiac pathology through objective measures, the focus shifts to addressing the perceptual component. A crucial step involves psychoeducation, clearly explaining the benign nature of the detected rhythm (if applicable) and demonstrating the mechanism of the symptom-anxiety feedback loop. Furthermore, conditions such as **Postural Orthostatic Tachycardia Syndrome (POTS)** often involve highly pronounced arrhythmia perception due to persistent autonomic dysregulation, where the rapid, often exaggerated heart rate response upon standing is profoundly felt. In these cases, treatment must target the underlying autonomic dysfunction while simultaneously employing psychological strategies to manage the associated health anxiety and hypervigilance.

Measurement and Assessment Techniques

Accurate assessment of arrhythmia perception requires a combination of objective physiological measures and subjective self-report tools. The gold standard for objectively quantifying interoceptive accuracy related to the heart is the **Heartbeat Detection Task (HBDT)**. In this task, participants are typically asked to count their heartbeats during specified, non-feedback intervals without taking their pulse. Their counted number is then compared to the actual number of beats recorded simultaneously via an electrocardiogram (ECG). The resulting accuracy score provides a reliable index of their objective cardiac awareness. Variations of this task include the heartbeat discrimination task, where participants must decide whether an auditory tone is in sync or out of sync with their actual heartbeat.

Subjective assessment relies heavily on standardized questionnaires designed to measure self-reported cardiac symptoms and related anxiety. Tools such as the **Palpitation Sensation Scale (PSS)** or specialized symptom diaries allow patients to track the frequency, intensity, duration, and associated distress of their perceived cardiac events. These self-report measures are vital for

gauging interoceptive sensibility (confidence in perception) and the emotional impact of the symptoms, even if they do not accurately reflect objective cardiac accuracy. Combining subjective diaries with objective monitoring--such as having patients press an event button on a Holter or wearable monitor every time they feel a palpitation--allows clinicians to correlate the patient's subjective report with the actual underlying rhythm, revealing the degree of concordance or discordance between perception and physiology.

Neuroimaging techniques, particularly functional Magnetic Resonance Imaging (fMRI) and electroencephalography (EEG), are increasingly used in research settings to explore the neural correlates of arrhythmia perception. These methods allow researchers to observe activation patterns in key interoceptive brain regions, such as the insula and ACC, during tasks requiring cardiac attention or following the presentation of emotionally salient cardiac information. For example, studies have shown that individuals with high anxiety or panic disorder exhibit greater activation in the anterior insula when asked to focus on their heart, suggesting a heightened cortical representation or exaggerated processing of visceral signals, which provides a neural basis for their hyper-awareness and subsequent distress.

Therapeutic Interventions for Maladaptive Perception

Interventions for maladaptive arrhythmia perception--where high distress accompanies benign or non-existent arrhythmias--are primarily behavioral and cognitive, often involving psychological therapy alongside optimized pharmacological management. **Cognitive Behavioral Therapy (CBT)** is the most effective psychological intervention, directly targeting the catastrophic misinterpretations and attentional biases that fuel the symptom-anxiety cycle. CBT techniques teach patients to identify their fearful thoughts (e.g., "This flutter means I am dying"), challenge the evidence for these thoughts, and substitute them with more rational and balanced appraisals (e.g., "This is a normal PVC, possibly caused by stress, and it is harmless").

A critical component of CBT often involves **exposure therapy** or symptom induction techniques. Patients might be encouraged to intentionally provoke benign cardiac sensations (e.g., through rapid stair climbing, spinning, or hyperventilation) in a safe, controlled environment. The goal is desensitization: by repeatedly experiencing the physical symptoms without the feared catastrophic outcome, the conditioned link between the sensation and danger is gradually extinguished. This process helps patients relearn that the physical sensations, though uncomfortable, are not inherently dangerous. Mindfulness-based interventions are also gaining traction, focusing on helping individuals observe their internal sensations (including heartbeats) in a non-judgmental, detached manner, thereby reducing the emotional reactivity and subsequent anxiety amplification associated with perception.

Pharmacological interventions often serve an adjunctive role by reducing the peripheral input that

triggers the perception. For patients with a high burden of benign but highly perceived arrhythmias (like frequent PVCs), **beta-blockers** may be prescribed. While these medications primarily aim to reduce the frequency of the ectopic beats, they also dampen the force of contraction and overall sympathetic tone, effectively lowering the intensity of the afferent signal transmitted to the brain. By reducing the physical salience of the cardiac event, the medication makes it easier for the patient to engage in cognitive restructuring and break the anxiety cycle. Ultimately, successful treatment requires collaboration between cardiology (to manage the rhythm) and psychology (to manage the perception and associated distress).

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