

Chapter 60

Approach to Tachycardia in the ICU



60.1 Introduction

Tachycardia, defined as a heart rate exceeding 100 beats per minute (bpm), is a common occurrence in the intensive care unit (ICU). It can range from a benign physiological response to a manifestation of life-threatening arrhythmias. Rapid identification and appropriate management are crucial to prevent hemodynamic compromise and adverse outcomes [1, 2] [Ref: Algorithm 60.1].

60.2 Initial Evaluation and Assessment

When a patient presents with tachycardia in the ICU, the first step is a thorough evaluation to determine the presence of life-threatening symptoms such as hypotension, ischemic chest pain, dyspnea, altered mental status, or signs of shock. These symptoms suggest that the tachycardia may be compromising cardiac output and end-organ perfusion.

Immediate assessment should focus on airway, breathing, and circulation (ABCs). Ensure the airway is patent, provide supplemental oxygen to maintain oxygen saturation (SpO_2) of at least 94%, and establish continuous monitoring of heart rhythm, blood pressure, and SpO_2 . Intravenous access should be secured promptly to facilitate the administration of medications or fluids as needed. A 12-lead electrocardiogram (ECG) is essential for rhythm analysis and aids in identifying the specific type of tachycardia.

Identifying and correcting reversible causes is paramount. Common contributors include hypoxia, electrolyte imbalances (such as hypo- or hyperkalemia, hypomagnesemia, hypocalcemia), acid-base disturbances, hypovolemia, pain, anxiety, and

fever. Addressing these factors can often alleviate tachycardia without the need for advanced interventions [3].

A thorough physical examination has to be done. Look for fever, anemia, and dehydration (dry mucosa).

All systems must be thoroughly examined.

CNS: Look for fever, seizure, delirium, headache, and other reversible causes.

NCCT brain may be done to look for SAH or stroke. Meningitis, traumatic brain injury, stroke, and autonomic dysfunction can also cause tachycardia. Inadequate sedation of ventilated patients can also lead to tachycardia. Hypoglycemia may also cause tachycardia.

CVS: ECG should be done to know the type of tachyarrhythmia. Chest pain, AMI, and hypotension can also cause tachycardia.

RS: Bronchospasm, dyspnea due to pneumonia, pneumothorax, massive pleural effusion, pulmonary edema, or respiratory distress due to any cause can also cause tachycardia. Endotracheal tube block due to secretions or mucus plug can also cause tachycardia. Ventilator dyssynchrony and endotracheal tube in situ can also lead to tachycardia. Pulmonary embolism, diffuse alveolar hemorrhage, and hemoptysis should also be kept in consideration.

Abdomen: Pain abdomen due to any cause can also lead to tachycardia, e.g., appendicitis, cholecystitis, pancreatitis, gastritis, colitis, esophageal spasm, perforation, peritonitis, and intestinal obstruction. Acute gastroenteritis leading to severe fluid loss is also a cause for the same.

Genitourinary: Renal and ureteric stones can lead to pain and thus tachycardia.

Cystitis and acute urinary retention can also cause tachycardia.

Peripheral: Peripheral vascular diseases, thrombophlebitis, and deep vein thrombus can lead to pain and thus tachycardia.

Endocrinology: Thyroid and adrenal disorders can also lead to tachycardia.

Hypoglycemia can also cause tachycardia.

Sepsis: Infection and sepsis has to be looked for. It can lead to SIRS and cause tachycardia. Source of sepsis should be looked for.

Electrolytes: Potassium, Calcium, and magnesium abnormalities can lead to tachyarrhythmias.

Drugs: Drug abuse, bronchodilators, thyroid medicines, and vasopressors (adrenaline, noradrenaline), dobutamine, dopamine, and methylxanthines.

Others: Neuroleptic malignant syndrome, malignant hyperthermia, and pheochromocytoma.

60.2.1 Rhythm Analysis

Accurate rhythm analysis is critical for determining the appropriate management strategy. The ECG should be assessed for QRS complex width and rhythm regularity:

- **QRS Width:**
 - **Narrow QRS Complex (<120 ms):** Indicates that ventricular depolarization is occurring via the normal His-Purkinje system, suggesting a supraventricular origin.
 - **Wide QRS Complex (≥ 120 ms):** May indicate ventricular tachycardia (VT) or supraventricular tachycardia (SVT) with aberrant conduction (e.g., bundle branch block or preexcitation).
- **Rhythm Regularity:**
 - **Regular Rhythm:** Consistent R-R intervals.
 - **Irregular Rhythm:** Variable R-R intervals.

60.3 Differential Diagnosis of Tachycardias

- **Narrow QRS Complex Tachycardias.**
 - **Regular Rhythm.**

Sinus tachycardia is characterized by a gradual onset and termination, with heart rates typically less than 150 bpm. It is often a physiological response to stressors such as pain, hypovolemia, or hypoxia. Management focuses on treating the underlying cause rather than the tachycardia itself.

Atrioventricular nodal reentrant tachycardia (AVNRT) and atrioventricular reentrant tachycardia (AVRT) present with sudden onset and termination, with heart rates ranging from 150 to 250 bpm. Initial management includes vagal maneuvers to stimulate the vagus nerve and slow conduction through the atrioventricular (AV) node. If these are ineffective, adenosine is administered as a rapid intravenous bolus (starting with 6 mg, followed by 12 mg if necessary). Beta-blockers or calcium channel blockers, such as verapamil, may be used if adenosine is contraindicated or ineffective. Synchronized cardioversion should be done in hemodynamically unstable patients (50–100 joules) [4].

- **Irregular Rhythm.**

Atrial fibrillation (AF) is identified by the absence of discernible P waves and an irregularly irregular rhythm. Management focuses on rate control and anticoagulation. Beta-blockers (e.g., esmolol) or calcium channel blockers (e.g., diltiazem) are used to control the ventricular rate. In patients with heart failure or contraindications to these medications, digoxin or amiodarone may be considered. Anticoagulation is essential for stroke prevention, especially if the duration of AF exceeds 48 hours. The choice between novel oral anticoagulants (NOACs) and traditional agents like warfarin depends on patient-specific factors, including renal function and potential drug interactions. Synchronized cardioversion should be done in hemodynamically unstable patients.

Atrial flutter presents with characteristic sawtooth flutter waves on ECG and an atrial rate around 300 bpm. Management is similar to that of AF, with a focus on rate control and anticoagulation. Synchronized cardioversion may be more effective in atrial flutter and can be considered at lower energy levels (50–100 joules).

- Wide QRS Complex Tachycardias.
 - Regular Rhythm.

Ventricular tachycardia (VT) with pulse is a life-threatening arrhythmia characterized by wide QRS complexes and a regular rhythm. Features suggestive of VT include AV dissociation, fusion beats, capture beats, QRS morphology consistent with ventricular origin, and extreme axis deviation. Immediate management involves the administration of antiarrhythmic medications such as amiodarone (150 mg IV over 10 minutes) or procainamide (10–15 mg/kg IV over 30 minutes). If the patient is hemodynamically unstable or if pharmacological therapy is ineffective, synchronized cardioversion starting at 100 joules is indicated.

SVT with Aberrancy can mimic VT but is due to supraventricular impulses conducted aberrantly through the ventricles, often because of preexisting bundle branch block patterns. Differentiating SVT with aberrancy from VT is crucial, as the management differs. Criteria such as the Brugada algorithm or Vereckei criteria may aid in differentiation. If SVT with aberrancy is confirmed, management is similar to that of narrow QRS complex SVT.

- Irregular Rhythm.

Polymorphic VT, such as torsades de pointes, is characterized by varying QRS amplitude and axis on the ECG and is often associated with a prolonged QT interval. Management includes the administration of magnesium sulfate (2 grams IV over 10 minutes) and correction of electrolyte abnormalities. Overdrive pacing may be necessary if the arrhythmia is refractory to medical therapy.

Atrial fibrillation with preexcitation occurs in patients with accessory pathways (e.g., Wolff-Parkinson-White syndrome) and presents as an irregular wide-complex tachycardia. AV node blocking agents are contraindicated as they may enhance conduction through the accessory pathway and precipitate ventricular fibrillation. Procainamide is the preferred agent to stabilize the rhythm in this scenario.

60.4 Mechanisms of Tachyarrhythmias

Understanding the underlying mechanisms of tachyarrhythmias aids in predicting recurrence and tailoring interventions:

- Increased Automaticity: Enhanced spontaneous depolarization of pacemaker cells, leading to arrhythmias such as sinus tachycardia.

- **Reentry Circuits:** Occur when a propagating impulse fails to extinguish itself and reenters and reactivates myocardial tissue, causing arrhythmias like AVNRT, AVRT, and VT.
- **Triggered Activity:** Results from after depolarizations that reach threshold potential, leading to arrhythmias such as torsades de pointes.

Proarrhythmic substrates include structural heart diseases that predispose patients to arrhythmias:

- **Myocardial Scar Tissue:** Post-myocardial infarction scarring can create reentrant circuits leading to VT.
- **Hypertrophic Cardiomyopathy:** Disorganized myocardial architecture increases the risk of ventricular arrhythmias and sudden cardiac death.

60.5 Management of Sinus Tachycardia

Differentiating between physiological and inappropriate sinus tachycardia is essential:

- **Physiological sinus tachycardia** is a normal response to stressors. Management involves treating the underlying cause without specific cardiac interventions.
- **Inappropriate sinus tachycardia** is characterized by an elevated heart rate at rest without an identifiable cause. Management may require beta-blockers or calcium channel blockers to control the heart rate. Conditions like postural orthostatic tachycardia syndrome (POTS) should be considered, and management tailored accordingly [5]

60.6 Treatment Strategies and Advanced Therapies

60.6.1 Acute Management Flowcharts

Utilizing flowcharts can streamline decision-making in acute settings by guiding clinicians through treatment choices based on QRS width, rhythm regularity, and hemodynamic stability. These visual aids enhance efficiency in time-sensitive situations.

60.6.2 Advanced Therapies

For patients with persistent or recurrent tachyarrhythmias despite optimal medical therapy, advanced interventions may be necessary:

- Catheter Ablation: Recommended for certain SVTs and VT, as per AHA guidelines, to eliminate the arrhythmogenic focus or pathway.
- Implantable Cardioverter-Defibrillator (ICD): Considered in patients at high risk of sudden cardiac death, such as those with significant left ventricular dysfunction or previous cardiac arrest, following the 2017 AHA/ACC/HRS guidelines.

60.6.3 Anticoagulation in Atrial Fibrillation

Patients with AF, especially those with prolonged arrhythmia duration or high thromboembolic risk, require anticoagulation:

- Risk Assessment: Use the CHA₂DS₂-VASc score to evaluate stroke risk.
- Anticoagulant Options:
 - Novel Oral Anticoagulants (NOACs): Such as apixaban and rivaroxaban, are preferred due to their predictable pharmacokinetics and ease of use.
 - Warfarin: May be used in patients with contraindications to NOACs or with mechanical heart valves.
 - Considerations in Critically Ill Patients: Renal function, potential drug interactions, and bleeding risks must be carefully assessed when initiating anticoagulation.

60.7 Prognostic Insights and Long-Term Management

Tachycardia episodes in the ICU have significant prognostic implications:

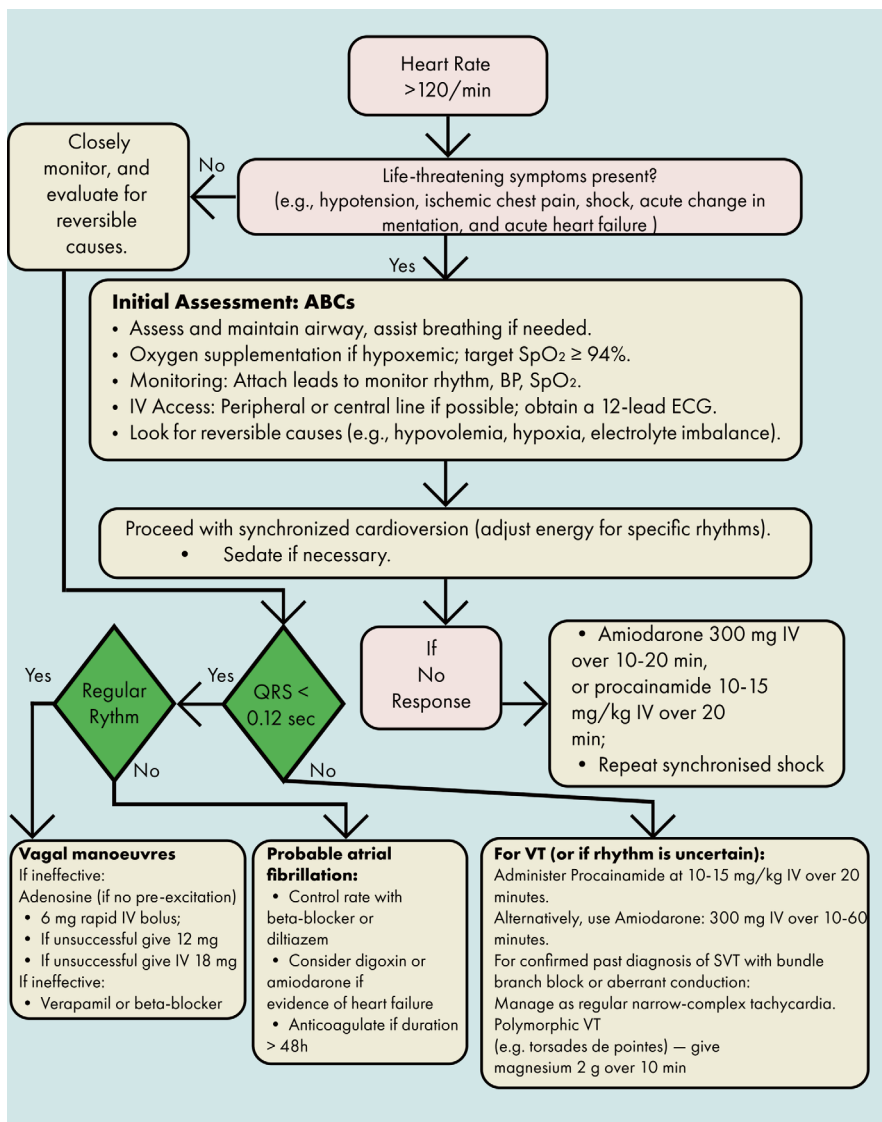
- Recurrence Rates: High in patients with underlying heart disease or persistent triggers.
- Progression to Sustained Arrhythmias: Early identification and management can prevent deterioration to more severe arrhythmias requiring long-term interventions.
- Outcomes: Vary depending on the arrhythmia type, underlying cause, and timeliness of management.

60.8 Conclusion

Effective management of tachycardia in the ICU requires a systematic and comprehensive approach that prioritizes rapid assessment, identification of the arrhythmia type, and prompt initiation of appropriate therapy. Incorporating the latest ESC and AHA/ACC/HRS guidelines ensures that care aligns with current standards and evidence-based practices.

Emphasizing the correction of reversible causes and providing early systemic support are crucial steps in optimizing patient outcomes. Understanding the mechanisms of tachyarrhythmias aids in predicting recurrence and tailoring interventions. Advanced therapies should be considered for patients with refractory or recurrent arrhythmias.

Algorithm 60.1: Approach to tachycardia in the ICU



Bibliography

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