ARRHYTHMIAS IN THE ICU

Nora Goldschlager, MD
MACP, FACC, FAHA, FHRS
SFGH Division of Cardiology
UCSF

IDENTIFIED VARIABLES IN ARRHYTHMOGENESIS

- Ischemia/infarction (scar)
- Electrolyte imbalance
- Proarrhythmia
- Autonomic nervous system
  - QT interval
  - Heart rate variability
  - Baroreflex sensitivity

VENTRICULAR TACHYCARDIA

- Sustained (> 30 sec duration or immediately hemodynamically destabilizing)
- Nonsustained (< 30 sec duration)
- Monomorphous (same QRS configuration in given lead)
- Polymorphous (multiple QRS morphologies in given lead)
  - Without long QT (generally ischemic)
  - With long QT (Torsades de pointes)

HEMODYNAMICALLY DESTABILIZING VT: CLINICAL CORRELATES

- Age
- EF
- Rate
- Duration
- VA conduction
- Depressed baroreflex sensitivity

ACCELERATED VENTRICULAR RHYTHM

- Rates between ‘idioventricular’ escape rate and VT (110/min)
- Classically has onset with slowing of sinus rate and offset with increase in sinus rate; Isorhythmic AV dissociation common
- Classically has onset and offset with fusion complexes
- Thought to be automatic
- Usually lasts seconds; may last minutes to hours (rare)
- May indicate reperfusion injury in acute MI patients
- Not a rhythm of digitalis toxicity
- Benign
MECHANISMS OF ARRHYTHMOGENESIS

- Abnormal automaticity
- Reentry
- Triggering (afterdepolarizations)

SOME ECG FEATURES OF VT MECHANISMS

Automatic: Warmup
- Warmdown
- Uniform morphology
Reentry: Monomorphic
Afterdepolarizations: Polymorphic
- Usually nonsustained
- Pause dependency
- QTU prolongation
- U wave accentuation
$K^+ > 7.5 \text{ mEq/dl}$

$K^+ - 4.8 \text{ mEq/dl}$

IV amiodarone
AFTERDEPOLARIZATIONS

**Early:**
- Occur during repolarization
- Enhanced Ca\(^{++}\) and Na\(^{+}\) inflow
- Occurrence favored by long AP duration (e.g., Purkinje tissue), bradycardia, hypoK\(^{+}\), hypoMg\(^{++}\), IA antiarrhythmic agents
- Arrhythmias suppressed by Mg\(^{++}\)

**Delayed:**
- Occurs after AP complete, during phase 4
- Can be induced by digitalis, catecholamines, caffeine, histamine, cocaine
- Arrhythmias suppressed by Mg\(^{++}\)

BRADYCARDIA-DEPENDENT AFTERPOLARIZATIONS
Post-extrasystolic u wave accentuation

MIMICS OF VT

- Sinus tachycardia
- IVCD, including rate-dependent
- Hyperkalemia (sinoventricular conduction, wide QRS)
- Acute MI (ST segment elevation)
ANTIARRHYTHMIC AGENTS IN ICU: VENTRICULAR ARRHYTHMIAS

- Lidocaine
- IV procainamide (monomorphic VT, normal QT)
- IV magnesium (Torsades de pointes, ? Monomorphic VT)
- IV β-blocker
- IV amiodarone
- Cardiac pacing

TYPES OF SUPRAVENTRICULAR ARRHYTHMIAS

- Sinus node
  - Sinus tachycardia (physiologic)
  - Sinus node reentry (pathologic)
- Atrioventricular (AV)-node independent (originates in the atrial myocardium)
  - Atrial tachycardia
  - Atrial flutter
  - Atrial fibrillation
- AV-node dependent
  - AV nodal reentrant tachycardia
  - AV reentrant tachycardia
  - Junctional tachycardia
ARRHYTHMIAS USUALLY NOT ASSOCIATED WITH ACUTE MYOCARDIAL INFARCTION
- Atrial tachycardia
- Reentrant supraventricular tachycardia
- Multifocal atrial tachycardia

PATHOGENESIS OF ATRIAL TACHYARRHYTHMIAS IN ACUTE MI
- Pericarditis
- Significant left ventricular dysfunction
- Bradycardia-tachycardia syndrome
- Enhanced sympathetic tone
- Sinus node and/or atrial infarction

ATRIAL TACHYCARDIAS
- Automatic (focal)
- Multifocal
- Interatrial reentry

ATRIAL TACHYCARDIA
- Without AV block
  - Congestive heart failure
  - Pulmonary disease and its Rx
  - Pericarditis
- With AV block
  - Digitalis toxicity
  - D/d atrial flutter
REEENTRY SUPRAVENTRICULAR TACHYCARDIAS

- Interatrial reentry
- Atrial flutter (intraatrial reentry)
- AV node reentry
- AV reentry
  - Orthodromic
  - Antidromic
**REENTRANT SUPRAVENTRICULAR TACHYCARDIA: ANTIARRHYTHMIC RX**

Fast pathway
- IA, IC agents
- Amiodarone
- Beta blockers
- Calcium channel blockers

Slow pathway
- Adenosine
- Digitalis
- Beta blockers
- Calcium channel blockers
- Amiodarone
- IC agents

**ATRIAL FLUTTER**

Mimics:
- NSR
- Reentrant SVT
- IVCD
- VT
- ST elevation
- ST depression
ATRIAL FIBRILLATION IN THE ICU

Duration  
Paroxysmal, persistent, chronic

Diagnosis  
Rheumatic, nonrheumatic
Lone

Onset  
New (acute), known recent, chronic
MANAGEMENT STRATEGIES FOR AF IN THE ICU

Ventricular rate control:
- IV β-blocker, Ca++ channel blocker,
digoxin, Amiodarone

Arrhythmia suppression:
- Rx underlying condition
IA, IC, III agents

ADENOSINE: TACHYCARDIA RESPONSE

Terminates
- AV nodal reentrant
- AV reentrant
- SA reentrant
- Atrial (interatrial reentrant)

Not terminated, ventricular rate slowed
- AF
- Atrial flutter
- Atrial (ectopic)

Not affected
- VT (most)
- Preexcited but not involving the AV node