ECG Differential Diagnosis of Wide QRS Tachycardia, or Wide Complex Tachycardia (WCT)

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Surawicz, B. 2001. Ch 17, 18
Wide QRS Tachycardia

**Definition:** rate $\geq 120$ and QRS $\geq 0.12$ sec (but 5% of VTs are QRS 0.11 or less)

**Regular:**
- Monomorphobic VT
- SVT
  - aberrancy
  - prior IVCD or BBB
  - accessory pathway (antidromic AVRT)

**Irregular:**
- Atrial fibrillation
  - aberrancy
  - prior IVCD or BBB
  - accessory pathway (rate $>220$ or RR $<250$ msec)
- Polymorphic VT
- Torsades de Pointes

Determining the type of WCT

• Primary diagnostic tool: ECG
• Adjunctive tools
  – Physical examination
    • Variable S1, Intermittent cannon A waves
  – Intracardiac electrogram rarely used acutely
  – AV nodal blocking agents or maneuvers
    • CSM, adenosine, others (esmolol)
  – Therapeutic trial of antiarrhythmic agent
Question 2: What is the rhythm?

ECG Diagnosis of Regular WCT – AV Relationships

• (“Cherchez le P”)
• Independent P waves (complete AV dissociation)
• 2:1 VA conduction (best in V1)
• 1:1 VA conduction with short R-P interval (not conclusive)
• Fusion beat or capture (Dressler) beat

Clinical status usually not helpful to distinguish between VT and SVT with aberrancy

Hurst, 1998, p. 912
ECG Diagnosis of Regular WCT – QRS Morphology

- **QRS duration** >0.14 favors VT and **QRS axis** < -30 favors VT, neither is conclusive, especially if SVT with preexisting BBB or if antidromic WPW
- **Concordant** positive or negative in V1-6 strongly favors VT
- **Polymorphic** tachycardia usually VT, exclude AF with WPW and multiple tracts

Hurst, 1998, p. 912
ECG Diagnosis of Regular WCT - 2

- **RBBB in V1 favoring VT:**
  - monophasic R or qR
  - triphasic favors aberrancy
- **In V1 favoring VT:**
  - R taller than sinus, wider than 30 msec
  - S with notched downslope or > 70msec to nadir
- **In V6 favoring VT:**
  - R/S <1, or qR or QS pattern

Hurst, 1998, p. 912
Question 2: What is the rhythm?

ECG Diagnosis of Regular WCT - 3

- Favors VT: LBBB pattern with RAD
- Bidirectional tachycardia usually VT if regular, SVT if paired beats
- Caveat: VT can be relatively narrow, even narrower than the patient’s native BBB beats
- VT usually < 220 BPM, unless ischemic or reperfusion (or bundle branch reentry), which may be 250-280

Hurst, 1998, p. 912
Ventricular Tachycardia Terminology

- Sustained - >30 sec
- Nonsustained - ≥ 3 spontaneous beats, or ≥ 6 induced beats
- HR 120-200 ventricular tachycardia
- (HR 110-120 ventricular tachycardia)
- HR <110 accelerated ventricular rhythm
- HR >200 (SCD guidelines say >300) ventricular flutter

Surawicz, B. 2001. Ch 17
Sustained Monomorphomic VT

• Rate usually 140-200
• Regular in over 90% of cases
  – Irregularity up to maybe 0.29 sec in RR interval, average difference between longest and shortest RR is 0.13 sec, more irregular at start and stop, longest interval is often first or last
• Most often initiated by PVC, but PAC also possible initiator; R-on-T in only 13%, actually prematurity of PVC initiating VT is generally longer than the usual PVC in that patient; initiating PVC may be different from VT morphology or identical to it

Surawicz, B. 2001. Ch 17
Sustained Monomorphic VT

- AV Dissociation: retrograde conduction may occur 1:1 in 25 - 50%, VA conduction with variable block in 15 - 20%, and AV dissociation in 35%, less VA conduction if VT is rapid (15% if rate 200)
- Ventricular capture or fusion ("Dressler" beats) are occasionally present – maybe 5% of VT

Surawicz, B. 2001. Ch 17
Localizing Site of VT

- RBBB probably comes from LV
- LBBB probably comes from RV if no heart disease, but may be from LV if heart disease such as DCM or ischemia
- Q in I and $V_6$ anterior septal origin, not basal or posterior septal
- R in I, $V_1$ and $V_2$ likely posterior origin
- Superior axis probably comes from near apex

Surawicz, B. 2001. Ch 17
Causes of LBBB Morphology in VT

- Can be LV tachycardia if CAD or DCM
- RV cardiomyopathy (ARVD – arrhythmogenic RV dysplasia)
- Uhl’s anomaly (parchment RV)
- Tetralogy of Fallot postoperative
- No structural heart disease

Surawicz, B. 2001. Ch 17
Question 3: What is the underlying structural or functional problem?

Underlying Structure or Function

- Coronary disease
  - Acute MI / Chronic
- LVH
  - Secondary / HCM
- Myopathy
  - DCM (RV, LV)
  - Inflammatory
  - Infiltrative
- Primary electrical
  - Diseased pathways
- Coronary flow changes
  - Vasomotion
  - Ischemia/reperfusion
- Systemic factors
  - Hemodynamic problems
  - O2, pH, electrolyte
- Neurophysiologic
- Toxic
  - Proarrhythmic
  - Cardiotoxic

Hurst, 1998, p. 879
Primary vs Secondary Arrhythmia

• **Primary**: the cause is the cardiac disease process, so treatment is directed at the arrhythmia with secondary attention to the disease process.

• **Secondary**: the cause is the hemodynamic or metabolic abnormality, so treatment is directed at the primary problem, with secondary role of antiarrhythmic agents.
Management Depends on Diagnosis

- What is the clinical significance of rhythm?
- What is the rhythm?
- What is the underlying structural problem or the functional factors?
- Is the problem Primary or Secondary?
Overview of Approaches to Arrhythmia Management

- **General systemic support**
  - Vital Support
  - Milieu control

- **Electropharmacologic therapy**
  - Control triggers
  - Control sustained arrhythmia

- **Catheter ablation**

- **Surgery**
  - Antiarrhythmic
  - Antiischemic
  - Structural repair

- **Device application**
  - Acute (Cversion, Defib, temp pacer)
  - Chronic (pacer, ICD)

Hurst, 1998, p. 877
Overview of **Acute** Approaches to Arrhythmia Management

- **General systemic support**
  - Vital Support
  - Milieu control

- **Electropharmacologic therapy**
  - Control triggers
  - Control sustained arrhythmia

- **Catheter ablation**

- **Surgery**
  - Antiarrhythmic
  - Antiischemic
  - Structural repair

- **Device application**
  - Acute (Cversion, Defib, temp pacer)
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Hurst, 1998, p. 877
Management of PVC’s

• No structural disease:
  • Reassure
  • Low-dose beta-blockade or anxiolytic
  • MVP: same

• Acute syndromes
  • no prophylaxis
  • Ischemia or reperfusion - lidocaine
  • Myocarditis/pericarditis - oral agents > 2 months

• Chronic disease
  • beta-blockade
  • ?amiodarone
  • other agents
Management of Ventricular Tachycardia

- Nonsustained VT, similar to PVC’s, but higher risk… ultimately possibly ICD
- Repetitive monomorphic VT
  - possibly RVOT tachycardia
  - poss Ca++ blockade or beta blockade (no structural disease)
- Sustained VT - cardiovert if ischemia/infarction, poor CNS perfusion

Hurst, 1998, p. 878
Management of VT - 2

- **Amiodarone** 150 mg over 10 min, then 1 mg/min for 6 h, then 0.5 mg/min for 18 h
- **Procainamide** 0.2-0.5 mg/kg/min to 500-1000 mg, 2-6 mg/min
- **Lidocaine** 1-2 mg/kg bolus over 2-5 min, repeat ½ in 20-40 min, 1-4 mg/min (“often ineffective”) - lower if shock or low-output (reduced hepatic blood flow)
- **Sotalol** (?not available IV in USA)

Management of VT - 3

- Bundle branch reentry
  - cure by RBB ablation

- Catecholamine/metabolic mediated VT
  - initiate with isoproterenol, stress
  - suppress with beta-blockade
  - some may suppress with Ca++ blockade

- RV cardiomyopathy

- VT after congenital heart surgery
  - Tetralogy of Fallot, TGA

- Bidirectional VT – may be digitalis toxicity
Management of Torsades de Pointes

- prolonged QT in sinus rhythm
- VT morphology
- Congenital, several types

Acquired
- Class IA, class III
- Worsen: low K, low Mg
- Phenothiazine, antibiotic, pentamidine, cocaine, terfenadine

- Magnesium SO4 2 gm IV over 2 min, then 2 -20 mg/min
- Overdrive pacing
- Isoproterenol (avoid in ischemia)
- Lidocaine
Management of VF

- Defibrillation
- ACLS
- Amiodarone is an option
WCT Case - 1

• 61 yo, assaulted, orbital fracture, subsequent dietary supplements, subsequent GI upset, then racing heart, dyspnea, vomiting

• Pulse 200, 125/75, resp 22, jvp 14, lungs clear, heart sounds normal but rapid

• ECG QRS duration 125 msec

WCT Case 1

WCT Case 1

Echo: reduced EF

Native sinus QRS is narrow with left axis deviation

Onset R to nadir S >100ms

LBBB and LAD suggest origin inferior wall of RV or IVS

Monomorphic VT - 3 Types

- **Focal origin**
  - RVOT VT
  - LVOT VT
  - LV VT verapamil sens

- **Bundle-branch reentry**
  - conduction system
  - cardiomyopathy
  - valvular disease
  - muscular dystrophy
  - CAD

- **Scar-related reentry**
  - healed MI
  - RV cardiomyopathy
  - DCM
  - Sarcoidosis
  - Scleroderma
  - Giant-cell myocarditis
  - Healed incision
  - repaired Tetralogy

Case 2
Case 2

Sinus tachycardia, dramatic transmural injury

P waves
Case 3
Atrial Flutter, LBBB, prolonged QT best in V3
Case 3

Torsade de Pointes

“Long-short”, provokes even more prolonged QT
Set up for VT/VF
Case 3

Sinus rhythm after defibrillation
Frequently Torsade is preceded by bigeminy
Atrial fibrillation and nonsustained VT, wide QRS on native beats
Case 6
Case 6

Sinus rhythm with narrow QRS, late PVC, with NSVT with retrograde conduction
Case 7

April 2000
Acute ischemia
April 2000

Nonsustained VT, not exactly monomorphic, baseline atrial fibrillation

Case 7
Baseline ECG 14 hr prior

Case 7

April 2000
Baseline ECG 1 da prior
April 2000
Case 8

31 March 2000

[ECG diagram]
Baseline ECG shows inferior injury and then polymorphic VT
Same patient few seconds later, better polymorphic VT
Case 8

4 days later, 15 April 2000
February 1988

Case 9
Sustained VT, baseline sinus rhythm showed Inferior MI and normal QRS duration
Case 9

6 mo prior to Feb 1988

Same patient with inferior MI and normal QRS duration
Sustained VT, with baseline ECG showing QRS duration of 0.11 sec and inferior MI, probably recent
Case 10

Baseline 6 mo prior

Mar 1986
Case 11
Sustained VT 23 Nov 1997, rate 202, QRS duration 0.17
Baseline ECG: inferolateral MI with QRS0.12 and LAE
Case 11

Sustained VT 1 Dec 1997, rate 164, QRS duration 0.20
Case 11

Baseline ECG with anterolateral MI, LAE, QRS 0.12
Case 12
21 year old man with clear AV dissociation
What is expected on physical examination?

Case 12
21 year old man – second episode

Case 12
Baseline ECG from 21 year old man with VT, shows repolarization abnormality

Case 12
Case 13
Case 13

Initiation and termination of Torsade
AIVR without significant pulse
Case 14

Rapid monomorphemic sustained VT
Case 15

29 yo man post surgery for VSD and Tetralogy, seizure
Inducible on second EPS
Rapid monomorphous Sustained VT - received ICD
Case 15

4 minutes after conversion: Injury pattern
Several hours after conversion: sinus tachycardia
Case 16
Sinus tachycardia and hyperkalemia
Hyperkalemia can also mimic ST elevation of acute MI
Very irregular WCT, looks like VT, but so irregular
Wonder about Afib but no fib waves
Baseline ECG shows WPW pattern, not on all tracings.
Case 18
Case 18

WCT from WPW and sinus tachycardia
Sept 1998, rate 264

Case 19
Sept 1998, 50 minutes later

Case 19
October 1987, rate 160

Case 20
October 1987, 2 hr later

Case 20
October 1987, 5 da prior

Case 20
Sept 2005, rate 148  

Case 21
WCT with 1:1 VA conduction
Sept 2005, 2 hr later
June 1998, 35 minutes later  

Case 22