ECG Diagnosis of Wide-Complex Tachycardia: SVT vs. VT

Paul D. Varosy, M.D.
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Overview
• Differential diagnosis of Wide-Complex Tachycardia (WCT) with a regular rhythm
• SVT vs. VT approaches
• Pitfalls and Caveats
• Review

Differential Diagnosis of WCT

Very Common:
• Supraventricular tachycardia (SVT) with aberrancy
• Ventricular tachycardia (VT)

Less Common:
• SVT with drug or electrolyte induced QRS widening

Rare:
• Pre-excited tachycardia
SVT With Aberrancy

- Conduction to the ventricles via the His-Purkinje system, but with an abnormality
  - Right Bundle Branch Block (RBBB)
  - Left Bundle Branch Block (LBBB)
  - Intraventricular Conduction Delay (IVCD)
- These can be
  - Pre-existing BBB (helpful clue)
  - SVT-associated

SVT with Aberrancy

- Any SVT can be conducted with aberrancy:
  - Sinus Tachycardia
  - Atrial tachycardia
  - Atrial flutter
  - Atrioventricular nodal reentrant tachycardia (AVNRT)
  - Junctional Tachycardia
  - Orthodromic Atrioventricular Reentrant Tachycardia (AVRT)

Ventricular Tachycardia

- A focal or reentrant arrhythmia arising within the ventricles
- Wide complex, because almost all involve myocyte-to-myocyte conduction from the exit site of the tachycardia.
  - Rarely, bundle-branch reentry VT is seen, mimicking SVT with aberrancy

Ventricular Tachycardia

- Ischemic heart disease
- Cardiomyopathies
  - Familial and idiopathic nonischemic dilated cardiomyopathy
  - Hypertrophic cardiomyopathy
  - Arrhythmogenic right ventricular cardiomyopathy
- Congenital heart disease
- Long QT syndrome
- Idiopathic VT
  - RVOT / aortic cusp VT
  - Idiopathic left septal (fascicular) VT
  - Mitral annular VT
Drug and Electrolyte Abnormalities

• Hyperkalemia
  – Causes QRS widening
  – Common in End-Stage Renal Disease population, who is also at risk for VT!

• Drug effects:
  – Class Ic antiarrhythmics (flecainide and propafenone) – use-dependent QRS widening
  – Tricyclic antidepressants

Preexcited Tachycardia

• Any SVT with antegrade conduction down an accessory pathway (WPW syndrome) will produce a wide QRS.
  – Slow myocyte-to-myocyte conduction arising from the ventricular insertion of the pathway
  – QRS morphology during tachycardia will look a lot like VT!

Preexcited Tachycardia

• Differential Diagnosis:
  – Antidromic Atrioventricular reentrant tachycardia (AVRT)
  – Any SVT with the accessory pathway functioning as an innocent bystander

Clue: Normal Sinus Rhythm ECG will generally show evidence of preexcitation!

General Approaches to WCT

• Clinical Characteristics of the patient
• Classic RBBB or LBBB morphology argues STRONGLY for SVT with aberrancy
• Features suggestive of VT:
  – QRS Morphology not consistent with classic BBB
  – VA dissociation
  – Capture and fusion complexes

• Algorithms
Clinical Characteristics of the Patient

- Absence of structural heart disease makes SVT more likely.
  - But idiopathic VT can be seen!

- History of structural heart disease makes VT more likely

Right Bundle Branch Block

Left Bundle Branch Block

Does it look like a classic BBB?

- Quick Method
- Griffith Method
Does it look like a classic BBB?

• Quick Method
  – RBBB:
    • Lead I: terminal broad S wave
    • V1: rsR' or notched monophasic R with notching on ascending limb of R wave
  – LBBB:
    • Lead 1: monophasic R only!
    • V1: Dominant S wave with rapid, un-notched descending limb

Evans, G.T. Practical ECG Interpretation. 1998.

Does it look like a classic BBB?

• Griffith Method: Three questions
  – For RBBB-type complexes
    • Is there an rsR' morphology in V1?
    • Is there an RS complex in V6 (small septal q OK)?
    • Is the R/S ratio in V6 > 1?
  – For LBBB-type complexes
    • Is there an rs or QS complex in V1 and V2?
    • Is the onset of the QRS to the nadir of the S in V1 < 70 ms?
    • Is there an R wave in lead V6 without a Q?
  – Any “No” results in a default to VT
  – For VT: Sensitivity ~90%; Specificity ~75%

Griffith et al, Lancet 1994;343:386-388
Features strongly suggestive of VT

- QRS morphology NOT consistent with classic BBB
  - Not exact match of BBB
  - Positive or negative concordance
    - rare (<5% prevalence), highly specific (near 100%)
  - Other morphological criteria
    - Many, several of which are incorporated into Brugada algorithm
- VA dissociation
  - ~50% prevalence, highly specific
- Capture and Fusion Complexes
  - Rare (<7% prevalence), highly specific
Brugada Algorithm

- Study of 554 wide-complex tachycardias
  - EP study-confirmed diagnoses
    - 384 VT
    - 170 SVT
  - Paucity of idiopathic VT
- Algorithm they developed has 4 steps
- Excellent cumulative discrimination:
  - Cumulative sensitivity 99%
  - Cumulative specificity 97%

Brugada Algorithm: Steps

<table>
<thead>
<tr>
<th>Step</th>
<th>Cumulative Sensitivity for VT</th>
<th>Cumulative Specificity for VT</th>
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<tbody>
<tr>
<td>1. Absence of an RS complex in all precordial leads.</td>
<td>21%</td>
<td>100%</td>
</tr>
<tr>
<td>2. Precordial RS interval &gt;100 ms</td>
<td>66%</td>
<td>98%</td>
</tr>
<tr>
<td>3. VA dissociation</td>
<td>82%</td>
<td>98%</td>
</tr>
<tr>
<td>4. Morphological criteria for VT</td>
<td>99%</td>
<td>97%</td>
</tr>
</tbody>
</table>

Brugada Step 4: Morphological Criteria

- RBBB-type complexes (features not consistent with classic RBBB)
  - V1:
    - Monophasic R
    - QR or RS
  - V6
    - QS or QR
    - R/S ratio < 1

(Diagnosis of VT requires one positive in V1 and one positive in V6)

Brugada Step 4: Morphological Criteria

- LBBB-type complexes (features not consistent with classic LBBB)
  - V1 or V2 (Kindwall criteria):
    1. R width >30 ms
    2. Notched S descent
    3. RS interval >60 ms
  - V6
    - QS or QR

(Diagnosis of VT for any ONE of the above)
**Pitfalls and Caveats**

- Most of these studies did not include many idiopathic VT cases
  - Fascicular VT can have RBBB + LAFB (or LPFB) appearance!
  - The diagnostic performance in idiopathic VT is less clear
- Preexcited tachycardias will be falsely diagnosed as VT
- Bundle-branch reentry VT may be falsely diagnosed as SVT with aberrancy (unless VA dissociation is present)

**Review**

- Differential diagnosis of WCT with a regular rhythm
- SVT vs. VT approaches
  - Identify typical BBB (Griffith)
  - Brugada Algorithm
- Pitfalls and Caveats