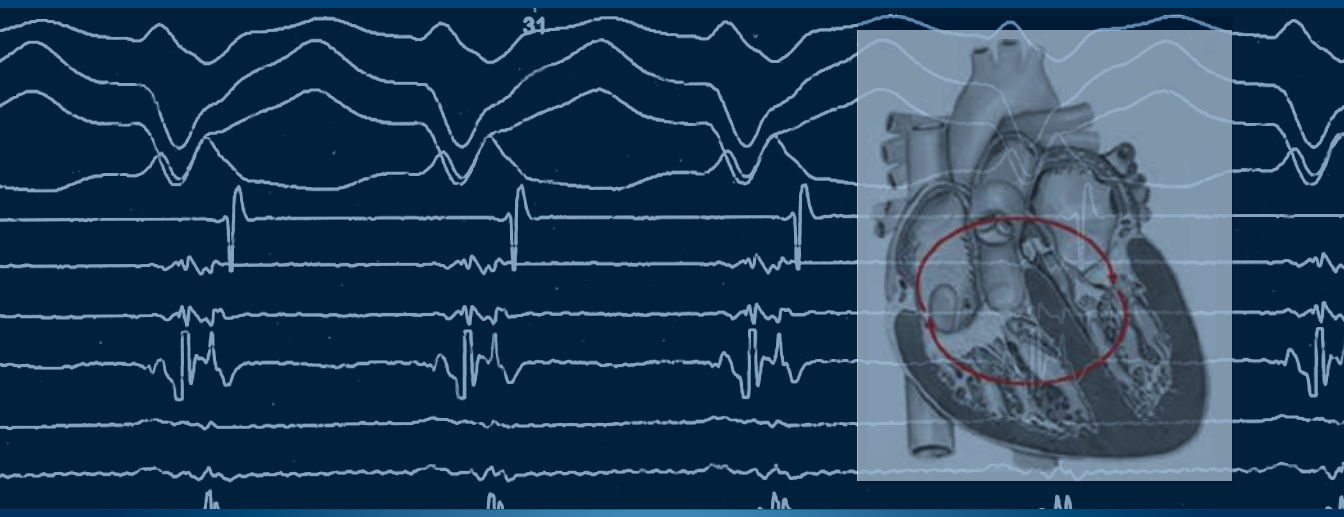
200 Review Questions and Answers

THIRD EDITION

Essential Cardiac Electrophysiology

The Self-Assessment Approach



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Essential Cardiac Electrophysiology

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Foreword

It is a rare honor, and indeed a privilege, to be asked to write a foreword for this edition of *Essential Cardiac Electrophysiology: The Self-Assessment Approach* written by Professor Abedin, who is an esteemed electrophysiologist and an exceptional teacher. This book, now in its third edition, continues a tradition set by the first edition. The information is presented in a way that achieves something very rare in the field of medical books: it provides a succinct overview of a vast field without compromising sophistication.

Essential Cardiac Electrophysiology will be instantly enjoyed by electrophysiologists at all career stages as it communicates highly relevant information and provides an instant check of one's knowledge base. This book would be the medical textbook equivalent of an aircraft flight manual for clinical electrophysiologists, as it provides all the necessary information without compromising important nuances. The crucial concepts are very nicely elucidated, and every chapter starts with a self-assessment that can help guide in-depth study based on the "pre-flight" check. The *Third Edition* has been updated in a way to keep clinical practice in context and is highly relevant to practice, and not just for knowledge assessment or test-taking.

There are many treasures in this book for the discerning reader. *Essential Cardiac Electrophysiology* can also serve as a guide to the literature in the field for the diligent student by encouraging him or her to locate original references for almost every point made in this wonderful book. For the people who have had the privilege of interacting with Professor Abedin, it will be obvious that the book accurately reflects his deep commitment to scholarship and imparting knowledge.

—Kalyanam Shivkumar, MD, PhD, FHRS, FRCP (Lond-Hon)
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October 2019

Preface

This book is a conduit for the transfer of knowledge from the experts in the field of electrophysiology to its students. I am not an expert in all of the subjects discussed in this book, but my goal is to crystallize and synthesize information in a way that will enhance learning and recall.

Since the publication of the *Second Edition*, there has been an exponential increase in the use of technology in the diagnosis and treatment of arrhythmias, but an understanding of physiology remains vital. The approach of this book is to apply basic pathophysiologic principles in order to understand complex electrophysiology issues. As electrophysiologist Mark Josephson had said, "Do not take the physiology out of electrophysiology."

This *Third Edition* maintains the objective described in the first edition of *Essential Cardiac Electrophysiology*, eloquently put by Albert Einstein: *"Everything should be made as simple as possible, but not one bit simpler."*

Information, when utilized, becomes knowledge; knowledge that is used to do good becomes wisdom. It requires learning, which is best achieved by reiteration, testing, and application. In this book, that process of learning is achieved by repetition, a self-assessment approach, clear illustrations, and the distillation of factual information. The approach to delivering the information in this book remains unique. Essential and relevant information is presented in a bullet format.

This *Third Edition* has been updated to include new information. There are three new chapters, over 200 multiple-choice questions, numerous illustrations, and a treasury of electrophysiology pearls. Some of the fundamental electrophysiologic concepts that have stood the test of time appear as in the previous editions. Controversial issues have been avoided. This book is neither a standalone textbook of electrophysiology nor a manual of how to perform electrophysiology procedures, and it assumes a prior knowledge of the field.

Any project of this magnitude is likely to have errors or omissions. Constructive criticism, comments, and suggestions are always welcomed. Please send comments, critique, and suggestions to essentialep@gmail.com.

—Zainul Abedin

7
Differential Diagnosis of Wide Complex Tachycardia

Self-Assessment Questions

1. A 52-year-old male, who suffered from uncomplicated inferior wall myocardial infarction (MI) 3 years ago, became aware of the palpitations four months ago. Palpitations would last for several hours, during which he has no other symptoms. During one such episode, he came to the emergency department (ED). Palpitations had persisted for 3 hours. Blood pressure was 106/70. Patient was alert and in no distress. The ECG strip is shown (**Figure 7 Q1**). What will be the next step?

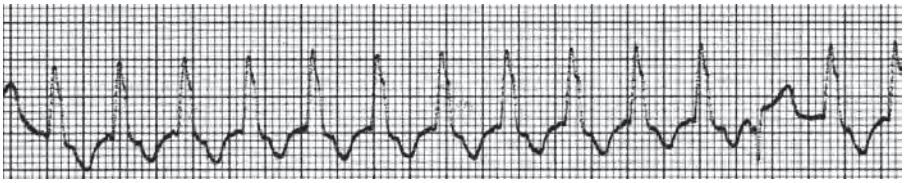

Figure 7 Q1

A. IV adenosine
B. 200 mg of PO flecainide and continue maintenance dose
C. Cardioversion
D. Valsalva maneuver

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2. A 67-year-old female whose baseline ECG shows prolonged PR interval, right bundle branch block (RBBB), and old inferior MI presents to the ED with palpitations. The 12-lead ECG is shown in **Figure 7 Q2**.

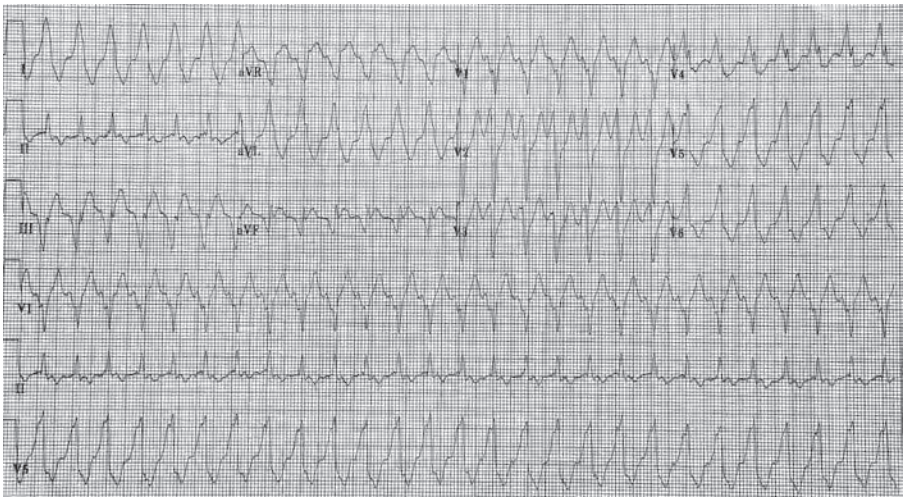

Figure 7 Q2

What is the likely diagnosis?

A. Supraventricular tachycardia (SVT) with aberrant conduction
B. Ventricular tachycardia (VT)
C. Preexcited AV reentrant tachycardia
D. SVT bystander accessory pathway conduction

3. A 62-year-old male was brought to the ED because of dizziness and palpitations. Electrocardiogram was recorded (**Figure 7 Q3**).

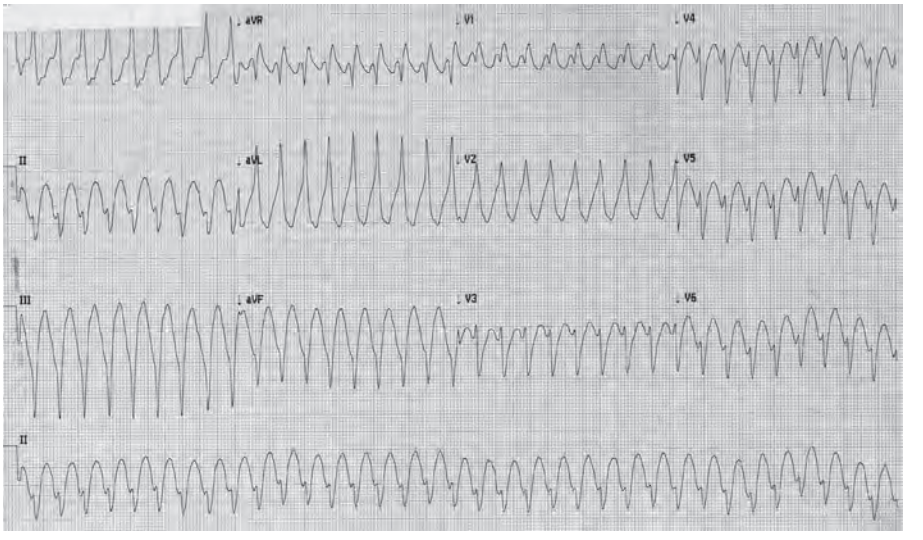

Figure 7 Q3

What is your diagnosis?

A. VT
B. SVT with aberrant conduction
C. Preexcited AV reentrant tachycardia
D. SVT bystander accessory pathway conduction

4. A 71-year-old male was brought to the hospital because of shortness of breath. An ECG was recorded (**Figure 7 Q4**).

Figure 7 Q4

What is the diagnosis?

A. VT
B. Preexcited AV reentrant tachycardia
C. SVT bystander accessory pathway conduction
D. SVT with aberrant conduction

Answers on page 337.

WIDE COMPLEX TACHYCARDIA (WCT)[1–5]

The differential diagnosis of a wide QRS tachycardia includes:

- VT.
- SVT, in the presence of functional or persistent bundle branch block.
- Preexcited SVT: antidromic AV reentry, or atrial tachycardia, or atrioventricular nodal reentry tachycardia (AVNRT) with bystander preexcitation.
- Ventricular paced rhythm.

Differential Diagnosis (Table 7.1)

Clinical features[6–8]

- WCT in the presence of clinical or electrocardiographic diagnosis of old MI is likely to be VT.

Electrocardiographic features[9–11]

- Presence of AV dissociation, capture, or fusion beats are the hallmark of VT (**Figure 7.1**).
- In lead V1, a triphasic complex with RBBB morphology and initial portion of the QRS similar to sinus rhythm is suggestive of SVT. Broad monophasic complexes are suggestive of VT.
- With left bundle branch block (LBBB) morphology in lead V1, if the QRS demonstrates narrow (<30 ms) initial r and sharp smooth descent, it is likely to be due to SVT with aberrant conduction.
- Notching in the down slope of the QRS and an interval of 60 ms from the onset of the QRS to the nadir of the S wave is suggestive of VT (**Figure 7.2**).
- LBBB morphology with right-axis deviation is invariably due to VT.
- RBBB morphology with normal axis is suggestive of SVT (uncommon in VT).
- Concordance pattern is uncommon in SVT. Positive concordance may be present in preexcited tachycardia.
- Presence of northwest axis suggests VT (**Figure 7.3**).
- Presence or preserved Q during WCT is suggestive of VT (Figure 7.1).
- Absence of RS complex in precordial leads (concordant pattern) is suggestive of VT. If the RS pattern is present, the interval from onset of R wave to nadir of S wave of >100 ms is suggestive of VT.
- If the QRS duration during tachycardia is narrower than QRS duration during sinus rhythm, it is suggestive of VT.

- Occurrence of contralateral BBB during sinus rhythm and WCT is highly suggestive of VT. If RBBB was present during sinus rhythm and LBBB developed during SVT, it will result in complete heart block unless BBB pattern is due to peripheral conduction delay.
- QRS alternans does not help in differentiating WCT.
- Some of the criteria may not be reliable in the presence of preexisting BBB during sinus rhythm.
- In the presence of preexisting RBBB, AV dissociation, precordial concordance, right superior axis, and monophasic R wave in V1 are highly suggestive of VT.
- If the WCT does not conform to any patterns of aberration, it is likely to be due to VT.
- In lead aVR (1) presence of an initial R wave; (2) width of an initial r or q wave >40 ms; and (3) notching on the initial downstroke of a predominantly negative QRS complex suggests VT (**Figure 7.4**).
- Ventricular activation–velocity ratio (V_i/V_t) is the vertical excursion (in mV) recorded during the initial (V_i) and terminal (V_t) 40 ms of the QRS complex. If $V_i/V_t > 1$, it suggests SVT. If $V_i/V_t \leq 1$, it suggests VT (**Figure 7.5**).

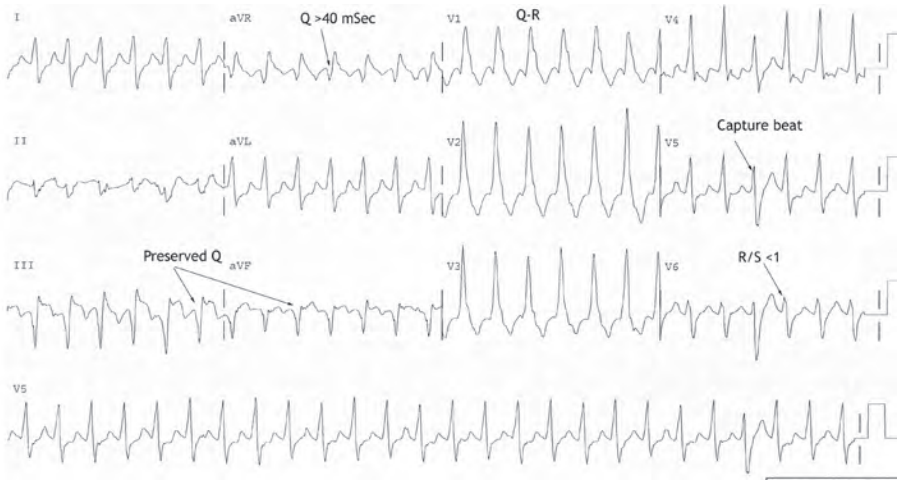

Figure 7.1 ECG observations that suggest a diagnosis of VT.

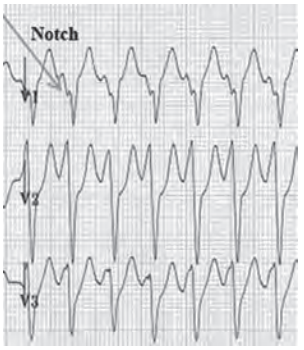

Figure 7.2 Notching in the descending limb of the QRS in V1.

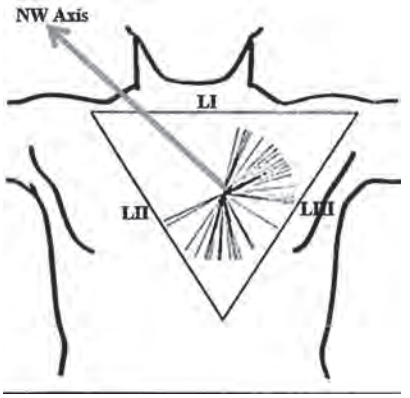

Figure 7.3 Northwest axis suggests a diagnosis of VT.

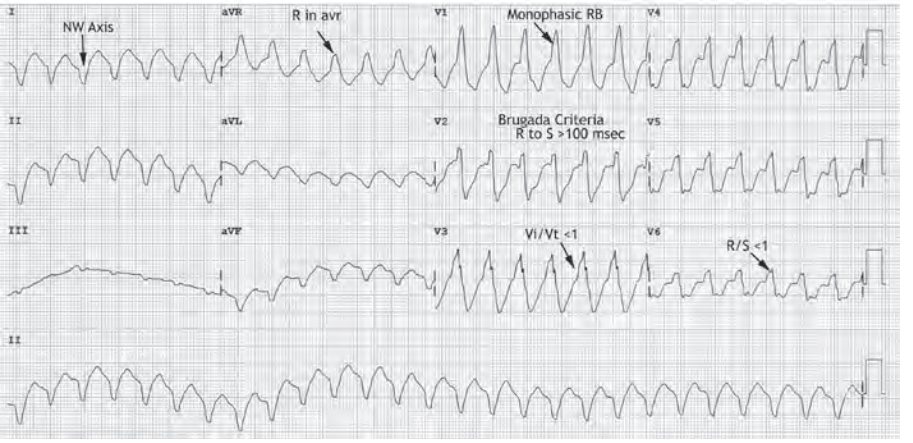

Figure 7.4 Twelve-lead ECG of a wide complex tachycardia, where multiple observations, including the R in aVR, fulfill the criteria for the diagnosis of VT.

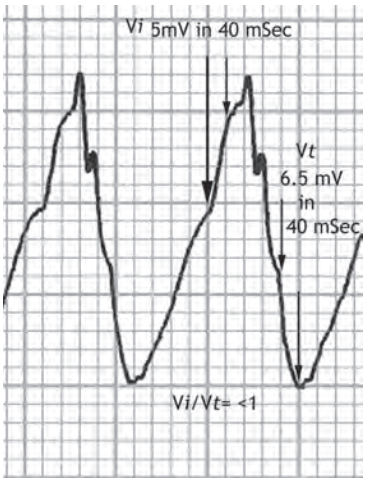

Figure 7.5 Assessment of V_i/V_t ratio.

Table 7.1 Differential Diagnosis of WCT[12–16]

Clinical Features	SVT with Arrhythmogenic Cardiomyopathy	VT
H/O MI	Less likely	More likely
Cannon waves in jugular veins		If present, suggest AV dissociation
Cannon sounds, variable intensity of S1		If present, suggest AV dissociation
Carotid sinus pressure, Valsalva, adenosine	Terminates tachycardia	Produces AV dissociation
ECG Features		
QRS duration	<140 ms	>140 ms
QRS axis frontal plane	Normal	Right superior
Change in axis from sinus rhythm	<40 degrees	>40 degrees
QRS similar during sinus rhythm and WCT	Suggestive of SVT	Uncommon
RBBB Morphology		
QRS in V1	Triphasic	Mono- or biphasic
QRS in V6	R/S ratio >1	R/S ratio <1
LBBB Morphology		
QRS in V1	Narrow r, sharp descent	Notching, R to S >60 ms
QRS V6	RS	qR QS
LBBB right axis deviation	Less likely	Likely to be VT
RBBB normal axis	Likely SVT	Less likely
Concordance pattern V lead	Uncommon	Common
Preserved Q during WCT	Unlikely	Common
AV dissociation, fusion, capture. Number of V > A	Unlikely	Diagnostic of VT
RS pattern in V leads	Unlikely	Suggestive of VT
If RS pattern present in V leads (Brugada)	RS <100 ms	RS >100 ms
QRS narrower during tachycardia than in sinus rhythm	Unlikely	Likely
Contralateral BBB during WCT	Unlikely	Suggestive of VT
R in aVR	Unlikely	Suggestive of VT
Width of an initial r or q wave >40 ms in aVR	Unlikely	Suggestive of VT
Ventricular activation–velocity ratio (V_i/V_t)	>1 mV	<1 mV

Exceptions to VT Criteria

- Bundle branch reentry tachycardia may mimic SVT with aberration of LBBB morphology. Presence of AV dissociation will help in making the correct diagnosis.
- VT can be irregular during first 30 seconds.
- Narrow complex VT is likely to originate from septum or the fascicle.
- Fusion complexes may occur with two ventricular ectopic foci.
- AV dissociation can be present in junctional tachycardia.

Self-Assessment Answer Key

Questions begin on page 329.

1. C
2. B
3. A
4. D

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