Fast Facts Workbook for Cardiac Dysrhythmias and 12-Lead EKGS

Paul L. Desmarais
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Paul L. Desmarais, PhD, RN, has been a practicing RN for 40-plus years, starting as an orderly at O’Bleness Memorial Hospital in Athens, Ohio, in 1975 and Good Samaritan Medical Center in Zanesville, Ohio, in 1976 and progressing to staff nurse in 1978 after graduating from Ohio University–Zanesville. He then worked his way up to become a staff nurse in the ICU at Nashua Memorial Hospital (later to become Southern New Hampshire Medical Center) and then charge nurse and nurse manager of the telemetry unit at Southern New Hampshire Medical Center in Nashua, New Hampshire. He was also the critical care coordinator and acting assistant chief nurse at the Veterans Administration Hospital in Manchester, New Hampshire, from 1983 to 1986. He obtained his bachelor’s degree from St. Anselm’s College in Manchester, New Hampshire, in 1984, followed by his master’s degree in nursing, and PhD in nursing from the University of Massachusetts–Lowell in 2003. He continued to work as a bedside nurse even after he began his career as an academic teacher until he retired from bedside care in 2014.

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FAST FACTS WORKBOOK for CARDIAC DYSRHYTHMIAS AND 12-LEAD EKGS

Paul L. Desmarais, PhD, RN
I have used the content of this manual for many years to help students grasp the concepts that are critical to understanding dysrhythmia recognition and 12-lead EKG principles. The information provided in this volume is a compilation of basic knowledge gathered from so many sources that acknowledgment of individuals is nearly impossible. Therefore, this volume is dedicated to all the instructors, nurses, physicians, patients, and authors with whom I have interacted over the years and whose brains I have picked. I was able to glean little bits from so many, and they were all smarter than I could ever hope to be.

Obviously, I owe a great deal to my family, especially my wife, Cecile, for putting up with my idiosyncrasies for so many years and for “slapping” me occasionally when I was at the verge of quitting. I would not be where I am today without her support.

Finally, to Dylan, the student who came to my office to insist that I put this volume out for publication. This is your fault, Dylan, and all the students who have to read this will be able to blame you. One more, “finally,” to all the students who used this before it was a book and who supported Dylan. I’m glad that it was helpful to you all, and I hope that it will help others.
# Contents

**Preface**  
x

**General Rules and Procedures**  
xiii  

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## Part I  WORKBOOK

1. Atrial Rhythms  
   - 3  
2. Junctional Rhythms  
   - 15  
3. Heart Blocks  
   - 23  
4. Ventricular Rhythms  
   - 31  
5. Paced Rhythms  
   - 61  
6. 12-Lead EKGs  
   - 75  
7. All Together Now!  
   - 97  

## Part II  ANSWERS

- Answers to Chapter 1: Atrial Rhythms  
  - 125  
- Answers to Chapter 2: Junctional Rhythms  
  - 139  
- Answers to Chapter 3: Heart Blocks  
  - 147  
- Answers to Chapter 4: Ventricular Rhythms  
  - 153  
- Answers to Chapter 5: Paced Rhythms  
  - 187  
- Answers to Chapter 6: 12-Lead EKGs  
  - 201  
- Answers to Chapter 7: All Together Now!  
  - 209  

*References*  
- 239  

*Index*  
- 241  

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This workbook did not start out to be a workbook. As a typical egomaniacal critical care nurse, I believed that I had a duty to write the definitive book on dysrhythmia recognition. I actually did that and started the workbook, when the epiphany came to me that my “book” was basically the same as every other dysrhythmia book out there. Some are more in depth than others, but they all cover about the same topics and theories. I really did not have anything new to add. However, what always bothered me about those other books was their lack of actual guided practice.

Most of those other books provided examples and some practice, but most of the rhythms were textbook quality, which made them easy to decipher, and there were very few “demonstrations” of how to interpret them. As mentioned, I realized that my book was pretty useless, but a workbook, especially one that used actual rhythm strips, would be extremely valuable. Hence, the creation of this current tome. Not all the rhythms are actual patient rhythms, but most are. I found it difficult to find patients who would willingly provide me with some of the more lethal rhythms so that I could finish this book.

I was also bothered by the small amount of information that was out there on 12-lead EKG interpretation. What is out there tries to explain all the complexity of the 12 lead, and it can be very complex. This workbook tries to get away from that complexity and to simplify the process. In no way does it pretend to be the definitive authority on 12-lead interpretation. What it attempts to do is give the average nurse the tools to determine whether the patient is safe or not.

Most books will tell you that ST elevation indicates injury, whereas ST depression indicates ischemia. Hence, the dreaded ST-elevation myocardial infarction (STEMI) causes everyone in the emergency department to scurry for the thrombolytic drugs, whereas the person who presents with ST depression may be put on the back burner for a while.

Whether or not ST elevation indicates injury depends on the lead that the elevation is in and whether or not the elevation is an actual change or a reciprocal change. ST depression in leads V1 and V2 can actually be ST elevations in the posterior wall. It is right that we should respond quickly when ST elevation is present, but there is danger in ignoring ST depression.

The cause of ST depression is ischemia. ST elevation indicates myocardial cell injury, but the cause of the injury is ischemia. Both ST depression and elevation indicate ischemia. As long as ischemia is present, the patient is at risk for dysrhythmia and sudden death.
The purpose of the 12-lead EKG section of this workbook is not to make people experts in 12-lead EKGs, but to be expert enough to tell whether or not the patient is safe. The focus of the workbook is to help develop confidence in the reader relative to dysrhythmia recognition through practice. If the workbook does this, I will consider it a success.

The workbook is also designed to be used as a companion to almost every established dysrhythmia textbook published. It can be used as an addendum to any of the fine textbooks out there. As such, I offer it to you to help you provide safer patient care.

Paul L. Desmarais
General Rules and Procedures

Learning to recognize lethal and nonlethal dysrhythmias and to determine whether a patient is safe or at risk using a 12-lead EKG requires learning to use a systematic approach to interpretation. It is not mere recognition of dysrhythmia or learning what a picture means. It is gathering the right data to come up with the proper interpretation of the rhythm. This section provides the basic rules and procedures needed to begin basic rhythm and EKG interpretation.

In this section you will learn:
- Some basic rules of cardiology
- To measure appropriate interval spacing
- To recognize the origin of the P wave
- How to determine the type of heart block present
- The significance of the Q wave, ST elevation/depression, and T wave in the 12-lead EKG
- How the different leads of the 12-lead EKG relate to one another

1. When impulses arise from the same area of the heart and travel through the same tissue, they all look the same.
2. If impulses do not look the same, they are coming from different places in the heart.
3. If P waves look “normal” and consistent, they are assumed to be coming from the sinoatrial (SA) node.
4. P waves that do not look normal are coming from the atria. (All P waves come from the atria.)
5. If the P wave comes after the QRS complex, the impulse is arising from the area of the heart known as the atrial-ventricular (AV) junction.
6. If there is no P wave and the QRS looks nearly normal, the impulse is arising from the AV junction.
7. If the PR interval is less than 0.10 seconds wide, the impulse is arising from the AV junction.
8. If there is no P wave and the QRS is greater than 0.12 seconds wide, the impulse is arising from the ventricle.
9. The normal PR width is between 0.10 and 0.20 seconds.
10. If there are more P waves than QRS complexes, there is some type of heart block present.

11. If the PR interval is greater than 0.20 seconds and consistent and if every P wave has a QRS after it, the block is a first-degree block.

12. If there are more P waves than QRS complexes and the PR interval progresses in width before “dropping” a beat, the block is a second-degree block (Mobitz type I).

13. If there are more P waves than QRS complexes and the PR interval is constant in width when it is present, the block is a second-degree block (Mobitz type II).

14. If there are more P waves than QRS complexes and the PR interval is erratic in width, the block is a third-degree block (complete heart block).

15. For the 12-lead EKG:
   a. Significant Q waves (at least one fourth as deep as the R wave is tall or >0.04 seconds wide) indicate myocardial infarction if they occur in two or more related leads.
   b. ST elevation or depression indicates the presence of ischemia.
   c. Inverted T waves signify that something is going on and further assessment is needed.
   d. Related leads are:
      i. Leads II, III, and aVF (augmented vector foot) = Inferior wall
      ii. Leads V1, V2, V3, and (sometimes) V4 = Anterior wall
      iii. Leads I, aVL (augmented vector left), V5, V6, and (sometimes) V4 = Lateral wall
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Fast Facts Workbook for Cardiac Dysrhythmias and 12-Lead EKGs
The P wave is the key to determining from where a rhythm arises. Understanding this concept is central to all further interpretation. All P waves are produced in the atria. This includes sinus P waves because the sinoatrial (SA) node is in the atria. If all the P waves look the same, they are coming from the same place and going through the same tissue. If they look different, they are coming from different places and/or following a different pathway.

In this chapter, you will learn:

- To determine the origin of the P wave
- How to determine rate on a rhythm strip
- The terms tachycardia and bradycardia
- To determine whether a rhythm is regular or irregular
- The significance of certain “intervals”

**RULES**

1. When impulses arise from the same area and travel through the same tissue, they all look the same.
2. If impulses do not look the same, they are coming from different places.
3. If P waves look “normal” and consistent, they are assumed to be coming from the SA node.
4. P waves that do not look normal are coming from the atria. (All P waves come from the atria.)
5. Look for the “3-second” markers. The time between the first and third marker is 6 seconds.
6. To determine rate, count the number of complexes between the first and third marker (6 seconds) and multiply by 10.
7. To determine atrial rate, count the number of P waves in 6 seconds and multiply by 10.
8. To determine the ventricular rate, count the number of QRS complexes in 6 seconds and multiply by 10.
9. Rates greater than 100 beats per minute (bpm) are considered tachycardia.
10. Rates slower than 60 bpm are considered bradycardia.

11. Determine regularity (rhythm) of the strip by evaluating consistent time patterns between the same portion of adjacent complexes (i.e., P-P intervals or R-R intervals).

12. If the rhythm is irregular, determine whether irregularity is due to early (premature) beats or late (escape) beats or whether something is missing.

13. Evaluate P waves for origin. Ask these questions: “Do all the P waves look the same?” “Do they all have QRS complexes after them?” Remember that normal-looking P waves arise in the SA node. Those P waves that look different originate in the atria.

14. Measure PR interval. Normal should be between 0.10 and 0.20 seconds (2½ little boxes to 5 little boxes).

15. Evaluate QRS complexes. Ask these questions: “Do they all have P waves in front of them?” “Do they all look the same?” “Do they all look normal?”

16. Measure the QRS complex. It should be less than 0.12 seconds wide (three small boxes). Less than 0.12 seconds indicates rapid conduction through the ventricles using normal conductive pathways. Greater than 0.12 seconds indicates conduction defects/delays or travel through muscle rather than the normal conductive pathways.

17. Measure the QT interval. It should be less than one half the R-R interval. A greater QT interval indicates a delay in repolarization and increases the risk of arrhythmia production.

18. Normally, each QRS should have only one P wave. If there is more than one P wave per QRS and the atrial rate is normal, this is indicative of some sort of atrioventricular (AV) block.

19. If there is more than one P wave per QRS and the atrial rate is rapid, those P waves are not P waves they are F waves (flutter waves) and are diagnostic markers for atrial flutter.

20. If there are no P waves and the pattern is irregular, the diagnosis is atrial fibrillation.
RHYTHMS

EKG 1.1

- Rate: Atrial ___________  Ventricular ___________
- Rhythm: Regular ___________  Irregular ___________
- P wave origin: ___________
- PR interval: ______________
- QRS: _______________
- QT interval: ______________
- Underlying rhythm: __________
- Variant: _______________
- Diagnosis: ________________________________
- Treatment: ___________________________________
  ___________________________________
  ___________________________________
  ___________________________________

Answer on page 126

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EKG 1.2

- Rate: Atrial ____________ Ventricular ____________
- Rhythm: Regular ____________ Irregular ____________
- P wave origin: ____________
- PR interval: ____________
- QRS: ____________
- QT interval: ____________
- Underlying rhythm: ____________
- Variant: ____________
- Diagnosis: __________________________________________________________
- Treatment: __________________________________________________________
  __________________________________________________________
  __________________________________________________________
EKG 1.3

- Rate: Atrial ____________  Ventricular ____________
- Rhythm: Regular ____________  Irregular ____________
- P wave origin: ______________
- PR interval: ______________
- QRS: ______________
- QT interval: ______________
- Underlying rhythm: __________
- Variant: ______________
- Diagnosis: ____________________________
- Treatment: ____________________________
  ____________________________
  ____________________________
  ____________________________
Answers to Chapter 1: Atrial Rhythms
**EKG 1.1**

- **Rate:** Atrial 80 beats per minute (bpm) Ventricular 80 bpm
- **Rhythm:** Regular
- **P wave origin:** SA node
- **PR interval:** 0.12 seconds
- **QRS:** 0.08 seconds
- **QT interval:** 0.36 seconds (R-R interval = 0.72 seconds)
- **Underlying rhythm:** Sinus rhythm
- **Variant:** None
- **Diagnosis:** Normal sinus rhythm
- **Treatment:** None

**Discussion**

- **Rate:** There are eight P waves in the 6-second strip (between the first and third 3-second marker): 8 × 10 = 80 P waves per minute. There are also eight QRS complexes between those markers, giving a ventricular rate of 80 bpm (beats per minute).
- **Rhythm:** The interval between the R waves is consistent, meaning that the rhythm is regular.
- **P wave origin:** Because the P waves all look the same, they are most likely coming from the same place and going through the same tissue. The assumption is that place of origin is the sinoatrial (SA) node. This will be a “sinus something.”
- **PR interval:** The PR interval is consistently three little blocks wide. Each block is 0.04 seconds wide so the PR width is consistently 0.12 seconds. That is within the normal range (0.10–0.20 seconds).
- **QRS:** The QRS complexes all look the same and are 0.08 seconds (two blocks) wide, making them normal in configuration.
- **QT interval:** The QT interval is exactly one half the R-R interval. One half or less is acceptable. Greater than one half the R-R interval may place the patient at risk for arrhythmia.
- **Underlying rhythm:** The P wave is sinus in origin. The rate is within normal limits and the rhythm is regular. This is a normal sinus rhythm. There are no variations noted.
Rate: Atrial 80 bpm  Ventricular 80 bpm

Rhythm: Regular

P wave origin: SA node

PR interval: 0.16 seconds

QRS: 0.08 seconds

QT interval: 0.36 seconds (R-R interval = 0.68 seconds)

Underlying rhythm: Sinus rhythm

Variant: QT greater than one half of R-R interval

Diagnosis: Normal sinus rhythm

Treatment: None. Watch QT interval and evaluate causes and risk.

Discussion

Rate: There are eight P waves and eight QRS complexes between the first and third 3-second marker (6 seconds), giving a rate of 80 bpm.

Rhythm: The R-R interval is consistent, indicating that the rhythm is regular.

P wave origin: All the P waves look the same, indicating that they are all coming from the same place. That same place is assumed to be the SA node.

PR interval: The PR interval is consistent at 0.16 seconds (four boxes). That is an acceptable width (0.10–0.20 seconds).

QRS: The QRS is narrow (<0.12 seconds wide) and consistent in appearance.

QT interval: The QT interval is a tad more than one half the R-R interval and bears watching for progression and the development of premature beats.
**EKG 1.3**

- **Rate:** Atrial 110 bpm  Ventricular 110 bpm
- **Rhythm:** Regular
- **P wave origin:** SA node
- **PR interval:** 0.12 seconds
- **QRS:** 0.08 seconds
- **QT interval:** 0.28 seconds (R-R interval = 0.56 seconds)
- **Underlying rhythm:** Sinus
- **Variant:** Rapid rate
- **Diagnosis:** Sinus tachycardia

**Discussion**

- **Rate:** There are 11 P waves and QRS complexes between the first and third 3-second marker (6 seconds), indicating an atrial and ventricular rate of 110 bpm.
- **Rhythm:** The rhythm is regular.
- **P wave origin:** All the P waves are consistent, indicating that they are probably coming from the SA node.
- **PR interval:** The PR is consistent at 0.12 seconds wide.
- **QRS:** The QRS complexes are consistent and 0.08 seconds wide.
- **QT interval:** The QT interval is one half the R-R interval and bears watching for progression and the development of arrhythmias.
- **Diagnosis:** The origin of this rhythm is the SA node, but the rate is rapid (>100 bpm), making this a sinus tachycardia.
EKG 1.4

- Rate: Atrial 50 bpm  Ventricular 50 bpm
- Rhythm: Regular
- P wave origin: SA node
- PR interval: 0.18 seconds
- QRS: 0.08 seconds
- QT interval: 0.40 seconds (R-R interval = 1.26 seconds)
- Underlying rhythm: Sinus
- Variant: Bradycardia
- Diagnosis: Sinus bradycardia

- Treatment: Assess the patient. The treatment in this case would depend on whether or not the patient is symptomatic. If not, leave him or her alone. He or she may be sleeping comfortably, dreaming about how he or she won that gold medal. Don’t take that away from him or her. If, however, the patient is complaining of chest discomfort, shortness of breath, and so on, atropine would be the drug of choice. If atropine is not effective, epinephrine or dopamine might be used. If none of the medications work, apply the transcutaneous pacemaker.

- Discussion
  - Rate: There are five P waves and five QRS complexes between the first and third 3-second marker (6 seconds) of this strip, making the atrial and ventricular rates 50 bpm.
  - Rhythm: The R-R intervals are consistent, making the rhythm regular.
  - P wave origin: All the P waves look the same, indicating that they are coming from the same place and going through the same pathway. The assumption is that the source of the P waves is the sinoatrial (SA) node.
  - PR interval: The PR interval is within the normal limits (0.10–0.20 seconds).
  - QRS: The QRS complexes all look the same and are within normal limits (<0.12 seconds).
  - QT interval: The QT interval is less than one half the R-R interval.
  - Diagnosis: The source of this rhythm is the SA node, but the rate is slow (<60 bpm), making this a sinus bradycardia.