Choosing the Right Monitor
Ambulatory Monitors in the Primary Care Office

Martin C. Burke, D.O.
Chief Scientific Officer
CorVita Science Foundation

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• Educational and clinical research grants
  • Astra Zeneca-research
  • Biosense Webster-research
  • Medtronic -research
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  • Abbott- research
  • AtaCor Medical, Inc.- co-founder, Equity
  • Bardy Diagnostics- equity
  • AJ Medical, Inc. – research, equity

Symptoms

• Palpitations
• Near Syncope
• Syncope

• Chest pain
• Abnormal ECG
• Cardiac arrest prevention
• Cryptogenic stroke

Syncope
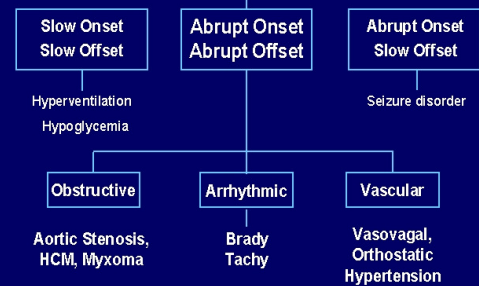
Causes of Arrhythmic Syncope

• Very rapid VT or TdP, with hypotension
• Atrial fibrillation or atrial flutter with very rapid ventricular response as in WPW
• AV block
• Sinus arrest

Atrial Fibrillation
Background

• Most common cardiac arrhythmia
  • overall prevalence of ~1%
• Increased risk of mortality, heart failure and thromboembolic events.
• Hospitalization rates increased by 23% from 2000 to 2010;
• In-hospital mortality 1% and as high as 1.9% for patients >80y/o; Concomitant heart failure up to 8.2%

Circulation. 2014 Jun; 129 (23): 2371-9.

Slide 1:

Prevalence of Diagnosed Atrial Fibrillation in Adults: National Implications for Rhythm Management and Stroke Prevention: the AnTicoagulation and Risk Factors In Atrial Fibrillation (ATRIA) Study FREE

Alan S. Go, MD; Elaine M. Hylek, MD, MPH; Kathleen A. Phillips, BA; YuChiao Chang, PhD; Lori E. Henault, MPH; Joe V. Selby, MD, MPH; Daniel E. Singer, MD

JAMA. 2001;285(18):2370-2375. doi:10.1001/jama.285.18.2370.
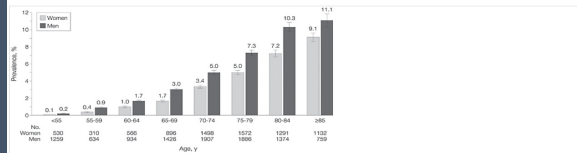
- Prevalence of atrial fibrillation increases with age
- Prevalence is higher in men than women in all age groups

Slide 2:

The estimated US prevalence of atrial fibrillation (AF) in the year 2050 ranges from 5.6 million to as high as 15.9 million individuals.
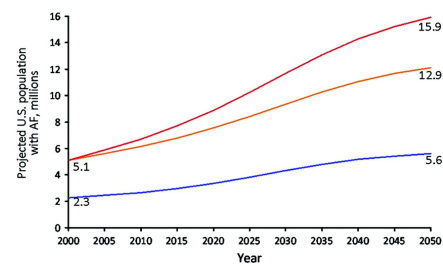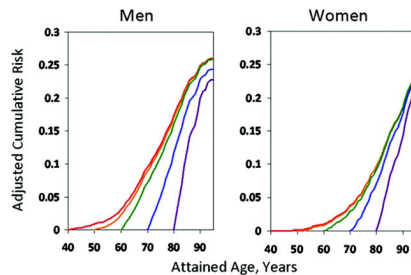

Jared W. Magnani et al. Circulation. 2011;124:1982-1993

American Heart Association.

Slide 3:

Lifetime risk for developing atrial fibrillation (AF) from the Framingham Heart Study.

Jared W. Magnani et al. Circulation. 2011;124:1982-1993

American Heart Association.

Slide 4:

Why Talk About Cryptogenic Stroke?

- 678,000 ischemic strokes every year in the US[1]
  - Leading cause of disability in the US and worldwide
- ~200,000 cryptogenic strokes yearly[1]
- Most cryptogenic stroke patients receive anti-platelet for secondary prevention[2]
- Long-term monitoring reveals AF in ~30% of cryptogenic stroke patients[3-9]
  - These patients benefit from anticoagulant therapy

Ischemic Stroke
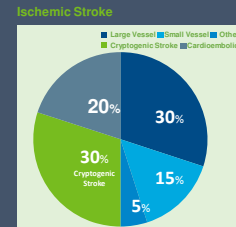
[1] Mozzafarian D, et al. *Circulation.* 2015;131:e29-e322.
[2] Kernan WN, et al. *Stroke.* 2014;45:2160-2236.
[3] Sacco RL, et al. *Ann Neurol.* 1989;25:382-390.
[4] Petty GW, et al. *Stroke.* 1999;30:2513-2516.
[5] Kolominsky-Rabas PL, et al. *Stroke.* 2001;32:2735-2740.

[6] Schulz UG, et al. *Stroke.* 2003;34:2050-2059.
[7] Schneider AT, et al. *Stroke.* 2004;35:1552-1556.
[8] Lee BI, et al. *Cerebrovasc Dis.* 2001;12:145-151.
Sanna T, et al. *N Engl J Med.* 2014;370:2478-2486.

Slide 5:

Types of Ambulatory Monitors

- 12 lead ECG
- Wearable ECG Monitors
- Holter Monitor 24-48 hour
- 30 Day Event Monitor
  - Continuous-automatic
  - Patient Activated
- Implantable Loop Recorders
  - Inability to capture with non invasive
  - Evaluation of atrial fibrillation
  - Evaluation of cryptogenic stroke

Slide 6:

Slide 1: QT interval
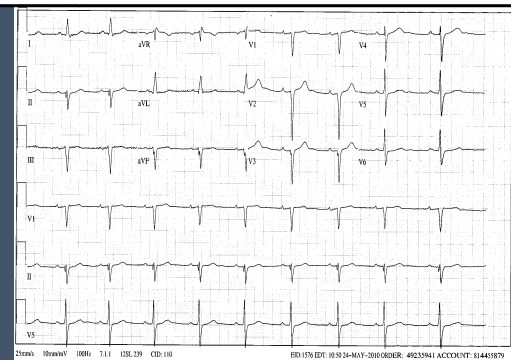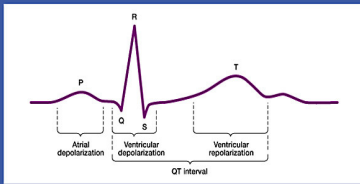
QT interval

- QT interval = time from beginning of ventricular depolarization through repolarization as seen on the ECG
- QT interval shortens as heart rate increases
- QT interval lengthens as heart rate decreases

[1] Tortora GJ. *Principles of Anatomy and Physiology.* 1995.
[2] Conover MB. *Understanding Electrocardiography.* 1995.

Slide 2: Diagnosis Strategies

24-48 hours of monitoring	Up to 30 days of monitoring	Up to 30 days of monitoring
External loop recorder	Event-triggered loop recorder	Ambulatory event monitor
Saves all cardiac rhythm data	Saves events only	Saves all cardiac rhythm data
	62% patient compliance[1]	53-90% patient compliance*[2-5]

* Dependent on type of MCT.
1. Vasamreddy CR, et al. *J Cardiovasc Electrophysiol.* 2006;17:134-139;
2. Gladstone DJ, et al. *N Engl J Med.* 2014;370:2467-2477;
3. Rosenberg MA, et al. *Pacing Clin Electrophysiol.* 2013;36:328-333;
4. Kamel H, et al. *Stroke.* 2013;44:528-530.
5. Shinbane JS, et al. Heart Rhythm Society 2013 34th Annual Scientific Sessions, Volume 10, Issue 5S, 2013.

Slide 3: Traditional ECG Monitor Placement

Slide 4
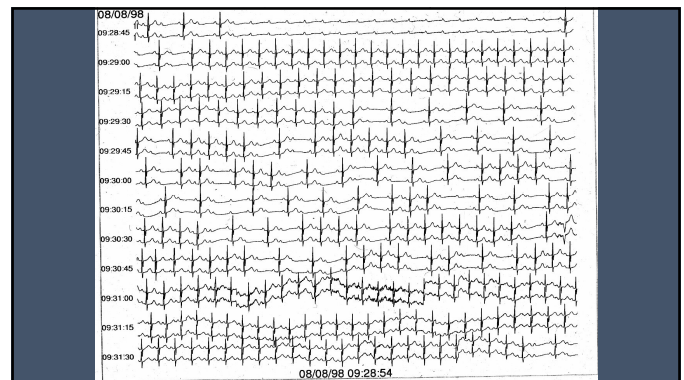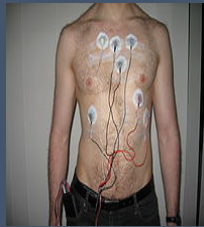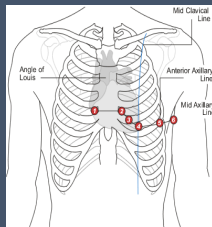
Slide 5: Minimizing Electrode Spacing

10 cm

7 cm

4 cm

2.5 cm

Burke et al., J Electrocardiology 2002

Slide 6: Mean QRS Amplitude in Bipolar Chest Leads from Optimal Locations

	SR (mV)	VF (mV)
4-10cm array (40 patients)	1.6	0.9
2.5cm array (20 patients)	1.3	0.8

Burke et al., J Electrocardiology 2002

Slide 1

BardyDx

CAM™ IS THE FIRST P-WAVE CENTRIC ECG MONITOR™

IRHYTHM ZIO PATCH

MCOT
BioTel

Slide 2 — Wearable ECG Monitors

SpO2 Measurement

ECG Measurement

Rudy et al. J Electrocardiology 2005

Slide 3 — Reveal LINQ™ SYSTEM

SIMPLE INSERTION PROCEDURE

Best location: 45 degrees to sternum over 4th intercostal space, 2 cm from left edge of sternum

97% of physicians found the insertion tool simple and intuitive.

World's Smallest ICM

Requires minimal procedure time and clinical resources

[1] Reveal LINQ Usability Study. Medtronic data on file. 2013.
Burke MC et al. J Electrocardiology 2002

Slide 4 — CRYSTAL AF: monitoring with ICM superior to SOC

FOR THE DETECTION OF AF[1]

Detection of Atrial Fibrillation by 36 months
Hazard ratio, 8.8 (95% CI, 3.5 – 22.2)
P < 0.001 by log-rank test

Reveal™ ICM — 30%
Control — 3%

# at Risk	0	6	12	18	24	30	36
Control	220	194	167	114	72	36	7
ICM	221	191	173	102	57	29	8

Sanna T, et al. N Engl J Med. 2014;370:2478-2486.

Slide 5 — Prevention of Thromboembolism

TABLE 1 The 2009 Birmingham Schema Expressed as a Point-Based Scoring System, With the Acronym CHA₂DS₂–VASc

Risk Factor	Score
Congestive heart failure or left ventricular dysfunction	1
Hypertension	1
Age ≥75 yrs	2
Diabetes mellitus	1
Stroke, transient ischemic attack, or thromboembolism	2
Vascular disease (prior myocardial infarction, peripheral artery disease, or aortic plaque)	1
Age 65–74 yrs	1
Sex category (i.e., female)	1
Maximum total points	9

Chest 2010; 137: 263-72

Slide 6 — Case 1

- 29 y/o female with repeated episodes of palpitation. The events occur sporadically but at least once a month.
- The patient has not experienced syncope but does have anxiety and mild dyspnea associated with the events.

Case 1

- Physical exam is normal
- ECG is normal

- What monitor should we order?

Case 2

- 82 y/o male with chronic atrial fibrillation who has no symptoms.
- The patient has undergone CABG surgery 10 years ago. He has hypertension and hyperlipidemia
- He takes digoxen, metoprolol and Lipitor.
- His exam reveals mild JVD, HR irregular, irregular, lungs clear and the remainder of the exam is unremarkable.

Case 2

- Important issues with this patient….

  - What type of monitoring if any would help this patient?
  - LV function
  - 24 hr average heart rate
  - Ischemic status

The Holter Report

Case 3

- 73 y/o male with near syncope. The patient has history of hypertension and hyperlipidemia.
- Takes Lopressor, vasotec, digoxen, aspirin and Crestor.
- His exam has a paradoxically split S2 and is otherwise unremarkable.
- His ECG is sinus rhythm with bifascicular block

What diagnostic test is next?

A. 30 day event monitor
B. 48 Hour Holter Monitor
C. Echocardiogram
D. Stress test
E. None of the above

Unexplained Syncope