PAC, PVCs, Holter Monitors

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• While we have received unrestricted educational grants from several pharmaceutical companies, most presentations have no mention of specific products and are unrelated to the supporting companies or their products. No specific presentations will be supported or sponsored by a specific company.

• Information on specific products will be presented in the context of an unbiased overview of all products related to treating patients.

• All scientific research related to, reported or used in this CME activity in support or justification of patient care recommendations conforms to the generally accepted standards.

• Clinical medicine is based in evidence that is accepted within the profession.
Premature atrial contraction (PAC) is premature activation of atria from an atrial site other than sinus node.
PAC-Prevalence

• Common in all age groups
• Normal hearts/SHD
• Frequency increases with age
• Circadian variation
• Mechanism is not clear or well investigated

• Re-entry

• Abnormal automaticity

• Triggered activity
PAC-Etiology

• Idiopathic (pulmonary veins)

• Toxins/chemicals (alcohol, smoking)

• CAD/post-MI

• Any condition increases atria size/pressure

• COPD, bronchodilator use
PAC-Clinical manifestations

- Asymptomatic (mostly)
- Palpitation
- Dizziness
- Lightheadedness, dizziness, pre-syncope
84yo male with pre-syncope/syncope
PAC-Diagnosis

- ECG/Holter
- Relatively early P wave with a different morphology compared to sinus P wave
- P wave may be hidden in T wave
- PR shorter or longer
- Narrow QRS, aberrantly conducted, no conduction through AV node
PAC-Investigation

- 24-hour-Holter
- Echocardiogram
- Other tests as indicated
PAC-Treatment

- Reassurance
- Minimize triggers
- Medications (BB/AAD)
- Ablation (CM, persistent severe symptoms)
55yo female blocked bigeminal PACs necessitating ablation
PACs are typically non-life-threatening events, and they are not associated with increased mortality in the long term?

A. Agree  
B. Disagree
PAC-Prognosis

- Mostly depends on presence of underlying SHD

- Frequent PACs associated with increased CV mortality over 10-18 years (HR: 2.03, 95% CI 1.12-3.66)* & (HR 1.41, 95% CI 1.08-1.80)** & (HR 1.4, 95% CI 1.2-1.6)***

- Frequent PACs may be associated with new Afib and adverse CV events (HR 4.9, 95% CI 2.7-5.6, men)/ (HR 3.9, 95% CI 2.7-5.6, women)****


PVC-Definition

Premature and wide complex QRS from ventricle
Bizarre morphology
T wave in the opposite direction from QRS vector
A fully compensatory pause (usually)
PVC-Prevalence

• Common

• 80% healthy population over 24-h-Holter

• Structurally normal hearts/SHD

• Frequency increases with age and SHD
PVC-Mechanism

• **Re-entry**: Most common: myocardial fibrosis, conduction delay, etc

• **Enhanced automaticity**: Electrolyte abnormalities, ischemia, cathecholamines

• **Triggered activity**: Electrolyte abnormalities (hypokalemia), ischemia, CM, excess calcium, drug toxicity (digoxin, QT prolonging medications)
Re-entry Mechanism

The Mechanism of Reentry

A

B

C

D

x – Slow conduction pathway  y – Fast conduction pathway
Abnormal automaticity

1. Slope of phase 4 is increased.
2. Threshold potential (TP) is more negative.
3. Maximum diastolic potential (MDP) is more positive.
Triggered activity

Phase 2 (A) and PHASE 3 (B) EAD

DEA (C)
PVC-Associated Conditions

• Idiopathic (outflow tracts, left fascicles)
• SHD
• COPD, sleep apnea, PHT, other pulmonary Dz
• Endocrinopathies (thyroid, adrenal etc)
• Nicotine, alcohol, other stimulants (beta agonists, cocaine etc)
PVC-Clinical manifestations

- No symptom (commonly)
- Palpitation (skipping a beat, strong beat…)
- Dizziness
- Rarely hemodynamic compromise (depressed LV function, underlying bradycardia)
- PVC-induced CM
PVC-Diagnostic Evaluation

- ECG
- Ambulatory monitorization
- Echocardiography
- ETT
- B/W for TSH, electrolytes
- Sleep apnea investigation
PVC-Holter

- Diagnosis
- Morphology
- Quantification (variability!)
Outflow Tract PVCs

RVOT

LVOT
PVC-ETT-1

- PVC induction
- Response to exercise
- PVC morphology
- NSVT/VT induction
- Ischemia findings
• 2 to 8 percent of asymptomatic men and women have exercise induced PVC

• Age, male sex, history of hypertension, obesity

• Evidence for increased cardiovascular risk with exercise induced PVC
PVC-Patterns/Variations

• Unifocal/multifocal (RVOT vs ARVC)

• Bigeminy, trigeminy, and quadrigeminy

• R-on-T phenomenon

• Short coupling intervals
PVC-Treatment

- Management of SHD, if any
- Symptom??
- Triggers
- Reassurance
- BB/CCB
- AAD
- Ablation
PVC-Prognosis

• Associated with increased mortality

• PVC on a 2-min-ECG is associated with greater than two-fold increase in mortality from coronary heart disease compared with those without any PVCs*

• PVC on a 2-min-ECG is associated with two-fold increase in sudden cardiac death compared with those without PVCs**


PVC-Prognosis

• The frequency of PVCs may play a role in prognosis

• 1139 patients without known SHD undergoing 24-h-Holter

• Median F/U of 13 years

• Patients in the upper quartile of PVCs (more than 0.123 % of total heart beats)

• Decreased LV ejection fraction (OR 3.1, 95% CI 1.4-6.8) & HF (OR 1.5, 95% CI 1.1-2.0)

• Higher likelihood of all-cause mortality (OR 1.3, 95% CI 1.1-14.9)

PVC-Ischemic Stroke

- Prospective evaluation of 14,783 subjects Atherosclerosis Risk In Communities Study

- PVCs were seen in 6.1 percent of the participants at baseline on a two-minute ECG

- The incident stroke in individuals with any PVC was 6.6% compared with 4.1% in those without PVC (HR 1.7, 95% CI 1.3-2.2)

- Reasons for Geographic and Racial Differences in Stroke (REGARDS) study.
  - PVC on baseline ECG
  - 24.460 pts
  - Mean age
  - More stroke in PVC group (HR 1.4, 95% CI 1.1-1.8)

- Mechanism not clear (formation of thrombi or embolization through cardiac remodelling, atrial
• 6101 men aged 42 to 53yo
• 2.3% had frequent PVCs during exercise (≥2 sequential PVCs or PVCs constituting more than 10% of all ventricular depolarizations during any of the 30-sec ECG)
• 23-year follow-up
• Patients with PVCs had a significantly higher rate of all-cause mortality (41 vs 26%) and cardiovascular mortality (16 vs 6.4%, adjusted relative risk 2.5, 95% CI 1.7-3.9)

• A meta-analysis of 10 observational studies

• Asymptomatic patients (n = 1239) with no clinical evidence of heart disease

• Composite endpoints including all-cause mortality, cardiac mortality and cardiovascular events

• Exercised-induced PVCs were associated with an 80 percent increased risk of developing adverse cardiovascular events over 16 years (RR 1.82, 95% CI 1.44 to 2.30)

• Sensitivity analysis: only PVCs on the recovery phase of an exercise test, not during exercise, had adverse prognostic significance.

• Autonomic dysfunction???
Since PVC are associated with increased mortality, PVC suppression with anti-arrhythmic drugs improves survival?

1. Agree
2. Disagree
Take home points

• Ectopic beats are common

• Treatment is mostly symptomatic unless there is SHD

• Frequent ectopic beats seems to be associated increased cardiovascular outcomes

• No evidence for suppression of ectopic beats with medications improves prognosis
Holter-Indication

• Diagnosis of arrhythmias

• Assessment of efficacy of drug therapy (Afib rate/rhythm control, PVC/PAC suppression)

  • Risk stratification (HCM, ARVC, long QT, Brugada syndrome etc)

• Ischemia

• Assessment of cardiac device function
Symptom-rhythm correlation

- Symptom-rhythm correlation is the key

- Lack of mention of symptoms or symptom-rhythm correlation means the report is incomplete
Burden of Ectopy*

- 1-24: Rare (1 or less/h)
- 25-249: Infrequent (1-10/h)
- 250-719: Moderately frequent (10-30/h)
- 720-1440: Frequent (1/1-2min)
- >1440: Very Frequent (>1/min)

Common Holter findings

• Asymptomatic pauses (Mobitz type 1, non-conducted PAC, Vagal overtone, pause during Afib, pathological pauses etc…)

• Brief irregular supraventricular rhythms (PAF, AT/AFL with variable AV conduction, repetitive PACs etc)
Non-conducted PAC
Sinus rate: 53 bpm
Sinus rate: 64 bpm
Mobitz-2
Pt-C/1

Sinus rate: 50 bpm
Sinus rate: 72bpm
Mobitz-2  Pt-D/1

Sinus rate 66 bpm
Mobitz-2
Pt-D/2

Sinus rate: 60 bpm
Mobitz-2
Pt-D/3

Sinus rate: 140 bpm
Mobitz 1 or 2 ????  Pt-E
Conversion pause

paper speed 12.5mm/sec

8-sec pause
Supraventricular run

Atrial Fibrillation

Repetitive supraventricular ectopy

Atrial tachycardia with variable block

Irregular supraventricular tachyarrhythmia resembling atrial fibrillation

Atrial fibrillation cannot be excluded
Thank you...