Arrhythmia Review Course 2

Bradycardia and Pacemaker

프로그램 디렉터: 신동구
패널: 박규환, 송인걸, 이대인, 이소령, 천광진
Case. F/70

• 2016.12 Consultation from neuro-surgery due to traumatic intracranial hemorrhage which may be related to syncope
Holter monitoring

**Interpretation**

Basal ECG - Atrial tachycardia with block & A-Flu. & A-fibrillation

Intermittent sinus rhythm & ectopic atrial rhythm & frequent SVPBs, aberrancy

Pause (>3.0sec) with Sx.(dizziness) : 86times/24hrs (Longest 7.32sec at 15:06)

& junctional rhythm & junctional escaped beats & sinus bradycardia

--> occurred mainly at 11:20~16:00

Uniform VPBs : 3times/24hrs

Sx. (+)
Sinus pause following AF termination

7.3 seconds
Case. F/49

- 2009   Medical f/up d/t postpartum DCMP
- 2012~ AF with rapid ventricular response
- W/up
  - 2009~ TTE: EF 30~50%, wax and wane
  - 2014   CAG: WNL
  - Biopsy was not done due to patient’s refusal
2012: AF c LAFB
2014 AF c LAFB / incomplete RBBB
2014 AV dissociation, junctional escape beating
Case. M/67

- 2014 Dilated cardiomyopathy with LBBB
  - LVEF 35%, LVEDd = 67mm
  - Medication: perindopril 2mg qd, spirolactone 25mg qd, carvedilol 3.125mg qd
- 2015.7 Dyspnea improved
  - LVEF = 57%, LVEDd = 58mm
- Syncope
Previous ECG: 2014.12.15

67 year-old/male, syncope
ECG at ER (2015.3.27)

67 year-old/male, syncope

K = 5.9mEq
Temporary Pacing

67 year-old/male, syncope
F/U ECG (2015.3.27)

67 year-old/male, syncope
EPS: Catheter Positioning
Basic Intervals
AEST 600/320: HV block
## Indication for cardiac pacing in patients with BBB

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) BBB, unexplained syncope and abnormal EPS. Pacing is indicated in patients with syncope, BBB and positive EPS defined as HV interval of $\geq 70$ ms, or second- or third-degree His-Purkinje block demonstrated during incremental atrial pacing or with pharmacological challenge.</td>
<td>I</td>
<td>B</td>
<td>25, 31</td>
</tr>
<tr>
<td>2) Alternating BBB.</td>
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a: Class
b: Level
c: Reference
Positive EPS

• sinus node recovery time >1500 ms
• corrected sinus node recovery time >525 ms
• baseline HV interval ≥70 ms
• second- or third-degree His–Purkinje block during incremental atrial pacing or after intravenous class IC antiarrhythmic drugs
• induction of sustained monomorphic VT or rapid SVT that provoked hypotension or reproduced spontaneous symptoms
Brief History before sick sinus syndrome

• CHA2DS2-VASc score = 2 (age, sex)

• AF ablation was done 2016.11

• Propafenone and bisoprolol
Case. M/75

- 2010  Hemodialysis due to chronic kidney disease
- 2012  Propafenone due to atrial fibrillation
- 2016.9 ER visit due to dyspnea and fever
  - K level: 6.0 mEq
  - Leukocystosis -> urinary tract infection
Temporary pacemaker
3 days after admission

Amiodarone loading
3 days after amiodarone
Treatment

Unstable TdP  
Defibrillation, not cardioversion

Stable
- First line: magnesium sulfate (2gm/2-15min)
- Second line (>100bpm): Temporary pacing
  Isoproterenol (2mcg/min)

Correct the cause of TdP and K > 4.0 mEq
Case. F/78, dizziness

- Frequent dizziness and presyncope for 1 month

- PMHx: HTN - Amlodipine 5mg qd, HCT 25mg qd

- Lab, TTE: N-S
Initial ECG on admission
24hr Holter (LMC)

Complete AV block

N-N Pause 2392 ms
24hr Holter (LMC)

Bradycardia-induced Torsade de pointes
Case. F/78, dizziness

- Permanent pacemaker (DDDR) implantation

- Improvement in dizziness after the procedure
Case. F/50, recurrent syncope

- Repetitive syncopal episodes every year

- Referred for evaluation and treatment of malignant VA (TdP): EP study and ICD implantation
  - Detected by head-up tilt test
Baseline ECG
Head-up tilt test (LMC)

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<th>Blood Pressure</th>
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<td></td>
<td>12(min)</td>
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<td>15(min)</td>
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<td>18(min)</td>
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<td>38</td>
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Recovery

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<td>159 / 78</td>
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<td>2(min)</td>
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<tr>
<td>3(min)</td>
<td>44</td>
<td>134 / 74</td>
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Comment:
1. Standing 24 min 후 어지림 호소, HR 38 까지 낮아지는 양상과 함께 Eyeball deviation→seizure임.
2. Hand grip test : 134/74-44 →130/72-45
3. Type 2B(Cardioinhibition with asystole)
24hr Holter (LMC)
24hr Holter (LMC)
Case 4, F/50, recurrent syncope

• CAG: no luminal stenosis
  - Ergonovine provocation test: negative

• Epinephrine challenge test
  : possible to exclude Long QT syndrome
Head-up tilt test

Vasovagal syncope  
- Cardioinhibitory type
Head-up tilt test

Sinus pause more than 3 seconds
Treatment

• Midodrine, isometric/isotonic exercise
  >> Mechanical device implantation (ICD, PM)
Cardiac pacing in patients with VVS

2017 ACC/AHA/HRS guideline (Syncope)

Recommendation for Pacemakers in VVS

<table>
<thead>
<tr>
<th>COR</th>
<th>LOE</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>IIb</td>
<td>B - R</td>
<td>Dual-chamber pacing might be reasonable in a select population of patients 40 years of age or older with recurrent VVS and prolonged spontaneous pauses (404-408,410).</td>
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2012 ACC/AHA/HRS focused update of guideline

Recommendations for Permanent Pacing in Hypersensitive Carotid Sinus Syndrome and Neurocardiogenic Syncope

Class IIb

1. Permanent pacing may be considered for significantly symptomatic neurocardiogenic syncope associated with bradycardia documented spontaneously or at the time of tilt-table testing (Sutton et al., 2000; Ammirati, Colivicchi, & Santini, 2001; Connolly et al., 2003; Sheldon et al., 1998). (Level of Evidence: B)
Case. M/67, Syncope

• Syncope #2, Dizziness for 6 months

• PMHx
  : Angina pectoris (2012-2 LCX PCI #1)
  Old CVA (Lt. thalamic infarction)
  Hypertension

• Lab: N-S
Baseline ECG
Intermittent failure of sinus node impulse generation → Sinus pause
Case. M/70, DOE & dizziness

- DOE, Palpitation, Dizziness for 5 years

- PMHx: hyperthyroidism, PTU 1T bid PO

- Lab: normal TFT

- TTE: N-S
Electrocardiography
P-P interval progressively shortens prior to the dropped P wave

→ 2\textsuperscript{nd} degree SA block, Type 1 (Wenckebach)
Case. M/50, Syncope

• Frequent syncopal episodes for 1 weeks

• PMHx: N-S

• Lab: Hb N-S
Electrocardiography
The pause surrounding the dropped P wave is an double of the preceding P-P interval → 2nd degree SA block, Type 2
SA block

**P cell**: Central core of pacemaking cell producing the sinus impulses

**T cell**: Outer layer of transitional cells transmitting the sinus impulses out into the RA

Failure of P cells to produce an impulse → Sinus pause

Failure of the T cells to transmit the impulse → SA exit block

① First degree SA block
② Second degree SA block: Type I, type II

Only can be Diagnosed from the 12-lead ECG

③ Third degree SA block
SA block

Delay between impulse generation and transmission to the atrium

Intermittent dropped P waves with a constant interval between impulse generation and A depolarization

Progressive lengthening of the interval between impulse generation and transmission → culminating in failure of transmission

None of the sinus impulses are conducted to the RA
Case. F/53, recurrent syncope

2014 Holter, HUT : WNL
2016 Brain MRI, EEG, TMT, EchoCG : WNL
2017 CCTA : normal coronary

Holter: minimum HR 42/min (10am)
maximum RR 1.58 sec (3pm)
EPS, corrected SNRT 1216ms

→ Implantable loop recorder implantation
After 1 month

Syncope, 10pm

ILR analysis
- 11.4 sec pause was detected.

Sick sinus syndrome
→ Permanent pacemaker implantation
Permanent pacemaker implantation
Case. F/59, Chest discomfort and palpitation

- PMHx: HTN (+) – valsartan 80mg qd
- ECG: NSR
- Echo
  - LVEDD/LVESD: 52/35mm
  - LVEF: 61%
  - No significant abnormal findings
• Holter (2015.10.22)
  – Paroxysmal AF (<1%)
  – Frequent PACs (1%)
  – Min 38, AVG 69, Max 174 bpm
  – Max RR pause 1.96 sec (23:39:11)
• FU Holter (2015.11.03)
  – Min 36 (04:48:32), AVG 69, Max 133 bpm
  – Paroxysmal AF (<1%)
  – Max RR pause 2.48 sec (06:43:16)
  – Frequent PACs (6%)
• OPD F/U
  – 간헐적으로 두근거린다. 부정맥 생기면 증상 느낀다.
  – 간헐적으로 어지럽기도 하다.
  – 걸을 때 숨도 조금 차다.
Non-conducted PAC
F/U Holter (2016.10.26)

• Min 32 (05:45:17), Avg 74, Max 169
• Paroxysmal AF (14%)
• Frequent PACs (3%)
• Max RR pause 4.64 sec (14:00:52)
• Tachycardia-bradycardia syndrome
• Sick sinus syndrome

Permanent pacemaker implantation
Case. F/61

Exertional dyspnea, NYHA class II

2:1 AV block
# Treadmill test

## Exercise Test Summary

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<th>Stage Name</th>
<th>Time in Stage</th>
<th>Speed (mph)</th>
<th>Grade (%)</th>
<th>HR (bpm)</th>
<th>BP (mmHg)</th>
<th>Comment</th>
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<td>STANDING</td>
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<td>0.00</td>
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<td>EXERCISE</td>
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<td>10.00</td>
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Treadmill, Baseline ECG
Peak exercise

Advanced AV block during exercise
Recovery, 3 min

→ Permanent pacemaker implantation
Case. M/66, Traumatic C-spine injury, 6 months ago
Bradycardia after C-spine OP, Quadriplegia

Isoproterenol infusion 후 recovery 되어 stop
Amiodarone투여시 bradycardia
Propafenone 300mg BID add
Quadriplegia & tracheostomy, 요양병원 전원
After 6 months later, OPD visit on foot with palpitation
EP study
Entrainment, compatible for CTI AFL
AFL termination, but...
AV dissociation

200 ms

500 ms
Wenckebach?
One to One
AV dissociation, V rate increase
Holter, AV dissociation
Holter, AV dissociation
Case. F/70

- Dizziness and chest discomfort
  ➔ ER visit and admission

- PMHx: HTN (losartan 50mg qd)
1\textsuperscript{st} degree AV block & LBBB

HR : 60 bpm
PR interval : 202 msec
QRS duration : 182 msec

2014.05.22
• Echo
  – LVEDD/LVESD : 51/38 mm
  – LVEF : 43%
  – LAD territory RWMA (+)

• CAG
  – Near normal coronary artery
F/U ECG

HR : 67 bpm
PR interval : 201 msec
QRS duration : 166 msec

2016.05.19
• Dizziness develop (2017.06.03)

→ ER refer
Temporary pacemaker
Permanent pacemaker
Case. F/75, DOE

CAVB, s/p PM (3 years ago)

Dyspnea on exertion (NYHA II~III/IV)
ECG before PM

Rate 38
RR 1579
PR interval
QRS 178
QT 592
QTc 471

... Axis ...

P 87
QRS 232
T -69

[ PID: 11461900 / Date: 2013-11-07 ]

Unconfirmed Diagnosis

- ABNORMAL ECG -
Paced rhythm after PM

Summary Report

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<tr>
<th>Report Number</th>
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<td>Total Beats</td>
<td>90918</td>
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<tr>
<td>Hour Analyzed</td>
<td>21:54:56</td>
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<td>Unknown Beats</td>
<td>1711</td>
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<td>Percent AFIB</td>
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Heart Rates

| Min      | 53 BPM at 13:54:06-1 Bradyarrhythm Runs | 166 |
| Max      | 111 BPM at 20:24:00-1 Longest         | 72  |
| Avg      | 72 BPM Min rate                        | 47  |

Rate Dependent Events

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<thead>
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<th>Total Beats</th>
<th>Ventricular Events</th>
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<td>AVR/VVR Runs</td>
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<td>Max VE/Minute</td>
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<td>Mean VE/Hour</td>
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<td>VS/VPR</td>
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Impressions and Findings

1. Atrial paced rhythm (GDR); average HR 72 BPM.
2. Max HR 89 BPM; Brugada syndrome.
3. One year Holter.

ApVp

One year Holter
QRS 214 ms
TTE

EF 22%
After CRT-D
F/U TTE

EF 45%
Case. M/51, Palpitation

C.C: intermittent palpitation, dyspnea 3 days ago

Sick sinus syndrome, s/p DDDR PM 5 years ago

(타병원)
Initial ECG

- Vent. Rate: 67 bpm
- PR interval: 182 ms
- QRS duration: 194 ms
- QT/QTc: 440/434 ms
- P-R-T apex: 67-80/91 ms
- P duration: 58 ms

Interpretation:
Electronic ventricular pacemaker
Tachycardia

당직 전공의
IV diltiazem, amiodarone 사용에도
tachycardia 지속
Upper tracking rate 하향조정시 2:1 conduction되면서 tachycardia 지속
VVI mode로 변경
ECG strip
Case. M/64, DOE

Symptomatic sinus pause (4 sec)

HD#1, s/p pacemaker (DDDR, tined lead)

Difficult to optimal A lead positioning

<table>
<thead>
<tr>
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<th>DDDR(V)</th>
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<td>Pulse Amplitude (volts)</td>
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<td>Sense Config</td>
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HD# 2, Capture failure, diaphragm capture

A lead sensing (-), V lead diaphragm capture
A lead dislodgement (tined)

Passive fixation, tined lead
Lead reposition with deflectable catheter
After reposition

6 months F/U CXR
Case. M/63, confused mental status

Underlying liver cirrhosis
Recurrent hepatic encephalopathy
Baseline ECG
Hospital course

No improvement of mental status

Newly detected sinus bradycardia and sinus pause
Several foci of high-attenuation lesion with surrounding low attenuation change at right frontal lobe and right basal ganglia

→ Malignant tumor, most likely
Case. M/51, Syncope

- Syncope and seizure-like movement for 1 day
- Recent URI Hx for 3d: cough, sputum, and rhinorrhea

- No PMHx

- Lab: ↑WBC 5980, ↑AST/ALT 153/55, ↑hsCRP 0.685,
  ↑TnI 26.02/CK-MB 78.2, ↑NT-proBNP 3041
Initial ECG (ER)
Temporary PM insertion (HD 1)
Coronary angiography (HD 5)

No luminal stenosis
F/U ECG (HD 15)
Baseline TTE (HD 5) and F/U TTE (HD 47)

LVEF 24%, severe global LV hypokinesis → normalized LV systolic function without RWMA
Clinical progress

• Medication
  - Perindopril 2mg qd
  - Furosemide 40mg bid
  - Spironolactone 25mg qd

• Fully recovered from acute myocarditis after optimal medical therapy