Mapping and Ablation of Atrial Tachycardia

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Atrial Tachyarrhythmia

- Sinus - - Inappropriate ST
  - Sino-Atrial reentry (Normal P wave)
    - Increased automaticity
    - Focal AT
      - Trigged activity
      - Micro-reentry
    - AT (Abnormal P)
      - Small reentry (Iatrogenic)
- Atrial fibrillation (No P wave)
  - Reentry AT
    - Scar-related macro-reentries
      - Typical AFL (Isthmus dependent)
      - Atrial flutter
        - Non typical AFL (Non isthmus dependent)

Activation Behavior of Different Types of AT

**Macro-reentry**
1. Circuit involving 3 or more segments
2. >75% of the CL is mapped along the circuit
3. Good PPI in 2 opposite segments

**Small reentry**
1. Centrifugal activation
2. >75% of CL is recorded
3. PPI increases with increasing distance from the source
4. Good PPI in only one segment

**Micro-reentry**
1. Centrifugal activation
2. <75% of CL is recorded
3. PPI increases with increasing distance from the source
4. Good PPI in only one segment
Understanding the Mechanism and Activation Behavior

3-D Mapping can understand:

- Origin (focal)
- Propagation (circuit)
- Voltage (substrate)
- Electrogram (fractionated)
- Conduction velocity (slow conduction)
Setting of the Window of Interest

Focal AT

Macro-reentry

Earliest P
REF : IC
50ms

REF : IC

A
Before
After
95% TCL
Our Experience

TCL

Cycle Length

LEAD II

Reference signal

50ms a b TCL Cycle Length

Pre-reference = \( a + 50 \text{ ms} \)
Post-reference = \( b = 95\% \text{TCL-Pre} \)
Focal AT (Activation mode)

- Centrifugal activation
- Whole chamber activation time < 75% TCL
- Only entrainment at the origin: PPI = TCL
- Fractionated electrogram at the hot spot if localized reentry
Mapping strategy

- Earliest site surrounded by the later activation.
- Can map using “leap frog” method.
- Unnecessary to map the whole chamber.
Distribution of Focal AT

Total RA 144 (73%)
- CT 62 (31%)
- Perinodal 22 (11%)
- R. septum 3
- CS os 16 (8%)

RAA 3 (0.6%)

Total LA 52 (27%)
- PV 35 (19%)
- LAA 2 (0.6%)
- LA roof 1
- CS body 3 (2%)
- L. septum 3 (0.6%)

Anatomic distribution of mitral and tricuspid annular atrial tachycardias

Full Knowledge of the Anatomical Neighbor Structure

Ouyang et al. JACC; 2006
Ouyang et al. JACC; 2006
RA anterior septal RF
NCC RF delivery

RF on
RA posterior wall earliest potential
Target at right inferior PV ostium
Successful Catheter Ablation of a Focal Atrial Tachycardia From the Ascending Aorta: A Novel Location and Approach
Minglong Chen, Bing Yang, Matthew Wright, José Angel Cabrera, Weizhu Ju, Hongwu Chen and Kejiang Cao
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Schematic demonstration of this novel activation

Spatial difference = 1.5 cm
Time difference = 47 ms
Macro-reentry AT

**Definition**
- 1. Circuit involving 3 or more segments
- 2. > 75% of the CL is mapped along the circuit
- 3. Good PPI in 2 opposite segments

**Mapping**
- H: high density
- A: Activation
- V: Voltage
- E: Entrainment

**Ablation Strategy**
- Linear lesion: Substrate based
- Anchors: Anatomical or EP barriers
- Additional substrate ablation: Preventing future ATs
Most of macro-reentry ATs are scar-related

Scar-related AT

- Surgical
- Post AF ablation
- Unexplained (Atrial Cardiomyopathy)

Stevenson IH, et al. Heart Rhythm, 2005
A: Scar AT
B: Scar flutter
C: Figure of “8” AT
Unexplained LA anterior wall scar Mediating macro-reentries

- No AF history
- Spontaneous LA macroreentries

Peri-mitral atrial flutter: personalized ablation strategy based on arrhythmogenic substrate

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Aims The aim of this study is to characterize the arrhythmogenic substrate for peri-mitral atrial flutter (PMAFL), thereby determining a personalized ablation strategy to treat PMAFL.

Methods and results Thirty-six consecutive PMAFL patients (mean age: 63.8 ± 11.3, 23 males) underwent detailed three-dimensional electroanatomic mapping in left atrium (LA). The LA was divided into septal-anterior wall (SAW), posterior inferior wall (PIW), and mitral isthmus (MI) region, respectively. Ablation strategy was determined based on the endocardial bipolar voltage map. Based on electrophysiological substrates, 10, 17, and 9 cases were classified into iatrogenic, spontaneous, and no-substrate PMAFL, respectively. The mean voltage in SAW was significantly lower in spontaneous PMAFL (iatrogenic: 1.07 ± 0.66 mV; spontaneous: 0.65 ± 0.44 mV; no-substrate: 1.60 ± 0.53 mV, P <0.001), while iatrogenic PMAFL patients had the lowest voltage in MI (0.51 ± 0.23 mV vs. 1.55 ± 0.78 mV, 1.61 ± 0.56 mV, P <0.001). No low-voltage or slow conduction zone was found in the no-substrate PMAFL group. Fifteen spontaneous PMAFLs were successfully terminated by modified septal-anterior (9/10) or conventional anterior ablation line (6/7). Eight iatrogenic PMAFLs (8/10) were terminated by reinforcing the previous ablation areas. Cardioversion without PMAFL ablation was done in no-substrate PMAFL patients. After a median follow-up of 12 (7–39) months, two spontaneous PMAFL patients received redo procedures for recurrence due to “gap” conduction.

Conclusions The ablation strategy for PMAFL patients should be based on the arrhythmogenic substrate, but not the indiscriminate MI ablation. No-substrate PMAFLs during AF ablation could be monitored after cardioversion and might not need further ablation.
Classification of Peri-mitral AFL

- Iatrogenic: I-PMAFL
  - Previous lesion placement at LA body

- Spontaneous: S-PMAFL
  - Unexplained LA scar

- No substrate: N-PMAFL
  - Often during AF ablation, caused by electrical remodeling
How to design the ablation line !?
0.15mV 45ms
0.13mV 35ms
0.33mV 32ms
0.41mV 20ms
0.13mV 18ms
0.24mV 38ms
0.67mV 32ms
0.10mV 20ms
0.28mV 28ms
0.10mV 20ms
0.33mV 32ms
0.67mV 32ms
0.15mV 45ms
0.13mV 35ms
0.24mV 38ms
0.13mV 18ms

SAW: 0.95m/s
MI: 0.91m/s
PW: 0.57m/s

PMAFL - 病例 3: 左房广泛消融术后

TCL: 210ms

Proximity to Endo-liner 28: -0.5 mm (Neg -10)

B

A

LAP: 3.9m/s

I-PMAFL TCL=207ms
Welcome to Nanjing!