Essential elements to increase efficient use of remote magnetic navigation

Use in conjunction with established best practices in EP ablation to evaluate outcomes

Ischemic VT Ablation Procedures

Set Up

- In the absence of a septal defect or other patient limitations, an antegrade/trans-mitral approach for Ischemic VT is favorable for magnetic catheter manipulation.

- Employing an 8.5F "Mullins style" curve or large curve steerable sheath, direct the sheath tip toward the mitral valve, resting at the plane of the mitral annulus. This sheath tip position at the valve allows for maximal stability and efficiency in mapping the left ventricle (LV). For example, this sheath position prevents the catheter tip from inadvertently re-entering the LA.

- A retrograde approach can impede stability of the magnetic catheter shaft, resulting in possible difficulty maintaining catheter location in the aorto-septal, aorto-basal or mitral-annular areas. Additionally, catheter advancement and retraction can become less responsive due to proximal catheter prolapse caused by significant catheter length outside of the sheath. If retrograde approach must be used then extending a long sheath close to the aortic valve can reduce limitations caused by too distal a sheath tip position.

- Position the CARTO® 3 system patches, location pad, and six dots such that the entire LV is centered. This position is normally further to the patient's left and more inferior than the position used for other chambers of the heart. This positioning helps prevent the catheter icon from disappearing on the 3D screens if the catheter travels outside the six dot registration area.

- Register to the *CARTO* 3 system with the catheter positioned at the mitral valve to facilitate automation.

Mapping

- Reproducing the manual mapping approach with a magnetic catheter will yield a map with an extremely high level of detail. This allows for optimal employment of Navigant® software's automated features when diagnosing scar areas and delivering subsequent treatment.

- Employ the following process to map the LV:

    1. Using *Navigant*'s Apex Preset Navigation, employ a 7 mm CAS step size to quickly advance to the LV Apex.

2. With the catheter tip oriented inferiorly on a 45° tangent, adjust CAS step size to 2 mm and retract the catheter superiorly towards the mitral valve, continually adjusting the vector to maintain a 45° inferior relationship with catheter tip to myocardium. Both FAM and activation points should be obtained as the map is created.

- Once the catheter is fully retracted back to a basal plane, repeat steps 1 and 2 in several geometric planes until a full circumferential map is obtained.

- Retract the catheter from apex to sheath, additional mapping points may be obtained by moving the vector laterally in small movements, maintaining the same catheter tip orientation to myocardium. If catheter movement is thwarted by anatomical obstruction, return catheter tip to original plane, and/or retract CAS in 2mm increments to navigate around obstruction.

Important Notes:

1. Lateral vector movements significantly away from the original plane of retraction can result in frequent and inefficient encounters with anatomical obstruction(s). These encounters may lead to excess vector movement and a perceived lack of catheter control.

2. Specifically, in mid chamber mapping, lateral movements will be obstructed by the valve apparatus. Re-set the catheter approach to a mid chamber superior position (radial), and repeat more frequently to obtain a complete map.

    - Upon completing mapping of the chamber body, it may be necessary to anchor the catheter in the apex in order to fully map the infero-mitral/basal aspect of the LV. To achieve this anchor point, orient the catheter tip superiorly with vector directed towards the basal target. Use a 7 mm CAS step size, and advance the catheter until a loop forms proximally in the apex. Evidence of adequate catheter advancement will be visualized when the catheter tip is freed from the basal myocardium and superior catheter movement can be freely achieved.

Treatment

- A primary value proposition of magnetic navigation is the ability to duplicate existing treatment approaches for challenging arrhythmia.

- Physicians typically utilize either a "homogenization approach" or a linear RF strategy to eliminate all potentials within the scar or prevent potentials from exiting into the healthy myocardium.

- Physicians experiencing magnetic procedure time equivalent to their manual approach report using power settings in a range between 45 and 50 Watts, advancing the catheter when desired EGM attenuation is achieved.

- Magnetic navigation strategies for each treatment approach are detailed below:

  - Homogenization approach:
    - Start with the catheter tip in the center of the scar.
    - Position the map view with the catheter and vector in the center of the screen.
    - Use the keypad set on 5° vector movements and 1mm CAS step size.
    - Systematically position the catheter tip between RF applications from the center to each edge of the scar as desired to completely cover the scar with RF application spots.

  - Linear approach:
    - Encircle the scar with a durable contiguous lesion set to prevent signal exit from within the scar. Ablation history should be employed to effectively identify any gaps or areas of sub-optimal RF delivery.
    - Utilize design line to encircle scar and provide an "automated assist" to navigate the scar border.

Confirm Treatment Effect

- Confirm acute endpoint according to standard EP practice. Ablation History data in *Navigant* and the magnetic catheter tip can assist in this process.

- If gaps in treatment exist, use Ablation History data in *Navigant* to assist in identifying these areas. Subsequently, employ automated features such as Click-and-GO, Go To Electrode, Target NaviLine, and Anatomical Presets to quickly reach the gap area for further treatment.

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Mastering Micro-movements with Magnetic Catheters

If more than two vector moves are employed without associated tip response, remove the vector input(s) to eliminate high amounts of stored energy. Subsequently, retract the catheter until the attitude of the tip changes, and then re-apply the desired vector.

If more than two CAS moves are employed without associated tip response retract CAS inputs until the attitude of the tip changes, and then adjust vector to regain tip control.

CARTO 3 System FAM Mapping Resolution Settings with Magnetic Catheters

Physicians who are expert in the use of the *CARTO* 3 system with magnetic catheters and FAM mapping state that they prefer a FAM resolution of 16 or 17. Resolutions lower than 16 produce excessive interpolation between independent catheter positions resulting in a map that looks complete but lacks sufficient fidelity. Conversely, resolutions greater than 17 produce a high fidelity map but display many holes in the map surface unless additional time is taken to ensure all independent catheter positions are close enough to each other to fill holes. Thus, selecting a FAM resolution of 16 or 17 best supports efficiently creating a high fidelity map.

Variables Influencing Efficient Ablation with a NaviStar® RMT ThermoCool® Catheter (power, time, force)

- When using a magnetic catheter, the amount of force applied to the tissue remains relatively constant throughout the cardiac cycle at a median level of approximately 10 grams[1].
- With this relatively constant level of force, the remaining variables that can be adjusted are power and time. Increasing power (rather than time) is the most efficient way to heat tissue to desired temperature levels.
- During manual ablations, physicians have the ability to increase force if initial RF energy applications result in rising edema. Physicians who are expert in magnetic catheter ablation minimize risk of edema by increasing power during the ***initial*** delivery of RF energy.
- With more than 75,000 Stereotaxis magnetic procedures completed to date, increasing power is common best practice of physicians.

[1]Nakagawa et al., 2014 AF Symposium