

## DISTINGUISHED TEACHER GOLDEN LIONEL AWARD



## LECTURE

The Continuing Challenge of Catheter Ablation for Ventricular Tachycardia WILLIAM G. STEVENSON

## The Continuing Challenge of Catheter Ablation for Ventricular Tachycardia

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# MY CONFLICTS OF INTEREST ARE

- patent for needle ablation consigned to Brigham and Women's Hospital
  - my spouse has received research funding from St Jude Medical

## **Scar-related Reentrant VT Late After MI**



- VT substrate is "stable"
- repeated VT episodes over yrs
- VT is inducible at EP study
- Drug efficacy for prevention is poor



## **Challenges for ablation of scar-related VT**



- Large scars and circuits
  - Endocardial, epicardial, intramural scar locations
- Multiple circuits are common
- Unstable VTs prevent extensive mapping during VT "Unmappable VT"

## INTERNATIONAL VT ABLATION CENTER COLLABORATIVE GROUP (IVTCC)

• 12 International VT Ablation Centers

BRIGHAM AND

- 2,061 patients referred for ablation of sustained monomorphic
   VT due to structual heart disease
- retrospectively analyzed in centralized database

Study period	2002 - 2013
Patients	2061
Age (median)	65 yrs / 87% male
Ischemic CM	53%
LV EF (median)	0.31
ICD	87%

🗃 DOKKYO UNIVERSITY 😈 TEXAS HEART INSTITUTE 🛛 TEXAS CARDIAC ARRHYTHMIA INSTITUTE 🚟 PCDD MCC



Cardios Anhythmia Ceo

#### 70% of patients were free of VT for one year Recurrent VT was associated with increased mortality or need from transplant



The IVTCC Investigators: Freedom From Ventricular Tachycardia after Catheter Ablation Is Associated With Improved Survival in Patients With Structural Heart Disease: Heart Rhythm 2015 (in press) http://dx.doi.org/10.1016/j.hrthm.2015.05.036



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# Complications of VT ablation in structural heart disease

Tung et al Heart Rhythm 2015

Patients	2061
Complications	6%
Death	0.1%
Vascular access	1.6%
Hemopericardium	1.7%
AV block	0.9%
Stroke/TIA	0.5%
coronary injury	0.2%

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# **Ablation Challenges**

- Defining ablation targets

   Scars, Channels, Foci
   (endocardial, epicardial, intramural)
- Achieving adequate ablation

   Adequate lesion size and durability
   Endo, Epicardial, Intramural
   Avoiding sensitive structures
   coronary arteries, valves, phrenic nerve
- Endpoints
  - -Verifying lesion creation
  - -Verifying absence of functioning arrhythmia substrate

Challenges for Catheter Ablation of Ventricular Tachycardia:

# Finding the target

- Unstable VT
  - -Solution?
    - Substrate Mapping during stable sinus or paced rhythm
    - Mapping VT during hemodynamic support



# Substrate Mapping to identify ablation targets during stable sinus or paced rhythm



Endo-Epicardial Homogenization of the Scar Versus Limited Substrate Ablation for the Treatment of Electrical Storms in Patients With Ischemic Cardiomyopathy

#### Dibiase et al JACC 2012





#### **Limited Substrate Ablation**



## Temporary Hemodynamic Support to allow extended mapping during VT



- Feasibility demonstrated
- Benefit is unclear
- Peripheral vascular disease and vascular access complications are concerns
- Potential role: for mapping during VT when substrate guided ablation fails?

Percutaneous Left Ventricular Assist Devices in VT Ablation. Multicenter Experience. Reddy et al Circ Arrh EP 2014. Miller et al. Percutaneous Hemodynamic Support With Impella 2.5 During Scar VT Ablation (PERMIT 1). Circ Arrh EP 2013 Lu et al Catheter ablation of hemodynamically unstable VT with mechanical circulatory support. Int J Cardiol 2013;168:3859

## **Outcome of catheter ablation varies with the type of** heart disease



Tokuda et al Circ Arrhythmia Electrophys 2012

Identification of specific scar / reentry circuit isthmus locations in different diseases are refining ablation strategies and clarifying challenges

# Contrast-Enhanced MRI-Derived Scar Patterns and Associated VT in NICM

#### Example of electroanatomical maps and a 3-dimensional (3D) scar reconstruction.



Piers S R et al. Circ Arrhythm Electrophysiol. 2013;6:875-883

## Nonischemic Cardiomyopathy Sustained Monomorphic VT: Scar location predicts VT morphologies, ablation approach and outcomes

#### **Basal Septal - Antero Septal Scar**



#### Septal ablation is required

Epicardial ablation not usually helpful
 Risk of AV block

Basal lateral LV ablation required





Piers S R et al. Circ Arrhythm Electrophysiol. 2013. Ororiz et al Circ Arrhythm Electrophysiol 2014;

# Tetralogy of Fallot: Ablation of anatomically defined reentry circuit isthmuses to treat VT



Ablation of inducible VT + conduction block in targeted isthmuses n = 25Freedom from SMVT 75 Logrank P<0.001 50 25 plete Success No Complete Success 60 after Procedure (months) Patients at Risk **Complete Success** 

#### Kapel and Zeppenfeld et al Circulation Arrhy EP 2014

No Complete Success



3D delayed –enhanced magnetic resonance sequences improve conducting channel delineation prior to VT ablation Andreu et al Europace 2015



## Achieving Permanent Ablation Lesions Remains a Challenge

**Recovery of inducible VT 3 days after ablation** Noninvasive stim (NIPS) 3 days after ablation



Modified from Frankel et al JACC 2012

## **Anatomic obstacles to ablation**

### Deep intramural reentry circuits



### **Epicardial coronaries and fat**



# Options When Endocardial Catheter Ablation Fails

- Percutaneous epicardial ablation
   Often needed for ARVC, nonischemic CM
- Surgery limited availability
- Transcoronary ethanol ablation useful in 1-2% of pts
- Bipolar ablation
- Needle catheter ablation (investigational)



# Catheter Ablation of Ventricular Tachycardia

- There has been substantial progress
- Significant challenges remain
  - -Targeting intramural sustrate
  - -Achieving permanent ablation lesions
  - Slowing progressive deterioration of pump function in patients with severe heart disease

**Thank You**