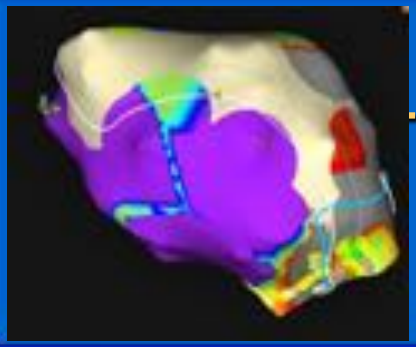
Advanced mapping and ablation of complex arrhythmias:
featuring the present and the future



'ATE OF THE ART IN MORPHOLOGY MAPPING DURING VT ABLATION

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VENICE 2015 ARRHYTHMIAS

DISCLOSURES

- **EUROPEAN ADVISORY BOARD**
  Medtronic Inc
- **INTERNATIONAL EXPERT PANEL**
  Biotronik
- **STRATEGIC BOARD MEETING**
  Sorin Group
- **SPEAKER'S BUREAU**
  Sorin Group
  Boston Scientific
- **CONSULTANT**
  St Jude Medical

➢ The role of catheter ablation in the treatment of ventricular arrhythmias has been changing in the last decade

- *> centers with a VT ablation programme*
- *> patients treated*
- *> complex substrates*
- *> severe heart disease and co-morbidities*
- *> success »» better outcomes*

3D mapping systems
image integration
catheter technology

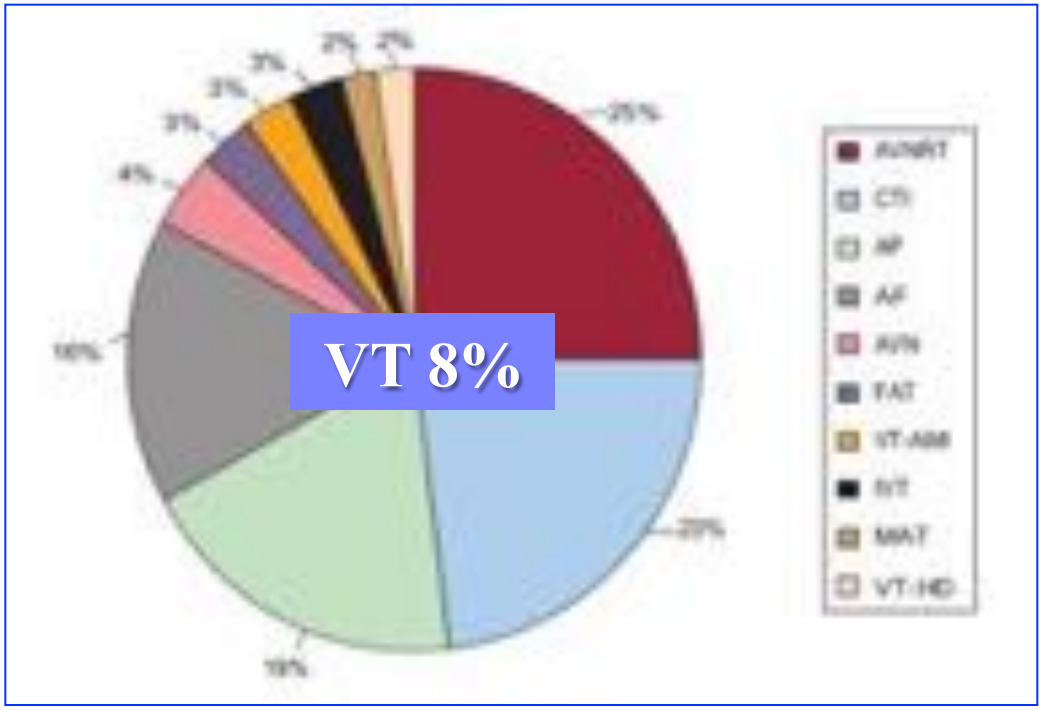
How Do We Manage Patients With Ventricular Tachycardia? An European Heart Rhythm Association Survey

Proclemer, et al. Europace 2013

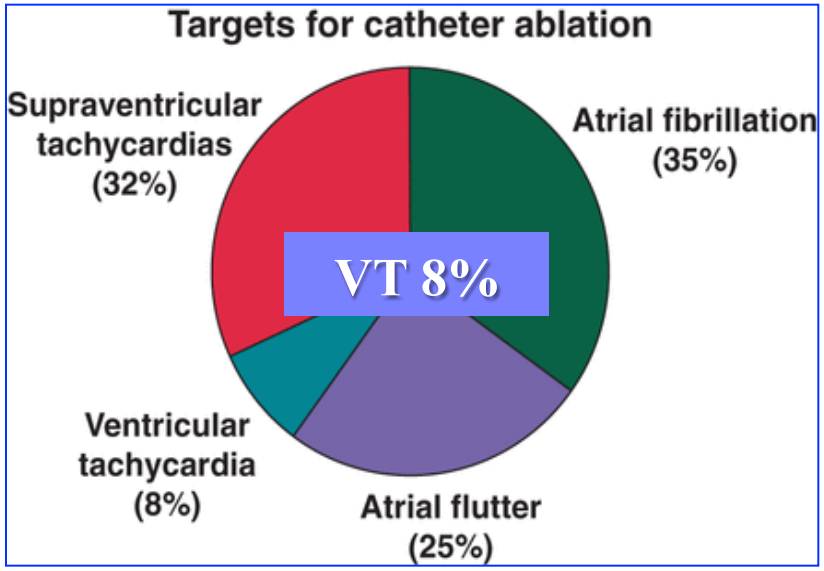
- **45 centers; 20 countries**
- **post-MI (55%), DCM (18%), idiopathic VT (11%), ARVD (5%), valvular disease (4%), hypertrophic cardiomyopathy (4%), channelopathies (4%), infiltrative cardiomyopathies (2%)**

RVOT 69%
LVOT 19%

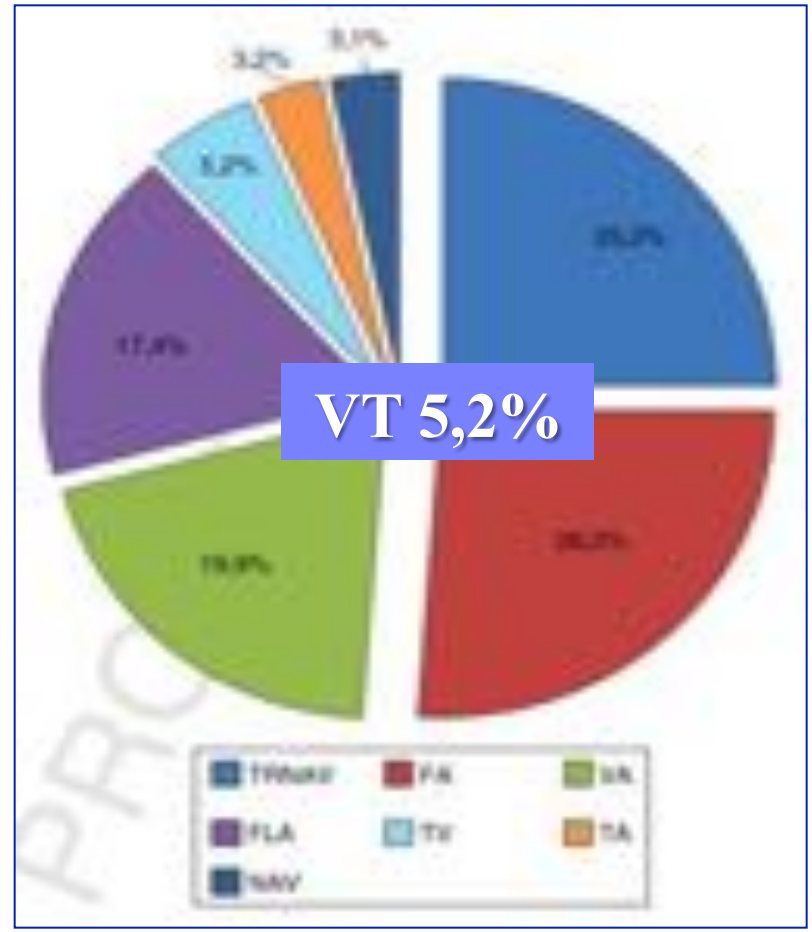
- **Success rate at 1 year follow-up: post MI 68%, DCM 52%, idiopathic RVOT/LVOT 79%**



Diaz-Infante, et al. Spanish Catheter Ablation Registry 2012



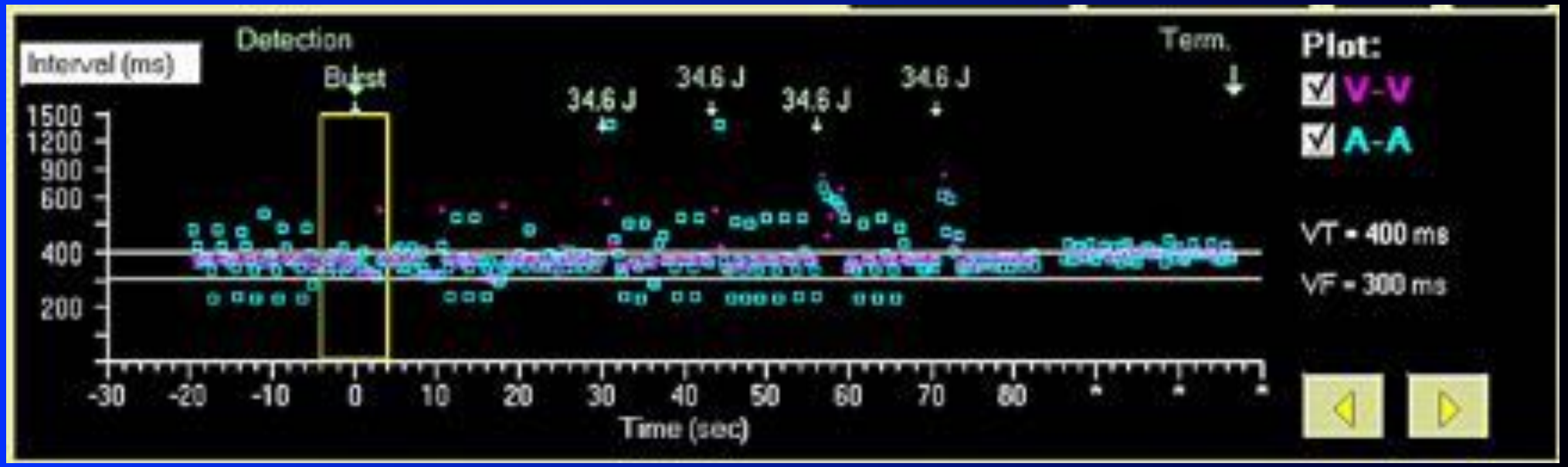
Neuberger, et al. German Survey 2013



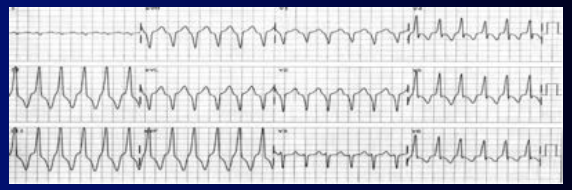
M. Oliveira, et al. Portuguese Catheter Ablation Registry 2012

- VT ABLATION -

- ICDs improve survival and reduce SD in high-risk pts, but **10%-20% experience repeated appropriated device therapies and "electrical storm"**.
- **AADs efficacy has been considered disappointing** and side effects are an important problem.
- **VT ablation can be lifesaving for pts with incessant or frequent VT**.



- Catheter Ablation for the treatment of VT -



- Significant developments in mapping and ablation technologies

  - 3D-electroanatomic mapping »»» substrate-based ablation during SR.

  - 3D-imaging integration (CT, MRI, PET) »» scar maps

  - morphology mapping

  - multielectrode non-contact mapping »» ability to ablate unstable VT/ non-sustained VT/ VEB or non-reproducible VTs.

  - irrigated catheters with contact tools/ needle irrigated RF catheter.

  - epicardial mapping/ablation.

  - percutaneous LV assist devices during VT ablation

*Despite the innovation and options in technology features ...It begins with the **Electrocardiogram and VT morphology***

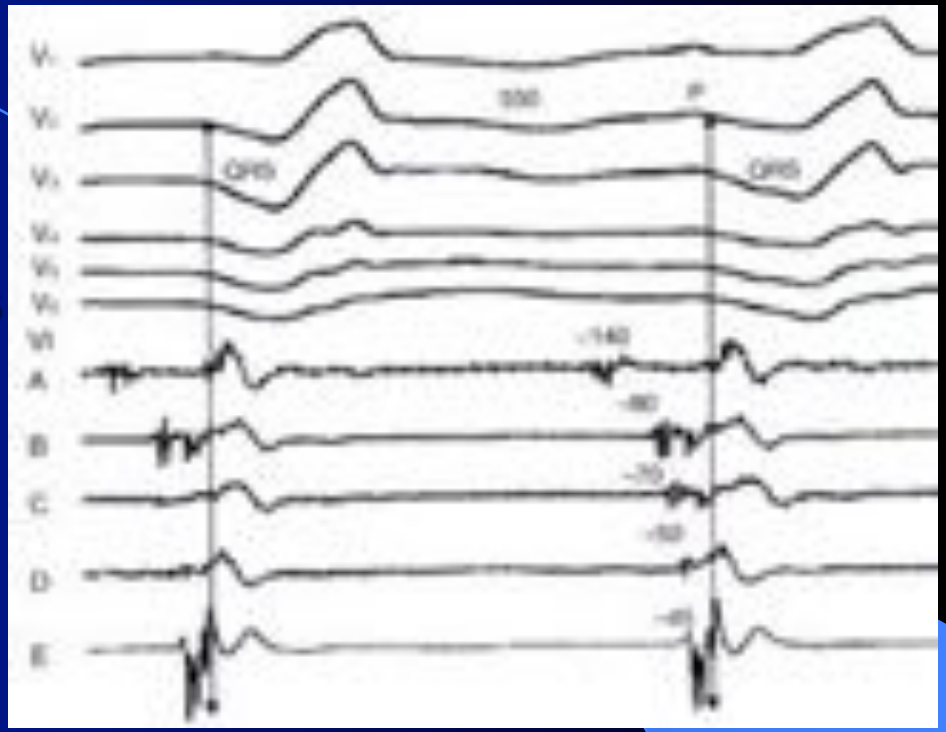
- **RBBB configuration ➔ Left Lateral exit**
- **LBBB configuration ➔ Septal or Right Ventricular exit**
- **Superior axis + positive in aVL and aVR ➔ Inferior wall exit**
- **Positive in inferior leads ➔ Anterior wall exit**
- **Positive pre-cordial concordance ➔ Basal exit**
- **Negative pre-cordial concordance ➔ Apical exit**

- **QS in any lead means the wavefront is moving away from that site**
  - V2-V4: anterior wall, V3-V5: apex, V5-V6: lateral wall

- **The more wider & more slurred the QRS ➔ more likely to be epicardial**

VT Mapping – from conventional to 3D mapping

- *mapping during VT*
  - »»» endocardial activation map
  - »»» low-voltage diastolic potentials (*pre-systolic/mesodiastolic*)
  - »»» entrainment
  - »»» earliest ventricular activation (focal *activity*)



- *<u>pacemapping (morphology)</u>*
- *mapping in sinus rhythm*
  - »»» low-voltage potentials (<1,5 mV), longer duration (>70 ms), late-potentials, fraccionated EGMs

ADVANCES IN MAPPING SYSTEMS FOR COMPLEX ARRHYTHMIAS

Integration with 3D-imaging (CT/MRI/PET)

Simultaneous electro-anatomic maps

Hybrid Contact-Non contact Mapping

High-resolution maps

Auto-mapping systems

Multiple Morphologies Match

Reducing radiation exposure

SUBSTRATE MODIFICATION

↑ SUCCESS RATE

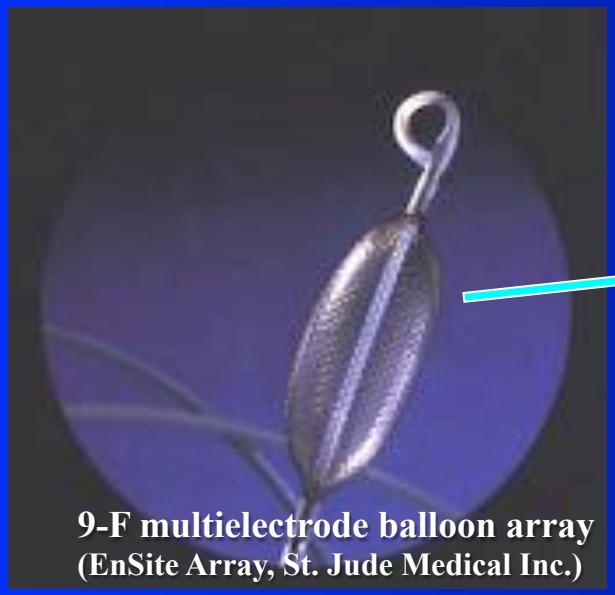
↑ SAFETY

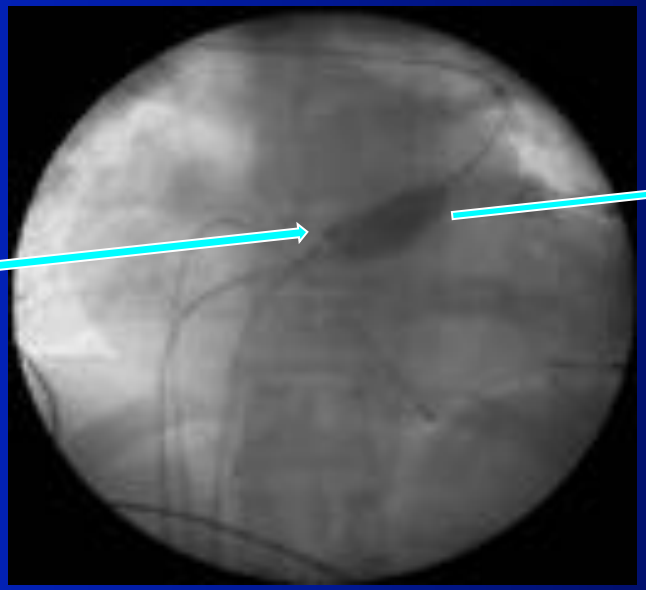
↑ CLINICAL OUTCOME

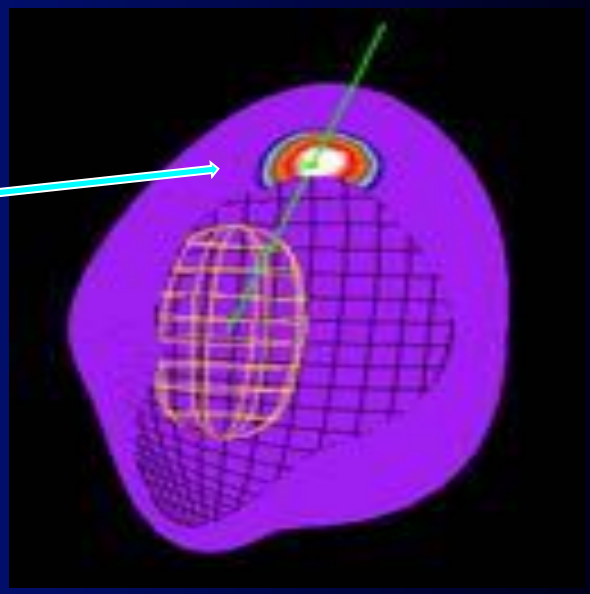
Catheter Ablation of Outflow Tract Ventricular arrhythmias guided by Non-contact System and Morphology Mapping

* In pts without inducible sustained ventricular arrhythmias conventional catheter ablation may be difficult to perform.

* The non-contact mapping system (*Ensite-Array*) allows ablation guided by a single ventricular ectopic complex, with recognized efficacy in the identification of focal activity that may facilitate the procedure.







Unipolar High-Density Non-Contact Mapping System

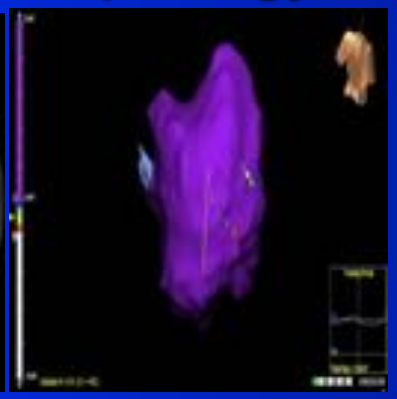
(EnSite 3000; Endocardial Solutions)

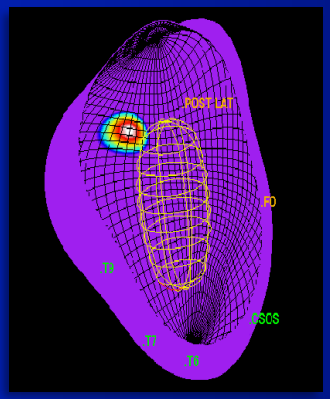
I. 3D reconstruction of ventricular geometry

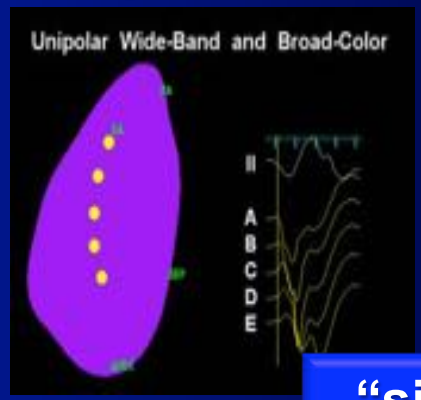
II. acquisition of maps during sinus rhythm and ventricular ectopic beats

III. non-fluoroscopic navegation with the roving catheter

IV. identify a morphology match ≥11/12 + early activation points

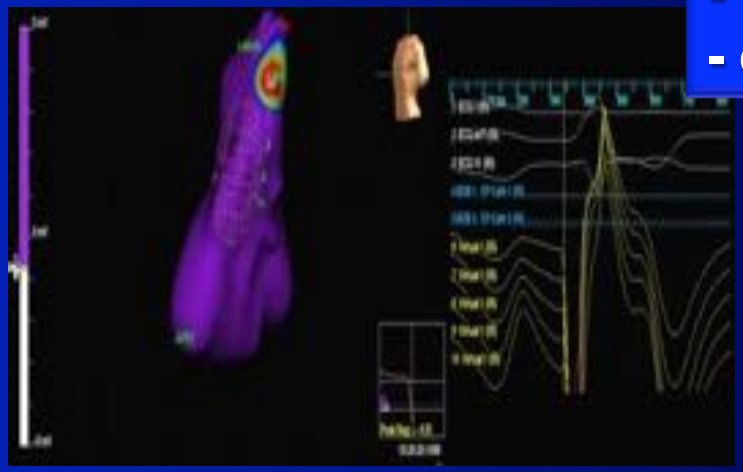






3D reconstruction of the ventricular outflow tract

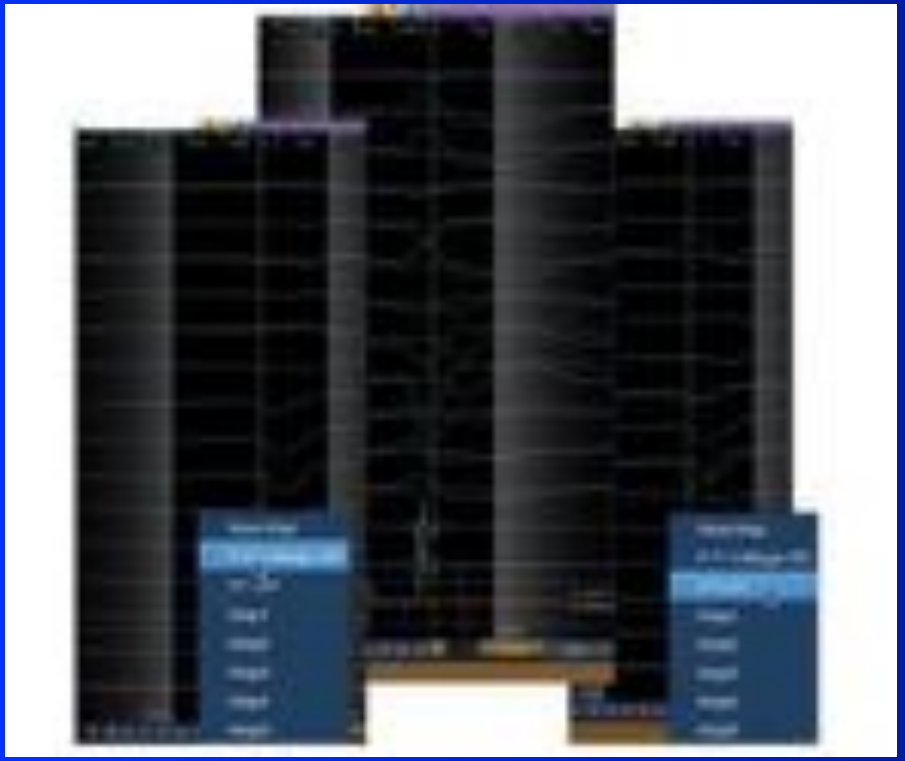
- "single beat mapping"
- endocardial activation



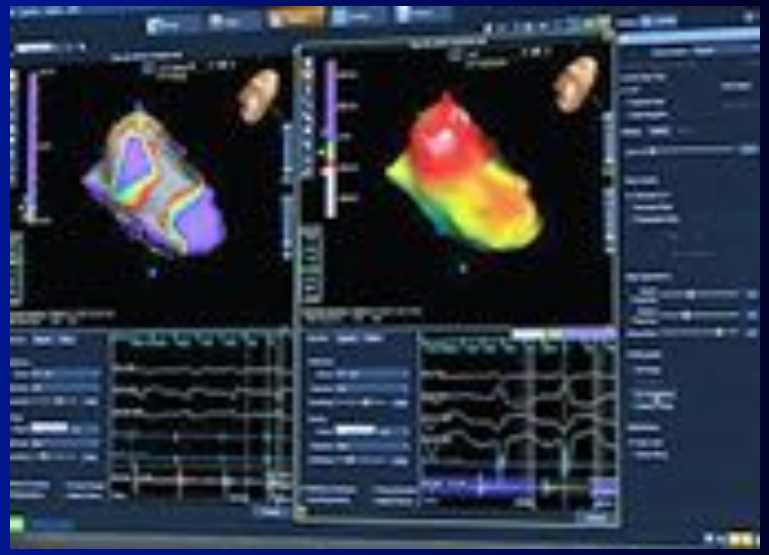
Mapping during spontaneous ectopic activity

activated clotting time maintained ±300 s

MORPHOLOGY MAPPING



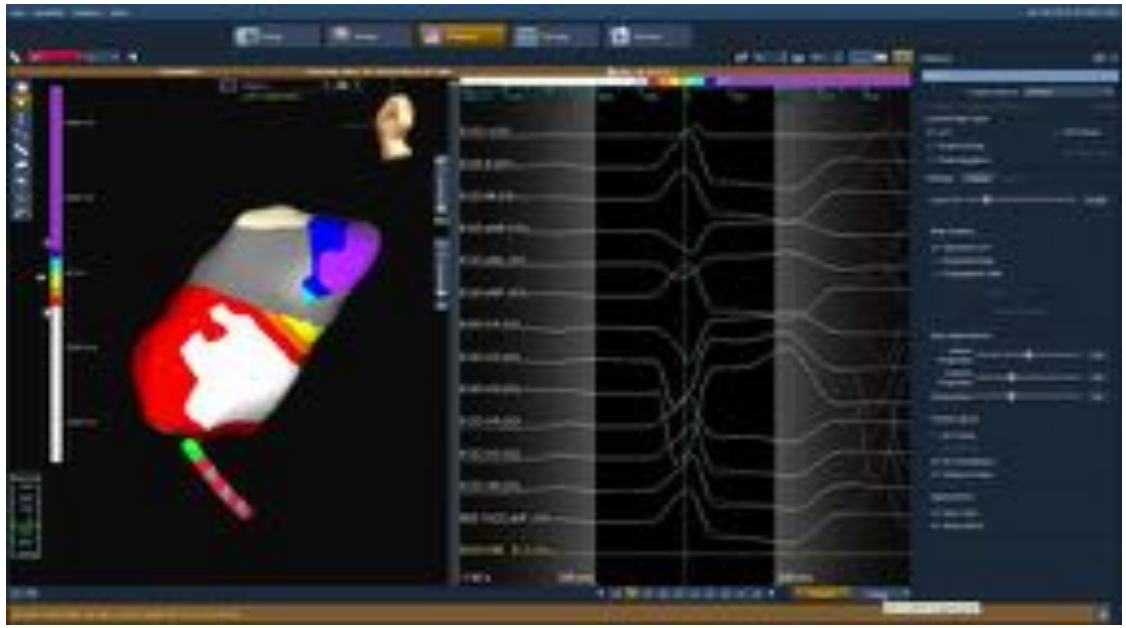
Multiple Morphology Mapping



EnSite™ Precision™ Mapping Module

- compare 12-lead ECGs for faster arrhythmia recognition
- compare current beat to previous beats for faster workflow
- simultaneously view unipole & bipole EGMs for precise timing analysis
- map multiple clinical arrhythmias

Multiple Morphology Mapping



Optimized Multiple Map Capabilities

Save Frozen Point to any Map 1, 2 or 3

- Hovering over map name in map list will display reference shadows for that map in the waveform display
- Helps to identify appropriate map for frozen point using a superimposed comparison to the map shadows
- Load map into map display maintaining the frozen beat

Multiple Morphology Mapping

- Load a different map without losing the frozen beat
- Provides efficient mapping for multiple morphologies
- Eliminates discarding a significant beat that doesn't match the currently opened map
  - Helps to identify appropriate map for frozen point using a superimposed comparison to the map shadows

Multiple Morphology Mapping provides clinical flexibility to change maps quickly with the current beat.

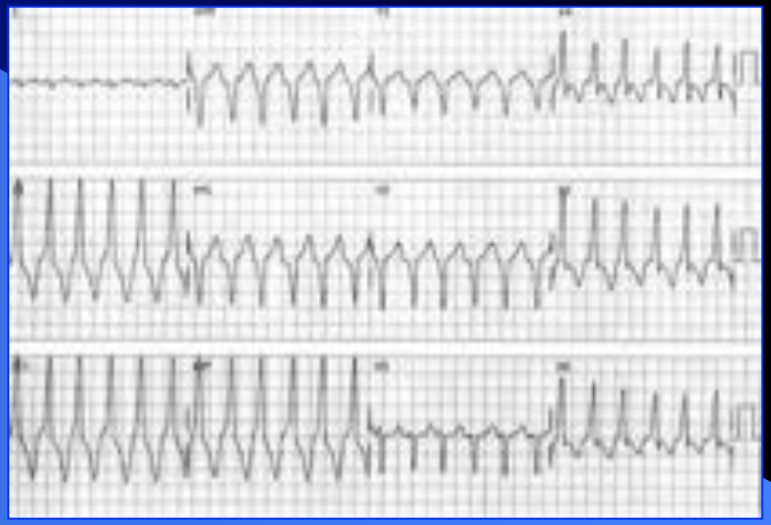
Catheter Ablation of Outflow Tract Ventricular arrhythmias guided by Non-contact Mapping System and Multiple Morphology Maps

Lousinha A, Oliveira M, et al. Rev Port Cardiol, 2014

32 symptomatic pts (27 ♀; 47±17 years)
Sustained VT (n=4)
Nonsustained VT / Frequent VEB - 16293±10511/24 h - (n=27)

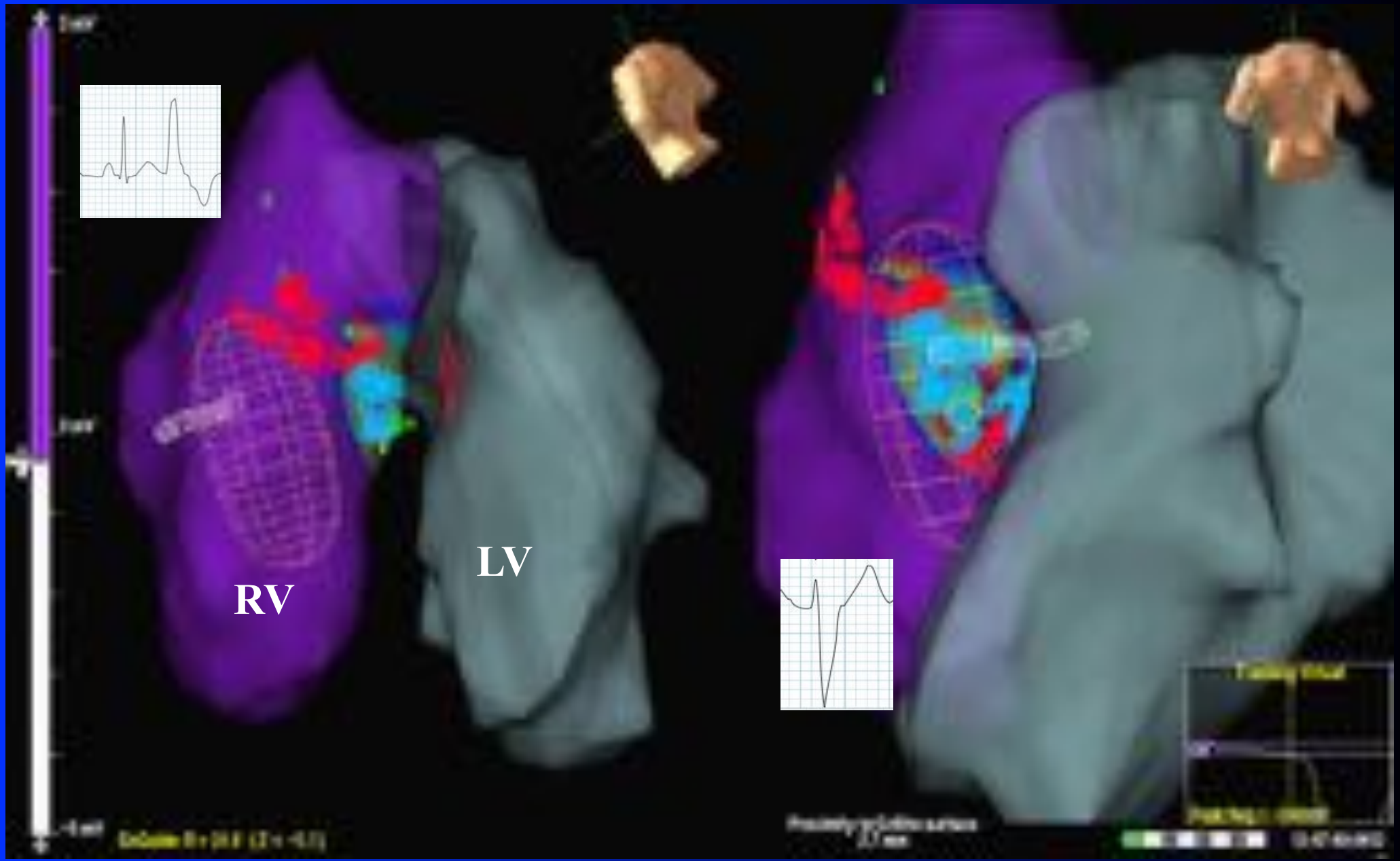
29P without structural heart disease
1P with atrial septal defect surgically corrected
1P had a previous acute myocardial infarction submitted to PCI
1P had hypertension (with LV hypertrophy)

Medication:
B-blocker or verapamil - 26
Amiodarone – 2
Sotalol - 3
Flecainide - 1

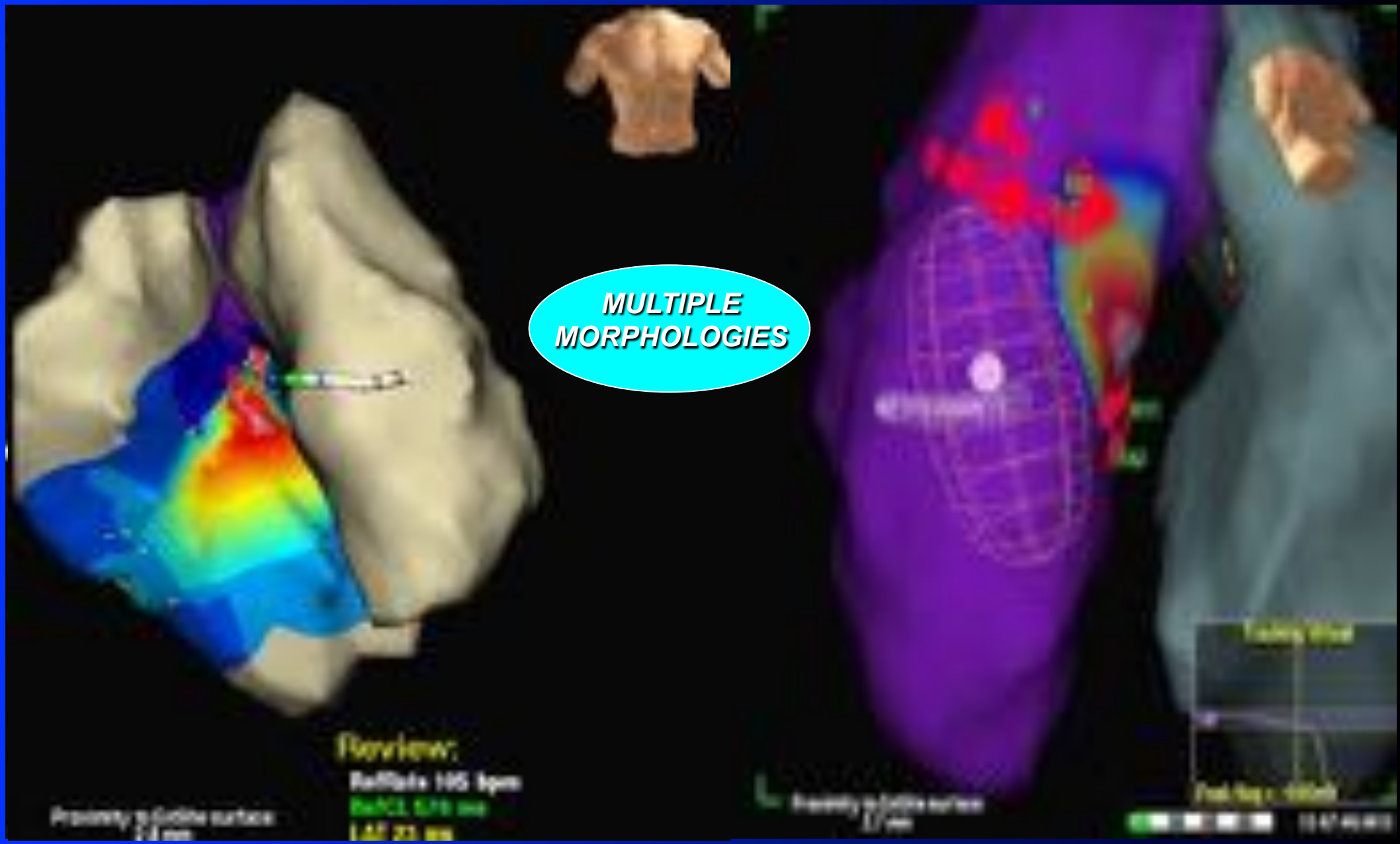


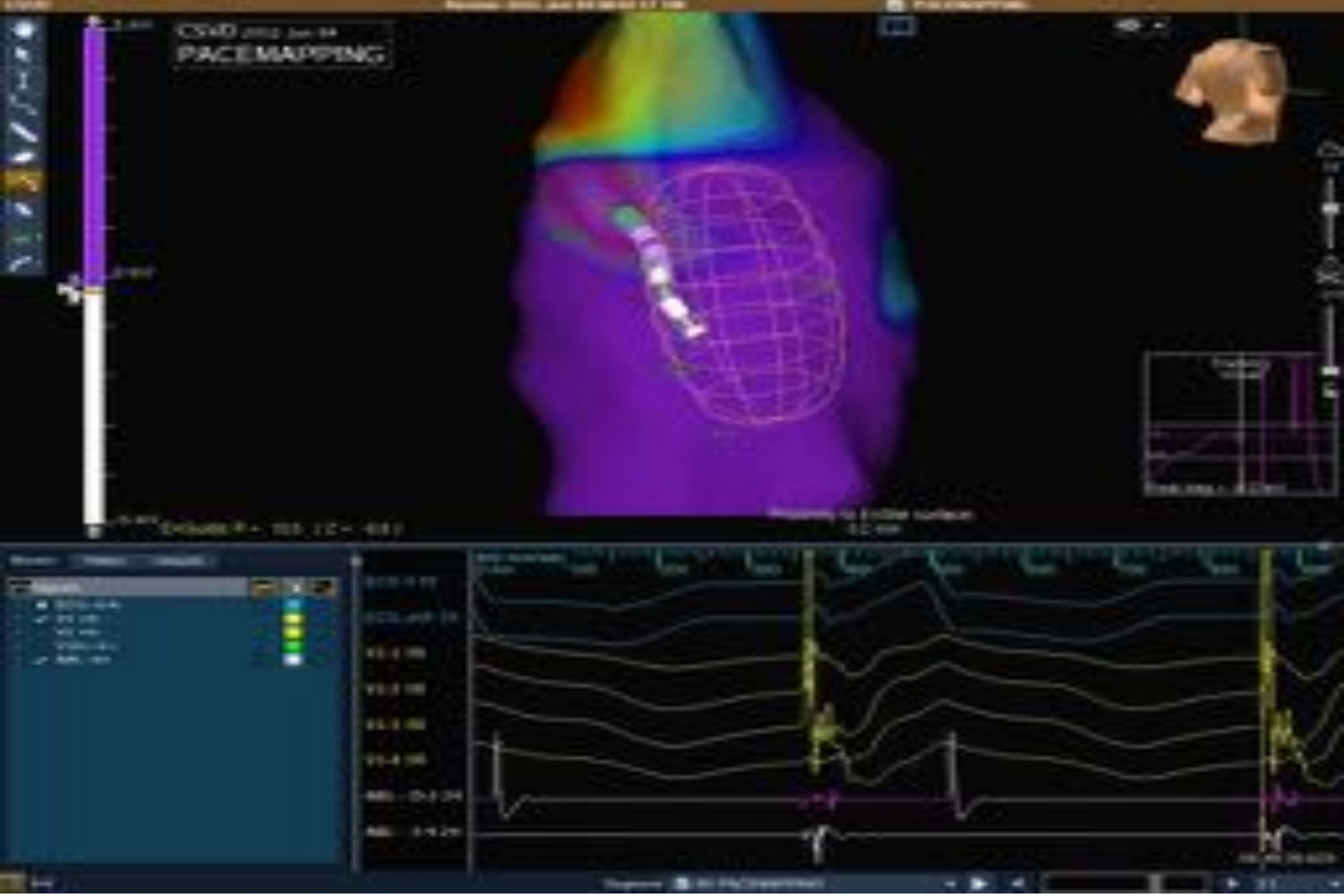
Sustained VT with origin in the RVOT

HYBRID CONTACT-NON CONTACT MAPPING IN VT ABLATION



NAVX ENSITE »» CONTACT-NON CONTACT TO MAP DIFFERENT ECTOPIES




PACEMAPPING

Idiopathic RVOT VEB Ablation

New ectopies in different locations…

Potential for Morphology Match…

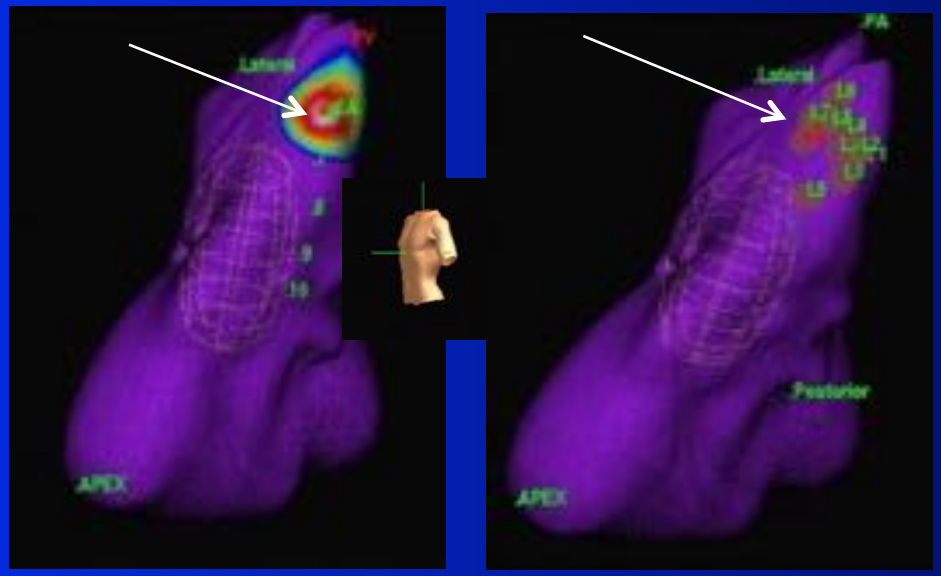
Idiopathic RVOT VEB Ablation

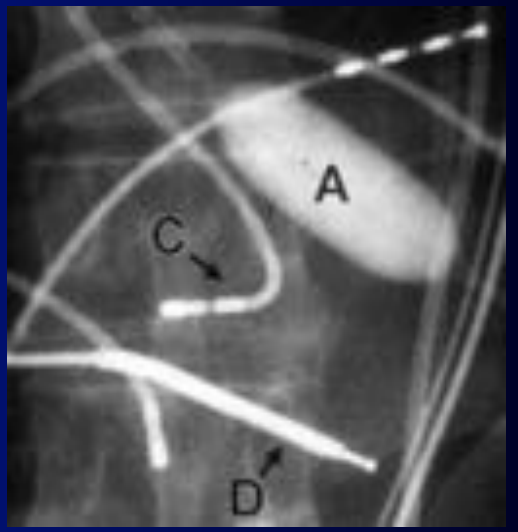
multiple focci in the same area…

… slightly differences in VEB morphology

a potential role for <u>Morphology Match</u>…

Origin of the arrhythmia: RVOT in 26P (81%) and LVOT in 6P (19%)





Radiofrequency: 11±5 RF applications (50w, 60ºC, 60s)

Total duration of the procedure: 120 ± 30 mn; ***Fluoroscopy time***: 18 ± 3 min

Acute success: **the index arrhythmia was eliminated in 28P (88%)**
– no inducibility under isoprenaline perfusion.

Complications: – 2 pericardial effusion, 1 pseudo-aneurysm of the femoral artery

Ablation of ventricular tachycardia in patients with severe left ventricular dysfunction and frequent appropriate ICD shocks: potential benefits of arrhythmogenic substrate modification

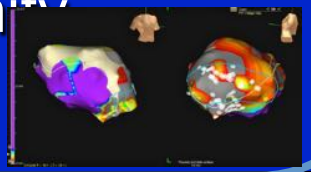
Oliveira M, et al. Rev Port Cardiol, 20145

- **18 men (ischemic cardiomyopathy 82%, 65±12 yrs, LVEF 27±7%)**
- **recurrent episodes of VT and/or arrhythmic storms despite AAD**

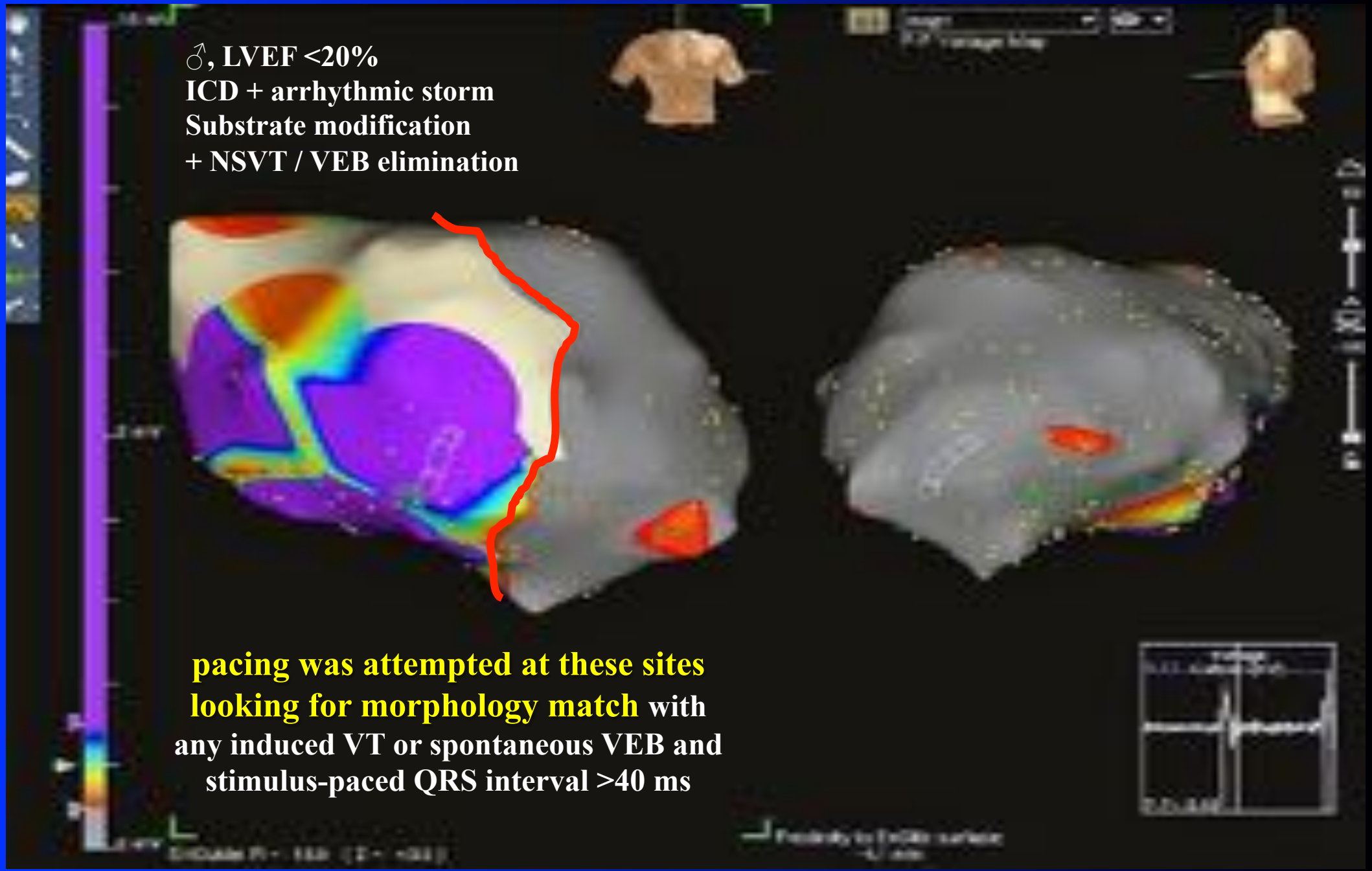
EPS/mapping - ventricular programmed stimulation (600 ms/S3) to obtain baseline VT documentation and confirm hemodynamic intolerance.

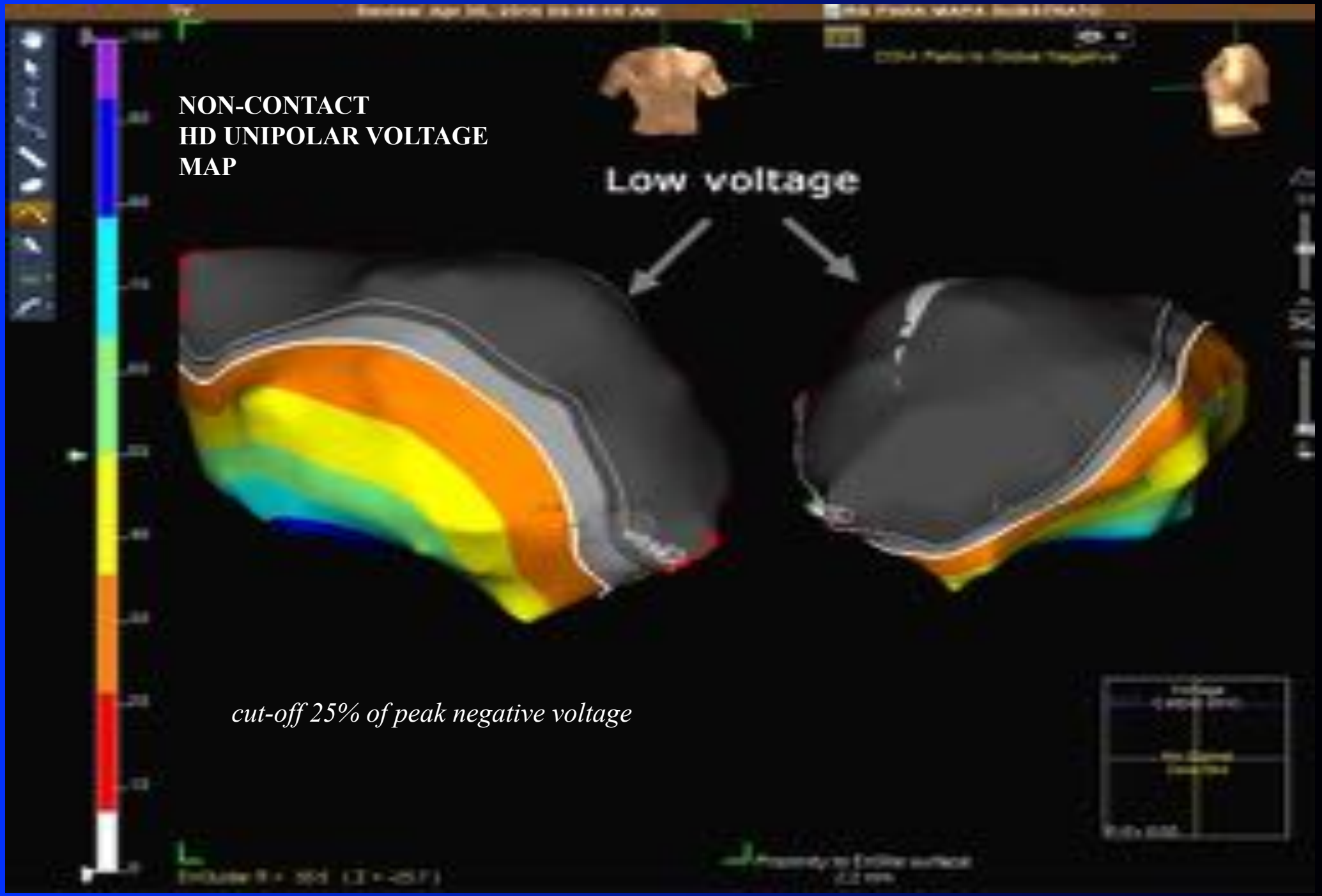
SR voltage map - 3D electroanatomic mapping (*Ensite NavX*) - bipolar and unipolar voltage maps - to delineate areas of scarred myocardium
(BIPOLAR: *ventricular bipolar voltage ≤0,5 mV – dense scar; 0,5-1,5 mV – border zone; ≥1,5 mV – healthy tissue; UNIPOLAR: scar tissue <25% of the maximum voltage)*

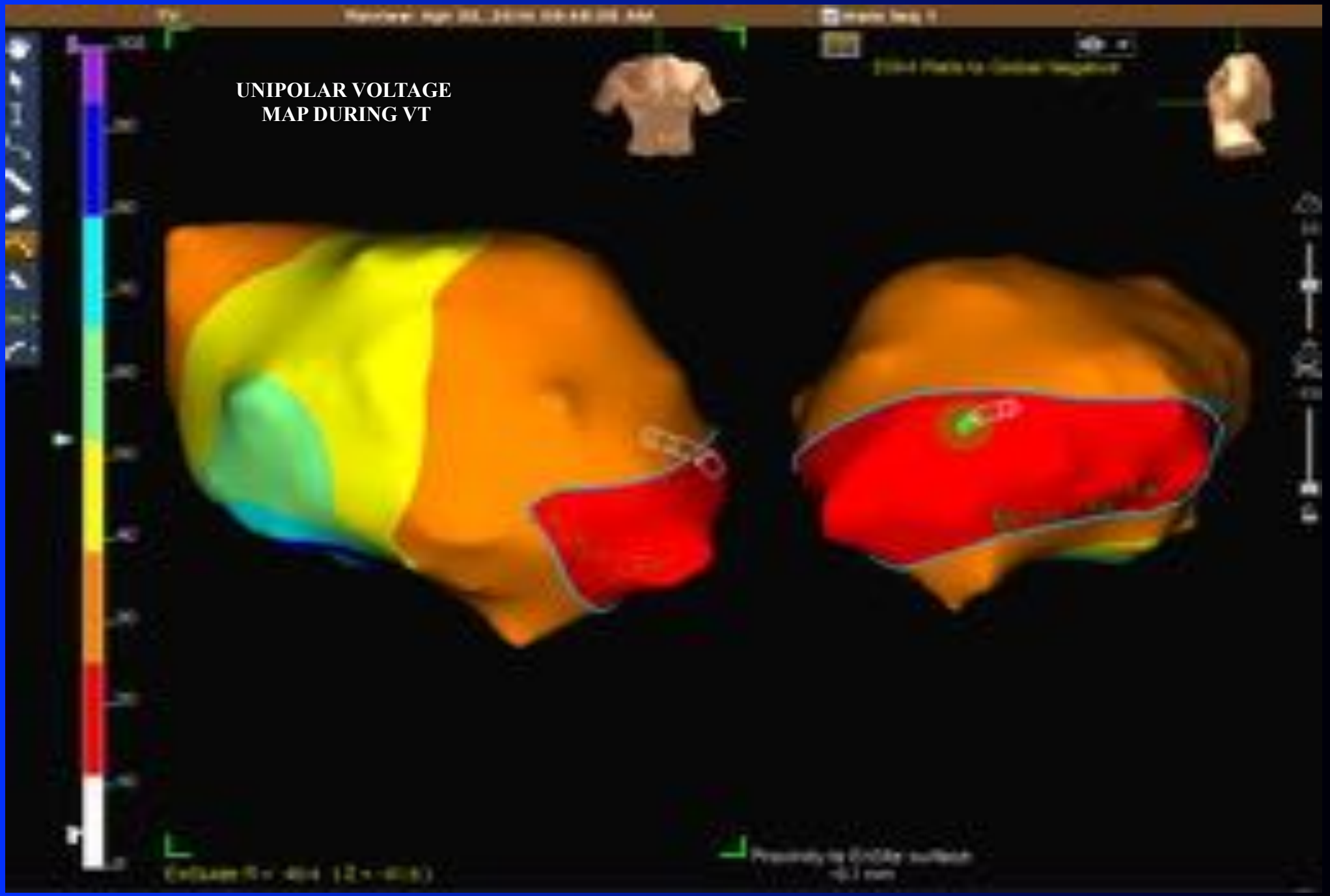
Substrate modification
-catheter elimination of abnormal LV electrograms during SR (*fractionated, splited, low-amplitude/long-lasting, late potentials, pre-systolic*)
-linear ablation based on the findings of scar areas and proximity to anatomic obstacles.
-pace-mapping + morphology match mapping techniques

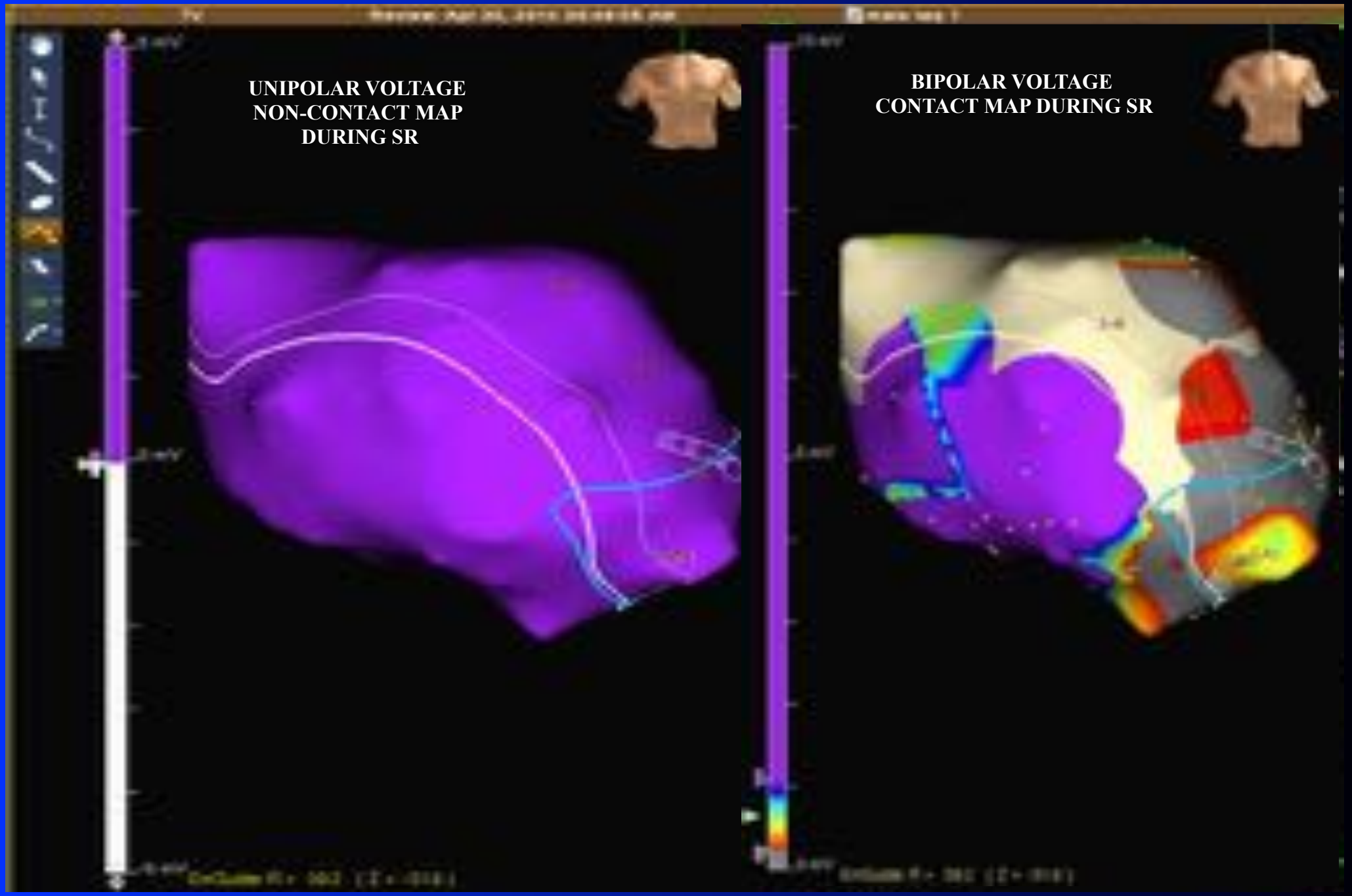


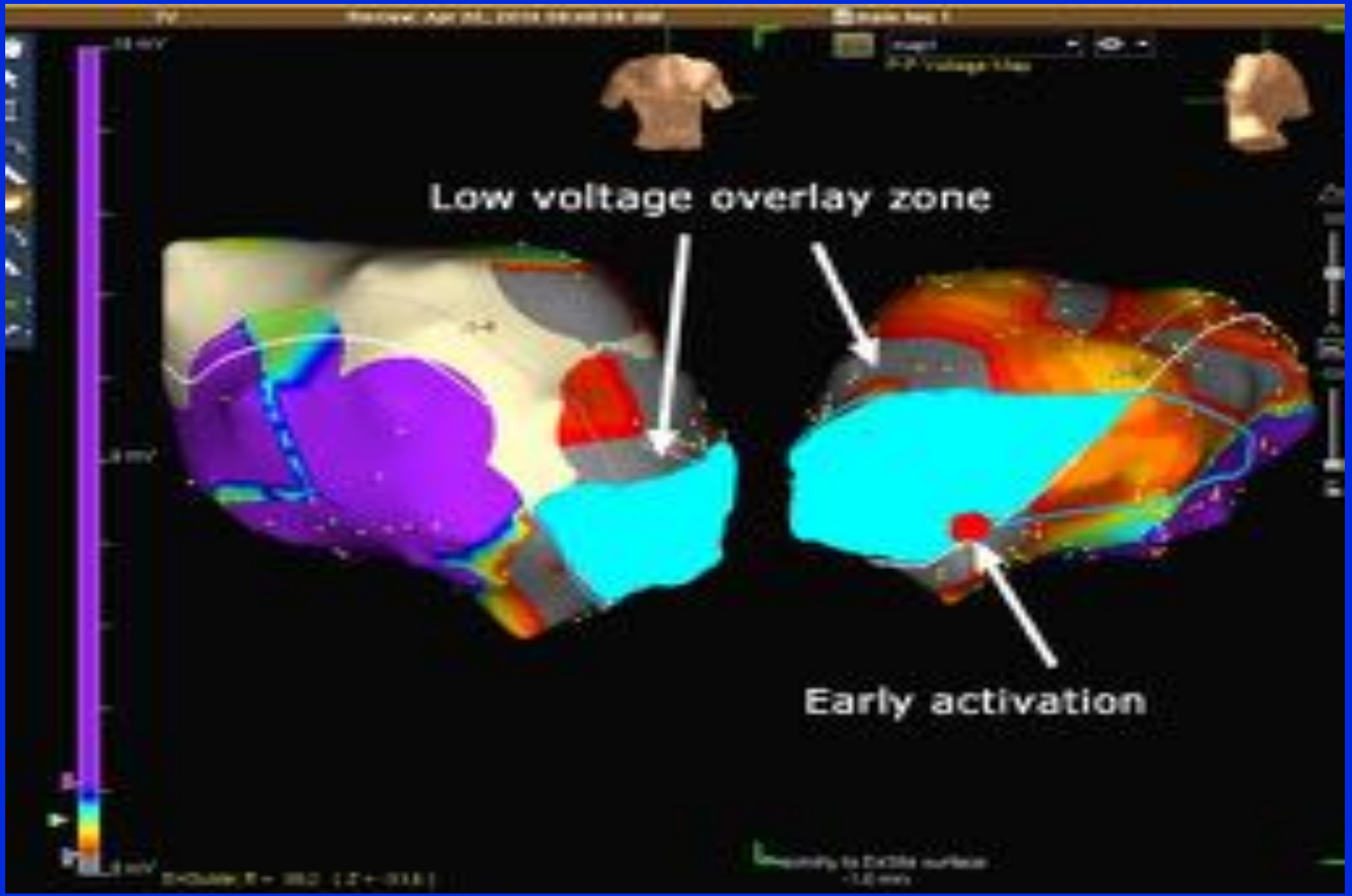
HYBRID CONTACT-NON CONTACT MAPPING IN VT ABLATION

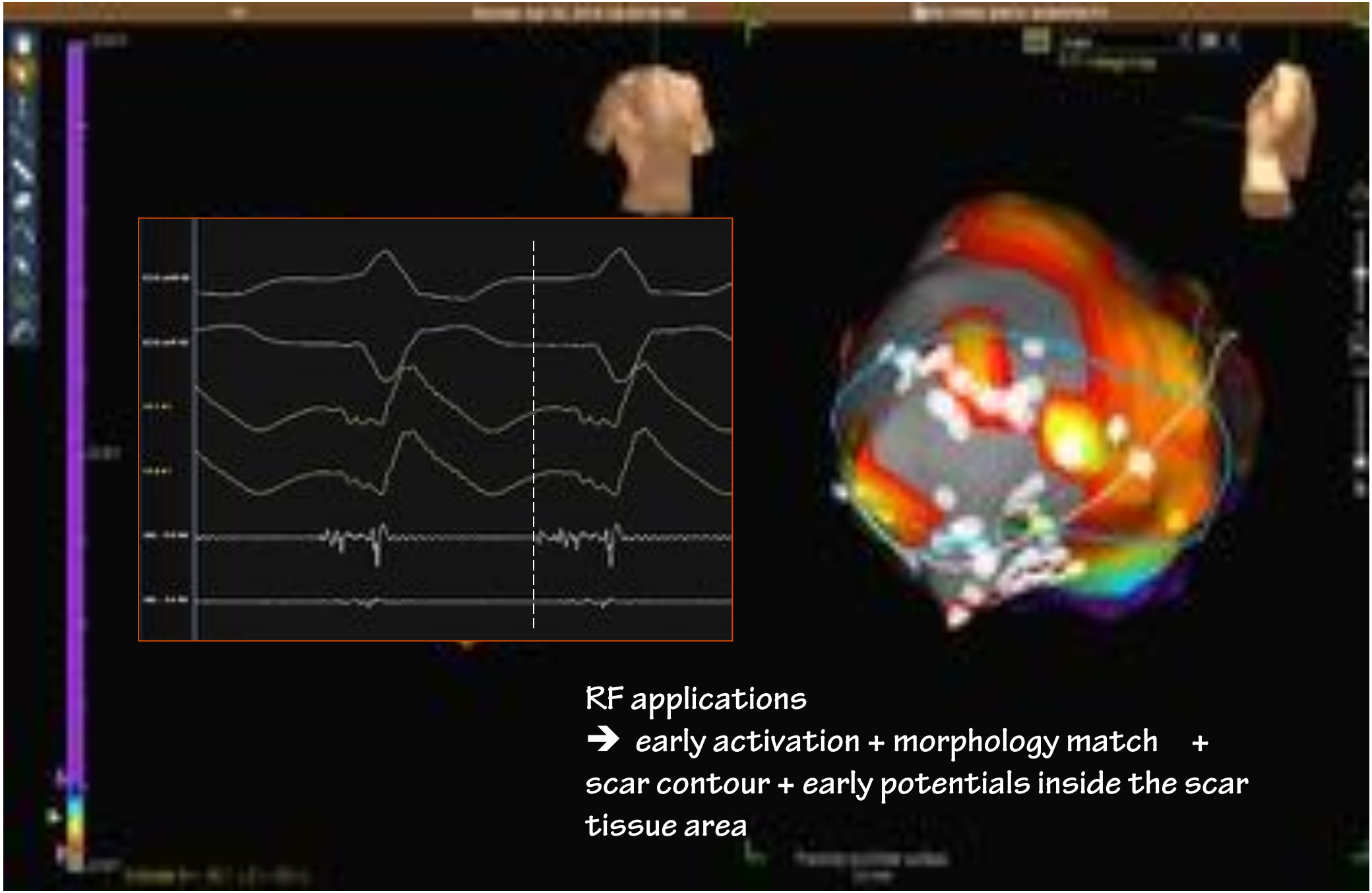



NON-CONTACT
HD UNIPOLAR VOLTAGE
MAP
Low voltage
cut-off 25% of peak negative voltage


UNIPOLAR VOLTAGE
MAP DURING VT


UNIPOLAR VOLTAGE
NON-CONTACT MAP
DURING SR
BIPOLAR VOLTAGE
CONTACT MAP DURING SR


Low voltage overlay zone
Early activation



RF applications

➔ early activation + morphology match + scar contour + early potentials inside the scar tissue area

Results

- VT induced in all P (1-7 morphologies; cycle 300-600 ms)
- LV access via transeptal catheterization (3P) or aortic retrograde approach (15P).
- Pace-mapping match with the induced VT ≥11/12 ECG leads obtained in 50%.
- Abnormal electrograms were identified and ablated in all P.
- Non-inducibility was achieved in 71% of the cases (not performed in 4 cases)
- One pericardial tamponade drained successfully.

- Total duration of the procedure - 130±45 mn.
- Fluoroscopic time - 16±11 mn.
- RF application time - 23±11 mn.

Advanced Mapping - featuring the future

- RAPID AQUISITION OF MAPS
- AUTO-MAPPING SYSTEMS
  (criteria to accept or eliminate points…)
- MULTIPLE MORPHOLOGY MATCH ("QUICK REVIEW")
- SIMULTANEOUS HIGH-RESOLUTION MAPS
- REDUCE RADIATION EXPOSURE

AUTOMATIC RECONSTRUCTION OF SIMULTANEOUS MAPS

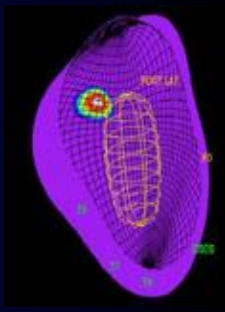
HIGH ACCURACY + LESS TIME-CONSUMING

NO NEED OF REFERENCE CATHETER »» EASY

CONCLUDING REMARKS

Thanks!

- *THE PROGNOSTIC IMPACT OF RECURRENT VT REPRESENTS AN IMPORTANT CHALLENGE IN HEALTH CARE.*
- *THE ROLE OF CATHETER ABLATION TO CONTROL RECURRENT VT HAS BEEN INCREASING IN THE LAST DECADE.*
- *YET, VT ABLATION REPRESENTS A SMALL PERCENTAGE OF ALL EP INTERVENTIONS ("limited" success in SHD, comorbidities, duration/mapping complexity/complications, post-ablation mortality stills high in SHD).*



- *SIGNIFICANT DEVELOPMENTS IN MAPPING AND ABLATION TECHNOLOGIES*
- *MAPPING DECISIONS SHOULD BE INDIVIDUALIZED ACCORDING TO THE PATIENT CHARACTERISTICS AND EXPERIENCE OF THE CENTER.*
- *MULTIPLE MORPHOLOGY MAPPING AND 3D ELECTRO-ANATOMIC HIGH-DENSITY SISTEMS MAY BE AN EFFECTIVE ALTERNATIVE FOR THE ANALYSIS AND TREATMENT OF VTs*
- *NEW STRATEGIES COMBINING DIFFERENT INNOVATIVE TOOLS (QUICK-AUTOMATED-ACCURATED) MAY CONTRIBUTE TO IMPROVE VT MAPPING/ABLATION SUCCESS AND SAFETY.*