Bipolar vs Unipolar mapping for VT

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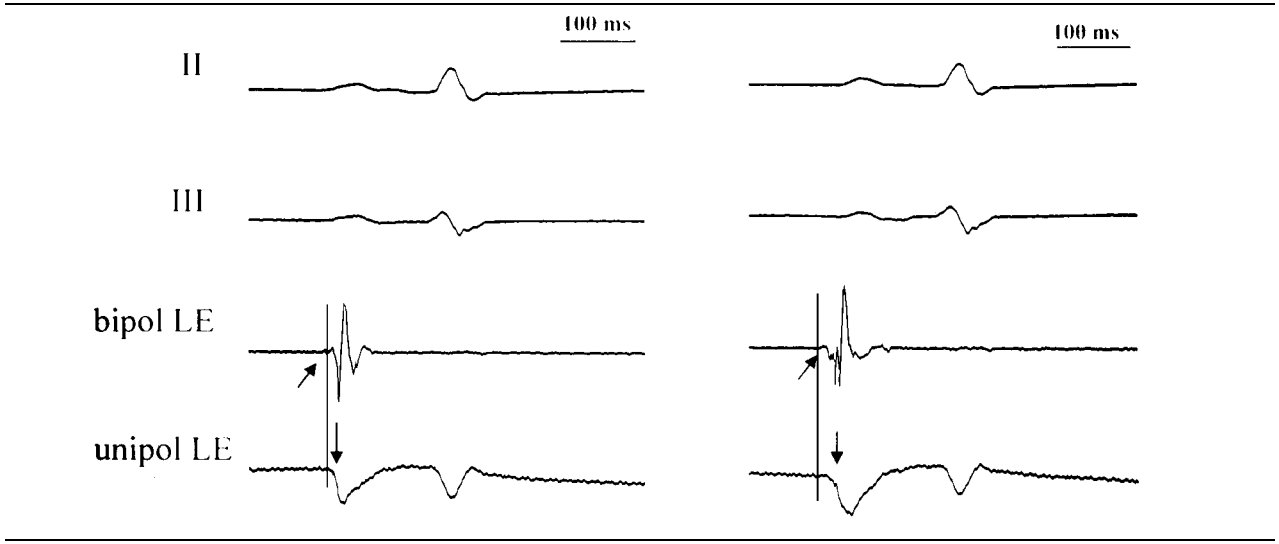
Disclosures

- Research agreements with:
  - Biosense Webster
  - St Jude
  - Medtronic
  - Hansen medical
  - Boston Scientific

Bipolar vs unipolar

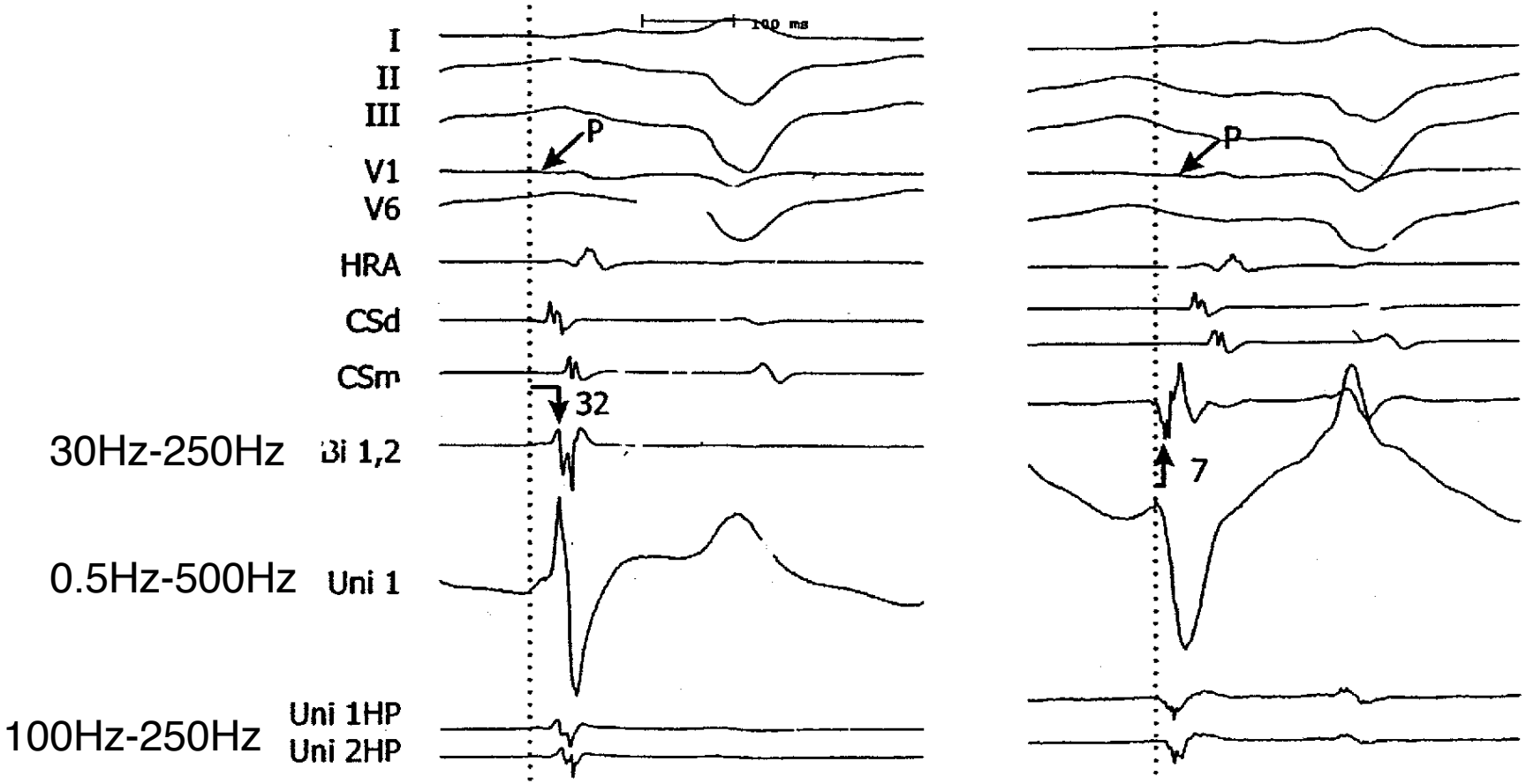
- Bipolar easier to time than unipolar for LAT



Weiss et al JICE 2001

Single catheter mapping of AT

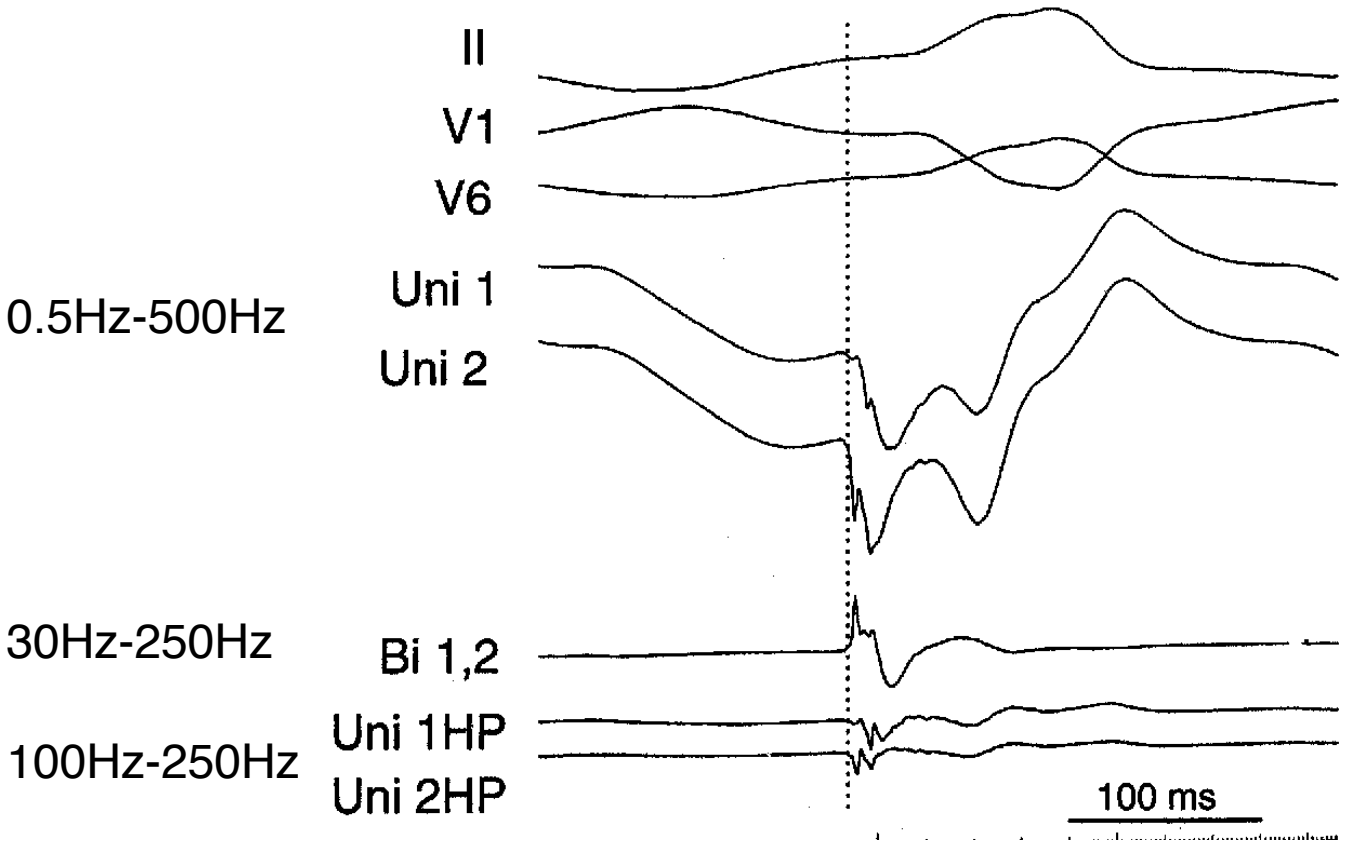
- Unipole marks p wave onset



Delacretaz et al PACE 2001

Single catheter mapping of AT

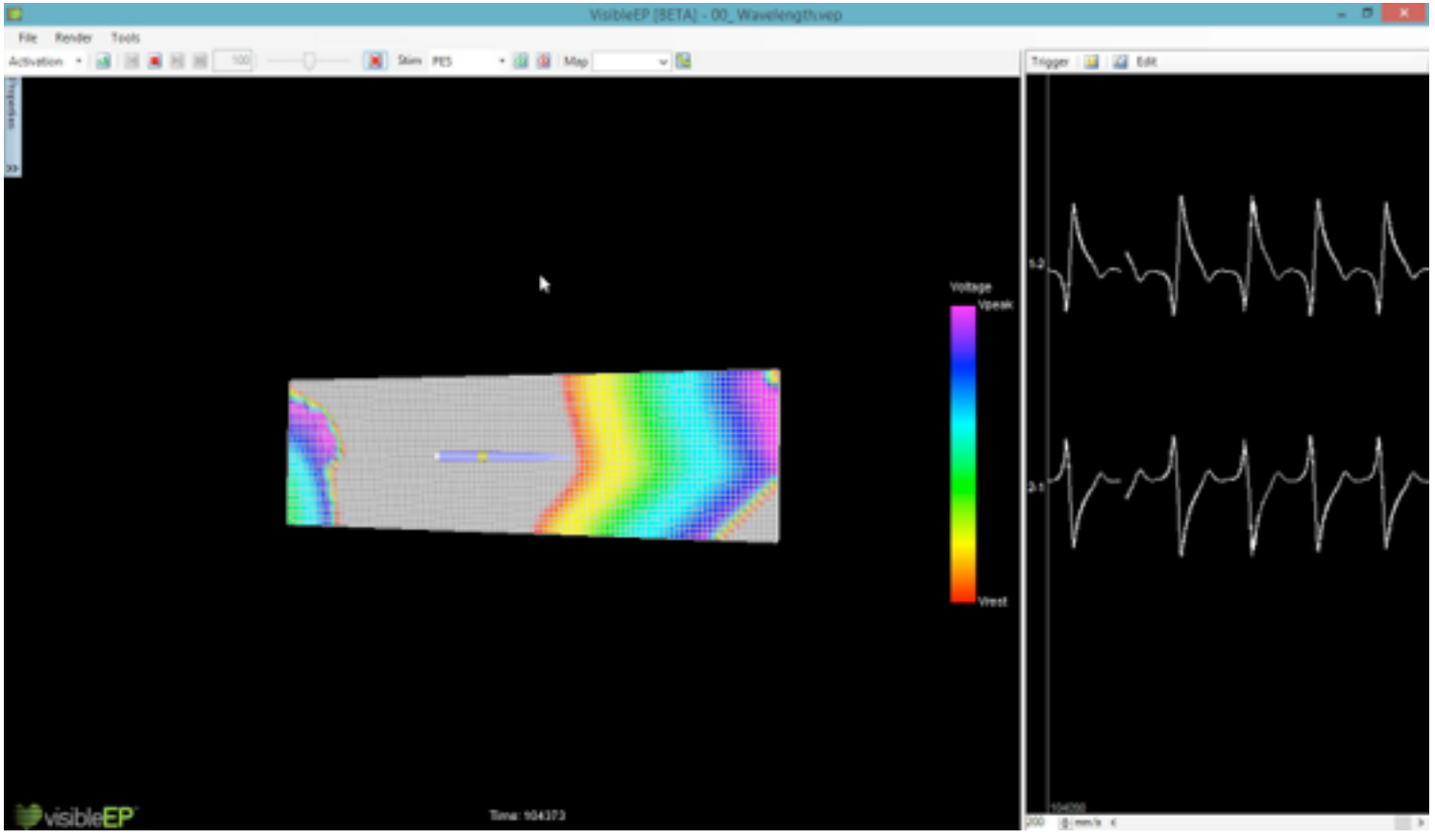
- Potential errors



Delacretaz et al PACE 2001

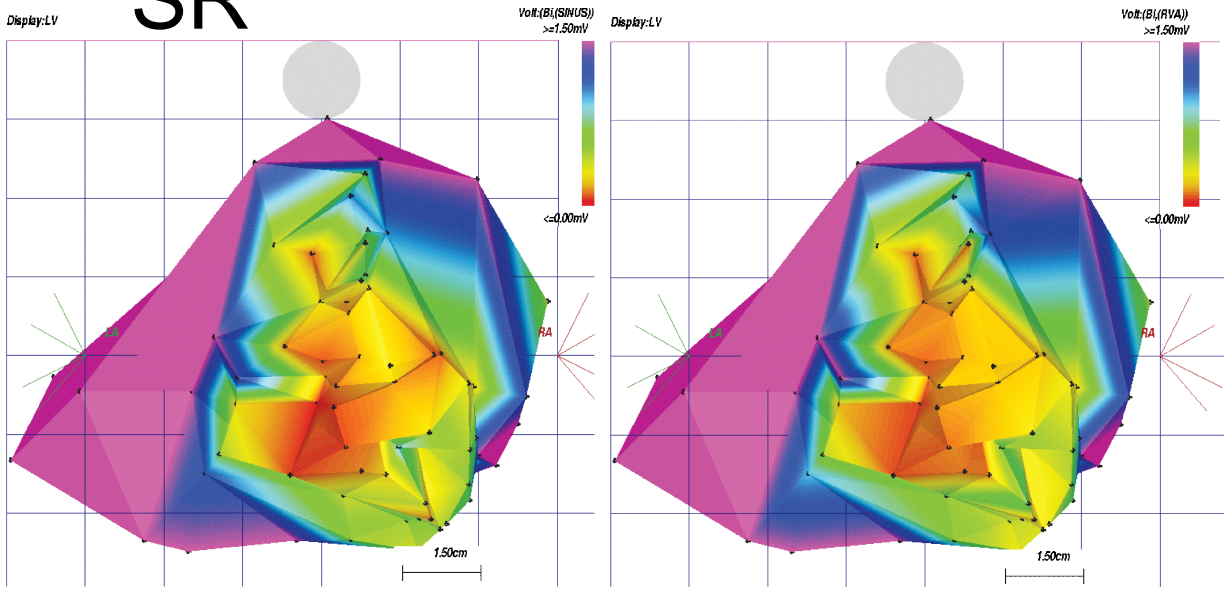
Bipolar voltage mapping

- Voltage dependent on catheter orientation and electrode spacing

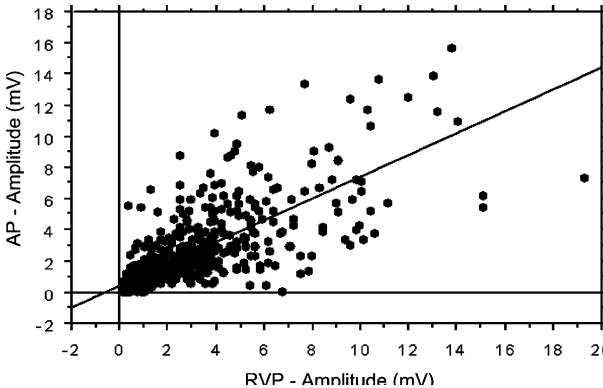


Bipolar voltage mapping

- Wavefront changed by V or A pacing during SR



AP RVP



- Δ wavefront ⇒ Δ voltage but primarily in normal voltage areas

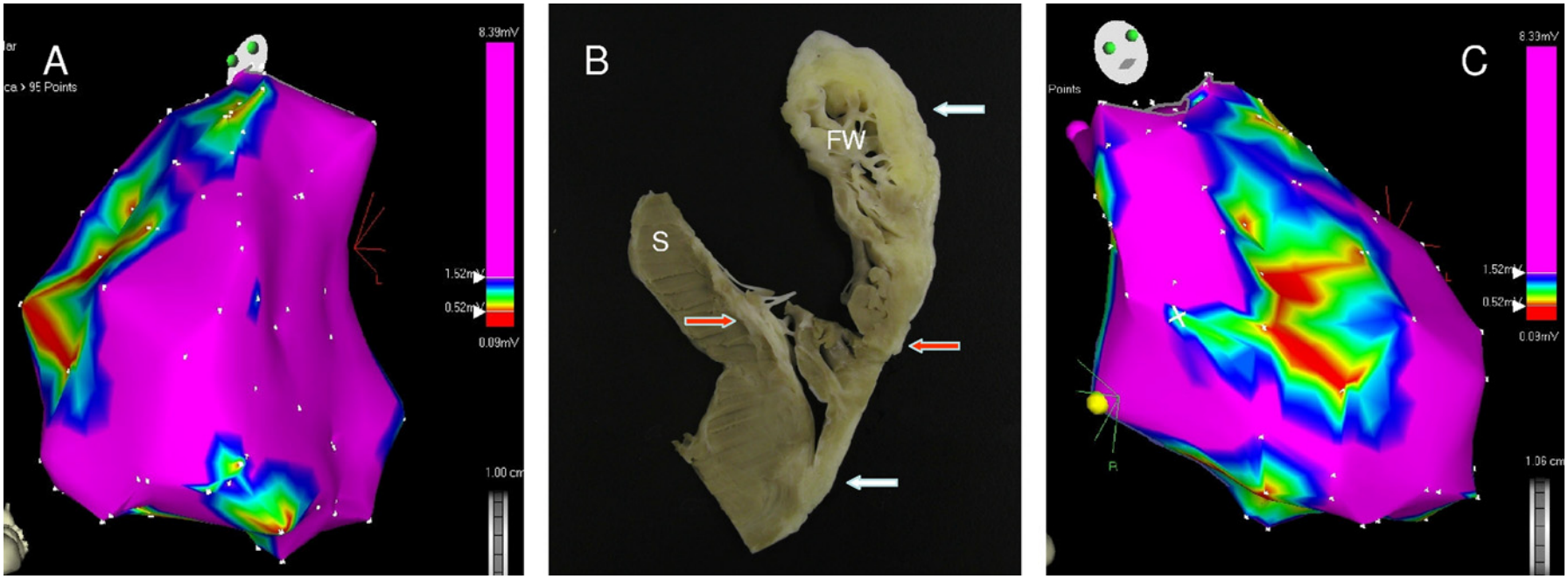
Brunkhorst et al JICE 2005

Identification of epicardial ventricular scar

- Useful if:
  - failed endocardial ablation/ substrate map
  - potential epicardial source e.g. non-ischaemic cardiomyopathy

Identification of non-endocardial scar

- Pt undergoing transplant for ARVC



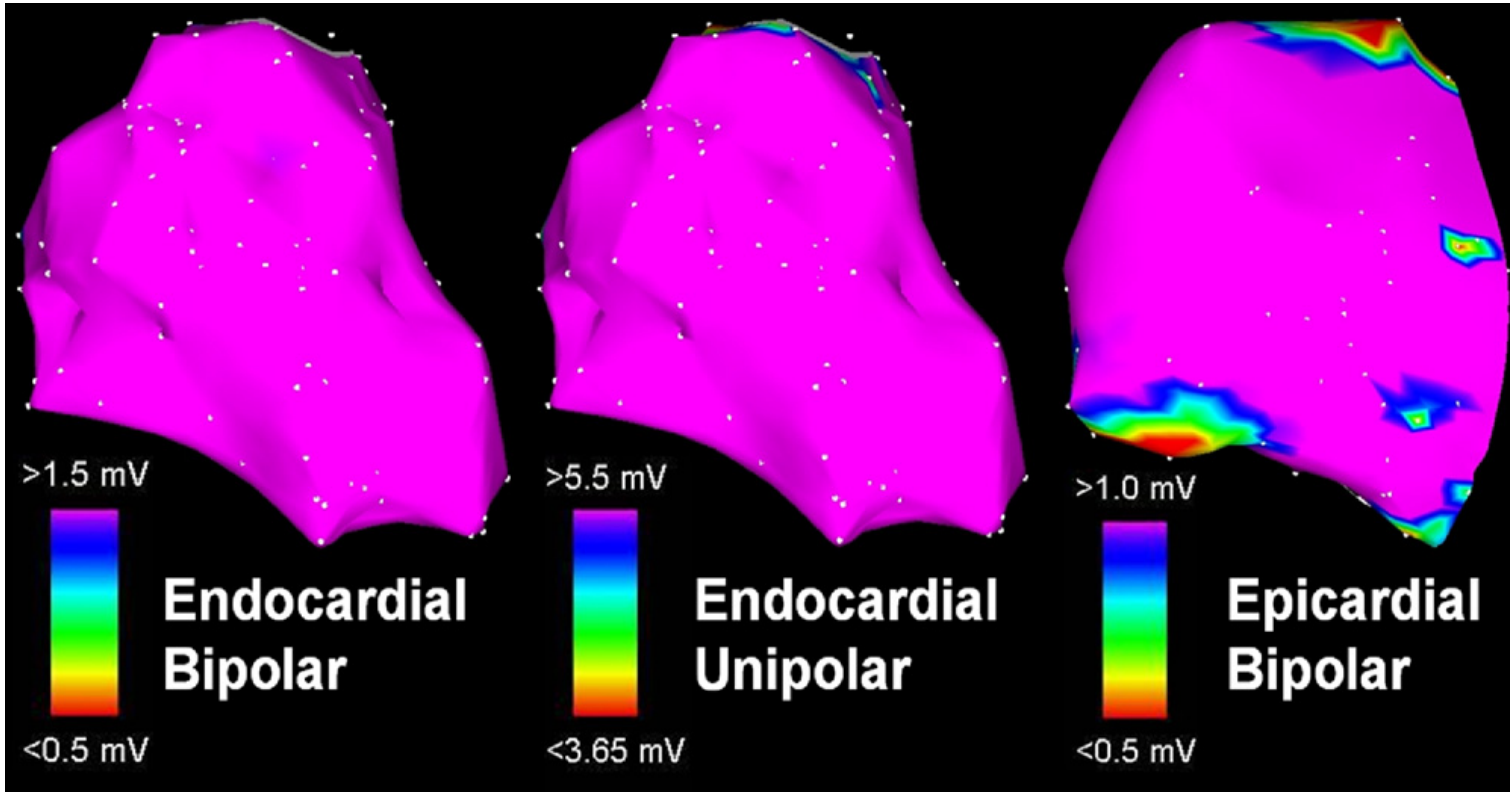
- Scar missed if >40% of myocardial wall preserved

Avella et al HRhythm 2010

Arrhythmogenic cardiomyopathy

- Endocardial and epicardial bipolar maps cf unipolar endocardial

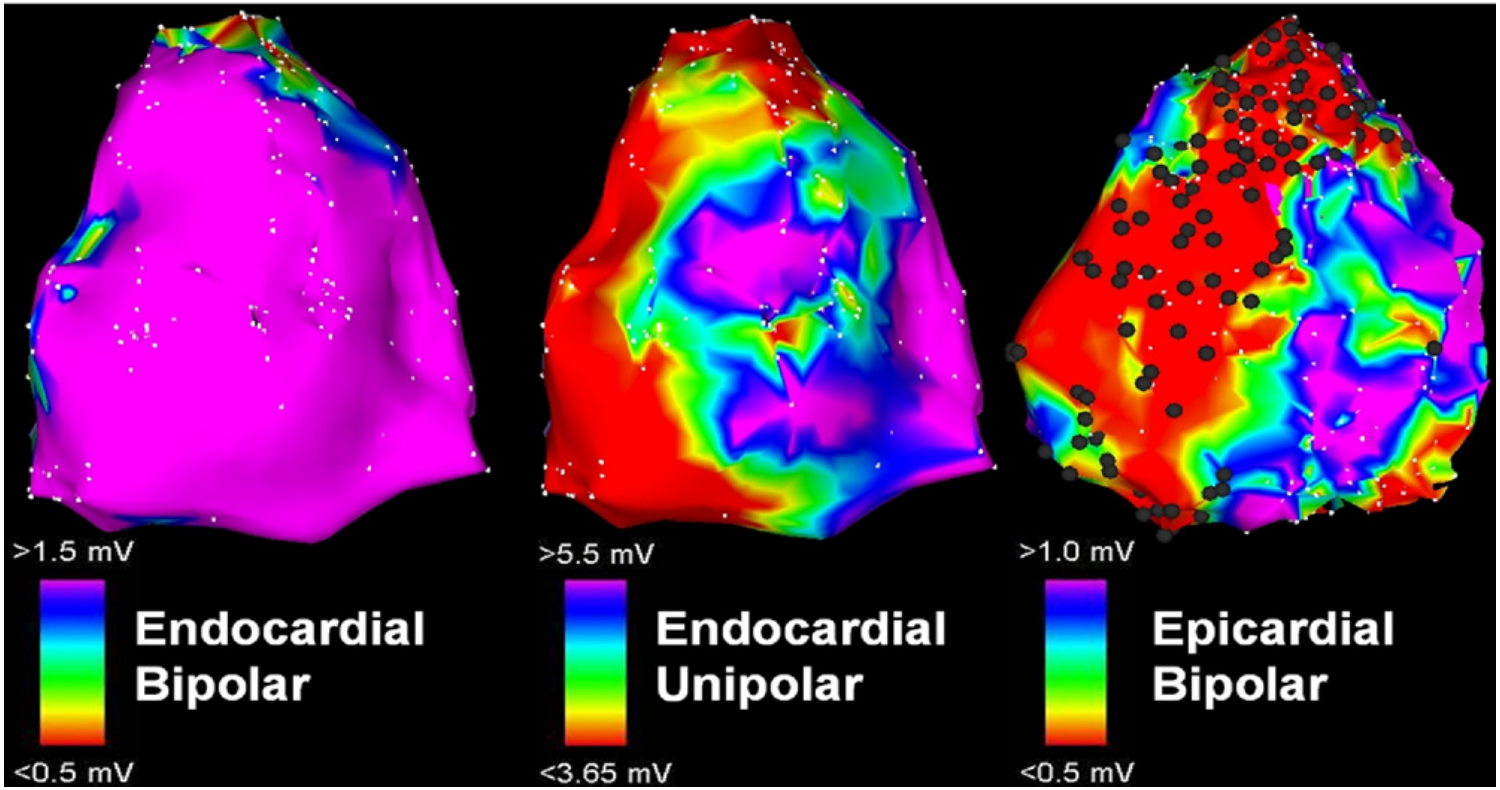
95% Uni >5.5mV in normal hearts



Polin et al HRhythm 2011

Arrhythmogenic cardiomyopathy

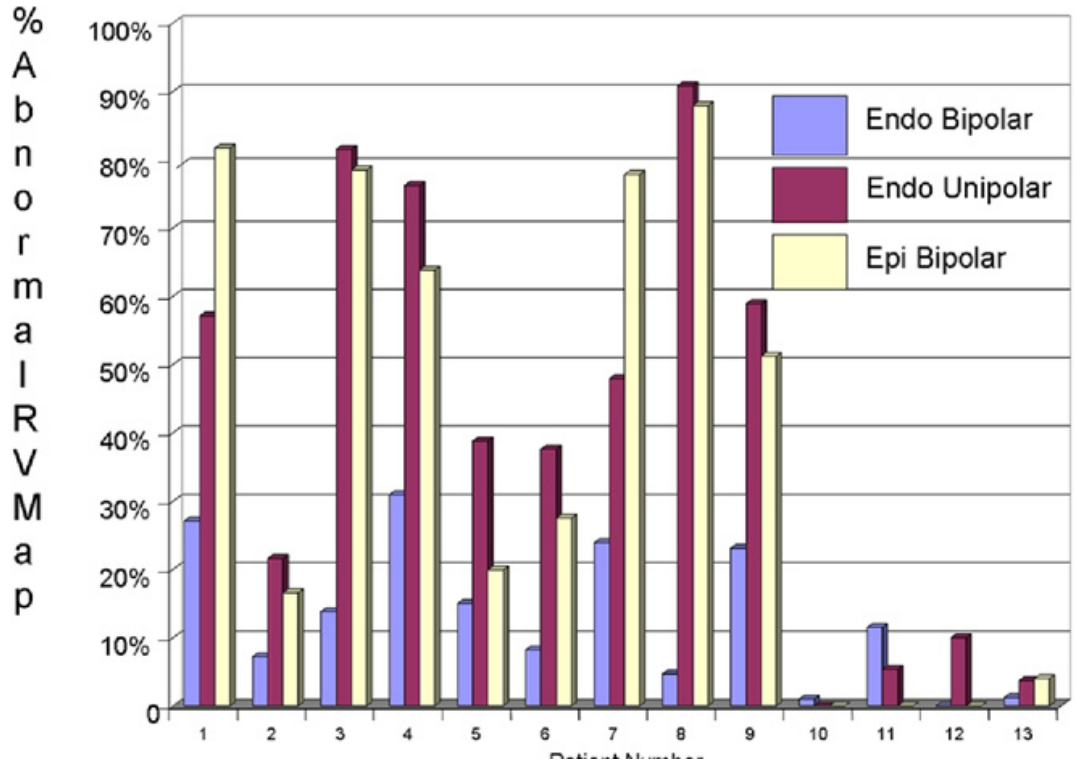
- Endocardial and epicardial bipolar maps cf unipolar endocardial



Polin et al HRhythm 2011

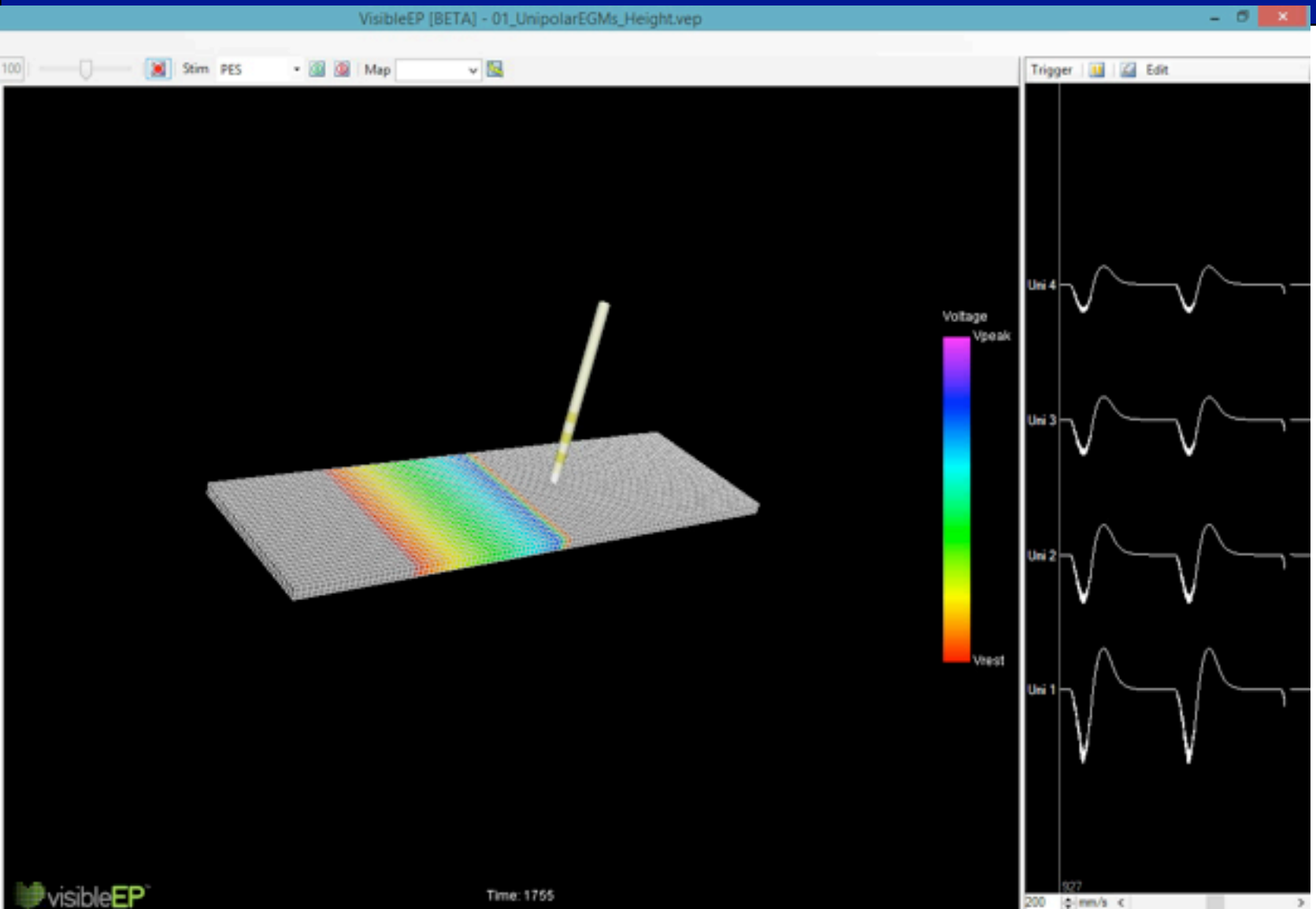
Both bipolar and unipolar may overestimate scar

- Bipolar - epicardial fat
- Unipolar - contact etc



Polin et al HRhythm 2011

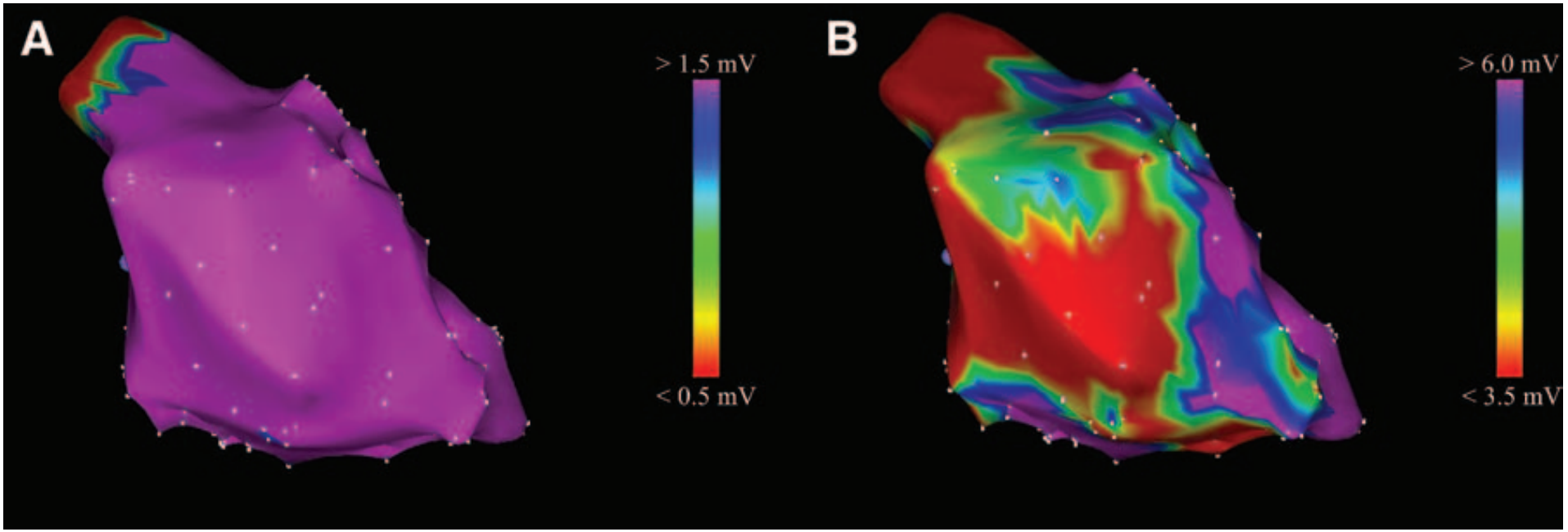
Unipolar contact affects voltage



Egram “sharpness” or frequency a better predictor

Can scar predict risk in ARVC?

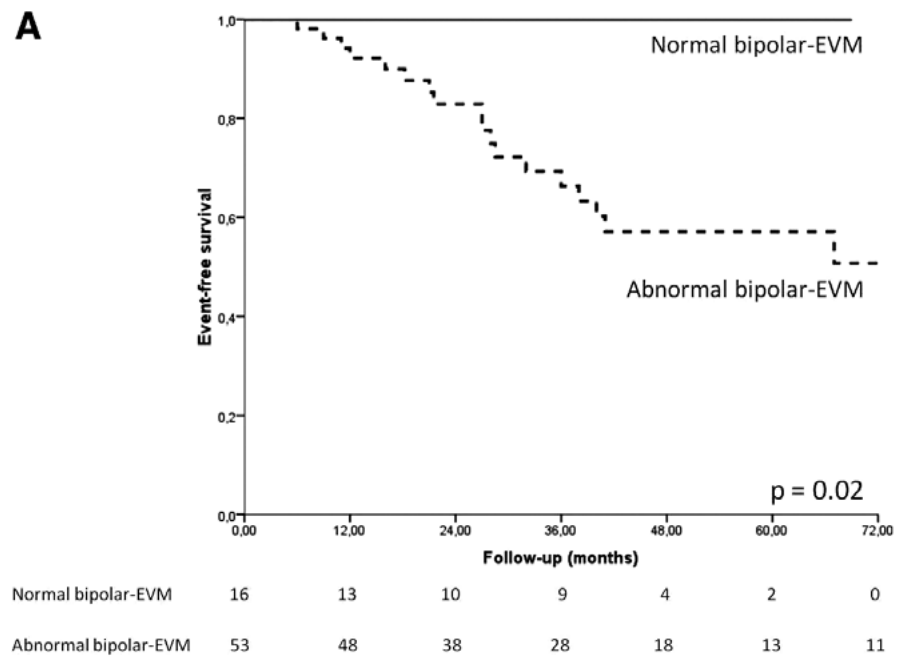
- n=69 ARVC:
  - abnormal EVM >1cm^2 bipolar <1.5mv or unipole <6mV

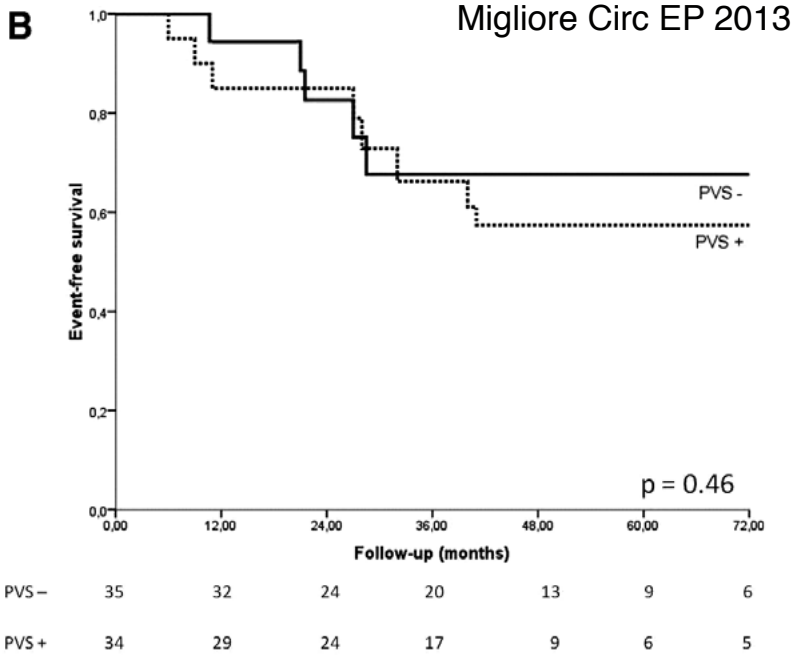


Migliore Circ EP 2013

Risk prediction with voltage mapping in ARVC

- Event rate (sudden death or VT/F)





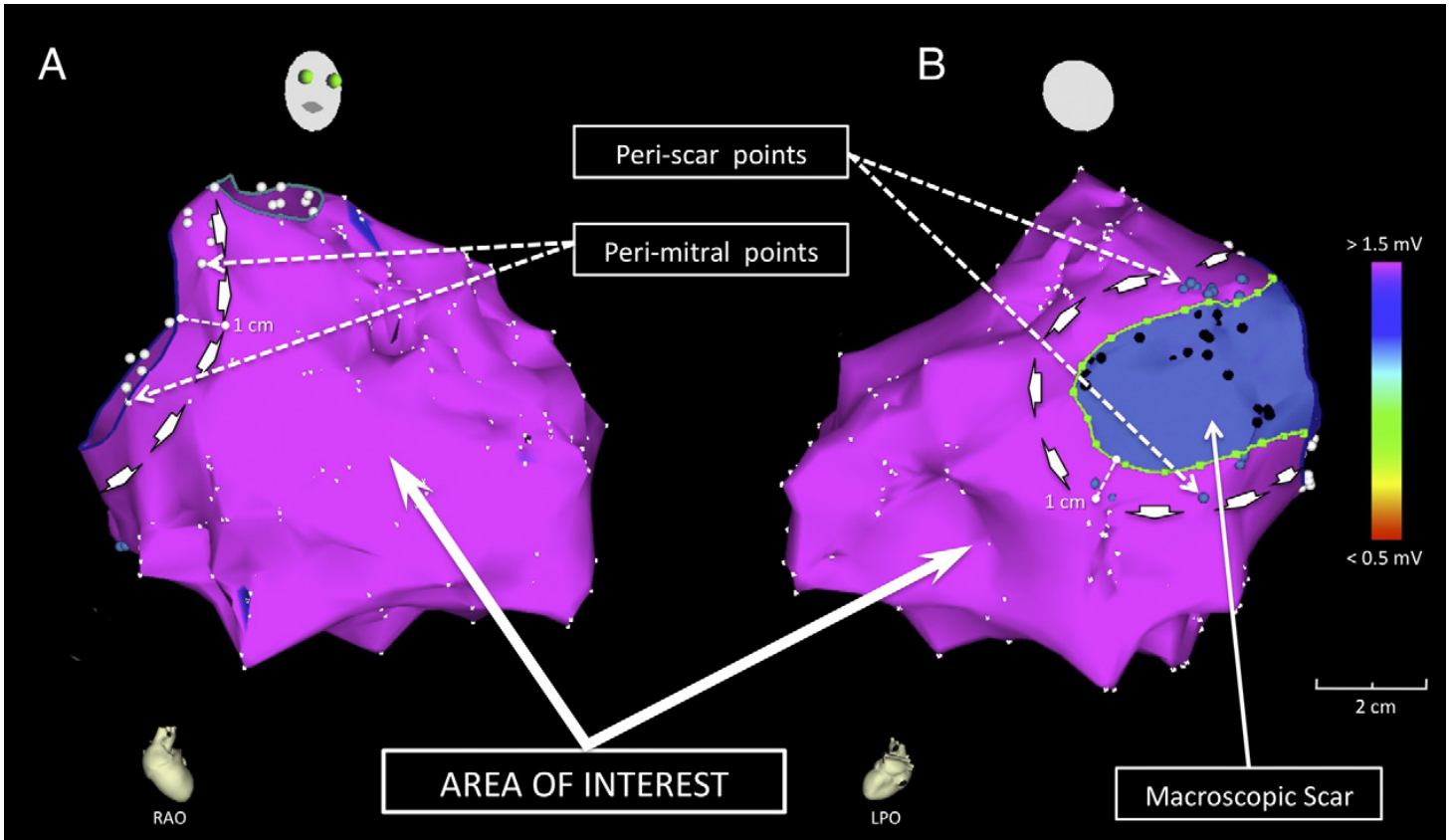
Abnormal map	HR	CI	P	HR	CI	P
Bipole	1.7	1.5-2.0	<0.001	1.6	1.2-1.9	<0.001
Unipole	1.3	0.6-2.3	0.3			

Risk prediction with ARVC

- Unipolar mapping too sensitive
- Risk likely to be related to volume rather than transmurality
- Bipole may be too crude a method for defining risk

Unipolar mapping to identify irreversible myocardial damage

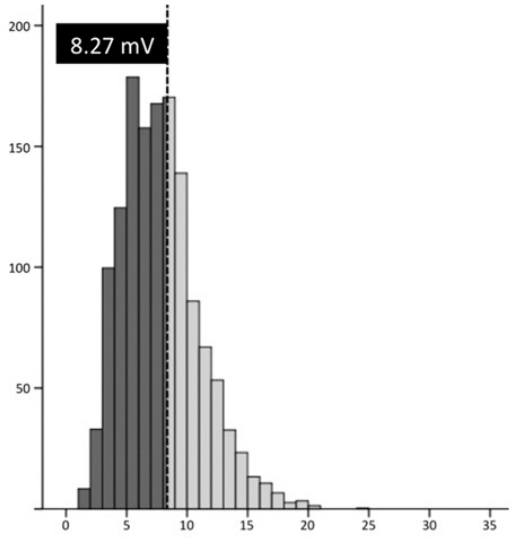
- Normal/Ectopy induced/Idiopathic cardiomyopathy
- Scar excluded (MRI, bipolar endo/epi defined)
- Unipolar voltages mapped



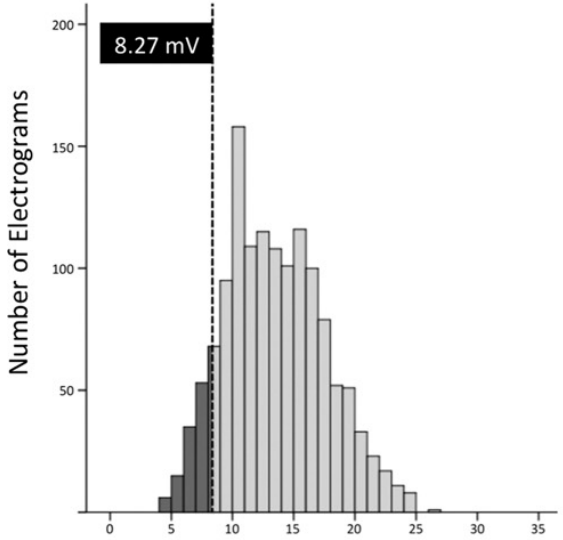
Campos et al
JACC 2012

Unipolar voltages of “normal” myocardium

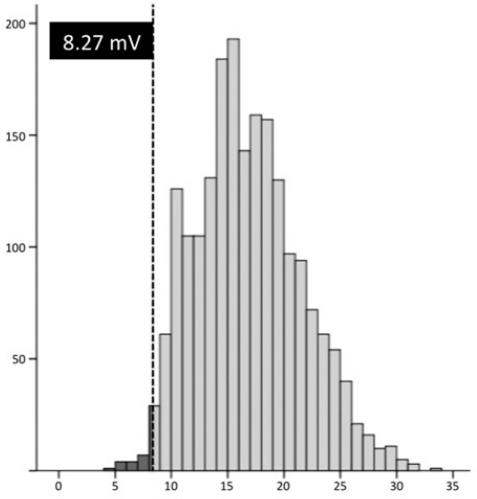
Irreversible



Reversible



Normal

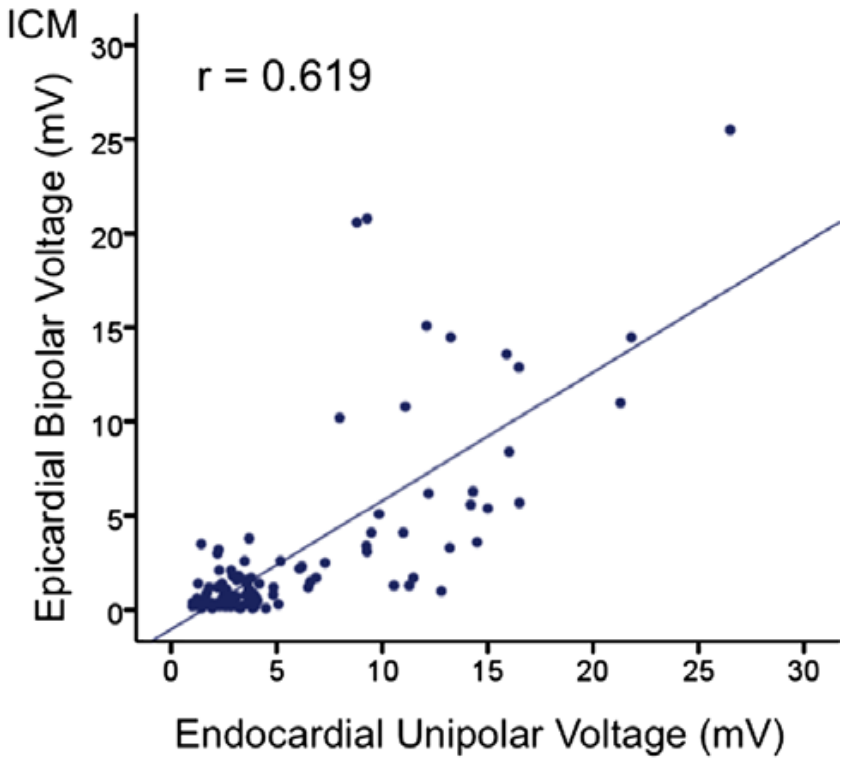


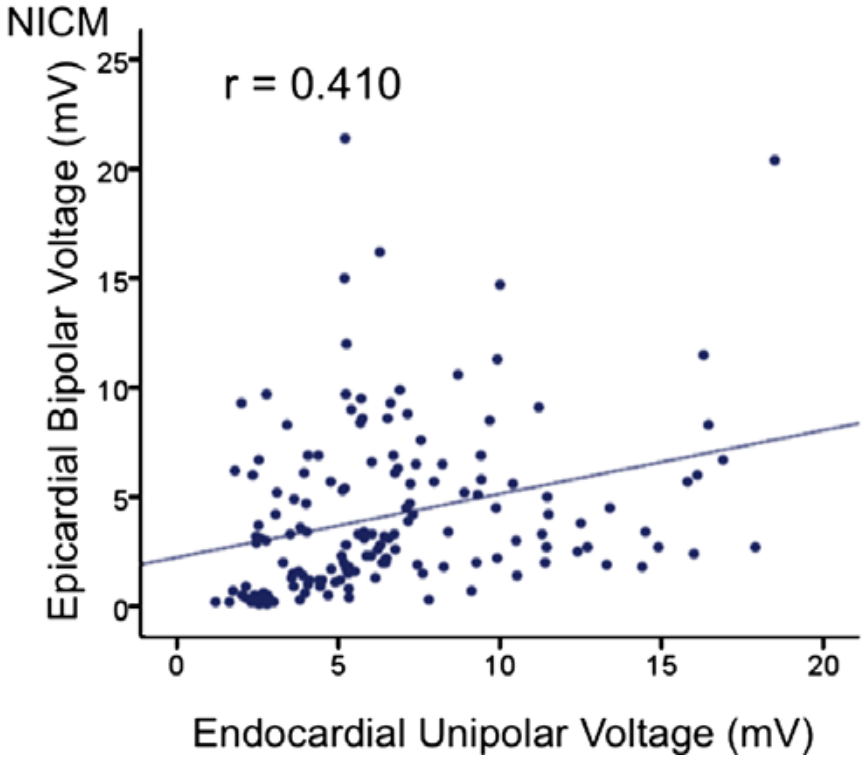
Unipolar voltage

Campos et al
JACC 2012

Ischaemic vs non-ischaemic voltage mapping

- Unipolar endo correlated to epicardial scar

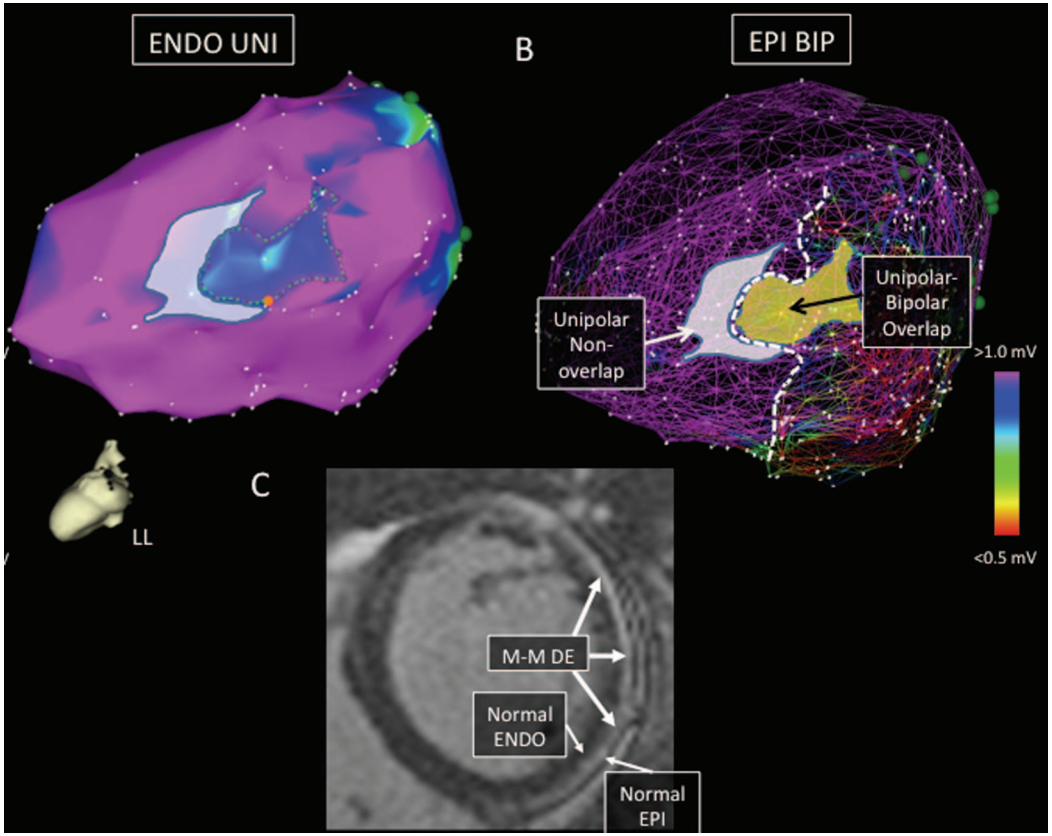




Tokuda et al JAHA 2012

Identification of mid-myocardial scar

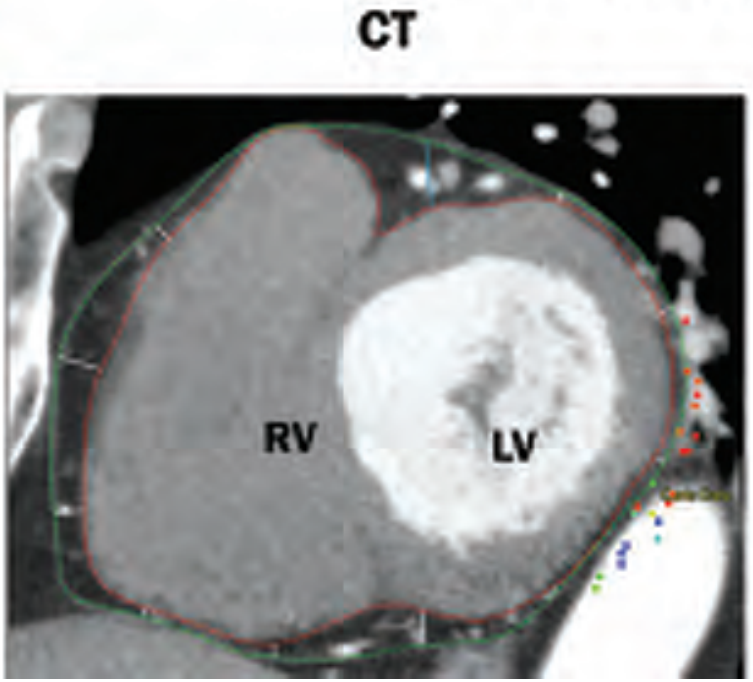
- Abnormal endo uni with normal epi bi

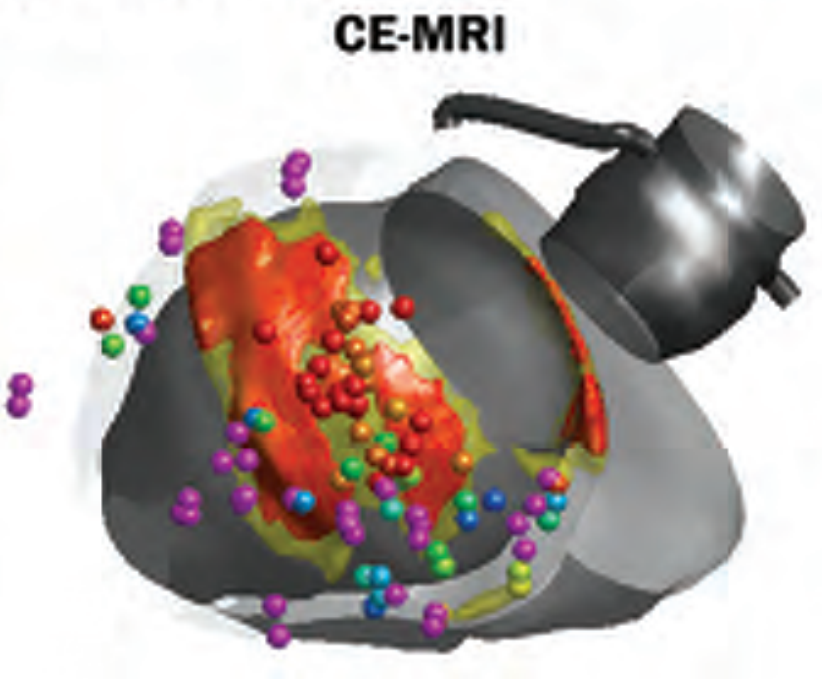


Hutchinson et al Circ EP 2013

DIstinction of scar/fat/viable myocardium

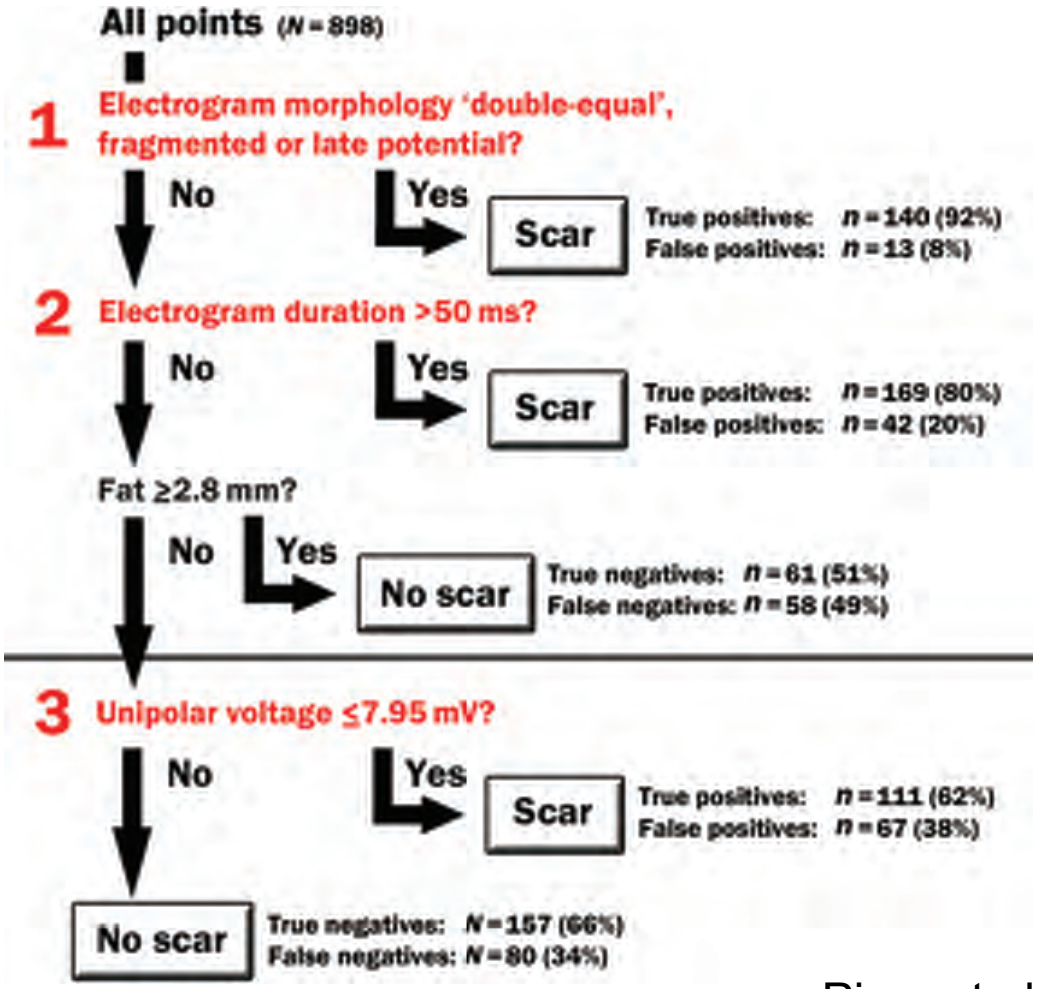
- Epicardial bipolar/unipolar EAM on 3D imaging





Piers et al EHJ 2013

Algorithm for identification



Piers et al EHJ 2013

Other considerations

- Voltage definitions vary
- Contact often difficult to achieve epicardially
- Contact detection may offer new insights

Conclusions

- Bipolar easier to achieve clean signals and easier to measure
- Unipolar may offer insights into 3 dimensionality of tissue
- True clinical advantages yet to be proven