Neuro-specific stimulation of the left atrial ganglionated-plexus sites reveals triggered atrial activity

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Background

- The ganglionated plexuses (GPs) are crucial part of the intrinsic cardiac autonomic nervous system that with stimulation can induce atrial arrhythmia.
- They contain both parasympathetic and sympathetic nerves and are located in the epicardial fat pad of human hearts.¹

Earliest link between vagal stimulation and AF

A = High rate atrial pacing causing AF then self-termination

B = Vagal stimulation and High rate pacing Pacing stopped AF continues

C = When vagal stimulation stops, AF terminates

Moe, AHJ '59
What we see in Holters of patients with paroxysmal AF...

SVEs

AF
We can replicate atrial ectopics and AF using high frequency stimulation (HFS)

Aims

1. To confirm that it is feasible and safe to globally map the whole left atrium for ectopy-trIGGERING GPs.

2. To characterise and describe GPs in a human left atrium with known PAF.
Single-centre prospective study of PAF patients indicated for AF ablation

**Inclusion criteria**

- 18-85yrs old, good LVSF, <5cm LA diameter, no stroke in the past 6 months, no significant CAD

**Exclusion criteria**

- On amiodarone

Patients stopped all AADs 48hours prior to their scheduled ablation
Methods

GA induction + TOE

TSP -> 3D CARTO mapping of left atrium

HFS mapping of the whole of left atrium

Tag both +ve and –ve responses to HFS on CARTO geometry

Pace for at least 4 beats to ensure no V capture. HFS at 40Hz, 14V, 20ms delay from pacing spike to ensure HFS is delivered within the atrial refractory period.

A positive response to HFS was called ectopy-triggering GP site (ET-GP).
Example catheter set-up for HFS testing

Tags

Green = ET-GP
Purple = HFS –ve
Single ectopy with HFS

- ECG
- BP
- CS
- MAP
- PV

Ventricular signal from atrial pacing

Ectopy from PV
Repetitive ectopy <30s

- Ectopic beat leads in CS 9-10, then patient develops sustained AF

**ECG**

**BP**

**CS**

**MAP**

**PV**

- Ventricular signal from atrial pacing

- Rapid ectopy firing
Sustained AF with HFS

ECG
BP
CS
MAP
PV

Ventricular signal from atrial pacing
AF initiated
SVE in Holter and with stimulation of ET-GP in same patient
AF onset in Holter and with stimulation of ET-GP in same patient

AF onset in a Holter ECG pre-ablation

AF onset from ET-GP stimulation
Results

• LA was mapped in 34 patients

• Data from 25 patients was analysed.

• Out of 3043 HFS sites analysed, 527 (17%) were ET-GP sites.

• Average $104 \pm 22$ HFS sites were tested in each patient, identifying $23 \pm 6$ ET-GPs. (Range 6-41)
Out of 527 GP sites...
Where are ET-GPs most likely located in the L atrium?

• 24 patients’ left atrial 3D anatomical map was exported from CARTO.

• All the GP sites and –ve HFS sites were overlaid and transformed onto one representative left atrial geometry, using a semi-automated process.

• A probability of 1 was applied to ET-GP sites and 0 for sites with –ve HFS response.

• A Gaussian kernel was applied over each measured site and averaged across all the patients.
Transformation of HFS points from CARTO geometry to reference shell
Probability map of ET-GPs

Around the veins and the roof had the highest probabilities of ET-GPs:

30%-45%
Conclusion

• It is feasible and safe to globally map the left atrium in patients to identify ET-GPs.

• We have demonstrated that ET-GP stimulation can show similar patterns to AF initiation in Holters of PAF patients.

• The majority of GP sites trigger ectopy and/or non-sustained atrial arrhythmias and a minority trigger sustained atrial arrhythmias.

• The highest probability areas of ET-GPs were around the PVs and the roof of the atrium.
Thank you.