Use of Terminal Unipolar Electrogram Current of Injury as a Novel Marker to Estimate Contact: *An Acute Canine Study*

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Background

Contact with the myocardium is an important pre-requisite in electrophysiological procedures:

1. For mapping myocardial signals.
2. For delivering adequate ablation lesions.

Conversely, excessive contact is associated with procedural complications.

Current signal recording systems have limited dynamic range and bandwidth. Therefore, signal saturation occurs.

We hypothesized that increased dynamic range, increased sampling rate and wider bandwidth improves signal acquisition/display and would be capable of demonstrating current of injury (COI) on the local EGM.

Aim

We aimed to demonstrate that the current of injury (COI) within the local myocardial electrogram varied proportionally to the contact with the myocardial tissue.

Methods

We performed uni-/bi-polar intracardiac mapping using a Smart-Touch® catheter (Biosense Webster, CA) to obtain contact force (CF) measurements whilst simultaneously recording signals comparing PURE EP™ (BioSig Technologies, MN) with a standard recording system (**Table 1**).

Signals were recorded from 4 anesthetized canines in an acute study setting.

Tissue contact was assessed using the Thermocool Smart-Touch® catheter in 2 of the 4 studies.

Intracardiac echocardiography (ICE) was used in the other 2 studies.

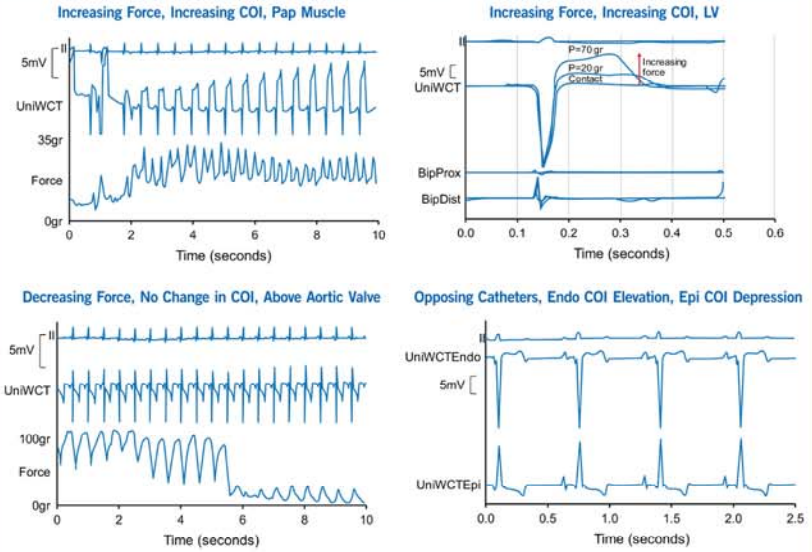
We compared the magnitude of COI as recorded on unipolar local electrogram tracings with the contact force pressure tracings from the ablation catheter.

Measures were made at baseline and with increasing pressure at various cardiac locations.

Table 1: System Comparison

	System A	PURE EP™
Bandwidth	0.05-500 Hz (Based on 977 s/s)	0.05-1,000 Hz
Sampling rate	977 Samples/sec	2,000 Samples/sec
Dynamic range	Noise not published	105 dB
A/D converter	12-bit	24-bit
Minimum CMRR @ 60 Hz	100 dB	110 dB
Input impedance	>10^9 Ω	>500 MΩ
Noise	Noise unknown	1 µV RMS
Hardware gain	Programmable (From 50-10,000 in 8 steps)	Fixed at 10

Figure 1: Central Illustration



Intracardiac electrograms obtained from the PURE EP™ System (0.05Hz-1KHz, 24-bit A/D conversion, 2000 samples/second sampling rate, no saturation in ±250mV range). (A) Increasing COI with increasing force of contact; (B) Graded increase in the COI with increasing force of contact; (C) No increase in COI when measured above the aorta despite increasing contact; (D) Change in the direction of the COI vector when assessed over the epicardium. COI: Current of Injury; Uni WCT: unipolar-Wilson central terminal; endo: endocardial; epi: epicardial; BipProx:Bipolar Proximal; BipDist: Bipolar Distal

Results

- **See Central Illustration.**
- Increasing amplitude of COI corresponded with increasing force of contact in both the ventricles and the atrium.
- No COI was noted within the aorta despite increasing pressure.
- The COI vector was inverted when assessed on the epicardium.
- Immediate reduction in COI with decrease in contact was also present.
- These findings were reproducible across multiple sites in all experiments.

Conclusions

- COI may be used to assess force of contact with the myocardium.
- Further investigations are needed to calibrate the magnitude of COI with existing technology.

Disclosures

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