JACC: CLINICAL ELECTROPHYSIOLOGY
VOL. 2, NO. 7, 2016

ISSN 2405-500X/$36.00
PUBLISHED BY ELSEVIER
http://dx.doi.org/10.1016/j.jacep.2016.04.007

Novel Electrophysiology Signal Recording System Enables Specific Visualization of the Purkinje Network and Other High-Frequency Signals

Ammar M. Killu, MBBS,[a] Niyada Naksuk, MD,[a] Kalpathi L. Venkatachalam, MD,[b] Samuel J. Asirvatham, MD[a,c]

High-frequency signals (e.g., Purkinje potentials) are of interest in arrhythmia syndromes such as fascicular tachycardia and ventricular fibrillation. However, restricted dynamic range and sampling rate in modern electrophysiology recording systems make it challenging to identify high-frequency, low-amplitude signals, especially those temporally situated near low-frequency, high-amplitude signals or large sharp peaks. Although increasing gain accentuates their appearance, clipping and artifact may occur.

It is undetermined whether: 1) increased dynamic range and sampling rate; and 2) use of additional filtering and processing (PURE-EP, BioSig Technologies, Minneapolis, Minnesota), will improve recording of Purkinje potentials and other high-frequency signals. As such, we performed unipolar and bipolar cardiac conduction system mapping using various catheters while simultaneously comparing PURE-EP (0.05 to 1 kHz, 24-bit A/D conversion, 2000 samples/s sampling rate, low gain with no saturation in the ±250 mV range) with a standard recording system (0.05 to 500 Hz, 12-bit A/D conversion, 977 samples per second sampling rate). The additional high-pass filtering and processing in PURE-EP enables the detection and visualization of high-frequency signals in the presence of larger waveforms.

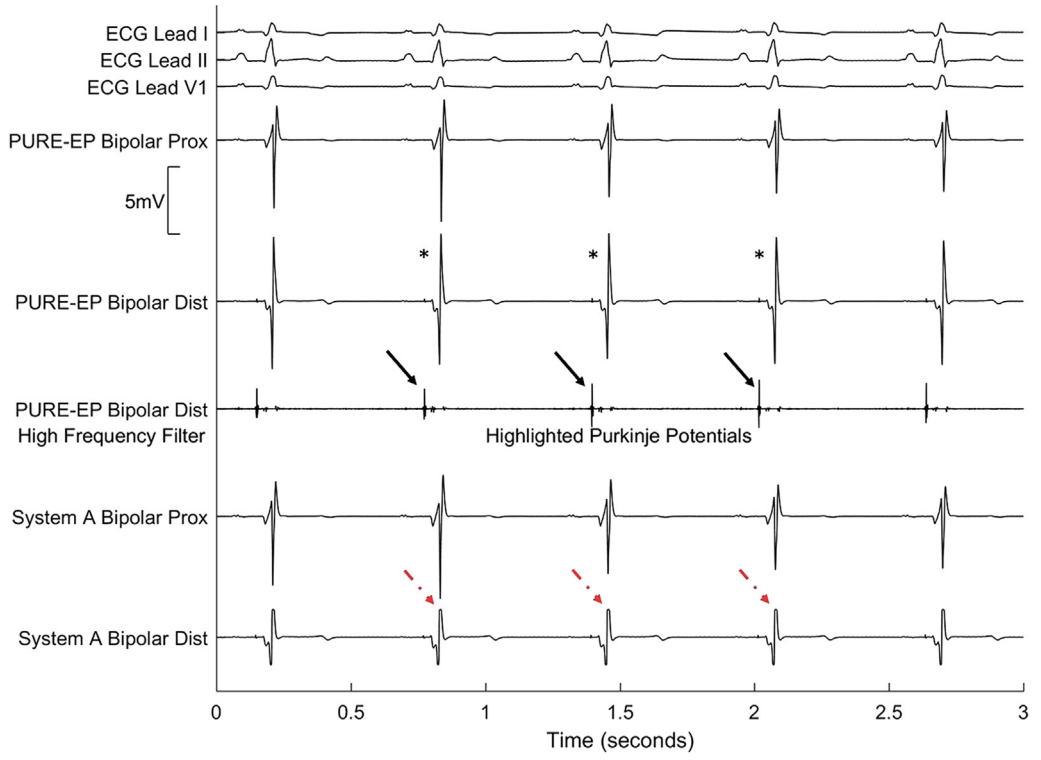
PURE-EP consistently demonstrated superior Purkinje potentials and other high-frequency signal visualization compared with the standard recorder in all sites of the cardiac conduction system. The PURE-EP system has the capability to display the same channel with different processing options to highlight specific features while still displaying the original electrogram signal. For example, the new system only demonstrated high-frequency signals which correlated with Purkinje potentials (**Figure 1**). Traditional EP recording systems have fixed dynamic range and sampling rate and, therefore, lack the adjustability demonstrated by the PURE-EP system. Such features may improve mapping/ablation outcomes in arrhythmia syndromes dependent on the Purkinje network.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. Samuel J. Asirvatham, Division of Cardiovascular Diseases and Department of Pediatrics and Adolescent Medicine, Mayo Clinic, 200 First Street SW, Rochester, Minnesota 55905. E-mail: Asirvatham.Samuel@mayo.edu.

From the [a]Division of Cardiovascular Diseases, Mayo Clinic, Rochester, Minnesota; [b]Division of Cardiovascular Diseases, Mayo Clinic, Jacksonville, Florida; and the [c]Department of Pediatrics and Adolescent Medicine Mayo Clinic, Rochester, Minnesota. Dr. Venkatachalam is a consultant to BioSigTech Corporation. Dr. Asirvatham has received honoraria for consulting from Abiomed, Atricure, Biotronik, Biosense Webster, Boston Scientific, Medtronic, Medtelligence, St. Jude, Sanofi-Aventis, Wolters Kluwer, Elsevier, and Zoll; is a co-patent holder; and may receive future royalties from Aegis (appendage ligation), Access Point Technologies (atrial fibrillation ablation and coagulum reduction during ablation), Nevro (use of nerve signal modulation to treat central, autonomic, and peripheral nervous system disorders, including pain), Sanovas (lung ablation), and Sorin Medical (tricuspid valve project). All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received February 8, 2016; revised manuscript received April 12, 2016, accepted April 14, 2016.

FIGURE 1 Intracardiac Electrograms Obtained From CardioLab and PURE-EP Signal Recording Systems



Compared with CardioLab, PURE-EP demonstrated high-frequency signals without artifact and clipping **(*)**. In addition, the PURE-EP automated filtering algorithm illustrates high-frequency signals that correlated with Purkinje potentials **(black arrows)**. Although CardioLab demonstrates the Purkinje signals, clipping of the ventricular electrogram occurs **(red arrows)**.

KEY WORDS dynamic range, electrophysiology, frame rate, mapping, Purkinje, signals