Novel Techniques To Analyse Gastric Slow Wave Recordings

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Introduction
The motility of the gastrointestinal (GI) tract is governed by a rhythmic electrical activity, termed the slow wave [1]. Gastric slow wave dysrhythmias have been associated with several motility disorders, such as gastroparesis and gastroesophageal reflux [2]. However, the clinical significance of gastric dysrhythmias still remains uncertain [2].

Current algorithms and software have concentrated on detecting the activation phase of the slow wave event [3]. However, the recovery phase is also an important aspect to understand the mechanism of the slow wave event, because the Activation-Recovery interval (ARI) is hypothesised as a parameter that is associated with gastric dysrhythmias. In this study, a novel recovery-phase detecting method is applied to investigate this relation.

Signal Processing
The signals were analysed by the software package GEMS (Gastrointestinal Electrical Mapping Suite) that was developed in MATLAB version [1]. The activation map was visualised by GEMS as well. A novel method was developed in MATLAB to detect the recovery phase of slow wave. This algorithm utilized the smoothed non-linear energy operator(SNEO) to amplify the larger deflections in the signal.

A flow chart demonstrating the procedures for detecting recovery phase. (A) Example of Slow wave signal and its transformed form. (B) An illustration of fiducial markers for quantification and interpretation of gastric slow wave activity [1].

Results

Experimental results of a porcine study that presented both dysrhythmias and normal slow wave activities. (A) Position diagram showing the electrodes were placed on the greater curvature of stomach, near the normal pacemaker region of the stomach. (B) Activation maps of normal slow wave (a) versus dysrhythmic slow wave in the same position (b). Each black dot represented an electrode and each isochrones corresponded to 1s of propagation. An ectopic pacemaker (abnormal pacemaker region) propagated in elliptic path as shown in B(b). (C) illustrates the change in mean ARI between each clustered wave. Each clustered group denotes the spatial information of slow wave propagation over the recording region. The dysrhythmic slow wave had shorter ARI compare with normal slow wave. (Average 4.2±0.1s for normal slow wave and 3.9±0.1s for dysrhythmic slow wave, P<0.001).

Conclusions
- A novel method has been developed to detect the recovery phase of slow wave and explored a new path to analyse the mechanism of slow wave event.
- Results from the porcine study revealed that the ARI of dysrhythmic slow wave patterns were shorter than the ARI of normal wave pattern in general.
- Further experimental and mathematical modelling studies are required.

References