Advances in ECG-based cardiac ischemia monitoring – A review

John Wang

Philips Healthcare, Cambridge, MA, USA

Real-time ST-segment monitoring for ischemia detection was introduced for clinical use in the ’80s. To overcome limitation on the number of monitored leads, diagnostic 12-lead acquisition were subsequently developed. Derived 12-lead from 5-wire and 6-wire lead sets were also developed when direct 12-lead acquisition was not practical. Several innovative graphical solutions were developed to manage the 12-lead ST monitoring data, including: ST-map and ST-compass for better visual tracking of ST measurements; STEMI-map based on J-point ST measurements for accurate tracking of STEMI criteria; and 3D ST trend and ST-topology plots for efficient ST trending review. To further improve accuracy of acute ischemia/infraction detection, two methods based on 12-lead ECG are being developed: (1) The vessel-specific leads (VSLs) method measures ST elevation from three optimal leads, calculated from the 12-lead ECG, for detecting ST-segment deviation during coronary occlusion. Preliminary results showed that the method can identify acute ischemia with higher sensitivity and specificity in comparison to the currently used STEMI criteria applied to the same 12 standard leads. The use of only three leads to track evolving acute ischemia greatly reduces the complexity in monitoring. (2) The Computed Electrocardiographic Imaging (CEI) method presents a bull’s-eye polar plot of the heart-surface potentials based on inverse calculation from the body-surface-potential-map (BSPM) derived from the 12-lead ECG. Early results showed that this method could be a useful clinical decision support tool for increasing the accuracy of ECG-based triage of chest-pain patients. Whether these new methods can be successfully implemented for routine clinical use remains to be validated. CEI as well as several other electrical imaging methods, which present ST-segment potentials on the heart surface using display formats that are compatible with other diagnostic imaging modalities, should allow the electrocardiographic information to be more easily incorporated into a cardiac multi-modality imaging (MMI) decision support system.