CardioScan

Non-arrhythmic indications for ambulatory ECG monitoring

There are a number of computerised packages that can measure Holter ECG recordings over a 24 or shorter period.

They require high quality tracings and despite being available in a Holter monitor report, none have been found to be useful in routine medical management.

ST segment analysis

The incidence of ST segment depression in ambulatory ECG recordings is high particularly with rapid heart rates and does not always indicate myocardial ischaemia. What is poorly understood is the significance of marked ST changes in asymptomatic patients without documented coronary artery disease. In studies comparing the ST changes in ambulatory ECG monitoring with stress testing, ST segment changes are infrequent when the stress test is normal and more likely when the stress test is indicative of myocardial ischaemia.

There is also a significant correlation between the magnitude of changes comparing the two tests, but as an investigative tool, ST segment analysis is not sensitive enough to diagnose coronary artery disease and myocardial ischaemia.

Although the usual changes indicative of myocardial ischaemia are ST depression, ST elevation can occasionally be seen with transmural ischaemia, such as severe coronary atherosclerotic obstruction or spasm. Knowing this, ambulatory ECG monitoring may, on occasion, be extremely useful in specific situations, where the exercise test is unhelpful

Heart rate variability

THeart rate variability is a clinical assessment of the autonomic nervous system using the intervals between heart beats over a fixed period of time and can be performed both supine and erect. The measurements are heart rate fluctuations in milliseconds around an average rate and reflect aerobic fitness. Other factors that affect the results include age, gender, respiration, general wellbeing and time of day. During exercise, as the heart rate increases the heart rate variability falls. Similar falls occur during stress and anxiety. This reflects increasing sympathetic tone, whereas vagal tone increases heart rate variability. The technique has become popular with sports scientists and fitness instructors and can be incorporated into smartphone applications and heart rate fitness monitors where the pulse and heart rate is monitored rather than the ECG. Measurements can be performed daily and high values are said to reflect good health and high levels of fitness. Some fitness instructors use the values to determine if the client is performing beyond their ability, whereas sports scientists use the technique to monitor stress and recovery in professional athletes.

Heart rate variability analysis of the ECG can be readily incorporated into a 24-hour Holter monitor. True physiologic recordings require P wave measurements, but in clinical ECG monitoring, this is very difficult and the R-R measurements are used instead. The technique obviously ignores any fluctuation in atrio-ventricular conduction, whereas atrial and ventricular ectopy are further confounders and can be deleted from the measurements if recognised. A number of other time domain indices including short term measurements can be built into Holter monitor software algorithms and can be presented in the report, but usually remain of academic or research interest only. For presentation in the report, these intervals can be converted into geometric patterns such as sample density distributions or Lorenz plots.

Reduction in heart rate variability has been shown to be a strong and independent predictor of mortality following an acute myocardial infarction. Abnormal results also occur with diabetic neuropathy, left ventricular dysfunction, sepsis and following cardiac transplantation. These abnormal findings reflect changes in autonomic function and may alert the investigator to a predisposition for potentially lethal cardiac arrhythmias and sudden death. Despite the availability in most Holter monitors, there is surprisingly very little clinical use of this inexpensive tool. This is probably due to a lack of understanding of the significance of the seemingly complicated results presented in the report as well as the concern for incorrect conclusions from confounding artefact, collection times, age and arrhythmias.

Signal-Averaged ECG

The signal-averaged ECG is an accurate method of recording low-amplitude micro-volt cardiac potentials and, in particular, the high-frequency late potentials of the QRS that are important in risk stratification of serious ventricular tachyarrhythmia events. For ambulatory ECG monitoring, there is a requirement for reduction of corporeal and extra-corporeal noise, particularly from skeletal muscle.

Monitoring Changes in QT and QTc intervals

Holter analysis software packages provide continual measurements of the QT and QTc intervals with the mean results routinely presented in the report summary or on request, a detailed 24-hour presentation is available for all monitoring leads. The use of Holter monitoring to measure the QT and QTc changes in patients with a family history of long QT syndrome or for high risk patients commencing drugs known to increase the QT interval, has been underutilised.

Obstructive Sleep Apnoea

Obstructive sleep apnoea syndrome is characterised by episodes of partial or complete upper airways obstruction, which in turn disrupts nocturnal ventilation and has been shown to be associated with cardiovascular disease. As a component of cardiorespiratory polysomnography, ambulatory ECG monitoring has always been part of sleep apnoea protocols in order to document a broad range of nocturnal rhythm disturbances including marked sinus arrhythmia, sinus bradycardia, sinus pauses as well as atrioventricular block, ectopy and tachyarrhythmias. With greater understanding of nocturnal heart rate variability and its relationship to autonomic dysregulation, interest has focussed on whether this simple tool can be used to assess and diagnose sleep apnoea. The question has been posed whether inexpensive conventional nocturnal ECG monitoring alone can be successfully adapted to diagnose sleep apnoea without the added expense of cumbersome measurements of airflow, blood oxygen saturation, brain wave morphology and eye, chest and limb movements.

For patients with obstructive sleep apnoea, spectral analysis of RR variability during ECG monitoring has shown an increase in low frequency normalised units and a decrease in high frequency normalised units, due to increased sympathetic tone during disordered breathing. Unfortunately, sleep disorders present a complex interaction between the normal sympathetic and parasympathetic changes of sleep coupled with the changes found during apnoeic periods and therefore at best, heart rate variability can only be used as a screening tool identifying patients at high risk of obstructive sleep apnoea. An additional finding with ambulatory ECG monitoring is that inspiration, expiration and respiratory rate can be determined electronically by changes in the relative positioning of chest electrodes, thus creating miniscule reproductive changes in QRS axis with respiration. Whether monitoring minute ventilation during ambulatory ECG recordings can improve the use of heart rate variability to reliably diagnose obstructive sleep apnoea has yet to be determined.

For more information on diagnosis, common heart conditions, symptoms and treatment, visit www.cardioscan.co/resources/patient-fact-sheets

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