ECG HEART MODEL

HE-5000

Reference Manual

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HE-5000
ECG HEART MODEL

The HE-5000 ECG Heart Model is a reproduction of a human heart which realistically simulates that of a patient. As a result of quality construction and the ease of replacing individual parts, this simulator should provide many years of training when reasonable care and maintenance is practiced.

ITEM INCLUDED:

(1) HE-5000 ECG Heart Model

OVERVIEW:

The HE-5000 ECG Heart Model is designed to help health and allied health professionals to understand how the 12 lead ECG is used to quickly and accurately diagnose patients with acute myocardial infarction. Most textbooks focus on simple pattern recognition for learning how to interpret the ECG. We have discovered that it is far simpler to describe the origins of the ECG using an anatomic model, which overlays the electrocardiographic surface ECG leads on a heart model with an accurate anatomical representation of the normal coronary artery anatomy, namely the HE-5000 ECG Heart Model. The acute myocardial infarction Emergency Quick Reference and Student Guide for the HE-5000 ECG Heart Model is targeted primarily for medical and nursing students, as well as paramedics, emergency medical technicians, and emergency room personnel.

BACKGROUND AND PATHOPHYSIOLOGY:
(AMI Quick Reference Guide, Page 1)

The introductory portion of this teaching guide lays the groundwork for the importance of the problem at hand. Cardiovascular diseases continue to be the leading cause of death in the Western civilization and of these, heart attack is the most common cause of death. It is now well established that if heart attack patients can be treated with thrombolytic drugs or emergence coronary angioplasty within one hour of symptoms, the mortality from heart attack drops to as low as one percent. Unfortunately, when the diagnosis, or treatment, is delayed, the mortality jumps to almost ten percent. Without thrombolytic treatment or angioplasty, the overall mortality is approximately fifteen percent or higher, depending on the clinical status of the patient. Therefore, it is important for ALL personnel caring for chest pain patients to facilitate making the diagnosis of acute MI and initiate treatment to minimize heart muscle damage and save lives.
HEART ATTACK SYMPTOMS:
(AMI Quick Reference Guide, Page 2)

The symptoms of myocardial infarction are fairly self explanatory. It is important to emphasize that not all patients will have typical chest pressure. Epigastric pain is quite common and is the leading symptom associated with misdiagnosis of acute MI. Patients with risk factors for coronary disease (family history of heart attack, bypass surgery or PTCA; history of hypertension, smoking, high cholesterol, diabetes or lack of physical exercise), and unrelenting epigastric pain, should be screened with an electrocardiogram to rule out the possibility of an acute inferior myocardial infarction. Once a patient is recognized as having any of the symptoms associated with acute myocardial infarction, the next step is the quick performance of vital signs simultaneously while electrodes are being applied to the patient for performance of a state ECG.

A. Frontal Plane Leads:
(AMI Quick Reference Guide, Page 3 & 4)

When viewing the HE-5000 ECG Heart Model from the front, the frontal plane leads are visualized, including leads II, III and AvF, reflecting the inferior surface of the heart, and leads I and AvL reflecting the lateral surface of the heart. It is important to point out the anatomical relationship of the right coronary artery coursing along the right and inferior surface of the heart (as viewed facing the model and underneath the heart), and leading along to the inferior surface of the left ventricle. Sudden occlusion of this vessel, then, would result in ischemia with a concurrent injury pattern in the distribution of this vessel. When looking at the HE-5000 ECG Heart Model from the bottom of the model, you can see the leads II, III and AvF emanating from this area. Therefore, ST segment shifts, particularly the injury pattern, caused by ischemia from a right coronary occlusion will be reflected most frequently in leads II, III and AvF. Conversely, on can also see the circumflex coronary artery coursing around the left lateral and posterior aspect of the Heart Model (viewed to the right side and from behind). Occlusion of the circumflex vessels will result in an injury pattern which is reflected in leads I and AvL. Occasionally the circumflex artery extends to the back and posterior surfaces of the heart as well, producing an additional injury pattern in leads II, III and Avf, or V5 and V6.

B. Horizontal Plane Leads:
(AMI Quick Reference Guide, Page 5)

When viewing the HE-5000 ECG Heart Model from above, and the front, the left anterior descending coronary artery can be seen coursing along the from surface of the heart between the right and left ventricles. Leads V1 through V6 emanate from the surface of the left ventricle in the distribution of the left anterior descending coronary artery. Consequently, as sudden occlusion of this vessel will typically produce an injury pattern in a combination of two or more of the V leads. Typically, an injury pattern isolated to V1 and V2 is termed an anteroseptal infarct. An injury pattern in leads V2 through V4 would be termed an anterior infarct, and an injury pattern in leads V2 through V6 would
be termed an anterolateral infarct. Occasionally the injury pattern extends to leads I and
AvL, and this would also be termed an anterolateral infarct.

ECG COMPONENTS: WAVES & SEGMENTS:
(AMI Quick Reference Guide, Pages 6 & 7)

The waves and components of the ECG are illustrated on page 6 of the AMI Quick
Reference Guide. The P-wave is associated with atrial depolarization. The QRS wave
reflects ventricular depolarization, while the T-wave represents ventricular repolarization.
In other words, the atria contract after receiving the signal contained in the P-wave, while
the ventricles contract after receiving the QRS signal. Injury or ischemic ST segment
shifts occur during the segment between the QRS waves and the T-wave. The J point is
the junction of the QRS segment and the ST segment. Deviations in ST segments are
reflected by J point elevation or depression. The normal ST segment should slope slightly
upward from the base line, as illustrated on page 6 in the AMI quick Reference Guide.
Injury patterns associated with coronary occlusions that are acute, consist of an elevation
of the J point with an up sloping of the ST segment, as illustrated in the top figure on
page 7 of the guide. Conversely, if one were to take the ECG pattern demonstrated on the
bottom of page 7 and turn the guide over, holding it up to the light, one would see an ST
depression pattern which is on one surface of the heart is reflected to the anatomical
opposite side of the heart as a negative ST shift. Therefore, the ST depression (see page 6
of the AMI Quick Reference Guide) that occurs as a reciprocal change in response to an
injury pattern on the opposite side of the heart, serves to confirm the diagnosis of acute
myocardial infarction. The combination of an injury pattern on one side of the heart,
coupled with a reciprocal change, or ST depression, on the opposite side of the heart, is
highly diagnostic of acute myocardial infarction. Since the treatments for acute
myocardial infarction are not without risk, patients exhibiting these findings are
considered ideal and certain candidates for thrombolysis or acute angioplasty.

V. ST SEGMENTS WITH ISCHEMIA
(AMI Quick Reference Guide, Page 8)

ST depression can also occur in the case of myocardial ischemia. In other words, when
the artery is not completely blocked off, limited blood flow arrives that the heart muscle,
causing an ischemic condition which does not ordinarily result in tissue damage, but may
result in some impairment of regional heart function. If the ECG demonstrates ST
depression in an anatomical distribution, such as leads III and AvF, or V2 through V5,
without evidence of an accompanying injury pattern in other regions of the heart, at the
same time the patient is experiencing chest pain, this could be considered highly
suggestive of a severe restriction in blood flow to that particular region of the heart.
These patients are at risk as well, only perhaps not as great a risk as those with clear-cut
injury pattern. Thus, the 12 lead ECG is a very useful tool for diagnosing not only acute
heart attack patients, but also those with serious, and potentially life threatening,
limitations in coronary blood flow (non-Q MI or unstable angina). The HE-5000 ECG
Heart Model can be used to demonstrate the concept of reciprocal ST change simply by
putting one’s finger at the origin of V2 or V3 on the surface of the heart. If one points
inferiorly through the heart, the projection of the direction of your finger exits in the direct region of leads II, III and AvF. Thus, the concept of projection of the injury pattern through the heart can be effectively made. The reverse motion can be used by pointing up through the heart from the inferior portion of the heart to demonstrate the effect of an inferior injury pattern appearing as anterior ST depression.

NOTE: Not all injury patterns are associated with reciprocal ST changes. In those cases, the diagnosis of AMI is more difficult and must rely on a synthesis of clinical information (chest pain and character, risk factors, etc.), as well as ECG findings.

VI. DIFFERENTIAL DIAGNOSIS OF OTHER CAUSES OF CHEST PAIN
A. Pericarditis
(AMI Quick Reference Guide, Page 9)

It is helpful to consider the differential diagnosis of chest pain, especially in conditions where the ECG is not diagnostic.
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