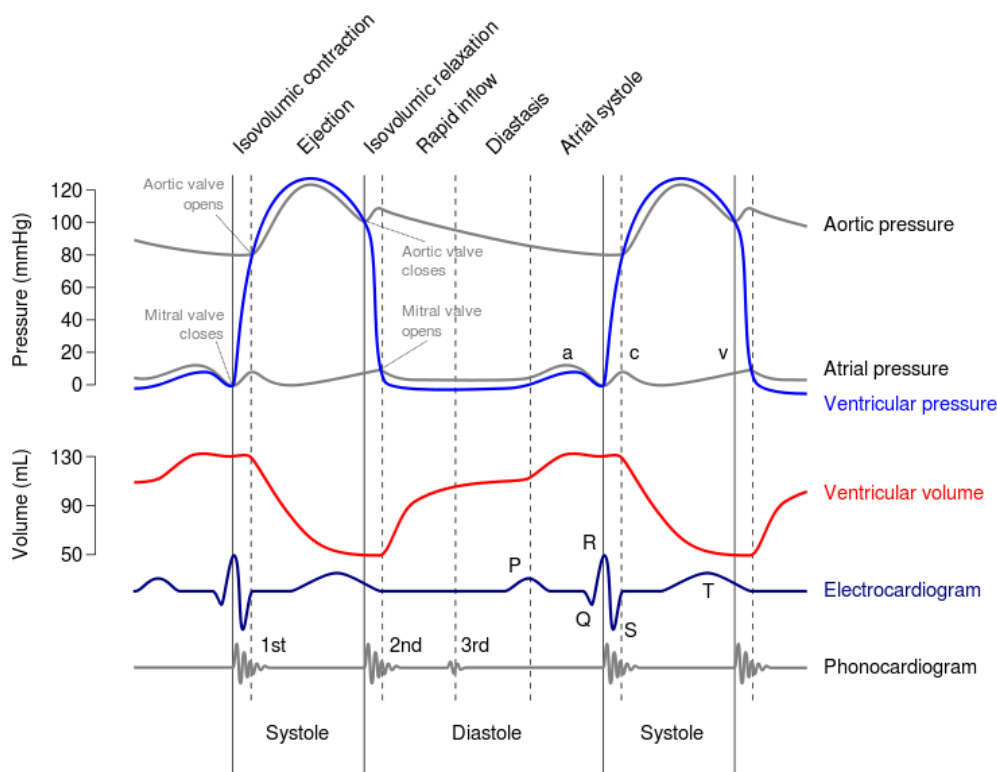


Phonocardiography

PCG(Phonocardiography) is the measure of the heart sounds. It is captured using a stethoscope and microphone. These sounds are generated by valve closure as well as by blood flow turbulence during systole and diastole.

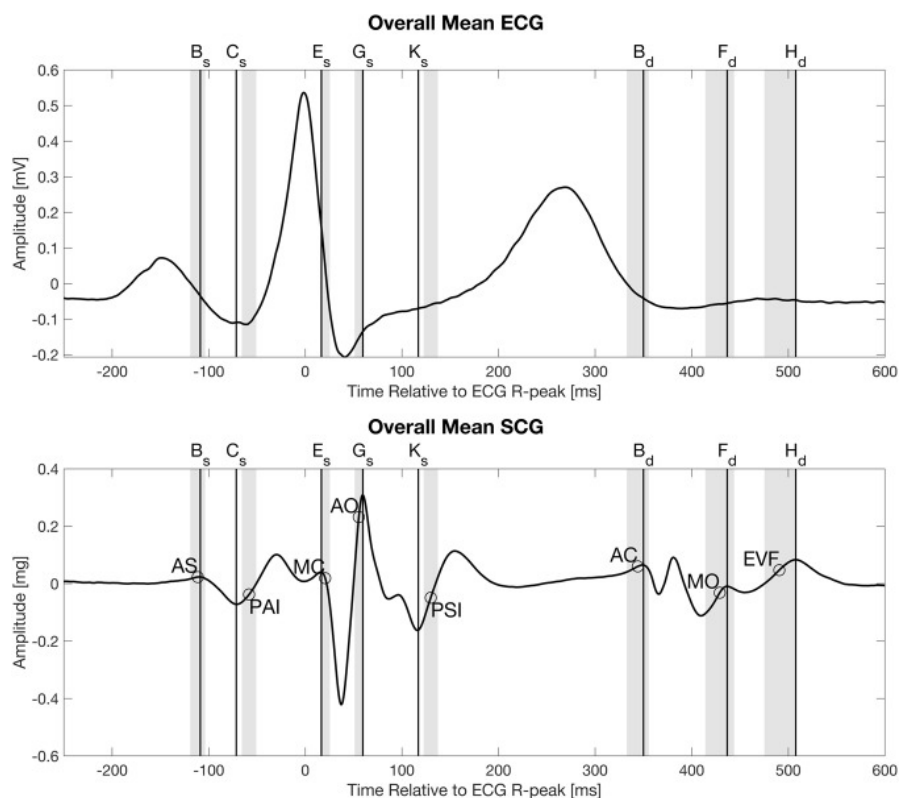
- In a normal heart, two dominant sounds, S1 and S2, appear in rhythmical form. S1, the first heart sound, occurs when the atrioventricular valves (tricuspid and mitral) close at the beginning of systole. S2, the second heart sound, occurs when the aortic valve and pulmonary valve (semi-lunar valves) close at the end of systole.
- It allows the detection of sub-audible sounds and murmurs, and makes a permanent record of these events. The ability to quantitate the sounds made by the heart provides information not readily available from more sophisticated tests, and it provides vital information about the effects of certain drugs on the heart. It is also an effective method for tracking the progress of the person's disease.



Seismocardiography

SCG(Seismocardiography) is a noninvasive method to record ultra low-frequency cardiac vibrations from the chest wall using an accelerometer. The chest acceleration induced by the motion of myocardium is recorded using an accelerometer commonly mounted on the lower part of the sternum.

- In 1957, SCG was recorded under the name of precordial ballistocardiogram. It was used in the early 1960s for monitoring heart rate variability. Afterward, in the late 1980s, SCG was introduced as a technology for monitoring cardiac function. In 1990, SCG promised to provide measures of cardiac contraction and timing of events in the cardiac cycle. But the technique never made it to the clinic due to the advances in ECG and other medical imaging techniques and due to the bulky accelerometers.
- The development of much smaller, lighter and highly sensitive accelerometers transformed SCG to a wearable technology. Wearable systems have been studied in relation to changes in the SCG related to posture, walking and the assessment of heart failure.
- SCG is thus being revised as an easy to use, non-invasive measuring technique of the cardiac performance and health status.
- The signal is deterministic and even though it is more detailed than, for instance, the electrocardiogram (ECG).
- Accurate determination of events, including AO, could make SCG a diagnostic tool for cardiac disease, comparable with the ECG. In addition, SCG could become an important tool in e.g., arterial pulse transit time (PTT) analysis for the assessment of vascular status.



AS- Atrial Systolic Onset, PAI- Peak Atrial Inflow, MC- Mitral Valve Closure, AO- Aortic Valve Opening, PSI- Peak Systolic Inflow, AC- Aortic valve Closure, MO- Mitral valve Opening, EVF- Peak Early Ventricular Filling

Electrocardiography

ECG(Electrocardiography) is the study of the heart's electrical activity, most commonly recorded via placement of electrodes on the skin. These electrodes detect the small electrical changes that are a consequence of cardiac muscle depolarization followed by re-polarization during each cardiac cycle (heartbeat).

- ECG signals are recorded to examine heart rate, heart rate variability, analysis of the waveform morphology, etc.
- There are three main components to an ECG: the P wave, which represents the depolarization of the atria; the QRS complex, which represents the depolarization of the ventricles; and the T wave, which represents the re-polarization of the ventricles.
- The sinoatrial (SA) node acts as the pacemaker of the heart. During each heartbeat, SA node give an electric pulse which starts depolarization which spreads throughout the atrium, and passes through the atrioventricular (AV) node down into the Bundle-of-His and into the Purkinje fibers, spreading down and to the left throughout the ventricles. This orderly pattern of depolarization gives rise to the characteristic ECG tracing.

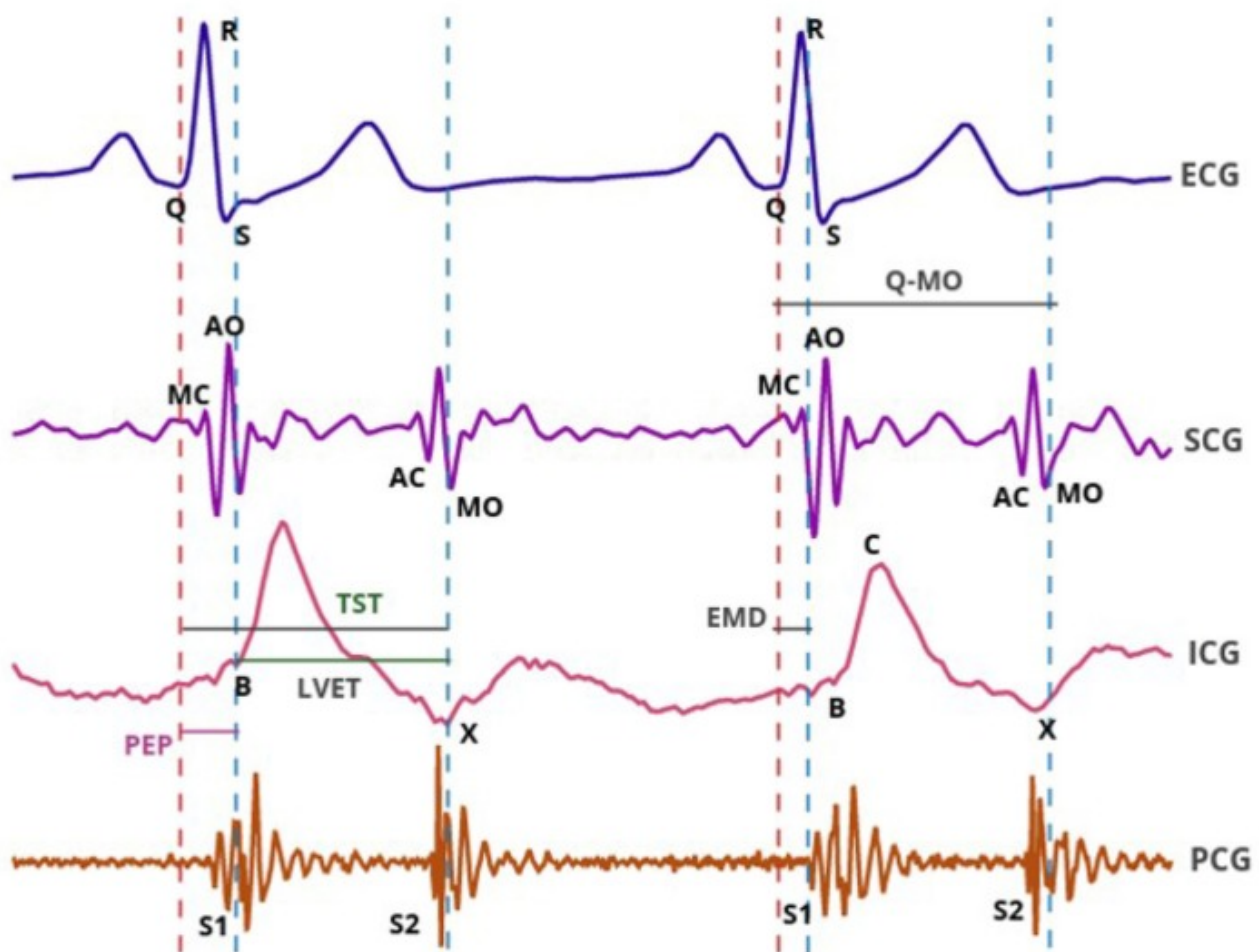


Figure: Comparison of Timings of ECG, SCG, PCG signals