Electrocardiographic Characterization of Acute Myocardial Ischemia

Medical Motivation:
Improve diagnostic accuracy of ECG based early detection of myocardial ischemia in patients at risk of coronary artery disease.

Clinical Setting - Patient Evaluation

1. Patient Symptoms
- Chest Pain
- Shortness of Breath
- Anxiety, Sweating
- Abnormal ECG

2. ECG Diagnostic Tests
Continuous Monitoring
Exercise Stress Testing

3. Patient Evaluation
- ECG Nomenclature
  - ST Elevation
  - ST Depression
  - Normal ST

Abnormal ECG Patterns
- Heart Attack
- Myocardial Ischemia
- Acid Reflux
- Unknown Causes

Experimental Setting - Ischemia Characterization

1. Ischemia Profile
Ischemia = imbalance between blood supply and metabolic needs of the heart

2. Experiments
- Canine Heart
- Cannula
- Blood Pump
- Electrodes
- Measurement of electric fields from the heart during ischemia

3. Electrical Profile of Ischemia
High Resolution 3D mapping of ischemia

In Silico Setting - Ischemia Modeling

1. Ischemia Simulation
Forward Problem
Bioelectric Source → Volume Conductor → Surface Potentials

2. Ischemia simulation to improve patient diagnosis
Patient
ECG Diagnostic Tests
- ST Elevation
- ST Depression

Abnormal ECG Patterns
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Patient Treatment
Ischemia Diagnosis
YES / NO

Extent of Ischemia

Ischemia Simulation