

EFFECTS OF ELECTROLYTE IMBALANCES ON THE HEART (Handout)

In these examples our focus is on what's in the ECF around the cells, not the ICF inside the cells. Theoretically K^+ , Ca^{++} , and Na^+ imbalances could all be factors but in reality Na^+ imbalances rarely affect the heart. You are much more sensitive to changes in K^+ and Ca^{++} .

POTASSIUM - affects mainly the electrical activity of the heart especially repolarization and RMP.

HYPERKALEMIA

- **Key to understanding:** The excess K^+ is not likely to be excess that you ate. The excess results when K^+ exits from the cells due to altered mem. permeability e.g. May be due to acidosis, burns, crushing injuries, etc.
- When there is a surplus of K^+ outside the cardiac cells there is less tendency for the K^+ inside the cells to diffuse out. This decreases RMP closer to threshold and therefore decreases amplitude of AP
- therefore decreases rate of AP transmission and contractility
- therefore slows HR and decreases SV ... therefore decreases CO
- can lead to HEART BLOCK (failure of the conduction system) and ectopic foci
- presents initially on EKG as peaked but symmetrical T waves

HYPOKALEMIA

- Could be from not eating enough K^+ or due to loss through kidneys due to kidney disease or diuretics.
- increases RMP (hyperpolarization)
- therefore HR decreases (yes, the same as with hyperkalemia) because it takes longer to depolarize
- amplitude is not effected so strength of contraction (contractility) is still good

CALCIUM - affects mainly the contractility (strength) of the heart

HYPERCALCEMIA

- causes increased amplitude of AP due to increased # of Ca^{++} entering therefore increased contractility
- Causes (indirectly) a decrease in the frequency of nerve impulses so (HR decreases?)
- presents initially on EKG as shortened S-T segment
- additional sign is flaccid extremities

HYPOCALCEMIA (rare)

- usually causes death by way of skeletal muscle tetany before getting low enough to affect heart
- would increase HR but decrease contractility
- presents initially on EKG as prolonged S-T segment
- additional sign is spastic extremities