Ion Channels

Structure comparison of K+ channels and characteristics of the Hyperpolarization-activated cation currents (HCN)
Presentation Outline

- Voltage gated ion channels
- Superfamily of voltage gated K+ channels
- Characteristics of HCN:
  - Function
  - Structure
- Comparison voltage gated K+ channels/HCN
Presentation Outline

1. Voltage gated ion channels
2. Superfamily of voltage gated K+ channels
3. Characteristics of HCN:
   - Function
   - Structure
4. Comparison voltage gated K+ channels/HCN
1. Voltage gated ion channels

- Ion channels
  - Vh dependent
  - ligand dependent
    - Na+
    - K+
    - Ca2+
    - HCN
  - Mechanosensitive channels
Voltage gated ion channels

- 6 Transmembrane domains
- 1 pore domain
- 1 selectivity domain
2. Superfamily of voltage gated K+ channels

Exemple:

- 6 TM domains
- 1 Ion channel domain
### 3. Characteristics of HCN

**Function:**

- Expressed in heart and nerve cells
- Cardiac and neuronal pacemaker function
- Setting of resting potentials

![Image of ion channels and HCN-related processes]
Physiological characteristics and structure:

- 3 particular characteristics:

  - Activated by hyperpolarization:

    ![Graph showing activation by hyperpolarization with EC50 and Vm (mV) axes]
- selectivity: Na+/K+

- Regulated by cAMP:
Structure

➔ 4 isoforms: HCN1-4:
Description of the domains

6 TM domains:

[Diagram showing 6 transmembrane (TM) domains with amino acid sequences and annotations]

S1

HCN1: L1 M L L M MVGNL V L L PVGIFFF
HCN2: FT M L L F MVGNL V L L PVGIFFF
HCN3: L1 M L L L MVGNL V L L PVGIFFF
HCN4: LT M L L L MVGNL V L L PVGIFFF

S4

KTARALRIVRFTKILSLLRLL
cAMP binding domain:

HCN1

HCN2

HCN3

HCN4
Question

Which sequence explain the different selectivity between K+ channel and HCN
4. Comparison between VGK+ channels and HCN

Potassium Channel

HCN1

Conclusion: Big differences in the sequences: link with function?
Sequence Alignment of Transmembrane domains

Conclusion:

- Differences for TM1
- TM4 is more conserved its differences can not explain the selectivity difference of those two channels

Which difference is responsible of the selectivity?
**Conclusion:**

- Both have signature sequence of K+ selective channels (GYG)
- Amino acids forming the pore before GYG are different, this difference could explain the special selectivity of HCN
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