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Calcium channel

A **calcium channel** is an ion channel which shows selective permeability to calcium ions. It is sometimes synonymous as voltage-gated calcium channel,^[1] although there are also ligand-gated calcium channels.^[2]

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Comparison tables

The following tables explain gating, gene, location and function of different types of calcium channels, both voltage and ligand-gated.

Voltage-gated

Type	Voltage	α_1 subunit (gene name)	Associated subunits	Most often found in
L-type calcium channel ("Long-Lasting" AKA "DHP Receptor")	HVA (high voltage activated)	Ca _v 1.1 (CACNA1S (http://www.genenames.org/data/hgnc_data.php?match=CACNA1S)) Ca _v 1.2 (CACNA1C (http://www.genenames.org/data/hgnc_data.php?match=CACNA1C)) Ca _v 1.3 (CACNA1D (http://www.genenames.org/data/hgnc_data.php?match=CACNA1D)) Ca _v 1.4 (CACNA1F (http://www.genenames.org/data/hgnc_data.php?match=CACNA1F))	$\alpha_2\delta$, β , γ	Skeletal muscle, smooth muscle, bone (osteoblasts), ventricular myocytes** (responsible for prolonged action potential in cardiac cell; also termed DHP receptors), dendrites and dendritic spines of cortical neurons
P-type calcium channel ("Purkinje") /Q-type calcium channel	HVA (high voltage activated)	Ca _v 2.1 (CACNA1A (http://www.genenames.org/data/hgnc_data.php?match=CACNA1A))	$\alpha_2\delta$, β , possibly γ	Purkinje neurons in the cerebellum / <u>Cerebellar granule cells</u>
N-type calcium channel ("Neural"/"Non-L")	HVA (high-voltage-activated)	Ca _v 2.2 (CACNA1B (http://www.genenames.org/data/hgnc_data.php?match=CACNA1B))	$\alpha_2\delta/\beta_1$, β_3 , β_4 , possibly γ	Throughout the <u>brain</u> and peripheral nervous system.
R-type calcium channel ("Residual")	intermediate-voltage-activated	Ca _v 2.3 (CACNA1E (http://www.genenames.org/data/hgnc_data.php?match=CACNA1E))	$\alpha_2\delta$, β , possibly γ	<u>Cerebellar granule cells</u> , other neurons
T-type calcium channel ("Transient")	low-voltage-activated	Ca _v 3.1 (CACNA1G (http://www.genenames.org/data/hgnc_data.php?match=CACNA1G)) Ca _v 3.2 (CACNA1H (http://www.genenames.org/data/hgnc_data.php?match=CACNA1H)) Ca _v 3.3 (CACNA1I (http://www.genenames.org/data/hgnc_data.php?match=CACNA1I))		neurons, cells that have pacemaker activity, bone (osteocytes), thalamus (<u>thalamus</u>)

Ligand-gated

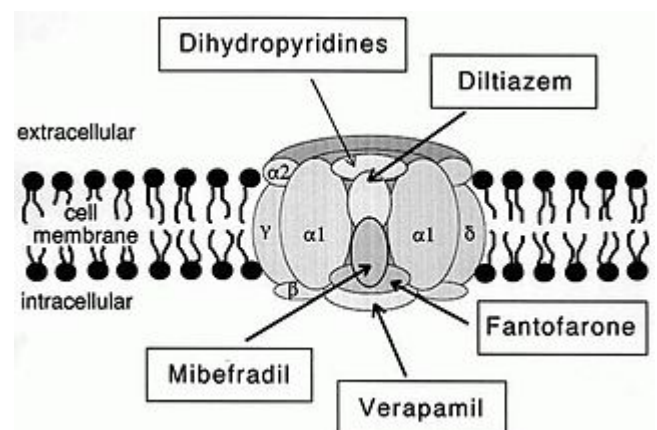
- the *receptor-operated calcium channels* (in vasoconstriction)
 - P2X receptors^[3]

Type	Gated by	Gene	Location	Function
<u>IP₃ receptor</u>	<u>IP₃</u>	ITPR1, ITPR2, ITPR3	<u>ER/SR</u>	Releases calcium from ER/SR in response to IP ₃ by e.g. GPCRs ^[4]
<u>Ryanodine receptor</u>	dihydropyridine receptors in T-tubules and increased intracellular calcium (Calcium Induced Calcium Release - CICR)	RYR1, RYR2, RYR3	<u>ER/SR</u>	Calcium-induced calcium release in myocytes ^[4]
<u>Two-pore channel</u>	Nicotinic Acid Adenine Dinucleotide Phosphate (NAADP)	TPCN1, TPCN2	endosomal/lysosomal membranes	NAADP-activated calcium transport across endosomal/lysosomal membranes ^[5]
<u>Cation channels of sperm</u>	Calcium (CICR)	PKD2 family	sperm (specifically flagella)	non-selective calcium-activated cation channel directing sperm in female reproductive tract ^[6]
<u>store-operated channels</u>	indirectly by <u>ER/SR</u> depletion of calcium ^[4]	ORAI1, ORAI2, ORAI3	<u>plasma membrane</u>	provide calcium signaling to the cytoplasm ^[7]

Pharmacology

L-type calcium channel blockers are used to treat hypertension. In most areas of the body, depolarization is mediated by sodium influx into a cell; changing the calcium permeability has little effect on action potentials. However, in many smooth muscle tissues, depolarization is mediated primarily by calcium influx into the cell. L-type calcium channel blockers selectively inhibit these action potentials in smooth muscle which leads to dilation of blood vessels; this in turn corrects hypertension.^[8]

T-type calcium channel blockers are used to treat epilepsy. Increased calcium conductance in the neurons leads to increased depolarization and excitability. This leads to a greater predisposition to epileptic episodes. Calcium channel blockers reduce the neuronal calcium conductance and reduce the likelihood of experiencing epileptic attacks.^[9]



Depiction of binding sites of various antagonistic drugs in the L-type calcium channel.

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External links

- "Voltage-Gated Ion Channels" (<http://www.iuphar-db.org/IC/ReceptorFamiliesForward>). *IUPHAR Database of Receptors and Ion Channels*. International Union of Basic and Clinical Pharmacology.
 - "TRIP Database" (<http://www.trpchannel.org>). *a manually curated database of protein-protein interactions for mammalian TRP channels*.
 - Calcium Channels (https://www.nlm.nih.gov/cgi/mesh/2011/MB_cgi?mode=&term=Calcium+Channels) at the US National Library of Medicine Medical Subject Headings (MeSH)
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