Dopamine

Mechanism of action

Dopamine's mechanism of action depends on the dosage given, and it can cause vasodilation, increased urinary flow, increased cardiac output, or increased blood pressure, depending on the dose.

Dose

℞ Start with 2–5 mcg/kg/min and titrate.

In a dose (mcg/kg/min) 0.5–2.0 (sometimes up to 5) dopaminergic renal, mesenteric, coronary, & cerebral vasodilatation, (+) inotrope

In a dose (mcg/kg/min) 2–10 β1 positive inotrope

In a dose (mcg/kg/min) > 10 α, β & dopaminergic releases nor-epi (vasoconstrictor)

Indications

Specifically indicated for the correction of hemodynamic imbalances present in the shock syndrome due to myocardial infarction, trauma, endotoxic septicemia.

Dopamine is primarily a vasoconstrictor (β1 effects usually overridden by α-activity). 25% of dopamine given is rapidly converted to norepinephrine (NE). At doses > 10 mcg/kg/min one is essentially giving NE.

Used to treat low blood pressure, low heart rate, and cardiac arrest, especially in acute neonatal cases. It is also indicated for congestive heart failure, trauma, renal failure, and shock. Reactions to intravascular contrast medium if shock develops: add dopamine, start at 5 mcg/kg/min

Hypotension with bradycardia (vasovagal reaction).

Dopamine is ineffective for treating central neurological deficits such as Parkinson's disease, but its amino acid precursor, L-DOPA, can be administered systemically

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see Dopamine overdose hypothesis.

Dopamine (contracted from 3,4-dihydroxyphenethylamine) is a hormone and neurotransmitter of the catecholamine and phenethylamine families that plays a number of important roles in the human brain and body. Its name derives from its chemical structure: it is an amine that is formed by removing a carboxyl group from a molecule of L-DOPA.

Dopaminergic neurons of the midbrain are the main source of dopamine (DA) in the mammalian

central nervous system.

Degeneration primarily of pigmented (neuromelanin-laden) dopaminergic neurons of the pars compacta of the substantia nigra, resulting in reduced levels of dopamine in the neostriatum (caudate nucleus, putamen, globus pallidus).

Side Effects

May cause significant hyperglycemia at high doses.

Function

Prolactin is the only pituitary hormone predominantly under inhibitory control from the hypothalamus by prolactin releasing inhibitory factors (PIFs), with dopamine being the primary PIF.

Parkinsonism may be primary or secondary to other conditions. All result from a relative loss of dopamine mediated inhibition of the effects of acetylcholine in the basal ganglia.

In the brain, dopamine functions as a neurotransmitter—a chemical released by nerve cells to send signals to other nerve cells. The brain includes several distinct dopamine systems, one of which plays a major role in reward-motivated behavior. Most types of reward increase the level of dopamine in the brain, and a variety of addictive drugs increase dopamine neuronal activity. Other brain dopamine systems are involved in motor control and in controlling the release of several other important hormones.

The frontal lobe contains most of the dopamine-sensitive neurons in the cerebral cortex. The dopamine system is associated with reward, attention, short-term memory tasks, planning, and motivation. Dopamine tends to limit and select sensory information arriving from the thalamus to the fore-brain. A report from the National Institute of Mental Health says a gene variant that reduces dopamine activity in the prefrontal cortex is related to poorer performance and inefficient functioning of that brain region during working memory tasks, and to slightly increased risk for schizophrenia.

Recent animal research indicates that dopamine and serotonin, neuromodulators traditionally linked to appetitive and aversive processes, are also involved in sensory inference and decisions based on such inference. Bang et al. tested this hypothesis in humans by monitoring sub-second striatal dopamine and serotonin signaling during a visual motion discrimination task that separates sensory uncertainty from decision difficulty in a factorial design. Caudate nucleus recordings (n = 4) revealed

multi-scale encoding: in three participants, serotonin tracked sensory uncertainty, and, in one participant, both dopamine and serotonin tracked deviations from expected trial transitions within our factorial design. Putamen recordings (n = 1) supported a cognition-action separation between the caudate nucleus and putamen-a striatal sub-division unique to primates-with both dopamine and serotonin tracking decision times. These first-of-their-kind observations in the human brain reveal a role for sub-second dopamine and serotonin signaling in non-reward-based aspects of cognition and action [1)].

Dopamine agonist

Dopamine agonist.

Dopamine receptor

see Dopamine receptor.

Dopamine transporter

see Dopamine transporter

1)

Bang D, Kishida KT, Lohrenz T, White JP, Laxton AW, Tatter SB, Fleming SM, Montague PR. Sub-second Dopamine and Serotonin Signaling in Human Striatum during Perceptual Decision-Making. Neuron. 2020 Oct 5:S0896-6273(20)30715-7. doi: 10.1016/j.neuron.2020.09.015. Epub ahead of print. PMID: 33049201.