Vasopressors And Inotropes

by /

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Outlines

- Definition
- Adrenergic receptors
- Medications and calculations

Vasopressors

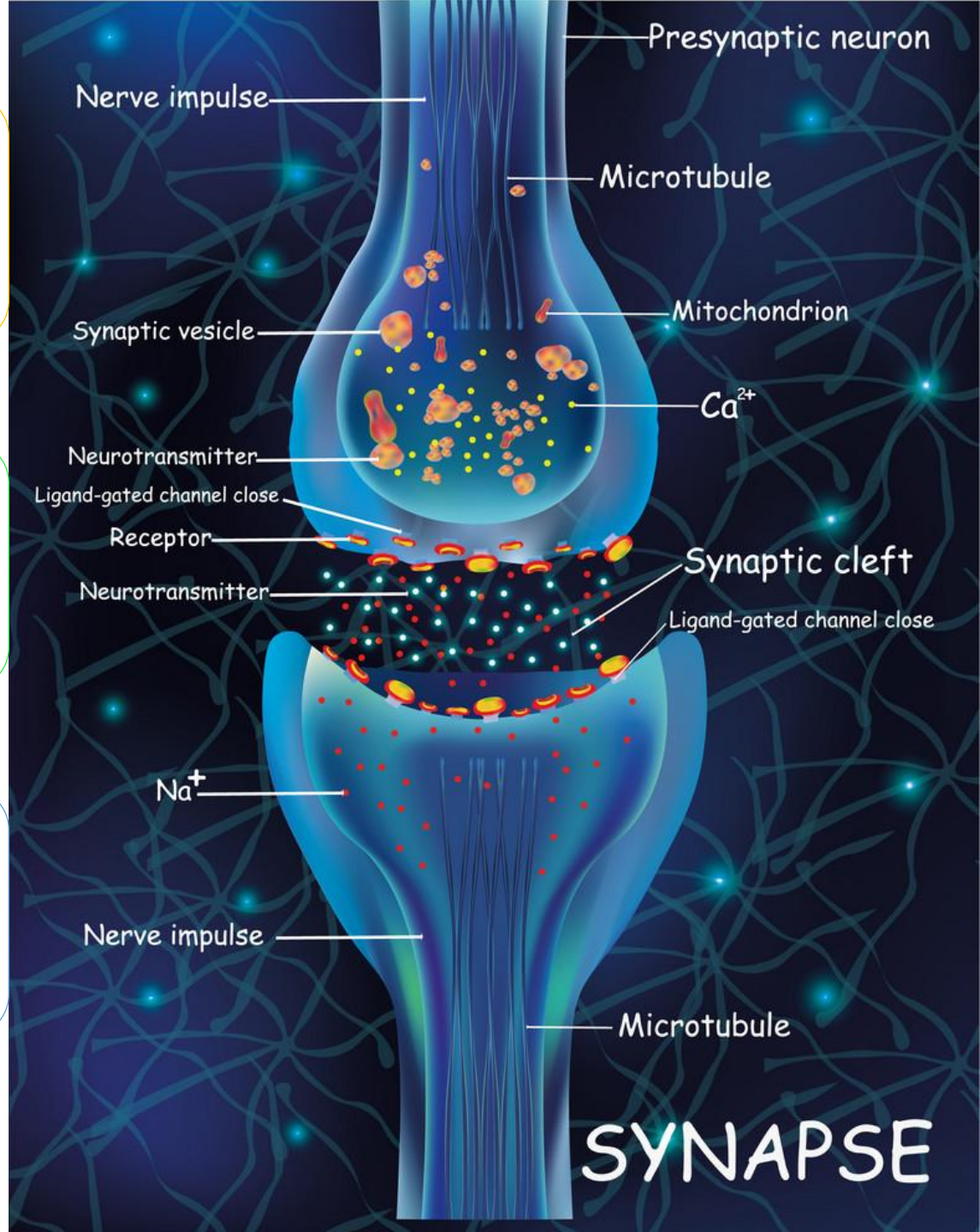
- Make your blood vessels narrower to increase your blood pressure.

Inotropes

- Help your heart pump more blood.

Together

- These two drugs can help your body send more blood to your organs so they can keep running.



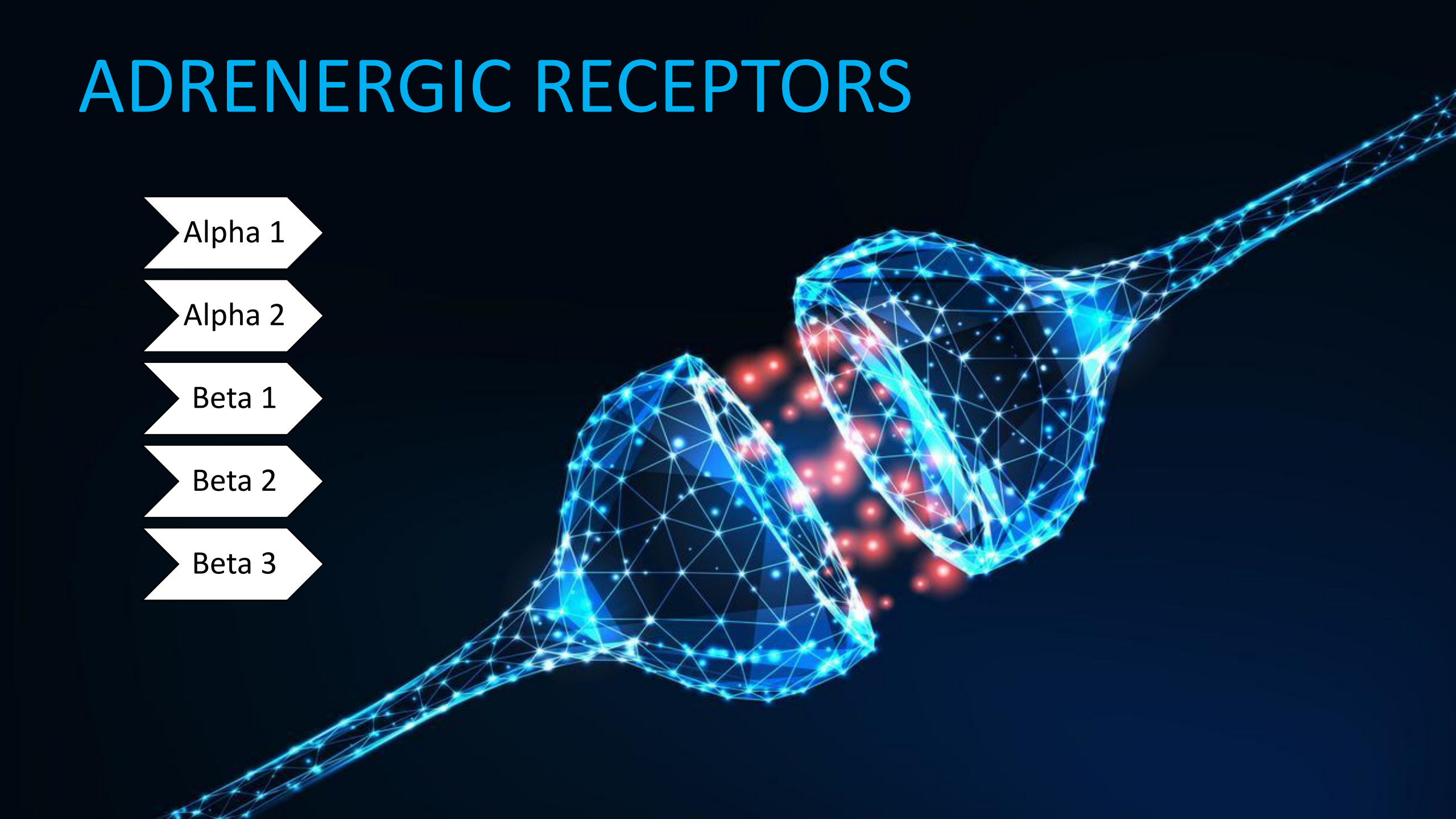
Types of receptor & expected physiologic response

Classification

Agent	Physiologic response	End result	Examples
Inotrope	↑ cardiac contraction	↑ CO, BP unchanged or ↑	Dop, dobut, milrin, Adr,
Chronotrope	↑ HR	↑ CO , ↑ HR	Isopren, dop, adr, dobut (higher dose)
Vasopressor	↑ vascular tone, ↑ SVR& PVR	↑ BP, CO unchanged or ↓	Adr,, NA, vasopressin, dop (higher dose)
Vasodilator	↓ arterial + venous tone, ↓ SVR & PVR	BP unchanged or ↓, CO ↑	SNP, NTG, milrinone
Inodilator	↑ cardiac contraction, ↓ SVR & PVR	↑ CO , , BP unchanged or ↑	Milrinone, dobut, levosimendan
Lusitrope	diastolic relaxation of ventricles	↑ CO (if diastolic dysfunction present)	milrinone

ADRENERGIC RECEPTORS

- Alpha 1
- Alpha 2
- Beta 1
- Beta 2
- Beta 3



Alpha Receptors

Alpha1 (Gq)

(Smooth Muscle Contraction)

Blood Vessels

Pupils

Pylorus

Urinary Sphincter

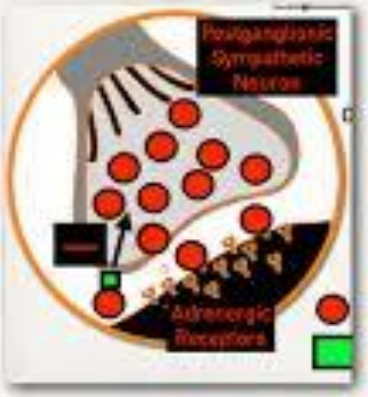
Prostate

Alpha1 (ONE)
O = Blood Vessels
N = Neck of bladder, prostate, stomach
E = Eye

Alpha2 (Gi)

(Inhibitory)

Presynaptic Nerve Terminals



Alpha2 (Two)
TWO = Terminal Weaning Off

Beta Receptors

Gs = Increases cAMP

Beta1 (Gs)

Heart

Kidneys

CO

Renin

Beta2 (Gs)

(Smooth Muscle Relaxation)

Lungs

Blood Vessels

GI Tract

Bladder

Uterus

Liver

Peristalsis

Digestion

Urination

Glucose

Beta3 (Gs)

Adipose Tissue

Bladder

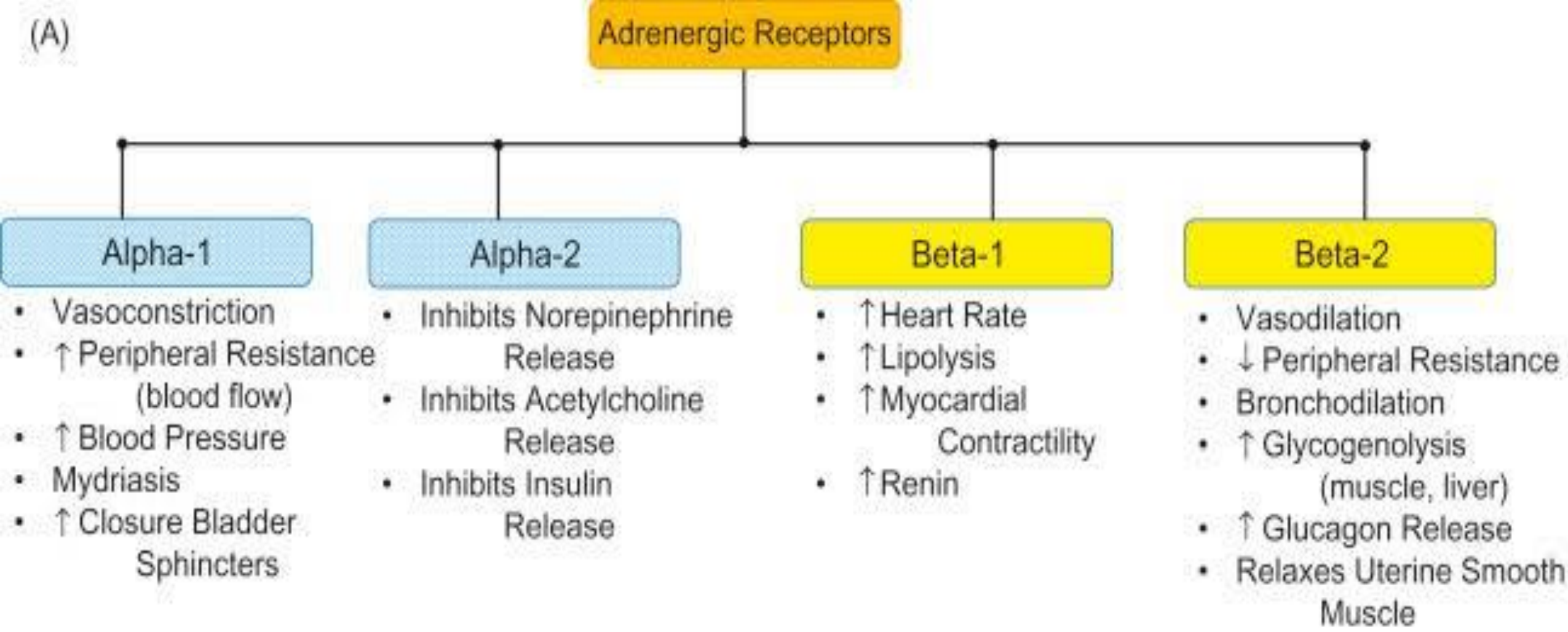
Lipolysis

Urination

Beta1 = Heart = 1 Heart

Beta2 = Lungs = 2 Lungs

(A)



(B)

Alpha-1	Alpha-2	Beta-1	Beta-2
NE > E	E > NE	E = NE	E >> NE
NE = Norepinephrine; E = Epinephrine			

Types of receptor & expected physiologic response

Types of receptor & expected physiologic response

Receptor	Physiologic response	Agent
Alpha 1	Systemic & pulmonary arteriolar vasoconstriction	Adr, NA, Dop
Beta 1	Increased contractility & heart rate	Adr > Dop, Dobut > NA
Beta 2	Systemic vasodilation, bronchodilation, hypokalemia	Adr, Dobut
Dopaminergic	Increased renal and splanchnic blood flow	Dopamine

Epinephrine also known as **adrenaline**, is both a neurotransmitter and a hormone.

It plays an important role in your body's "fight-or-flight" response.

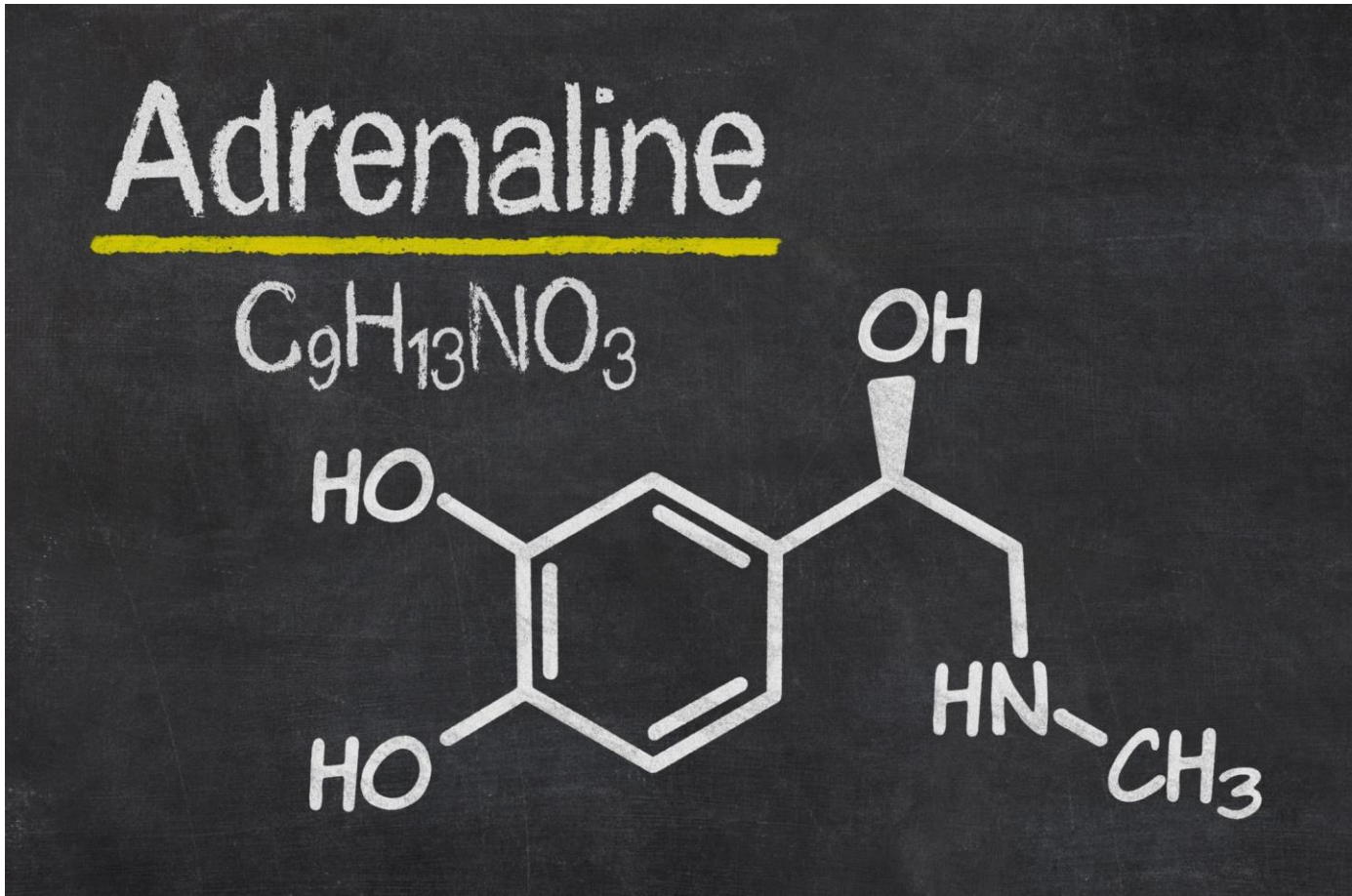
It's also used as a medication to treat many life-threatening conditions.

Could be taken IV, IM, SC, inhalation and ophthalmic.

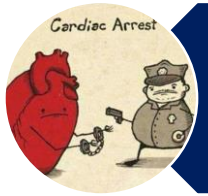
Epinephrine is also called a **catecholamine**

As a hormone, epinephrine is made from norepinephrine inside of your adrenal gland.

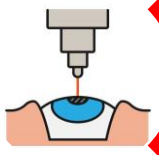
- x Can't be taken orally
- x Can't cross **BBB**
- x Metabolize by **MAO & COMT**



How is epinephrine used as a medication?



Cardiac arrest/cardiopulmonary resuscitation (CPR): epinephrine stimulates your heart.

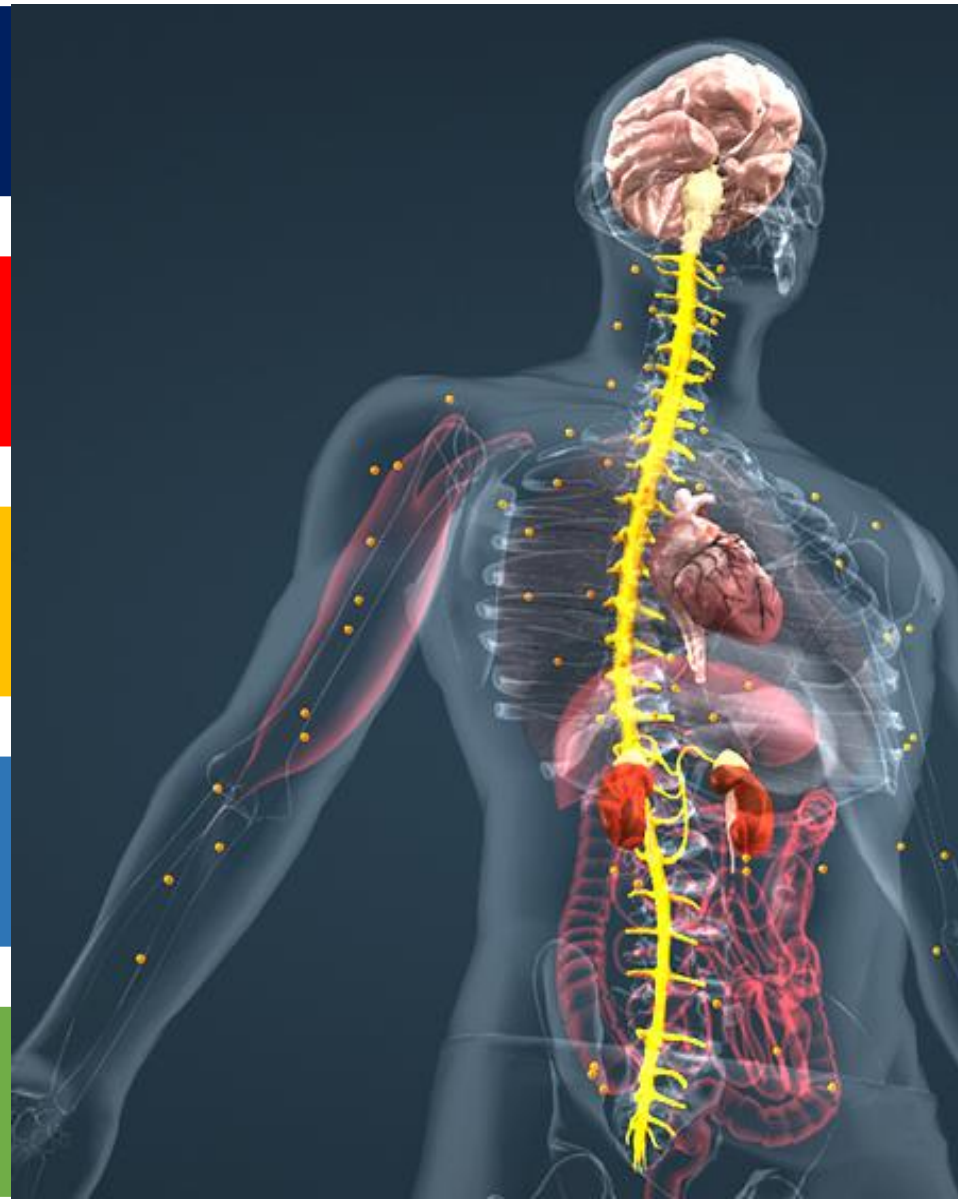


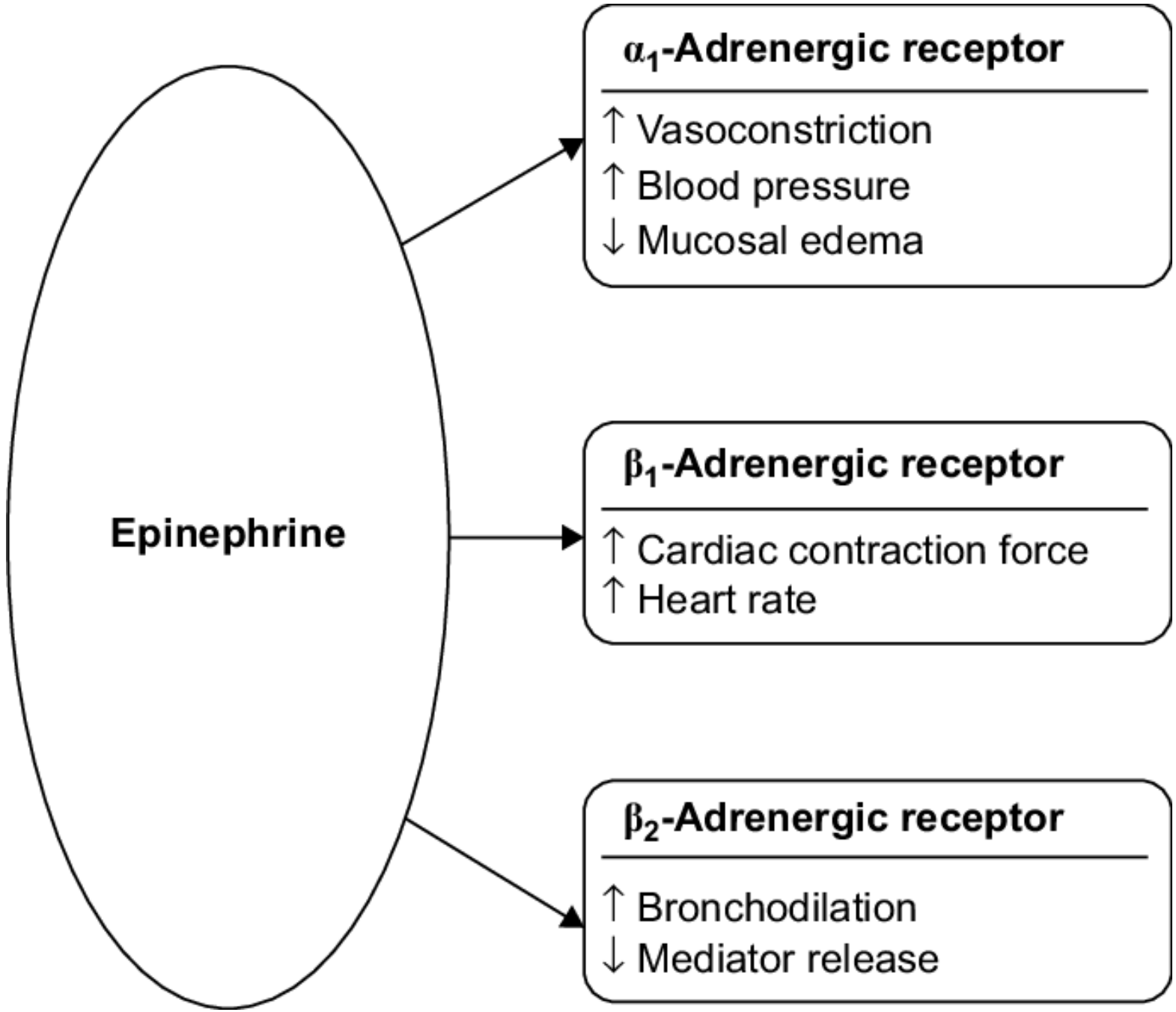
Eye surgery: epinephrine helps keep your pupils dilated.

Septic shock: epinephrine increases your blood pressure.

Asthma: epinephrine opens airways and decreases airway spasms.(Bronchodilation)

Anaphylaxis : epinephrine relaxes airway muscles. It's the first-response treatment for this severe, life-threatening allergic reaction (**intramuscular**)



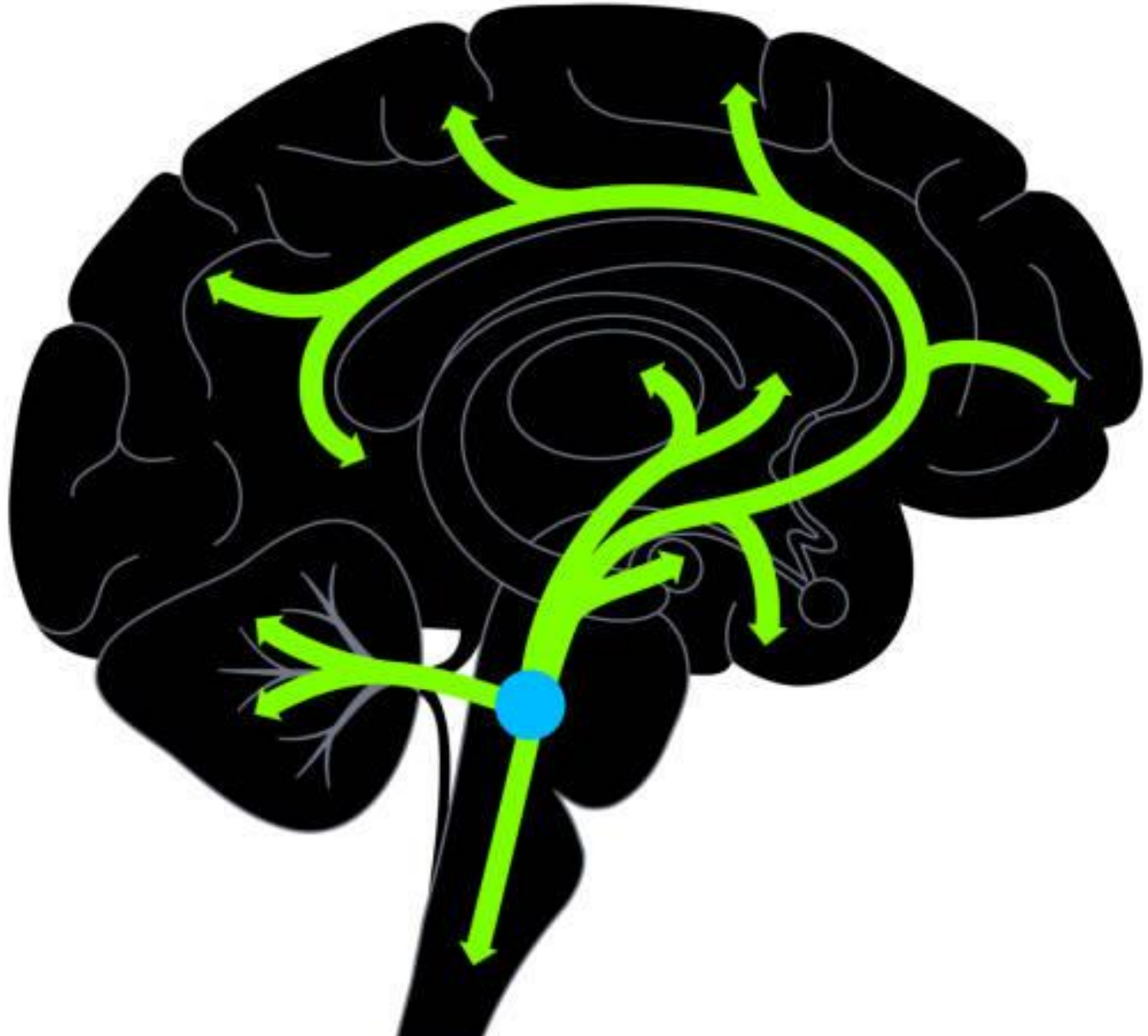

Epinephrine
α1-Adrenergic receptor
↑ Vasoconstriction
↑ Blood pressure
↓ Mucosal edema
β1-Adrenergic receptor
↑ Cardiac contraction force
↑ Heart rate
β2-Adrenergic receptor
↑ Bronchodilation
↓ Mediator release

Adrinaline side effects :

What health conditions result from high levels of epinephrine?

- High blood pressure (hypertension).
- Rapid or irregular heartbeat (Adrenaline can be used for both supraventricular and ventricular arrhythmia induction.)
- Excessive sweating.
- Cold or pale skin. (peripheral bad perfusion)

NOREPINEPHRINE



Norepinephrine (Noradrenaline)

Norepinephrine, also known as noradrenaline, is both a neurotransmitter and a hormone.

It plays an important role in your body’s “fight-or-flight” response.

As a medication, norepinephrine is used to increase and maintain blood pressure in limited, short-term serious health situations.

Norepinephrine (Noradrenaline)

As a neurotransmitter, it’s a chemical messenger that helps transmit nerve signals across nerve endings to another nerve cell, muscle cell or gland cell.

As a hormone, it’s released by your adrenal glands, which are hat-shaped glands that sit on top of each kidney.

Could be only **taken intravenous infusion.**

Systemic toxicity manifests as uncontrolled hypertension with signs and symptoms of end-organ ischemia.

Sometimes bradycardia.

DoPamine	doButamine
Natural (from dopa) catecholamine	Synthetic catecholamine
D1 < B1 < Alpha1	B1 ONLY (increase COP and HR)
Shock (septic)	Cardiogenic shock (echo)
Intravenous infusion	Intravenous infusion
Side effects : affect kidney function, causing increased urinary flow and irregular heartbeat	Side effects : arrhythmia

Milrinone

Milrinone increases the strength of your heart muscles and widens your blood vessels.

It treats heart failure, which is a condition that prevents your heart from pumping very well.

A healthcare provider will give you this injection in a hospital or clinic setting. The brand name for this medication is Primacor®.

Milrinone

MOA : Milrinone is a phosphodiesterase-3 inhibitor.

This drug inhibits the action of phosphodiesterase-3 and thus prevents degradation of cAMP.

Normally, cAMP causes increased activation of protein kinase A (PKA).

PKA is an enzyme that phosphorylates many elements of the contractile machinery within the heart cell.

Milrinone

- Increase influx of calcium and influx of potassium.
- Increase myosin and actin filaments.
- Improving cardiac contractility (inotropy), cardiac relaxation (lusitropy), and inducing vasodilation and has the overall effect of increased cardiac output.

Milrinone

Side effects :

- Cardiovascular side effects have included ventricular arrhythmias (12%),
- Ventricular ectopic activity (8%),
- Supraventricular arrhythmias (3.8%),
- Sustained and nonsustained ventricular tachycardia (1% and 2.8%, respectively),
- Ventricular fibrillation (0.2%), and atrial fibrillation.

Amiodarone

MOA : Amiodarone is considered a class III anti-arrhythmic drug.

It blocks potassium currents that cause repolarization of the heart muscle during the third phase of the cardiac action potential.

As a result amiodarone increases the duration of the action potential as well as the effective refractory period for cardiac cells (myocytes). Therefore, cardiac muscle cell excitability is reduced, preventing and treating abnormal heart rhythms.[5,10]

USES :

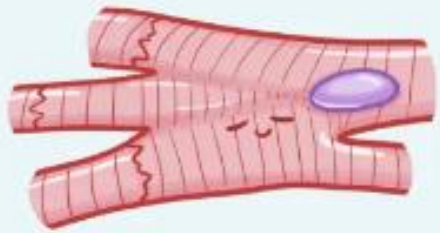
Amiodarone can be used to treat or prevent the recurrence of certain arrhythmias, including supraventricular arrhythmias (such as atrial fibrillations), ventricular arrhythmias, (such as ventricular fibrillation), and ventricular tachycardia.

CLASS III ANTIARRHYTHMIC MEDICATION

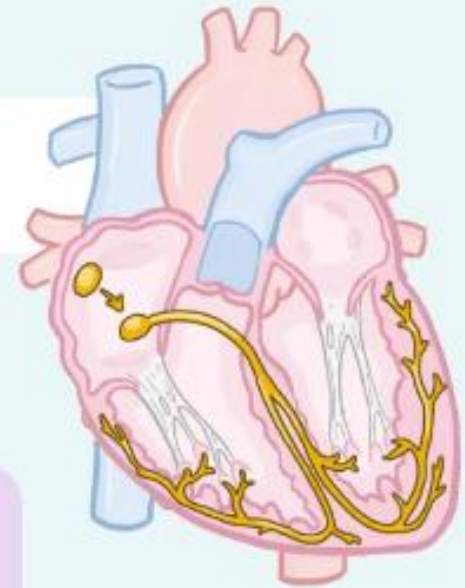
↳ TREATS/PREVENTS ARRHYTHMIAS & CARDIAC ARREST

HOW AMIODARONE WORKS

PREVENTS CONDUCTION of UNWANTED ELECTRICAL ACTIVITY (by ↓ excitability of heart tissue)



HEALTHY ELECTRICAL ACTIVITY



ARRHYTHMIA

DISTURBANCE in RATE, RHYTHM, ORIGIN, or CONDUCTION of ELECTRICAL ACTIVITY

SIDE EFFECTS

COMMON

* NAUSEA
* VOMITING
* WEIGHT LOSS
* BLUISH-GREY SKIN DISCOLORATION
* HYPO- or HYPER- THYROIDISM
* LIVER DISEASE
* HYPERSENSITIVITY

with LONG-TERM USE

¡ **DAMAGE to LUNGS**
↳ DRY COUGH, SHORTNESS of BREATH, CHEST PAIN

* **EFFECTS on HEART**
↳ SINUS BRADYCARDIA, ARRHYTHMIAS

RARE

* OPTIC NEUROPATHY
↳ LEADS to BLURRED VISION
* MEMORY LOSS
* CONFUSION
* PERIPHERAL NEUROPATHY

lidocaine

The lidocaine agent acts on sodium ion channels located on the internal surface of nerve cell membranes

lidocaine may cause stimulation of the CNS followed by depression and in the cardiovascular system, it acts primarily on the myocardium where it may produce decreases in electrical excitability, conduction rate, and force of contraction

lidocaine

USES :

Through an IV to treat **cardiac arrest** caused by ventricular arrhythmias that don’t respond to defibrillation.

Side effects :

Bradycardia, hypotension, cardiovascular collapse, cardiac arrest

Calculations

Drug	Preparation/Diluent	Dose **Maximum dose**
Adrenaline 1 mg/ml	---- ml/ 24 ml Not to exceed 4 mg adrenaline /24 ml G5% (preferred) / N.S	Continuous infusion : (0.1---1 mcg/kg/min) **Maximum dose:** **1 mcg/kg/min**
Noradrenaline 4 mg base (8 mg salt)	4 mg base (8 mg salt) / 100 ml (40 mcg/ml) G5% / N.S	Continuous Infusion : (0.05 – 2 mcg/kg/min) **Calculated on base N.E** **Maximum dose:** **2 mcg/kg/min**

Calculations

Dobutamine (250 mg/20 ml)	250 mg / 50 ml (5000 mcg/ml) G5% / N.S	2– 20 mcg/kg/m **Maximum dose:** **40 mcg/kg/min**
Milirinone (10 mg/10 ml)	10 mg /50 ml (200 mcg/ml) G5% / N.S	**Loading dose (optional)** 50 mcg /kg over 10 to 60 minutes **Maintenance Dose:** 0.25 – 0.75 mcg/kg/min.(up to **(Maximum 1 mcg/kg/min)**

Calculations

Amiodarone 150 mg/3 ml	**Minimum dilution up to** **6 mg/ml**. commonly used(3 -1.5 mg/ml) **Usual preparation :** 1.2 ml (60 mg amiodarone)/40 ml G5%. ---**1.5 mg/ml** 2.4 ml(120 mg amiodarone)/40 ml G5%- ---**3 mg/ml** **G5% only** Check for I.V Y-site incompatibility	**Loading dose :** **5 mg/kg over 30 to 60 MIN.** (max.300 mg) may repeat initial loading dose to a maximum total initial load: **10 mg/kg; do not exceed total daily** bolus of 15 mg/kg/day. **Maintenance Dose :** 5 – 15 mcg /kg /min		-used bolus infusion time of 60 minutes to avoid hypotension.

Calculations

LIDOCAINE 2% *2gm /100 ml* *(20mg/1ml)*	**Given undiluted** **Bolus :** **(The injectable solution of 20 mg/mL may be administered undiluted)** **Continuous IV infusion:** **Dilute in D5W or N.S to a concentration (1 to 8 mg/mL)** **Agreed Fixed preparation for bolus and I.V infusion)** **dilute 20 ml of 2% lidocaine diluted to 50 ml G5% or N.S)** **(8 gm/ml)**	**Loading dose**: **1 mg/kg/dose;** (dilute 1 ml lidocaine 2% to 20 ml G5% or Ns), and **give 1 ml /kg** then continuous IV infusion; may administer second bolus if delay between initial bolus and start of infusion is >15 min. **Maintenance dose:** **(20 to 50 mcg/kg/m).** Do not exceed 20 mcg/kg/m in patients with shock, hepatic disease, cardiac arrest, or CHF.	**May be given undiluted ,but better diluted to a concentration up 8,000 mcg/mL (8mg/mL)**	


Thank You