Cholinoceptor (cholinergic receptor)

Inhibit the release of transmitters(Heteroceptor)

M1: CNS neurons,Sympathetic postganglionic and some presynaptic site

M2: myocardium ,smooth muscle ,some presynaptic site ,CNS

M3 : Exocrine gland, all blood vessel (smooth muscle and endothelium), CNS

M4: CNS

M5:CNS

Nicotinic NN: Postganglionic neurons, some presynaptic cholinergic terminals. → In the brain, they increase the release of dopamine, serotonin, and many transmitters

Nicotinic NM: Skeletal muscle neuromuscular end plates.

both receptors (NM and NN)are stimulated by Ach and nicotine but they are different.

Adrenoceptors

Alpha1 (α)1:

Postsynaptic, especially smooth muscle.

Formation of IP3 and DAG, increased intracellular Ca producing smooth muscle contraction.

Alpha2 (α) :

Presynaptic adrenergic nerve terminals, platelets, lipocytes, smooth muscle.

Inhibits NE release.

Inhibition of adenylyl cyclase, decreased cAMP

Beta1 (β1) :

Heart, lipocytes, brain;, juxtaglomerular apparatus of renal tubules.

Stimulation of adenylyl cyclase, increased cAMP

Beta2(β2):

smooth muscle & cardiac muscle.

Stimulation of adenylyl cyclase and increased cAMP.

Beta3 (β3) :

lipocytes;

Stimulation of adenylyl cyclase & increased cAMP

Dopamine receptors

D1 (DA 1, D5) :

Brain, especially smooth muscle of the renal vascular bed.

Stimulation of adenylyl cyclase and increased cAMP.

D2 (DA 2, D3, D4):

Brain, especially smooth muscle; presynaptic nerve terminals (D2).

Inhibition of adenylyl cyclase; increased potassium conductance.

↓ dopamin release → ↓ cAMP ↑

* Direct effect of autonomic nerve activity

-In eye :

a) RADIAL muscles that have an a1 receptors: when stimulated → it causes the pupil widen, which is called mydriasis

b) CIRCULAR muscles that have M3 receptors: stimulated → decrease the pupil size, which is called miosis

Contraction ----→ elevate near vision

The state of pupil depends on the amount of light:

- Bright light → circular muscles are activated → miosis
- Dark (lights are off) → radial muscles are stimulated → mydriasis → increase pupil size → more light comes → able to see

تتحكم بمدى الرؤية

It can contract and relaxe under the effect of parasympathetic only

near vision

Far vision

- Heart

In the SA node beta 1 receptors activation increases the heart rate and M2 receptors activation decreases it.

The original pacemaker is the SA node, if any other component becomes the pacemaker, it is called an ectopic pacemaker, this will result in very rapid and fast contraction of the heart (arrythmia) which can lead to death.

As we said, B1 activation increases the heart rate, that's why people who suffer from arrythmia are given beta blockers.

Contractility in general is increased by beta 1 activation

Contractility of the atria is decreased by M2 activation, while for the ventricles they don't have M3 receptors, in fact, they don't have any parasympathetic innervation.

- Bronchiolar smooth muscle

we use drugs that stimulate b2 receptors for people with bronchial asthma to DILATE the bronchioles - -> breath better

When M3 receptors are stimulated bronchioles contract --> bronchospasm --> wheezing --> difficulty breathing

- Genitourinary

The bladder has b2 receptors --> relaxes // the bladder Sphincter has a1 --> contract

When those cases happen together --> DIFFICULTY in urination.

When somebody is very worried, he goes frequently to the bathroom, every time he goes to the bathroom he doesn't evacuate the bladder properly

so after minutes he comes back , WHY??

Because the sympathetic nervous system is acting on the bladder , While urination depends on the parasympathetic system that causes

i) Bladder wall contraction : urine is pushed out

ii)Sphincter relaxation : open sphincter : urination

Penis and seminal vesicles have a receptors responsible for the ejaculation and M receptors responsible for erection

-In Skin :

Smooth muscles have a receptors --> contract

Sweet glands have M receptors --> increase

Both have ONLY SYMPATHETIC stimulation, although sweet glands have muscarinic receptors, but they are sympathetic not parasympathetic

-In Liver :

B2 activation --> Glycogenolysis (breakdown of glycogen) --> increase glucose level, which is important in emergency so muscles can move and can brain think since they need glucose as fuel.

But this is bad for DIABETIC people;
If someone has diabetes and gets an infection or gets angry --> activate sympathetic system --> blood glucose level increase by Glycogenolysis and gluconeogenesis Also lipolysis in fat cells is increased by b3 effect

-In Kidney :

It releases renin by b1 stimulation

-In blood Vessels:

-alpha 1 receptors activation on skin splanchnic vessels causes contraction
- beta 2 activation on skeletal muscle vessels causes relaxation
- by NO effect M3 and M5 receptors in the endothelium of skeletal muscle vessels will be activated and cause relaxation
Pay attention, the relaxation here happened by drug effect NOT be Ach effect.

Baroreceptor

stretch/mechanical receptors that sense the increase in the stretch of great arteries like aorta and carotid artery

1- when blood pressure increases, the arteries will be stretched, these baroreceptors will sense this stretch in the neuron connected to cardioregulatory centers in brainstem and send a signal to the brain, the brain immediately activates the parasympathetic vagus nerve that causes the heart rate to decrease (bradycardia). So any increase in the blood pressure causes the reflex decrease in the heart rate and vice versa

2- When blood pressure decrease, this will be sensed by the sensory baroreceptors, they send a signal to the brain to activate the sympathetic nerve that cause increase in heart rate (tachycardia) to balance the blood pressure and keep the homeostasis of the body . The cardioregulatory centers in the brain stem coordinate this process

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