Understanding of Autonomic Nervous System with special reference to Vata Dosha

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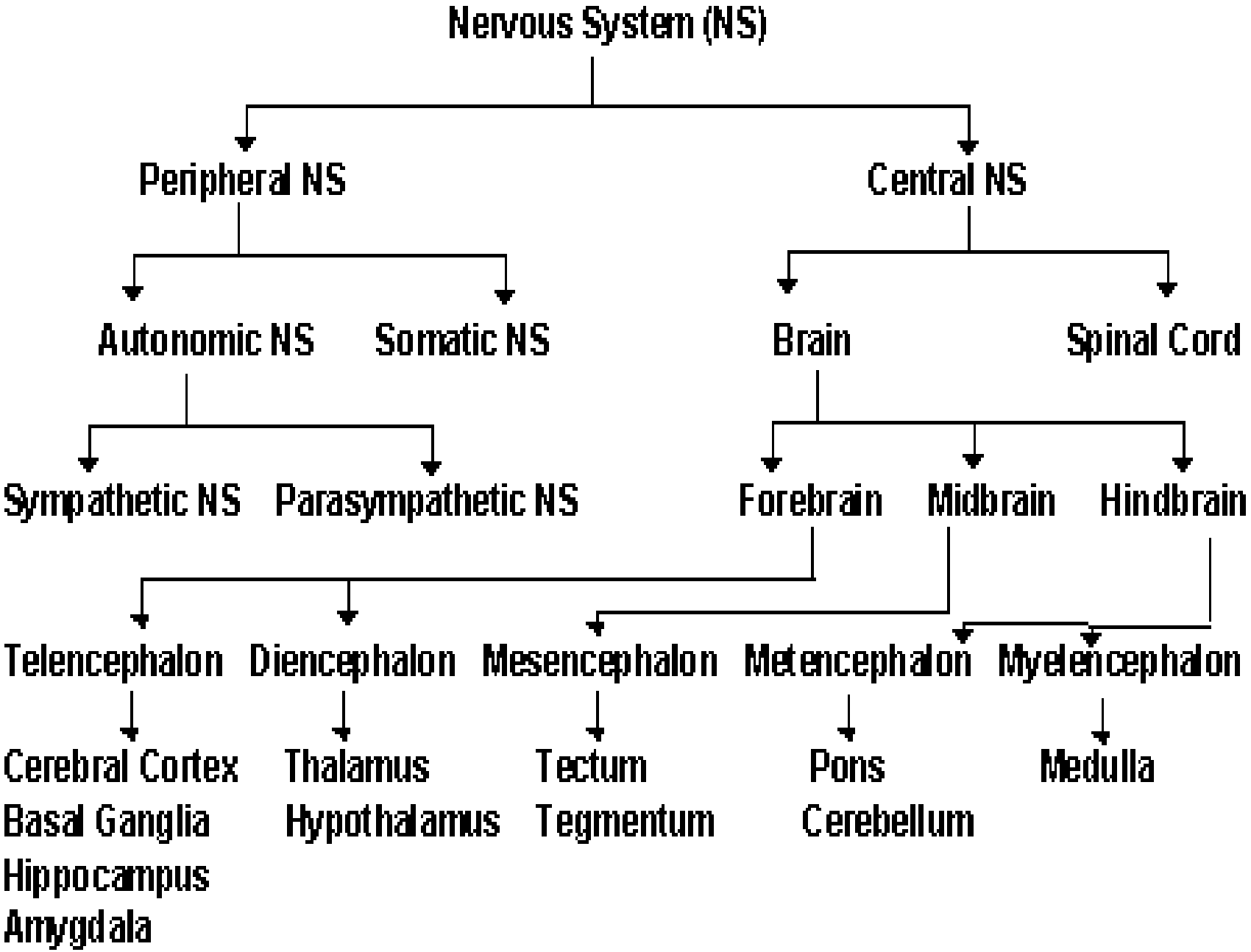

Nervous System (NS)
Peripheral NS
Central NS
Autonomic NS
Somatic NS
Brain
Spinal Cord
Sympathetic NS
Parasympathetic NS
Forebrain
Midbrain
Hindbrain
Telencephalon
Diencephalon
Mesencephalon
Metencephalon
Myelencephalon
Cerebral Cortex
Basal Ganglia
Hippocampus
Amygdala
Thalamus
Hypothalamus
Tectum
Tegmentum
Pons
Cerebellum
Medulla

Autonomic Nervous System:

- Derived from the words auto means ‘self’ and nomos means ‘control’.
- Emotional responses of the body and responses to environment.
- Primarily concerned with regulation of visceral or vegetative functions of the body. So, it is also called **Vegetative** or **Involuntary nervous system.**

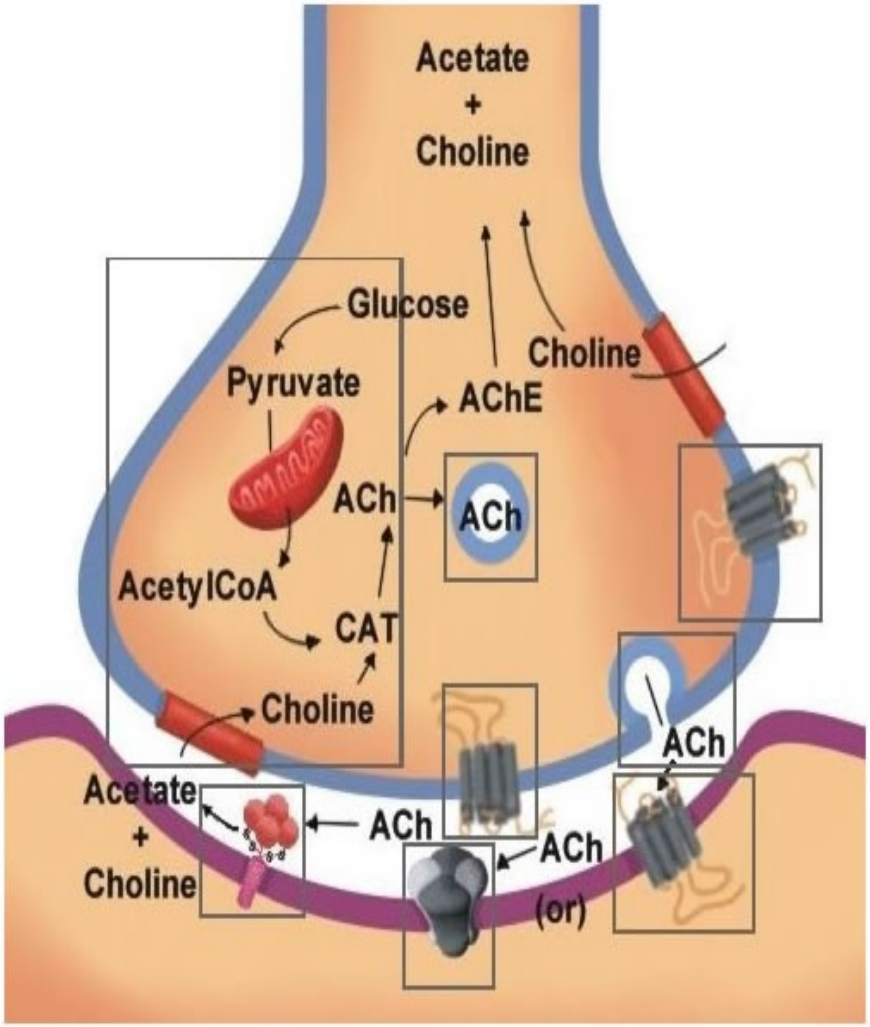
Innervation

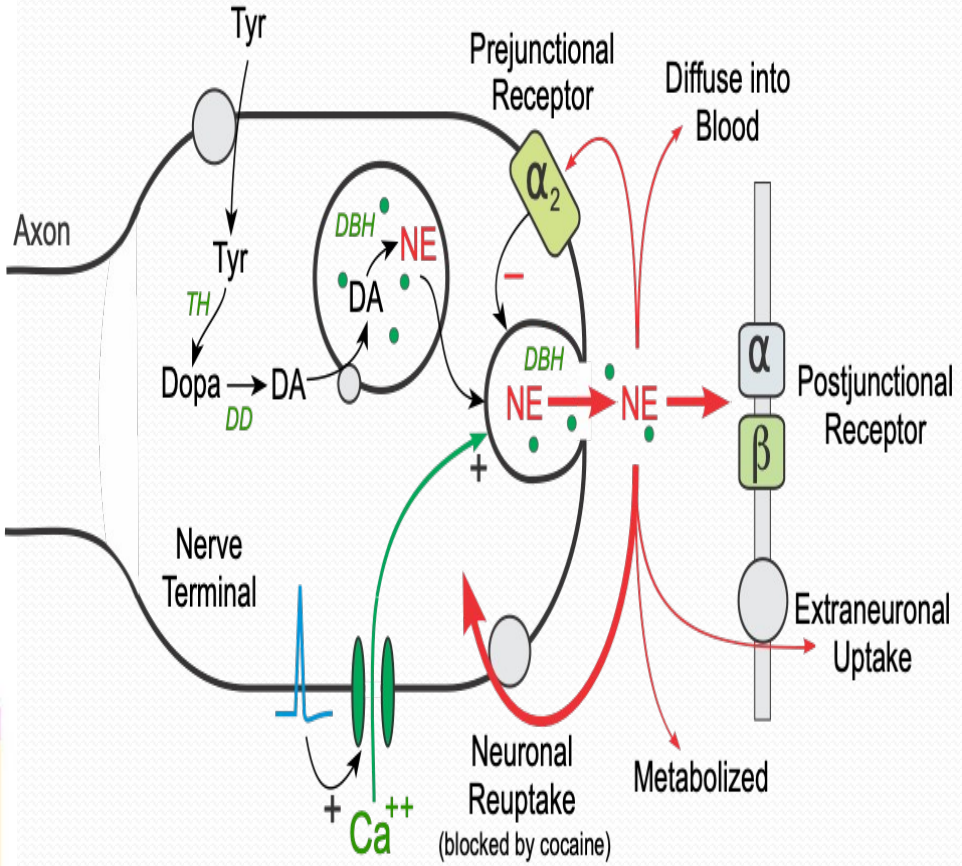
- All smooth muscles
- All the glandular structure
- Myocardium
- Innervates all over the body EXCEPT neuromuscular structure of skeletal muscle.

Biochemical substances

- Acetylcholine
- Noradrenaline

Synthesis of Ach and NE



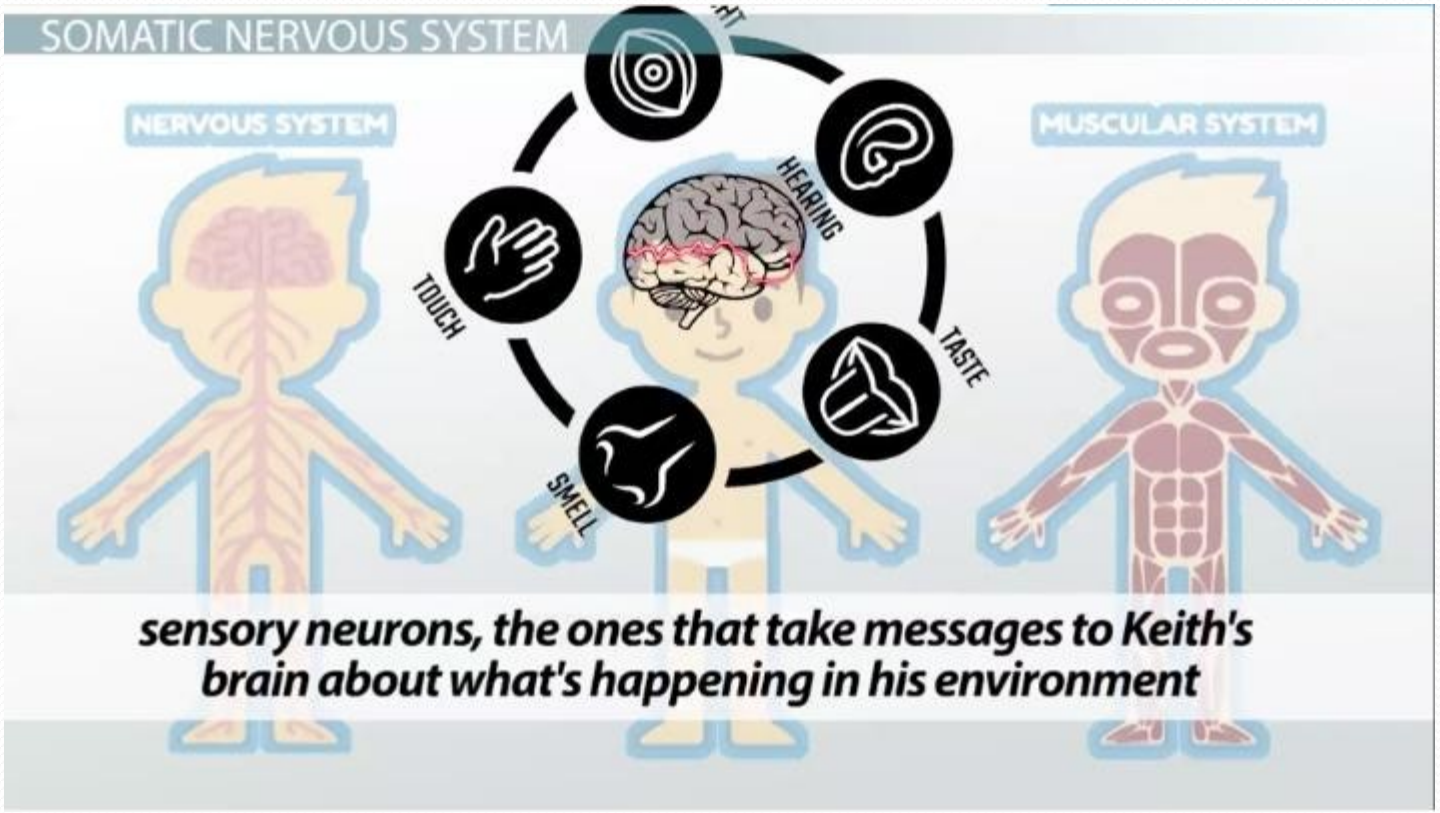


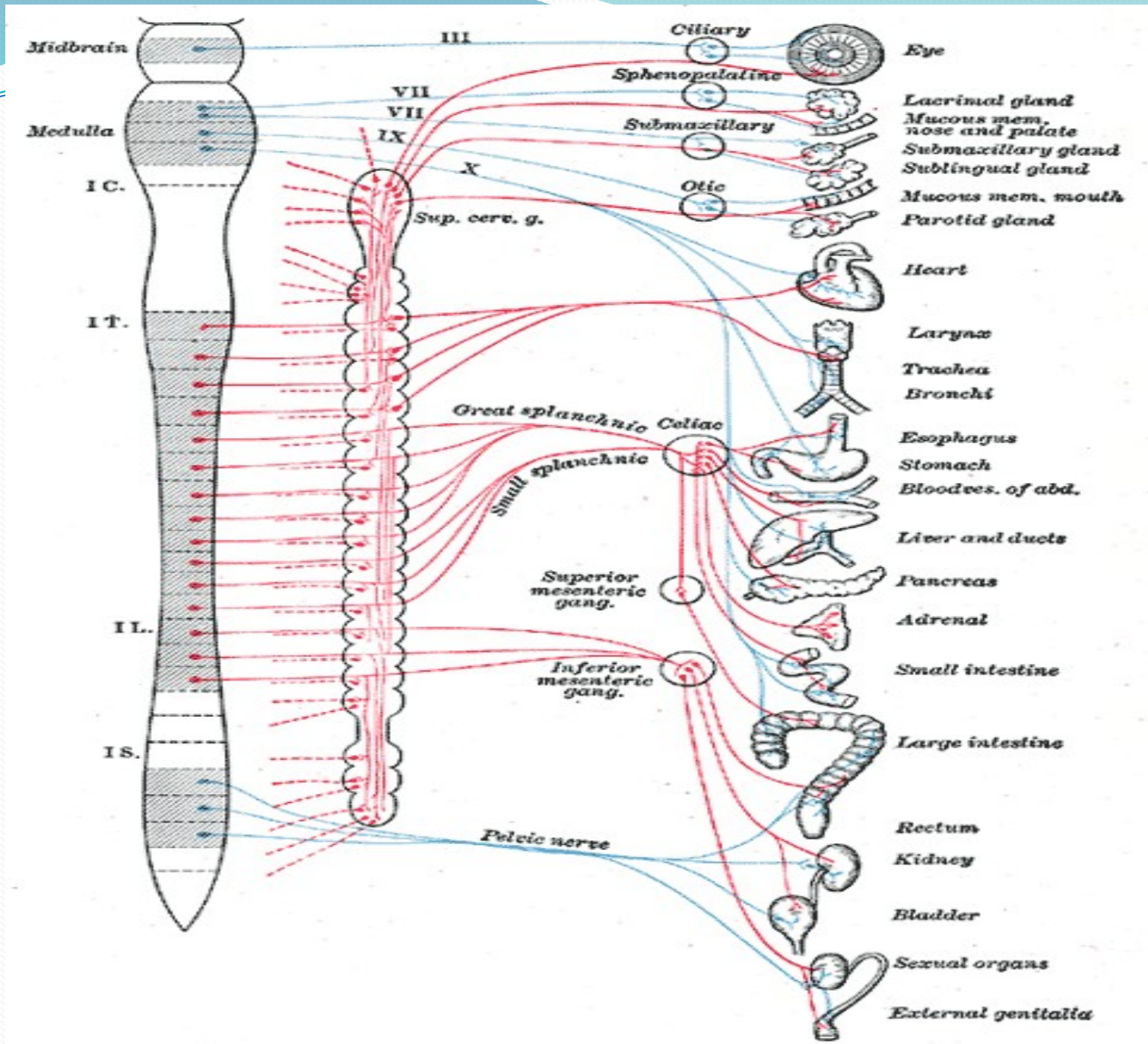
Tyr, tyrosine; *TH*, tyrosine hydroxylase; *DD*, DOPA decarboxylase; *DA*, dopamine; *DBH*, dopamine β-hydroxylase; *NE*, norepinephrine

Division

- Three division—
  1. Sympathetic
  2. Parasympathetic
  3. ENS

Various influencer of autonomic system




Midbrain
Medulla
I C.
I T.
I L.
I S.
III
VII
VII
IX
X
Sup. cerv. g.
Ciliary
Sphenopalatine
Submaxillary
Otic
Great splanchnic
Celiac
Small splanchnic
Superior mesenteric gang.
Inferior mesenteric gang.
Pelvic nerve
Eye
Lacrimal gland
Mucous mem. nose and palate
Submaxillary gland
Sublingual gland
Mucous mem. mouth
Parotid gland
Heart
Larynx
Trachea
Bronchi
Esophagus
Stomach
Bloodves. of abd.
Liver and ducts
Pancreas
Adrenal
Small intestine
Large intestine
Rectum
Kidney
Bladder
Sexual organs
External genitalia

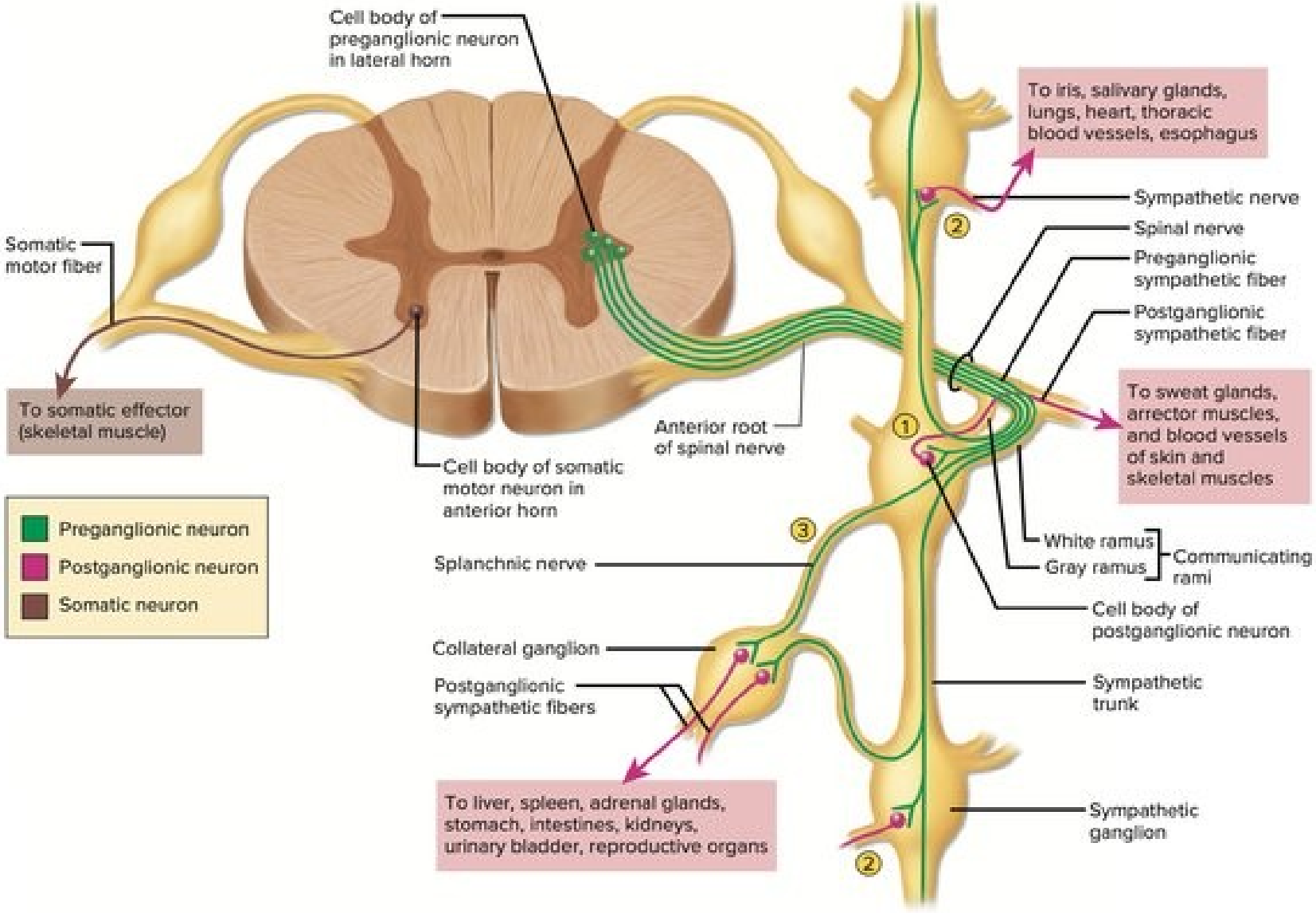


FIGURE 15.5 Neural Pathways Through the Sympathetic Chain Ganglia. Sympathetic fibers can follow any of the three numbered routes: (1) the spinal nerve route, (2) the sympathetic nerve route, or (3) the splanchnic nerve route. The somatic efferent pathway is shown on the left for comparison.

Sympathetic System:

- Emergency conditions
- Exercise
- Stressful situations, sympathetic system provides the desirable assistance.
- Critical situations in life.
- Sympathetic system also helps to control normal functions of the body such as regulation of blood pressure, respiration, metabolism, etc.

Sympathetic Division:

- **Thoracolumbar outflow** T1 to T12 and L2,3 and 4
- Preganglionic fibers from anterolateral horn to paravertebral ganglion is cholinergic in nature.
- Preganglionic fibers leave the spinal cord through anterior nerve root and white rami communicants and terminate in the postganglionic neurons, which are situated in the sympathetic ganglia.
- Gray rami division supplies to smooth blood vessels of skin, hair and skeletal muscle.

SYMPATHETIC GANGLIA:

- Ganglia of sympathetic division are classified into 3 groups:

I. Paravertebral or Sympathetic chain ganglia
II. Prevertebral or Collateral ganglia
III. Terminal or Peripheral ganglia.

I) Paravertebral or Sympathetic Chain Ganglia

- Paravertebral or Sympathetic chain ganglia are arranged in a segmental fashion along the **anterolateral horn** of vertebral column.
- Ganglia on either side of the spinal cord are connected with each other by longitudinal fibers, to form the sympathetic chain. Both the chains extend from skull to coccyx.
- Ganglia of the sympathetic chain (trunk) on each side are divided into four groups.

II) Pre-vertebral or Collateral Ganglia:

- Pre-vertebral ganglia are situated in thorax, abdomen and pelvis, in relation to aorta and its branches.
- **Pre-vertebral ganglia are:**
  a) Celiac ganglion
  b) Superior mesenteric ganglion
  c) Inferior mesenteric ganglion.
- Pre-vertebral ganglia receive preganglionic fibers from T_5 to L_2 segments.
- Postganglionic fibers from these ganglia supply the visceral organs of thorax, abdomen and pelvis.

III) Terminal or intramural / Peripheral Ganglia:

- Terminal ganglia are situated within or close to structures innervated by them.
- Heart, Bronchi, Pancreas and Urinary bladder are innervated by the terminal ganglia.
- Adrenal medulla innervated through celiac ganglion.

Functions of ANS

Can be broadly categorized into five parts:

1) Maintenance of homeostatic conditions of the body.
2) Regulation of visceral activities.
3) Smoothening body's responses to environmental changes.
4) Coordination of body's responses to exercise and stress.
5) Assisting the endocrine system to regulate reproductive functions

Sympathetic Nervous system

- **Sympathetic stimulation**-

All tissue have ---alpha 1 Adrenergic receptor

except

Heart (beta 1),

Juxtaglomerular apparatus (beta 1)

lipocytes (beta1/beta3)

- **Inhibition** –

All tissue have inhibited - beta 2 receptor.

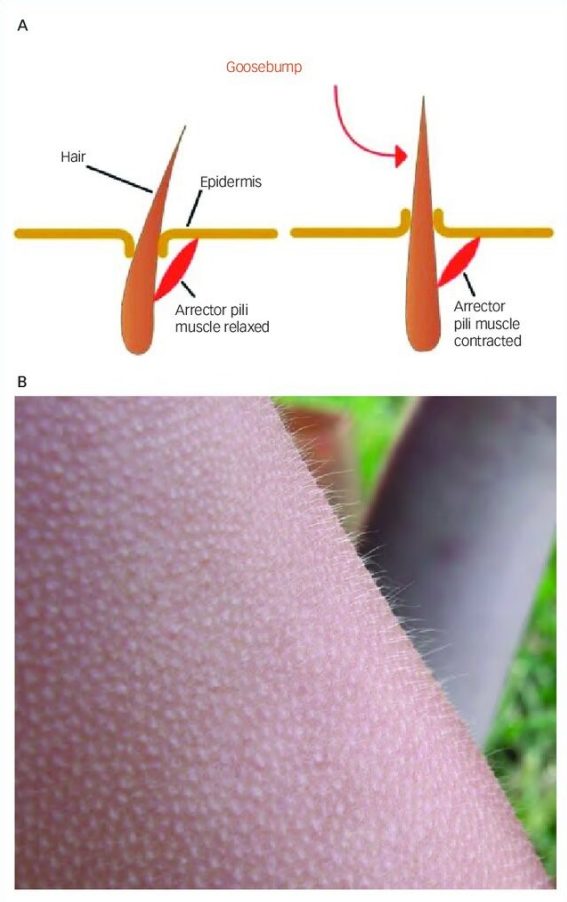
except

Presynaptic nerve ending,

Platelets,

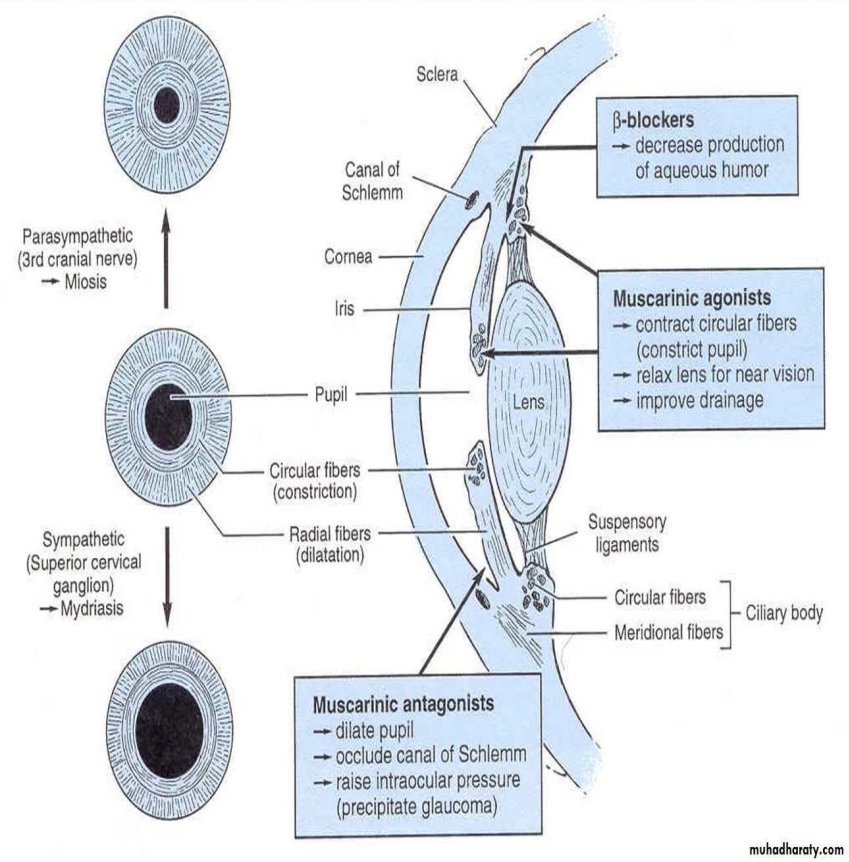
GIT have alpha2 receptor.

Cutaneous action--



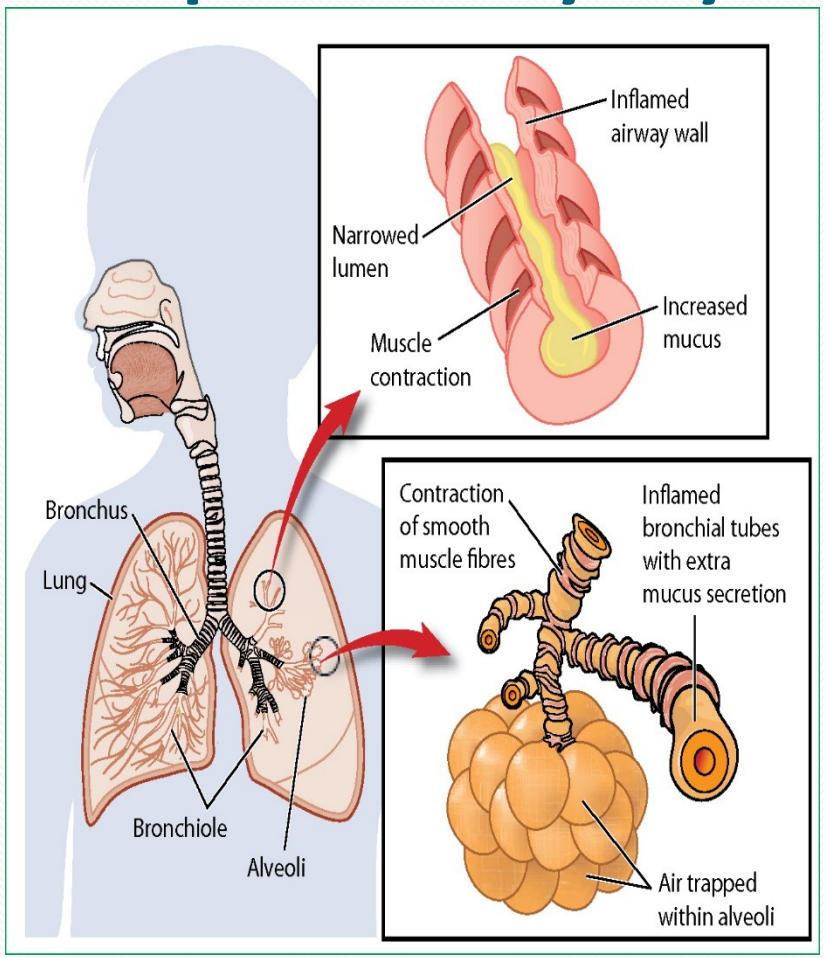
- Arrector pili – contraction- erection – (alpha 1)piloerection
- Skin-blood vessels – alpha 1

Eye– pupil dilator and ciliary muscle



- Pupil dilatory or radial muscle have alfa 1 receptor.
- Ciliary muscle have beta 2 receptor.
- Mydriasis.

Respiratory system



- Blood vessels constrict- alfa 1.
- Mast cell inhibition– beta 2.
- Smooth muscle relaxed – beta 2.

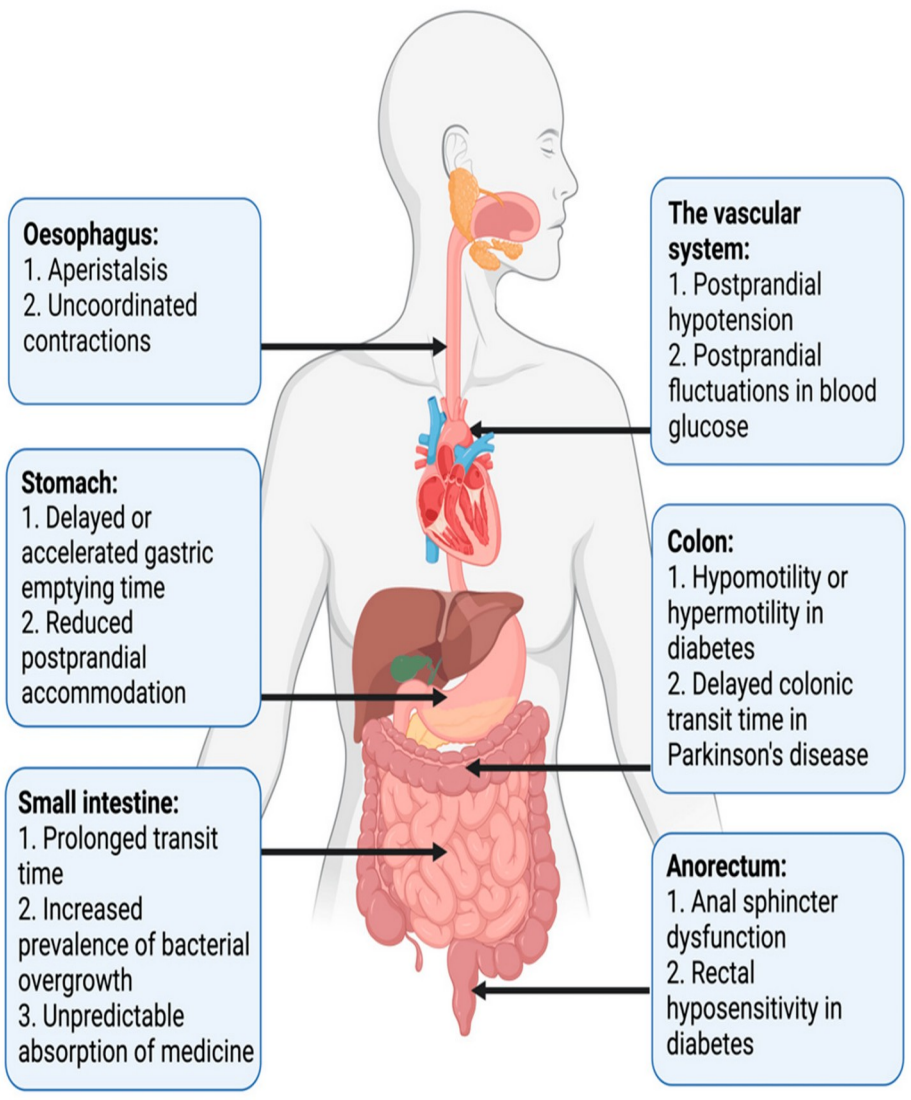
Cardio-vascular system

Table 9.6: Comparative effects of adrenaline, noradrenaline and isoprenaline

		Adr	*NA*	*Iso*
1.	Heart rate	↑	↓	↑↑
2.	Cardiac output	↑↑	–	↑↑
3.	BP—Systolic	↑↑	↑↑	↑
	Diastolic	↓↑	↑↑	↓↓
	Mean	↑	↑↑	↓
4.	Blood flow			
	Skin and mm	↓	↓	–
	Sk. muscle	↑↑	–, ↓	↑
	Kidney	↓	↓	–
	Liver	↑↑	–	↑
	Coronary	↑	↑	↑
5.	Bronchial muscle	↓↓	–	↓↓
6.	Intestinal muscle	↓↓	↓	↓
7.	Blood sugar	↑↑	–, ↑	↑

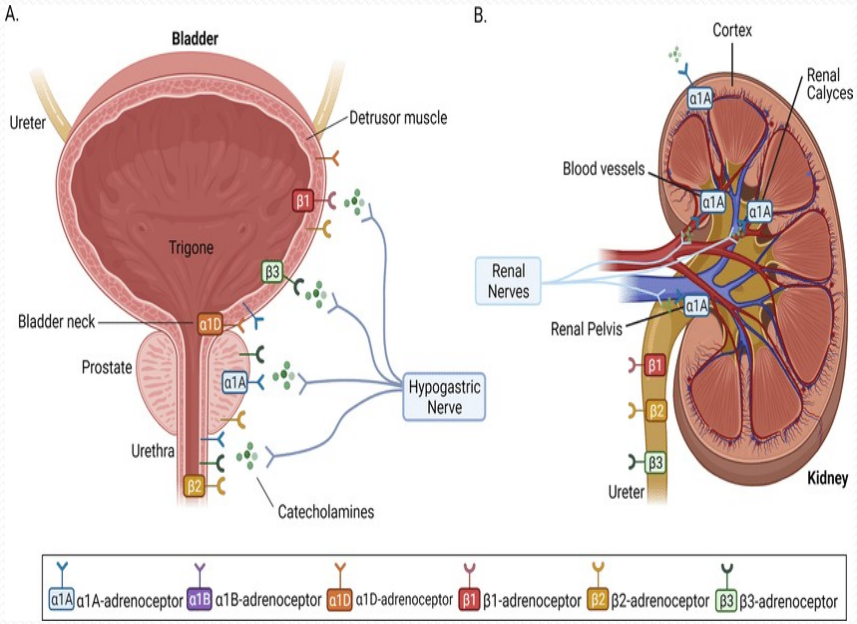
- Skin – alfa 1
- GIT– alfa 1
- Kidney—alfa 1
- Skeletal muscle– beta 2
- CNS and coronary artery- alfa 1and beta 2 -- autoregulation
- Lungs blood vessels- alfa 1
  - SA node- beta 1- chronotropic
  - AV node- beta 1-dromotropic
  - Fibre- beta 1 bathmotropic
  - Myocardium- beta1 ionotropic

Gastrointestinal system



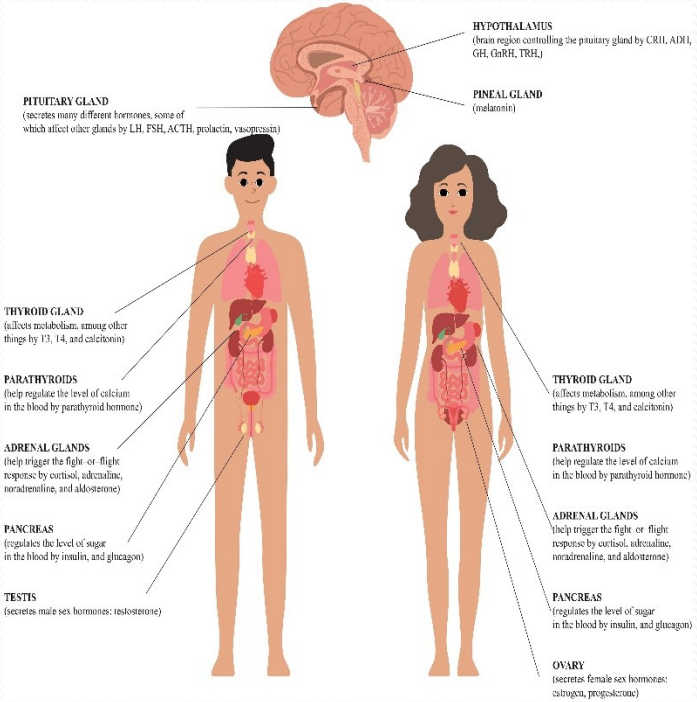
- GIT blood vessels– alfa 1.
- Sphincter – alfa 1.
- Less peristalsis– beta 2.

Urinary system



- Inhibition of Detrusor muscle- beta 2.
- Constriction of sphincters – alfa1.

Genitalia



- In male no erection—no ejaculation.
- In female– uterus have alfa 1 receptor and tendency contract, but genetically after fertilization alfa 1 gene shifted to form beta 2 gene protein be relaxed.

Biochemistry

Glycogenolysis increase

gluconeogenesis increases

Glycogenesis decreases

Fatty acid decreases

PARASYMPATHETIC DIVISION:

- Otherwise called the **Cranio-sacral outflow** (the fibers of this division arise from Brain and Sacral segments of spinal cord).

1) CRANIAL OUTFLOW OR CRANIAL PORTION OF PARASYMPATHETIC DIVISION:

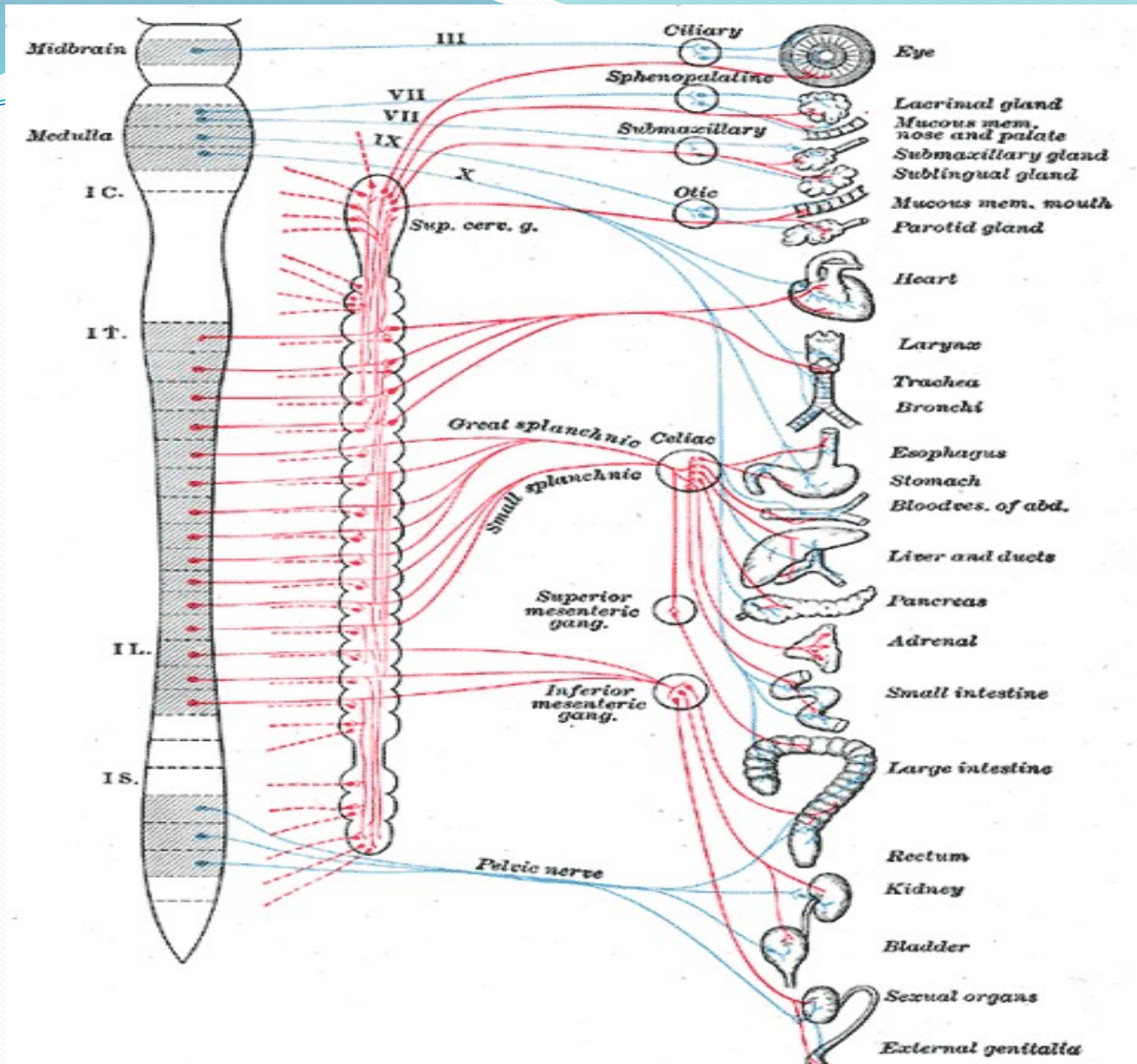
- Cranial outflow or cranial portion of parasympathetic division arises from brainstem.
- It innervates the blood vessels of head and neck and many thoraco-abdominal visceral organs.

Cont…

- Cranial outflow includes the following cranial nerves:

a) Oculomotor (III) nerve
b) Facial (VII) nerve
c) Glossopharyngeal (IX) nerve
d) Vagus (X) nerve.

- Sacral has s2,3,and 4 segment.


Midbrain
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Small splanchnic
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Inferior mesenteric gang.
Pelvic nerve
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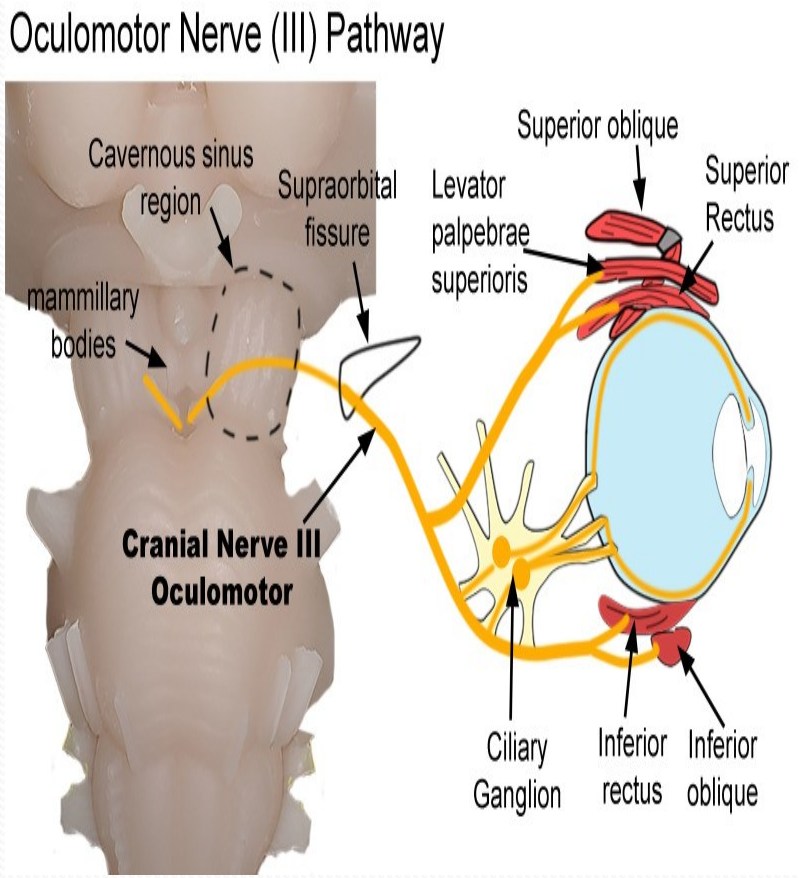
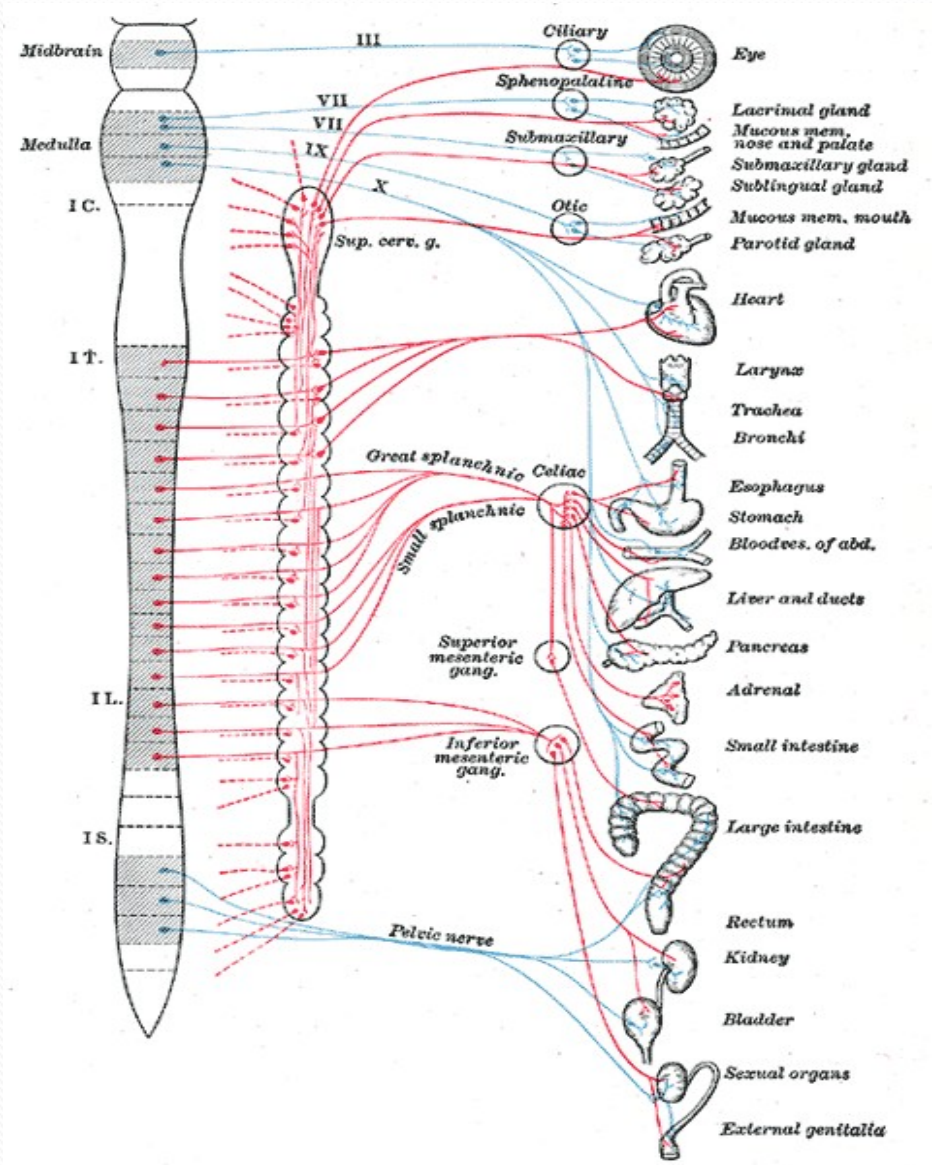
Lacrimal gland
Mucous mem. nose and palate
Submaxillary gland
Sublingual gland
Mucous mem. mouth
Parotid gland
Heart
Larynx
Trachea
Bronchi
Esophagus
Stomach
Bloodves. of abd.
Liver and ducts
Pancreas
Adrenal
Small intestine
Large intestine
Rectum
Kidney
Bladder
Sexual organs
External genitalia

3rd nerve



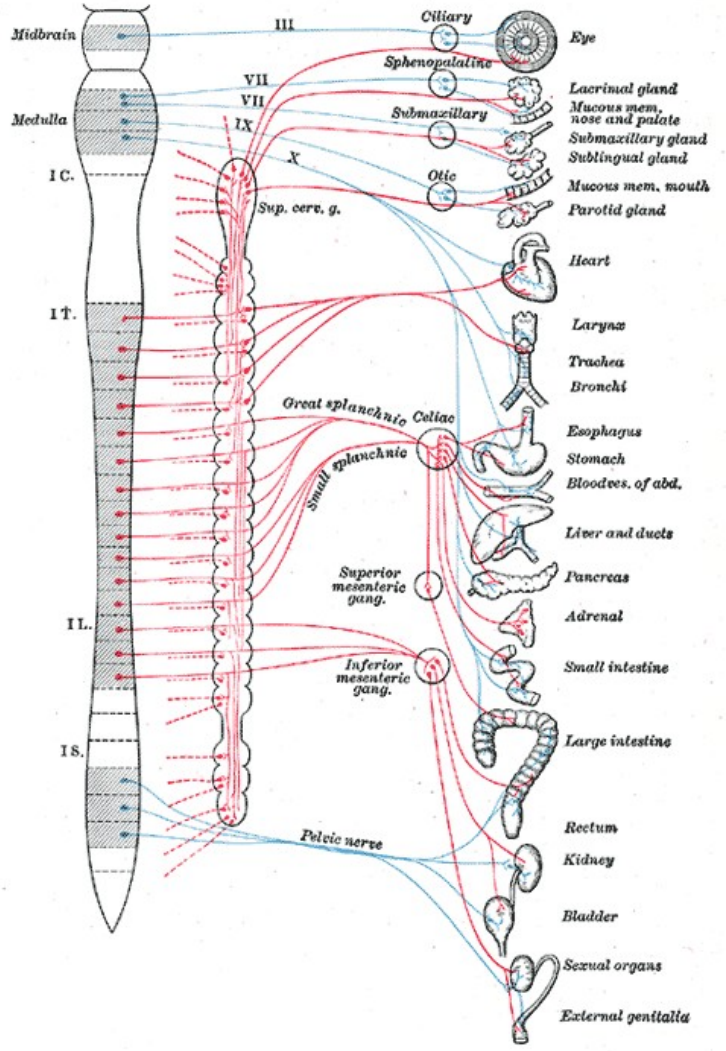
- Motor in nature
- Preganglionic nerve terminate in ciliary ganglion and post ganglionic supply to circular and ciliary body.
- Meiosis and near vision
- It has muscarinic receptor.

7th Nerve



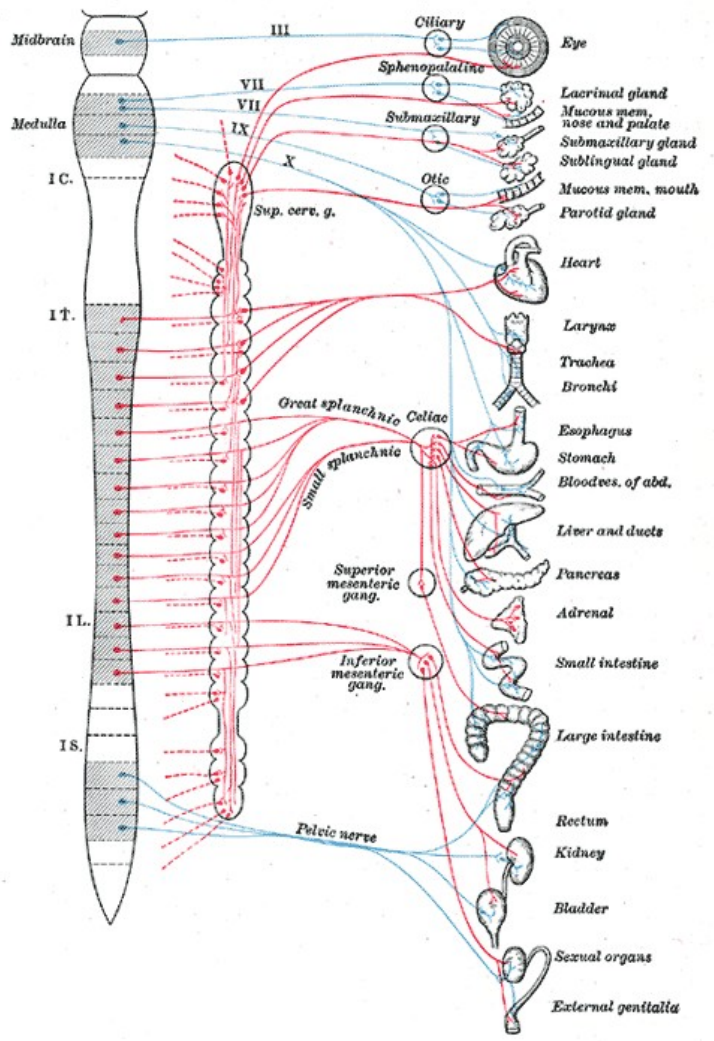
- Superior salivatory nucleus
- Pterygopalatine ganglion supplied to lacrimal gland, nasal and palatal glands.
- Submandibular ganglion- sublingual and submandibular gland.

9th Nerve



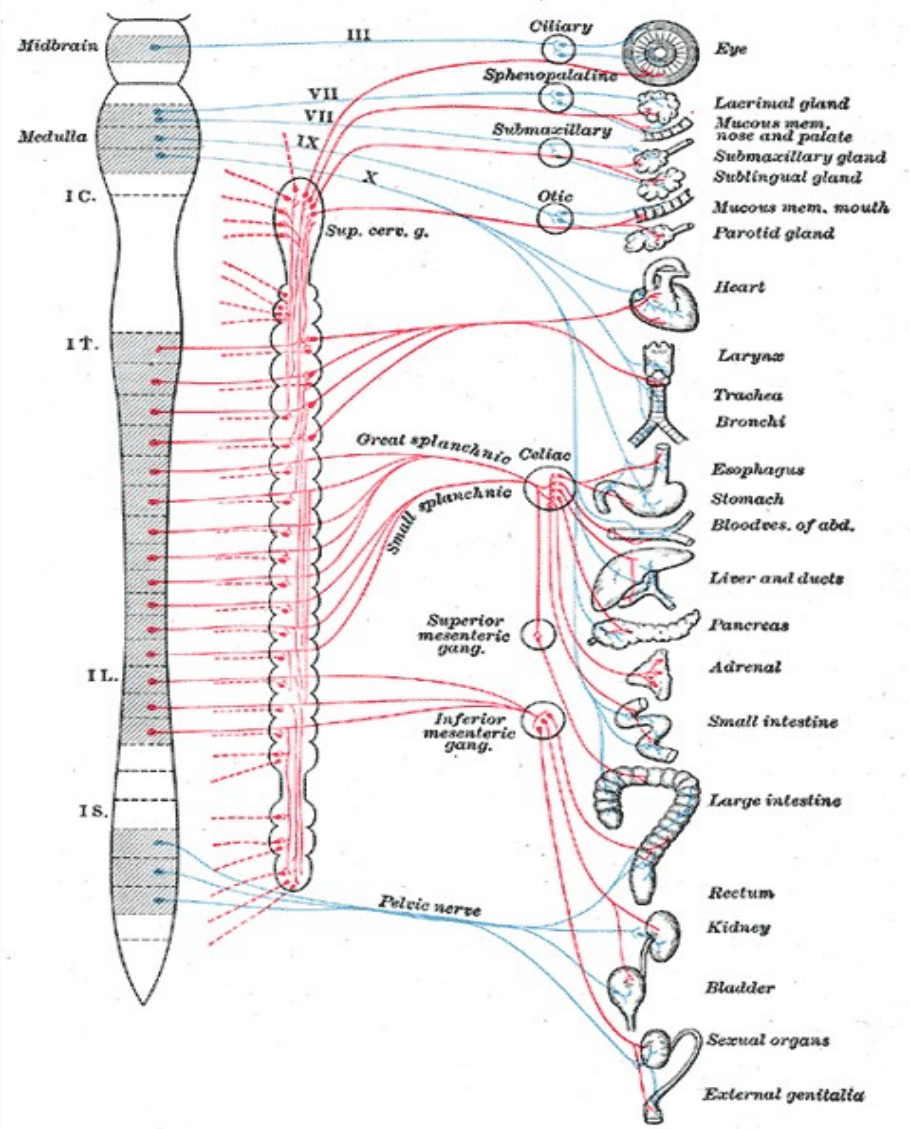
- Origin from inferior salivatory nucleus--Otic ganglion post ganglionic with auricular nerve-supplied to parotid gland.

10th vagus nerve



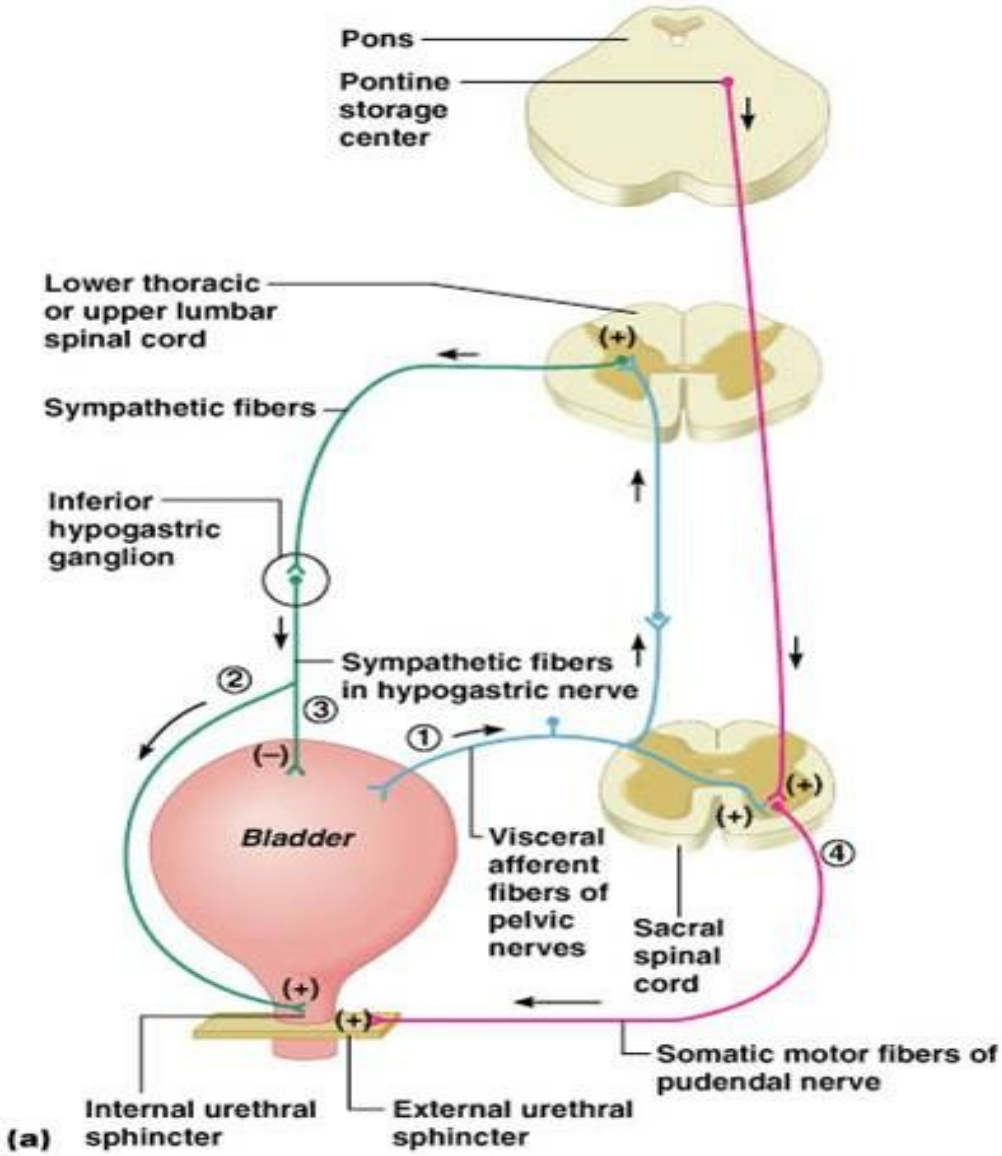
- Dorsal nucleus of vagus supplied through intramural ganglion supplied to pharynx, larynx, oesophagus, heart, lungs, stomach, liver, pancreas, small intestine, colon,

Sacral part – s2 to s4



- Intramural ganglion- Pelvic, some part of transverse colon, descending colon, rectum, sigmoid colon, urinary bladder, male and female genitalia.

Micturition



Filling of urinary bladder

↓

Stimulation of stretch receptors

↓

Afferent impulses pass via pelvic nerve

↓

Sacral segments of spinal cord

↓

Efferent impulses via pelvic nerve

↓

Contraction of detrusor muscle and relaxation of internal sphincter

↓

Flow of urine into urethra and stimulation of stretch receptors

↓

Afferent impulses via pelvic nerve

↓

Inhibition of pudendal nerve

↓

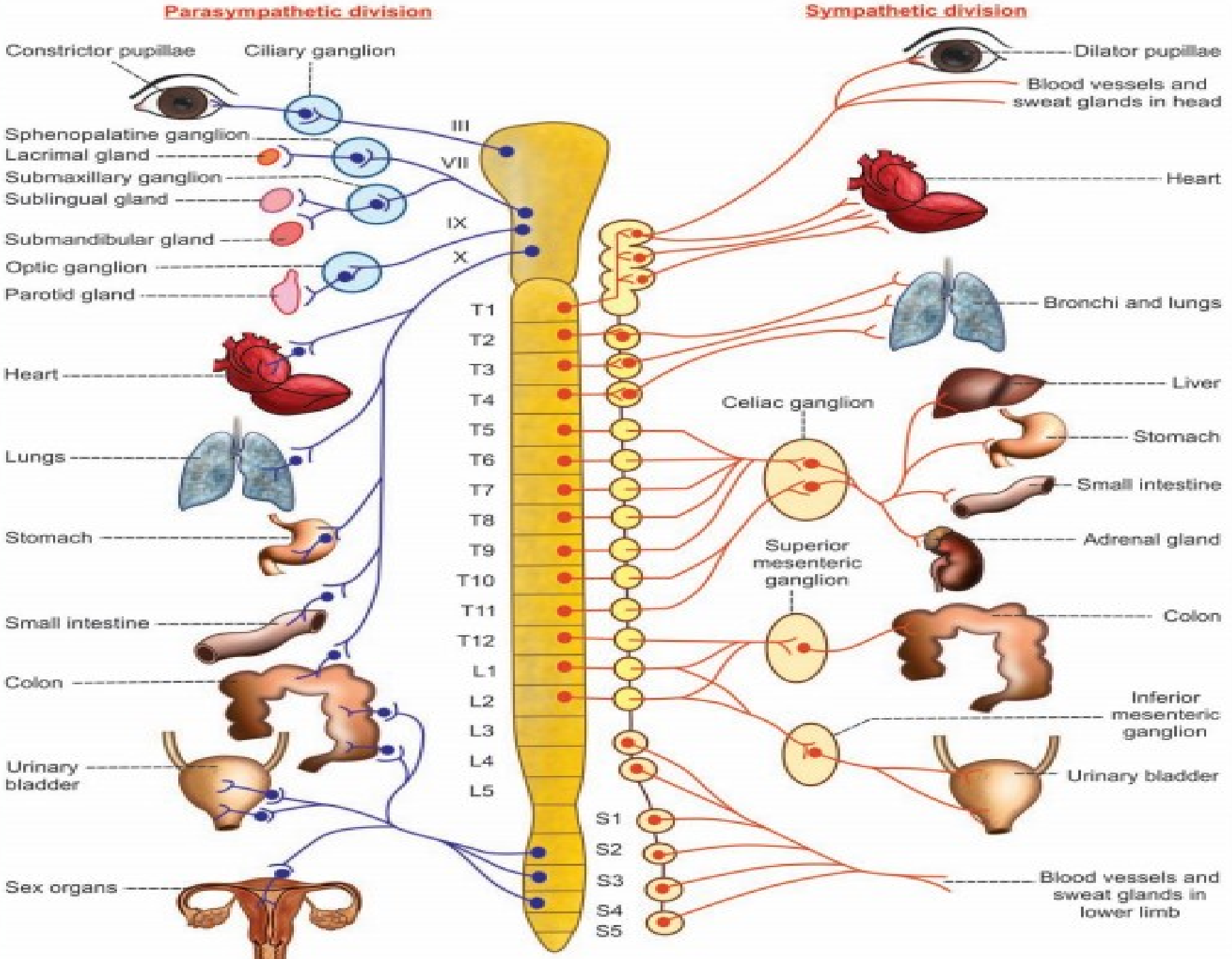
Relaxation of external sphincter

↓

Voiding of urine

Micturition-Sensory input from UB

- Stretch receptor and sensory input through s2,3 and 4 and pudendal nerve from external sphincter.
- Sympathetic innervation in circumstances condition leads to beta 2 for detrusor muscle and alfa1 for internal sphincter.
- Ponto-spinal path inhibits to lumber and sacral nerve to for micturition.


Parasympathetic division
Sympathetic division
Constrictor pupillae
Ciliary ganglion
Sphenopalatine ganglion
Lacrimal gland
Submaxillary ganglion
Sublingual gland
Submandibular gland
Optic ganglion
Parotid gland
III
VII
IX
X
Heart
Lungs
Stomach
Small intestine
Colon
Urinary bladder
Sex organs
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
Dilator pupillae
Blood vessels and sweat glands in head
Heart
Bronchi and lungs
Liver
Celiac ganglion
Stomach
Small intestine
Adrenal gland
Superior mesenteric ganglion
Colon
Inferior mesenteric ganglion
Urinary bladder
Blood vessels and sweat glands in lower limb

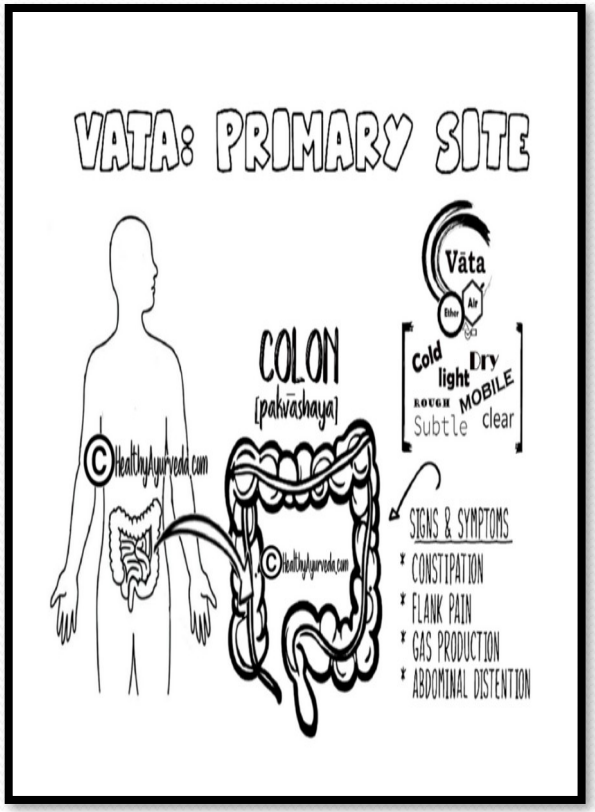
FUNCTIONS OF ANS:

TABLE | C:C: Actions of sympathetic and parasympathetic divisions of autonomic nervous system

Effector organ		Sympathetic division	Parasympathetic division
1. Eye	Ciliary muscle	Relaxation	Contraction
	Pupil	Dilatation	Constriction
2. Lacrimal glands		Decrease in secretion	Increase in secretion
3. Salivary glands		Decrease in secretion and vasoconstriction	Increase in secretion and vasodilatation
4. Gastrointestinal tract	Motility	Inhibition	Acceleration
	Secretion	Decrease	Increase
	Sphincters	Constriction	Relaxation
	Smooth muscles	Relaxation	Contraction
5. Gallbladder		Relaxation	Contraction
6. Urinary bladder	Detrusor muscle	Relaxation	Contraction
	Internal sphincter	Constriction	Relaxation
7. Sweat glands		Increase in secretion	–
8. Heart – rate and force		Increase	Decrease
9. Blood vessels		Constriction of all blood vessels, except those in heart and skeletal muscle	Dilatation
10. Bronchioles		Dilatation	Constriction

वात के स्थान (GENERAL LOCATIONS

- सर्वशरीरचरास्तु वातपित्तश्लेष्माणः।(च.सू.२०/९)
- बस्तिः पुरीषाधानं कटिः सक्थिनी पादावस्थीनि पक्वाशयश्च वातस्थानानि, तत्रापि पक्वाशयो विशेषेण वातस्थानं। (च.सू.२०/८)
- तत्र समासेन वातः श्रोणिगुदसंश्रयः।(सु.सू.२१/६)
- पक्वाशयकटीसक्थिश्रोत्रास्थिस्पर्शनेन्द्रियम्| स्थानं वातस्य, तत्रापि पक्वाधानं विशेषतः|| (अ.ह.सू.१२/१)
- अधोनाभ्यास्थिमज्जानौ वातस्थानं प्रचक्षते । (का.सं.सू.२७)



GENERAL FUNCTIONS OF VATA

- उत्साहोच्छवासनिश्वासचेष्टावेगप्रवर्तनैः||१||
  सम्यग्गत्या च धातूनामक्षाणां पाटवेन च| (अ.ह.सू.११/२)
- तत्र प्रस्पन्दनोद्वहनपूरणविवेकधारणलक्षणो वायुः पञ्चधा प्रविभक्तः शरीरं धारयति। (सु.सू.१५/४)
- उत्साहोच्छवासनिः श्वासचेष्टा धातुगतिः समा|
  समो मोक्षो गतिमतां वायोः कर्माविकारजम्|| (च.सू.१८/४९)

SPECIFIC FUNCTIONS OF VATA

- वायुस्तन्त्रयन्त्रधरः, प्राणोदानसमानव्यानापानात्मा, प्रवर्तकश्चेष्टानामुच्चावचानां, नियन्ता प्रणेता च मनसः, सर्वेन्द्रियाणामुद्योजकः, सर्वेन्द्रियार्थानामभिवोढा, सर्वशरीरधातुव्यूहकरः, सन्धानकरः शरीरस्य, प्रवर्तको वाचः, प्रकृतिः स्पर्शशब्दयोः, श्रोत्रस्पर्शनयोर्मूलं, हर्षोत्साहयोर्योनिः, समीरणोऽग्नेः, दोषसंशोषणः, क्षेप्ता बहिर्मलानां, स्थूलाणुस्रोतसां भेत्ता, कर्तागर्भाकृतीनाम्, आयुषोऽनुवृत्तिप्रत्ययभूतो भवत्यकुपितः| (च.सू.१८/५०)

प्राण वायु

- स्थानं प्राणस्य मूर्धोरःकण्ठजिह्वास्यनासिकाः|
  ष्ठीवनक्षवथूद्गारश्वासाहारादि कर्म च|| (च.चि.२८/६)
- प्राणोऽत्र मूर्धगः|
  उरःकण्ठचरो बुद्धिहृदयेन्द्रियचित्तधृक्||
  ष्ठीवनक्षवथूद्गारनिःश्वासान्नप्रवेशकृत्| (अ.ह.सू.१२/४)
- यो वायुर्वक्त्रसञ्चारी स प्राणो नाम देहधृक् |
  सोऽन्नं प्रवेशयत्यन्तः प्राणांश्चाप्यवलम्बते ||
  प्रायशः कुरुते दुष्टो हिक्काश्वासादिकान् गदान्॥ (सु.नि.१/१३-१४)

उदान वायु

उदानस्य पुनः स्थानं नाभ्युरः कण्ठ एव च|
वाक्प्रवृत्तिः प्रयत्नौर्जोबलवर्णादि कर्म च|| (च.चि.२८/७)

उरः स्थानमुदानस्य नासानाभिगलांश्चरेत्||
वाक्प्रवृत्तिप्रयत्नोर्जाबलवर्णस्मृतिक्रियः| (अ.ह.सू.१२/५)

उदानो नाम यस्तूर्ध्वमुपैति पवनोत्तमः ||
तेन भाषितगीतादिविशेषोऽभिप्रवर्तते |
ऊर्ध्वजत्रुगतान् रोगान् करोति च विशेषतः || (सु.नि.१/१४-१५)

व्यान वायु

- देहं व्याप्नोति सर्वं तु व्यानः शीघ्रगतिर्नृणाम्|
  गतिप्रसारणाक्षेपनिमेषादिक्रियः सदा|| (च.चि.२८/९)
- व्यानो हृदि स्थितः कृत्स्नदेहचारी महाजवः|
  गत्यपक्षेपणोत्क्षेपनिमेषोन्मेषणादिकाः|
  प्रायः सर्वाः क्रियास्तस्मिन् प्रतिबद्धाः शरीरिणाम्||
  (अ.ह.सू.१२/६-७)
- कृत्स्नदेहचरो व्यानो रससंवहनोद्यतः ||
  स्वेदासृक्स्त्रावणश्चापि पञ्चधा चेष्टयत्यपि|
  क्रुद्धश्च कुरुते रोगान् प्रायशः सर्वदेहगान् || (सु.नि.१/१७-१८)

समान वायु

- स्वेददोषाम्बुवाहीनि स्रोतांसि समधिष्ठितः|
  अन्तरग्नेश्च पार्श्वस्थः समानोऽग्निबलप्रदः|| (च.चि.२८/८)
- समानोऽग्निसमीपस्थः कोष्ठो चरति सर्वतः|
  अन्नं गृह्णाति पचति विवेचयति मुञ्चति|| (अ.ह.सू.१२/८)
- आमपक्वाशयचरः समानो वह्निसङ्गतः|
  सोऽन्नं पचति तज्जांश्च विशेषान्विविनक्ति हि ||
  गुल्माग्निसादातीसारप्रभृतीन् कुरुते गदान्। (सु.नि.१/१६-१७)

अपान वायु

- वृषणौ बस्तिमेढ्रं च नाभ्यूरू वङ्क्षणौ गुदम्|
  अपानस्थानमन्त्रस्थः शुक्रमूत्रशकृन्ति च|| (च.चि.२८/१०)
- अपानोऽपानगः श्रोणिबस्तिमेढ्रोरुगोचरः|
  शुक्रार्तवशकृन्मूत्रगर्भनिष्क्रमणक्रियः|| (अ.ह.सू.१२/९)
- पक्वाधानालयोऽपानः काले कर्षति चाप्यधः |
  समीरणः शकृन्मूत्रं शुक्रगर्भार्तवानि च ||
  क्रुद्धश्च कुरुते रोगान् घोरान् बस्तिगुदाश्रयान्। (सु.नि.१/१९-२०)

Applied aspect of ANS

- Megacolon
- Raynaud's disease
- Myasthenia gravis

Thank You