

AUTONOMIC NEURONES

SOMATIC vs. AUTONOMIC

	<i>somatic (afferent & efferent)</i>	<i>autonomic (efferent only)</i>
structures innervated by neurites	skeletal mm.	smooth m., cardiac m., glandular epithelium, sensory receptors, etc.
nature	voluntary (mostly)	involuntary (generally in a reflex)
effect	excitatory	excitatory or inhibitory
role	stiffening of skeletal mm.	homeostasis of 'vegetative' vital functions – <i>la vie organique</i>
peripheral ganglia in efferent path*	none	<i>usually one</i> – cranial or terminal ganglia (parasymp.); paravertebral or prevertebral ganglia (symp.)
neurone(s) of efferent path	1 – in motor nuclei of cranial nn. & spinal cord ventral horn	2 – 1 st in brain & s. cord, 2 nd in peripheral autonomic ganglion*

PARASYMPATHETIC (Langley, 1905) vs. SYMPATHETIC (Winslow, 1732)

	<i>parasympathetic</i>	<i>sympathetic</i>
general distribution	head, neck, viscera, erectile tissue (not limbs & body wall)	vascularized tissues of body (nn. accompany vx.)
input from CNS	craniosacral (Langley, 1900) CN III, VII, IX, X S2,3,4 ventral rami (pelvic splanchnic nn.)	thoracolumbar spinal cord T1–L2 via 'white' ramus communicans (pl. rami communicantes)
central soma	brainstem nuclei of 4 cranial nn., grey matter of sacral spinal cord	lateral horn of spinal cord from (C8)T1–L2 (L3)
ganglia* & fibres <i>Ratio preg. : postg. fibres: 1 : 10–200 (sympathetic > parasymp)</i>	ciliary – CN III; pterygopalatine & submandibular – CN VII; otic – CN IX; ganglia in walls of viscera – CN X, S2,3,4) <u>long</u> preganglionic fibres <u>short</u> postganglionic fibres	sympathetic trunk (22–23 paravertebral ganglia, etc.) & prevertebral (collateral) ganglia <u>short</u> preganglionic (white ramus communicans) <u>long</u> postganglionic (grey ramus communicans)
general effects	' <i>rest & digest</i> ' conserve & restore; anabolism; supply glands except sweat NB. extreme terror: ↑parasymp.	' <i>fight & flight</i> ' rapid catabolism for energy to cope with stress; sweat glands
extent, duration of effect	localized & brief	widespread & lasting
transmitter at ganglion	acetylcholine (ACh)	acetylcholine (ACh)
transmitter at organ	acetylcholine (ACh) = 'cholinergic'; also VIP, ATP	norepinephrine (NA) = 'adrenergic'; except ACh in sweat glands [^] & penile vv.; also NPY, ATP

NB: * Peripheral sympathetic neurones are not confined to ganglia: they are embedded in sympathetic nn., i.e., in grey & white rami communicantes, splanchnic nn., etc. (Pick, 1970).

[^] Sympathetic nn. are generally vasoconstrictor; sympathetic vasodilation in coronary aa. is mostly due to inhibition of parasympathetic nn.

Afferent nn. for autonomic reflexes are found in somatic nn.; visceral afferent fibres accompany autonomic nn. (rami communicantes, splanchnic nn., vagus, etc.)

SPECIFIC PHYSIOLOGICAL EFFECTS

	<i>parasympathetic stimulation</i>	<i>sympathetic stimulation</i>
heart	++ decreases rate (& strength ?)	increases rate & strength; dilates coronary aa.
bronchi	constricts; bronchosecretion	dilates by inhibiting parasym.
pupil	constricts (miosis)	dilates (mydriasis)
ciliary body	stiffens causing lens to thicken = accommodation for near vision	
blood vessels	little effect in many vessels; (constricts coronary aa.) (? dilates pulmonary aa.)	vasoconstriction (generally, e.g., in skin), vasodilation of coronary aa. by parasymp. inhibition
intestines	++ motility (peristalsis); (occasional weak inhibition) increases secretion of glands; defecation (relaxes sphincter m.)	inhibits motility (occasional activation) inhibits secretion excitatory to anal sphincter
liver		increases release of glucose
suprarenal glands*		++ epinephrine & norepinephrine
salivary & lacrimal glands	++ secretion; vasodilation	? more viscous secretion due to vasoconstriction
lacrimal gland	stimulates tear secretion	
bladder	++ stiffening of detrusor m.; sphincter relaxation	(? weak stiffening & vasoconstriction ?)
sex organs	dilates blood vessels of penis & clitoris, testis & ovary; secretion of sex glands	ejaculation; vasoconstriction; vasodilation of penile vx. (ACh)
sweat glands		stimulates (= sudomotion; ACh)
hair		erection (= piloerection)

NB. Terror may activate parasympathetic nn. to inhibit sphincters of stomach, bladder & rectum, with decrease in heart rate (vasovagal syncope).

Stimulation of parasympathetic nn. has little effect on liver, adrenal glands, sweat glands, skeletal mm., skin, or hair. Vasodilation in skeletal mm. in exercise is due to local release of NO from endothelium.

* Cells of suprarenal medulla are considered to represent postganglionic sympathetic neurons.

ENTERIC NERVOUS 'SYSTEM' (Remark, 1847; Langley, 1900)

- a neuronal network within GIT (as distinct from sympathetic nerves and parasympathetic ganglia).
- comprises sensory & motor neurones, interneurones (excitatory, inhibitory), neurites, dendrites & glial cells in alimentary canal (oesophagus to anus), pancreas & gall bladder, i.e., intrinsic to viscera.
- in alimentary canal, is usually found in 2 annular plexuses in different layers: larger myenteric (Auerbach's) plexus; smaller submucosal (Meissner's) plexus.
- involved in reflex peristalsis and secretion from intestinal mucosa, hormone release, etc.
- functions reflexly in absence of extrinsic autonomic input, but modified by extrinsic input.
- transmitters include nitric oxide (NO), vasoactive intest. peptide (VIP), substance P, ATP, GABA, etc.
- co-transmitters: ACh & SP in excitatory cells; ATP, NO, VIP in inhibitory cells.

References

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