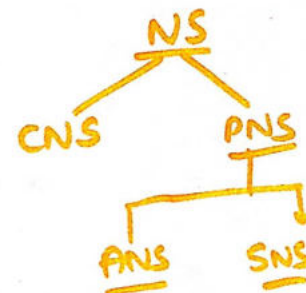




AUTONOMIC NERVOUS SYSTEM

CONTROLS AUTONOMOUS / VISCERAL FUNCTION ✓
(unconscious)

NERVES IN ANS → PRE-GANGLIONIC (MYELINATED) ✓
→ POST-GANGLIONIC (NON-MYELINATED) ✓



ESSENTIALS OF MEDICAL SCIENCE

SOMATIC NS → CONTROLS VOLUNTARY FUNCTION ✓
→ ALL NERVES ARE MYELINATED. ✓



SYMPATHETIC
N.S
(SNS)

"EMERGENCY" ✓

↑

MYDRIASIS ✓

DILATE ✓

↓ ✓

↓

↓

↓ MICTURITION

↑↑

① HEART RATE

② PUPIL SIZE

③ BRONCHUS

④ HCl SECRETION

⑤ PERISTALSIS

⑥ APPETITE

⑦ BLADDER

LIPOLYSIS

PARASYMPATHETIC
N.S
(PSNS)

"REST - DIGEST SYSTEM" ✓

↓

MIOSIS

CONSTRICT ✓

↑ ✓

↑

↑ ✓

↑ MICTURITION

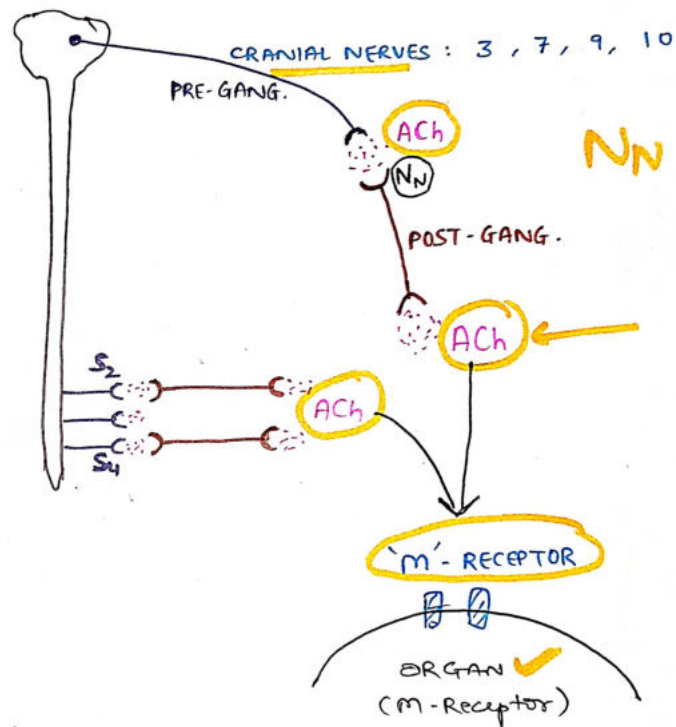
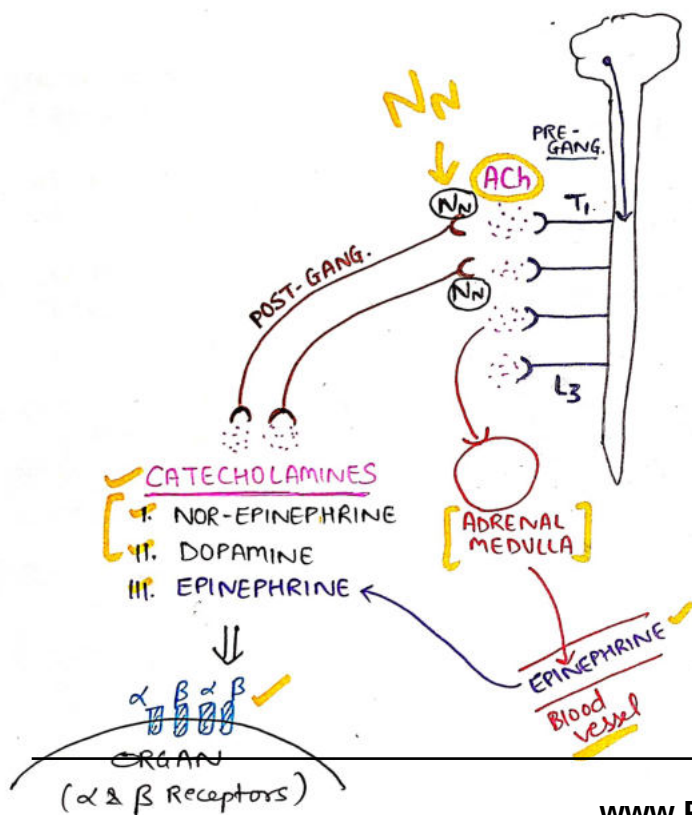


S.N.S (ADRENERGIC N.S)

P.S.N.S (CHOLINERGIC N.S)

THORACO - LUMBAR OUTFLOW ✓
(T₁ to L₃)

CRANIO - SACRAL OUTFLOW
(CN 3, 7, 9, 10) (S₂-S₄)



MAIN NEUROTRANSMITTER : ACETYL CHOLINE (ACh)

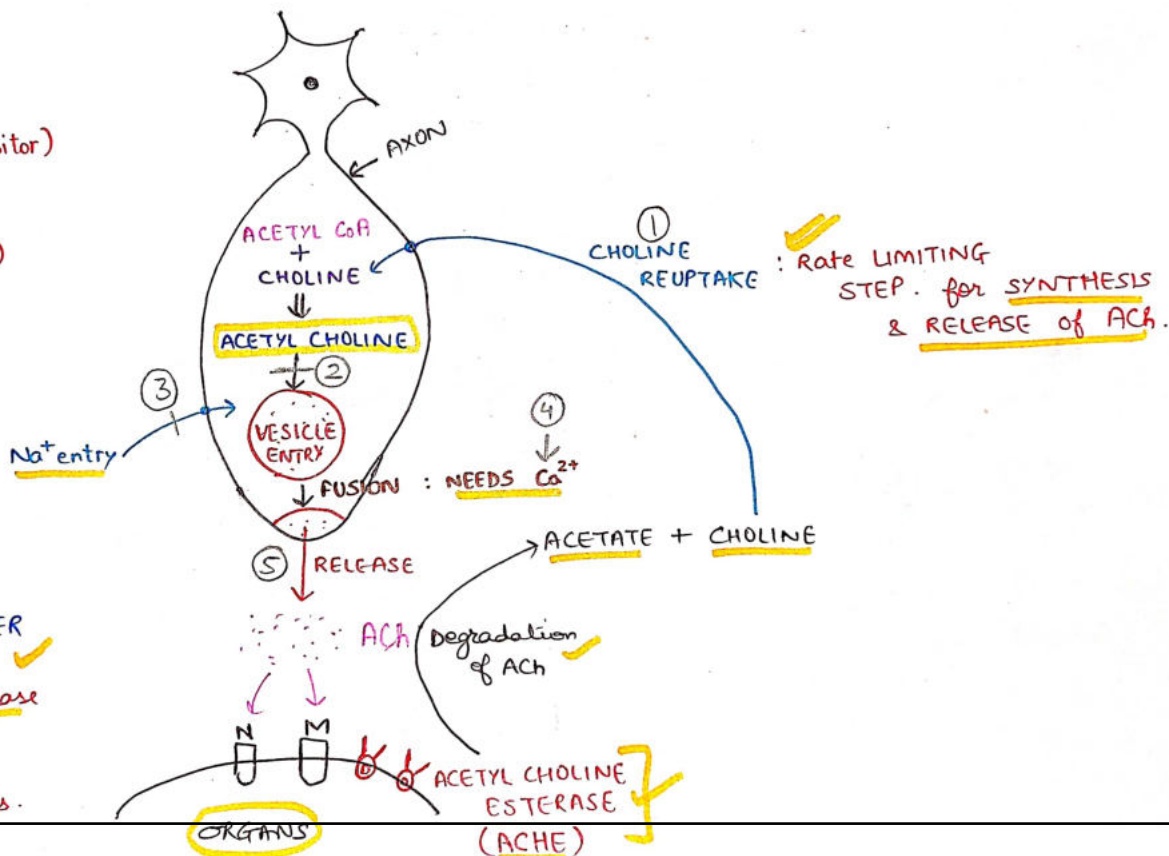
① HEMICHOLINIUM ✓
(Choline Reuptake Inhibitor)

② VESAMICOL ✓
(⊖ entry into vesicles)

③ SAXITOXIN ✓
TETRADOTOXIN ✓
(# Na⁺ channel)

④ BOTULINUM TOXIN ✓
(⊖ Ca²⁺-Snare protein)
∴ ↓ Release of ACh

⑤ BLACK WIDOW SPIDER TOXIN ✓
(Causes Sudden Release of ACh)
↓
depletion of stores.



BOTULINUM TOXIN USES :

✓

① T/t of MUSCLE SPASTICITY

e.g. ACHLASIA
BLEPHAROSPASM

② T/t of CHRONIC MIGRAINE
HEADACHE

③ T/t of HYPER-HIDROSIS

④ COSMETIC USE IN FACIAL WRINKLES & etc.

ACh DEGRADATION :

ENDOGENOUS ACh

- Degraded by Acetyl
Choline Esterase
(AChE)



Attached on
post synaptic
organs

EXOGENOUS ACh

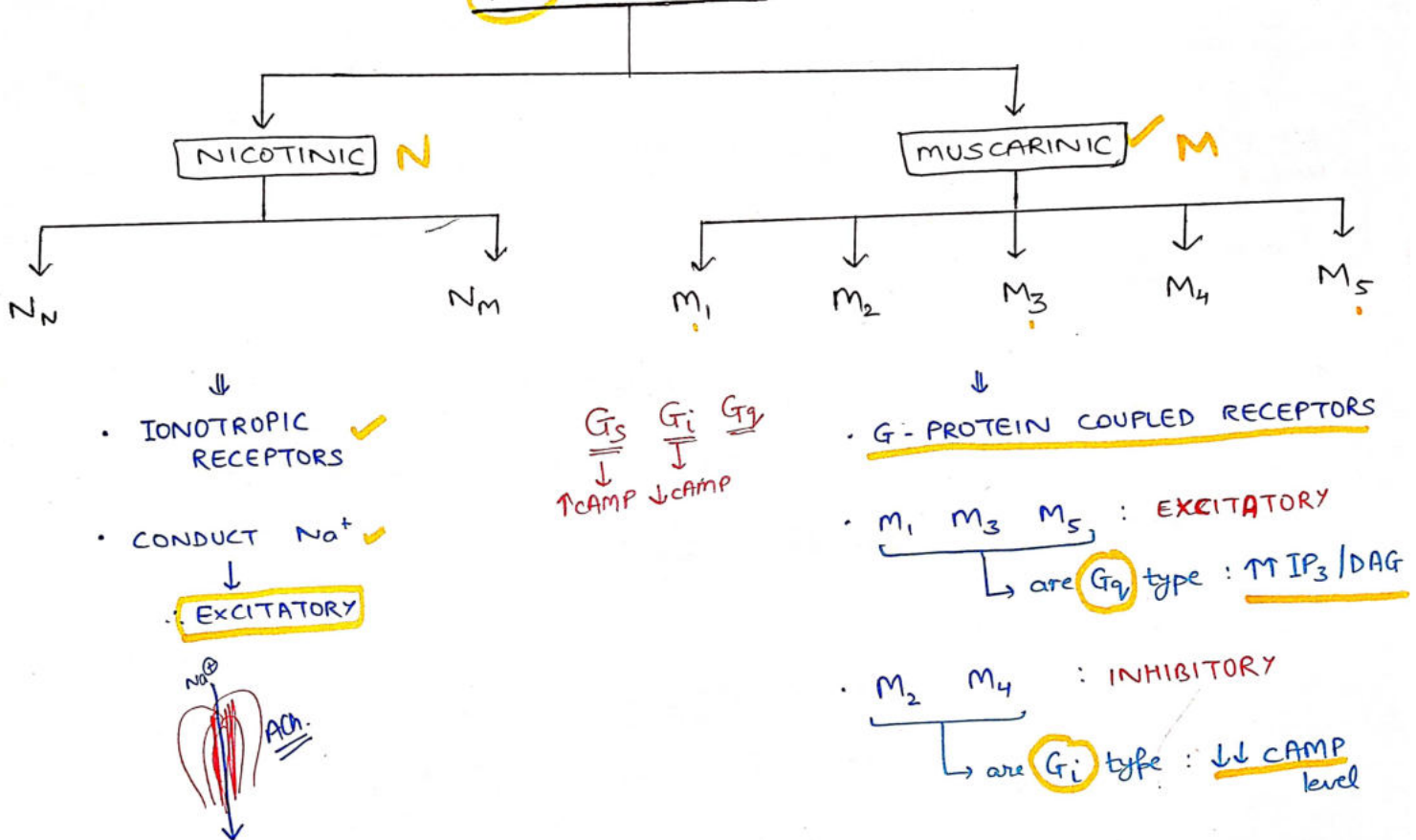
- Degraded by PseudoCholine
Esterase (PACHE)

⊕

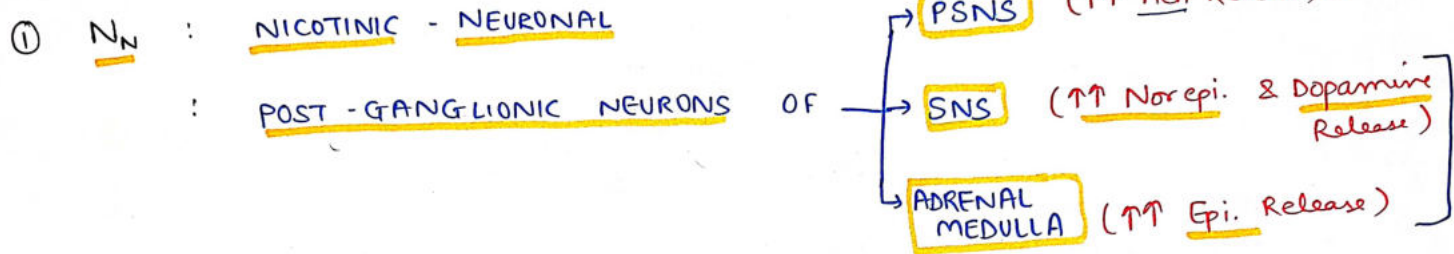
Butyryl Choline
Esterase (BACHE)



circulates in Plasma
⊕ Blood



LOCATION



② N_m : NICOTINIC - SKELETAL MUSCLES

: PART OF SOMATIC N.S.

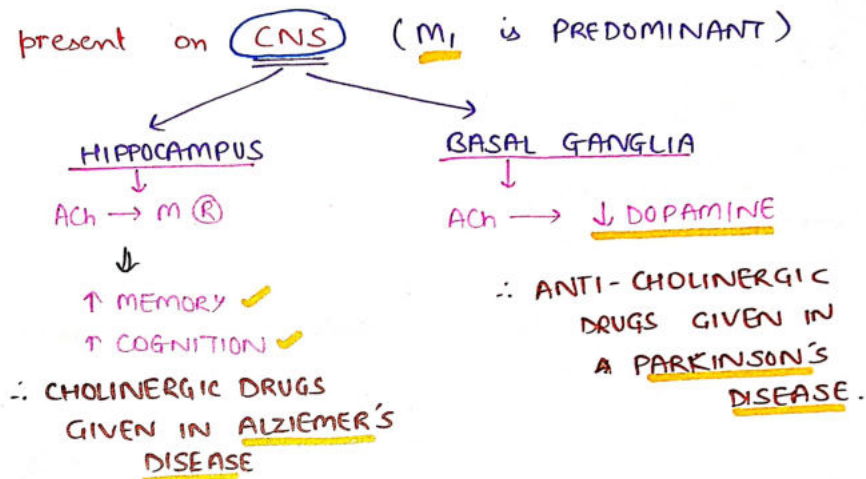
: function : MUSCLE CONTRACTION [Na⁺ entry → Depolarisation] ✓

N_m ANTAGONISTS : k/a NON-DEPOLARIZING MUSCLE RELAXANTS ✓

- CURARE ✓
- CURIUM ✓
- CURIUM ✓
- CURINE ✓

eg. d-Tubocurarine ✓
Vecuronium etc. ✓

MUSCARINIC (R) : ① All present on CNS (M₁ is PREDOMINANT)



② Periphery :

i) M₁ : ✓ STOMACH → ↑ HCL PRODUCTION
(G_q)

ii) M₂ : ✓ HEART → ↓ HEART RATE
(G_i)

M₂ M₄

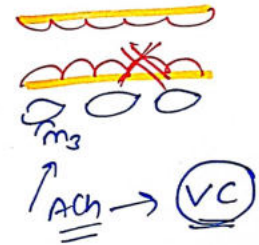
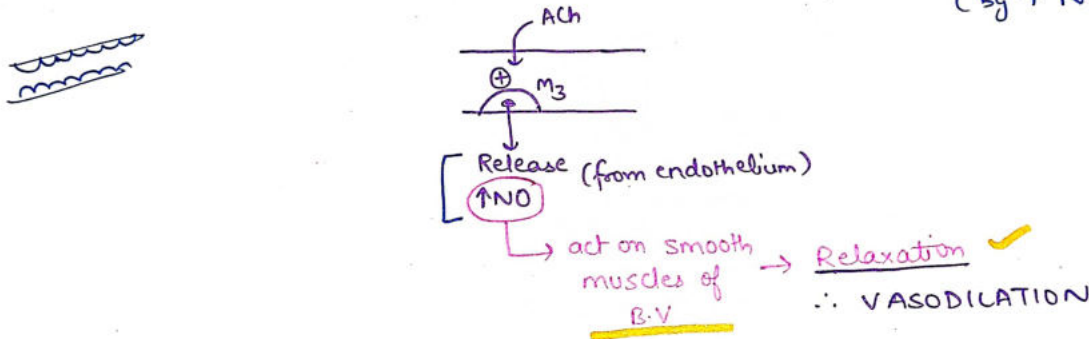
iii) M_3 : Rest of Body
(G_q)

① GLANDS : ↑ SECRETION

∴
↑ SWEATING ✓
↑ LACRIMATION ✓
↑ SALIVATION ✓
↑ PANCREATIC ENZYME SECRETION ✓

② ENDOTHELIUM OF BLOOD VESSELS : VASODILATION

(by ↑ NO gas Release)



③ SMOOTH MUSCLES : ↑ CONTRACTION

ACh → M_3

∴
• BRONCHO-CONSTRICTION ✓
• BLADDER CONTRACTION ✓
• INTESTINAL CONTRACTION ✓
• MIOSIS (Sphincter pupillae contraction)

∴ Effect of ACh :

- D DIARRHOEA ✓
- U URINATION ✓
- M MIOSIS ✓
- B BRADYCARDIA ✓
- B BRONCHO CONSTRICTION ✓
- E EMESIS ✓
- L LACRIMATION ✓
- S SWEATING ✓

CHOLINERGIC DRUGS

⊖ ACh Esterase enzyme

DIRECTLY ACTING
(Receptor Agonist) **N/M**

• **ESTERS**
(Synthetic)

- METHACHOLINE ✓
- CARBACHOL ✓
- ACETYL CHOLINE ✓
- BETHANECHOL ✓

MCAB

• **ALKALOIDS**
(Natural)

- NICOTINE ✓
- LOBELINE ✓
- ARECHOLINE ✓
- MUSCARINE ✓
- PILOCARPINE ✓✓

NLAMP

INDIRECTLY ACTING
(AntiCholine Esterase)

✓ **REVERSIBLE**

3° AMINE NH_3

- PHYSOSTIGMINE ✓
- TACRINE ✓
- DONEPILZIL ✓
- GALANTAMINE
- RIVASTIGMINE

✓ **IRREVERSIBLE**

✓ **CARBAMATES**

✓ **ORGANOPHOSPHATE**

4° AMINE NH_4^+

- NEOSTIGMINE ✓
- PYRIDOSTIGMINE ✓
- EDROPHONIUM ✓
- AMBENONIUM

BETHANECHOL : M₃ Agonist. : ✓ CONTRACT SMOOTH MUSCLES
ESTER +

: Function :- i) BLADDER = CONTRACT DETRUSSOR MUSCLE. ✓

∴ USED AS A R_x FOR

✓ NON-OBSTRUCTIVE URINARY RETENTION.
(e.g. POST OPERATIVE URINARY RETENTION)

ii) INTESTINE = USED AS R_x FOR PARALYTIC ILEUS ✓
(MEGACOLON)

✓ **PILOCARPINE** : OBTAINED FROM PILOCARPUS PLANT.

ALKALOID

: EFFECTS - IN LOW DOSE = M ⊕ i.e. Bradycardia ✓
Hypotension etc. ✓

IN HIGH DOSE = M ⊕ ✓

N ⊕ : Tachycardia

: USES = i) TOPICAL EYE DROPS (0.5-4%) - MIOTIC AGENT ✓
(PILOCARPINE)

- DOC: OPEN-ANGLE GLAUCOMA ✓
- Rx: ACUTE CONGESTIVE GLAUCOMA ✓
- USED TO REVERSE THE PUPILLARY DILATION AFTER REFRACTION TESTING. ✓
- USED ALTERNATIVELY WITH MYDRIATICS TO BREAK ADHESIONS B/W IRIS & LENS. ✓

ii) TO INCREASE SALIVATION (SIALAGOGUE). - FOR Rx OF XEROSTOMIA. (Dry Mouth)]

: S/E = i) CONSTRICION OF PUPIL ∴ ↓ VISUAL ACUITY.
(PILOCARPINE)

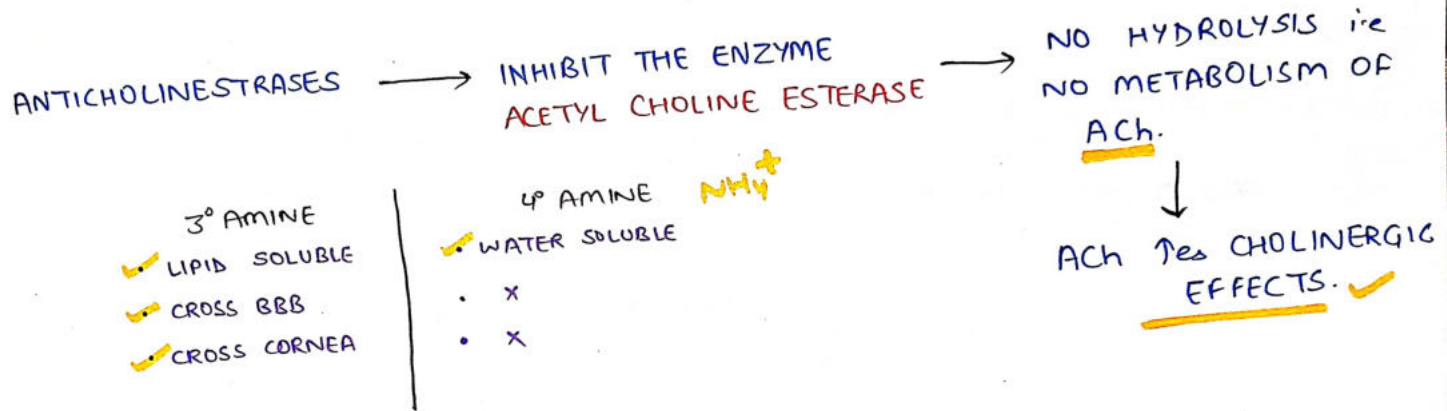
ii) CRYING ∴ OF ↑ LACRIMATION & PUNCTAL STENOSIS OF NASO-LACRIMAL DUCT. ✓

iii) CILIARY SPASM LEADING TO PAIN & STINGING SENSATION. ✓

iv) SYSTEMIC S/E:

- Bradycardia ✓
- Diarrhoea ✓
- Bronchospasm etc. ✓

ANTI-CHOLINESTRASES



REVERSIBLE ANTI-CHOLINESTRASES :
(3° AMINES)

- i) PHYSOSTIGMINE : Uses = a) GLAUCOMA - It reduces IOP by Producing Miosis. ✓
b) ATROPINE POISONING - (DOC): i/v PHYSOSTIGMINE ✓
- to be given slow i/v bcoz it can cause Bradycardia.

ii) DRUGS FOR ALZHEIMER'S DISEASE : ✓
Neurodegeneration
of Cholinergic Neurons.

a) Centrally Acting Anti-Cholinesterases : ↑es ACh in BRAIN ✓
↓
↑↑ COGNITION &  MEMORY ✓

NC
↓
DRUGS :
• TACRINE : Banned
• DONEPILZIL : DOC :: ORAL & LONGEST ACTING
• GALANTAMINE
• RIVASTIGMINE

b) MEMANTINE : NMDA Blocker
↳ Ⓡ of Glutamate

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QUATERNARY AMINES $\rightarrow$

(i) NEOSTIGMINE : indirect action = INHIBITS CHOLINESTERASES $\therefore$ $\uparrow$ ACh concentration at NMJ.

direct action = STIMULATES N_m RECEPTORS at NMJ.

$\therefore$ MUSCLE POWER IN PATIENTS WITH MYASTHENIA GRAVIS.

(ii) PYRIDOSTIGMINE : same features like Neostigmine.
: LONGER ACTING

(iii) EDROPHONIUM : RAPID ONSET & SHORT ACTING (8-10 minutes)

Uses = a) DIAGNOSIS OF MYASTHENIA GRAVIS [TENSILON TEST]
b) DIFFERENTIATE B/W MYASTHENIC CRISIS & CHOLINERGIC CRISIS.

USES OF REVERSIBLE
ANTICHOLINESTRASES :

- I. GLAUCOMA - as MIOTICS.
- II. MYASTHENIA GRAVIS
- III. CURARE POISONING & REVERSAL OF NON-DEPOLARIZING
MUSCLE RELAXANTS. ✓ $N_M \#$
- IV. ATROPINE POISONING.
- V. POSTOPERATIVE URINARY RETENTION & PARALYTIC ILEUS
- VI. SNAKE BITE POISONING : venom → Blocks N_M (R) → SKELETAL MUSCLE
PARALYSIS ✓
&
RESPIRATORY PARALYSIS ✓
(COBRA)

[Rx : ANTIVENOM
+
NEOSTIGMINE ✓]

MYASTHENIA GRAVIS

AUTOIMMUNE DISEASE ✓



ANTIBODIES PRODUCED → BLOCKS Nm^{R} of NMJ. → $\left. \begin{array}{l} \downarrow \text{QUANTITY} \\ \downarrow \text{QUALITY} \end{array} \right\} \text{ OF } Nm^{\text{R}}$



- SYMPTOMS : WEAKNESS , FATIGUE
- MOST COMMON
MUSCLE INVOLVED : OCULAR ✓
- MOST RESISTANT/
LAST MUSCLE INVOLVED : DIAPHRAGM
- CAUSE OF DEATH : RESPIRATORY PARALYSIS. ✓

DIAGNOSIS OF MG : i) TYPICAL SIGNS & SYMPTOMS - weakness & fatigue

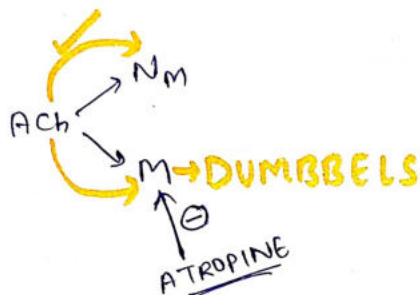
ii) EDROPHONIUM TEST - Edrophonium (2-10mg) i/v ✓
(Tensilon Test)

100 → ~~XX~~ 50 ← ACh.M

↓
↑ ACh
↓
Improvement in
SYMPTOMS OF MG ✓

iii) DEMONSTRATION OF CIRCULATING ANTIBODIES TO
N_M RECEPTORS.

TREATMENT : i) SYMPTOMATIC Rx :- ANTICHOLINESTRASES ✓



[NEOSTIGMINE
PYRIDOSTIGMINE]

⇒ INHIBITS METABOLISM
OF ACh PROLONGING
ITS ACTION AT
RECEPTORS.

+

ATROPINE → Blocks
muscarinic side effects
of ACh.

ii) DEFINITIVE Rx :-
(Remove Antibodies)

DOC PREDNISONE ✓
(corticosteroid)

↓
S/E: Cushing
syndrome ✓

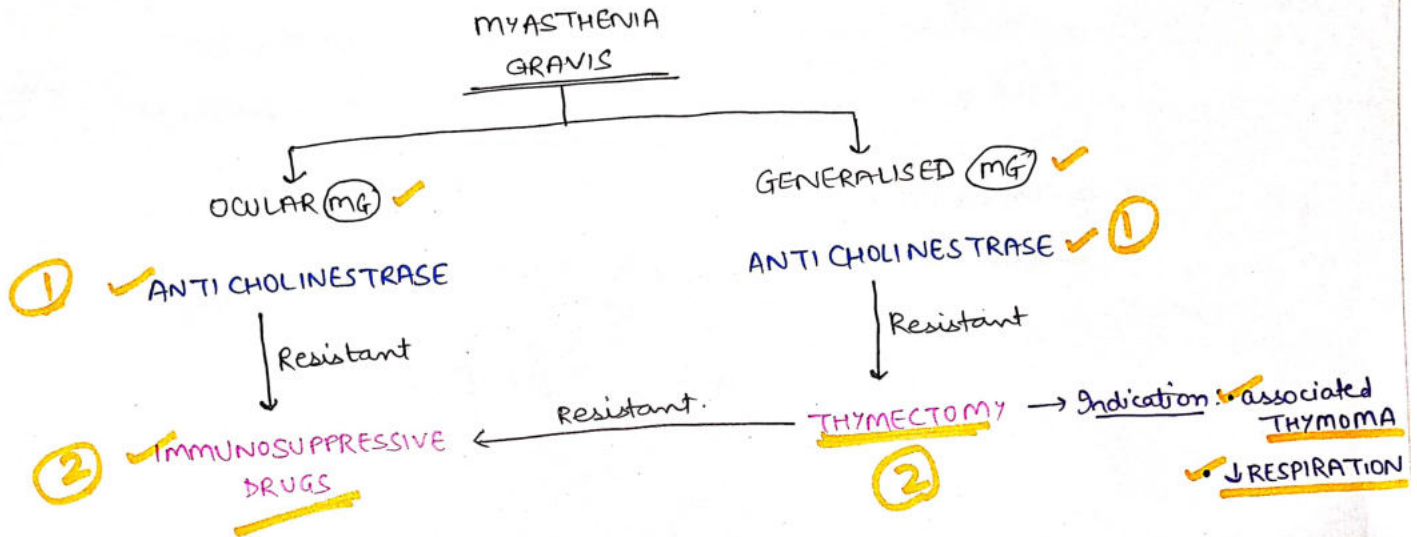
+ AZATHIOPRINE ✓
(steroid sparing
agent)

or
CYCLOPHOSPHAMIDE
etc.

* PLASMAPHERESIS & IMMUNE THERAPY MAY BE
USEFUL IN RESISTANT CASES. ✓

* LONG TERM USE OR OVERDOSE OF ANTICHOLINESTRASES
LEADS TO CHOLINERGIC CRISIS.

(Severe muscular weakness & neuromuscular
prolonged depolarization) ✓

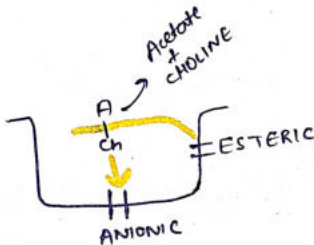


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IRREVERSIBLE ANTI-CHOLINESTERASES

CARBAMATES

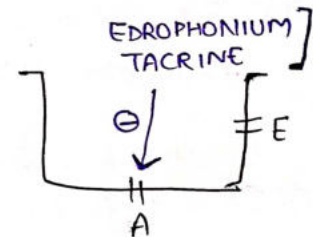
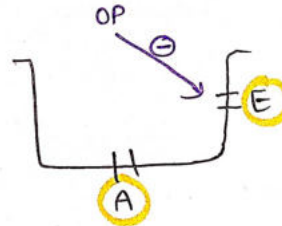
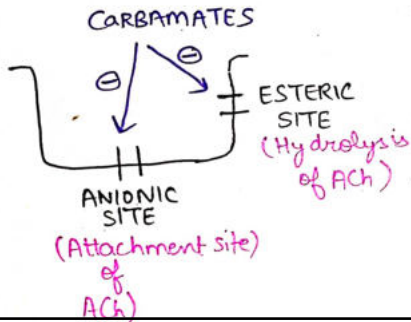
- CARBARYL
- ALDICARB
- PROPOXUR

CAP



ORGANOPHOSPHATES

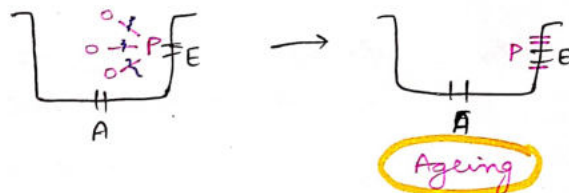
- MALATHION ✓
- PARATHION ✓
- CHLORPYRIFOS ✓
- NERVE GASES : TABUN ✓
SARIN ✓
SOMAN ✓



OP POISONING :- MOST DANGEROUS

∴ OP are highly lipid soluble drugs ∴ absorb from any body surface. ✓

• OP undergoes ageing ✓



Signs &

Symptoms :-

i) MUSCARINIC EFFECTS -

DUMBBELS

red BRONCHIAL
SECRETION

✓ PROFUSE SWEATING, SALIVATION,
LACRIMATION, BRONCHOSPASM,
VOMITING, MIOSIS, BRADYCARDIA,
HYPOTENSION, ABDOMINAL CRAMPS
etc.

ii) NICOTINIC EFFECTS - MUSCLE WEAKNESS & PARALYSIS
DUE TO PROLONGED DEPOLARIZATION.

iii) CENTRAL EFFECTS - HEADACHE, CONFUSION, CONVULSIONS,
COMA & DEATH d/t RESPIRATORY
FAILURE MAINLY. ✓

Diagnosis :

- i) HISTORY OF EXPOSURE ✓
- ii) CHARACTERISTIC SIGNS & SYMPTOMS ✓
- iii) ESTIMATING CHOLINESTERASE ACTIVITY IN BLOOD IS DECREASED. ✓

Treatment : General Measures :

- i) Remove contaminated clothes ; wash skin with soap & water ✓
- ii) Gastric lavage till returning fluid is clear.
- iii) Airway should be maintained.
- iv) Artificial Respiration is given, if necessary.
- v) Diazepam should be used cautiously by slow i.v. injection to control convulsions.

① BLOCK ACh RECEPTORS

DOC ATROPINE

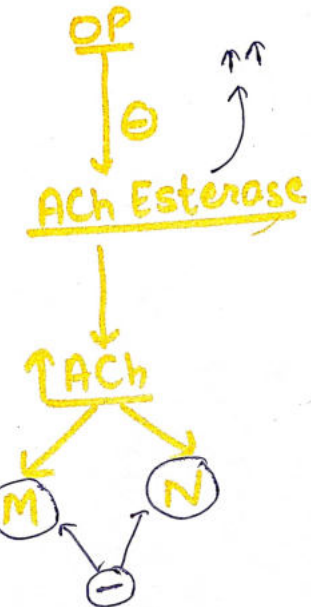
2mg i/v stat

Repeated every 5-10 minutes doubling the dose

Till ATROPINIZATION occurs.

ATROPINIZATION: • mydriasis ✓
• Tachycardia ✓
• Constipation ✓
• DRYNESS OF BRONCHIAL SECRETION ✓

DEFINITIVE & MOST RELIABLE SIGN OF ATROPINIZATION.



② REACTIVATE CHOLINE ESTERASE ENZYME ✓

OXIMES [• PRALLIDOXIME ✓
• OBIDOXIME ✓
• DIACYL MONOXIME ✓]

* ONLY GIVEN IN OP ✓✓

* C/I IN CARBAMATE POISONING. ✗

* NOT EFFECTIVE IN AGEING OF OP.

OXIMES: BIND TO ANIONIC SITE OF AChE enzyme & REMOVES OP FROM ESTERIC SITE. ✓

* IN CARBAMATE ANIONIC SITE ALREADY OCCUPIED. ∴ OXIMES FURTHER WORSENS SYMPTOMS.