



Drugs Related to Balance System

Objectives:

- To differentiate between classes of drugs used to control or to prevent vertigo.
- To hint on some disorders of balance.
- To detail on some drugs used to control or to prevent vertigo.
- Identify drugs that can precipitate vertigo.

Color index:

- Drugs names
- Doctors notes
- Important
- Extra

[Editing File](#)

Drugs Related to Balance System

Vertigo Vs Dizziness:

| Dizziness | Vertigo |
|---|---|
| <ul style="list-style-type: none">- Used to express subjective patient complaints related to changes in sensation, movement, perception, or consciousness.- Lighted headedness: Symptom of feeling about to faint. | <ul style="list-style-type: none">-Part of dizziness, complain in change in sensation of movement only (SPINNING). <p><u>Types:</u></p> <ul style="list-style-type: none">• Objective: object is moving while the patient is stationary.• Subjective: patient is moving while surrounding is stationary. <ul style="list-style-type: none">- BALANCE DISORDER (the individual will feel unsteady when standing or walking) |
| | Symptoms |
| | <ul style="list-style-type: none">- SPINNING(Vertigo).- Confusion or disorientation.- Falling or feeling as if one is going to fall.- Nausea or vomiting.- Sweating.- Nystagmus (Abnormal eye movement). |

Pathophysiology of vertigo (Extra):

As we know that **vestibular system** is used to maintain the balance



by detecting angular and linear acceleration of the head.



Sensory information from the vestibular system is then used to provide a **stable visual image** of the retina (while the head moves) & make adjustment in **posture** that are necessary to maintain balance.

➔ **Vertigo** happens if there is abnormality in the vestibular system or CNS structures that process signals from the semicircular canals.

Drugs Related to Balance System

Balance disorders:

1- Benign paroxysmal positional vertigo (BPPV)

non fatal, happened suddenly, and triggered by head movement

a change in head position causes a sudden sensation of spinning.

2- Acute labyrinthitis

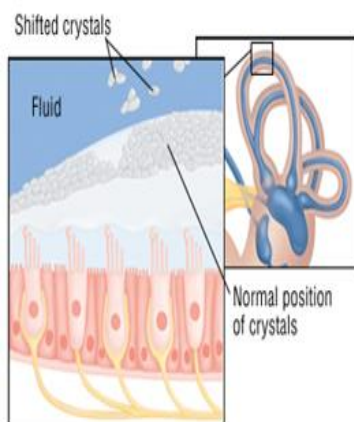
Inflammation of the balance apparatus of the inner ear, probably caused by a **viral** infection.

3- Ménière's disease

 2:43 min

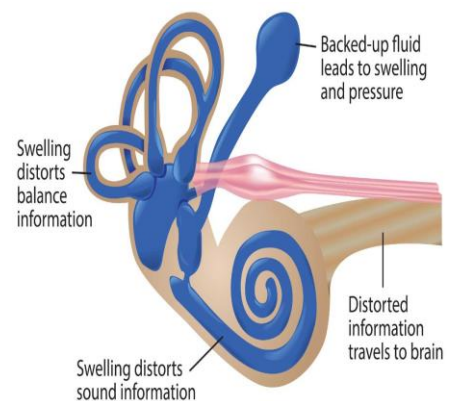
its cause is unknown = idiopathic

This causes repeated **episodes of dizziness**, usually with **ringing in the ear** & progressive low-frequency **hearing loss**



The symptoms of meniere's disease might be caused by dislodgement of the crystals which are formed of calcium carbonate. they're located within the margin of the three canals in the inner ear where they might enter the fluid which will cause imbalance and ringing in the ear.

fluid accumulation in inner ear can cause swelling and pressure which will disturb the signaling information between inner ear and brain.



Mind Map

Drugs Related to Balance System

Specific treatment

Involves targeting the **underlying cause** of the Vertigo (e.g. ear infection, use Antibiotics, or inflammation with anti-inflammatory drugs)

Symptomatic treatment

Involves **controlling** the acute symptoms and autonomic complaints (e.g., vertigo and vomiting)

Prophylactic treatment

Aims to **reduce the recurrence** of specific vertiginous conditions.

Vestibular suppressants

Reduce the intensity of **vertigo** and **nystagmus** evoked by a vestibular imbalance.

- 1- Anti-cholinergics.
→ **hyoscine**
- 2- Benzodiazepines.
→ **Lorazepam**,
Clonazepam,
Diazepam
- 3- Betahistine.

Antiemetics

Used to control **vomiting & nausea**

- 1- Antihistamines.
→ **dimenhydrinate**
- 2- Phenothiazines.
→ **prochlorperazine**
- 3- Dopamine antagonists.
→ **metoclopramide**
→ **domperidone**

- 1- Diuretics¹:
Except Loop diuretics.²
“e.g. furosemide”
- 2- Corticosteroids³.
- 3- K & Ca²⁺ Channel Blockers⁴
→ **Cinnarizine**
→ **Antihistamine**

Mnemonic!
Don't **C**ome **C**lose because they are prophylactics, so you don't want the symptoms to come in the first place!
Don't - Diuretics
Come - Corticosteroids
Close - Ca²⁺ Channel Blockers

1- Loss of Na & H₂O → ↓ H₂O in the endolymph.
2- Because they are **ototoxic** → ↑ incidence of vertigo.
3- To ↓ inflammation.
4- ↑ Vasodilatation.

Vestibular suppressants

| Drug | Anti-Cholinergics | Benzodiazepines | Betahistine |
|-----------------|---|---|---|
| | | <p>Hyoscine (scopolamine)</p> | |
| Mech. of action | <p>1- Inhibit firing in vestibular nucleus neurons.</p> <p>2- Reduce the velocity of vestibular nystagmus.</p> | <p>- Minimize anxiety and panic associated with vertigo</p> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>Mnemonic! minimize anxiety , "Dont Cry , Laugh" D= Diazepam C= Clonazepam L=Lorazepam</p> </div> | <p>- It is a structural analog of histamine with:</p> <p>1-Weak histamine H1 receptor agonist → By stimulating H₁ receptors located on BV in the inner ear→ local vasodilation and ↑ permeability → helps to reverse the underlying problem of endolymphatic hydrops.</p> <p>2-More potent histamine H3 receptor antagonist properties → By blocking H3 receptors → ↑ the local concentration of histamine in the inner ear.</p> <p>- increases the level of serotonin in the brainstem → ↓ the activity of vestibular nuclei.</p> <p>-activation of presynaptic (H3)→inhibitory action → inhibit histamine release. -activation of postsynaptic(H1)→excitatory action →release histamine . -Betahistine→ will block H3→histamine release increased.</p> |
| P.K | — | — | <p>- Tablet or oral solution.</p> <p>- Rapidly and completely absorbed (Lipid soluble)</p> <p>- t_{1/2}= 3-4 h. excreted in <u>urine</u> within 24h.</p> <p>- <u>Low</u> protein binding.</p> |
| Indications | <p>-sedation - motion sickness.</p> <p>Hyoscine = high = like in an airplane > motion sickness :)</p> | <p>- In small dosages useful for the management of acute vertigo.</p> <p>- used as anti depressant, anti seizure, anticonvulsants, and hypnotics</p> | <p>Meniere's disease</p> <div style="border: 1px dashed black; padding: 5px; margin: 10px 0;"> <p>how to remember that Betahistine is used for Merniere's disease? Merniere betahistine = مين ياي بيتنا هالحين ؟</p> </div> |
| ADRs | <p>- Dry mouth. - Blurred vision. - sedation. تعتبر جانب مضر لسائق السيارة مثلاً وتعتبر نافعة للخائف من vertigo</p> | <p>- Dependence. - Impaired memory. -increased risk of falling.</p> | <p>-Headache -Nausea. -GIT side effects. H1 agonist = cramps</p> |
| C.I | <div style="border: 1px dashed black; padding: 5px;"> <p>Mnemonic! Balance Helps Cats Leap Down</p> <p>Balance - Betahistine Helps - Hyoscine Cats - Clonazepam Leap - Lorazepam Down - Diazepam</p> </div> | | <p>- Pheochromocytoma (Histamine is active=catecholamine= Active tumor) - Bronchial asthma. bronchoconstriction - History of peptic ulcer. H2 in stomach - Hypersensitivity reaction.</p> |

Anti-emetics (مضادات التقيؤ)

| Drug | Anti-histamines | Phenothiazines | Dopamine antagonists |
|-------------------------------|--|---|--|
| | <p>Dimenhydrinate</p> | <p>Prochlorperazine</p> | <p>Metoclopramide Domperidone</p> |
| <p>Mech. of action</p> | <ul style="list-style-type: none"> - Block H1 receptors in CRTZ "chemoreceptor trigger zone" CTRZ: it's the vomiting center in brain. - Has a sedative effects. - Has a weak anticholinergic effects. (treats vertigo and vomiting) - ↓ Excitability in the labyrinth & blocking conduction in vestibular-cerebellar pathways | <p>(stronger to prevent vomiting and cause depression)</p> <p>↓</p> <ul style="list-style-type: none"> - Blocks dopamine receptors at CRTZ. - Antipsychotic, some sedation & antiemetic. | <ul style="list-style-type: none"> - Block DOPAMINE D2 receptors in the CRTZ of the medulla, resulting in potent central antinausea & antiemetic action - Has some sedative action. - Potent gastroprokinetic effect. يخفف ضغط ال GI |
| <p>Indications</p> | <ul style="list-style-type: none"> - Vertigo. - Prevent nausea & vomiting associated with Motion sickness. قبل السفر | <ul style="list-style-type: none"> - One of the Best antiemetics in vertigo. - has some vestibular suppressant action. (effects in brain) - Schizophrenia | <p>----</p> |
| <p>ADRs</p> | <ul style="list-style-type: none"> - Sedation. - Dizziness. - Anticholinergic side effects (e.g. dry mouth and blurred vision) | <p>----</p> | <ul style="list-style-type: none"> - Restlessness or drowsiness. - Extrapyramidal manifestations on prolonged use. يعطي نفس أعراض Parkinsons Dopamine is low |
| <p>C.I</p> | <ul style="list-style-type: none"> - Glaucoma → bc of the anticholinergic effect → IOP. - Prostatic enlargement → bc anticholinergics cause urinary retention (block) | <p>----</p> | <div style="border: 1px dashed black; padding: 10px;"> <p>Mnemonic! Dizzy Minds Don't Prance</p> <p>Dizzy - Dimenhydrinate Minds - Metoclopramide Don't - Domperidone Prance - Prochlorperazine</p> </div> |

K & Ca²⁺ channel blockers (prophylactic)

| Drug | Cinnarizine | |
|-----------------|--|---|
| Mech. of action | - Selective Ca²⁺ channel blocker (vascular smooth muscle relaxation). - Anti-Histamine, Anti-Serotonin and Anti-Dopamine . - ↑ hydrostatic pressure on hair cells activates K ⁺ currents. Cinnarizine inhibits K⁺ currents → lessen <u>vertigo</u> and motion- induced <u>nausea</u> by dampening the over-reactivity of the vestibular hair cells. - It promotes cerebral blood flow → Improve memory especially in elderly pts. | |
| P.K | - orally in tablet form. - Rapidly absorbed. - Low oral bioavailability due to hepatic first pass metabolism. - If administered IV in lipid emulsion, it has better bioavailability. | |
| USES | - Nausea and vomiting associated with <u>motion sickness</u> , vertigo and Meniere's disease. | |
| ADRS | - Sweating. - Headache. | - Drowsiness. - Muscle rigidity and tremor → same symptoms of Parkinson's. |
| C.I | - Parkinsonism → bc they suffer from shortage of dopamine. - Car drivers. → bc of anti-histaminic effect → sedation. | |

Drugs inducing vertigo

important to know each drug will have functional or structural effect.

Drugs producing damaging effects on **structure** or **function** of labyrinthine hair cells & / their neuronal connections.

A- Vestibular toxins

Alter function

Affect the **balance**.

1- Drugs altering **fluid** & **electrolyte balance**.

→ **Diuretics**. (not loop)

2- Drugs altering (**Inhibit**) **vestibular firing** (neuronal depressants).

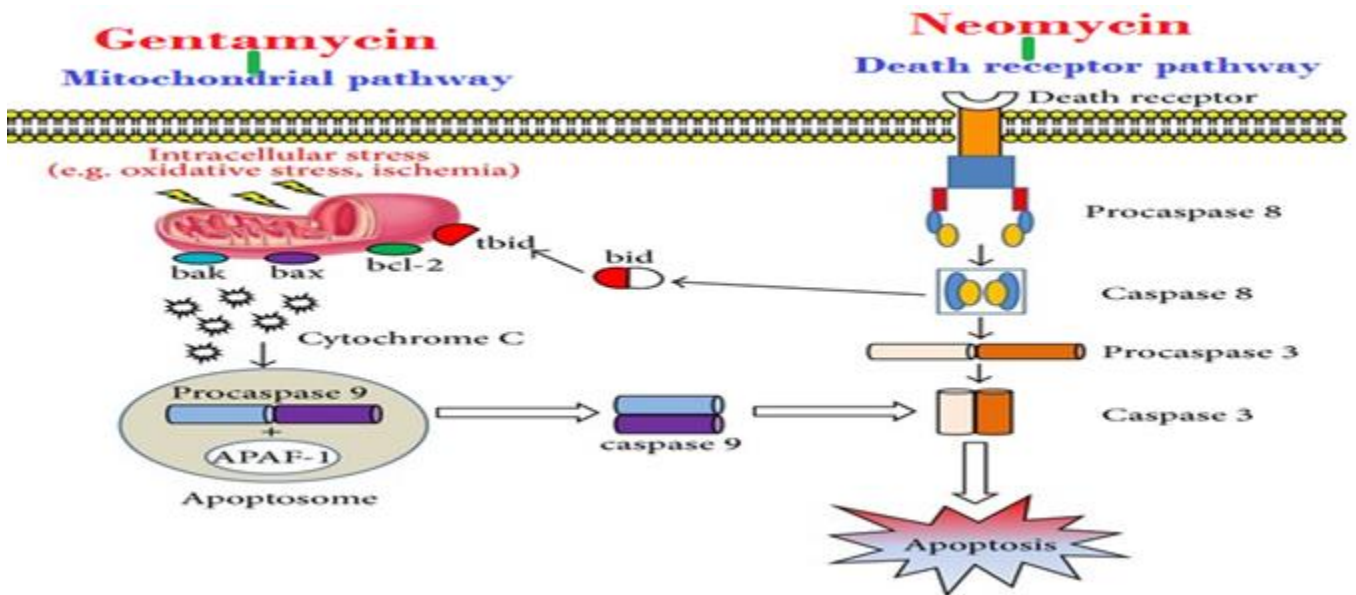
→ **Anticonvulsants**, **Antidepressants**, **Sedative hypnotics**
Alcohol, **Cocaine**.

B- Mixed ototoxins

Affect **hearing** & balance.

B- Mixed ototoxins → Affect balance & hearing

| Altering Structure | Altering Function |
|---|--|
| <p>Aminoglycoside antibiotics;</p> <ul style="list-style-type: none"> - Gentamycin, - Neomycin, - Kanamycin, - Streptomycin. <div style="border: 1px dashed black; padding: 5px; width: fit-content; margin-left: 20px;"> <p>we avoid aminoglycoside if there is an inner ear infection + vertigo</p> </div> | <ul style="list-style-type: none"> - Quinine, chloroquine, quinidine → Anti-malarial drugs. - Nitrogen mustard → Anti-cancer drug. - Loop diuretics - NSAIDs - Tobacco |
| <p style="text-align: center;">GentaMycin</p> | <p>- How functional derangement is induced by these drugs?</p> <p>↓ Local blood flow</p> <p>→ biochemical changes</p> <p>→ ↓ electrochemical transduction</p> <p>→ ↓ firing of impulse</p> |
| <p>Induce apoptosis by evoking free radicals → Mitochondrial Pathway.</p> | |
| <p style="text-align: center;">NEomycin</p> | |
| <p>Induce apoptosis by activating caspases → DEath Receptor Pathway. (protease enzymes)</p> | |



Questions

MCQs

1- Which of the following is most likely to induce parkinsonism-like extrapyramidal symptoms?

- A. Hyoscine
- B. Metoclopramide
- C. Dimenhydrinate
- D. Lorazepam

2- Which of the following agents decreases nausea and vomiting by blocking dopaminergic receptors in the chemoreceptor trigger zone (CTZ)?

- A. Prochlorperazine
- B. Lorazepam
- C. Cinnarizine
- D. Hyoscine

3- Which of the following is a selective Ca²⁺ channel blocker?

- A. Cinnarizine
- B. Dimenhydrinate
- C. Gentamicin
- D. Betahistine

4- Which of the following drugs is contraindicated in patients with glaucoma?

- A. Clonazepam
- B. Hyoscine
- C. Cinnarizine
- D. Dimenhydrinate

5- All of the following induce vertigo except?

- A. Neomycin
- B. Alcohol
- C. Anticholinergics
- D. Antidepressants

6- which of the following is contraindicated in parkinsonism?

- A. Dimenhydrinate
- B. Cinnarizine
- C. Betahistine
- D. Anticholinergics

7- which of the following is contraindicated in Pheochromocytoma

- A. Betahistine
- B. Hyoscine
- C. benzodiazepines
- D. metoclopramide

Questions

MCQs

8- One of the Best antiemetics in vertigo?

- A. Betahistine
- B. dimenhydrinate
- C. metoclopramide
- D. prochlorperazine

9- Meniere's Disease caused by disorder of ?

- A. outer ear
- B. inner ear
- C. tympanic cavity
- D. tympanic membrane

10- patient came to the hospital with meniere's disease, which one of the following drugs will be the drug of choice as prophylactic?

- A. furosemide
- B. cinnarizine
- C. Dimenhydrinate
- D. Betahistine

SAQ

1- What are the different pharmacological approaches in dealing with balance disorders? give an example for each.

Specific treatment for the underlying cause, e.g. Antibiotics.

Symptomatic treatment to control the acute symptoms, e.g. Antiemetics.

Prophylactic treatment to reduce the recurrence, e.g.: Corticosteroids.

2- drugs Used to control vomiting & nausea?

- 1- dimenhydrinate
- 2- prochlorperazine
- 3- metoclopramide
- 4- domperidone

3- list 3 of Cinnarizine ADRs?

- 1- Sweating
- 2- Muscle rigidity and tremor
- 3- Drowsiness

MCQs Answers:

- 1- B
- 2- A
- 3- A
- 4- D
- 5- C
- 6- B
- 7- A
- 8- D
- 9- B
- 10- B

Questions

Cases:

1- A patient complained of sweating and tremors after treatment for vertigo.

A. What is the drug he most likely used?

Cinnarizine

A. What is the mechanism of action?

Cinnarizine is a selective Ca^{2+} channel blocker, it inhibits K^{+} currents. Inhibition of K^{+} currents lessen the vertigo & motion-induced nausea by dampening the over-reactivity of the vestibular hair cells.

A. What are some other ADRs the drug might cause?

Drowsiness, headache, and muscle rigidity.

2- A 31 year old female had symptoms of meniere's disease. after taking one tablet of the medication she developed hypersensitivity reaction and headache.

A. what is the drug she most likely used?

Betahistine

A. what is the mechanism of action?

- It is a structural analog of

histamine with:

1-**Weak histamine H1 receptor agonist** → By stimulating H_1 receptors located on BV in the inner ear → local vasodilation and ↑ permeability → helps to reverse the underlying problem of endolymphatic hydrops. (accumulation of endolymph)
→ Reduce pressure in endolymph.

2-**More potent histamine H3 receptor antagonist properties**

→ By blocking H_3 receptors in presynaptic nerve end → prevent reuptake of Histamine by H_3R → ↑ the local concentration of histamine in the inner ear

→ ↑ the direct **H1-agonist** activity.

- increases the level of **serotonin** in

the brainstem → ↓ the activity of vestibular nuclei.

A. other ADRs the drug might cause?

-GIT side effects.

-Nausea

Special thank for team 435 ❤️



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References:

- Doctors' slides and notes.
- Pharmacology Team 435.

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