

Balance disorders in children

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Introduction

1. Young children don't usually complain of vertigo
2. History can be elusive
3. Diagnosis can be elusive
4. Other than middle ear disease & congenital or hereditary sensorineural conditions excluded migraine is the condition associated with giddiness
5. Posterior fossa diseases should be considered in older children

Reassurance plays a vital role

8% of children in the age group of 1-15 years experienced vertigo

If appropriate antimigraine treatments are effective

Cinnarizine can be used

Maturation of the vestibular system

Phylogenetically vestibular system is older than auditory. Each stage in development is in advance of auditory system

At 4 months of age the baby can tilt its head to keep it vertical

Otic capsule develops early in gestation between 4th - 12th week of intrauterine life

Vestibular system is the first sensory system to develop. Full term babies demonstrate doll's eye response

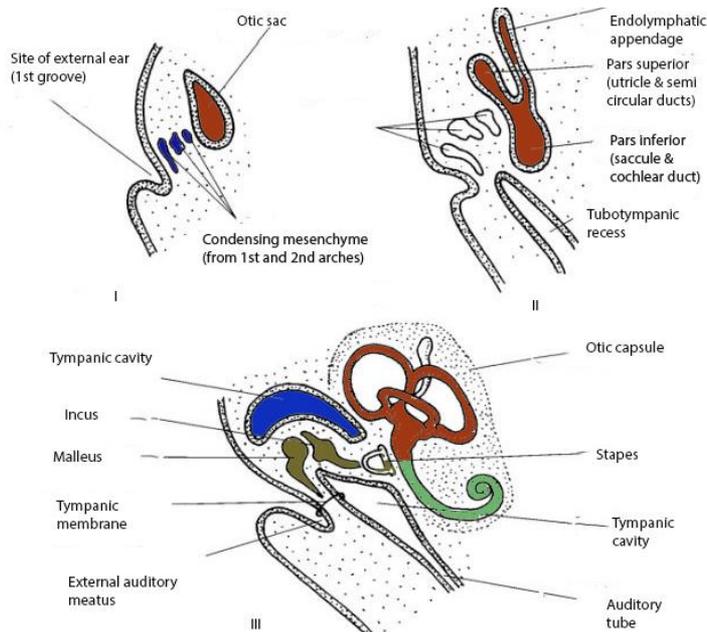
Vestibular nerve myelinates by 16 weeks

By 24 weeks there is a primitive vestibulo-ocular reflex present

Moro reflex is present in normal child at birth

Cochlear duct has two and half coils by 50 mm stage

Semicircular canals are formed from the utricular portion of otic vesicle by 30 mm stage



Normal ENG values for canal paresis and directional preponderance calculations are wider than those seen in adults.

Maximum slow phase velocity readings are often similar to those in adults

After Birth

1. Maturation of vestibulospinal & vestibulo-ocular reflexes continues and are maximal at 6-12 months of age
2. Bithermal caloric responses can be demonstrated in 9 month old babies
3. Vestibular nystagmus in children is of low frequency and greater amplitude

Assessment of the Dizzy Child

Vision is the most important sense for locomotor milestones

Symptoms

1. Vertigo is difficult to recognize in children when compared to adults
2. Child suddenly cries out, drop to the floor or cling to the legs of adults
3. Pallor
4. Sweating
5. Vomiting
6. Lying face down in the cot showing reluctance to be moved

Children born with congenital lack of normal vestibular function have no balance

History

History taking should be directed at:

1. BPV of childhood
2. Migraine associated vertigo
3. Epilepsy
4. Central causes of ataxia and loss of balance
5. Vestibular neuronitis
6. BPPV
7. Meniere's disease

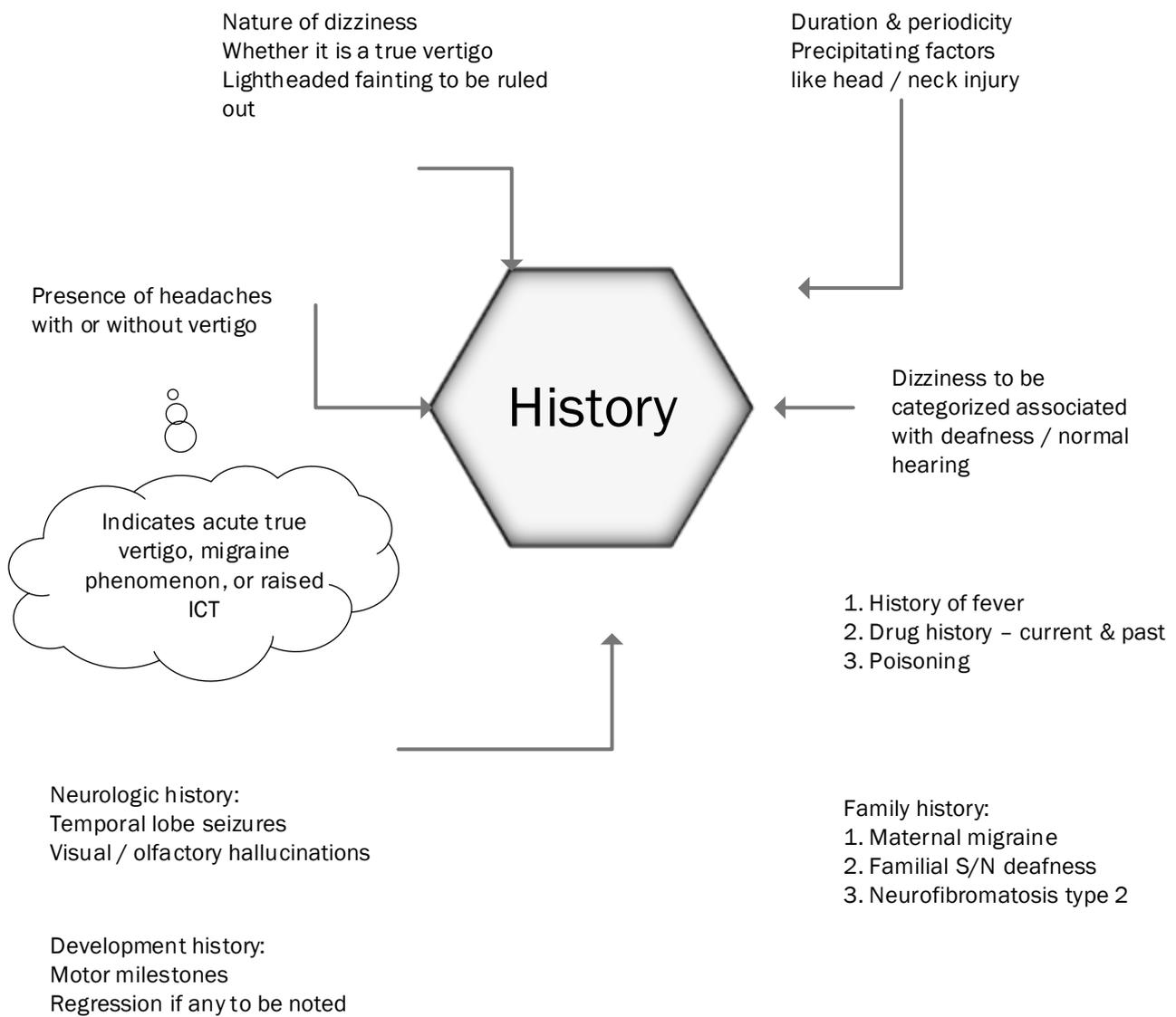
By teenage migraineous vertigo, psychogenic vertigo could be common

Presentation of vertigo varies dramatically according to the age of the child. Young children cannot describe this sensation. They may present with torticollis. They may cry suddenly, lie in the cot face down. Some may even close their eyes and hold on to the legs of the adults close by. Children may present with delayed milestones, or may have falling attacks. Children by 5 years should be able to describe acute episodes of vertigo.

Causes of childhood vestibular symptoms

Conditions with hearing loss	Conditions with normal hearing
OME	Motion sickness
Suppurative ear disease	BPV of childhood
Cholesteatoma with fistula	Basilar migraine
Temporal bone trauma	Seizure disorders
Barotrauma	BPPV
Meniere's disease	Post traumatic vertigo
Enlarged vestibular aqueduct syndrome	Posterior fossa tumors
Congenital temporal bone anomalies	Cardiac causes
Dehiscent superior canal syndrome	Acute poisoning
Drug induced ototoxicity	Multiple sclerosis / Lyme disease
Congenital syphilis	CNS infections
Herpes zoster oticus	Meningitis
Congenital CMV infection	Chiari malformation
Metabolic conditions – Hurler syndrome	Hereditary cerebellar ataxia
Usher syndrome	Acute cerebellar ataxia

History Taking



Examination

Most of the pediatric vestibular examination can be carried out through observation of the child from the waiting area, and while moving into the consultation room.

Otoscopy – Is possible after winning the confidence of the child.

Facial nerve should be examined.

Tongue movements and gag reflex should be examined

Eye movements should be looked for (Nystagmus)

Latent nystagmus should be checked out for

Strabismus to be checked for

Romberg test

Unterberger test

Tandem heel to toe test (to identify cerebellar ataxia)

Dix Hallpike positional maneuver

Rotation testing using office chair

Neurological examination of limbs

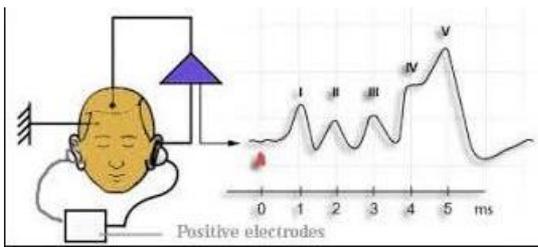
Investigations



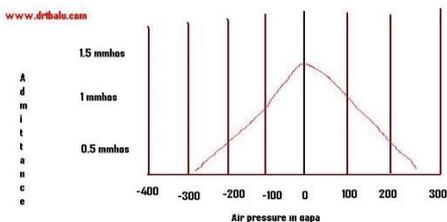
PTA



Visual reinforcement audiometry



BERA



Tympanometry

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Blood tests

1. Hb
2. WBC count
3. ESR (other inflammatory markers)
4. C reactive protein
5. Congenital syphilis
6. HIV

Bithermal caloric testing. This will reveal the status of the vestibular apparatus and their excitability. Caloric test will not evoke nystagmus if the labyrinth is not functional.

Electronystagmography

Video nystagmography where eye movements can be recorded

Recording of ocular VEMP in children over the age of 2

EEG in indicated children

Imaging

MR imaging

CT imaging (HRCT) bony labyrinth will reveal labyrinthine anatomical abnormalities

Dizziness & Balance disturbance

Vertigo

Ataxia

Normal hearing

Hearing loss

Hereditary ataxia posterior fossa disease

S/N loss

OME/CSOM Surgery

HRCT
Temporal bone abnormalities

Syndromes:
Pendred
Usher
CHARGE
Wardenburg
Branchio-otorenal

1. Ototoxic medications
2. Barotrauma / Head injury
3. Perilymph fistula

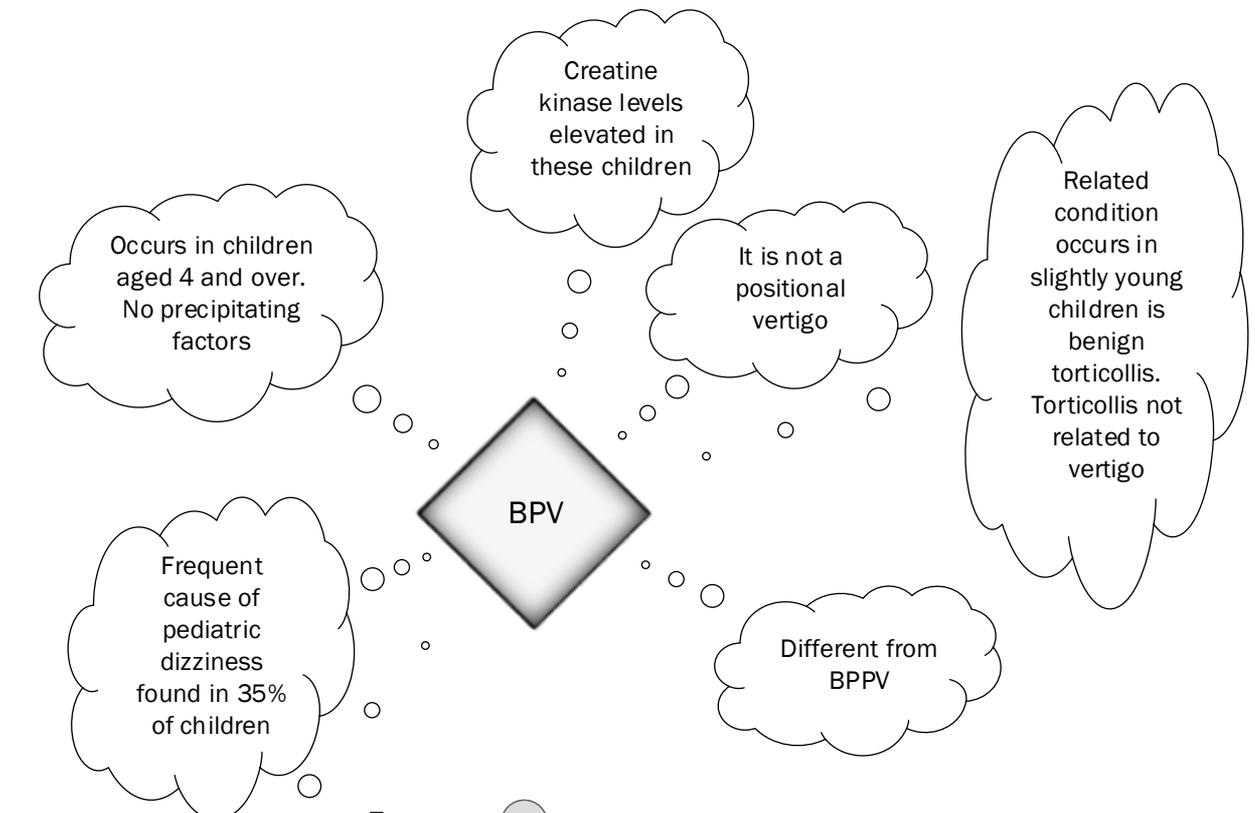
Vertigo - <1 minute. BPV of childhood / BPPV

Vertigo > 10 mins Vomiting + Headache + = Migraine

1 - 2 prolonged episodes of vertigo (vestibular neuronitis / labyrinthitis)

Vertigo with hallucination (seizure disorder)

Benign Paroxysmal Vertigo of childhood



Features

1. Short lived acute vertigo lasting for 30-60 seconds
2. Child may cry / fall / try to hold on to something including adult's legs
3. Anxious and pale. Sweating +
4. Vomiting
5. Rapid return to normalcy within a few minutes
6. Nystagmus + during the attack
7. Condition resolves with age. Totally disappears by the age of 8

Migraine & Vertigo

1. This is a common multifactorial neurovascular disorder
2. Several mutations have been discovered for rare forms of migraine
3. Prevalence in children – 8%
4. Different from that of adults – Head ache is shorter and bilateral
5. Vestibular type of migraine
6. Basilar type of migraine is diagnosed when other symptoms associated with posterior circulation are present
7. Vestibular migraine demonstrate directional preponderance on rotational testing and unilateral reduce caloric response
8. Dietary triggers if identified should be avoided
9. Fasting is the common trigger and hence regular feeds is a necessity
10. If attacks occur more than once a week migraine prophylaxis should be initiated
11. Headache in children over 12 years can be treated with triptans
12. EEG shows diffuse polymorphic subdelta – delta activity
13. VNG showed abnormalities during the active phase of the disease

Vestibular neuronitis

1. Symptoms are more or less similar to that of adults
2. These patients have acute and severe vertigo, vomiting, with normal hearing
3. Nystagmus is demonstrable during the acute phase
4. Nearly half of these children develop recurrent episodes
5. Attacks become progressively less severe as the child ages
6. Vestibular rehabilitation is the best way to manage these children

BPPV

1. It is rare in children
2. Occurs following head injury or a marked whiplash injury
3. Characteristic positional nystagmus is seen in children also
4. As in adults it does not occur spontaneously
5. It has good prognosis
6. Exact pathogenesis is not still clear

Post traumatic vertigo

Dizziness and head ache commonly follow head injury in children

High incidence of persistent post traumatic symptoms makes diagnosis that much difficult

Difficult to differentiate from functional complaints

Vestibular conditions with associated hearing loss

OME & CSOM

1. Glue ear may be detected in the clumsy child with poor balance and who is more prone to falls than his siblings / peers
2. CSOM with cholesteatoma carries a possibility of fistula in the lateral canal account for the dizziness

Menieres

Uncommon
Clinical features are indistinguishable from that of adults
Early onset tends to be associated with more aggressive disease and a likelihood of relatively early bilateral involvement

Temporal bone abnormalities & hearing loss

1. sensorineural deafness and vestibular symptoms associated with temporal bone abnormalities
2. CHARGE syndrome
3. USHER syndrome

Enlarged vestibular aqueduct syndrome

Rare congenital anomaly
Vestibular disturbance is uncommon
Seen in 4% of children
Fluctuating hearing loss is bilateral
Vestibular aqueduct radiologically is wider than 1.5 mm at its midpoint or wider than 2 mm at the operculum is defined as enlarged.
Most children have stable hearing at least in one ear
Found in nearly 30% of children with Wardenberg syndrome
These children are autosomal recessive inheritance

Conservative management is advised

Patent cochlear aqueduct

Cochlear aqueduct at its narrowest portion is 0.14 mm wide
It widens as it opens into the posterior fossa with a very variable size at that point
Sensorineural deafness associated with this condition is attributed to defects at the fundus of the internal auditory canal

SCC dehiscence

This condition is demonstrated in HRCT
Vertigo / Oscillopsia is evoked by loud noises or by stimuli that results in changes in middle ear and intracranial pressure
Tullio phenomenon and Hennebert's sign is positive
Positive fistula test
Evoked eye movements on valsalva
Surgical repair of fistula

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Perilymph fistulae

1. Usually seen in association with temporal bone anomalies and pre-existing severe or total hearing loss in the affected ear
2. They may present with recurrent meningitis or with CSF behind intact ear drum
3. Can develop directly from blunt trauma to middle ear, iatrogenic trauma, barotrauma. Surgery is indicated in all these conditions
4. Spontaneous fistula is rather rare
5. Hearing loss, vertigo and tinnitus. These symptoms may be fluctuating

Drug induced vertigo

Ototoxic medicines (aminoglycosides) can cause marked vestibular dysfunction
Acute vertigo at the time of administration of the drug
SM and GM are more selectively vestibulotoxic
Antimalarials like mefloquine is cleared slowly from the body can cause dizziness and hearing loss
Platinum based cytotoxic agents can cause ototoxicity

Central causes

Ataxia – Commonly seen in cerebellar, posterior column and vestibular disease in children
Infections, and rare hereditary and metabolic causes.
Vitamin E deficiency and Refsum disease should be identified as they are potentially reversible

Hereditary cerebellar ataxia

Slowly progressive ataxia
Posterior fossa tumor should be excluded by imaging
Genetically about 20 forms of autosomal dominant and recessive cerebellar ataxia has been identified

Refsum

Disorder of lipid metabolism with pigmentary retinopathy, demyelinating neuropathy, ataxia and hearing loss
There is progressive difficulty in walking which develops between the ages 4 and 7

Chiari malformations

Type I malformation is characterized by cerebellar tonsil herniation through foramen magnum
Type II malformation is same as I except in addition there is a non communicating hydrocephalus and spina bifida
Type III in addition to the above can have cervical or occipital bifida

Treatment

Medical

1. Reassurance of patient's parents
2. Vestibular sedatives
3. Antihistamines like cyclizine / cinnarizine can be used for prolonged attacks
4. Hyoscine patches have been advocated
5. Domperidone is useful for associated sickness
6. Dopamine antagonists like phenothiazine such as prochlorperazine are effective vestibular suppressants
7. HT3 antagonists such as ondansetron can be used as an antiemetic
8. Vestibular migraine can be treated with domperidone, cinnarizine can be used to manage nausea
9. Sumatriptan may be useful in the management of headaches
10. Rizatriptan is very potent and useful than sumatriptan
11. Propranolol can be used as a prophylactic

In BPPV Epley maneuver can be used

Other vestibular rehabilitation exercises could be prescribed for children with unilateral vestibular symptoms to hasten central compensation at the earliest.

Surgery:

Indicated for specific underlying conditions. Unilateral glue ear can be managed by insertion of grommet

Perilymph fistula due to barotrauma should be closed via middle ear exploration

Perilymph fistula similarly should also be surgically closed

Cholesteatoma of middle ear again needs surgical management