BMJ Best Practice

Assessment of dizziness

Straight to the point of care

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Summary

Dizziness is the sensation of disturbed spatial orientation without a distorted sense of motion.[1] Patients may use the term to indicate lightheadedness, imbalance (disequilibrium), pre-syncope, or vertigo. These symptom types overlap substantially and patients most often report feeling off-balance or unsteady. Over 60% of patients experience more than one type of dizziness.[2]

Dizziness is a common symptom: the prevalence in the general population ranges from 15% to 30%, and approaches 50% for patients aged over 85 years.[2] [3] [4] Dizziness accounts for approximately 5% of emergency department and unselected outpatient visits and up to 8% of primary care visits.[5] [6]

The aetiology is diverse and includes vestibular, cardiovascular, neurological, and psychogenic causes.[5] A detailed history, paying particular attention to timing and triggers of the patient's symptoms, will narrow down the differential diagnosis, which can be confirmed with clinical examination and, if needed, further investigations.

Aetiology

Dizziness has many possible aetiologies. The most common are vestibular, cardiovascular, neurological, and psychogenic.[6]

Patients may use the term dizziness to describe vertigo, pre-syncope, lightheadedness, and imbalance (disequilibrium). Vertigo is a sensation of distorted self-motion, occurring at rest or during an otherwise normal head movement.[1] Vertigo usually indicates a problem with the peripheral (inner ear, vestibular nerve) or central (brainstem, brain) vestibular system.[7] Imbalance may be neurological in origin and lightheadedness and pre-syncope may be cardiovascular in origin. Patients with psychogenic dizziness report a variety of symptoms, such as rocking, floating, or swimming sensations.[3]

Symptoms may overlap substantially and patients most often report feeling off-balance or unsteady. Over 60% of patients experience more than one type of dizziness.[2] Evaluating the timing and triggers of dizzy episodes can help the clinician make a correct diagnosis.[8]

Vestibular

- Benign positional paroxysmal vertigo (BPPV): the most common cause of vertigo, affecting 107 people in 100,000 per year.[9] In the US, BPPV is diagnosed in 17% to 42% of patients presenting with vertigo.[10] Prevalence increases with age and women are affected more frequently than men.[4] [11]
    - BPPV is caused by loose otoconia particles (calcium carbonate crystals) in the semi-circular canals, usually the posterior canal.[10]
    - Patients experience vertigo with changes in head position relative to gravity (e.g., rolling over in bed or looking up).
    - Torsional, upbeating nystagmus provoked by the Dix-Hallpike manoeuvre is diagnostic of posterior semi-circular canal BPPV.[10]
- Labyrinthitis: an acute bacterial or viral infection of the labyrinth of the inner ear. The patient often presents after an upper respiratory infection or acute otitis media. Patients may have associated symptoms of tinnitus and hearing loss, because the cochlea is located within the bony labyrinth.[12] [13] Patients with acute otitis media may also report otalgia, otorrhoea, and fever.[14]
- Vestibular neuritis (neuronitis): an acute peripheral neuropathy probably due to reactivation of a viral infection (e.g., herpes simplex virus), which affects the vestibular nerve. Patients present with acute onset vertigo but do not have hearing loss or tinnitus. Changes in head position exacerbate symptoms and loss of balance is a prominent feature.[12]
- Meniere's disease: usually presents in middle-aged people, with fluctuating auditory and vestibular symptoms. Prevalence estimates vary from around 3.5 per 100,000 to 200 per 100,000 adults.[15] [16] [17] [18] The underlying cause remains unknown; hereditary factors are thought to play a role.[19]
    - Classic Meniere's disease has the triad of vertigo, hearing loss, and tinnitus. Spontaneous vertigo attacks last 20 minutes to 12 hours with documented low- to mid-frequency sensorineural hearing loss in the affected ear before, during, or after one of the episodes of vertigo. The tinnitus is usually described as roaring in nature and may be severe. Aural fullness, a sensation of pressure and fullness in the ear, may also be present during an episode.

- An atypical presentation of Meniere's disease is fluctuating hearing loss and tinnitus without vertigo. This is usually referred to as cochlear hydrops, and up to 40% of patients will eventually develop vertigo.[20]
- Bilateral disease may be present in around 30% to 50% of patients.[21] [22]

- Superior canal dehiscence syndrome (SCDS): a vestibular disorder caused by a pathological third window into the labyrinth that can present with autophony, sound- or pressure-induced vertigo, and/or altered middle-ear pressure, and chronic disequilibrium, among other vestibulocochlear symptoms.[23]
  - Many patients with SCDS present after head trauma and are initially diagnosed with post-traumatic vertigo, labyrinthine concussion, or perilymphatic fistula.
- Perilymphatic fistula: an abnormal communication between the perilymph-filled space of the inner ear and an air-filled space in the middle ear, mastoid or cranium.[24] The fistula develops in the round or oval window. It may occur after stapes surgery, head trauma or barotrauma. It is characterised by episodic vertigo and fluctuating sensorineural hearing loss.[24]
- Cholesteatoma: a mass of keratinising squamous epithelium within the middle ear or temporal bone. Patients may present with vertigo.[25] Associated symptoms include otorrhoea and hearing loss.[26]
- Previous mastoid surgery with a mastoid cavity: these patients are prone to dizziness with an ear infection.
- Persistent postural-perceptual dizziness (PPPD): a chronic vestibular disorder. It is one of the most common types of chronic dizziness in people aged 30 to 50 years.[27] [28] [29] Five diagnostic criteria must be satisfied to make the diagnosis:[30]
  - one or more symptoms of dizziness, unsteadiness, or non-spinning vertigo present on most days for 3 months or more
  - persistent symptoms occurring without provocation but exacerbated by upright posture, active or passive motion, or exposure to moving stimuli
  - disorder precipitated by conditions that cause vertigo including acute, episodic, or chronic vertigo or neurological or medical illness, or psychological distress
  - symptoms cause significant distress or functional impairment
  - symptoms are not better accounted for by another disease or disorder.

Neurological

- Vestibular migraine: one of the most common causes of vertigo and dizziness.[31] It often occurs in patients in their 40s with a personal or family history of migraine.[32] [33]
  - Associated symptoms include headache, photophobia, phonophobia, nausea, and fatigue.[31] Episodes last minutes to days.[7] [34]
- Posterior fossa tumours: include vestibular schwannomas (acoustic neuroma), meningiomas, cerebellar or brainstem tumours, and epidermoid cysts. May cause hearing loss and/or cranial nerve palsies.
- Cerebellar disorders: the most common diagnoses are sporadic adult-onset degenerative ataxia (26%); idiopathic down beating nystagmus syndrome (20%); cerebellar ataxia, neuropathy, and vestibular areflexia syndrome (10%); episodic ataxia type 2 (7%); and multiple system atrophy cerebellar type (6%).[35]

- Multiple sclerosis: vertigo is a common symptom. It may be peripheral (i.e., caused by involvement of the vestibular apparatus of the ear), central (i.e., caused by lesions affecting the vestibular pathways), or of combined aetiology.[36] Prolonged spontaneous attacks of vertigo occur if a demyelinating plaque occurs at the root entry zone of the vestibular nerve or nucleus, and this presents as an acute peripheral vestibular disorder, such as vestibular neuritis.[3]
- Posterior circulation stroke: may be due to infarction or haemorrhage. One in five strokes affects the posterior cerebral circulation: the vertebral, basilar and posterior cerebral arteries and their branches.[37]
    - Symptoms are variable and often non-specific, however dizziness is one of the most common presenting symptoms. Vertigo is continuous and prolonged. Other common presenting symptoms include unilateral limb weakness, dysarthria, headache, diplopia, nausea, and vomiting.[7] [37] The presentation may be very similar to vestibular neuritis.
    - Patients may have at least one vascular risk factor (age >60 years, hypertension, diabetes, smoking, obesity).[7]
    - Signs include nystagmus, unilateral limb weakness, gait ataxia, unilateral limb ataxia, dysarthria, facial numbness, Horner's syndrome, and diplopia.[7] [37] Patients usually cannot stand without support, even with the eyes open, whereas patients with acute vestibular neuritis or labyrinthitis are usually able to do so.
    - Lateral medullary infarction (Wallenberg's syndrome) is caused by occlusion of the ipsilateral vertebral artery that supplies the posterior inferior cerebellar artery. Patients have prolonged vertigo lasting several days. Signs include: truncal ataxia, ipsilateral limb ataxia, diplopia, multidirectional nystagmus, ipsilateral Horner's syndrome ipsilateral facial pain, hoarseness, dysphagia, and loss of pain and temperature sensation of the ipsilateral face and contralateral trunk and limbs.[37] [38]
- Vertebrobasilar insufficiency: describes transient ischaemia of the vertebrobasilar circulation. It is usually the result of atherosclerosis and affects the territory supplied by the anterior inferior cerebellar artery. Patients present with episodic vertigo, diplopia, headaches, vomiting, ataxia, blindness, imbalance, and bilateral weakness.[39] Patients may experience drop attacks, sudden falls secondary to loss of limb tone without loss of consciousness. Episodes last between 30 seconds and 15 minutes and typically start after abruptly standing or turning the head.[39]
- Vertebral artery dissection: may be traumatic or spontaneous and is a cause of posterior circulation stroke in young adults. Symptoms include headache, dizziness, tinnitus, neck pain, and signs include ataxia and dysarthria.[40] [41] Predisposing factors are hypertension, history of recent infection and certain connective tissue disorders (Ehlers-Danlos syndrome, Marfan syndrome, osteogenesis imperfecta, and fibromuscular dysplasia).[42] [43]
- Arnold-Chiari malformation type 1: an abnormality of the base of the skull, associated with brain stem and cerebellum herniation through the foramen magnum into the spinal canal. The most common symptom is occipital headache. Other symptoms may include dizziness, unsteadiness, and hearing loss.[44] Symptoms can mimic those of BPPV.[45] The condition might be asymptomatic.
- Idiopathic intracranial hypertension (pseudotumor cerebri): characterised by raised intracranial pressure that is not caused by a mass lesion; associated with headache and transient poor vision. These patients are often obese and complain of clumsiness, imbalance, and dizziness rather than true vertigo. Some patients present with bilateral sixth nerve palsy or tinnitus. Incidence is increasing with the rise in obesity.[46]

- Normal pressure hydrocephalus: associated with normal intracranial pressure and enlarged ventricles (hydrocephalus). Patients present with ataxia, urinary incontinence, and cognitive dysfunction.[47] The diagnosis may be difficult to establish.
- Mal de debarquement syndrome: patients experience swinging, swaying, unsteadiness, and disequilibrium after exposure to motion. There may be a history of a long voyage or air travel. It is thought to be due to a conflict between the sensory inputs from the visual, vestibular, and somatosensory systems and the central vestibular nuclei, cerebellum, and parietal cortex.
- Paraneoplastic cerebellar degeneration: a rare complication of cancer of the ovary, breast, or lung, or of Hodgkin's lymphoma. Auto-antibodies are thought to be directed against Purkinje cells. The anti-Yo antibody can present years before tumour detection. Anti-Tr antibody is associated with Hodgkin's lymphoma.
- Secondary syphilis: may present with bilateral sensorineural hearing loss or vertigo. Late neurosyphilis may present with hearing loss, fluctuating hearing, or vestibular symptoms.[48]

Infectious

- Coronavirus disease 2019 (COVID-19): dizziness is a common symptom reported in approximately 7.2% of patients.[49] May be a direct consequence of the virus affecting vestibular function or an indirect effect of hypoxia, dehydration, or fever.[50]

Cardiovascular

- Dizziness: may be associated with palpitations or provoked by exercise if there is a cardiovascular cause.[51] Dizziness with a cardiovascular aetiology may cause pre-syncope and/or vertigo.[52] Nearly two thirds of of patients with cardiovascular causes of dizziness report vertigo, and vertigo is the only type of dizziness described in 37% of these patients.[52] Diagnosis of haemodynamic orthostatic dizziness/vertigo requires:[53]
    - ≥5 episodes of dizziness/vertigo that occur in an upright position, and improve on sitting or lying down, AND
    - hypotension, tachycardia, or syncope documented on standing or tilt-table test (definite diagnosis), OR
    - at least one of: generalised weakness/fatigue, poor concentration, blurred vision, and/or palpitations (probable diagnosis), AND
    - exclusion of other possible causes.
- Pre-syncope: lightheadedness without an illusion of movement. Symptoms may include generalised weakness, giddiness, headache, blurred vision, loss of vision, paraesthesia, nausea, vomiting, and diaphoresis. Symptoms last a few seconds to a few minutes. The patient senses an impending loss of consciousness but recovers before losing consciousness.[54] The mechanism is almost always a reduction in blood supply to the brain. The symptoms may be spontaneous, positional, or associated with various triggers, depending on the cause.[3] Pre-syncope is the most common subtype of dizziness in older people.[51]
- Orthostatic (or postural) hypotension: one of the most common causes of pre-syncope. Patients complain of dizziness on standing.[55] The cause is impaired peripheral vasoconstriction and/or

a reduction in intravascular volume. It is defined as a decrease in systolic blood pressure (BP) of ≥20 mmHg or a decrease in diastolic BP of ≥10 mmHg within 3 minutes of standing.[56] One study has suggested that BP should be tested within 1 minute of standing.[57] Orthostatic hypotension may occur in patients who take antihypertensive medication or who are volume depleted. It may be idiopathic or associated with autonomic dysfunction, such as in people with Parkinson's disease, multiple system atrophy, or diabetic autonomic neuropathy. Orthostatic hypotension is a recognised complication after bariatric surgery.[58]

- Arrhythmias, ischaemia, structural heart disease, and pulmonary embolism: may cause pre-syncope.[54] One study of 881 patients who attended the emergency department complaining of pre-syncope found that 5% had serious outcomes within 30 days of the index visit. Most patients with a cardiac cause for pre-syncope were diagnosed at the initial emergency department visit. The most common cardiac causes detected in this study were atrial fibrillation and sinus node dysfunction.[54] Other cardiac causes of pre-syncope detected in the study population were: supraventricular tachycardia, complete atrioventricular block, myocardial infarction, ventricular arrhythmia, pulmonary embolism, and structural heart disease.[54] In one study of patients undergoing monitoring for recurrent unexplained syncope, an arrhythmia was present in 25% of pre-syncopal events.[59]
- Postural orthostatic tachycardia syndrome: the most common autonomic disorder in young people. The patient has similar postural symptoms to people with orthostatic hypotension but with excessive postural tachycardia. Patients commonly present with complaints of postural lightheadedness, or dizziness. This is diagnosed by increased heart rate on standing, lack of orthostatic hypotension, and the absence of other conditions, such as dehydration, a primary cardiac cause, an endocrine disorder, or a nervous system disorder.[60]

Psychological

- Psychophysiological dizziness (mixed physiological and psychogenic aetiology): may occur spontaneously or after a labyrinthine disorder. Patients complain of a variety of symptoms, such as rocking, floating, or swimming sensations. The symptoms may worsen with stress or fatigue.[3]
- Primary hyperventilation: alveolar ventilation in excess of metabolic requirements, leading to decreased arterial partial pressure of carbon dioxide. Patients are usually young and female. Over half have a comorbid psychiatric condition. Fear, paraesthesia, and dizziness are the most common symptoms.[61]
- Psychogenic dizziness: panic disorder with agoraphobia, personality disorders, or generalised anxiety are often present in patients complaining of dizziness. If the dizziness is psychogenic, patients may demonstrate inappropriate or excessive anxiety or fear. Phobic postural vertigo is characterised by dizziness in standing and walking despite normal clinical balance tests. Patients may demonstrate anxiety reactions and avoidance behaviour to specific stimuli.[62]
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Metabolic

- Diabetes mellitus: dizziness may be associated with episodes of hypoglycaemia. Other features of hypoglycaemia include shakiness, sweating, irritability, confusion, tachycardia, and hunger.[63][64] Diabetic patients with peripheral neuropathy may have more difficulty in recovering from a peripheral vestibular disorder.[65]

Autoimmune

- Systemic lupus erythematosus: patients may complain of vertigo or hearing loss and may have abnormal nystagmography.[66] [67]
- Cogan's syndrome: an inflammatory disorder resulting in interstitial keratitis and audiovestibular dysfunction. The pathology involves plasma cell and lymphocyte infiltration of the spiral ligament, endolymphatic hydrops, and degenerative disease of the organ of Corti. There is also demyelination of the eighth cranial nerve and inner ear osteogenesis.[68]
- Granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis): characterised by granulomatous lesions of the upper respiratory tract, necrotising vasculitis, and glomerulonephritis.[69]
- Behcet's disease: a rare systemic autoimmune vasculitis, characterised by recurrent oral and genital ulceration, ocular inflammation and skin lesions. 15% to 47% of patients with Behcet's disease have vestibular involvement. This may cause dizziness, nystagmus and high-frequency sensorineural hearing loss.[70]

Drug-related

- Ototoxic drugs: aminoglycoside antibiotics such as gentamicin and neomycin are vestibulotoxic and cochleotoxic.[71] Ototoxicity has been described for topical as well as parenteral use.[72] Aminoglycosides may cause vertigo without causing hearing loss. Toxicity with parenteral use is related to the total dose administered. Risk factors for aminoglycoside-related ototoxicity include:[73] [74] [75]
    - duration of therapy >7 days
    - prior exposure to aminoglycosides
    - high dose
    - age extremes (<5 years and >60 years)
    - presence of specific mitochondrial DNA mutations (may account for up to 60% of aminoglycoside ototoxicity)
    - exposure to loud sounds
    - renal dysfunction
    - other ototoxic drugs (e.g., loop diuretics).
- Chemotherapeutic drugs: cisplatin, widely used in various soft-tissue neoplasms, may cause sensorineural hearing loss and tinnitus.[76] The severity of the sensorineural hearing loss is related to the cumulative dose.
- Alcohol: patients report feeling 'high', dizzy, and intoxicated after ingestion.
- Antihypertensives, anaesthetics, antiarrhythmics, drugs of misuse: may cause dizziness.
- Certain antiepileptic drugs (oxcarbazepine, topiramate): may increase the risk of balance disorders.[77]
- Alpha-adrenoreceptor blockers, beta-blockers, nitrates, antipsychotics, opioids, antiparkinsonian drugs, and phosphodiesterase inhibitors: associated with orthostatic hypotension.[78] [79]

Toxins

- Carbon monoxide poisoning: may be secondary to accidental exposure from residential boilers, central heating systems, cookers, fireplaces, and chimneys. The symptoms are often non-specific but may include vertigo, headaches, impaired concentration, pre-syncope, tachycardia, or angina.[80]

Traumatic

- Post-traumatic vertigo: generally occurs as a result of blunt head trauma. Patients may present with symptoms of BPPV, a traumatic perilymphatic fistula, post-traumatic Meniere's disease, or post concussion syndrome.[81] Acute symptoms of concussion include headache, imbalance, fatigue, sleep disturbance, impaired cognition, photophobia, and phonophobia.[82]

Urgent considerations

(See **Differentials** for more details)

Posterior circulation stroke

Posterior circulation stroke (ischaemic or haemorrhagic) may present in a similar fashion to vestibular neuritis, with sudden-onset intense vertigo, nausea, and vomiting.

Other presenting symptoms include unilateral limb weakness, dysarthria, headache, and diplopia.[7] [37] Vertigo is continuous and prolonged. Patients may have at least one vascular risk factor (age >60 years, hypertension, diabetes, smoking, obesity).[7]

Signs include nystagmus, unilateral limb weakness, gait ataxia, unilateral limb ataxia, dysarthria, facial numbness, Horner's syndrome, and diplopia.[7] [37] Patients usually cannot stand without support, even with the eyes open, whereas patients with acute vestibular neuritis or labyrinthitis are usually able to do so.

The head impulse, nystagmus, test of skew (HINTS) assessment identifies stroke with a high degree of sensitivity and specificity in patients with acute vestibular symptoms when administered by a health professional with training and experience in its use. In this setting, it may rule out stroke more effectively than early diffusion-weighted magnetic resonance imaging (MRI).[34] [83] However, HINTS assessment alone does not reliably rule out stroke when used by emergency physicians.[84]

Based on the HINTS model, one algorithm suggests that stroke should be considered in patients presenting with acute-onset dizziness if:[85]

- There is a central pattern of nystagmus
- There is skew deviation
- There is a negative head impulse test (in patients with nystagmus)
- There are any central nervous system signs on focused neurological examination, or
- The patient is unable to sit or walk unaided.

Check capillary blood glucose in all patients with suspected stroke and arrange urgent neuroimaging.[86] In most cases, a computed tomography (CT) head without contrast is appropriate and readily accessible. This can detect acute intracranial haemorrhage and large infarcts, and permits the clinician to assess the patient's suitability for thrombolysis.[86] [87] [88]

If the patient has had stroke symptoms for fewer than six hours, noncontrast CT is often performed first.[89] If the patient has had stroke symptoms for longer than six hours, MRI is recommended as the initial investigation.[89] MRI can be performed without contrast for patients with renal failure or contrast allergy.[89] MRI can determine the age of the infarct and evaluate other causes for the symptoms. It is more sensitive than CT for acute infarct.[88] [89]

Vertebral artery dissection

Vertebral artery dissection may cause stroke in children and young adults. May be traumatic or spontaneous. Symptoms are sudden-onset vertigo, headache (often unilateral), tinnitus, and neck pain.[41][90] Neurological signs may be absent but, if present, include ataxia and dysarthria.[40]

CT imaging and angiography (CT/CTA) and MRI and angiography (MRI/MRA) can identify cervical artery dissection. MRI/MRA better identifies small intramural haematomas, however CT is usually easier to access in the emergency setting.[91] Ultrasound may be considered as a follow-up investigation to assess arterial remodelling.[41] Digital subtraction angiography may be considered as a second-line imaging technique in patients with clinical symptoms and negative MRA and CTA.[41]

Anticoagulation or antiplatelet treatment should be started after confirming the diagnosis.[92] [93] Intravascular therapy is available in some centres. A combination of techniques including thrombolysis, thrombectomy, stenting, and angioplasty is used.[94]

Acute coronary syndrome

Patients with acute coronary syndrome (ACS) commonly report feeling dizzy/lightheaded; this is due to cerebral hypoperfusion as a result of hypotension and/or symptomatic bradycardia. Typical cardiac chest pain is a retrosternal sensation of pain, pressure, or heaviness radiating to the left arm, both arms, right arm, neck, or jaw, which may be intermittent or persistent. Immediate investigations include a 12-lead ECG, chest x-ray, cardiac biomarkers (high-sensitivity cardiac troponins), full blood count, and renal profile. Guidelines recommend that oxygen should not be routinely administered in normoxic patients with suspected or confirmed ACS.[95] [96]

- Unstable angina (UA): UA is characterised by specific clinical findings of prolonged (>20 minutes) angina at rest; new onset of severe angina; angina that is increasing in frequency, longer in duration, or lower in threshold; or angina that occurs after a recent episode of myocardial infarction.[97] The ECG may be normal or may show ST-segment depression, transient ST-segment elevation, or T-wave inversion.[97] Cardiac biomarkers should be measured on presentation to rule out acute myocardial infarction; subsequent/serial measurements may be needed.[97] [98] The early management of patients with suspected UA is focused on initial interventions (e.g., single loading dose of aspirin and pain relief with glyceryl trinitrate) and triage according to the presumptive diagnosis.
- Non-ST-elevation myocardial infarction (NSTEMI): initial ECG may show ischaemic changes such as ST depression, T-wave changes, or transient ST elevation; however, ECG may also be normal or show non-specific changes. High-sensitivity cardiac troponins are elevated (>99th percentile of normal) at presentation or after several hours.[99] Treatment is directed towards relief of ischaemia, prevention of further thrombosis or embolism, and stabilisation of haemodynamic status, followed by early risk stratification for further treatment.
- ST-elevation myocardial infarction (STEMI): suspected when a patient presents with persistent ST-segment elevation in two or more anatomically contiguous ECG leads in the context of a consistent clinical history.[100] Cardiac biomarkers are elevated. Treatment should, however, be started immediately in patients with a typical history and ECG changes, without waiting for laboratory results. Immediate and prompt reperfusion can prevent or minimise myocardial damage and improve the chances of survival and recovery.[101]

Arrhythmias

- Atrial fibrillation with a rapid ventricular rate causing ongoing chest pain, hypotension, shortness of breath, dizziness, or syncope requires immediate direct current (DC) cardioversion. To prevent thromboembolism, anticoagulation should be started before cardioversion and continued for at least 4 weeks afterwards without interruption.[102]

- Bradycardia associated with haemodynamic compromise (i.e., systemic hypotension, signs of cerebral hypoperfusion, progressive heart failure or angina) should be treated immediately, regardless of the cause. The most common medications used to increase ventricular rate are intravenous atropine and adrenaline (epinephrine). Medical therapy should be continued until temporary cardiac pacing is initiated.[103]

Pulmonary embolus

Typically presents with pleuritic chest pain, dyspnoea, and tachycardia. Six percent of patients with pulmonary embolus (PE) present with syncope or pre-syncope.[104] Computed tomographic pulmonary angiography (CTPA) is the best investigation for diagnosing and excluding PE; echocardiography is an alternative if CTPA is not immediately available or if the patient is too unwell to be moved.[104] In patients with suspected PE who are haemodynamically unstable and/or hypoxic, thrombolysis (unless contraindicated) should be started without delay.[104] Give high-concentration oxygen if oxygen saturations are <90%.[104] Titrate oxygen to achieve saturations of 94% to 98% (or 88% to 92% in patients at risk of hypercapnic respiratory failure).[105]

Carbon monoxide poisoning

Accidental poisoning can occur as a result of exposure to carbon monoxide (CO), a colourless, odourless gas generated from burning fuel. Sources include boilers, central heating systems, cookers, fireplaces, and chimneys. CO levels may rise if the outlet for these systems becomes blocked or if they are operated in an unventilated environment.[106]

Diagnosis of CO poisoning rests on a high index of clinical suspicion as symptoms vary and are mostly non-specific.[107] Symptoms include dizziness, vertigo, headache, nausea and vomiting, confusion, fatigue, chest pain, and shortness of breath.[108]

Physical examination may be normal. Signs are usually a consequence of hypoxia, and patients may present with tachycardia, hypotension, cardiac ischaemia, arrhythmias, cutaneous blisters, and pulmonary oedema. See Carbon monoxide poisoning .

Elevated carboxyhaemoglobin, measured using a CO oximeter, confirms the diagnosis. Normal levels are 1% to 3% in non-smokers and up to 10% in smokers.[108]

High-flow oxygen therapy should be initiated as soon as the diagnosis is considered, and should not be discontinued until the diagnosis is ruled out.[107] [108]

Approach

The history should include a description of the typical attacks, including their nature, duration, triggers and associated auditory symptoms (e.g., hearing loss, tinnitus, and aural pressure).

The examination should include otoscopy, eye examination, central nervous system examination, and specific tests depending on the patient's presentation.

The diagnosis of dizziness is usually made on the basis of the history and examination only. Investigations may not be necessary. Magnetic resonance imaging (MRI) of the brain and internal auditory meatus may be helpful to detect neurological pathology. Vestibular function tests are indicated in some cases. Tests of cardiovascular function are necessary if a cardiovascular cause is suspected.

History: characteristics of the current episode

The traditional approach to assessment is to classify the type of dizziness, with vertigo indicating a vestibular cause, disequilibrium a neurological cause and pre-syncope a cardiovascular cause.[109] However, symptom types overlap substantially and patients most often report feeling off-balance or unsteady. Over 60% of patients experience more than one type of dizziness.[2] Nearly two thirds of of patients with cardiovascular causes of dizziness also report vertigo, and vertigo is the only type of dizziness described in 37% of these patients.[52]

An initial approach that considers trigger (positional or not) and timing (episodic or continuous) may be more useful as a first step than classifying the symptoms according to type (true vertigo, pre-syncope, or dysequilibrium).[109] [110]

Duration of each episode of vertigo

- Seconds: may be due to benign paroxysmal positional vertigo (BPPV)[12]
- Seconds to minutes: may be due to labyrinthitis or vestibular neuronitis[12]
- Hours: may be due to Meniere's disease[12]
- Months: persistent postural-perceptual dizziness (PPPD) symptoms last for 3 months or more.[111]

Check for triggers

- Vertigo associated with BPPV occurs on head movement (e.g., bending down or looking up quickly) and is relieved by keeping the head still. Ask about turning or laying down in bed; vertiginous attacks triggered by turning or laying down in bed, together with dizziness lasting less than one minute, may help identify BPPV.[112]
- In labyrinthitis, symptoms are exacerbated by head movement, but are also present at rest.
- PPPD symptoms are exacerbated by being upright, active or passive motion independent of direction or position, and complex or moving visual stimuli. Triggered by conditions that cause vestibular symptoms or affect balance, including neuro-otological illness and psychological distress.[111]
- Dizziness on getting up quickly may be associated with orthostatic hypotension, postural orthostatic tachycardia syndrome, and pre-syncope.[113]
- Mild attacks of vertebrobasilar insufficiency may be associated with orthostatic hypotension.
- People with autonomic dysregulation present with dizziness on standing upright for prolonged periods, swimming, or running.
- Vertigo induced by loud sounds or coughing may be due to semi-circular canal dehiscence.

'TiTrATE' is an acronym for 'timing, triggers, and a targeted examination'. The authors of the acronym consider new onset vertigo as one of four distinct clinical syndromes, defined according to timing and triggers.

- Timing refers to the onset, duration, and evolution of the dizziness. Triggers are actions, movements, or situations that provoke the onset of dizziness in patients who have intermittent symptoms.[8]
- These syndromes are:
    - Triggered episodic vestibular syndrome (e.g., BPPV, orthostatic hypotension)
        - Discrete episodes of dizziness lasting seconds
        - Precipitated by a specific action or event
        - Recommended examination includes Dix-Hallpike test (see below), lying and standing blood pressure
    - Spontaneous episodic vestibular syndrome (e.g., vestibular migraine, panic attacks, Meniere's disease, cardiac arrhythmia)
        - Discrete episodes of dizziness lasting minutes to hours[15]
        - Most events have no clear trigger
        - Diagnosis made from history
    - Post-exposure acute vestibular syndrome (e.g., head injury, aminoglycoside exposure)
        - Persistent dizziness lasting days to weeks
        - History of trauma or toxin exposure
        - Diagnosis made from history
    - Spontaneous acute vestibular syndrome (e.g., vestibular neuritis, posterior circulation stroke)
        - Persistent dizziness lasting days to weeks
        - Associated nausea, nystagmus, gait unsteadiness and head motion intolerance
        - Recommended examination includes The head impulse, nystagmus, test of skew (HINTS) assessment.[8]

Presence of other otological symptoms

- Hearing loss may occur in Meniere's disease, labyrinthitis, posterior fossa tumours, cholesteatoma, superior semi-circular canal dehiscence (SCDS), and granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis).
- Tinnitus may occur in Meniere's disease, labyrinthitis, posterior fossa tumours and cholesteatoma.[114]
- Aural fullness occurs in Meniere's disease.
- Hyperacusis to bone-conducted sounds and autophony may occur in semi-circular canal dehiscence.
- Fever, otalgia, and otorrhoea may occur in acute otitis media associated with labyrinthitis.
- Malodorous ear discharge occurs in cholesteatoma.

Determine how the episodes began

- Patients with a preceding upper respiratory infection may have viral neuritis or labyrinthitis.[115]

- Patients with a history of sea, air, or train travel prior to the onset of symptoms and with symptoms occurring on disembarking may have mal de debarquement syndrome.[116]
- Patients with a history of trauma or barotraumas (e.g., scuba divers or pilots) may have a perilymphatic fistula.[24]

Ask about other more general symptoms associated with the vertigo

- The phrase 'Dangerous Ds' can be a useful reminder of some of the red-flag symptoms that indicate a serious central cause for vertigo. These are:
    - Diplopia
    - Dysarthria
    - Dysmetria
    - Dysphagia
    - Dysphonia[8]
- Associated chest pain, exertional pre-syncope, and dyspnoea a cardiovascular aetiology.[117]
- Nausea is often associated with peripheral vestibular disorders as a part of the autonomic response.
- Vestibular migraine may be associated with aura, visual disturbance, photophobia, or phonophobia, with or without headaches.[118]
- Posterior fossa tumours may cause headache.[114]
- Patients with idiopathic intracranial hypertension are often obese and may complain of clumsiness, imbalance, headache and transient poor vision.
- Patients with Cogan's syndrome have ocular symptoms including photophobia, ocular discomfort and redness.[119]
- Patients with granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis) may present with nasal crusting, ulceration or epistaxis.
- Recurrent genital and oral ulceration and uveitis occur in Behcet's disease.

Psychiatric symptoms

- Panic disorder with agoraphobia, personality disorders, or generalised anxiety is often present in patients complaining of dizziness. One study of 40 patients reported that an anxious, introverted temperament was strongly associated with chronic, subjective dizziness.[120]
- If the dizziness is psychogenic, patients may describe symptoms of excessive anxiety or fear. A hospital and anxiety depression scale of >8 is diagnostic.[121]
- Phobic postural vertigo is characterised by dizziness on standing and walking, despite normal clinical balance tests.
- Patients may describe avoidance behaviour to specific stimuli.[62]
- Patients with psychophysiological dizziness may describe an initial labyrinthine disorder with persisting symptoms.

History: identification of cause

History of trauma or surgery

- Dizziness may be a complication of stapedectomy and cochlear implantation.[122] [123]
- Patients who have had previous mastoid surgery with a mastoid cavity are prone to dizziness with ear infections.
- A perilymphatic fistula may occur after stapes surgery, head trauma or barotrauma.[24]

- Post-traumatic vertigo generally occurs as a result of blunt head trauma. Patients may present with symptoms of BPPV, a traumatic perilymphatic fistula or post-traumatic Meniere's disease.[81] Vertigo can also occur as part of a post concussion syndrome.
- Patients with SCDS may present after head trauma.
- Orthostatic hypotension is a recognised complication after bariatric surgery.[58]

History of other medical illnesses

- Diabetes mellitus may be associated with attacks of dizziness related to hypoglycaemic episodes.[65]
- Systemic lupus erythematosus may also be associated with dizziness.[66] [67]
- Dizziness occurs as an initial symptom in 5% of people with multiple sclerosis and occurs in 50% of patients at some point during the disease.[3]
- Patients with a history of migraine are more likely to have migraine-associated vertigo.[118]
- A history of certain connective tissue disorders, such as Ehlers-Danlos syndrome, Marfan syndrome, osteogenesis imperfecta, and fibromuscular dysplasia, predispose patients to cervical artery dissection. Hypertension, recent infection, or trauma are also predisposing factors.[42] [43]

Family history of illness

- There may be a family history of migraine.

Known or contact with infectious disease

- Secondary syphilis may present with bilateral sensorineural hearing loss or vertigo. Patients with otosyphilis often present with vertigo. Late neurosyphilis may present with hearing loss, fluctuating hearing, or vestibular symptoms.[68]
- Audiovestibular symptoms (including sensorineural hearing loss) may be caused by reactivation of latent HSV-1 infection and may be preceded by herpetic skin lesions.[68]
- COVID-19 infection is associated with dizziness.[49] [124] [125] [126]

Medication and drug history, and possible toxin exposure

- Drugs associated with ototoxicity (e.g., aminoglycoside antibiotics), particularly if these have been administered concomitantly with loop diuretics or aspirin, and chemotherapeutic agents (e.g., cisplatin).
- Anaesthetic medication, antiarrhythmic medication, and drugs of misuse may cause patients to feel dizzy.
- Oxcarbazepine and topiramate increase the risk of balance disorders.[77]
- Drugs associated with orthostatic hypotension: antihypertensive medication, alpha-blockers, beta-blockers, nitrates, antipsychotics, opioids, antiparkinsonian drugs, and phosphodiesterase inhibitors. [78] [79] [127]
- Alcohol intoxication can cause dizziness.
- Accidental exposure to faulty or inadequately vented residential boilers, central heating systems, cookers, fireplaces, and chimneys may cause carbon monoxide poisoning.

Risk factors for cardiovascular disease or stroke

- Hypertension, hyperlipidaemia, diabetes mellitus, smoking, and obesity.[7]

History of neoplastic disease

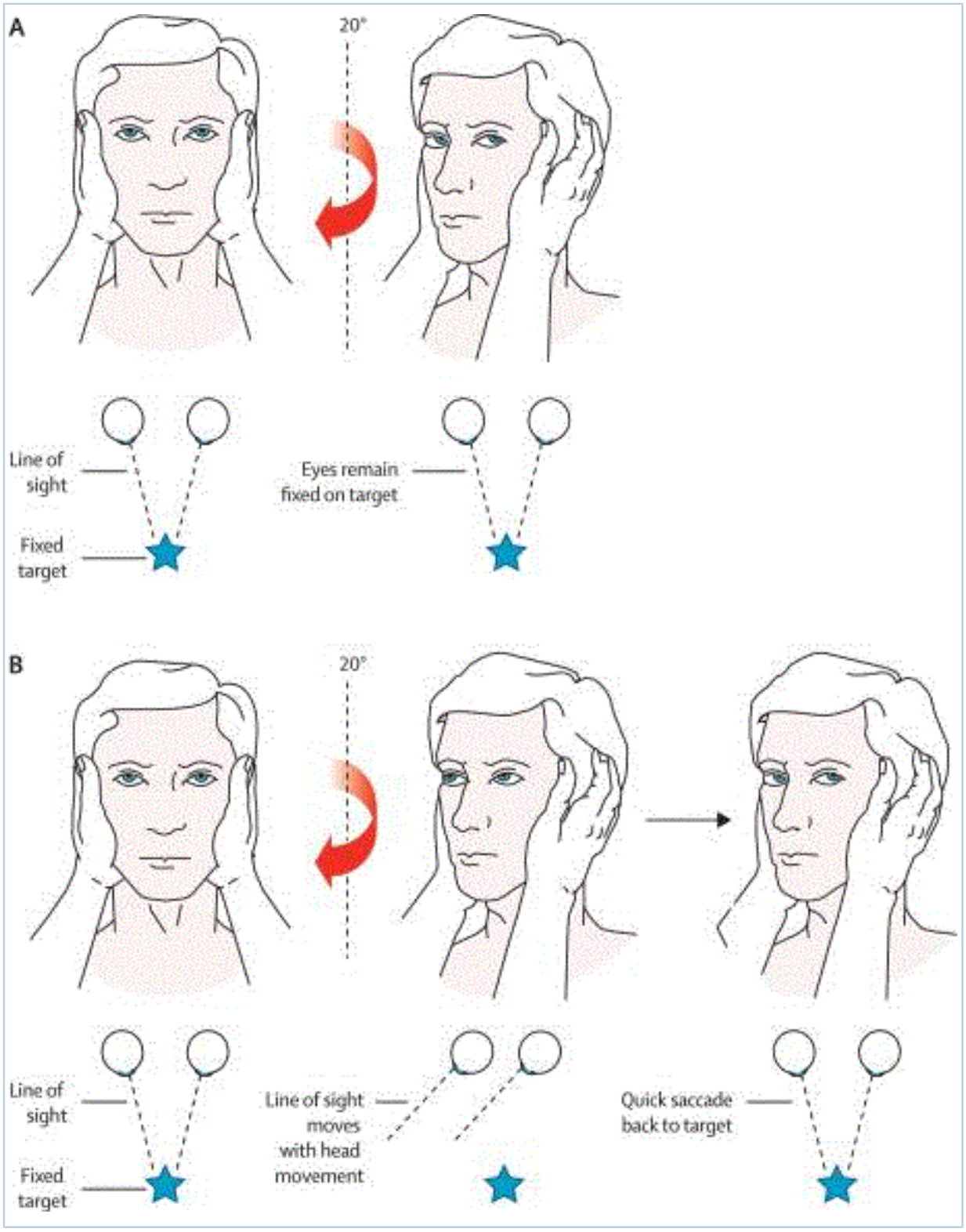
- Paraneoplastic cerebellar degeneration is a rare complication of cancer of the ovary, breast, or lung, or of Hodgkin's lymphoma.[3] [128]

Physical examination: HINTS

HINTS is a set of three examinations: the head impulse test, characterisation of spontaneous nystagmus, and test of skew. It can be performed quickly at the bedside and does not require any equipment.[129] It is a sensitive test for stroke in patients who have symptoms suggesting a vestibular cause of dizziness (e.g., vertigo, nausea or vomiting, unsteady gait, head-motion intolerance, nystagmus) and who have one or more risk factors for stroke.[83] HINTS has been found to identify stroke with a high degree of sensitivity and specificity in patients with acute vestibular symptoms if a healthcare professional with training and experience in the use of this test is available, and may rule out stroke more effectively than early diffusion-weighted MRI.[34] [83] However, HINTS assessment alone does not reliably rule out stroke when used by emergency physicians.[84]

Head impulse test

- The examiner turns the patient's head as rapidly as possible 15 degrees to one side and observes the patient's ability to keep fixating on a distant target. With a peripheral vestibular lesion, a saccade occurs as the vestibulo-ocular reflex fails, the patient cannot keep focusing on the target, and a catch-up movement occurs. After a cerebellar stroke, no catch-up saccade occurs: the head impulse test is negative.



Head impulse test. A: The right ear has intact peripheral vestibular function. When the head is turned to the right, the vestibulo-ocular reflex moves the eyes to maintain visual fixation. B: The right ear now has impaired vestibular function. When the head is turned to the right, the eyes move with it, breaking visual fixation, and a refixation saccade is seen as the eyes dart back to the examiner's face. This indicates a peripheral vestibular disorder on the right side

Reproduced with permission from Nelson JA, Viirre E. The clinical differentiation of cerebellar infarction from common vertigo syndromes. West J Emerg Med. 2009 Nov;10(4):273-7.

Characterisation of spontaneous nystagmus

- In vestibular neuritis, spontaneous nystagmus is torsional to horizontal and beating away from the side of the lesion. The nystagmus typically increases on looking towards the direction of the nystagmus, and decreases on looking away from the direction of the nystagmus (Alexander's law).[109]
- A central vestibular lesion produces vertical, bidirectional or pure rotatory nystagmus.
- In bidirectional nystagmus, the fast phase is to the left when the patient looks to the left, and to the right when the patient looks to the right.
- Both vestibular neuritis and central causes of vertigo can cause spontaneous horizontal nystagmus and gaze-evoked horizontal nystagmus.

Test of skew

- Skew deviation is vertical ocular misalignment resulting from a right-left imbalance of vestibular tone.
- Perform an alternating cover test by asking the patient to fix on a target (such as your nose), then cover and uncover each eye in turn.
- If the eyes are misaligned, after uncovering the affected eye it will move to refocus on the target. This is a positive result.
- If the eye does not move after it is uncovered, this is normal. This is a negative test of skew.

Based on the HINTS model, one algorithm suggests that stroke should be considered in patients presenting with acute-onset dizziness if:[85]

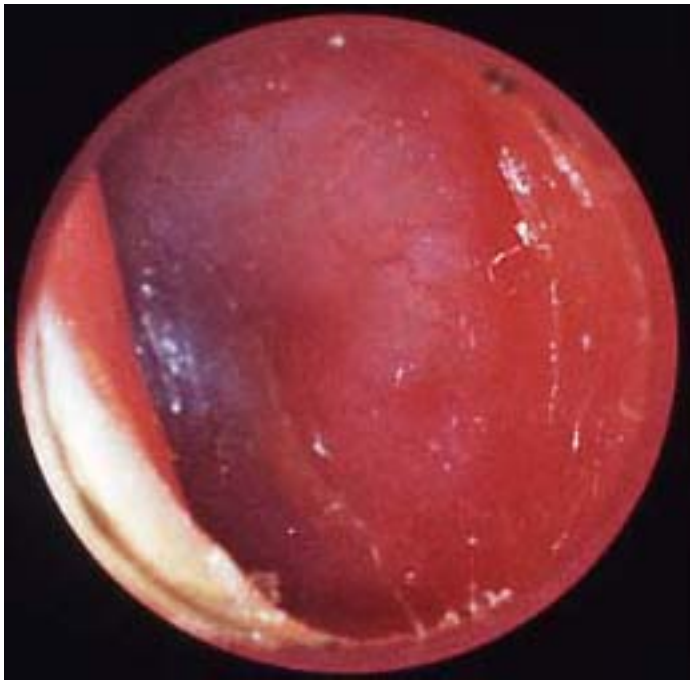
- There is a central pattern of nystagmus
- There is skew deviation
- There is a negative head impulse test (in patients with nystagmus)
- There are any central nervous system signs on focused neurological examination, or
- The patient is unable to sit or walk unaided.

In the absence of these symptoms, patients in the accident and emergency department setting may be treated as having vestibular neuritis.[85]

Physical examination: ear

Ear examination

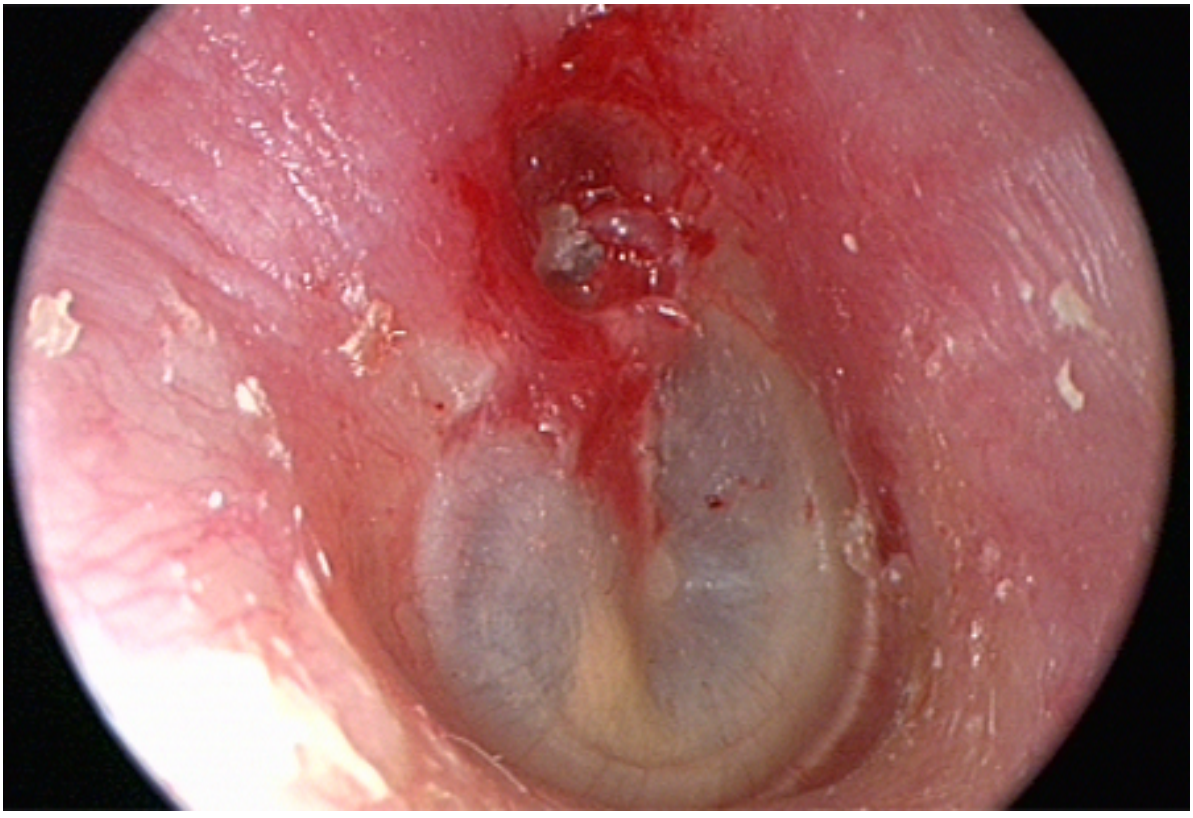
- The tympanic membrane in acute otitis media is erythematous, opaque, and bulging.



Erythematous bulging tympanic membrane due to acute otitis media

From the collection of Richard Buckingham, MD; used with permission

- Crust or keratin in the attic (upper part of the middle ear), pars flaccida, or pars tensa (usually posterior superior aspect)suggests cholesteatoma. The tympanic membrane may be perforated.



Cholesteatoma in attic (upper part of the middle ear)

From the collection of Susan A. Douglas, MBBS; used with permission

- There may be fluid or blood in the middle ear and/or cerebrospinal fluid (CSF) otorrhoea if the dizziness is related to trauma.

- People with granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis) may have signs of serous otitis media or chronic otitis media.

Tuning fork tests

- Used to determine whether hearing loss is conductive or sensorineural.
- Weber's test: a 512-Hz tuning fork is placed on the forehead or maxillary teeth, and the patient is asked to state in which ear the sound is louder. The sound will be perceived in the affected ear when a unilateral conductive hearing loss is present or in the unaffected ear when there is a unilateral sensorineural hearing loss.
- Rinne's testing allows the examiner to determine whether any hearing loss is secondary to middle ear (conductive hearing loss) or inner ear/eighth cranial nerve (sensorineural hearing loss) causes. The base of a 512-Hz tuning fork is placed on the mastoid and the patient indicates when he or she no longer hears the sound. Once the sound is no longer audible, the tuning fork is placed in front of the ear and the patient is asked whether he or she hears the sound. If the sound is louder when the tuning fork is on the mastoid, then the patient has a conductive hearing loss. If the sound is louder with the fork in front of the ear, hearing loss is sensorineural or normal. The result of this test is combined with the result of the Weber test to interpret the type of hearing loss.

The fistula test

- Performed by applying pressure on the tragus to occlude the ear or by pneumatic otoscopy (exerting pressure on each ear canal with a rubber bulb attached to an auriscope), thereby putting pressure on the middle ear.
- A positive result of induced dizziness and nystagmus occurs with SCDS, post-surgical dizziness, or perilymphatic fistula.
- Fistula test may be positive in people with cholesteatoma.
- A positive fistula test provides support for doing a temporal bone computed tomography (CT).

Physical examination: eye

Observation of eye movements

- Ophthalmoplegia with palsies of cranial nerves III, IV, or VI may occur with multiple sclerosis or with an intracranial lesion.[3]
- Neurological signs such as diplopia, disconjugate gaze, Horner's syndrome, and gait ataxia are in keeping with a central lesion.
- The presence of nystagmus may indicate peripheral or central pathology.
- A central vestibular lesion produces vertical, bidirectional, or pure rotatory nystagmus.
- Abnormal saccades and smooth pursuit may also indicate central pathology such as cerebellar disorders.
- Sound- or pressure-induced nystagmus in the plane of the semi-circular canal (positive Tullio and Hennebert tests) are a key finding in patients with SCDS.[23]

Fundoscopy

- Papilloedema may be present in idiopathic intracranial hypertension (pseudotumor cerebri)

Examination of the eyes with Frenzel glasses

- These glasses use +30 dioptre lenses to blur the patient's vision, remove optical fixation, and uncover vestibular nystagmus.[130] [131]
- It may be possible to use an ophthalmoscope instead of the Frenzel glasses to blur vision.
- Infrared video goggles may be used instead of Frenzel glasses.

Frenzel glasses

From Jung I, Kim J-S. Approach to dizziness in the emergency department. Clin Exp Emerg Med. 2015 Jun 30; 2(2):75-88; used with permission

Examination of dynamic visual acuity

- This tests the vestibulo-ocular reflex by observing the effect of head rotation on visual acuity (e.g., by reading the letters on a Snellen chart).[115]
- Abnormal results indicate a bilateral vestibular failure.

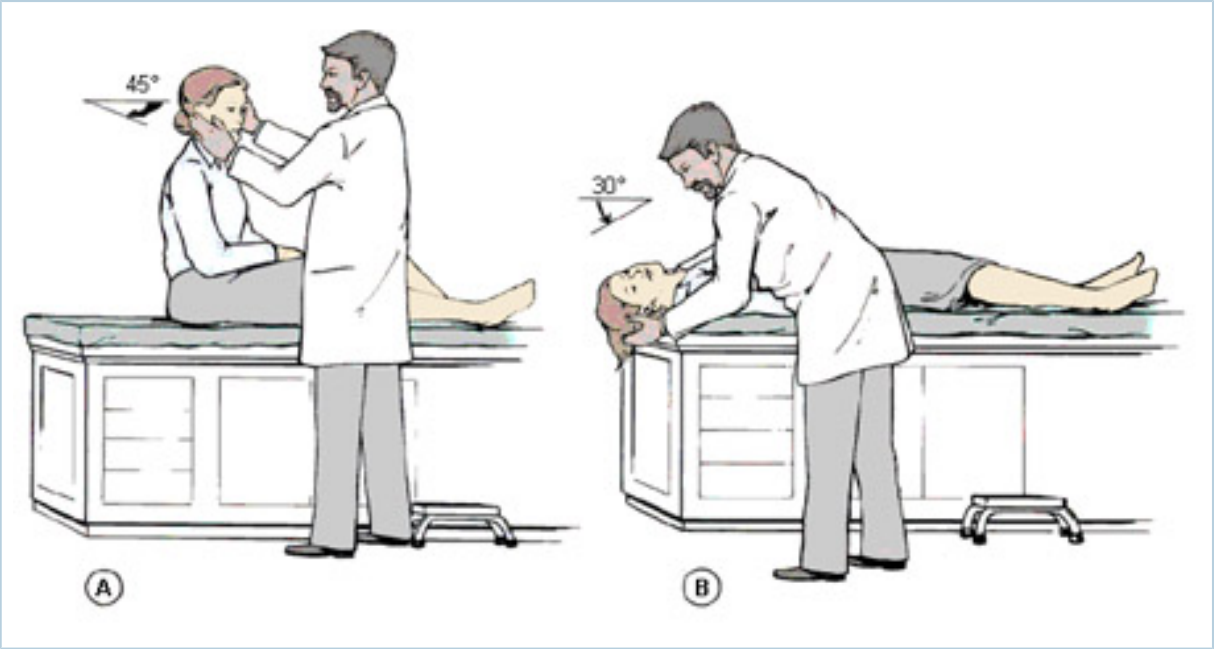
Observation of the eyes may lead to suspicion for other ophthalmological conditions, such as interstitial keratitis in Cogan's syndrome or uveitis in Behcet's disease.

Physical examination: clinical balance tests

The Dix-Hallpike test

- This is the gold standard test for the diagnosis of posterior canal BPPV.[10]
- The test is performed by sitting the patient upright on a bed; for the right side, the examiner stands on the patient's right side, rotates the patient's head 45 degrees to the right, and then moves the patient, whose eyes are open, to the supine right-ear down position, and then extends the patient's neck slightly so that the chin points slightly upwards. Patient's symptoms are noted and any nystagmus is observed. The test is repeated on the left with the examiner standing on the patient's left side.[10]

- Classically, the onset of peripheral nystagmus and symptoms is delayed by about 5 to 20 seconds. The provoked vertigo and nystagmus increase then resolve within 60 seconds.[10] The nystagmus fatigues on repeat testing, although this is not recommended because it unnecessarily subjects patients to further symptoms.[10]
- BPPV is typically due to posterior canal pathology. If the pathology affects the horizontal canal, the nystagmus may be more persistent and less fatigable.
- When symptoms are due to central pathology, the test causes nystagmus that is not fatigable, is down-beating, and is associated with minimal vertigo.
- The Dix-Hallpike test has been shown to have a positive predictive value of 83% and a negative predictive value of 52% for the diagnosis of BPPV.[132]



Dix-Hallpike manoeuvre

Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). CMAJ. 2003 Sep 30;169(7):681-93; used with permission

Supine lateral head turns

- If the Dix-Hallpike test is negative in a patient who has a history suggestive of BPPV, perform supine lateral head turns to test for lateral semi-circular canal BPPV.[10] Position the patient supine with the head in the neutral position, then quickly rotate the head 90 degrees to one side while observing the patient's eyes for nystagmus. The head is returned to the face up position, allowing all dizziness and nystagmus to subside; the head is then turned rapidly to the opposite side.[10]
- In most cases of lateral semi-circular canal BPPV, there is intense horizontal nystagmus beating towards the undermost (affected) ear when the patient is rolled to the affected side. When the patient is rolled to the unaffected side, there is less intense horizontal nystagmus beating towards the undermost ear.[10]

Physical examination: central nervous system

Examination of the other cranial nerves

- Facial nerve palsy may occur with cerebellopontine angle tumours, granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis) and cholesteatoma.

- Dysarthria can be a sign of posterior circulation stroke, vertebrobasilar insufficiency or vertebral artery dissection.
- Facial numbness may occur in posterior circulation stroke.
- Loss of pain and temperature sensation of the ipsilateral face occurs in Wallenberg's syndrome (lateral medullary infarction).[38]

Neurological examination

- Examination of cerebellar function is usually tested with the finger-to-nose test and rapid alternating hand movements.[131] This may be abnormal in cerebellar lesions.
- Ipsilateral limb ataxia and loss of pain and temperature sensation of the contralateral trunk occurs in Wallenberg's syndrome (lateral medullary infarction).[38]
- Various neurological signs may be present in people with multiple sclerosis (e.g., altered gait, weakness, nystagmus, cranial nerve palsies).
- Signs of peripheral neuropathy may occur in patients with diabetes mellitus (e.g., numbness and presence of painless injuries).
- Bizarre changes (e.g., 'wooden soldier' or 'scissor gait') may occur in psychogenic lesions.

Romberg and Unterberger (Fukuda) tests

- Provides information about the patient's balance with the eyes closed.
- Romberg test: the patient attempts to maintain a standing position with the feet together, eyes closed, and arms outstretched. The test is positive if the patient cannot maintain balance.
- Unterberger test: the patient performs stationary stepping with eyes closed for up to 1 minute. A tendency to veer towards the affected side occurs after a unilateral vestibular loss.
- These are non-specific tests that can be abnormal in peripheral or central lesions.[115]
- Patients with cerebellar infarction usually cannot stand without support, even with the eyes open, whereas a patient with acute vestibular neuritis or labyrinthitis can.

Physical examination: cardiovascular system and general examination

Cardiovascular examination

- Check for an irregular pulse, which could indicate an arrhythmia.
- Check lying and standing blood pressure (BP) and pulse should be checked in patients with postural symptoms. A fall in systolic BP of at least 20 mmHg or diastolic BP of at least 10 mmHg within 3 minutes of standing indicates orthostatic hypotension.[56]
- Where postural symptoms resemble those of orthostatic hypotension, but orthostatic hypotension is not demonstrated, an increased heart rate on standing may indicate postural orthostatic tachycardia syndrome.[60]
- Auscultate for carotid bruits and cardiac murmurs.

General examination may reveal evidence of other conditions (e.g., oral ulcers with Behcet's disease; evidence of multi-system involvement with systemic lupus erythematosus).

Investigations: pure-tone audiogram

- Demonstrates any associated hearing loss.

- A unilateral sensorineural hearing loss may occur in labyrinthitis and Meniere's disease (low frequency).
- Unilateral or asymmetrical sensorineural hearing loss should prompt investigation for a posterior fossa tumour (e.g., acoustic neuroma).[114]

Investigations: imaging of the head

CT scan of the petrous temporal bones

- A high-resolution thin-slice CT scan is useful in patients with suspected SCDS.[88] [133]
- Useful in the diagnosis of middle ear or mastoid disease. May be helpful to confirm cholesteatoma.[134]
- Should be performed if temporal bone fracture is suspected.[135]

CT scan of the brain

- Usual initial imaging investigation for patients with suspected acute stroke if the patient has had symptoms for fewer than six hours. Noncontrast CT detects intracranial haemorrhage and large infarcts, allowing the treating clinician to make management decisions quickly.[86] [89]
- The American Heart Association/American Stroke Association guidelines recommend that all patients admitted to hospital with suspected acute stroke should have brain imaging on arrival to hospital and in most cases, noncontrast CT will provide the necessary information to make decisions about acute management.[86]
- The National Institute for Health and Care Excellence in the UK advises that patients with suspected acute stroke should have brain imaging with a noncontrast CT within one hour if any of the following apply:[87]
    - Indications for thrombolysis or thrombectomy
    - On anticoagulant treatment
    - Known bleeding tendency
    - Glasgow Coma Score below 13
    - Unexplained progressive or fluctuating symptoms
    - Papilledema, neck stiffness, or fever
    - Severe headache at onset of stroke symptoms

MRI of internal auditory meatus and brain

- Contrast-enhanced MRI with MR angiography is recommended for patients who have a suspected acute stroke. MRI can determine the age of the infarct and evaluate other causes for the symptoms. It is more sensitive than CT for acute infarct.[88] [89] If the patient has had stroke symptoms for less than six hours, noncontrast CT is often performed first.[89] If the patient has had stroke symptoms for longer than six hours, MRI is recommended as the initial investigation.[89] MRI can be performed without contrast for patients with renal failure or contrast allergy.[89]
- Contrast-enhanced MRI is the investigation of choice for suspected posterior fossa tumours.[134]
- Demonstrates malformations (e.g., Arnold-Chiari malformation type 1).
- Demyelinating lesions may be seen on MRI in people with multiple sclerosis.
- Advances in MRI techniques enable visualisation of endolymphatic hydrops.[136]

- MRI angiography may be performed in cases of suspected vertebrobasilar insufficiency (demonstrating occlusion of the cerebellar arteries), Wallenberg's syndrome (demonstrating occlusion of the ipsilateral vertebral artery), or vertebral artery dissection.

Investigations: vestibular function tests

Numerous tests are available, such as electronystagmography (ENG), caloric testing, video head impulse test (vHIT), and vestibular evoked myogenic potentials.

- The tests can be useful in cases of diagnostic uncertainty to demonstrate a unilateral or bilateral vestibular loss.
- Typically, a directional preponderance (nystagmus greater in one direction than the other) of 26% to 30% indicates significant asymmetry, and a canal paresis (reduced function) of 22% to 25% indicates a unilateral vestibular loss.[115]
- Computerised dynamic posturography testing: utilises a computerised controlled platform and visual booth to assess sensory and motor components of balance.[131] The test results in 6 abnormal sensory patterns useful for clinical diagnosis and rehabilitation.
- Rotatory chair testing: an adjunctive balance test that may be used if ENG is abnormal.
- Electrocochleography: may be useful in the diagnosis of Meniere's disease. The trans-tympanic test is a more invasive type of electrocochleography and is a more sensitive test than extra-tympanic electrocochleography.
- Acoustic reflex assessment: involves exposing the patient to loud noise to observe the muscle that causes movement of the stapes to protect the ear. It is a secondary assessment of stapes function and would be abnormal in people with otosclerosis (pathological temporal bone remodelling) and normal in people with SCDS.
- vHIT: this tests the vestibulo-ocular reflex of all the semi-circular canals.[137]
- Vestibular evoked myogenic potential: indicated only when SCDS is suspected.[138] In this case, increased amplitude may be demonstrated.[133]

Investigations: cardiovascular

ECG

- Recommended in patients when a cardiac cause of dizziness is suspected.

Echocardiography

- May be useful for patients with syncope where cardiac pathology is suspected.[139]

Cardiac monitoring

- Indicated in patients with pre-syncope where an arrhythmia is suspected.

Tilt-table testing

- Done in cases where orthostatic hypotension or postural orthostatic tachycardia syndrome is suspected, or there is a possibility of autonomic dysregulation.[60] [139][140]
- Symptoms are provoked on testing.

Further investigations in specific circumstances

- Antinuclear antibodies, double-stranded DNA, Smith antigen if systemic lupus erythematosus is suspected.[141]
- Antineutrophil cytoplasmic antibody and biopsy of lesions for histology if granulomatosis with polyangiitis [formerly known as Wegener's granulomatosis] is suspected.
- Treponemal antibody tests if syphilis infection is suspected.
- Blood glucose monitoring and HbA1c in patients with diabetes mellitus who have dizzy episodes possibly related to hypoglycaemia. A lower than expected HbA1c is suggestive but not diagnostic of hypoglycaemic episodes. Self-monitored blood glucose levels are required for confirmation.
- Blood glucose must be checked in all patients with a suspected stroke.[86]
- Assess carboxyhaemoglobin levels using a carbon monoxide oximeter in cases of suspected carbon monoxide poisoning.[108]
- Serum drug levels may be appropriate if the symptoms are thought to be medication- or drug-related.

Slit-lamp ophthalmoscopic examination

- Necessary if the diagnosis of Cogan's syndrome is considered.

Exploratory tympanotomy

- May be done to investigate the cause of post-surgical dizziness or when there is a suspected diagnosis of perilymphatic fistula.

Lumbar puncture and measurement of CSF pressure

- Required to diagnose benign intracranial hypertension and normal pressure hydrocephalus.

Cisternography

- Performed to demonstrate the absence of obstruction of the cerebral aqueduct or of CSF outflow from the 4th ventricle in people with normal pressure hydrocephalus.

Differentials overview

Common

- Benign positional paroxysmal vertigo (BPPV)
- Meniere's disease
- Vestibular neuritis
- Labyrinthitis
- Vestibular migraine
- Pre-syncope
- Orthostatic hypotension
- Postural orthostatic tachycardia syndrome
- Diabetes mellitus
- Alcohol
- Drugs
- Coronavirus disease 2019 (COVID-19)

Uncommon

- Cholesteatoma
- Superior semi-circular canal dehiscence
- Perilymphatic fistula
- Persistent postural-perceptual dizziness (PPPD)
- Posterior fossa tumour
- Multiple sclerosis
- Posterior circulation stroke
- Vertebrobasilar insufficiency

Uncommon

Arnold-Chiari malformation type 1
Wallenberg's syndrome (Lateral medullary infarction)
Trauma
Vertebral artery dissection
Paraneoplastic cerebellar degeneration
Idiopathic intracranial hypertension
Normal pressure hydrocephalus
Mal de debarquement syndrome
Psychophysiological dizziness
Psychogenic dizziness
Systemic lupus erythematosus (SLE)
Cogan's syndrome
Granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis)
Behcet's disease
Carbon monoxide poisoning
Post-surgery
Secondary syphilis

Differentials

Common

◊ Benign positional paroxysmal vertigo (BPPV)

History	Exam	1st Test	Other tests
vertigo on rolling over in bed or looking up, which lasts for seconds	Dix-Hallpike test: diagnostic of BPPV, typically demonstrating nystagmus and symptoms that are delayed by about 15 seconds, peak in 20-30 seconds, and then decay with complete resolution of the episode of vertigo; supine lateral head turns: similar to the Dix-Hallpike manoeuvre, a positive test is noted when the patient experiences vertigo with nystagmus.	»**none:** diagnosis usually made clinically with Dix-Hallpike test and supine lateral head turns	»**pure-tone audiogram:** normal pattern »**brain MRI:** normal Can be useful in diagnosing or excluding central nervous system conditions such as multiple sclerosis, posterior fossa tumours, and ischaemic processes that may mimic BPPV.

◊ Meniere's disease

History	Exam	1st Test	Other tests
spontaneous vertigo attacks (each lasting 20 minutes to 12 hours) with documented low- to mid-frequency sensorineural hearing loss in the affected ear before, during, or after one of the episodes of vertigo, with fluctuating aural symptoms (hearing loss, tinnitus, or ear fullness) in the affected ear	usually normal, Romberg's test may be positive, may have horizontal and/or rotatory nystagmus which is suppressed by fixation	»**pure-tone audiogram:** sensorineural hearing-loss pattern usually at low frequencies	»**electronystagmography:** normal or unilateral reduction in function »**electrocochleography:** abnormal action potential:summating potential (AP:SP) ratio with abnormal tone burst amplitude measurements Sensitivity of extra-tympanic electrocochleography is lower than that of transtympanic testing. »**MRI of internal auditory meatus and brain:** normal Done to exclude acoustic neuroma.

Common

◊ Vestibular neuritis

History	Exam	1st Test	Other tests
acute onset of vertigo with nausea and vomiting, lasting days but without hearing loss; single episodes frequently recur; symptoms exacerbated by changes in head position	acute episode: may be nystagmus to the affected side, head impulse test will be abnormal (due to loss of the vestibulo-ocular reflex); loss of balance; between episodes of vertigo examination may be normal	»**pure-tone audiogram:** normal pattern Rules out labyrinthitis or Meniere's disease, which would both be associated with hearing loss.	»**MRI brain:** normal Performed in patients in whom acute cerebellar stroke is suspected as a differential of vestibular neuritis.

◊ Labyrinthitis

History	Exam	1st Test	Other tests
acute onset of vertigo with nausea and vomiting lasting days; associated hearing loss with or without tinnitus; may be a preceding history of acute otitis media	nystagmus is usually horizontal, and severity improves as the illness resolves; patients may have difficulty walking; unilateral sensorineural hearing loss demonstrated with Rinne and Weber tuning fork tests; ear examination may demonstrate evidence of acute otitis media (bulging, erythematous, or opaque tympanic membrane); post-aural redness or swelling may occur if mastoiditis complicates the infection	»**pure-tone audiogram:** unilateral sensorineural hearing-loss pattern; a conductive loss pattern may occur if acute otitis media is present	»**CT scan petrous temporal bones:** may demonstrate evidence of middle-ear or mastoid opacification Ordered if the patient is suspected of having mastoiditis. »**MRI of internal auditory meatus and brain:** normal Done to exclude retrocochlear pathology if the patient has an asymmetric hearing loss.

◊ Vestibular migraine

History	Exam	1st Test	Other tests
personal history or family history of migraine; vertigo with or without headaches; symptoms variable including true episodic vertigo, movement-provoked disequilibrium,	usually normal, may have positional nystagmus and positive Romberg test in acute attack[118]	»**pure-tone audiogram:** normal pattern	»**MRI brain:** normal Used primarily to exclude other causes of central vertigo.[118]

DIAGNOSIS

Common

◊ Vestibular migraine

History	Exam	1st Test	Other tests
lightheadedness, symptoms similar to benign positional paroxysmal vertigo, photophobia, phonophobia, or other auras, or symptoms similar to Meniere's disease; associated symptoms of nausea and fatigue; symptoms might last minutes to days			

Pre-syncope

History	Exam	1st Test	Other tests
variable depending on specific cause but may include generalised weakness, giddiness, headache, blurred vision, and diaphoresis; may be paraesthesia, nausea, and vomiting; patients have a sensation of an impending loss of consciousness	vasovagal attack: hypotension and bradycardia during attack; cardiopulmonary disease: altered cardiac rhythm, murmurs, evidence of cardiac failure	»**ECG:** may demonstrate arrhythmia, ischaemic changes or signs of structural heart disease	»**echocardiogram:** may be evidence of structural heart disease »**cardiac or event monitoring:** arrhythmia may be detected associated with symptomatic episodes »**tilt-table testing:** may demonstrate evidence of autonomic neuropathy if symptoms are provoked

◊ Orthostatic hypotension

History	Exam	1st Test	Other tests
dizziness on standing from a lying or sitting position, episodes are usually transient, may be a history of hypotension, antihypertensive medication use, dehydration, or autonomic dysfunction (e.g., with Parkinson's	drop in systolic BP by 20 mmHg or diastolic BP by 10 mmHg within three minutes of standing from a lying position	»**none:** diagnosis usually made clinically without further investigations Heart rate should be recorded at the same time as the BP measurements, a heart rate increase <0.5 bpm per mmHg systolic	»**tilt-table testing:** demonstrates orthostatic fall in BP

Common

◊ Orthostatic hypotension

History	Exam	1st Test	Other tests
disease, multiple system atrophy, diabetic autonomic neuropathy); if associated with autonomic dysfunction may also have dizziness with standing upright for prolonged periods, swimming, or running and may complain of feeling 'spacey' or 'foggy' without vertigo during exertion; may be a history of bariatric surgery		BP fall indicates a neurogenic cause (e.g., peripheral neuropathy).	

◊ Postural orthostatic tachycardia syndrome

History	Exam	1st Test	Other tests
dizziness and palpitations on standing from a lying or sitting position, episodes are usually transient; may be fatigue, nausea, pre-syncope or syncope, more common in women and girls between 12-50 years of age	increase in heart rate on standing (and with tilt table study) by 30 bpm or >120 bpm and associated postural symptoms; lack of orthostatic hypotension; absence of other conditions that may cause orthostatic hypotension, such as dehydration, a primary cardiac cause, an endocrine disorder, or a nervous system disorder[60]	»**tilt table study:** confirms excessive postural tachycardia, excludes orthostatic hypotension	

◊ Diabetes mellitus

History	Exam	1st Test	Other tests
most commonly occurs in people with a known history of diabetes mellitus; often, dizziness may coincide with episodes	may be signs of peripheral neuropathy including numbness and presence of painless injuries	»**blood glucose:** low during attacks It may be possible to record blood glucose during an attack. If not,	»**serum HbA1c:** elevated compared with non-diabetic levels, but result may be lower than expected

Common

◊ Diabetes mellitus

History	Exam	1st Test	Other tests
of hypoglycaemia where patient feels unwell, clammy, generally weak; may be a preceding peripheral vestibular disorder and prolonged symptoms, particularly with associated peripheral neuropathy (associated numbness in feet and legs and history of painless injuries)		a blood glucose diary review may be helpful. The timing of episodes of dizziness can be analysed in respect of any risk factors for hypoglycaemia (meal timing, excessive activity without compensatory dietary changes, alcohol consumption, prolonged abstinence from food).	A lower than expected value relative to degree of observed control via finger-stick blood glucose may suggest, but not confirm, hypoglycaemia.[65]

◊ Alcohol

History	Exam	1st Test	Other tests
acute intoxication: patients report feeling 'high', dizzy, and intoxicated	smell of alcohol on the breath, disorientation, abnormal gait	»**blood alcohol level:** may be elevated	»**serum LFTs:** gamma glutamyl transpeptidase, aspartate aminotransferase, alanine aminotransferase may be deranged

◊ Drugs

History	Exam	1st Test	Other tests
history of aminoglycoside antibiotics, cisplatin, or other drugs that may cause dizziness (e.g., antihypertensive or anti-arrhythmic medication, diuretics, antipsychotic or antiparkinsonian medication, opioids, phosphodiesterase inhibitors, or	may be orthostatic hypotension on examination if taking antihypertensive, antipsychotic or antiparkinsonian medication, opioids, or phosphodiesterase inhibitors	»**clinical examination:** the diagnosis is often made clinically from the history and physical findings	»**serum drug levels of aminoglycoside:** may be elevated Aminoglycoside antibiotics: toxicity with parenteral use is related to the total dose administered. Risk factors are age >60 years, high serum drug levels, previous

Common

◊ Drugs

History	Exam	1st Test	Other tests
anaesthetic medication); may be hearing loss and tinnitus with aminoglycosides and cisplatin			sensorineural hearing loss, concomitant renal impairment, attendant noise exposure, duration of therapy >10 days, and simultaneous administration of other ototoxic agents (e.g., loop diuretics or aspirin). Ototoxicity has also been described for topical use.[72] »**urine drug-toxicity screen:** elevated levels of drugs or their metabolites »**blood drug-toxicity screen:** elevated levels of drugs or their metabolites »**pure-tone audiogram:** may be a sensorineural hearing-loss pattern or normal Aminoglycoside antibiotics are vestibulotoxic and cochleotoxic. They may result in vertigo without causing hearing loss. Cisplatin may cause sensorineural hearing loss and tinnitus.[76] »**m.1555A>G mutation screening:** may be present Mitochondrial DNA mutation in some cases of aminoglycoside toxicity.

Common

Coronavirus disease 2019 (COVID-19)

History	Exam	1st Test	Other tests
dizziness associated with a current or previous COVID-19 infection, typical symptoms are dry cough, fever, and dyspnoea; other common symptoms include anorexia, myalgia, and sore throat; may be travel history to an affected area or close contact with a suspected or confirmed case in the 14 days prior to symptom onset	may have fever and/or dyspnoea; patients with pneumonia or respiratory distress syndrome may have inspiratory crackles, rales, and/or bronchial breathing; patients with respiratory distress syndrome may have tachycardia, tachypnoea, or cyanosis accompanying hypoxia	»**real-time reverse transcription polymerase chain reaction (RT-PCR):** positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) RNA Molecular testing is required to confirm the diagnosis. Priorities for testing depend on local guidelines and available resources. Collect upper respiratory specimens (nasopharyngeal and oropharyngeal swab or wash) in ambulatory patients and/or lower respiratory specimens (sputum and/or endotracheal aspirate or broncho-alveolar lavage) in patients with more severe respiratory disease.	

Uncommon

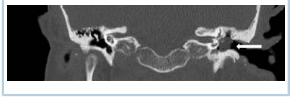
Cholesteatoma

History	Exam	1st Test	Other tests
malodorous ear discharge and hearing loss with or without tinnitus; less commonly vertigo, otalgia, altered taste, or facial weakness	otoscopy reveals crust or keratin in the attic (upper part of the middle ear), the pars flaccida, or the pars tensa (usually posterior superior aspect), with or without	»**pure-tone audiogram:** normal, conductive, or mixed conductive/sensorineural hearing-loss pattern	»**CT scan of the petrous temporal bones:** opacification of the middle ear, ossicular erosion, and erosion of the scutum; may demonstrate mastoid, cochlear,

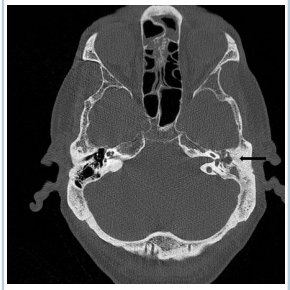
Uncommon

Cholesteatoma

History	Exam	1st Test	Other tests
	perforation of the tympanic membrane; fistula test may be positive		semi-circular canal, or intracranial involvement Particularly helpful if cholesteatoma is suspected but examination is indeterminate.



Cholesteatoma, coronal CT scan
From the collection of Susan A. Douglas, MBBS; used with permission



Cholesteatoma, axial CT scan
From the collection of Susan A. Douglas, MBBS; used with permission

◊ Superior semi-circular canal dehiscence

History	Exam	1st Test	Other tests
history of episodes of vertigo associated with sound or pressure such as coughing, sneezing, straining, or sudden loud noise	upward and torsional nystagmus evoked by Tullio (loud noise) and Hennebert (altered middle-ear pressure) tests	»**pure-tone audiogram:** conductive hearing-loss pattern »**CT scan petrous temporal bones:**	»**acoustic reflexes:** normal Involves exposing the patient to loud noise to observe the muscle

Uncommon

◊ Superior semi-circular canal dehiscence

History	Exam	1st Test	Other tests
and hyperacusis; a feeling of the affected ear being blocked; autophony; may be preceding history of trauma		bony dehiscence of the superior semi-circular canal on the affected side CT must be a thin cut 0.6 mm or less, and reconstructions parallel and orthogonal to the superior canal are necessary. »**vestibular evoked myogenic potential:** increased amplitude may be demonstrated	that causes movement of the stapes to protect the ear. It is a secondary assessment of stapes function and would be abnormal in people with otosclerosis (pathological temporal bone remodelling).

◊ Perilymphatic fistula

History	Exam	1st Test	Other tests
may have a history of surgery such as stapes surgery, head trauma or barotrauma; paroxysmal vertigo, imbalance, and hearing loss with or without tinnitus	may have a positive fistula test	»**pure-tone audiogram:** sensorineural hearing-loss pattern	»**exploratory tympanotomy:** fistula noted at the round or oval window

◊ Persistent postural-perceptual dizziness (PPPD)

History	Exam	1st Test	Other tests
Five diagnostic criteria must be satisfied to make the diagnosis: 1) History of dizziness, unsteadiness, or non-spinning vertigo on most days for ≥3 months. 2) Symptoms occurring without provocation but worse with upright posture, active or passive motion, or exposure to moving stimuli. 3) Precipitated by	physical examination normal	»**none:** diagnosis made based on clinical criteria Ongoing precipitating condition should be established.	

Uncommon

◊ Persistent postural-perceptual dizziness (PPPD)

History	Exam	1st Test	Other tests
conditions that cause vertigo, neurological or medical illness, or psychological distress. 4) Symptoms cause significant distress or functional impairment. 5) Symptoms not better explained by another disorder.			

🚩 Posterior fossa tumour

History	Exam	1st Test	Other tests
typically unilateral hearing loss, dizziness, or vertigo and tinnitus	spontaneous nystagmus may be present	»**pure-tone audiogram:** unilateral sensorineural hearing-loss pattern »**contrast-enhanced structural MRI internal auditory meatus and brain:** space-occupying lesion in cerebellopontine angle	»**electronystagmography:** abnormal tracking and abnormal optokinetic nystagmus test

◊ Multiple sclerosis

History	Exam	1st Test	Other tests
vertigo as an initial symptom (5%) or at some point during their disease (50%); prolonged spontaneous attacks of vertigo may be similar to vestibular neuritis; variety of symptoms such as dizziness, diplopia, and altered gait	variety of neurological findings, such as nystagmus, ataxia, and cranial nerve palsies	»**pure-tone audiogram:** sensorineural hearing-loss pattern »**MRI brain and spinal cord:** demyelinating lesions demonstrated	

Uncommon

Posterior circulation#stroke

History	Exam	1st Test	Other tests
sudden intense vertigo, nausea, and vomiting, dysarthria, unilateral limb weakness, headache, diplopia	nystagmus present and may be bilateral or vertical (suggesting a central cause), head impulse test is negative, patients usually cannot stand without support; patients may have gait and limb ataxia, facial numbness, Horner's syndrome, diplopia	»**Blood glucose:** normal Excludes hypoglycaemia as a cause for focal neurological symptoms »**CT head without contrast:** may demonstrate haemorrhage or large infarction »**MRI brain:** lesions demonstrating cerebellar infarction or haemorrhage Should be done early because one third of patients will develop acute, potentially lethal posterior fossa oedema requiring emergency neurosurgical decompression.[130]	

Vertebrobasilar insufficiency

History	Exam	1st Test	Other tests
episodic vertigo lasting between 30 seconds and 15 minutes and typically starting after abruptly standing or turning the head; associated with diplopia, dysarthria, ataxia, drop attack, and clumsiness of the extremities; may have risk factors for stroke such as hypertension, hyperlipidaemia, diabetes, smoking, or heart disease	usually normal	»**MRI brain ± angiogram:** may be lesions demonstrating areas of infarction; vascular occlusion of the cerebellar arteries may be demonstrated on angiography	

Uncommon

Arnold-Chiari malformation type 1

History	Exam	1st Test	Other tests
occipital headache, dizziness, unsteadiness, and hearing loss, but may be asymptomatic[44]	may be downbeat nystagmus, most prominent on lateral gaze; positional testing may precipitate dizziness with downbeat nystagmus	»**MRI brain/spine:** craniocervical lesion	

Wallenberg's syndrome (Lateral medullary infarction)

History	Exam	1st Test	Other tests
double vision, abnormal balance, facial or limb numbness, prolonged vertigo lasting several days	abnormal eye movements; ipsilateral Horner's syndrome; diplopia; ipsilateral limb ataxia; truncal ataxia; dysphagia and hoarseness; loss of pain and temperature sensation of the ipsilateral face and contralateral trunk	»**Blood glucose:** normal Excludes hypoglycaemia as a cause for focal neurological symptoms[86] »**CT head without contrast:** may demonstrate haemorrhage or large infarction[86] »**MRI brain ± angiogram:** occlusion of the ipsilateral vertebral artery may be demonstrated	

Trauma

History	Exam	1st Test	Other tests
history of head trauma (e.g., a fall, an assault, or a motor vehicle accident), vertigo, disequilibrium, tinnitus, pressure, headache, diplopia	evidence of fluid or blood in the middle ear, evidence of a temporal bone fracture (e.g., mastoid and periorbital ecchymosis, abnormal neurological findings, cerebrospinal fluid otorrhoea).	»**CT scan petrous temporal bones:** temporal bone fracture demonstrated	»**electronystagmography:** abnormal response of affected side »**caloric testing:** abnormal response of affected side »**MRI scan head:** intracranial pathology Performed if there is a history of head

Uncommon

Trauma

History	Exam	1st Test	Other tests
			injury with abnormal neurology.

Vertebral#artery dissection

History	Exam	1st Test	Other tests
more likely to be a young adult or trauma patient; dizziness, headache, and neck pain; may be history of predisposing factors, such as hypertension, recent infection, connective tissue disorder (e.g., Ehlers-Danlos syndrome, Marfan syndrome, osteogenesis imperfecta, fibromuscular dysplasia)	dysarthria, visual field deficits, ataxia	»**MRI angiogram:** may demonstrate double lumen in artery, evidence of intramural haematoma or pseudoaneurysm »**CT angiogram:** may demonstrate double lumen in artery, evidence of intramural haematoma or pseudoaneurysm	»**carotid ultrasound with colour doppler:** may demonstrate arterial dissection Not usually recommended as an initial investigation. Ultrasound with colour doppler is operator dependent and sensitivity varies depending on artery involved.[41][43]

Paraneoplastic cerebellar degeneration

History	Exam	1st Test	Other tests
history of cancer of the ovary, breast, or lung, or history of Hodgkin's lymphoma; dizziness, nausea and vomiting, gait instability, altered speech, and dysphagia	nystagmus, ocular dysmetria, abnormalities of pursuit, saccadic oscillations, and an ataxic gait with or without features of the associated cancer	»**MRI brain:** evidence of cerebellar degeneration CT scan or MRI may be performed. MRI is preferred. »**CT scan brain:** evidence of cerebellar degeneration CT scan or MRI may be performed. MRI is preferred. »**CT scan or MRI of body:** tumour demonstrated	»**anti-Yo and anti-Tr autoantibodies:** positive These may be positive years before tumour detection. Anti-Tr antibody is associated with Hodgkin's disease. »**biopsies of accessible lesions:** neoplasm detected This is necessary if the cancer diagnosis has not yet been made.

Uncommon

◊ Idiopathic#ntracranial hypertension

History	Exam	1st Test	Other tests
often obese; headaches and transient episodes of poor vision; dizziness and tinnitus	papilloedema on fundoscopy; some have bilateral 6th nerve palsy	»**MRI brain:** slit-like ventricles demonstrated »**Visual field testing:** visual field defects; enlarged blind spot, inferonasal loss, other nerve fibre bundle defects, or constriction of the field	»**lumbar puncture and measurement of cerebrospinal fluid (CSF) pressure:** CSF pressure elevated Performed after excluding intracranial mass lesions.

◊ Normal pressure hydrocephalus

History	Exam	1st Test	Other tests
history of abnormal balance, urinary incontinence, and cognitive dysfunction	ataxic gait, cognitive dysfunction	»**MRI brain:** normal	»**lumbar puncture and measurement of cerebrospinal fluid (CSF) pressure:** normal CSF pressure Lumbar puncture may be diagnostic if symptoms improve. »**cisternography:** no blockage of the cerebral aqueduct or of CSF outflow from the 4th ventricle

◊ Mal de debarquement syndrome

History	Exam	1st Test	Other tests
swinging, swaying, unsteadiness, and disequilibrium after exposure to motion (e.g., long voyage, air travel); symptoms may last for hours, months, or years; symptoms occur after disembarking; not associated with nausea or vomiting	usually normal	»**pure-tone audiogram:** normal pattern	»**electronystagmography:** normal Performed to rule out vestibular pathology.

Uncommon

◊ Psychophysiological dizziness

History	Exam	1st Test	Other tests
a variety of symptoms such as rocking, floating, or swimming sensations; symptoms may worsen with stress or fatigue	anxious, may be hyperventilating, normal clinical balance tests	»**hospital anxiety and depression scale:** may be abnormally high (>8)	

◊ Psychogenic dizziness

History	Exam	1st Test	Other tests
dizziness on standing and walking; may demonstrate anxiety reactions and avoidance behaviour to specific stimuli; may be history of panic disorder with agoraphobia, personality disorders, or generalised anxiety; inappropriate or excessive anxiety or fear	normal clinical balance tests	»**hospital anxiety and depression scale score:** abnormally high (>8)	

◊ Systemic lupus erythematosus (SLE)

History	Exam	1st Test	Other tests
history of SLE, photosensitive rash, fatigue, weight loss, alopecia, joint pain, symptoms of vertigo with or without hearing loss	clinical features of SLE: malar rash, discoid rash, oral ulcers, hypertension, peripheral oedema, retinal vasculitis	»**antinuclear antibodies (ANA), anti-double-stranded DNA antibodies, anti-Smith antibodies:** ANA titre ≥1:80; anti-double-stranded DNA antibodies or anti-Smith antibodies positive[141] Performed if diagnosis of SLE has not already been made.	»**electronystagmography:** abnormal »**MRI brain:** may demonstrate white matter lesions or cerebral atrophy[148] Described as the initial presentation in some patients.[149]

Uncommon

◊ Cogan's syndrome

History	Exam	1st Test	Other tests
history of photophobia, ocular discomfort, lacrimation, fluctuating hearing loss, imbalance or vertigo	ocular redness	»**pure-tone audiogram:** sensorineural hearing-loss pattern May fluctuate.	»**slit-lamp examination:** may demonstrate features of interstitial keratitis, uveitis, episcleritis, or scleritis »**fluorescent treponemal antibodies absorption test:** negative Non-syphilitic interstitial keratitis is a key diagnostic feature of Cogan's syndrome.[150]

◊ Granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis)

History	Exam	1st Test	Other tests
dizziness or vertigo, hearing loss, facial weakness; may have symptoms of nasal involvement with excessive nasal crusting, epistaxis or nasal discharge; lower respiratory tract symptoms of dyspnoea, cough, haemoptysis or chest pain; fever, night sweats, anorexia, weight loss, malaise; neurological symptoms of numbness, focal weakness or headache; ocular symptoms of redness, pain, diplopia, visual blurring; arthralgia, myalgia or joint swelling; purpuric, nodular, haemorrhagic or ulcerative skin lesions	serous otitis media (tympanic membrane retracted or concave, with impaired mobility), facial palsy, nasal lesions or upper respiratory tract lesions mucosal bleeding, ulceration or crusting; may have septal perforation or saddle nose deformity; may have crackles, focal dullness to percussion or rhonchi; fever; mononeuritis multiplex; red eye, proptosis, reduced visual acuity, retinal exudates and haemorrhage; palpable purpura, cutaneous nodules, haemorrhagic and ulcerative skin lesions; joint tenderness or	»**antineutrophil cytoplasmic antibody (ANCA):** positive	»**biopsy of lesions for histology:** granulomatous inflammation, necrosis and vasculitis; minimal/absent immune deposits on immunofluorescence and electron microscopy »**Urinalysis and urine microscopy:** may show haematuria, proteinuria; dysmorphic red blood cells, RBC casts Indicated in all patients with suspected disease. They reveal the earliest indication of renal involvement, detectable prior to elevated serum creatinine.

Uncommon

◊ Granulomatosis with polyangiitis (formerly known as Wegener's granulomatosis)

History	Exam	1st Test	Other tests
	swelling, muscle weakness		»**CT chest:** lung nodules (which may cavitate); infiltrates Indicated in all patients with suspected disease, as lung involvement is asymptomatic in one third of patients.

◊ Behcet's disease

History	Exam	1st Test	Other tests
recurrent genital and oral ulceration, eye pain, photophobia, blurred vision, headache, hearing impairment, tinnitus, dizziness	genital ulcers, oral ulcers, red eye, acne lesions, erythema nodosum, superficial thrombophlebitis	»**none:** diagnosis is based on clinical criteria[151]	

Carbon monoxide poisoning

History	Exam	1st Test	Other tests
may be history of suspected accidental exposure from residential boilers, central heating systems, cookers, fireplaces, and chimneys; often non-specific symptoms, such as vertigo, headaches, impaired concentration, pre-syncope, angina, shortness of breath, nausea and vomiting, fatigue[108]	may be normal; flushed cheeks, tachycardia, hypotension	»**carboxyhaemoglobin level:** elevated	»**chest x-ray:** may be signs of non-cardiogenic pulmonary oedema »**ECG:** may be tachycardia, arrhythmias, features of cardiac ischaemia »**blood glucose:** may be elevated »**lactate:** may be elevated in severe poisoning »**cardiac biomarkers:** may be elevated

Uncommon

◊ Post-surgery

History	Exam	1st Test	Other tests
history of a surgical procedure (e.g., stapedectomy, middle-ear surgery, or cochlear implantation)	positive fistula test	»**pure-tone audiogram:** elevated hearing thresholds or severe-to-profound hearing-loss pattern Post-stapedectomy or middle-ear surgery hearing loss.	»**exploratory tympanotomy:** perilymphatic fistula may be present at the round or oval window Post-stapedectomy patients.

Secondary syphilis

History	Exam	1st Test	Other tests
hearing loss or vertigo with or without other variable symptoms (e.g., malaise, myalgia, rash); late neurosyphilis: may present with hearing loss, fluctuating hearing, or dizziness or vertigo with or without other variable symptoms (e.g., personality change, altered mood, loss of anal and bladder sphincter control)	variable signs, including lymphadenopathy, rash, mucosal ulceration with or without signs of more specific organ involvement (e.g., uveitis, meningism, seizures, nephrotic syndrome); late neurosyphilis: signs of tabes dorsalis (e.g., ataxia, Argyll-Robertson pupils, areflexia, loss of vibration/ proprioception, positive Romberg sign), may have signs memory impairment, confusion, tremor	»**treponemal-specific serology:** positive Tests may be treponemal enzyme immunoassay, *Treponema pallidum* particle agglutination assay, *T pallidum* haemagglutination assay, fluorescent antibody absorption, or immunocapture assay. Remain positive lifelong in the presence of current or past infection. As false-positive results for treponemal tests are possible, a positive result should be confirmed by another type of treponemal test. »**non-treponemal serology:** positive Non-treponemal tests include the Venereal	»**caloric test:** abnormal

Uncommon

Secondary syphilis

History	Exam	1st Test	Other tests
		Disease Research Laboratory test, the rapid plasma reagin test, or cardiolipin-based tests. »**pure-tone audiogram:** sensorineural hearing-loss pattern	

Guidelines

United Kingdom

Suspected neurological conditions: recognition and referral (https://www.nice.org.uk/guidance/ng127)

Published by: National Institute for Health and Care Excellence
Last published: 2023

North America

Appropriateness criteria: dizziness and ataxia (https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria)

Published by: American College of Radiology
Last published: 2023

Clinical practice guideline: Ménière's disease (https://www.entnet.org/quality-practice/quality-products/clinical-practice-guidelines)

Published by: American Academy of Otolaryngology-Head and Neck Surgery
Last published: 2020

ACR Appropriateness Criteria: hearing loss and/or vertigo (http://www.acr.org/Quality-Safety/Appropriateness-Criteria)

Published by: American College of Radiology
Last published: 2018

Clinical practice guideline: benign paroxysmal positional vertigo (https://www.entnet.org/quality-practice/quality-products/clinical-practice-guidelines)

Published by: American Academy of Otolaryngology-Head and Neck Surgery
Last published: 2017

Evaluation and management of patients with syncope: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society (https://professional.heart.org/en/guidelines-and-statements)

Published by: American College of Cardiology, American Heart Association, Heart Rhythm Society
Last published: 2017

Key articles

- Bhattacharyya N, Gubbels SP, Schwartz SR, et al. Clinical practice guideline: benign paroxysmal positional vertigo (update). Otolaryngol Head Neck Surg. 2017 Mar;156(suppl 3):S1-47. Abstract
- Basura GJ, Adams ME, Monfared A, et al. Clinical practice guideline: Ménière's disease. Otolaryngol Head Neck Surg. 2020 Apr;162(2_suppl):S1-55. Full text (https://aao-hnsfjournals.onlinelibrary.wiley.com/doi/10.1177/0194599820909438) Abstract
- American College of Radiology. ACR appropriateness criteria: dizziness and ataxia. 2023 [internet publication]. Full text (https://acsearch.acr.org/docs/69477/Narrative)
- American College of Radiology. ACR Appropriateness Criteria: hearing loss and/or vertigo. 2018 [internet publication]. Full text (https://acsearch.acr.org/docs/69488/Narrative)
- Shen WK, Sheldon RS, Benditt DG, et al. 2017 ACC/AHA/HRS guideline for the evaluation and management of patients with syncope: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. Circulation. 2017 Aug 1;136(5):e60-122. Full text (https://www.ahajournals.org/doi/10.1161/CIR.0000000000000499)

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Images

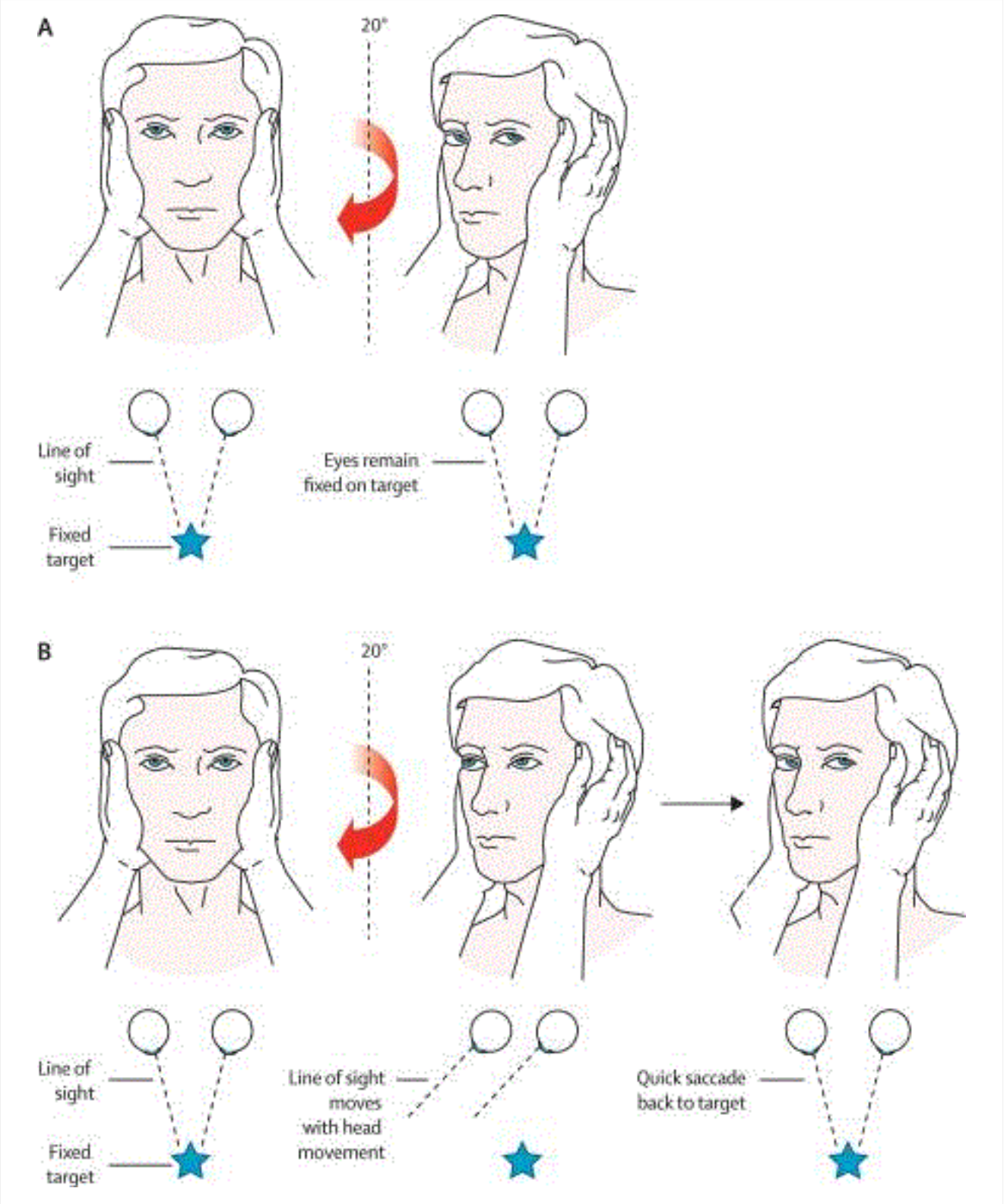

Figure 1: Head impulse test. A: The right ear has intact peripheral vestibular function. When the head is turned to the right, the vestibulo-ocular reflex moves the eyes to maintain visual fixation. B: The right ear now has impaired vestibular function. When the head is turned to the right, the eyes move with it, breaking visual fixation, and a refixation saccade is seen as the eyes dart back to the examiner's face. This indicates a peripheral vestibular disorder on the right side

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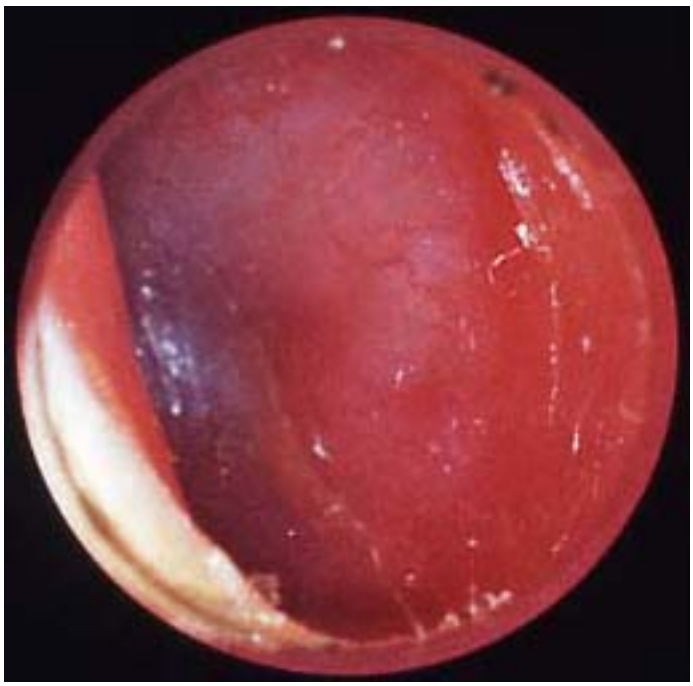

Figure 2: Erythematous bulging tympanic membrane due to acute otitis media

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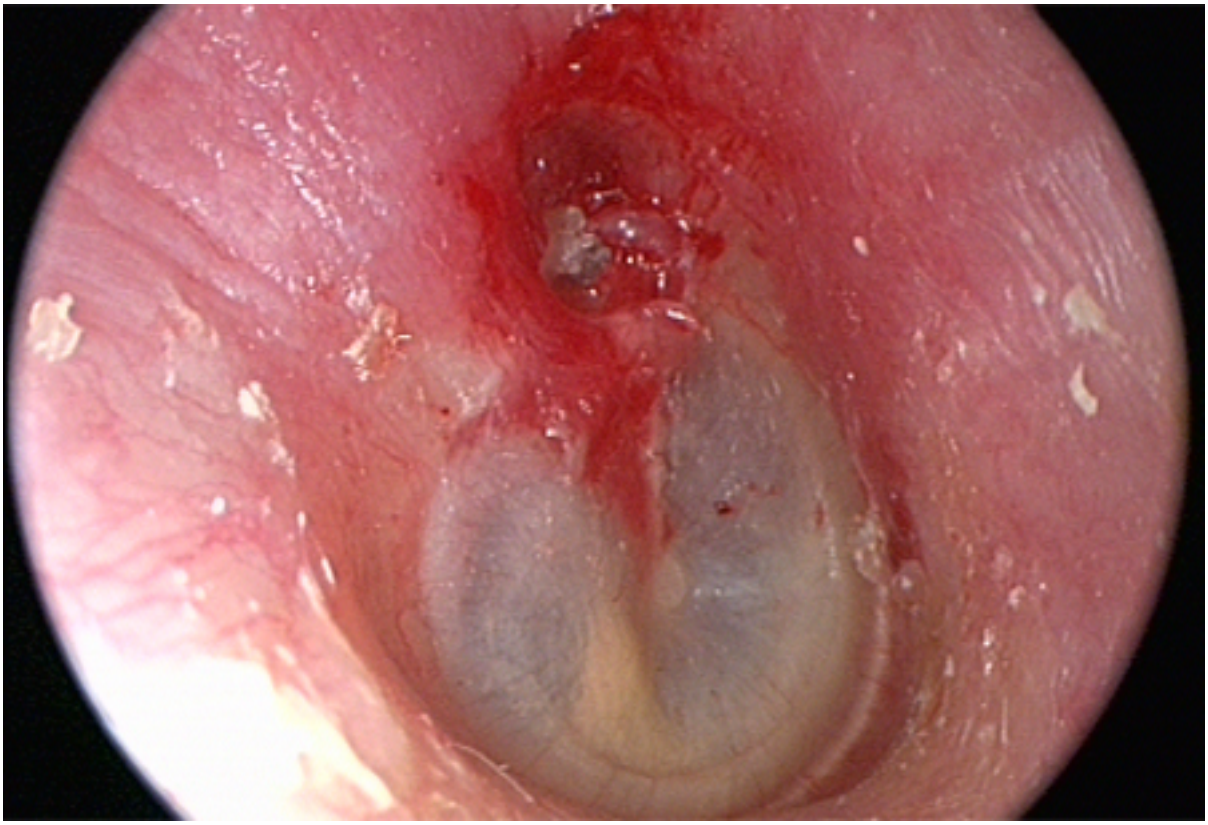

Figure 3: Cholesteatoma in attic (upper part of the middle ear)

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Figure 4: Frenzel glasses

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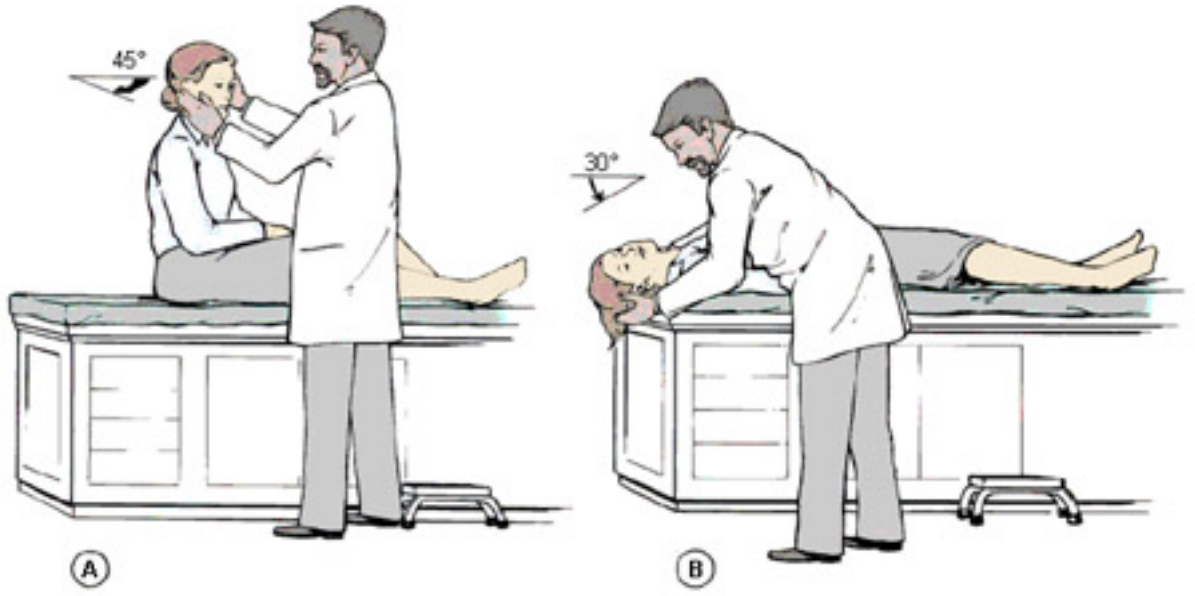

Figure 5: Dix-Hallpike manoeuvre

Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). CMAJ. 2003 Sep 30;169(7):681-93; used with permission

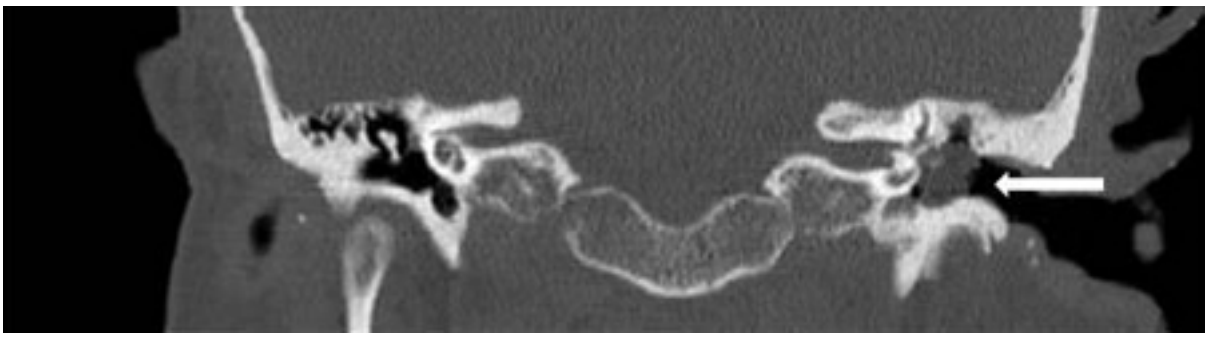

Figure 6: Cholesteatoma, coronal CT scan

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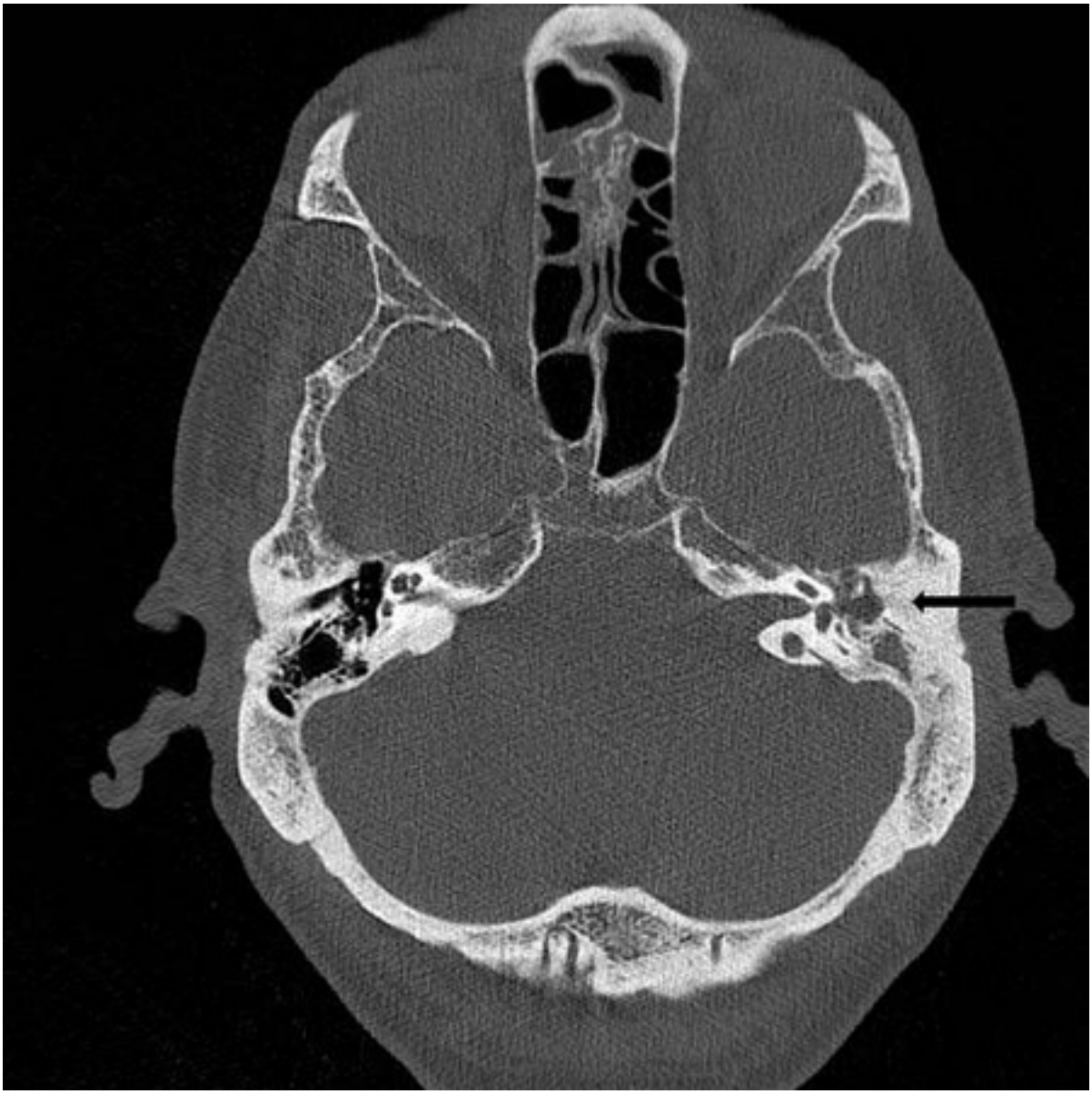

Figure 7: Cholesteatoma, axial CT scan

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Figure 1 – BMJ Best Practice Numeral Style

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