

- Home environment review
- Creatine: nitrogenous organic acid that helps to supply energy to all cells in the body, primarily muscle. This is achieved by increasing the formation of adenosine triphosphate (ATP).
- ACE inhibitors: pharmacodynamics (action of drug on the body) not entirely clear. It is possible that they improved cardiac output, and hence, muscle blood supply.

Physical activity levels for older people

- To benefit health, physical activity should be at an **intensity that raises the heart rate sufficiently to leave the individual breathing more heavily than usual, and feeling warmer**
- Moderate activities such as brisk walking, swimming, social dancing, climbing stairs, cycling, heavy DIY, gardening or housework
- **150 minutes/wk of moderate intensity:** in bouts of >10min or 75 min/wk of vigorous intensity
- **Strength and balance activities – this is the most effective treatment for sarcopenia**
- Endurance is also important

Parkinson's disease (PD)

- **Degeneration of the substantia nigra** in the neocortex and basal ganglia (dopaminergic neurones) => **low levels of dopamine in the nigrostriatal pathways**
- Can cause Parkinsonism, dementia, falls and disability, as well as many other complications
- Cause unknown (idiopathic PD)
- Gradual onset over years: may be 20 yrs from onset to death
- **Interruption of basal ganglia function => results in problems with initiation and control of movement (bradykinesia, rest tremor, non velocity dependent hypertonicity - rigidity, postural instability and abnormal shuffling slow gait)**
- Later effects on higher centres including cognition (**PD with dementia**)
- Mean age of onset 65 yrs
- Prevalence 160/100,000 population
- Prevalence 3.5% in over 85's

Diagnosis of PD

- **Clinical diagnosis**
- **Bradykinesia (slowness of movement)**, plus at least two of:
 - **Resting tremor** (4-6 Hz): often **asymmetrical** e.g. only on one side, or worse on one side
 - **Rigidity** (non spastic hypertonicity, lead pipe, cog wheel due to superimposed pill rolling resting tremor)

- **Impaired righting reflexes** (the righting reflex, also known as the Labyrinthine righting reflex, is a reflex that corrects the orientation of the body when it is taken out of its normal upright position)
- Often affects arms more than legs; often **asymmetrical**
- **Idiopathic PD should respond to a trial of L-dopa.** The medication levodopa is often prescribed to help diagnose Parkinson's or rule out other conditions. If symptoms rapidly improve after taking levodopa then it is highly likely you have Parkinson's disease.
- **DAT scan: allows doctors to differentiate Parkinson's from other movement disorders.** Conventional brain imaging scans such as MRI and CT scan are unable to diagnosis Parkinson's disease. A DAT scan uses radio-isotopes to measure dopamine levels in the brain. **Lower dopamine transporter levels are indicative of PD.** These scanners are becoming more widely available in the NHS and used to support the diagnosis of Parkinson's disease.

Parkinsonism

Parkinsonism may be due to:

- Drugs (e.g. **dopamine blockers** such as metoclopramide (anti-emetic) and antipsychotics)
- Stroke disease (if basal ganglia is damaged) – Vascular Parkinson's
- Idiopathic PD (should respond to a trial of L-dopa)
- **Parkinson plus syndromes**
 - Progressive supranuclear palsy PSP: Parkinsonism + involvement of ocular pathways (e.g. supranuclear ophthalmoplegia => impaired vertical eye movements, diplopia) and pseudobulbar palsies (e.g. UMN involvement with dysphagia and dysarthria and brisk bulbospinal reflexes with spasticity). Dementia can also occur.
 - Multisystem atrophy - MSA: Parkinsonism + ANS dysfunction + cerebellar dysfunction. Dementia does not occur.
- **Can be confused with essential tremor:** tremor of the arms, hands or fingers but sometimes involving the head or other body parts during voluntary movements such as eating and writing; **kinetic/postural/action tremor**; cause unknown but **often familial - autosomal dominant AD**

Consequences of PD

- **Immobility**
- **Falls**
- Impaired confidence
- Incontinence (cannot reach toilet or ANS involvement)
- Dementia (late stages)

PD also affects other parts of the body

Muscle and joint weakness

- Sarcopenia (age related muscular degeneration): results in muscle atrophy + muscle weakness or decreased physical ability
- Neuromuscular pathology (e.g. stroke, PD, myasthenia gravis, polymyositis)
- Joint pain / immobility e.g. OA, RA

These problems may be measured by: increased postural sway, reduced reach, reduced walking speed or **reduced ability to get out of a chair** (get up and go test)

Gait disturbance and ataxia

- Sensory ataxia: sensory and proprioceptive problems in lower limbs and feet or due to sensory pathways in spinal cord in particular the dorsal columns (e.g. due to diabetic neuropathy or B12 deficiency). Results in high stepping or stamping gait.
- Basal ganglia ataxia e.g. PD, HD
- Vestibular ataxia e.g. due to vestibular (inner ear) disease
- Cerebellar ataxia
- Other neurodegenerative disorders affecting relevant areas of brain or spinal cord

These problems may be measured by: full neurological exam including basal ganglia/cerebellar functioning, increased postural sway, reduced reach, reduced walking speed or **reduced ability to get out of a chair**

Visual problems

- Especially reduced edge contrast from cataract
- Age related macular degeneration (ARMD)
- Glaucoma
- Diabetic retinopathy
- Varifocal lens (various focal lengths for myopia and hyperopia) can increase risk of falls

Environment

- Stairs
- Poor lighting
- Slippery floors
- Poor housing
- Loose mats
- Uneven pavements

- Other causes e.g. hypoglycaemia, hypocapnia (induces cerebral vasoconstriction), hypoxaemia, and anaemia

Pathophysiological mechanisms of syncope include:

- Impaired baroreceptor response: carotid hypersensitivity
- Reduced blood volume (hypovolaemia)
- Altered cerebral autoregulation e.g. hypocapnia, anemia, hypoxaemia
- Cardioinhibitory e.g. -ve chronotropic (decreased HR) and -ve inotropic (decreased force of contraction)
- Vasodepressor (dilation of peripheral arterioles => decreased TPR => decreased MAP) e.g. vasovagal syncope
- Hypoglycaemia

Orthostatic (postural) hypotension

- Incidence 4-33% (increases with age)
- Avoid exacerbating factors (drugs and alcohol)
- Specific measures
 - Don't sleep flat
 - Don't lie down during day
 - Don't stand around
 - Cross legs, arms, get up slowly
 - Don't strain
 - Don't be greedy
 - Don't get heated up
 - Avoid certain medications

Risk factors synergy

- **Risk factors (RF) interact and are likely synergistic (1+1=3)**
- 10 - 27% per year when one RF present
- 69 - 78% per year when four or more present
- **Hip weakness, unstable balance, and polypharmacy may predict close to 100% risk of falling over 1 year**

How do we assess fallers?

History

- **Acidic drugs require an acidic ($\approx \text{pH} < 7.35$) environment for absorption** e.g. phenytoin (AED), aspirin, penicillins
- **Basic drugs require a basic ($\approx \text{pH} > 7.35$) environment for absorption** e.g. diazepam, morphine, pethidine

In the elderly we have an increase in gastric pH (less acidic) and a decrease in small intestine surface area. Gastrointestinal absorption is affected by an **increase in gastric pH (less acidic)** and a **decline in small intestine surface area**. However, these changes usually have **little clinical impact**. They may have an impact if

Less acidic $\Rightarrow$ acidic drugs absorption is decreased and basic drugs absorption is increased
Less surface area $\Rightarrow$ less absorption

- Previous GI surgery
- NG tube or PEG feed
- Transdermal patches and oedema

Think about best route of delivery:

- Liquid/syrup for dysphagia
- Can tablets be crushed for PEG or NG tube?
- Confused patients refusing tablets / acute agitation
- Nil by mouth (NBM) patients for surgery or investigations

Drug distribution

- **Far greater changes and impact are seen with body distribution changes.**
- **There is a decrease in total body water (TBW) $\Rightarrow$ therefore hydrophilic drugs** (e.g. digoxin and lithium) have a smaller volume of distribution requiring **smaller doses.**
- **There is an increase in body fat tissue** (proportional to muscle mass), so that **lipophilic drugs** (e.g. diazepam, anaesthetics) have a larger volume of distribution (and thus a **longer half life**) making use of these drugs undesirable.
- There is often a **decrease in serum albumin with aging** that can affect the distribution of highly protein bound drugs (e.g. phenytoin, amiodarone) resulting in the need for lower dosing. **Albumin is basic and binds to acidic drugs.**
- **START LOW AND GO SLOW**

Stage	GFR	Description	Treatment Stage
1	90+	Normal kidney function but urine findings or structural abnormalities or genetic trait point to kidney disease	Observation, control of blood pressure
2	60-89	Mildly reduced kidney function, and other findings (as for stage 1) point to kidney disease	Observation, control of blood pressure and risk factor
3A 3B	45-59 30-44	Moderately reduced kidney function	Observation, control of blood pressure and risk factor
4	15-29	Severely reduced kidney function	Planning for endstage renal failure
5	<15 or on dialysis	Very severe or endstage kidney failure (sometimes call established renal failure)	Treatment choices

GFR: Glomerular Filtration Rate

Pharmacodynamics

- Pharmacodynamics= drug action on the body +ADRs
- General principle: Lower doses achieve same effect in the elderly (common e.g. alcohol) => start low and go slow**
- However, it is important to remember that some effects are decreased (e.g effect of beta blockers on heart rate)
- The therapeutic index (also known as therapeutic ratio) is a comparison of the amount of a therapeutic agent that causes the therapeutic effect to the amount that causes toxicity
- Quantitatively, it is the ratio given by the lethal or toxic dose divided by the therapeutic dose
- Therapeutic Index (TI) = LD50/ED50 or MTC/MEC**
- Median lethal dose= LD50; Median effective dose = ED50 ; MTC= minimum toxic concentration; MEC= minimum effective concentration
- The therapeutic window decreases with age**
- The closer to 1 the therapeutic ratio is, the greater the risk of toxicity
- Beware of drugs with a narrow therapeutic index i.e. <2.**
 - Vancomycin
 - Warfarin
 - Phenytoin
 - Lithium
 - Digoxin
 - Carbamazepine

- **Prescription cascade refers to the process whereby the side effects of drugs are misdiagnosed as symptoms of another problem resulting in further prescriptions (polypharmacy) and further side effects and unanticipated drug interactions.**
- This may lead to further misdiagnoses and further symptoms.
- Such cascades can be reversed through **deprescribing**
- Examples include:
 - NSAIDs => fluid retention and hypertension => antihypertensive therapy
 - Metoclopramide (dopamine blocker used as an antiemetic) => Parkinsonism => levodopa
 - Dihydropyridine Ca²⁺ blocker => oedema => furosemide (diuretic)
 - NSAIDs => gastric ulcer => H₂ blocker => delirium => haloperidol (haldol)
 - Thiazide diuretic => gout => NSAID => increased BP => 2nd antihypertensive drug
 - Sudafed (OTC decongestant) => urinary retention => alpha blocker (e.g prazosin)
 - Antipsychotic => akithesia => more meds

Adverse drug reaction (ADRs)

- **The elderly are at high risk for adverse drug reactions (ADRs).**
- This risk is determined more by the high number of medications taken by elders (polypharmacy), than it is by their age alone.
- As the number of medications a person takes increases, the risk of an ADR increases exponentially.
- In frail elders, the presentation of adverse drug reactions can often be atypical, and may be confused with a new medical condition, and not recognized as a reaction to a drug. This can result in additional drugs prescribed in response to treat the symptom of an ADE, instead of stopping the offending drug.
- This phenomenon has been referred to as the prescribing cascade, and is felt to be one of the principle drivers of polypharmacy in the elderly.
- **Prescribers need to rely on careful medication history taking (including OTC preparations) in order to diagnosis ADR's that present in atypical ways.**

ADRs occur as a result of

- Drug-drug interactions including drug-OTC/herbal reactions
- Drug-disease interactions (e.g. beta blocker and asthma)
- Drug-food interactions
- Drug side effects
- Drug toxicity

- Instrumental ADL (instrumental activities of daily living (IADLs) are not necessary for fundamental functioning, but they let an individual live independently in a community e.g. housework, managing money, use of telephone or other form of communication etc)
- Participation measures

Discharge Planning

- Housing and residential care
- Home assessment
- Home alterations, aids appliances
- Home services and social care teams
- Financial issues and benefits
- Transition to community rehabilitation
- Return to work, leisure and other life roles

AGEING: SUMMARY OF COURSE

- We live in an **ageing population** and there is going to be even more older people in the future (and less younger people to support society financially)
- This will cause major challenges for health care providers (as well as society)
- Older individuals are very **heterogeneous** across any measure of physiological or daily functions (e.g. spectrum from severely frail to "fit as a fiddle")
- Many older individuals have a **loss of homeostatic reserve (frailty)** due to cumulative defects across multiple body systems => small insults can produce major problems
- **Frailty = accumulated deficits across multiple systems => loss of homeostatic reserve** (there are scales to quantify frailty)
- It is NOT being old which causes illness; it is illness which causes frailty e.g. illness causes frailty (loss of homeostatic reserve) which predisposes to more illness => vicious cycle
- Although getting old is often associated with the accumulation of diseases, it is not an inevitable part of aging
- **The comprehensive geriatric assessment (CGA) is the standard of care for older people** - it is an evidence based method for looking and solving problems in older people. It reduces death, reduces hospitalisation, improves cognition and reduces nursing home admission. If it were a drug it would be the best drug we have! The number needed to treat is approximately 3. **The CGA looks at a wide range of problems from medical, psychological, functional (activity level / QoL), and social/environmental. Requires MTD assessment.**