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Anaesthesia for the elderly

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"Elderly patients undergoing surgery are at greater risk of a decline in physical and/or mental function, which may not have resolved by the time of discharge."

The outcome of surgery in elderly patients is directly related to the care they receive during the entire perioperative process. Anaesthesia makes up only one component of this but is directly associated with the mortality and morbidity seen in this population group. As the average population age increases and the number of elderly requiring surgery follows suit, the need to understand the challenges in anaesthetising elderly patients becomes more important.

Definition of aged

No clear definition of old age exists. Suggestions that age in proportion to local life expectancy in a specific population should be used have resulted in old age varying from above 45 to 75 in women and 55 to 75 in men. Generally, 65 is considered as aged in the normal working population while physiologically old age appears to be over 80.

Pathophysiological changes with ageing

General changes associated with ageing

There is a continuous diminution in physiological function as the number of parenchymal cells decreases and inactive interstitial cells increase. Body habitus changes as muscle size and bulk decreases, fat distribution is changed, vertebral bodies and disks collapse producing a kyphosis with flexion deformities across joints. Skin becomes thinner and more fragile.

Cardiovascular system

Myofibrils enlarge but decrease in number. Muscle is replaced by collagen and fat. Calcification and amyloid deposits along with a reduction in pacemaker cells increase conduction abnormalities. Coronary blood flow is reduced by atherosclerosis, calcification and luminal plaque formation. Arterial sclerosis increases peripheral vascular resistance, producing hypertension, while diminished vagal and sympathetic responses reduce vascular compensation. Autoregulation of blood flow is impaired in the elderly along with the physiological response to hypovolaemia which can be exacerbated by the use of beta-blockers and ACE inhibitors.

The heart becomes less compliant, stroke volume decreases, ejection time is prolonged as valves calcify, and diastole is shortened worsening coronary perfusion. Maximum cardiac output and functional cardiac reserve decreases with an end result that the elderly have very little cardiac reserve if placed under cardiac stress. Tachycardia leads to diminished ventricular filling and diastolic coronary perfusion which is worsened by the presence of arrhythmias, especially atrial fibrillation. This is complicated by disease states such as atherosclerosis, ischaemic heart disease, hypertension, hypercholesterolaemia, type 2 diabetes mellitus and obesity.

Respiratory system

Aging produces reduced pulmonary elasticity, lung and chest wall compliance and all lung volumes except residual volume which is increased. Closing capacity approaches functional residual capacity from 44 years in a supine and 66 years in the erect position resulting in atelectasis, VQ mismatch and hypoxaemia – increasing work of breathing. Postoperative chest infection is more common due to a diminution in muscular strength, less ability to cough, cilia degenerating in the bronchial mucosa and suppression of glottic reflexes allowing microaspiration to occur.

PaO_2 decreases with age about 0.3% per year until 75 years old where it stabilises at around 83 mmHg (Sea level). (*PaO2* = 109 mmHg – (0.43 × age)). $PaCO_2$ remains constant.

Renal system

Renal blood flow, glomerular filtration, tubular function, concentrating ability, drug elimination and renal synthetic functions are all reduced. Creatinine levels change as muscle bulk reduces and may not correspond to creatinine clearance.

Nervous system

CNS function declines with age and is associated with perioperative confusion that may lead onto dementia. This can be exacerbated by underlying cerebrovascular disease.

Autonomic dysfunction is associated with hypotension (especially on induction), arrhythmias and delayed gastric emptying. Abnormal temperature regulation is seen with increasing age.

Endocrine

Type II diabetes is seen in up to 25% of patients over 80 years.

Haematology

Anaemia is common. Iron stores are reduced, EPO production decreased, synthesis slow while small bleeds may not be adequately compensated for. Transfusion makes no difference if haemoglobin is above 8 g/dL. In anaemia that is unresponsive to therapy look for occult malignancy, chronic infection or poor nutrition.

Immunity is reduced due to atrophy of the thymus (less T cells) and abnormal marrow production of lymphocytes.

Pharmacology

Their chronic medication should generally not be withdrawn or stopped suddenly, but may interact with all anaesthetic agents.

Pharmacokinetic alterations are variable and require some understanding.

- Absorption may be slowed due to delayed uptake and poor cardiac output.
- Distribution is greater due to decreased protein synthesis, binding, obesity and increased free water.
- Metabolism and elimination are usually prolonged as blood flow to the liver and kidneys is reduced in combination with diminished enzyme activity and protein binding.

The net result is that to achieve adequate plasma concentrations initial doses should be similar to those used in younger patients, but may take longer to reach the desired effect. The effects are longer lasting so additional or top-up doses should be smaller and/or given at longer intervals.

Pharmacodynamics

Increased sensitivity especially to CNS depressants. MAC is decreased by 6% per decade after 40 years of age. (Sevoflurane has a MAC of 2 at 40 years and 1.6 at 80 years.)

Nutrition

Malnutrition is common and a marker for increased morbidity and mortality.

Musculoskeletal and dermatological

Skin lesions are common and occur easily due to thin skin which heals very poorly. Care should be taken to protect pressure points and when moving the elderly, covering eyes, securing IV lines and airway devices.

Arthritis, with joint and spinal deformities make procedures difficult and add risks of pressure sores, fractures and positioning difficulties.

What are the perioperative concerns

Preoperative testing

1. Multiple medical conditions may be present. History may require some collateral if confused, but is useful in excluding reasons for falls and assessing true level of function. Carers will often be able to provide a list of medication.
2. Bloods – RBC and U&E may show evidence of correctable conditions that can help in optimising organ function.
3. ECG – probably better for detecting arrhythmias than ischaemia.
4. Cardiopulmonary exercise testing has been shown to identify those who may benefit from optimisation of their cardiac status, but as most of the surgery in this age group is urgent or emergent its implementation is problematic.[4]
5. Geriatric Frailty test

   Having 3 of the following symptoms is associated with increased morbidity and mortality and occurs in 20–30% of overs 75s. (Canadian Veterans Heart Study)

   - Unintentional weight loss (at least 4 kg in last year)
   - Self-reported exhaustion
   - Weak grip strength
   - Slow walking speed
   - Low physical activity.
6. Cognitive testing – often difficult due to hearing and visual loss.

The abbreviated mental test is easily used, simple and reproducible. A score of less than 7 out of 10 questions suggests cognitive impairment.

Question	Score
What is your age?	1
What is the time to the nearest hour?	1
What is the year?	1
Give the patient an address, and ask them to repeat it at the end of the test.	1
What is the name of the hospital or their address?	1
Can the patient recognise two persons (the doctor, nurse, relation, etc.)?	1
What is your date of birth?	1
Historical date e.g. When did World War 1 begin?	1
Name the president.	1
Count backwards from 20 down to 1.	1

The mini mental state exam is often quoted as a test of mental function, but is copyrighted and needs to be bought from Psychological Assessment Resources. It includes most of what is found in the abbreviated mental test.

Delirium

Incidence of 0% to 73% postoperatively. It is a medical emergency. Symptoms can last up to 6 months and can also occur post sedation with regional anaesthesia or just with admission to hospital. Delirium may be a predictor for development of postoperative cognitive dysfunction (POCD) and is associated with increased risk of dementia, death, increased length of hospital stay and readmission.

Comorbidity in the elderly

Comorbidities are common in all elderly patients. A Korean study of 2767 people over 80 found that 78% had been diagnosed with a disease, and 47% had been diagnosed with more than two diseases. The mean number of morbidities per person was 1.62 (± 1.35). Morbidities were related to gender (more in women), income, employment, alcohol intake and social status. Chronic disease was the most common, then hypertension, arthritis, diabetes mellitus, osteoporosis and arthritis.

A 2003 sample study of 200 over 60-year-olds from India showed the following conditions to be present:

Anaemia (66.5%), dental problems (63%), hypertension (49%), COAD (42%), cataract (38%), osteoarthritis (knee), (33%), skin and nail infections (24.5%), urinary incontinence (20%), pruritus (19.5%), deafness (19%), parasthesia (17.5%), prostate enlargement (17%), valvular heart disease (16.5%), peptic ulcer disease (14.5%), diabetes mellitus (5.5%), obesity (5%).

Scoring comorbidities:

The Charlson comorbidity index and its many modifications is a predictor of annual mortality associated with a combination of chronic comorbidities. Each condition is scored according to its mortality risk (i.e. 1, 2, 3, or 6). Age is added in some scores at a rate of 1 per decade after 40.

Score	Condition
1	Myocardial infarct, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic lung disease, connective tissue disorder, peptic ulcer, liver disease, diabetes
2	Hemiplegia, moderate or severe kidney disease, diabetes with end organ damage, non metastatic tumour, leukaemia, lymphoma
3	Moderate or severe liver disease
6	Metastatic tumour, AIDS

Score: < 3 have a greater than 90% chance of 1-year survival.
Score: 3–8 has a 50–90% chance of survival.
Score: > 8 has a 50% chance of 1-year survival.

Types of surgery

Day case surgery in the elderly requires a structured plan in place that includes home care and a readmission policy. The advantages are a quicker return to familiar environments, less confusion, early mobilisation and less exposure to hospital infections.

Emergency surgery – Patients are acutely ill with little time for optimisation. Greater risk of morbidity and mortality. (Mortality is up to twice that of elective surgery). Rapid evaluation of the patient is required with concurrent optimisation which may need to be continued during surgery.

Anaesthesia and surgery concerns

The decision to operate on an octogenarian should be taken in conjunction with the patient, family and carers, weighing up the risks of surgery, comorbidity, potential postoperative function and benefit. Many anaesthetic techniques using all agents have been used successfully including: balanced anaesthesia using volatile, opiates and muscle relaxants. Regionals with or without sedation. TIVA, TCI and ketamine. The care and technique of delivering the anaesthetic is probably more important than the agents used. Personal choice of technique should depend on previous experience of that type of procedure combined with knowledge of how an octogenarian with comorbid disease is likely to react to a specific anaesthetic.

General principles

- **General patient care:** Elderly patients must be allowed to make a meaningful decision of the risk and benefits of the procedure.
- Systems to address the global needs of the elderly undergoing surgery have shown reductions in morbidity, mortality, delirium and hospital stay unrelated to any surgical or anaesthetic intervention. An example is the "POPS" pathway – Proactive Pathway for Older People undergoing Surgery which provides a method of multidisciplinary, pre-operative, comprehensive geriatric assessment.
- Staff should be experienced in detecting and treating conditions in elderly patients.
- Delirium needs to be detected early and managed as cognitive impairment preoperatively is likely to result in POCD.

1. **Rapid mobilisation:** Is associated with early discharge and reduced morbidity. Anaesthetic techniques allowing early ambulation should be used:

- Short acting drugs, regional techniques, optimal fluid usage, optimising nutrition and pain control.
- Depth of anaesthesia monitoring – prolonged deep anaesthesia has been associated with poorer outcome after anaesthesia.

2. **Drug doses**: Drugs take longer to work (slow arm/brain circulation), distribution is greater and elimination is slower (slower metabolism and elimination). Hypotension is common. MAC is lower. - *Give doses to effect. Wait for them to work and increase the dosing interval. Adding ephedrine may be useful in speeding up onset and reducing hypotension at induction.*
3. **Fluids:** Fluid balance is a nightmare. Level of hydration is difficult to assess. Anti-diuretic hormone is less effective. Dehydration is common in emergencies, bowel prepped and the malnourished. Large volumes of fluid may be poorly tolerated, especially in CCF, COAD, renal or hepatic dysfunction. – *Goal directed fluid administration with inotropic or vasopressor cardiovascular support as necessary.*

4. **Analgesia:** Regionals are great, but, what do you do when they wear off? Opiates can cause confusion, NSAIDs worsen renal function and have gastric side effects. Intramuscular injections and topical patches are unpredictable. – *Paracetamol ivi or per os is a good mainstay. Tramadol or an opioid PCA using easy to depress electronic buttons rather than mechanical devices may be necessary.*
5. **Thermoregulation:** Decreased metabolic rate, minimal shivering and impaired thermoregulation predispose to hypothermia and addition cardiovascular stress. – *Use all the tricks to keep them warm, but watch out for burns.*
6. **Supplemental oxygen:** Evidence is growing that 100% oxygen maybe toxic and 60% is probably good enough provided the sats are fine. Nasal cannulae are well tolerated but may be associated with sinusitis long term as nasal mucosa dries out. – *keep flows at 2 L/min and watch sats.*
7. **Pressure points, positioning and skin:** Increased pressure sores with prolonged surgery due to hypoperfusion and delayed mobilisation. – *Pad pressure points, a bolster under Achilles tendons to lift heels of the bed.* Atherosclerosis can cause vertebrobasilar insufficiency, fractures can occur if osteoporotic. *Look after the neck especially in extension.* Skin lesions from handling and dressings. – *HANDLE WITH CARE. Watch adhesive tape, never pull sheets out from under patient.*
8. **High care or ICU**: Useful in frail patients with organ dysfunction especially for emergency, prolonged, cavity opening surgery or fluid shifts. Elderly can become very confused by the noise, lights, lack of rest or sleep. – *Discharge as soon as possible.*
9. **Anticoagulation**: Immobile elderly patients are at risk of DVT. – *Anticoagulate from admission or as soon as possible.* Watch for bleeding – *especially with combinations or multiple anticoagulants.*
10. **Mobilise:** Slowly, early with physio help.
11. **Regular medication** – If it has been stopped it should be continued or restarted from the day of surgery – *Do not stop beta-blockers or statins for surgery. Follow guidelines for antiplatelet drugs in patients with stents.*
12. **Confusion:** Not all confusion is delirium. – *Look for wound infections, pneumonia, UTI, DVT, electrolyte disturbances, hypoglycaemia, hypoxia, alcohol withdrawal and opiate administration.*
13. **Blood transfusion:** Due to low iron stores anaemia is common. Transfusion of greater than 1000 ml of blood is a major contributor to early postoperative delirium. – *Transfuse only if necessary. Suggested triggers are Hb < 7 g/dL or < 8 g/dL with cardiac disease.*

Regional vs general anaesthesia:

Regional anaesthesia with minimal sedation has revolutionised cataract surgery with nonagenarians and centurions being done regularly. Peripheral limb surgery with sedation and a block is well tolerated. In hip surgery (Cochrane data base) spinal or epidural anaesthesia may reduce mortality in the first month (6.9 vs 9.4%) but with no effect on overall mortality. DVT rates were reduced with spinal or epidural anaesthesia (30 vs 47%). There is not enough data available for regional blocks with or without general anaesthesia.

Neither technique appears to offer a survival benefit in major surgery.

Fractures:

The commonest reason for an emergency operation on an octogenarian is a fracture following a fall. Around 80% of the 300 000 hip fractures a year in the USA occur in the 75–95-year age group.

Medical causes of the fall should always be excluded. (Arrhythmias, myocardial infarction, TIA, stroke, pulmonary embolus, GIT bleed). Hip fractures have a high mortality after 65 years of age (14–35% in the first year and 5% a year thereafter) and are often considered a pathological condition, no matter what the mechanism of the injury.

Increased mortality is associated with: Delay of surgery for more than 96 hours, dementia, congestive cardiac failure, metastatic malignancy, renal disease (or elevated creatinine), higher ASA scores, albumin < 35 g/L, lactate on admission > 3 mmol/L, prolonged surgery and age > 80.

Cataracts

Cataract surgery up to the mid-1990s was performed almost exclusively under general anaesthesia. The advance of phaecoemulsion of the lens and implants using foldable intraocular lenses means that smaller incision surgery without total ocular akinesis can now be performed under local anaesthesia with or without sedation.

Type of block	Technique	Complications	Differences
Retrobulbar	Local anaesthesia (LA) injection behind the globe. Needs 10 ml, pressure on eye and adding hyalase aids spread of LA. Takes up to 20 min to work. Added facial nerve block stops blinking.	Globe perforation Retrobulbar haematoma Optic nerve damage Occular muscle injury	Akinesis better than sub-Tenon or topical. Little difference between Retro and peribulbar.
Peribulbar	LA injection around globe. (As with Retrobulbar)		
Sub-Tenon	Transconjunctival infiltration of LA directly into sub-Tenon space, in inferior-nasal quadrant, using a blunt 19-gauge Southampton cannula.	No Akinesia. Patients need to be awake.	Less pain on injection. No facial numbness. Quicker onset time. Better pain relief than topical. Contra-indicated in revision surgery as scarring of sub-Tenon space increases risk of globe perforation
Intracameral block	Modified sub-Tenon. 0.2–0.5 ml of preservative free bupivacaine injected directly into the anterior chamber through a corneal incision done under topical anaesthesia.		
Topical anaesthetic drops	LA drops applied onto cornea and into incision.	More vitreous loss than sub-Tenon. Endothelial reactions.	Shorter period of analgesia.

Agents used: Procaine (1%/2%/10%), Proparacaine (0.5%), Oxybuprocaine (0.4%), Tetracaine (0.5%/1%), Bupivacaine (0.25%/0.5%), Etidocaine (1%), Lignocaine (0.5%/1%), Prilocaine (4%), and Ropivacaine (0.2%/1%). All these agents have different rate of onset and duration of anaesthesia.

Sub-Tenon and intracameral anaesthesia is currently the local anaesthetic technique of choice in the UK (47% compared to topical 33%, peribulbar 16%, retrobulbar 2%, and others 2%).

Sedation is often used in conjunction with these blocks. Intravenous sedation with 1–3 mg of midazolam only is often adequate as deep sedation is not desirable as patients move on waking from sedation and cannot respond to commands ("Vocal local").

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