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DISEASE MANAGEMENT

Balance risks and benefits when selecting anaesthetic and perioperative care options in elderly surgical outpatients

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Abstract Careful consideration of the relative risks and benefits of anaesthetic and analgesic options are required in elderly patients undergoing elective ambulatory surgery. In general, anaesthetic doses are reduced in the elderly because of altered pharmacokinetic/pharmacodynamic drug profiles due to age-related physiological changes. Patients at risk of postoperative nausea and vomiting require emetic prophylaxis. Postoperative pain is best targeted with a multimodal opioid-sparing regimen, with opioids only for rescue analgesia.

Ambulatory setting for elective surgery has advantages

Elderly people need surgery four times more frequently than the rest of the population [1], presenting a significant worldwide public health challenge [2]. One way to help reduce healthcare costs associated with the demand for surgery for elderly patients is to offer efficient ambulatory surgery, especially as many of the common elective surgical procedures required by elderly patients can be performed in the ambulatory setting [2].

Although age is independently associated with a higher rate of unanticipated hospital admission in the 30 days after surgery in the ambulatory setting [3], recent advances in anaesthesia, surgical techniques and patient monitoring technology means the ambulatory setting offers many potential advantages for elderly surgical outpatients [2]. This article gives an overview of the perioperative management of elderly outpatients as proposed by Cao et al. [2].

First conduct a full preoperative patient risk assessment

Preoperative evaluation of the patient should include a comprehensive history (including a directed pain history) and a direct physical examination [2]. Routine laboratory tests are unnecessary for patients with well-controlled (stable) comorbid disease; a randomized, single-blind pilot study in 1068 patients undergoing ambulatory surgery found there was no significant difference in the incidence of perioperative adverse events or in the incidence of adverse events occurring within 30 days after surgery between the group who had no preoperative laboratory testing and those who underwent preoperative testing [4]. However, selective diagnostic tests should be conducted for high-risk patients with known comorbidities and according to the type of surgery to be performed [2]. Table 1 lists risk factors and comorbidities requiring careful assessment.

Many factors influence choice of anaesthetic technique

There is no definitive evidence for the superiority of general over regional anaesthesia (or vice versa) for primary surgical anaesthesia in elderly patients [7]. Choice of anaesthetic technique generally plays a minor role in

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Table 1 Preoperative assessment of risks, as reviewed by Cao et al. [2]

Assessment	Comments
Diabetes mellitus	Perioperative uncontrolled diabetes mellitus may lead to electrolyte imbalance, dehydration and wound infections
	Management: maintain blood glucose at < 200 mg/dL (intraoperative) and at < 150 mg/dL (postoperative)
	Avoid blood glucose levels of < 80 mg/dL
Cardiac risks	Elderly patients have an ↑ risk of perioperative cardiac adverse events
	Use the American College of Cardiology/American Heart Association algorithm for noncardiac surgery to assess cardiac risk [5]
	Continue β-blockers and statins up to and including the day of surgery; less evidence exists for continued use of calcium-channel blockers, ACE inhibitors and angiotensin-receptor blockers
	Management of patients receiving chronic antithrombotic therapy involves careful evaluation of individual risks/benefits [6]
Respiratory risks	A serum albumin level of < 35 g/L is a strong predictor of ↑ postoperative pulmonary complication risk
	Preoperative spirometry and chest radiography useful in patients with COPD and/or asthma
	Risk reduction strategies may be used (e.g. preoperative tiotropium or systemic corticosteroids for COPD patients; smoking cessation)
Renal function	Patients with pre-existing renal insufficiency, diabetes or chronic hypertension have an ↑ risk of perioperative acute renal failure
	Monitor urine output perioperatively in patients with existing renal failure or an ↑ risk of postoperative renal impairment
	Optimize renal function: provide adequate hydration, carefully control blood pressure, avoid nephrotoxic drugs, monitor blood glucose levels, correct any electrolyte imbalances; and estimate creatinine clearance (serum creatinine is an insensitive indicator of renal function in the elderly)
Functional status	Many elderly patients are frail; assess functional level using a validated scale throughout the perioperative period
	Structured training programmes may ↑ patients' functional exercise capacity and improve surgical outcomes
Nutritional status	Poor nutritional status is associated with perioperative complications that ↑ the risks of serious postoperative complications (e.g. pneumonia, infection and sepsis) and 30-day mortality
	Assess nutritional status using indicators such as serum albumin concentration, mid-arm muscle circumference, presence of decubitus ulcers. and dysphagia

COPD chronic obstructive pulmonary disease, ↑ increase(d)

recovery from anaesthesia and in minor postoperative complications or discharge [8].

The anaesthetic plan should be tailored to the individual patient [7]. Anaesthesia technique is influenced by type of surgery, surgeon preference, patient comorbidities and patient preference [2]. For example, for minor procedures, monitored anaesthesia care is an excellent alternative to general and regional anaesthesia; while it requires careful evaluation of the level of sedation, it is associated with shorter recovery times than either general or regional anaesthesia, resulting in reduced costs and early discharge home [2].

Adjust anaesthetic doses to account for pharmacokinetic differences…

In general, anaesthetic drug pharmacokinetic profiles differ between elderly patients and younger adults [2], as shown by the following examples.

- Centrally active anaesthetic drugs (e.g. opioid analgesics, volatile agents, benzodiazepines and sedative hypnotics) have a longer elimination half-life and increased drug action in the elderly because of age-resulted increases in adipose tissue leading to a larger total volume of distribution because of expansion of this 'lipid reservoir' [2].
- Water-soluble anaesthetics have higher average and maximum drug concentrations because of reduced total body water volume and thus central volume of distribution in the elderly [2].
- Age-related reductions in liver mass with consequent decreases in hepatic blood flow [9], and also age-related loss of kidney parenchymal thickness, decline in renal blood flow, and up to a 50% decrease in creatinine clearance (between the ages of 20 and 90 years) [10], all affect the metabolism and excretion of many different anaesthetic, analgesic and muscle relaxant drugs in the elderly [11].

… and increased sensitivity in the elderly

In general, elderly patients are more sensitive to most anaesthetic drugs because of age-related physiological changes, including reductions in brain mass, number of neurons, neurotransmitters, receptors and number of pain-transmitting peripheral nerve fibres [11]. For example,

elderly patients have up to a twofold increase in sensitivity to the ventilator-depressant effects of opioid analgesics relative to younger patients [12]. There is risk, therefore, of relative overdosing of both centrally-acting inhaled and intravenous anaesthetic drugs [2] and local anaesthetics used in neuraxial and peripheral nerve blocks (PNBs).

Start low and go slow for general anaesthesia

It is essential to reduce anaesthetic drug doses and titrate carefully in the elderly patient. Recommended dose reductions for general anaesthesia of elderly patients undergoing ambulatory surgery are summarized in Table 2.

Use sedative premedication sparingly

To minimize prolonging emergence from anaesthesia in the outpatient setting, avoid sedative premedication if possible [2]. If required, for example to reduce patient anxiety or facilitate patient positioning, use single doses of short-acting benzodiazepines (e.g. intravenous midazolam 0.5–1 mg) or propofol 20 mg [13].

Low risk of cardiorespiratory depression with propofol

Elderly patients are more likely to develop hypotension after induction of anaesthesia because of their less compliant vasculature and a higher incidence of chronic hypertension [2]. Titrated doses of intravenous propofol to induce general anaesthesia should minimize acute respiratory depression [2].

Adjuvant nitrous oxide may be useful

The addition of nitrous oxide to inhaled or intravenous anaesthetic drugs may be useful in the outpatient setting because it is rapidly eliminated and has both anaesthetic- and analgesic-sparing effects [2]. In a prospective single-blind study in 69 outpatients requiring minor surgery (< 1 h duration), nitrous oxide + a standard intravenous propofol induction of 1.5 mg/kg was associated with a 19% reduction in the propofol maintenance dosage relative to propofol alone, without any increase in the frequency of postoperative nausea and vomiting (PONV) [14]. However,

Table 2 General anaesthesia drug dose adjustments for elderly ambulatory surgery patients, as recommended by Cao et al. [2]

Drug	Usual dose	Dose/dose adjustment	Notes
Intravenous anaesthetics (risk of overdosing because of reduced cardiac index and reduced baroreflex response in the elderly)			
Etomidate	0.3–0.4 mg/kg	0.2 mg/kg	
Midazolam	0.2–0.3 mg/kg	0.05–0.15 mg/kg (premedication)	Benzodiazepines exert a more potent and prolonged sedative, amnestic and respiratory-depressant effect in elderly
		20% reduction (aged > 55 years)	
		75% reduction (aged > 90 years)	
Propofol			
Bolus	1.5–2.5 mg/kg	20% reduction	
Infusion	4–12 mg/kg/h	30% reduction	
Inhalational agents (risk of overdosing because of discrepancies between end-expiratory and plasma concentrations)			
Desflurane	6.6%	Reduce minimum alveolar concentration by 6% per decade of increasing age	
Isoflurane	1.2%		
Sevoflurane	1.8%		
Opioids			
Fentanyl	1–2 μg/kg (short-term)	50% reduction	To minimize acute autonomic responses and movements in response to pain, premedicate with intravenous fentanyl 0.5 μg/kg
Morphine	0.1–0.2 mg/kg	50% reduction	
Remifentanil			
Bolus	0.5–1 μg/kg	50% reduction	
Infusion	0.2–0.5 μg/min	33% reduction	

the possible increase in risk of PONV and postoperative myocardial infarction remains controversial [2].

Consider properties when choosing a neuromuscular blocking agent

If a predictable duration of effect is required, ester-based neuromuscular blocking agents (e.g. cisatracurium) are preferred over steroid-based neuromuscular blocking agents (e.g. rocuronium) in the outpatient setting [2]. If tracheal intubation is required, then short-acting or intermediate-acting neuromuscular blocking agents should be used [2].

Watch for adverse effects with neuraxial anaesthesia

Spinal and epidural anaesthesia are a type of regional anaesthesia that blocks nerves in the CNS [7]. Spinal anaesthesia gives a complete and widespread sensory block, whereas epidural anaesthesia can give more precise control of the length of sensory block [2]. However, both produce adverse effects, such as perioperative hypotension, postoperative urinary retention, PONV, dizziness and delayed ambulation time, especially in male elderly outpatients [15]. Neuraxial anaesthesia-related hypotension and bradycardia may be potentially dangerous in patients with reduced cardiovascular reserve [2].

Consider unilateral spinal anaesthesia in heart disease

Unilateral spinal anaesthesia is a one-sided block with minimal sensory and motor block on the non-operative side that provides cardiovascular stability, an important benefit for elderly outpatients with heart disease [2].

Lower doses of spinal or short-acting local anaesthetics may reduce recovery times

Traditional doses of spinal anaesthetics may prolong recovery time and may not be suitable in the setting of short-duration outpatient surgeries (e.g. hernia repair, prostate biopsy and knee arthroscopy) [2]. Mini-doses of spinal anaesthetics (e.g. intrathecal lidocaine 10–30 mg, bupivacaine 3.5–7 mg and ropivacaine 5–10 mg) + a potent opioid (e.g. fentanyl 10–25 μg) provide optimal anaesthesia and also faster motor and sensory recovery from the block, although time to discharge home may still be longer than with general anaesthesia [2].

A more predictable discharge time may be achieved by using short-acting local anaesthetics in elderly outpatients [2]. In a randomized, double blind study in 30 knee arthroscopy outpatients who received premedication with intravenous midazolam, 2-chloroprocaine provided excellent anaesthesia with a faster recovery time than lidocaine [16]. Median recovery of sensory and motor function was 95 and 60 min with 2-chloroprocaine versus 120 and 100 min with lidocaine 50 mg (both $p < 0.05$) [16]. The incidence of transient neurological symptoms was lower with the chloroprocaine than lidocaine (0 vs 33% of patients; $p = 0.042$) [16].

Selective regional blocks ideal for elderly ambulatory surgery patients

Regional nerve blocks using local anaesthetics are ideal for ambulatory surgery in the elderly because they are site-specific, with few adverse effects [17]. Advances in PNB techniques, such as ultrasound guidance, multistimulation and use of continuous peripheral catheters, have renewed interest in their use [18]. PNBs may be used as the primary anaesthesia, as adjuncts to general anaesthesia or to manage postoperative pain [2].

PNBs provide fast-track recovery from orthopaedic surgery

Using a PNB for orthopaedic surgery in the elderly outpatient reduces requirement for use of opioids postoperatively, facilitates recovery from surgery and enables earlier ambulation and discharge home [2]. Consider an adductor canal block for total knee arthroplasty in the elderly, as it can facilitate a quicker recovery than femoral or sciatic nerve blocks, which may exacerbate motor weakness and impair/delay rehabilitation [2]. In a randomized study in 151 patients undergoing unilateral total knee arthroplasty, PNB (adductor canal block) + periarticular infiltration provided better management of postoperative pain than PNB or periarticular infiltration alone [19]. Walking on postoperative day 1 was significantly ($p < 0.0001$) less painful for recipients of the combination analgesia than for recipients of either monotherapy; numeric rating scale score of 3.3 with combination therapy versus 6.2 with PNB only and 4.9 with periarticular infiltration only [19].

Prolong analgesia by adding a corticosteroid

PNBs are often used as an adjunct to general anaesthesia or as the primary anaesthetic in painful shoulder surgeries to improve analgesia and facilitate mobilization [20]. Corticosteroids may be added to the anaesthetic regimen to prolong the duration of local anaesthetic action after PNBs [21]. In a randomized, double-blind trial in adults

undergoing painful shoulder surgery, the addition of dexamethasone (≈ 8 mg) increased the median duration of analgesia from single-injection interscalene PNBs with ropivacaine (22.2 vs 11.8 h; $p < 0.001$) or bupivacaine (22.4 vs 14.8 h; $p < 0.001$) [20]. Similar results were reported for mepivacaine in another trial [21].

Proactively manage postoperative complications for optimal recovery

Common postoperative complications in the elderly include pain, PONV, post-discharge nausea and vomiting (PDNV), delirium and cognitive dysfunction, and gastrointestinal dysfunction [2].

Enhanced recovery after surgery (ERAS) programmes are multidisciplinary care pathways that aim to improve recovery after surgery by reducing intra-operative blood loss, decreasing the incidence of postoperative complications and reducing time to recovery [2]. The use of an ERAS programme can decrease postoperative complications by 50%, reduce length of stay by 30% and decrease readmission rates (and thus overall health costs), as reported in a meta-analysis of 7 studies of ERAS programmes for patients undergoing colorectal surgery [22].

If an ERAS programme is not used, recovery can be promoted in several other ways, including the following [2]:

- Use of short- and ultra-short-acting anaesthetic drugs
- Administration of intravenous fluids to take into account the effects of aging, anaesthetic drugs and analgesics on physiological responses
- Provision of chewing gum, oral laxatives and prokinetic agents to restore normal bowel function.

Target postoperative pain with an individualized regimen

Pain after surgery is too common in elderly outpatients [2]. The standard approach for the prevention of pain in this setting is a multimodal analgesic regimen, adapted for the elderly patient by taking into account their pre-existing medical conditions (and any chronic medications), the type of surgery, and their prior experience with postoperative analgesia [2].

The aim is to provide optimal analgesia that is as safe as possible and that can be managed away from the hospital or day surgery setting, while also reducing the long-term risk of chronic opioid dependency [2].

Avoid opioids if possible

The routine use of opioid analgesics should be avoided in order to prevent adverse effects and addiction. Perioperative adverse effects of extensive opioid use include drowsiness/sedation, hallucinations, PONV, urinary retention, constipation, and cardio-respiratory depression [2]. In a retrospective study of 390,000 elderly outpatients (age > 66 years) receiving minor ambulatory surgery, opioid-naïve individuals who received an opioid analgesic within 7 days of their surgery were 44% more likely to be using opioids 1 year after the surgery than those who did not [23].

Tailor treatment to pain intensity

Non-opioid analgesics may be used in the elderly, although potential adverse effects need to be carefully considered and contraindications avoided. Non-opioid options include NSAIDs, paracetamol (acetaminophen), corticosteroids and other agents (e.g. ketamine, gabapentanoids, dexmedetomidine and esmolol).

For mild intensity pain, administer oral paracetamol and NSAIDs (unless contraindicated), but use only in the early post discharge period (2–5 days) because their adverse effects are dose and time dependent [2]. For moderate intensity pain, consider single-injection PNBs or wound/periarticular/local infiltration analgesia [2]. For severe intensity pain, options include: paracetamol and NSAIDs; epidural analgesia, continuous PNBs, and infiltration analgesia; and small doses of potent opioids (e.g. fentanyl 25–50 μg or intravenous sufentanil 5–10 μg) or opioid injection [2]. Opioids should be reserved as short-term rescue therapy [2].

Assess PONV risk and manage accordingly

Common and distressing complications of surgery and anaesthesia are PONV and PDNV; consequences of PONV and PDNV include dehydration, electrolyte imbalance, pulmonary aspiration, wound dehiscence and delayed discharge [2].

Although numerous patient-related, anaesthetic-related and surgery-related factors contribute to the incidence of post-operative emetic symptoms, four are used in scoring clinical risk (Fig. 1) and are included in consensus clinical guidelines on the management of PONV [24]. Figure 1 summarizes the suggested treatment algorithm for prophylactic management of PONV according to patient PONV risk.

There is a wide variety of antiemetic drugs and non-pharmacological interventions (e.g. acupuncture) for the treatment or prophylaxis of PONV; metoclopramide is one

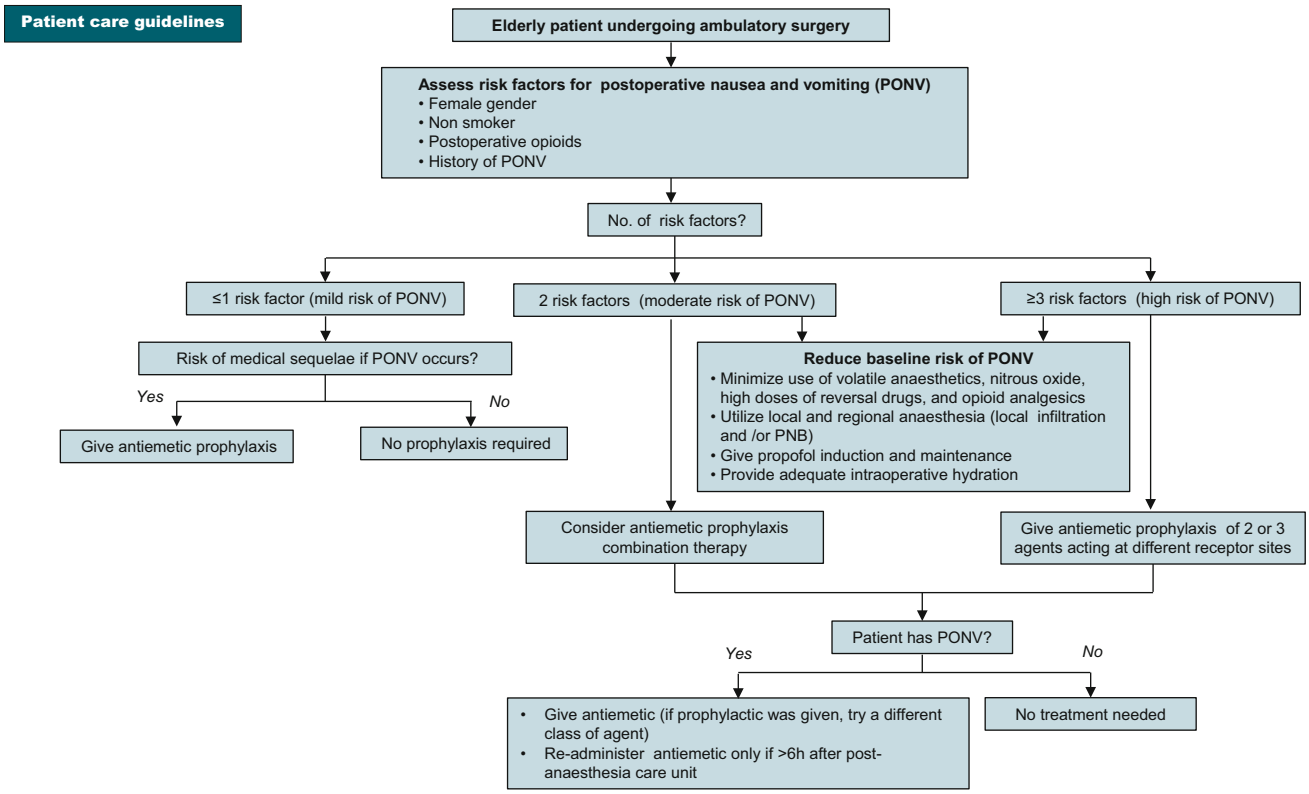

Fig. 1 Management of postoperative nausea and vomiting in elderly patients undergoing ambulatory surgery, as suggested by Cao et al. [2]

of the most commonly used drugs [2]. Combination therapy, where agents act at different neuroreceptor sites, is recommended in patients at risk of PONV [2]. According to a meta-analysis of clinical trials in 1946 surgical patients, dexamethasone + either ondansetron or granisetron reduced the risk of PONV relative to the use of serotonin 5-HT_3 receptor antagonists alone [25]. For example, the number needed to treat to prevent late nausea with dexamethasone + granisetron relative to granisetron alone was 7.8 (95% CI 4.1–66).

Watch for postoperative delirium and cognitive dysfunction

Postoperative delirium occurs in 5–15% of elderly patients undergoing noncardiac surgery and postoperative cognitive dysfunction in 10–13% (at 3 months) [26]. Risk factors for delirium include age > 65 years, poor vision or hearing, severe illness (e.g. admission to an intensive care unit), infection, and chronic cognitive decline or dementia [7]. While postoperative delirium is usually temporary, postoperative cognitive dysfunction may be more persistent and is associated with prolonged hospitalization, delayed recovery and an increased risk of disability and mortality [2].

If an elderly patient develops postoperative delirium or cognitive dysfunction, it is important to identify possible precipitating factors (e.g. poorly controlled pain, pneumonia, infections, urinary retention, faecal impaction, hypoglycaemia, hypoxia, electrolyte abnormalities) [7]. Treat underlying causes and use standard nonpharmacological or pharmacological modalities to treat delirium thereafter [2].

Take home messages

- A proactive individualized approach is required for prompt recovery from ambulatory surgery in the elderly
- Careful preoperative assessment of risks, comorbid disease and chronic medications, PONV risk and magnitude of postoperative pain expected is recommended
- Anaesthetic drug dose should be adjusted for age and co-existing medical conditions
- PNBs are increasingly used for anaesthesia and perioperative analgesia
- Minimize opioid use to help reduce the risk of opioid-related adverse effects and risk of opioid dependency
- The standard of care for postoperative pain is the combination of potent non-opioids + a long-acting local anaesthetic

- Elderly outpatients with moderate-to-high risk of PONV should be given a combination of prophylactic antiemetic drugs

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Compliance with ethical standards

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