Anaesthesia in Older People

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ABSTRACT

Older people are presenting in increasing numbers for surgical procedures. The anaesthetist must be aware of the physiological changes produced by ageing and the various age-related disease processes coexisting in the elderly. Significant changes to the pharmacokinetics and pharmacodynamics of most of the commonly administered anaesthetic drugs occur in older people. This has a direct impact upon the safe delivery of anaesthesia in this patient population. Subcutaneous infiltration of local anaesthetic drugs without sedation is the anaesthetic technique of choice but is only appropriate in certain minor surgical procedures. Otherwise, no one anaesthetic technique has been demonstrated to be superior in the older patient. Anaesthesia may be successfully administered to older people provided the anaesthetist carefully evaluates and optimises the patient's medical condition prior to surgery, modifies the anaesthetic accordingly, and pays close attention to detail.

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INTRODUCTION

Changing population demographics, combined with advances in surgical techniques, have meant the elderly (defined for the purpose of this article as people over the age of 65) now comprise a greater percentage of the anaesthetist's daily workload.[1]

Advanced age is no longer considered a contraindication to anaesthesia and surgery. A recent retrospective study on the outcomes of anaesthesia and surgery in people 100 years and older showed their survival rates at 30 days, and at one year, were no different to birth-matched peers from the general population.[2] The elderly do however experience higher morbidity and mortality rates than a similar younger population of patients. The reason for this is the presence of coexisting disease in the elderly, and the nature of the surgery, rather than old age on its own.[3]

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Chronological age per se is therefore a poor predictor of outcome following anaesthesia and surgery. Attention must be focused on the various coexisting diseases present in the individual elderly patient, as this will better reflect the likelihood for potential complications.

Delivery of anaesthesia may be subdivided into three separate stages: preoperative assessment, anaesthesia for the surgical procedure, and recovery and the postoperative phase. The physiological changes produced by ageing, in conjunction with the presence of age-related disease, must be considered during each stage of the anaesthetic to safely and effectively deliver anaesthesia to the elderly.

PHYSIOLOGY OF AGEING

The ageing process is associated with a progressive reduction in function of the various body systems.[3] In addition the ability of these systems to compensate for changes produced by anaesthesia and surgery is also impaired. This will impact directly on the ability of elderly patients to tolerate specific anaesthetic techniques (see Table 1).

PREOPERATIVE ASSESSMENT AND PREPARATION

Successful preoperative assessment of the elderly patient involves identifying and optimising any coexisting disease. Many disease processes of importance to anaesthesia occur with greater frequency in elderly patients (Table 2). Undiagnosed or poorly treated disease, in particular disease of the cardiovascular or respiratory systems, can produce mortality or significant morbidity in the perioperative period. In such situations deferral of surgery may be necessary to further evaluate the patient and improve the treatment of their underlying medical condition. For emergency but not immediately life-threatening surgery, short-term deferral of a procedure (e.g. a few hours) may allow time for correction of problems such as hypovolaemia, hypothermia, electrolyte and metabolic disturbances.

Successful preoperative assessment of the elderly patient is dependent upon taking a thorough

Table 1. Physiological changes of ageing and their relevance to the anaesthetist

Body system	Physiological change	Consequence to anaesthetist
Cardiovascular	Reduced elasticity Ventricular hypertrophy Reduced beta receptor responsiveness	Reduced maximum cardiac output Decreased ability to mount compensatory tachycardia
Respiratory	Decreased tissue elasticity and chest wall compliance	Impaired gas exchange Decreased p_a0_2
Central nervous system	Neuronal loss	Reduced anaesthetic requirement
Renal	Tissue loss	Reduced ability to tolerate fluid overload and excrete drugs
Hepatic	Tissue loss	Reduced ability to metabolise drugs

Table 2. Diseases occurring with greater frequency in elderly patients

Organ system	Disease process
Central nervous system	Dementia Cerebrovascular disease
Cardiovascular system	Ischaemic heart disease Congestive cardiac failure Hypertension Sick sinus syndrome (conduction abnormalities) Peripheral vascular disease
Respiratory system	Chronic obstructive pulmonary disease Restrictive lung disease
Endocrine	Diabetes mellitus
Musculoskeletal	Osteoporosis Arthritis

history and examination. The history may not always be reliable, especially in relation to the medications the patient is currently taking. Many elderly people take multiple medications, which may produce specific side effects and drug interactions and affect safe delivery of anaesthesia. Of particular concern are those patients receiving warfarin, insulin or oral hypoglycaemic agents. Alternative anticoagulant and diabetic regimens will need to be arranged. Close monitoring of both the international normalised ratio (INR) and blood glucose respectively is necessary for these patients to safely undergo anaesthesia and surgery.

The absence of overt disease does not exclude the possibility of underlying undiagnosed disease. Routine use of preoperative screening tests in the elderly is considered cost-effective as certain diseases are more prevalent in this age group. All patients over the age of 65, including otherwise fit individuals, should normally receive an electrocardiogram (ECG), full blood examination (FBE), and urea and creatinine as part of their preoperative assessment.[4] Additional investigations may be needed depending on the patient's general health. An ECG is normally performed routinely in males over 50 and females over 65 years of age due to the increased prevalence of ischaemic heart disease in these two groups. FBE may reveal anaemia, and urea and creatinine may show renal impairment.

Premedication

Premedication is prescribed for a number of different reasons, the main one being to reduce patient anxiety prior to surgery. In the elderly sedative premedication is generally unnecessary and usually avoided. Certain premedications may cause excessive preoperative sedation, delayed emergence from anaesthesia, and even postoperative delirium in the elderly. These include long-acting benzodiazepines such as diazepam, and the centrally acting anticholinergic agents atropine and scopolamine.[5]

In most cases the preoperative visit by the anaesthetist along with careful explanation of the proposed anaesthetic technique is sufficient to allay any underlying fears. If anxiolytic premedication is deemed necessary a reduced dose of a short-acting benzodiazepine such as temazepam may be appropriate.

Importantly, premedication in the elderly is generally prescribed for reasons other than anxiolysis. This includes the use of bronchodilators to treat reversible small airway obstruction, and acid aspiration prophylaxis (ranitidine, sodium citrate) in the setting of known hiatus hernia and gastro-oesophageal reflux.

ANAESTHETIC TECHNIQUE

At present there is no conclusive evidence that any one anaesthetic technique is clearly superior in the elderly patient.[6,7] The use of subcutaneous infiltration of local anaesthetic drugs without sedation is probably devoid of mortality or major morbidity; however, this technique is only applicable to certain minor surgical procedures.[3] Choice of anaesthetic technique will be dependent upon the patient's physical status, the nature of the surgical procedure and the anaesthetist's and patient's personal preference.

GENERAL ANAESTHESIA

The one consistent observation regarding all agents

that produce anaesthesia or depress central nervous system (CNS) function is that elderly people require less of any of these agents than younger patients to produce the same effect. Appropriate dose reduction of anaesthetic agents administered to elderly patients is necessary to prevent prolonged duration of action and unwanted side effects.

Intravenous Anaesthetics

Intravenous anaesthetic agents are used to induce general anaesthesia. The two most commonly used intravenous agents are propofol and thiopentone. In the elderly the required induction dose of both thiopentone and propofol is reduced by up to 50% of the standard adult dose.[8,9] Whether this reflects a true increase in potency of these agents or is simply the result of altered drug pharmacokinetics in the elderly is not certain.[7]

Rapid administration of either propofol or thiopentone can lead to standard adult doses being given to induce anaesthesia. The elderly have a prolonged circulation time, and display a delay in redistribution of the intravenous anaesthetic agent from the plasma to the site of action in the CNS.[8] Administering propofol or thiopentone too quickly may result in more drug being given than is actually needed to induce anaesthesia. This relative overdose may then produce unwarranted cardiovascular side effects, in particular hypotension.[9]

Propofol may be administered by infusion to maintain anaesthesia, a technique termed total intravenous anaesthesia. The elimination half-life of propofol is increased in the elderly due to a reduction in plasma clearance.[10] Propofol infusions must therefore be discontinued earlier in elderly patients to prevent prolongation of recovery from anaesthesia.

Inhalational Anaesthetics

Maintenance of general anaesthesia is usually provided by one of the inhalational agents. Commonly used agents worldwide include halothane, isoflurane, enflurane, sevoflurane and desflurane. There is no one inhalational agent of choice in the elderly.

The minimum alveolar concentration of all the inhalational agents decreases in a linear fashion from adulthood by about 6% per decade.[3] This means that an elderly patient requires significantly less inhalational agent than a young adult to produce surgical anaesthesia.

Rapid gas analysis allows accurate breath-to-breath measurements of both inspired and end tidal inhalational anaesthetic agent concentrations in patients receiving general anaesthesia. This allows the anaesthetist to appropriately reduce the delivered concentration of inhalational anaesthetic agent to the elderly patient.

All the volatile anaesthetic agents produce unwanted cardiovascular side effects, which are enhanced in the elderly. Halothane causes a decrease in heart rate and dose-dependent myocardial depression, both of which lead to hypotension.[11] Isoflurane and sevoflurane cause dose-dependent hypotension due to a reduction in systemic vascular resistance.[12,13] Both enflurane and halothane produce greater direct myocardial depression than equipotent doses of isoflurane.[11]

Physicochemical characteristics of the newer agents, sevoflurane and desflurane, allow for faster uptake and elimination which would offer potential advantages in the elderly.[14] However, in one study recovery from prolonged desflurane anaesthesia produced only transient advantages compared to either isoflurane or propofol.[15]

Isoflurane, sevoflurane and desflurane (not available in Australia) are probably the preferred agents for use in the elderly in most situations.

Neuromuscular Blocking Drugs

This class of drug is often required to provide muscle relaxation for surgery or to facilitate endotracheal intubation. Suxamethonium is the only currently available agent able to produce rapid onset neuromuscular blockade (within 15-20 seconds). Suxamethonium is metabolised by plasma cholinesterase and there is no apparent change in clinical effect in the elderly,[7] although concurrent medication may influence duration of action.[16]

The remaining neuromuscular blocking drugs do not display age-related changes in potency; however, most will have a prolonged duration of action in the elderly.[3] This is because, apart from atracurium and cisatracurium, they all undergo hepatic metabolism and renal excretion, processes which are impaired in the elderly. Atracurium and cisatracurium are metabolised independently of the liver and kidney by Hoffmann degradation and plasma hydolysis. Dose reduction is not needed for either drug in the elderly.[17,18] Cisatracurium offers some advantages over atracurium as it produces less histamine release; however, it has a longer duration of action.

Administration of the non-depolarising relaxants should be monitored with a peripheral nerve stimulator so correct timing of supplemental doses may be given. If this is done any non-depolarising blocking drug may be safely administered in the elderly. Choice of agent is usually determined by duration of action and side effect profile.

Reversal of Neuromuscular Blockade

Reversal of neuromuscular blockade is often required if residual neuromuscular blockade is present at the end of surgery. This is achieved by administration of an anticholinesterase, usually neostigmine, in conjunction with an anticholinergic, such as atropine or glycopyrrolate. Atropine crosses the blood brain barrier and may produce postoperative confusion in the elderly,[19] making glycopyrrolate the preferred agent.

Neostigmine is associated with an increased incidence of cardiac arrhythmias in elderly patients with

cardiovascular disease.[20] The use of shorter acting agents such as atracurium or vecuronium may avoid the need for reversal of neuromuscular block.

Opioid Analgesic Drugs

Any general anaesthetic will incorporate the provision of pain relief. Intraoperative analgesia is primarily provided by opioid analgesics or local anaesthetics. Elderly people display an increased sensitivity to all opioid analgesics and dose reduction is needed.[21] The effect of ageing on the pharmacokinetics of opioids is inconsistent, although it is apparent that fentanyl pharmacokinetics are unchanged by age.[22]

Relative overdosage of opioids results in excessive sedation and respiratory depression which may prolong recovery from general anaesthesia. Choice of opioid is dependent on the type of surgery. Fentanyl or morphine are popular choices although again no one agent is clearly superior. It is important to stress that this class of drugs may be safely given to elderly people provided the appropriate dose adjustments are made.

REGIONAL ANAESTHESIA

Local anaesthetic drugs can be used by a number of different routes: central neuraxial blockade (spinal or epidural analgesia), major plexus blockade (e.g. brachial plexus block), peripheral nerve block (e.g. femoral block), or subcutaneous infiltration. They may be used as the sole anaesthetic technique, or in conjunction with sedation or general anaesthesia.

Spinal anaesthesia is produced by injection of a local anaesthetic drug into the cerebrospinal fluid. In general, no specific dose adjustments are normally needed when performing spinal anaesthesia in the elderly.[23]

Epidural anaesthesia is achieved by injection of a local anaesthetic into the epidural space. In the elderly anatomical changes within the epidural space result in a greater cephalad spread of local anaesthetic.[24] Rapid administration of large doses of local anaesthetic into the epidural space is not recommended. Careful titration of small aliquots of local anaesthetic allows the anaesthetist to produce the appropriate block for the proposed surgery.

Both techniques may produce significant hypotension due to a reduction in systemic vascular resistance secondary to concomitant sympathetic blockade. This may occur in spite of intravenous fluid loading,[25] and will often require administration of vasopressors. In elderly patients hypotension is poorly tolerated and may produce ischaemia of a number of vital organs including the heart, brain and kidney.

With respect to other forms of regional anaesthesia (plexus blockade, nerve blockade) no specific dose reduction is generally required in the elderly patient.

INTRAOPERATIVE CARE

In addition to providing and monitoring delivery of anaesthesia, the anaesthetist is responsible for overall patient care during the conduct of the anaesthetic. Elderly patients are at greater risk of many complications and so it is essential the anaesthetist pays attention to detail.

Osteoporosis, osteoarthritits, and reduced tissue and skin perfusion in the elderly mean they are more likely to experience position-related injury.

Intravenous fluid therapy must be closely monitored to prevent inadvertent fluid imbalance. Hypovolaemia and hypervolaemia are both poorly tolerated due to poor functional reserve of the renal and cardiovascular systems respectively. Hypovolaemia may precipitate acute tubular necrosis while hypervolaemia may lead to acute pulmonary oedema. An indwelling urinary catheter, intra-arterial line, and central venous pressure line may all assist in providing a more accurate assessment of the elderly patient's fluid balance status.

Hypothermia occurs more commonly in elderly patients undergoing either general anaesthesia or central neuraxial blockade. This is because temperature homeostatic mechanisms are not as efficient as those of younger patients.[26,27] Consequently routine temperature monitoring becomes more critical in the elderly, along with the need to actively warm the patient to maintain normothermia.

RECOVERY AND POSTOPERATIVE CARE

Recovery from anaesthesia may be substantially prolonged in the elderly if appropriate dose reductions of the various anaesthetic agents are not made and hypothermia is allowed to occur. Other causes of delayed recovery may be more common in the elderly including electrolyte disturbances secondary to diuretic therapy and hypoglycaemia in a diabetic. Cerebrovascular accident is fortunately rare but is always a potential risk in the elderly patient with underlying cerebrovascular disease who experiences intraoperative hypotension.

Postoperative Analgesia

Some alteration in pain perception occurs in the elderly due to peripheral deafferentation.[7] However, elderly patients like their younger counterparts may experience significant postoperative pain requiring administration of potent analgesics including opioids and local anaesthetics. In adults over 20 years of age the approximate average first 24-hour morphine requirements following major surgery decreases by about 1 mg per year of age.[21] However, within each age group there may be up to an 8-10 fold difference in morphine requirements.[21]

Opioids are the main form of postoperative analgesia in all age groups. Following more major surgery intravenous opioid patient-controlled analgesia is a suitable way of administering opioids to elderly patients provided they can understand the technique. Non-steroidal anti-inflammatory drugs have been shown to reduce opioid requirements by 20-40% but must be used with caution in the elderly.[21] Paracetamol is a safe and useful alternative in the elderly.

Local anaesthetic techniques including continuous epidural analgesia can provide excellent analgesia and they have an important role in specific situations.

Postoperative Cognitive Dysfunction (POCD)

A recent multicentre international study demonstrated that POCD is detectable in 25% of patients over 60 years of age one week after general anaesthesia for major surgery.[28] In the same group of patients the incidence was still 10% after three months. In this study advancing patient age was associated with an increased likelihood of developing POCD.[28] Interestingly, choice of anaesthetic technique, hypotension, and hypoxaemia were not associated with an increased risk of developing POCD.[28]

Further work needs to be done in this area particularly to determine whether POCD may be associated with CNS structural changes and permanent neurological damage.

CONCLUSION

Anaesthesia for the elderly patient offers specific challenges to the anaesthetist. Age-related physiological changes and coexisting disease produce an overall reduced functional reserve in these patients. Significant dose reduction of all general anaesthetic agents is required and the anaesthetist must display heightened vigilance during the anaesthesia and surgery. No one anaesthetic technique is considered to be preferable in the elderly, and the most important thing the anaesthetist can do is to select a suitable technique for the individual patient and perform it well.

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