Anaesthesia and the elderly

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Summary

The peri-operative management of elderly patients presents a variety of problems to the anaesthetist. These include organ dysfunction associated with the ageing process and the high incidence of serious disease affecting major organ systems. In addition, elderly patients commonly require multiple drug therapy. As such they are likely to suffer adverse drug effects and interactions, events more liable to occur in these patients as a result of both pharmacokinetic and pharmacodynamic factors. Occasionally serious interactions may occur with drugs used during anaesthesia. The importance of adequate pre-operative assessment and preparation cannot be overemphasized, as well as the need for a team approach to the management.

The elderly, arbitrarily defined as persons over the age of 65 years, constitute a significant proportion of the population, and it is estimated that over 50% of such persons will undergo a surgical procedure in their remaining lifespan. In addition, developments in patient care have allowed increasingly complex surgical procedures to be undertaken, such that it is unusual to withhold such treatment on the basis of age alone.

The administration of an anaesthetic to the elderly patient poses a variety of problems to the anaesthetist. These include organ dysfunction secondary to the ageing process, coexistent disease and concomitant drug therapy. Finally, it is as well to remember that disease may present somewhat atypically in these patients, e.g. intra-abdominal disorders. Precautions must therefore be taken to be able to deal with more extensive surgical procedures than originally anticipated, if necessary.

Deterioration of organ function associated with the ageing process affects all major systems. The primary biochemical change is thought to be defective protein synthesis and repair, whether due to wear and tear, cell mutation or toxic free radical production.1 This results in a decrease in the number of functioning cells as well as their efficiency. Thus, as ageing progresses, there are fewer nephrons in the kidney, fewer alveoli in the lungs and fewer myofibrils in muscle. These factors in themselves obviously render the patient more vulnerable to pathophysiological upsets occurring in the peri-operative period.

Pre-operative assessment

The pre-operative visit affords the anaesthetist the opportunity to assess the patient’s fitness for anaesthesia per se and, possibly of more relevance, his ability to withstand the physiological rigors of the postoperative period.

Cardiovascular function

Cardiovascular function in the elderly is invariably compromised to a greater or lesser degree. The ageing process produces impaired pump function as well as loss of elastic recoil of the vascular tree, resulting in systolic hypertension. Myocardial performance is further impaired by the high incidence of atherosclerosis in this age group. These factors result in the clinical syndromes of hypertension and ischaemic heart disease, manifested by impaired effort tolerance, angina, arrhythmias and myocardial infarction. In addition, because of changes in autoregulation of the cerebral blood flow, a higher perfusion pressure is required in the elderly to secure a given degree of brain perfusion.

During the operation, these factors result in defective blood pressure control, placing the patient at risk from both hypotension (decreased cerebral and myocardial perfusion) and hypertension (stroke, congestive cardiac failure and extension of myocardial infarction).2 These conditions must be adequately treated prior to anaesthesia and, particularly, no patient should be subjected to an elective operation within 6 months of a...
myocardial infarction. A pre-operative ECG is mandatory in all patients.

Some of these implications for the anaesthetist are presented in Table I, and the interested reader is referred to Goldman et al. for a more detailed consideration of these factors.

Respiratory function

With increasing age, a progressive diminution in the number of functional alveoli occurs, associated with loss of elastic recoil in the lungs and decreased ventilatory drive. The bellows function of the lungs is further impaired by reduced muscular power and relative stiffness of the thoracic cage. Respiratory function may be further aggravated by environmental pollution, smoking and intercurrent disease.

These effects result in an increased residual volume, a fall in functional residual capacity and a rise in closing volume, with deleterious effects on gas exchange, and account for the progressive fall in partial arterial oxygen pressure (PaO\textsubscript{2}) with advancing age. These effects are exaggerated in the supine position and postoperatively. Their relevance to the anaesthetist is presented in Table II.

Renal function

The glomerular filtration rate declines progressively with age after the 3rd decade, at the rate of ±1 ml/min/yr, with obvious implications as regards sodium and water balance and drug excretion. Care therefore needs to be exercised with intravenous fluid administration and drug dosages, notably in the case of the non-depolarizing muscle relaxants, digitalis and aminoglycoside antibiotics.

Temperature regulation

Efficiency of thermoregulation is markedly impaired in the elderly and hypothermia with its deleterious effects on cardiovascular function (arrhythmogenesis, impaired pump function) and hence tissue perfusion, is a major problem in these patients. Patient temperature should therefore be monitored as a routine, and the use of a warming blanket during the operation is strongly recommended in all major procedures.

Hypothermia may be further minimized by ensuring an adequate environmental temperature, warming of intravenous fluids, humidification and warming of inspired gases and limiting the exposed surgical field. In addition, drugs known to upset the thermoregulatory centre, e.g. phenothiazines, must be avoided.

Musculoskeletal and integumentary changes

Characteristic of the ageing process is the loss of muscular power, the development of brittle bones and the decrease in adipose tissue. As a result, difficulties may be experienced with venepuncture and bruising readily occurs. Due care must be exercised in the positioning of anaesthetized patients to avoid possible trauma and nerve compression.

Pharmacological considerations

Elderly patients are more likely to be taking multiple medications and because of defective pharmacokinetic factors (distribution, metabolism and excretion) as well as pharmacodynamic factors (altered receptor sensitivity) are more likely to experience adverse effects of drug therapy as well as adverse drug interactions.

Hypertension is common in the elderly but antihypertensive agents (and this includes β-blockers) must be continued in the peri-operative period. Blood pressure control is smoother and generally no interaction with anaesthetic agents occurs. Intra-operative bradycardia may be experienced in patients treated with β-blockers but responds to a β-agonist, e.g. isoprenaline, which may be required in increased dosage.

The risk of digitalis toxicity in the elderly precludes its use on a ‘prophylactic’ basis, and its use should be reserved for specific indications, viz. overt congestive cardiac failure and arrhythmia control. Diuretic therapy should alert the anaesthetist to the possibility of potassium depletion (which may be aggravated by hyperventilation intra-operatively) which may precipitate digitalis toxicity and relative hypovolaemia.

In the peri-operative period, diabetes mellitus is best managed using a sliding scale, remembering to reduce insulin dosages in patients normally managed on diet and oral hypoglycaemic agents. In patients with significant sepsis, little is to be gained by aiming for perfect control — this will not be achieved until sepsis has been eradicated, by surgical means if indicated.
However, surgery must not proceed until adequate hydration and correction of electrolyte disturbance and acidosis have been achieved. Oral hypoglycaemic agents other than tolbutamide carry significant risks of hypoglycaemia (chlorpropamide because of accumulation) and lactic acidosis (phenformin) and should be discontinued at least 48 hours pre-operatively.

Depression is fairly common in the elderly and monamine oxidase inhibitors, because of their adverse interactions with a wide variety of drugs, notably analgesics, must be discontinued at least 2 weeks prior to elective surgery. The tricyclic antidepressants are safe and may be substituted if necessary.

Of equal importance to the elderly patient at the pre-operative visit is reassurance. Patients fear the possible loss of their independence, so that a confident, compassionate and reassuring manner far outweighs the benefits of any premedicant drugs. Vagolytic agents, e.g. atropine, are almost never indicated and opiates, barbiturates, droperidol and hyoscine may all produce significant confusion in the postoperative period. These agents are best avoided — if any sedation is deemed necessary, a benzodiazepine derivative orally 2 hours before the operation is probably the best choice.

The importance of adequate pre-operative assessment and preparation of the elderly patient is reflected by the markedly higher mortality and morbidity in patients undergoing emergency surgical procedures.

Choice of anaesthetic technique

The administration of an anaesthetic is not in itself therapeutic but provides the conditions necessary for surgery. As anaesthetists our primary concerns are patient safety and the provision of optimal operating conditions for the surgeon, in that order.

The technique of anaesthesia selected in any given case is dependent on a variety of factors, not the least of which is the experience of the anaesthetist concerned.

All patients, irrespective of whether general or regional anaesthesia is employed, must be adequately monitored. Basic requirements include continuous ECG display, frequent measurements of temperature, pulse, blood pressure and capillary filling, as well as repeated assessment of adequacy of ventilation. More invasive monitoring, e.g. of central venous pressure (CVP) and urinary output, is necessary in major operations.

Regional techniques

Regional analgesia is strongly recommended in these phlegmatic patients, provided the anaesthetist is reasonably experienced in the chosen technique and that the latter is appropriate to the surgical procedure.

In general, regional techniques are most successful when employed for surgery on the limbs, as well as surface operations. The abdomen, e.g. field block for inguinal hernia. Intra-abdominal operations are generally not suitable, the procedures needed being technically more difficult to perform, uncomfortable to the patient and requiring a fairly high level of expertise to manage successfully.

Regional analgesia has the potential advantage of minimal cardiovascular upset, and largely avoids problems associated with drug metabolism and excretion. In addition, postoperative confusion is to a large extent eliminated, early ambulation achieved and respiratory complications minimized. However, regional analgesia is not without potential complications, some of the more important being outlined in Table III. In particular, a critical attitude towards supplementation of suboptimal blocks with intravenous sedatives must be developed. Constant vigilance must be maintained, even though the patient has had 'only a local block'.

General anaesthesia

General anaesthesia, unlike regional techniques, has the great merit that it always works. However, if the surgical procedure dictates a general anaesthetic, we need to think carefully about the method of administration.

The combination of anaesthetic agents, relative dehydration, impaired myocardial performance and poor cardiovascular reflexes renders these patients liable to develop hypotension during anaesthesia. In all but minor procedures, we strongly advocate establishing an adequate intravenous line prior to induction of anaesthesia.

Induction of anaesthesia

Induction of anaesthesia should be characterized by great care and follow a period of pre-oxygenation. Intravenous induction agents induce hypotension, primarily by causing peripheral vasodilatation, which should be treated by fluid infusion. There is little to choose between the various drugs — the choice of agent should rather be dictated by individual experience. Thiopentone has stood the test of time and is virtually free of hypersensitivity reactions. Minimal doses should be given, and adequate time allowed to elapse to assess their effects, as circulation time is often prolonged.

Maintenance of anaesthesia

Nitrous oxide/oxygen and halothane is the most widely used combination of agents and has proved its value. Especially in the elderly we need to remember its dose-related depressant effects on myocardial function and respiration. In addition, halothane may provoke arrhythmias, especially in the presence of coronary artery disease, hypoxia and hypercarbia — conditions more likely to obtain during prolonged spontaneous respiration. Clearly the choice of technique lies between spontaneous and controlled ventilation — the need for muscle relaxation, for surgical convenience, will dictate the latter.

Nitrous oxide/oxygen/halothane anesthesia with spontaneous ventilation may be provided with or without endotracheal intubation. The difficulty of maintaining an adequate airway with a mask in elderly edentulous patients renders endotracheal intubation desirable in operations lasting longer than 20 minutes. This has the added advantages of leaving a free hand to manage any additional problems, as well as allowing rapid institution of controlled ventilation if necessary. Endotracheal intubation should be performed under the best possible conditions and follow a 2-3 minute period of pre-oxygenation. Adequate intubating conditions are best achieved with the use of intravenous suxamethonium, preceded by intravenous atropine (0.6 mg) if necessary. A pressor response to

| TABLE III. COMPLICATIONS OF LOCAL ANAESTHETIC TECHNIQUE, E.G. EPIDURAL |
|--------------------------|--------------------------|
| **Toxicity secondary to agent used** |
| Hypersensitivity reaction — rare |
| High blood level — cardiovascular system and CNS: |
| (a) immediate — inadvertent intravenous injection |
| (b) delayed — relative or absolute overdose |
| **Complications secondary to procedure** |
| Misplacement of solution, e.g. |
| Intravenous injection — immediate CNS toxicity |
| subarachnoid — hypotension and respiratory depression |
| extraneural — failure of block |
| Trauma to neural tissue |
| Introduction of infection — epidural abscess, meningitis |
| Extensive block — hypotension |

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intubation often occurs but will be minimized by ensuring an adequate depth of anaesthesia prior to intubation. Intravenous fentanyl (100 μg) prior to induction is very helpful in this regard and substantially reduces the dose of the intravenous induction agent required. The use of long-acting muscle relaxants for intubation purposes must be avoided if the danger of aspiration of gastric contents is present. In addition, maintenance of a patent airway and hence effective ventilation prior to intubation may prove difficult in elderly edentulous patients. Furthermore, the effects of too large a dose of long-acting muscle relaxant may prove difficult to antagonize at completion of surgery.

The inspired concentration of halothane during maintenance of anaesthesia with spontaneous ventilation should never exceed 0.75-1.0%, in order to minimize myocardial and respiratory depression. If such depression does occur, or arrhythmias develop, ventilation must be controlled and halothane discontinued. The cause of the disturbance must be corrected and anaesthesia may then be maintained either by small doses of narcotics, e.g. morphine 1-2 mg or fentanyl 25-50 μg, or by the cautious introduction of enflurane 0.25-0.5% if available.

Controlled ventilation using nitrous oxide, oxygen and minimal halothane (at most 0.5%) is indicated when the surgical procedure demands muscle relaxation and/or in procedures lasting longer than ± 40 minutes in order to avoid progressive hypoventilation and its sequelae. Often adequate muscle relaxation can be provided by controlled ventilation alone or supplementation with small doses of narcotics. If a specific relaxant is employed, the absolute minimum should be given (1/4 to 1/3 the usual adult dose) and its effects assessed before repeating. Try and avoid giving relaxants within 30 minutes of the anticipated end of the procedure.

Besides the above advantages, controlled ventilation provides light planes of anaesthesia, so avoiding undue respiratory and cardiovascular depression during spontaneous ventilation. In our view, the risks of obtruding ventilatory drive in the recovery phase have been overemphasized; provided drugs are used judiciously, adequate antagonism of their residual effects is achieved and excessive hyperventilation is avoided.

During the operation, adequacy of tissue perfusion, as assessed by colour, capillary filling, blood pressure, pulse, CVP and urinary output must be constantly checked. Common causes of intra-operative hypotension include mechanical (intermittent positive-pressure ventilation, rapid postural changes), pathological (hypovolaemia and impaired cardiovascular reflexes) and drug therapy (anaesthetic agents) and must be rapidly corrected.

Assessment of fluid requirements is often difficult in these patients and firm guidelines are impossible to define — fluid therapy must be carefully individualized and given early. A reasonable approach would be to maintain blood pressure within 10-15% of the accepted normal pre-operative levels for elderly patients and to ensure an average urinary output of ± 1 ml/kg/h.

Indications for increased fluid administration over and above maintenance requirements (usually 1.5-2 l/24 h) include the presence of pre-operative dehydration, major surgery (because of fluid shifts) inadequate urinary output and poor tissue perfusion. The latter will be evidenced by a fall in blood pressure, tachycardia and poor capillary filling, associated with a low CVP or absence of neck vein engorgement. The response in these parameters to fluid challenges is very helpful in the assessment of further fluid requirements. Diuretics should only be used if objective evidence of fluid overload is present — not merely to encourage urine flow.

In the postoperative period, all elderly patients should receive supplemental oxygen by mask for at least 24 hours after but all the most minor procedures to prevent arterial desaturation. Judicious fluid therapy, minimal use of narcotic agents (1/4-1/3 the usual dose) and early ambulation are all important to a successful outcome.

### Conclusion

The administration of an anaesthetic to the elderly demands an awareness of the rather special problems that face these patients. Our objective should always be to reduce patient risk to the absolute minimum, a goal only achieved by attention to detail and close co-operation of medical and nursing staff.

Results of anaesthesia and surgery in elderly patients can be very gratifying and provided care is exercised, the stress of the peri-operative period is remarkably well tolerated.

### REFERENCES


