

Guidelines

Peri-operative care of the elderly 2014

Association of Anaesthetists of Great Britain and Ireland

Membership of the working party: R. Griffiths, F. Beech,¹ A. Brown, J. Dhesi,² I. Foo,³ J. Goodall,⁴ W. Harrop-Griffiths, J. Jameson,⁵ N. Love, K. Pappenheim and S. White

1 College of Emergency Medicine

2 British Geriatrics Society

3 Age Anaesthesia Association

4 Intensive Care Society

5 Royal College of Surgeons

Summary

- 1 Increasing numbers of elderly patients are undergoing an increasing variety of surgical procedures.
- 2 There is an age-related decline in physiological reserve, which may be compounded by illness, cognitive decline, frailty and polypharmacy.
- 3 Compared with younger surgical patients, the elderly are at relatively higher risk of mortality and morbidity after elective and (especially) emergency surgery.
- 4 Multidisciplinary care improves outcomes for elderly surgical patients. Protocol-driven integrated pathways guide care effectively, but must be individualised to suit each patient. The AAGBI strongly supports an expanded role for senior geriatricians in coordinating peri-operative care for the elderly, with input from senior anaesthetists (consultants/associate specialists) and surgeons.
- 5 The aims of peri-operative care are to treat elderly patients in a timely, dignified manner, and to optimise rehabilitation by avoiding postoperative complications. Effective peri-operative care improves the likelihood of very elderly surgical patients returning to their same pre-morbid place of residence, and maintains the continuity of their community care when in hospital.
- 6 Postoperative delirium is common, but underdiagnosed, in elderly surgical patients, and delays rehabilitation. Multimodal intervention strategies are recommended for preventing postoperative delirium.
- 7 Peri-operative pain is common, but underappreciated, in elderly surgical patients, particularly if they are cognitively impaired. Anaesthetists should administer opioid-sparing analgesia where possible, and follow published guidance on the management of pain in older people.
- 8 Elderly patients should be assumed to have the mental capacity to make decisions about their treatment. Good communication is essential to this process. If they clearly lack that capacity, proxy information should be sought to determine what treatment, if any, is in the patient's best interests.
- 9 Anaesthetists must not ration surgical or critical care on the basis of age, but must be involved in discussions about the utility of surgery and/or resuscitation.
- 10 The evidence base informing peri-operative care for the elderly remains poor. Anaesthetists are strongly encouraged to become involved in national audit projects and outcomes research specifically involving elderly surgical patients.

This is a consensus document produced by expert members of a Working Party established by the Association of Anaesthetists of Great Britain and Ireland (AAGBI). It has been seen and approved by the AAGBI Board.

Accepted: 25 October 2013

- *What other guideline statements are available on this topic?*

This guideline updates the 2001 AAGBI guideline *Anaesthesia and Peri-operative Care of the Elderly* [1]. Other guidelines informing the peri-operative care of the elderly include those published by the British Geriatric Society [2] and the American College of Surgeons/American Geriatrics Society [3]. The Royal College of Surgeons has published guidelines concerning emergency surgery [4] and surgery for high-risk patients [5], and the College of Emergency Medicine has produced guidelines concerning older people with urgent and emergency care needs [6], all of which are relevant to the peri-operative care of the elderly.

- *Why was this guideline developed?*

This guideline was developed to update the 2001 AAGBI guideline in light of the National Confidential Enquiry into Patient Outcome and Death's (NCEPOD's) 2010 report *Elective and Emergency Surgery in the Elderly: An Age Old Problem* [7], which, taken together with the Francis Report [8] and the Parliamentary and Health Service Ombudsman's 2011 report *Care and Compassion?* [9], indicates that peri-operative care of the elderly surgical patient is fragmented and managed poorly, resulting in potentially avoidable morbidity and mortality.

- *How does this statement differ from existing guidelines?*

This guideline is intended specifically to inform anaesthetists about best-practice management of the older surgical patient throughout the peri-operative period, as members of a multidisciplinary team. It updates the only previous specific professional guidance in this area [1].

- *Why does this statement differ from existing guidelines?*

This guideline is specific to the role of anaesthesia within the multidisciplinary peri-operative care

given to elderly surgical patients. Other relevant guidelines are either specialty-specific [4–6], disease-specific (for example, hip fracture [10]) or specific to only pre-operative assessment [3]. In common with other guidelines, this guideline reviews current evidence regarding best-practice anaesthesia, but also recommends best-practice in the numerous circumstances where evidence is controversial or incomplete, based on expert consensus opinion.

In light of the 1999 NCEPOD report *Extremes of Age* [11], the AAGBI developed its guideline *Anaesthesia and Perioperative Care of the Elderly* [1], which provided a framework for the management of patients aged over 80 years undergoing elective and emergency surgery. In 2001, when the guideline was published, ~6% of the population were aged over 75 years, and accounted for ~18% of surgical procedures performed. In 2010, the NCEPOD report *Elective and Emergency Surgery in the Elderly: An Age Old Problem* found that the care of elderly surgical patients had not improved significantly in the intervening decade [7]. Moreover, numerous reports have been published since (including the Francis Report [8] and Health Service Ombudsman's report *Care and Compassion?* [9]) that suggest that a culture of inadequate, disjointed and unsympathetic healthcare exists for elderly inpatients in the UK. This has contributed to the excess of expensive mortality and morbidity experienced postoperatively by older patients, and is of concern, given the rapidly changing demography of the population. Currently, ~8% of the population are now aged over 75 years and account for ~23% of surgical procedures performed (Fig. 1), but by 2025, ~10% of the population will be aged over 75 years, which is likely to increase the economic and clinical burdens on the National Health Service, unless the effectiveness and efficiency of surgical care can be rapidly and significantly improved for this vulnerable patient group [12].

In comparison with younger patients, older people undergoing elective and (particularly) emergency surgery are at higher risk of adverse postoperative outcomes, resulting from combinations of age-related physiological decline, multiple co-morbidity, polypharmacy, cognitive dysfunction and geriatric syndromes, including frailty. The provision of continuous, coherent, quality care to elderly patients with complex needs is difficult, but best achieved by a multidisciplinary approach involving primary care, emergency medicine, geriatricians, anaesthetists, intensivists, surgeons – and patients. The Working Party includes representation from all of these groups.

To reflect modern terminology, the concept of chronological age defining ‘older’ has been abandoned. Instead, the Working Party’s recommendations are intended to guide the provision of high-quality anaesthesia input for older people during each phase of their surgical journey. Supporting evidence for this advice is reviewed in the same *Anaesthesia* supplement in which this guideline is published.

Pathophysiology of ageing

Physiological decline is a feature of normal ageing and takes place in all organ systems at a rate of ~1% function per year after 40 years of age. Fundamentally,

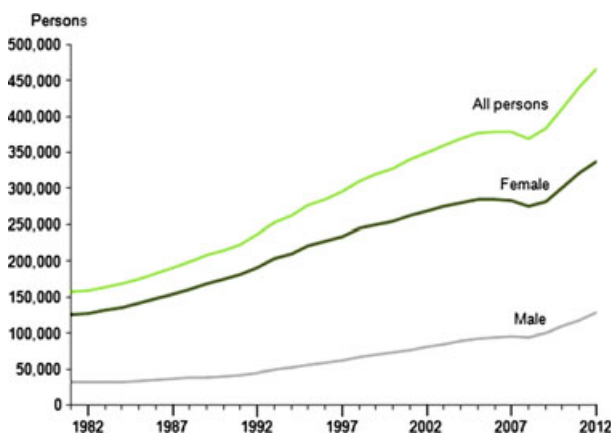


Figure 1 Population aged 90 years and over in England and Wales 1981–2012. Graph reproduced from the Office for National Statistics (see <http://www.ons.gov.uk/ons/rel/mortality-ageing/estimates-of-the-very-old-including-centenarians-/2002-2012/stbevo2012.html?format=print> under the Open Government Licence v2.0).

there is a reduction in organ reserve, which limits the physiological response to stressors, including acute illness, anaesthesia and surgery. Functional decline of the cardiovascular, respiratory, renal, central nervous, haematological/immunological and musculoskeletal systems is of greatest concern peri-operatively, and may influence outcome from elective or emergency surgery.

Cardiorespiratory systems

The inevitable physiological changes that occur in the ageing cardiovascular system are associated with changes in the autonomic nervous system, resulting in reduced cardiac responsiveness to stress [13]. A reduction in the responsiveness of beta-receptors renders the older patient effectively ‘beta-blocked’, which limits the ability to increase cardiac output and to respond to fluid losses. Cardiac output is further limited by age-related reductions in cardiac compliance. Baroreceptor dysfunction and reduced responsiveness to angiotensin II further limit the response to hypovolaemia. These factors may be compounded by co-morbid myocardial ischaemia related to atherosclerosis, and consequent cardiac polypharmacy.

Lung function declines with age due to loss of both lung and chest wall compliance, and oxygen diffusion capacity [13], more so if the patient has been a smoker. The closing volume increases, and ventilation/perfusion mismatch increases during tidal breathing when supine.

Together with an age-related decline in oxidative capacity, cardiopulmonary changes contribute to a decline in both oxygen uptake and oxygen delivery with age, rendering the patient at greater risk of peri-operative (myocardial and cerebral) ischaemia, resulting in poorer outcome.

Renal system

There is considerable variation in the decline of renal function with age, related to the nephrotoxic effects of co-morbidities (hypertension, diabetes) and drugs (particularly non-steroidal anti-inflammatory drugs and ACE inhibitors) [14]. Renal function affects the pharmacokinetics and pharmacodynamics of anaesthetic drugs, and therefore should be assessed routinely

before elective or emergency surgery in elderly patients [15].

Central nervous system

Age-related decline in cerebral and cerebrovascular function contributes to the relatively high prevalence of postoperative delirium and cognitive dysfunction experienced by elderly patients, which delays discharge and ongoing functional recovery [16].

Haematological/immunological systems

Anaemia is common in the elderly (~10%), particularly within the surgical population, and of often unexplained aetiology possibly related to erythropoietin resistance and stem-cell ageing [17]. ‘Immunosenescence’ describes the multifactorial deterioration of the immune system with age that reduces the capacity to counter infection and heal wounds, and may contribute to the development of inflammation-mediated organ dysfunction [18].

Musculoskeletal system

There is a general decline in muscle volume and function that, together with arthritic and osteoporotic skeletal changes, increases the likelihood of fragility fracture requiring orthopaedic surgery, and of impaired rehabilitation after all types of surgery. Immobility contributes to a greater prevalence of thromboembolism and pressure necrosis [19].

The surgical pathway

The peri-operative period is a continuum of inpatient care that follows outpatient diagnosis and precedes community rehabilitation after surgery, regardless of whether the patient is admitted for elective, urgent or emergency surgery. Rather than recommend management according to the urgency of surgery, the Working Party has considered clinical and organisational themes that are important throughout the peri-operative journey, and has placed particular emphasis on interventions that improve the poorer outcomes associated with emergency surgery.

In all cases, the Working Party recommends that:

- Continuity of care is best provided by the reciprocal flow of information between patients, their

relatives/carers, and primary and secondary care services [20];

- Patients who have conditions that may require future surgery, such as abdominal aortic aneurysm, should be given written information about symptoms and signs that require urgent review, and how to access this review;
- Where possible, treatment plans based on discussion between patients and senior doctors must be clearly documented in the patient’s notes in advance of hospital admission. This discussion should include proposed management of expected complications;
- Assessment and optimisation must start as early as possible, but will need to be tailored to the time available pre-operatively (longer for elective surgery, shorter for emergency surgery);
- Opportunities to optimise the patient’s pathophysiological condition must not be missed before surgery. This may involve fluid resuscitation before emergency surgery or the pharmacological manipulation of chronic co-morbidities before elective surgery.

Pre-operative care

The role of the emergency services

Ambulance personnel should be aware of age-related changes in the physiology of older patients, and appreciate how these might affect their interpretation of resuscitation protocols. For example, occult haemorrhage may not be recognised in the absence of reactive tachycardia.

Ambulance personnel are frequently able to assess the need for surgery and warn emergency departments in advance of arrival.

Priorities during ambulance transport include:

- *Analgesia*: An assessment should always be recorded of pain intensity in the conscious patient, regardless of cognitive impairment. Titrated intravenous opioids are effective, but their dose and time of administration must be recorded in writing and communicated to emergency department personnel, to minimise secondary overdose. Alternative analgesia includes (fracture) immobilisation, Entonox and paracetamol. Non-steroidal anti-inflammatory drugs should be avoided until renal function is ascertained [15];

- *Fluid resuscitation*: Hypovolaemia may result from haemorrhage, intestinal obstruction, inadequate dietary intake or diuretic medication, and can be difficult to assess. Intravenous access should be established, but the benefits of fluid resuscitation must be measured against the risks of fluid overload;
- *Warming*: Older patients may be hypothermic, related to body habitus (thin and frail), reduced temperature homeostasis and environmental factors (for example, immobility after a fall in a cool room). Core (tympanic) temperature should be measured at the scene, and active warming measures employed to normalise this to $\sim 37^{\circ}\text{C}$ [21];
- *History taking*: Ambulance personnel are often able to speak to relatives/carers, who may not travel to the hospital. Personnel should attempt to record details of pre-morbid physical and cognitive status, drug therapy and next-of-kin.

The role of the emergency department

Multidisciplinary assessment and treatment should be available around the clock for all elderly surgical patients, preferably in a distinct area of the emergency department, with the aim of time-limited onward discharge to more individually appropriate care. The College of Emergency Medicine recommends that “*given the frequent presence of complex co-morbidities in these individuals and their degree of need, early assessment and resuscitation should commence and continue in the ambulance and emergency departments. Rapid access to geriatricians, anaesthetists, intensivists and surgeons is essential to develop an early plan of intervention and provide targeted management of existing co-morbidities to decrease intra-operative and post-operative complications. Early senior decision making is also essential to provide the appropriate palliative care for people who are dying who would not benefit from invasive management*” [6].

Pre-operative assessment

Pre-operative assessment in older people enables:

- Risk-stratification, informing doctors, patients and their relatives/carers about the risks and benefits of having, or not having, surgery;

- Proactive identification and optimisation of modifiable risk factors, improving the likelihood of a successful surgical outcome [3].

‘Peri-operative risk’ defines the likelihood of an adverse outcome resulting from surgery and/or anaesthesia, and represents the sum of risk related to both the surgical procedure and the patient’s pre-morbid age and pathophysiological condition. Pre-operative assessment is more resource-efficient when targeted towards patients with higher peri-operative risk.

- *Risk related to the surgical procedure*: Observational data can be used to estimate the risk of adverse outcome after a range of surgical procedure, but are subject to operator and institution-specific variation [4]. Adverse outcomes are much more likely after emergency, rather than elective, surgery in older people [22]. Procedural risk may be reduced by using new surgical techniques, adapting peri-operative pathways to include high dependency/intensive care, or by performing a less invasive operation in the first instance to permit patient stabilisation before definitive surgery [23];
- *Risk related to the patient* [24]: Age-related physiological decline, multi-morbidity and frailty are independently associated with increased peri-operative risk. Pre-operative assessment of the higher-risk elderly patient, involving a structured multifactorial approach [25], therefore, should be undertaken by both a senior geriatrician and a senior anaesthetist with specific subspecialty training in geriatrics (depending on resources and time available).

The Working Party recommends that the components listed in Table 1 represent the minimum criteria for adequate pre-operative geriatric assessment specific to anaesthesia [3, 26–28]. Geriatricians and allied health professionals properly assess other domains, such as social circumstances, within a comprehensive geriatric pre-operative assessment.

Pre-operative optimisation of the older surgical patient

It is insufficient to undertake comprehensive assessment of the older surgical patient without also attempting to

improve his/her pre-operative health status. The benefits of pre-operative optimisation, however, must be balanced against the risks of delaying surgery to achieve these. For instance, pre-operative delay before hip fracture surgery and emergency laparotomy is associated with poorer postoperative outcome, suggesting that optimisation and surgery should take place simultaneously rather than consecutively [23].

Pre-optimisation should focus on reducing the risk of postoperative complications, namely:

- *Organ-specific morbidity*: Numerous guidelines are available concerning the peri-operative management of important co-morbidities, including diabetes, cardiorespiratory disease and anaemia. However, these should be tailored to suit the older patient, and may require more than one guideline, or conflicting guidance, to be taken into account,

along with any adverse effects relating to over-investigation or extending polypharmacy;

- *Ischaemia*: Age and disease-related declines in physiological reserve render the older patient at risk of organ-specific and generalised ischaemia. The brain and heart have an absolute requirement for oxygen, with peri-operative ischaemia increasing the likelihood of cardiac and cerebral dysfunction. Intervention, therefore, should aim to reduce oxygen uptake (analgesia, thermoregulation, antibiotics) and improve oxygen delivery (oxygen, fluids, medication review, avoidance of hypotension and severe anaemia);
- *Postoperative cognitive disorders (postoperative delirium (POD) and postoperative cognitive decline (POCD) [16]*: The process of identifying and reducing the risk of POD/POCD should begin pre-operatively. Patients are at higher risk of POD/POCD if

Table 1 Minimum components of pre-operative geriatric assessment specific to anaesthesia.

Domain	Items to be assessed	Appropriate assessment tools
Medical	Co-morbidity/severity: <ul style="list-style-type: none"> • Cardiovascular • Respiratory • Haematological • Renal • Nutritional • Musculoskeletal Previous anaesthesia Anaesthesia-specific Alcohol intake (Pain intensity) Presenting pathology	Vital signs, ECG, shuttle, CPET S_pO_2 , (pulmonary function tests) Full blood count Urea and electrolytes, estimated glomerular filtration rate Weight, body mass index, albumin (liver function tests) Assessment of potential nerve block insertion sites Enquiry after (age-related) problems Airway assessment, dentition CAGE questionnaire for alcoholism (Visual analogue pain score) Radiological
Medication	Medication review Anticoagulant therapy Relevant allergies	NSQIP pre-operative assessment Coagulation screen
Cognitive	Mental capacity Decision-making capacity Communication Risk factors for postoperative delirium	Ask 'Have you or (your carer) noticed a change in your memory?', Abbreviated mental test score Vision, hearing, speech NSQIP pre-operative assessment
Functional capacity	Gait and balance Mobility	6-metre walk Walks unaided/with stick/with frame/does not walk Housebound? (yes/no)
Use of functional aids	Visual Hearing Mobility Dentures	Glasses Hearing aids Walking stick, frame, wheelchair
Risk score	Pathology-specific Frailty	e.g. Nottingham Hip Fracture Score NSQIP pre-operative assessment

CPET, cardiopulmonary exercise test; NSQIP, National Surgical Quality Improvement Program.

they are very old, frail, cognitively impaired, or have cardio-/cerebrovascular disease and multimorbidity/polypharmacy. Early recognition should be communicated throughout the multidisciplinary care team, and facilitates multimodal interventions aimed at reducing the prevalence, severity and/or duration of POD;

- *Malnutrition:* Oral nutrition and supplementation counteract the effects of poor appetite and illness. For example, iron, vitamin B₁₂ and folate supplementation provided for subclinical nutritional anaemia at least 28 days before elective orthopaedic surgery reduces postoperative morbidity and mortality [29, 30]. Prolonged pre-operative fasting should be avoided (excepting possibly where there is intra-abdominal pathology) [31];
- *Functional decline:* Although currently there is insufficient evidence to support its use conclusively as standard practice, anaesthetists should be aware of their role in 'prehabilitation', that is, maintaining or enhancing an older patient's functional reserve to facilitate postoperative rehabilitation and discharge back into the community. This is a multimodal process that involves effective multidisciplinary communication about potential risk factors for postoperative morbidity, patient information and encouragement, enhanced recovery protocols, fluid therapy and avoidance of ischaemia, analgesia, thermoregulation, selection of the most appropriate anaesthetic technique, employment of postoperative care bundles, appropriate postoperative care planning, and avoidance of certain medications.

Decision-making

Pre-operative assessment allows for some determination of the risk to a patient of undergoing a particular intervention compared with the intended benefits. Risk scores (such as the Nottingham Hip Fracture Score [32]) are useful, but are derived from heterogeneous observational data, and often require positive or negative adjustment according to the individual patient. Furthermore, there may be a disparity between what doctors and patients view as 'risk' or 'acceptable risk'. Therefore, the manner and circumstances in which risk is communicated are important. In law, the stan-

dard of information is 'that which a reasonable patient in the patient's circumstances might want to know' [33]. In practice, this may include information about the nature, purpose, (short-term and long-term) risks and benefits of a specific procedure, an alternative procedure, or no procedure at all (conservative therapy). For older patients, the Working Party recommends that information should be provided specifically about how an intervention might affect the quantity or quality of a patient's remaining life; a pre-operative risk calculator is available for this purpose [24].

All staff involved in the care of older people undergoing surgery should be aware of their duties under the Mental Capacity Act 2005 [34], and in relation to professional guidance about 'best interests' determinations if an older patient lacks the mental capacity to make decisions [35–37]. Consultants should make decisions in relation to patients without capacity, after taking into account the expectations and known wishes of the patient, his/her relatives and/or carers.

If a patient is critically unwell, then decisions about the degree and appropriateness of intervention will need to be made, requiring input from senior surgeons, anaesthetists, intensivists, geriatricians and relatives/carers. Management of expectation is important, and the provision and intensity of postoperative support, and end-of-life care should be discussed pre-operatively.

High-risk surgery should not be carried out without a pre-operative commitment to appropriate postoperative care. Once the decision to operate has been made, appropriately experienced senior personnel should be available at all times of day to anaesthetise and operate on the patient, and organise appropriate postoperative care.

The nature of surgery

The Working Party strongly advocates senior multidisciplinary communication about the nature of surgical intervention before and during surgery. Anaesthetists must ask their surgical colleagues exactly what procedure is proposed and whether this is appropriate for the pathophysiological status of the patient, to plan anaesthesia accordingly. This may involve consideration, for example, of the type of access proposed (minimal access vs open approach), whether 'damage

control' surgery (e.g. stenting, defunctioning colostomy) [38] should be used in the first instance to allow further patient stabilisation, or whether palliative surgery is/becomes more appropriate.

Intra-operative management

Older people should expect the same level of dignity and anaesthesia care as younger adult patients [33]. Additional time may be required to allow older people to prepare themselves for surgery. Functional aids (glasses, hearing aids, dentures) should remain in place until just before the induction of anaesthesia.

Pre-operative checklist

The Working Party recommends use of a specific checklist by anaesthetists caring for patients over the age of 75 years (Table 2). It includes two sections that should be completed after the WHO Surgical Safety Checklist [39] 'sign in', before induction of anaesthesia, and 'time out' criteria, before surgical incision.

Temperature control

The importance of body temperature is often underestimated in the elderly. Peri-operative hypothermia is common, and associated with adverse outcomes that include postoperative delirium, cardiac dysfunction, prolonged hospital stay and poor wound healing [7, 40].

Elderly patients are at increased risk of hypothermia in the peri-operative period, and are more difficult to rewarm once hypothermic. Therefore, measures to maintain temperature, including regular assessment (tympanic pre- and postoperatively, tympanic/pharyngeal/oesophageal intra-operatively) and treatment (forced air warming, fluid warming) should be available peri-operatively [41], including during transport to and from theatres, and in the postoperative recovery area.

Table 2 Recommended pre-operative amendments to WHO Surgical Safety Checklist for all patients aged over 75 years.

Sign in: before induction of anaesthesia	Time out: before surgical incision
<input type="checkbox"/> Have vital signs been recorded (heart rate, blood pressure, heart rhythm, S_pO_2 , temperature)?	<input type="checkbox"/> Have possible areas of pressure damage been padded?
<input type="checkbox"/> Is the patient's resuscitation status known?	<input type="checkbox"/> What is the patient's haemoglobin concentration?
<input type="checkbox"/> Does the patient have dentures?	<input type="checkbox"/> What is the patient's eGFR?
<input type="checkbox"/> Does the patient have any pre-operative pressure sores?	
<input type="checkbox"/> Has the site of any nerve block been confirmed and marked?	

eGFR, estimated glomerular filtration rate

Monitoring

The patient should be monitored during anaesthesia according to AAGBI guidelines [42]. Additional monitoring is not used as frequently as it should be, given the greater peri-operative risk of morbidity and mortality in this patient population [7]. The Working Party recommends that anaesthetists routinely consider use of the following monitoring devices for the elderly, particularly during major or emergency surgery:

- *Intra-arterial blood pressure monitoring:* Currently, there is no internationally agreed definition of hypotension [43]; however, the 'least bad' definition is a fall in systolic blood pressure of more than 20% from pre-induction baseline, and the Working Party recommends that this is a suitable limit. Ideally, intra-arterial cannulation and transduction should commence before induction of anaesthesia, to diagnose, treat and therefore prevent the significant hypotension that can occur at this time in elderly patients. Beat-to-beat monitoring also reduces the incidence of hypotensive episodes occurring between non-invasive blood pressure measurements, and facilitates near-patient testing (haemoglobin concentration, blood glucose, arterial blood gases).
- *Central venous pressure:* There is a poor relationship between central venous pressure and blood volume, as well as poor correlation in response to a fluid challenge, particularly in elderly patients with poorly compliant ventricles and vasculature [44], potentially resulting in fluid overload. Central venous catheterisation may provide an additional route of venous access after complex surgery when vasoactive drug support or parenteral nutrition is necessary, but must be balanced against the com-

plications of such access, including insertion trauma and infection;

- **Cardiac output monitoring:** Although NICE guidelines recommend that oesophageal Doppler monitoring ‘should be considered for use in patients undergoing major or high-risk surgery’, there is limited evidence in the elderly and, especially, in emergency surgery [45]. Cardiac output monitoring using Doppler directed at the aorta (e.g. oesophageal Doppler/USCOM) may be less accurate in the elderly, as flow through a poorly compliant aorta may overestimate cardiac output, and result in insufficient fluid resuscitation [46, 47]. Use of other cardiac output monitoring technologies may also be problematic; therefore, intra-arterial blood pressure monitoring should be considered earlier in elderly unwell patients. Regardless of monitoring used, fluid therapy should be administered with great care and in divided boluses to allow assessment of response;
- **Cerebral oxygen saturation:** If episodes of cerebral oxygen desaturation ($> 15\%$) are indicative of cerebral ischaemia, then monitoring and early intervention (systolic BP $< 10\%$ fall from baseline, $S_pO_2 > 95\%$) may reduce the prevalence of POD/POCD [48], although further research is needed to confirm this;
- **Bispectral Index Monitors (BIS) or entropy monitors** should be used to guide depth of anaesthesia and sedation. The doses of anaesthetic agents required to induce and maintain general anaesthesia [49] and sedation [50] decrease with increasing age, and failure to adjust doses (which is common) can result in relative overdose and prolonged, significant hypotension [51]. Depth of anaesthesia monitors are recommended as an option by NICE “during any type of general anaesthesia in patients at higher risk of adverse outcomes. This includes ... patients at higher risk of excessively deep anaesthesia” [52]. If depth-of-anaesthesia monitors are unavailable, a Lerou nomogram (see Appendix 1) should be used to calculate the dose of inhalational anaesthesia according to age-adjusted MAC values [49]. Age-adjustment algorithms are built into the software of most new generation anaesthetic machines, and are routinely used for TIVA. A ‘triple low’ of low BIS and hypotension despite low inspired inhalational agent concentration

is associated with higher mortality and prolonged inpatient stay [53].

- **Peripheral nerve stimulation:** Pharmacokinetic and pharmacodynamic changes in the elderly can result in unpredictably prolonged neuromuscular blockade, suggesting that neuromuscular function monitoring should be used routinely for patients administered neuromuscular blocking agents [54, 55].

Fluid and electrolyte management

Fluid and electrolyte therapy is challenging in older surgical patients. Pathophysiological changes in elderly patients reduce homeostatic compensation for blood/fluid loss, but also for boluses of administered intravenous fluids. Prolonged pre-operative fasting should be avoided, with clear fluids normally allowed up to 2 h before surgery to avoid dehydration. High-risk patients undergoing major surgery appear to benefit from ‘restrictive’ fluid therapy that avoids hypovolaemia by administering enough fluid to replace pre- plus intra-operative losses [7, 11, 56]. Neither GIFTASUP [57] nor NICE [58] guidance is specific to fluid therapy in older patients.

Blood transfusion

Pre-operative and postoperative anaemia are common in the older surgical patient, and are associated with myocardial ischaemia, falls, poor wound healing and rehabilitation. However, there is a lack of evidence specific to the elderly surgical population about when and how much to transfuse to optimise haemoglobin concentration without incurring transfusion-related complications.

Observational data suggest that patients aged > 65 years have higher mortality after major non-cardiac surgery if there is ‘substantial’ operative blood loss or they have a pre-operative haematocrit $< 24\%$, but lower mortality if pre-operative haematocrit is $30\text{--}36\%$, and operative blood loss is < 500 ml [59]. It is hoped that peri-operative transfusion requirements in elderly patients are addressed by the forthcoming NICE guidelines, due to be published in May 2015.

Positioning

Positioning of the patient on the operating table must be sympathetic to his/her musculoskeletal condition,

and take into account, for example, kyphoscoliosis, arthritic joints and fixed flexion deformities. Functional splints should not be removed, if practicable.

Older patients are at higher risk of (preventable) peripheral nerve injuries during prolonged surgery, including the ulnar nerve when supine, the common peroneal nerve in lithotomy, the dependent radial nerve in the lateral position and the brachial plexus after prolonged periods of lateral neck flexion. Lower limb compartment syndrome can result from the lithotomy position, or prolonged intra-abdominal insufflation or pelvic surgery. The Working Party recommends that probable sites of nerve injury are comprehensively padded before the start of surgery, and assessed routinely every 30 min throughout surgery.

Elderly skin can be friable. Care should be taken when transferring the patient between his/her bed and the operating table, and when removing adherent items from the patient, for example, diathermy pads, tape holding the eyelids closed and surgical dressings. Similarly, friable skin is more prone to thermal damage, hence care should be taken with contact warming devices. Hair should not be removed with a razor.

Reduced skin depth and vascularity, together with reduced muscle mass, predispose the older patient to (preventable) tissue pressure necrosis, usually over bony protuberances, such as the heel. Prolonged hypotension may contribute to the development of pressure necrosis. 'Pressure sores' interfere with functional recovery, may be complicated by infection and pain, and contribute to delayed discharge.

Positioning, together with appropriate fluid therapy and antithrombotic measures, reduces the risk of peri-operative thrombo-embolism in the elderly [19].

Type of anaesthesia

The choice of anaesthesia – regional or general – appears to be of less importance than how sympathetically it is administered with regard to the patient's pathophysiological status. Observational studies and meta-analyses do not reliably show any significant difference in outcome between regional and general anaesthesia, but this may be because the outcomes measured are not specifically related to anaesthesia (e.g. 30-day mortality, length of stay [22, 24] or because regional anaesthesia is seldom administered

without sedation. The choice of technique, therefore, should be made according to the individual patient.

Intuitively, sympathetically administered regional anaesthesia, particularly with minimal/no sedation, would appear to offer some benefit in terms of avoiding short-term morbidities, including hypotension, delirium, cardiorespiratory complications and the need for opioid analgesia [60–62]. However, patients with cognitive dysfunction may not be able to comply with regional anaesthesia without heavy sedation, negating the benefits of avoiding the postoperative cognitive effects of general anaesthesia [63].

Age-related alterations in the pharmacokinetic and pharmacodynamic profiles of all anaesthetic agents render the older patient sensitive to relative overdose, resulting in myocardial depression, reduced blood pressure homeostasis and delayed recovery [64]. Particular care should be taken with hypnotic agents: the dose required to induce anaesthesia is lower, and the onset time longer [55]. Depth of anaesthesia monitoring is recommended.

End-of-surgery checklist

The Working Party recommends use of a specific checklist by anaesthetists caring for patients over the age of 75 years (Table 3) undergoing major and/or emergency surgery. It should be completed after the WHO Surgical Safety Checklist [39] 'sign out', before the patient leaves the operating theatre for the recovery area.

The Working Party supports the routine use of a specific end-of-surgery bundle for older patients undergoing emergency laparotomy (Table 4) [5].

Table 3 Recommended postoperative amendments to WHO Surgical Safety Checklist for all patients aged over 75 years.

Sign out: before patient leaves the operating theatre

- What is the patient's core temperature?
- What is the patient's haemoglobin concentration?
- Have age-adjusted and renal function-adjusted doses of postoperative analgesia been prescribed?
- Has a postoperative fluid plan been prescribed?
- Can the patient be returned safely to a general care ward?

Postoperative care

Definitions of levels of postoperative care are shown in Table 5 [5]. It is recommended that all patients with a predicted peri-operative mortality of more than 10% should be admitted to a level 2 or 3 critical care facility [5]. However, the Working Party recognises that, although access to critical care should not discriminate on the basis of age, there is a chronic mismatch between the number of beds needed to satisfy the 10% recommendation and the actual number of beds available, with no imminent prospect of the number of beds increasing significantly in the UK. Pragmatically, therefore, the Working Party recommends that anaesthetists routinely risk assess older patients towards the end of surgery with regard to the level of postoperative care they require, discharging patients into critical care facilities if this is likely to reduce morbidity or mortality significantly, or if identifiable organ support is required.

Anaesthetists are instrumental in reducing the need for, or required duration of, postoperative care, through appropriate intra-operative management of anaesthetic drug administration, blood pressure,

Table 4 Summary of end-of-surgery bundle for older patients undergoing emergency laparotomy.

Towards the end of surgery

1. Risk score (P-POSSUM) to decide on final patient destination (ward/high dependency/intensive care)
2. Measure lactate or base deficit
3. Assess fluid requirements
4. Assess \pm reverse neuromuscular blockade
5. Assess temperature

Table 5 Levels of postoperative care.

Level	Description	Patient characteristics
0	Ward	Basic observations
1	Enhanced ward	At risk of deterioration, more frequent observations, basic resuscitation
2	High dependency	Needs detailed observation, intervention or single organ support
3	Intensive care	Multiple organ support, complexity

patient temperature, fluid therapy and analgesia. Despite optimum management, however, patient pathophysiology may demand critical care admission. If this cannot be provided immediately, then postoperative care should be provided in the postoperative care unit (PACU), to a critical care standard and by suitably experienced personnel. The Working Party supports the discontinuation of an operating list (if appropriate) if anaesthetic personnel are required to provide such care in PACU, until such time as the patient can be transferred for definitive critical care.

Assessment of fitness for discharge from PACU is the decision of the responsible anaesthetist, and should take into consideration the patient's vital signs, temperature, urine output, pain and cognitive status. Good documented communication is essential to ensure the continuation of appropriate postoperative care.

The elements of good peri-operative care continue into the postoperative period, and are aimed at avoiding complications and re-enabling the patient. These include analgesia, maintenance of core temperature, fluid therapy and pressure care. Basic monitoring should be continued upon return to the ward, with all hospitals ensuring employment of Modified Early Warning Scores and provision of Critical Care Outreach teams [65].

Pain management

Inadequate analgesia for elderly surgical patients contributes to postoperative morbidity, including delirium [66], cardiorespiratory complications [67] and failure to mobilise [68]. Despite the general acknowledgement of this fact, postoperative pain is poorly assessed [69] and treated [70] in the elderly, particularly in patients who are cognitively impaired [69, 71]. Older people may also be more reluctant to acknowledge and report pain.

The 2007 British Pain Society/British Geriatrics Society guidelines include an algorithm for pain assessment in older people of all cognitive abilities (Appendix 2) [69].

The use of peri-operative analgesia protocols is recommended, and improves patient satisfaction [72], but must be individualised for each patient, to take into account, for example, his/her chronic pain status,

frailty, pain assessment, concurrent medication, renal function and cognitive impairment [73, 74].

Multimodal analgesia is not restricted to pharmacological agents, and may involve, for example, postural support, pressure care and patient warming. Nerve blockade is effective, if not always reliable [64]. Paracetamol is safe and should be considered first-line therapy.

Non-steroidal anti-inflammatory drugs should be used with caution if paracetamol is ineffective, and at their lowest doses and for the shortest duration, with proton pump inhibitor gastric protection and routine monitoring for gastric and renal damage.

Morphine is effective, but should be administered (for moderate or severe pain) cautiously, particularly to patients with poor renal or respiratory function, and the cognitively impaired; consideration should be given to the co-administration of laxatives and antiemetics, as required.

Anaesthetists should be familiar with which medications are potentially inappropriate for use in older patients according to Beers Criteria [75].

Postoperative delirium and postoperative cognitive dysfunction

The process of identifying and reducing the risk of POD/POCD should continue postoperatively [16]. Recovery room delirium is a strong predictor for postoperative delirium [76], and so the recovery area is an appropriate area for delirium testing [77]. High-quality peri-operative care reduces the incidence of delirium [78]. NICE recommend that DSM-IV (Diagnostic and Statistical Manual of Mental Disorders) criteria or short-CAM (confusion assessment method) are used to diagnose delirium [16]. Drugs that precipitate delirium, and that should therefore be avoided if possible in patients at risk, include benzodiazepines, opioids, antihistamines (including cyclizine) [79], atropine [80], sedative hypnotics and corticosteroids [75].

Nutrition

Nutrition should be continued from the pre-operative period or instigated early after surgery to improve wound healing and recovery; supplementation may be required. Anaesthetists can facilitate enteral nutrition by delivering age-appropriate anaesthesia and appropriate fluid therapy, avoiding reliance on postoperative

opioid analgesia, and preventing postoperative nausea. Enteral nutrition improves outcome compared with parenteral nutrition in the elderly [81].

Re-enablement after surgery

'Re-enablement' describes patients' return to their pre-operative level of function, and extends beyond mobilisation or rehabilitation. Anaesthetists contribute peri-operative components to the multidisciplinary process of a patient's re-enablement by providing appropriate care, important elements of which have been repeatedly emphasised above: age-appropriate anaesthesia; fluid therapy; thermoregulation; analgesia; communication; and risk assessment.

Ethicolegal issues

A stark conclusion common to many recent reports is that hospital care disregards the dignity of older patients [7–9]. This may contribute to poor continuity of care and outcome and is symptomatic of a low-quality culture of healthcare provision. Professional leadership is required to reverse these attitudes, and anaesthetists, as peri-operative physicians, are ideally suited to managing such a change. The Working Party strongly recommends that a consultant anaesthetist within each NHS Trust is appointed Lead Clinician for Geriatric Anaesthesia, and is encouraged to act as an 'older person's champion' within the operating department, responsible for improving the dignity and quality of care received by older patients undergoing surgery.

Issues concerning mental capacity and decision-making are discussed above. These are also of importance in discussing end-of-life care with patients or their relatives/carers, when further intervention is considered either futile or high-risk to the extent that resuscitation wishes need to be considered [33]. The Working Party recommends that all anaesthetists familiarise themselves with professional guidance about end-of-life care [36, 82], and, if in doubt about their professional and legal obligations, contact their hospital's legal representative for advice.

Research and Audit

A recurring theme in guidelines (including this document), reports, systematic reviews and meta-analyses of

peri-operative care for elderly patients concerns the lack of specific evidence on which to provide high-quality care [22], most being extrapolated from research involving younger surgical patients. This does not preclude the benefit of formulating guidelines with the aim of informing improvements in treatment where there is diversity in practice and outcome [83]. However, the Working Party strongly recommends that the evidence base for peri-operative care of the elderly is improved, and urgently. Randomised, controlled trials, although important, are of less relevance to assessment of multimodal interventions for elderly patients, and before-and-after interventional studies and observational studies may yield at least as much information.

To this end, the Working Party recommends that anaesthetists:

- Participate in national audit initiatives, including, for example, the National Emergency Laparotomy Audit [23] and the National Hip Fracture Database [10], to ensure the accuracy and completeness of submitted data;
- Develop and assess the performance of quality improvement metrics for elderly patients [84, 85];
- Undertake continuous quality improvement, as outlined in *Raising the Standard: a Compendium of Audit Recipes* [86] (especially sections 1.7, 1.10, 2.7, 3.4, 4.1–4.4, 4.7, 4.9, 11.3–11.6) and seek to adapt these specifically for elderly patients.

Resources for training

The Working Party recommends that the frail elderly are anaesthetised only by a senior anaesthetist with appropriate training and expertise in geriatric anaesthesia. However, given the anticipated increases in the number of elderly patient expected to require surgery in future, the Working Party recognises that the current pool of ‘geriatric’ anaesthetists is insufficient to fulfil this recommendation. The Working Party, therefore, strongly recommends that geriatric anaesthesia is specifically taught as a training module to anaesthetists in training, and that peri-operative care of the elderly surgical patient is included within the training curricula of UK and Irish medical schools, the Royal Colleges of Anaesthetists, Surgeons and Physicians [87] and the College of Anaesthetists of Ireland.

Additional resources for doctors, patients and carers

A number of documents are available that describe what elderly patients are entitled to expect from their inpatient care, and inform doctors about how to provide dignified, quality care for elderly surgical patients. These include:

- 1 The Royal College of Surgeons document *Access All Ages. Assessing the Impact of Age on Access to Surgical Treatment* makes recommendations about how to improve access for older people who need surgery by promoting age equality [88];
- 2 The Department of Health’s *National Service Framework for Older People* sets quality standards for health and social care, ensuring that older people are treated with respect and fairness [89];
- 3 The Centre for Policy on ageing’s *Ageism and Age Discrimination in Secondary Health Care in the United Kingdom* found that age discrimination in UK hospitals was rare after the introduction of the National Service Framework, but that further work needed to be done educating staff about ageism [90];
- 4 The NHS Confederation’s *Delivering Dignity. Securing Dignity in Care for Older People in Hospitals and Care Homes* sets out recommendations on how to tackle the underlying causes of poor care of the elderly in hospitals and in care [91];
- 5 House of Lords and House of Commons Joint Committee on Human Rights has examined how the principles of *The Human Rights of Older People in Healthcare* might be applied to ensure that older people in hospital are treated with greater dignity and respect [92];
- 6 The Patients Association report *Listen to Patients, Speak up for Change* urges hospital staff, patients and carers to bring poor NHS care to the attention of senior hospital managers, the Department of Health and government [93];
- 7 The King’s Fund has emphasised the importance of maintaining the continuity of care when hospital inpatients are admitted from, and discharged back to, the community, in *Continuity of Care for Older Hospital Patients. A Call for Action* [20].

Acknowledgements

The working party acknowledges the assistance of Dr. John Carlisle, Torbay Hospital, and Dr. Andrew Klein, Papworth Hospital.

Competing interests

RG chaired the AAGBI Hip Fracture Guidelines Working Party, was a member of the NICE guideline development group for CG124, and founded the Hip Fracture Perioperative Network; he is also Honorary Secretary of the AAGBI. SW is a member of the AAGBI Hip Fracture Guidelines Working Party, advised NICE during development of CG124, is a Council member of the Age Anaesthesia Association (whom he represents at the NHFD), is national research coordinator for the Hip Fracture Perioperative Network, and is an Editor of *Anaesthesia*. IF has lectured on geriatric anaesthesia on behalf of Baxter Healthcare. No other external funding or competing interests declared.

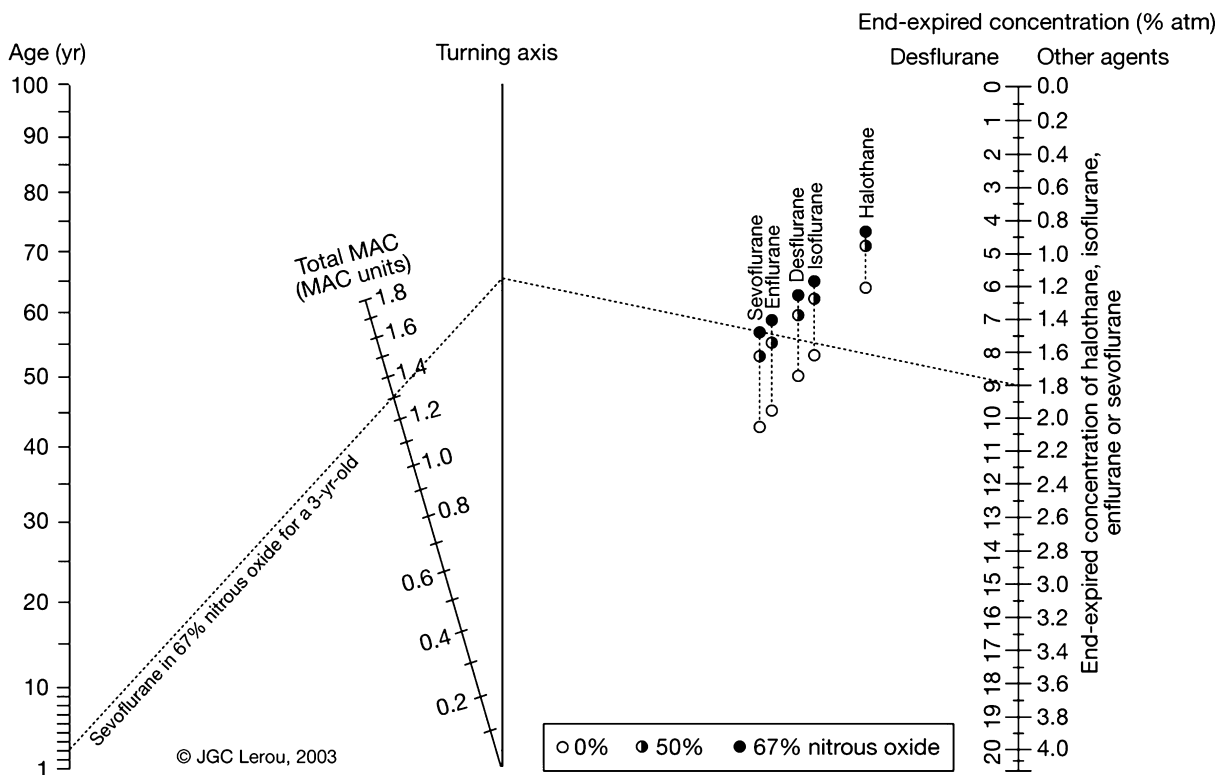
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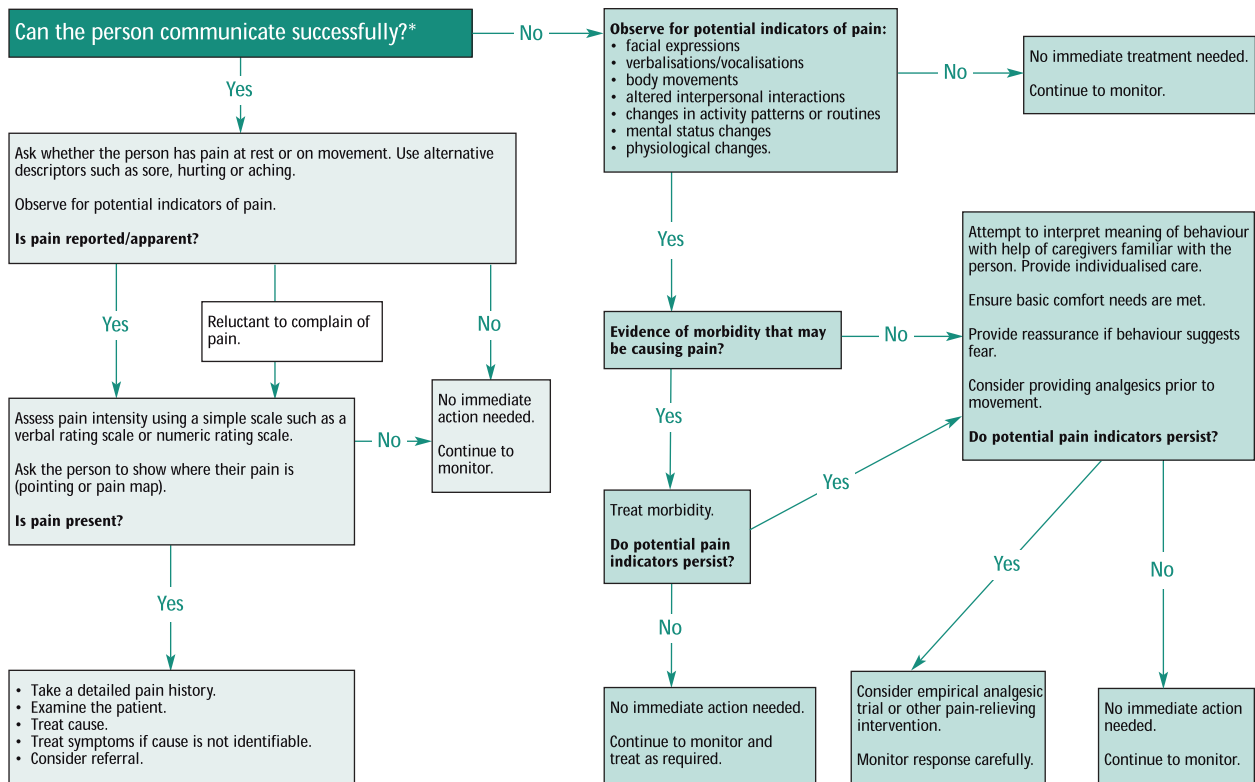
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Appendix 1



Lerou nomogram [49] relating age, total MAC expressed in MAC units, and end-expired concentrations of volatile agent and nitrous oxide. A result is found by drawing two straight lines. Example (dotted lines): if the measured end-expired concentrations of sevoflurane and nitrous oxide are 1.8% and 67% (at 1 atm), respectively, then the total age-related MAC is 1.3 in a 3-year-old. Reverse example: a total MAC of 1.3 in a 3-year-old, when using sevoflurane and nitrous oxide 67% in oxygen, requires an end-expired sevoflurane concentration of 1.8%. © 2004 Oxford University Press. Reproduced with permission [49].

Appendix 2



*If there is doubt about ability to communicate, assess and facilitate as indicated in Recommendations 4 and 5 of the Guidelines.

Royal College of Physicians/British Pain Society/British Geriatric Society. Algorithm for the assessment of pain in older people (Copyright © 2007 Royal College of Physicians. Reproduced with permission) [70].