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Review Article

Peri-operative optimisation of elderly and frail patients: a narrative review

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Summary

With increasing life expectancy and technological advancement, provision of anaesthesia for elderly patients has become a significant part of the overall case-load. These patients are unique, not only because they are older with more propensity for comorbidity but a decline in physiological reserve and cognitive function invariably accompanies ageing; this can substantially impact peri-operative outcome and quality of recovery. Furthermore, it is not only morbidity and mortality that matters; quality of life is also especially relevant in this vulnerable population. Comprehensive geriatric assessment is a patient-centred and multidisciplinary approach to peri-operative care. The assessment of frailty has a central role in the pre-operative evaluation of the elderly. Other essential domains include optimisation of nutritional status, assessment of baseline cognitive function and proper approach to patient counselling and the decision-making process. Anaesthetists should be proactive in multidisciplinary care to achieve better outcomes; they are integral to the process.

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Introduction

Global life expectancy has been increasing over the last few decades. In the UK for example, the proportion of population aged 65 or above is expected to increase from 16.9% to 24.7% between 2006 and 2046 [1], and provision of healthcare is one of the biggest concerns with this change. In the past, major surgery was seldom performed on patients older than 80 years. With advancements in surgical techniques and peri-operative care, surgery may be a viable treatment even at very advanced age [2]. Although chronological age itself predicts surgical outcome poorly, age-related decline in physiological reserve and functional capacity are inevitable, and affect all organ systems. When people live longer, more comorbidities appear; this will result in higher rates of peri-operative morbidity and mortality. This is already imposing a significant burden on healthcare systems, by increasing both the utilisation of intensive care facilities and length of hospital stay [3, 4]. Therefore, it is imperative to deliver both high-quality and efficient peri-operative care for elderly patients.

The 'elderly' represent a unique group of patients, with many challenges for the peri-operative care team. In this article, we review the following aspects of anaesthesia in the elderly: (1) the role of comprehensive geriatric assessment and innovative models of care; (2) the implications of frailty and its assessment; (3) the assessment and optimisation of nutritional status; (4) the assessment of neurocognitive dysfunction; and (5) patient counselling and approach to decision-making.

Comprehensive geriatric assessment and innovative models of care

Comprehensive geriatric assessment is an established method for evaluating and optimising physical, psychological, functional and social issues in elderly patients to improve long-term outcomes [5]. It involves a multidomain assessment, which necessitates collaboration from multidisciplinary teams in planning and implementing investigations and treatment, as well as arranging discharge and follow-up plans. Table 1 lists the main components of comprehensive geriatric assessment. This requires collaboration between all those involved in the peri-operative pathway, including anaesthetists, surgeons, geriatricians, nurses, therapists and dieticians [6]. Systematic review has confirmed its role in enhancing postoperative outcomes in elderly patients undergoing elective surgery [5].

Various care models have evolved, but none have proven to be superior to others because the setup, as well as the efficacy, is influenced by local resources, population distribution, the specific facilities of certain centres and available expertise [7]. We will describe some examples of well-known models.

Table 1 Components of comprehensive geriatric assessment.

Domain	Items to be assessed
Medical	Comorbid condition and diseases severity
	Medication review
	Nutritional status
Mental health	Cognition
	Mood, anxiety and fears
	Decision-making capacity
	Risk factors for postoperative delirium
Functional capacity	Activities of daily living
	Gait and balance
	Activity/exercise status
	Use of visual, hearing, mobility aids, dentures
Social circumstances	Informal support from family or friends
	Social network such as visitors or daytime activities
	Eligibility for receiving care resources
Environment	Home comfort, facilities and safety
	Transport facilities
	Accessibility to local resources
Risk score	Pathology-specific, for example, Nottingham Hip Fracture Score
	Frailty scores

Some services can be described as geriatrician-led. Here, pre-operative comprehensive geriatric assessment is provided by a consultant geriatrician-led multidisciplinary team, who liaises with the surgical teams about peri-operative medical care, focusing on functional optimisation and discharge planning for both emergency and elective patients. Examples of this model include the Pro-active care of Older People undergoing Surgery service at Guy's and St Thomas' NHS Foundation Trust [8] and the Systematic Care Older Patients undergoing Elective Surgery at Nottingham University Hospitals NHS Trust [9].

Other services are led by anaesthetists. In this model, patients are triaged based on predicted peri-operative risk of mortality. Those at higher risk will attend an anaesthetist-led clinic, where the anaesthetist will stratify the risk in detail by assessing patients' functional reserve, either by clinical assessment, or with objective physiological tests such as cardiopulmonary exercise testing. They will then discuss with the patients and their families about risks and benefits of surgery based on the assessment result. The clinic is supported by different streams of healthcare professionals providing expert advice and support. An example of this model is the Torbay Pre-operative Preparation Clinic, South Devon Healthcare NHS Foundation Trust [10].

Other models of care include peri-operative optimisation of senior health developed at Duke University School of Medicine [11], and the Michigan Surgical Home and Optimisation Program developed at the University of Michigan [12].

Frailty and its peri-operative implications

Traditional surgical risk assessment tools are typically organ specific. A classic example is the Goldman Cardiac Risk Index, which was published in 1977 [13]. Subsequently, various risk tools have been developed for predicting adverse outcomes in different organ systems such as pulmonary [14], renal [15] and neurological [16].

There is a growing interest in integrating concepts drawn from gerontology to peri-operative care of the elderly. Specifically, frailty has been used to provide additional prognostic insight for elderly patients not captured by organ-based risk scoring systems. 'Frailty' is defined as a state of high propensity for adverse health outcomes, including disability, dependency, falls, need for long-term care and mortality [17]. It is an age-related, progressive decline in multiple physiological reserves that results in diminished resilience, loss of adaptive capacity, and increased vulnerability to stressors [18]. Therefore, it is not surprising that frailty has been associated with adverse

postoperative outcomes, including postoperative medical complications, prolonged hospitalisation, institutionalisation, readmission and short- and long-term mortality [17, 19–21].

The prevalence of frailty is greater among women and increases with age. It is seen in 40% of patients aged 80 years or older (vs. 10% for those aged between 65 and 75) [22]. It is vital to assess frailty to predict the risk of adverse postoperative outcomes. Notably, the American College of Surgeons National Surgical Quality Improvement Program/American Geriatrics Society (ACS NSQIP/AGS) 2012 *Guidelines for the optimal pre-operative assessment of the geriatric surgical patient* outlined frailty assessment as a critical component in the pre-operative setting [23]. Moreover, the AGS and the National Institute on Aging published a major consensus statement in 2015 on '*Frailty for specialists*', which highlighted the importance of incorporating frailty assessment into the pre-operative journey [18].

Despite these guidelines and consensus, there is no single generally accepted definition of frailty. The two most commonly studied frailty assessment tools are the 'phenotypic' model and the 'deficit accumulating' model.

In 2001, Fried et al. first developed and operationalised a standardised phenotype of frailty, using data from over 5300 men and women over age 65 in the Cardiovascular Heart Study [17]. They proposed that frailty is a distinct clinical syndrome driven by the ageing process (including mitochondrial dysfunction, cellular senescence etc.), which contributes, along with comorbid diseases, to a pernicious cycle of frailty associated with sarcopenia and declining energetics and reserve. This phenotypic model encompasses decreased strength, decreased walking speed, low physical activity, self-reported exhaustion and unintentional weight loss (Table 2). It is a powerful prognostic tool for falls, incident disability, worsening mobility, hospitalisations and death. However, it does not account for changes in cognition or mood. Although this frailty evaluation is recognised by the ACS/AGS guidelines, subsequent authors have called for future work focused on the development of scales specific to the surgical population [18].

Table 2 Frailty phenotype [17].

Characteristic of frailty	Measurement
Weakness	Grip strength: lowest 20% (by sex, body mass index)
Slowness	Time taken to walk 15 feet: slowest 20% (by sex, height)
Low level of physical activity	kcal.week^{-1}: lowest 20% Men: < 383 kcal.week^{-1} Women: < 270 kcal.week^{-1}
Exhaustion, poor endurance	'Exhaustion' (self-report)
Weight loss	Unintentional weight loss > 10 lb in prior year

'Positive' for frailty phenotype: ≥ 3 criteria present. Pre-frail: 1 or 2 criteria present. Robust: no criteria present.

Another method to evaluate frailty utilises the deficit accumulation model, which is also known as the Rockwood Frailty Index. It was developed from the Canadian Study of Health and Aging by incorporating a predefined set of 70 clinical deficits in the domains of comorbidities, mood disorders, cognition, functional status and nutrition, with the likelihood of being frail increasing with the accumulation of more deficits [20, 24]. The frailty index is expressed numerically by dividing the number of deficits found by the number of potential deficits. This approach states that frailty is the result of an age-associated accumulation of health deficits and the more deficits an individual has, the greater their risk for an adverse outcome. It is a continuous variable and can stratify those with moderate to severe frailty more precisely than the categorical phenotypic model [25]. It has been applied to various elderly populations being exposed to stresses, and has been shown to be strongly predictive of mortality and other adverse outcomes.

Both the phenotypic model and the deficit accumulating model have invited criticism because their performance is time consuming and labour intensive when included in routine pre-operative assessment. Particularly, the Fried frailty criteria require the use of special equipment such as a dynamometer and the measurement of gait speed, whereas the original Rockwood Frailty Index requires assessment of 70 potential clinical deficits. Both models have been modified and studied in surgical populations. For instance, Huded et al. utilised modified Fried frailty assessment to predict the risk of institutionalised discharge in patients undergoing transcatheter aortic valve implantation [26]. Robinson et al. revealed six strong predictors for both 6-month mortality and post-discharge institutionalisation in patients undergoing major general, thoracic, vascular and urologic surgery [27]. Further work by the same group has demonstrated the ability of frailty scoring to forecast adverse outcomes in patients after elective colorectal and cardiac operations [28, 29]. Farhat et al. measured 11 deficits, which are collected as part of the ACS NSQIP, out of the 70 deficits in the initial Rockwood study, to create the modified frailty index. They demonstrated its high predictive value for both postoperative 30-day mortality and postoperative infection in over 35,000 patients undergoing general surgery [30].

The same index was applied to over 230,000 patients undergoing orthopaedic, vascular and general surgery, and was found to be predictive of postoperative complications and 30-day re-admissions [31].

The Clinical Frailty Scale was developed to enable frailty measurement in the outpatient setting [32]. It is a semi-quantitative tool that stratifies the elderly according to their relative degree of vulnerability using simple clinical descriptors [20]. It provides a global score ranging from 1 (robust health) to 9 (terminally ill). It is an attractive tool as it is simple and can be completed by any trained staff.

The Edmonton Frail Scale (EFS) [33] is a 17-point scale validated for use by non-geriatricians that can be completed within 5 min. The scale incorporates 10 domains, including medication use, cognitive impairment, balance and mobility. The 'get-up-and-go' test of the EFS has been shown to predict morbidity and mortality across surgical specialties [34]. Although the test is not applicable in emergency operations, it is valuable in the anaesthetic assessment clinic.

Undoubtedly, frailty is associated with adverse surgical outcomes [26, 35–37] but the recognition of frailty is only useful if it can modify peri-operative care and improve outcomes. At the anaesthetic clinic, we can discuss anticipated outcomes with patients and their families based on the magnitude of the frailty score and co-existing morbidities. This can enable them to have an insight into what could happen, and helps plan the subsequent care and location of subsequent care on discharge from hospital. In terms of surgical planning, for the frailest patients, we can advise surgeons to adopt the least invasive approach, or even consider a staged or 'damage control' approach, so as to minimise the stress induced by major surgery. In all circumstances, anaesthetists play an important role in initiating an appropriate level of monitoring, choosing and titrating anaesthetics meticulously intra-operatively [38], as well as maintaining normothermia, which can help to minimise complications for the most vulnerable.

Unfortunately, there is still a lack of evidence that frailty can be attenuated or reversed once it is established, although supervised exercise training programmes before surgery may improve mobility and functional ability in selected cases. Other adjuvant interventions include nutritional screening, red cell mass optimisation [39] and correction of sarcopenia (discussed later in this article). Further large-scale, multi-centre studies are required to determine what peri-operative programme will be most useful in minimising the deleterious impact of frailty on peri-operative outcomes.

Assessment and optimisation of nutritional status

Malnutrition is a strong independent predictor of higher peri-operative mortality, morbidities, length of hospital stay and re-admission rates. It thus increases the burden on healthcare systems [40–43]. The American Society for Enhanced Recovery and Peri-operative Quality Initiative (ASER/POQI) summarised the current challenges of peri-operative nutrition screening and therapy [40]. Two out of three patients undergoing gastrointestinal surgery are malnourished, which renders them three times more likely to suffer from complications and five times more likely to die. However, only around one-fifth of hospitals have a formal nutrition screening programme, and only one out of five patients receives nutritional support. The majority of surgeons believe peri-operative nutritional optimisation will reduce complication rates. It has also been shown that for every one unit of currency spent on nutrition therapy in hospitalised patients, 52 units will be saved in hospital costs. The group has also highlighted the urgent need to improve peri-operative nutrition assessment and interventions.

The European Society for Clinical Nutrition and Metabolism 2017 guidelines emphasised the importance of nutritional screening and interventions in enhanced recovery pathways [44]. They defined malnutrition as a body mass index (BMI) less than 18.5 $kg.m^{-2}$. Also, patients who sustained weight loss of more than 10% (or 5% within 3 months), in addition to low BMI or low fat-free mass index also fulfilled the diagnostic criteria of malnutrition. For older patients, a higher cut-off for BMI is preferred because research indicates that the risk for all-cause mortality increases starting at a BMI of 24 $kg.m^{-2}$ for the aged population, and doubles when BMI is < 22 $kg.m^{-2}$ for men and < 20 $kg.m^{-2}$ for women [45].

The ASER/POQI developed and proposed a peri-operative nutrition screening algorithm based on patient's BMI (cut-off at 18.5, or 20 if age > 65 years), recent weight loss more than 10% in 6 months, reported recent decreased oral intake and pre-operative hypoalbuminaemia (cut-off at 3 $g.dl^{-1}$) [43]. Checking serum albumin levels is inexpensive and routinely available, and represents a strong predictor of surgical risk and mortality. Its use as an indicator of malnutrition has been criticised because it is neither specific nor sensitive [46]. However, until a better marker is available, albumin level is still recommended as a component of the peri-operative nutrition screen.

Patients at high risk of malnutrition should be referred to a dietician for a comprehensive nutritional assessment [43, 44, 47]. Nutritional therapy is indicated in patients with, or at risk of, malnutrition. It should also be initiated if the

patient will not be able to have adequate oral intake for more than 5 days peri-operatively [43]. In principle, oral nutritional supplements should be considered before tube feeding, unless contraindicated. If oral and enteral routes are impossible, intolerable or inadequate (< 50% recommended protein/caloric requirement achieved), then parenteral nutrition is recommended. Oral nutritional supplementation, particularly with high protein content, can reduce the risk of developing pressure ulcers in the elderly. Achieving a goal of overall protein intake > 1.2 $g.kg^{-1}.day^{-1}$ is more important than achieving a total calorie intake.

Unnecessary prolonged pre-operative fasting should be avoided. In patients with minimal risk of aspiration, unrestricted access to solids and clear fluids should be allowed up to 6 h and 2 h, respectively, before anaesthesia. A pre-operative drink containing at least 45 g of carbohydrate is recommended in patients undergoing major surgery, except for patients with insulin-dependent diabetes [48]. Carbohydrate loading carries an additional benefit of reducing peri-operative discomfort and anxiety. Postoperatively, a high-protein diet should be commenced as tolerated, except in patients with significant bowel pathology. Traditional 'clear liquid' and 'full liquid' diets should not be routinely used.

Immunonutrition has been proposed as a risk reduction strategy in surgical patients [43, 48]. Particularly, arginine, omega-3 fatty acid and antioxidants are included in various nutritional formulae. Arginine is rapidly depleted after surgical stress, and it is important for the activation of T lymphocytes, promotion of T-helper cells and phagocytosis [49]. It is also a precursor of nitric oxide and proline, which are both important for anastomotic and wound healing. Nitric oxide promotes vasodilation and tissue oxygenation, whereas proline contributes to collagen deposition during healing. Omega-3 fatty acids play a wide range of anti-inflammatory roles and can reduce oxidative injury. Pre-operative immunonutrition should be considered for patients undergoing elective major abdominal surgery [43].

Despite the above-mentioned benefits of peri-operative nutritional interventions, there are many uncertainties which make its routine implementation difficult [48]. For instance, postoperative ileus and the potential benefits of early feeding are still poorly understood, and are controversial. Surgeons typically wait until the bowel function returns, or until it is clear that there are no immediate postoperative complications. Placement of enteral feeding tubes is not always easy, and sometimes even requires radiological confirmation. Moreover, it is difficult to ensure that elderly patients will take adequate supplementation, even with the assistance of a dietitian [47]. Therefore, it is essential to provide pre-operative education to patients and their families to improve compliance. Frequent and repeated assessment of nutritional status should be conducted for patients during their hospital stay [44].

The European Working Group on Sarcopenia in Older People (EWGSOP) defines sarcopenia as a syndrome characterised by progressive and generalised loss of skeletal muscle mass and strength with a risk of adverse outcomes such as physical disability, poor quality of life and death [50]. Sarcopenia is common in the elderly and can worsen personal health and produce a burden for the healthcare system. Buettner et al. recommended including sarcopenia in identifying frail patients at greatest risk for one-year mortality after gastrointestinal cancer surgery [48]. Although there is no standardised approach to diagnosing sarcopenia, the EWGSOP has proposed a screening algorithm for patients aged 65 years and above [50]. The diagnosis of sarcopenia is based on low muscle mass, together with either low muscle strength or poor physical performance. Physical performance is assessed by gait speed, with a cut-off of 0.8 $m.s^{-1}$; the lower the speed, the poorer the physical function. Muscle strength is assessed by grip strength, with cut-offs of < 30 kg for men and < 20 kg for women. Muscle mass is assessed by dual-energy X-ray absorptiometry, with cut-offs established using an appendicular skeletal mass index. The use of CT or MRI scanning for body composition measurement is advocated, especially for patients with cancer, because these imaging modalities are part of the workup in disease staging.

Nutrition and exercise are synergistic for the growth and maintenance of muscle. Elderly people are less able to utilise amino acids for protein synthesis at muscle level, due to anabolic resistance to a physiological dose of amino acids. Protein and leucine metabolites are key dietary components that contribute to muscle accretion and synthesis [51]. The combination of resistance training and an intake of high amounts of protein favours muscle mass deposition, and will improve strength and physical function. Optimisation of both diet and physical activity may help patients improve their tolerance to oncological treatment and health-related quality of life [52].

Postoperative cognitive disorders

Postoperative cognitive disorders are a spectrum of diseases ranging from immediate postoperative delirium to postoperative cognitive dysfunction. In a small group of unfortunate patients, the impairment can be long term and

permanent, which will substantially affect their quality of life. These disorders are commonly encountered in elderly surgical patients and will be elaborated in detail.

Delirium is an acute and fluctuating alteration of mental state of reduced awareness and disturbance of attention [53]. The diagnosis of delirium is challenging because symptoms wax and wane during the course of a day, and it is confounded by baseline cognitive impairment. Postoperative delirium, although transient, is not benign. Patients suffering from delirium often have a subsequent diagnosis of mild cognitive impairment or even dementia. It is also associated with prolonged hospitalisation, institutionalisation and higher long-term mortality [54]. The incidence of postoperative delirium varies in different groups. For example, it is reported as 4.0–53.3% in patients with hip fracture and 3.6–28.3% in all elective patients [55]. Common screening tools include the Confusion Assessment Method (CAM), Delirium Symptom Interview (DSI), and Nursing Delirium Screening Scale (NuDESC).

Pre-operative risk factors for postoperative delirium in the elderly include: frailty; pre-existing cognitive impairment; comorbidities (e.g. history of stroke, Parkinson's disease, depression, anxiety disorders and diabetes); malnutrition; prolonged fasting and dehydration; hypo- or hypernatraemia; use of anticholinergic drugs; alcoholism; and sensory impairment [56]. Peri-operative factors that increase the risk include: emergency surgery; duration and site of surgery (abdominal and cardiothoracic); greater intra-operative bleeding and transfusion requirement; hypothermia; urinary catheterisation; postoperative complications; and acute pain.

The European Society of Anaesthesiology recommends the implementation of fast-track surgery to prevent postoperative delirium in high-risk patients [53]. Routine premedication with benzodiazepines should be avoided. Depth of anaesthesia monitoring is advocated to avoid excessive depth and good pain control is important, including the use of a continuous intra-operative analgesic regimen such as remifentanil. The group also suggested implementing non-pharmacological measures to reduce postoperative delirium such as: cognitive orientation (clock, communication etc.); sensory enhancement with visual/hearing aids; noise reduction and good sleep hygiene; avoidance of unnecessary in-dwelling catheters; medication review; early mobilisation; and good nutrition. Medical evaluation is important to identify and manage triggering factors for postoperative delirium such as sepsis, dehydration, electrolyte imbalance, substance withdrawal, etc. [57]. Pharmacological treatments should be reserved for severe cases who could potentially cause harm to themselves or others. In such cases, drugs of choice include low-dose haloperidol or low-dose atypical neuroleptics. Total intravenous anaesthesia with propofol is associated with a lower rate of postoperative delirium than sevoflurane anaesthesia in elderly patients [58].

Unlike delirium, postoperative cognitive dysfunction does not have a uniform definition but, clinically, it can be defined as impairment of cognitive function, including memory, concentration, executive function and speed of mental processing [59–61]. In addition to mortality [62], postoperative cognitive dysfunction is associated with an increased risk of inability to work and social dependency, which imposes a huge burden on individuals and society [63]. According to a landmark study, the International Study on Postoperative Cognitive Dysfunction, postoperative cognitive dysfunction was present in 25.8% of elderly patients aged 60 years or above one week after major non-cardiac surgery, and in 9.9% of elderly patients 3 months after surgery. This compares with 3.4% and 2.8% in the respective control groups of similar patients who had not undergone surgery [64]. After cardiac surgery, rates of postoperative cognitive dysfunction lie between 43% and 81% at 1 week and between 6% and 39% at 3 months postoperatively. It can manifest days or weeks after surgery, and resolves more rapidly in younger populations [62]. However, it is difficult to reach the diagnosis, as different studies have adopted different time frames postoperatively for diagnosing the condition. Also, a baseline assessment of cognitive function before surgery is required for subsequent comparison. There is also a lack of consensus regarding which diagnostic tools should be used; formal psychometric testing is complicated and is impractical in the routine clinical setting.

Risk factors for postoperative cognitive dysfunction include: advanced age; lower educational level; history of stroke without residual impairment; pre-existing cognitive impairment; and depression. Peri-operative triggering factors include: long duration of surgery; type of surgery (cardiac, orthopaedic and vascular); postoperative delirium; respiratory complications; and infections [59, 60, 62, 64]. In cardiac surgery, the use of cardiopulmonary bypass has been implicated as a precipitating factor. However, no concrete evidence is available to support a direct causative relationship between anaesthesia, major surgery and postoperative cognitive dysfunction [65, 66]. Paradoxically, commonly encountered intra-operative events such as hypotension or hypoxia are not associated with the development of postoperative cognitive dysfunction [64].

To date there are no widely accepted management guidelines for postoperative cognitive dysfunction [53, 57,

67]. The adage 'prevention is better than cure' is apposite to this clinical condition and it is, therefore, important to identify high-risk patients and initiate appropriate preventive measures. The Association of Anaesthetists is currently preparing a guideline statement on the peri-operative care of people with cognitive impairment [68]. Pre-operatively, any pre-existing cognitive impairment or dementia should be documented. For high-risk cases, thorough discussion with, and counselling of, patients and families of the possibilities of cognitive change is highly recommended [59, 69]. Benzodiazepines must be avoided if possible. Minimally invasive surgery should be adopted, where appropriate, as it will decrease the extent of the inflammatory response.

There is growing evidence that processed electroencephalogram monitoring during anaesthesia reduces the incidence of postoperative cognitive dysfunction and delirium [70–72]. In a large randomised study, BIS™-guided anaesthesia, with a target of 40–60, was associated with a significant reduction from 14.7% to 10.2% in postoperative cognitive dysfunction at 3 months postoperatively [73]. The use of anaesthetics for non-anaesthetic purposes, for example, treating hypertension by increasing the dose of anaesthetic, is irrational and should be avoided. The use of near-infrared spectroscopy in cardiac surgery to avoid cerebral desaturation might be useful. There is no consistent evidence that any single anaesthetic agent or technique reduces the risk of postoperative cognitive dysfunction. In particular, there is no strong evidence that a propofol intravenous anaesthetic technique offers any advantages, although it may reduce delirium [58, 74]. Although it might be expected that regional anaesthesia would confer cognitive protection, once again evidence is lacking. Prolonged hospital stay, sleep deprivation and postoperative pain may all contribute to postoperative cognitive dysfunction. Minimising length of hospital stay by implementing fast-track surgery, optimising postoperative pain control (in particular avoiding opioids [75]), and improving sleep hygiene might decrease early postoperative cognitive dysfunction. All relevant staff should receive training in the evaluation and management of pain in patients with cognitive impairment [68].

Pre-operative counselling and shared decision-making

In a recent study, almost half of the patients over the age of 60 years wished to make decisions regarding medical care near the end of life. However, 70% of these patients lacked decision-making capacity [76]. It is important to have advance directives so that these individuals can receive care according to their wishes. Few patients undergoing high-risk surgical procedures have advance directives in place, and surgeons do not routinely discuss these issues pre-operatively [77, 78]. The best practices guideline 2016 from the ACS and the AGS on optimal peri-operative management of elderly patients provides several recommendations about patient counselling [79]. Pre-operatively, the healthcare team should explore and discuss with patients their personal values and treatment preferences, including specific outcomes that may be important to them, such as functional decline, loss of independence and the subsequent care burden. The team should ensure patients have an advance directive and a designated healthcare proxy; this information should be clearly documented in the patient's medical record. Whenever possible, early postoperative palliative care consultation should be considered in patients with a poor prognosis, especially those not expected to survive more than 6 months postoperatively. A structured approach to managing patients with existing advance directives should be in place.

Risk tools, such as the ASA physical status [80], Nottingham Hip Fracture Score [81] and mortality risk calculator [82], are useful in guiding decision-making. However, they are derived from heterogeneous observational data, which often require individualised adjustment. 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 conveyed are important [6, 83]. High-risk surgery should not be performed without a pre-operative commitment to appropriate postoperative care. If a patient is critically ill, the degree and appropriateness of intervention should be made in conjunction with senior surgeons, anaesthetists, intensivists, geriatricians and, most importantly, patients and their families.

In conclusion, as the world population ages, the demand for surgical care for elderly patients is increasing. These patients present unique challenges and need a tailored peri-operative care pathway. Anaesthetists should be proactive in both assessing and optimising medical conditions and the nutritional status of elderly patients pre-operatively. We should also explore social issues, and actively involve patients and their families in major decision-making. Peri-operative management should be multidisciplinary and patients' personal values and their quality of life should be the centre of any important clinical decision process.

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