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Review Article

Psychological and Neurocognitive Outcomes After Major Surgery in Older Adults: Redefining Surgical Success Beyond Traditional Outcomes

Gooya Tayyebi[1], Dorsa Kiani[1], Maedeh Bagheri[1], Seyed Kazem Malakouti[2], Seyed Hamzeh Hosseini[1*]

1. Psychosomatic Research Center, Department of Psychiatry, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran.

2. Geriatric Mental Health Research Center, School of Behavioral Sciences and Mental Health, Iran University of Medical Sciences, Tehran, Iran.

Background: Major surgery in older adults is increasingly common as life expectancy rises and advances in surgical, anaesthetic, and intensive care practices expand treatment options for this population. However, conventional surgical outcomes do not fully reflect the complexity of recovery in older patients. Psychological and neurocognitive complications represent frequent, clinically meaningful, and often under-recognised determinants of postoperative recovery. Older adults undergoing coronary artery bypass grafting, valve surgery, aortic and major vascular procedures, thoracic surgery, abdominal oncological surgery, and hip fracture repair are particularly vulnerable to postoperative delirium, perioperative neurocognitive disorders, depression, anxiety, sleep disturbances, post-traumatic stress symptoms, and post-intensive care syndrome. The development of these complications is multifactorial, involving interacting biological factors (neuroinflammation, cerebral hypoperfusion, and systemic stress responses), patient-related clinical factors (frailty, pre-existing cognitive impairment, pain, and polypharmacy), environmental and healthcare-related factors (intensive care exposure, sensory deprivation, and sleep disruption), and psychosocial factors (social isolation, emotional distress, and psychological stress associated with life-threatening illness). This narrative review integrates evidence from diverse surgical populations to provide a comprehensive framework linking preoperative vulnerability, perioperative insults, and postoperative psychological and neurocognitive outcomes. Beyond summarising existing knowledge, this review proposes a patient-centred model of surgical success that extends beyond survival and technical outcomes to include preservation of cognition, emotional well-being, sleep recovery, functional independence, and return to meaningful daily activities. By integrating geriatric, surgical, anaesthetic, and psychological perspectives, this review highlights the need for a multidimensional approach to evaluating outcomes after major surgery in older adults.

Keywords: Aged; Major Surgery; Postoperative Delirium; Perioperative Neurocognitive Disorders; Depression; Anxiety; Post-Intensive Care Syndrome; Geriatric Psychiatry.

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Corresponding author:
Seyed Hamzeh Hosseini
Address: Psychosomatics Research Center, Mazandaran University of Medical Sciences, Sari, Iran
E-mail: hosseinish20@gmail.com

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Introduction

Modern surgery has transformed the prognosis of older adults with complex cardiovascular, oncologic, abdominal, vascular, thoracic, and orthopedic disease. Procedures that were once considered prohibitive in advanced age-such as coronary artery bypass grafting (CABG), valve replacement, aortic surgery, major vascular reconstruction, thoracic resection, oncologic abdominal surgery, and hip fracture repair-are now routinely performed with acceptable short-term survival. This progress is an important achievement of contemporary medicine, but it also changes the ethical and clinical definition of a good surgical outcome (1-3). For many older adults, the outcomes that matter most extend beyond being discharged alive. They include preservation of cognition, emotional stability, independence, sleep quality, mobility, rehabilitation potential, and the ability to return to meaningful daily routines. A technically successful operation may still be followed by delirium, depression, anxiety, cognitive decline, sleep fragmentation, post-traumatic stress symptoms, prolonged dependency, or inability to return home. In these circumstances, the operation may be anatomically successful but personally devastating. The perioperative period should therefore be understood as a vulnerable window for brain and mental health deterioration Figure1.

Older adults often enter surgery with frailty, multimorbidity, subclinical cognitive impairment, sensory loss, polypharmacy, and limited physiological reserve. The surgical insult, anesthesia, inflammation, pain, blood pressure fluctuations, ICU exposure, sleep deprivation, and social disruption may then act as precipitating stressors. This interaction between vulnerability and stress explains why apparently similar operations may produce very different recovery trajectories across older patients (1-8).

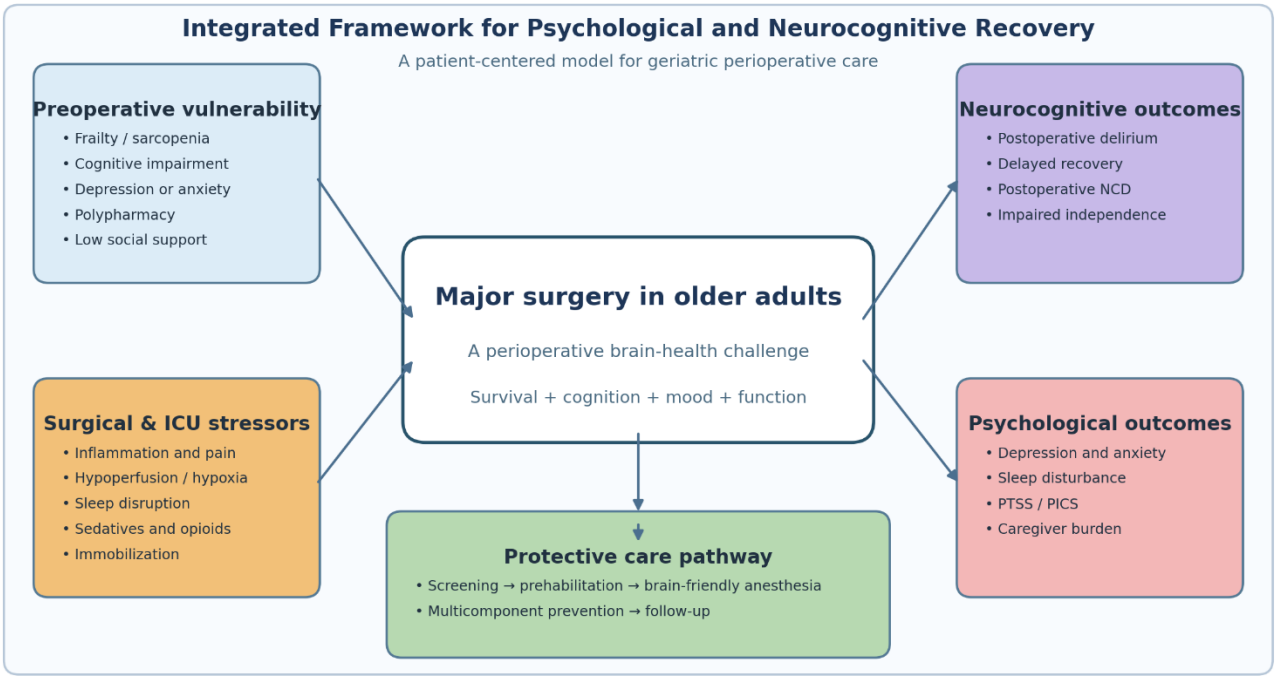


Fig 1. Integrated perioperative brain-health framework: A conceptual model showing how preoperative vulnerability and perioperative stressors interact to produce neurocognitive and psychological outcomes, and how protective care pathways can shift recovery toward cognition, mood, sleep, function, and independence.

The need to integrate mental health assessment into hospital-based medical care is also supported by recent multicenter data from Iran. In a cross-sectional study of 524 non-psychiatric inpatients admitted to general hospitals across seven Iranian cities, Ansari et al. found that 38.7% of patients met criteria for mental distress using the General Health Questionnaire-12. Mental distress varied across hospital wards and sociodemographic groups, supporting the view that psychological symptoms are common among medically hospitalized patients and should not be regarded as incidental or outside the scope of medical care. Although this study was not limited to older surgical patients, it strengthens the rationale for routine psychological screening within perioperative and inpatient pathways (9).

Although postoperative delirium and perioperative neurocognitive disorders have received increasing attention in geriatric surgical care, psychological and neurocognitive recovery after major surgery represents a broader and more complex spectrum of outcomes. Current perioperative models have primarily emphasised mortality, surgical complications, frailty, and functional recovery, while psychological well-being, emotional recovery, sleep quality, and stress-related symptoms have often been evaluated separately or remain under-recognised. In addition, existing frameworks frequently address individual complications rather than integrating these outcomes into a unified model of recovery. Therefore, there is a need for a comprehensive perspective that considers postoperative cognitive, psychological, and functional trajectories as interconnected components of surgical success in older adults.

This review argues for a patient-centred, brain-centred, and psychologically informed model of geriatric surgery. The purpose is to synthesise the evidence on postoperative psychological and neurocognitive complications, identify high-risk populations, summarise screening and prevention strategies, and propose a practical framework for redefining surgical success in older adults.

Methods and Literature Review Approach

This article presents a narrative synthesis of the current literature focused on older adults undergoing major surgery and the psychological, cognitive, sleep-related, and intensive-care-related outcomes associated with postoperative recovery. A targeted literature review was performed to identify clinically relevant evidence from diverse surgical populations. Priority was given to systematic reviews, meta-analyses, randomised clinical trials, large cohort studies, consensus statements, and clinical practice guidelines published in peer-reviewed journals.

The conceptual search domains included: “older adults” or “geriatric surgery”; “postoperative delirium”; “perioperative neurocognitive disorders”; “depression”; “anxiety”; “post-traumatic stress”; “post-intensive care syndrome”; “sleep disturbance”; “cardiac surgery” or “CABG”; “major vascular surgery”; “hip fracture”; “oncological surgery”; “frailty”; “prehabilitation”; and “delirium prevention.” Additional relevant observational studies were considered when they provided important clinical insights, particularly in areas where evidence was heterogeneous or limited Table 1.

Because the aim was to develop a clinically meaningful and integrative framework, findings were synthesised thematically rather than quantitatively pooled. The literature was organised into five major domains: (1) neurocognitive complications as important determinants of postoperative recovery; (2) psychological symptoms and their influence on rehabilitation and quality of life; (3) sleep disruption and intensive-care-related factors as contributors to adverse recovery trajectories; (4) frailty, cognitive impairment, depression, and polypharmacy as markers of vulnerability; and (5) prevention and management strategies requiring multidisciplinary care throughout the perioperative continuum (1–8, 10–21).

Why Older Adults Are Vulnerable

Older surgical patients differ from younger adults not only in chronological age but also in physiological reserve. Ageing is associated with reduced neuroplasticity,

impaired autonomic regulation, vascular stiffness, cerebral small-vessel disease, altered pharmacokinetics, lower sleep efficiency, sarcopenia, frailty, and a higher prevalence of subclinical cognitive impairment. These factors reduce the ability to maintain homeostasis during and after major surgery (2, 5–7). Frailty is particularly important because it reflects multisystem vulnerability rather than a single disease state. Frail patients are less able to compensate for inflammation, blood loss, hypotension, infection, immobility, and catabolic stress. They are more likely to experience delirium, falls, institutional discharge, prolonged rehabilitation, and mortality. Mild cognitive impairment and early dementia may also remain undetected before surgery but become clinically obvious after anaesthesia, ICU exposure, infection, pain, or sleep deprivation (2, 4–8).

Table 1. Key literature supporting a brain-health model of geriatric surgical recovery

Domain	Evidence signal	Clinical implication
Perioperative anxiety and depression	Review evidence indicates that the perioperative interval is a high-risk period for depression and anxiety in older adults; psychological symptoms influence pain, sleep, adherence, and recovery. (3, 10)	Screening and low-risk psychological support should be integrated into routine perioperative assessment.
Preoperative depression	Recent systematic review evidence shows that depression is common before elective surgery in older patients and is associated with adverse outcomes. (1)	Depression should be treated as a modifiable risk marker, not a secondary concern.
Postoperative delirium	Large cohort data and guidelines identify delirium as a common, dangerous, costly, and often preventable complication associated with mortality, major complications, and non-home discharge.(4, 5, 7, 8)	Delirium screening and multicomponent prevention should be standard for high-risk older adults.
Perioperative neurocognitive disorders	Updated nomenclature frames cognitive changes around anesthesia and surgery as a spectrum including delirium, delayed neurocognitive recovery, and postoperative neurocognitive disorder. (6)	Baseline cognitive testing is necessary to distinguish pre-existing impairment from postoperative decline.
Cognitive prehabilitation	Randomized trial evidence suggests that preoperative cognitive training may reduce delirium in selected cardiac surgery populations; evidence remains promising but not definitive. (13, 15)	Cognitive reserve may be a modifiable perioperative target.
Family-involved delirium prevention	Tailored, family-involved Hospital Elder Life Program interventions have reduced postoperative delirium and supported functional outcomes. (20)	Family participation should be operationalized as part of care rather than informal support only.
Sleep disturbance	Meta-analytic evidence supports an association between sleep disturbance and postoperative delirium. (12)	Sleep protection should be treated as a therapeutic intervention in hospitals and ICUs.
Post-intensive care syndrome	ICU survivorship literature emphasizes persistent physical, cognitive, and psychological impairment after critical illness. (14, 16, 18)	Post-discharge follow-up should include cognition, mood, PTSD symptoms, sleep, and caregiver burden.

Psychological vulnerability often coexists with biological risk. Older adults may approach surgery with fear of death, fear of dependency, fear of cognitive decline, uncertainty about prognosis, loneliness, financial concerns, or caregiver-related stress. Patients undergoing CABG, aortic procedures, cancer surgery, or vascular reconstruction may carry the additional psychological burden of life-threatening disease. These mental states influence pain perception, sleep, motivation, rehabilitation adherence, and the patient's interpretation of postoperative symptoms (1, 3, 19, 21).

Polypharmacy further increases risk. Benzodiazepines, anticholinergic drugs, sedatives, opioids, corticosteroids, and some psychoactive medications may contribute to delirium, falls, confusion, sleep disruption, and impaired cognition. Renal and hepatic impairment can prolong drug effects. Thus, older adults often enter surgery with multiple interacting risk factors for neuropsychiatric complications (2, 4, 5, 7).

High-Risk Surgical Settings

Cardiac Surgery and CABG

CABG, valve surgery, and combined cardiac procedures are among the most important operations associated with neuropsychological complications in older adults. Potential contributors include cardiopulmonary bypass, aortic manipulation, microembolisation, cerebral hypoperfusion, systemic inflammation, postoperative atrial fibrillation, mechanical ventilation, ICU admission, and pre-existing vascular disease (2, 11).

CABG should therefore be understood not only as a cardiac procedure but also as a neurological and psychological stress test. Depression and anxiety are common in patients with coronary artery disease and may persist or worsen after surgery. Delirium and postoperative cognitive decline remain among the most feared complications, particularly in patients with preoperative cognitive impairment, prior stroke, frailty, depression, high operative risk, prolonged intubation, arrhythmia, or extended ICU stay (11, 17).

Major Vascular and Aortic Surgery

Major vascular surgery-including open abdominal aortic aneurysm repair, thoracoabdominal aortic surgery, carotid procedures, and complex limb revascularization-is often performed in patients with diffuse atherosclerosis and a high burden of cerebrovascular disease. These patients may be especially vulnerable to cognitive changes due to impaired cerebral perfusion, embolic risk, blood pressure fluctuations, systemic inflammation, renal dysfunction, and ICU exposure (2, 8).

Emergency vascular procedures, bleeding, ischaemia, shock, and prolonged critical care further increase risk. Postoperative outcomes should therefore include not only graft patency or limb salvage but also delirium, cognition, function, mobility, mood, and discharge destination.

Major Abdominal, Thoracic, and Oncological Surgery

Major colorectal, hepatobiliary, pancreatic, gastric, thoracic, and other oncological procedures involve long operative duration, blood loss, postoperative pain, nutritional decline, catabolism, infection risk, and prolonged hospitalisation.

Cancer adds psychological stress through fear of recurrence, uncertainty, body-image concerns, treatment fatigue, and loss of independence. In older adults, the combined burden of cancer, surgery, anaesthesia, pain, inflammation, and postoperative dependency may precipitate delirium, depression, anxiety, insomnia, and functional decline. Multidisciplinary care should therefore begin before surgery and extend beyond discharge (4, 5, 7, 8, 20).

Hip Fracture and Major Orthopaedic Surgery

Hip fracture repair is one of the highest-risk settings for delirium in older adults. Patients are frequently frail, immobilised, dehydrated, sleep deprived, in severe pain, and exposed to opioids. Many have underlying cognitive impairment or sensory deficits. Delirium after hip fracture is associated with poor functional recovery, institutionalisation, caregiver burden, and mortality. Even elective arthroplasty may be followed by anxiety, sleep disturbance, pain-related catastrophising, or cognitive symptoms in vulnerable patients. The perioperative plan

should therefore include pain control that minimises deliriogenic medication exposure, early mobilisation, hydration, orientation, sensory support, and discharge planning (4, 5, 7).

Postoperative Delirium: Acute Brain Failure After Surgery

Postoperative delirium is one of the most common and clinically significant neuropsychiatric complications after major surgery in older adults. It is characterised by acute disturbance in attention, awareness, and cognition, typically fluctuating over time. Delirium may be hyperactive, hypoactive, or mixed. Hypoactive delirium is particularly easy to miss because patients may appear quiet, withdrawn, sleepy, or fatigued rather than agitated (4, 5, 7, 8).

Delirium is not a benign or transient inconvenience. It is associated with longer hospital stay, higher complication rates, increased mortality, non-home discharge, long-term cognitive decline, caregiver burden, and higher healthcare costs. Contemporary large-scale evidence in older adults undergoing major non-cardiac surgery has reinforced the association between postoperative delirium and death, major complications, and non-home discharge (2, 5, 7, 11). Regional evidence further supports the prognostic significance of delirium in hospitalised older adults. In a prospective cohort study from northern Iran, Mehrabani et al. evaluated 100 hospitalised patients with delirium and reported substantial short-term mortality, including 12% in-hospital mortality and 40% cumulative mortality at three months. Delirium severity and survival were associated with clinical and biological vulnerability markers, including dementia, cancer, cirrhosis, substance-related factors, elevated blood urea nitrogen, and inflammatory markers such as erythrocyte sedimentation rate and C-reactive protein.

Although this cohort was not restricted to postoperative patients, its findings reinforce the broader argument that delirium in older hospitalised adults is a serious brain-health event requiring early recognition, risk-factor assessment, and post-discharge follow-up (22). Risk factors include advanced age, pre-existing cognitive impairment, frailty, sensory impairment, dehydration, infection, anaemia, pain, sleep disruption, polypharmacy, emergency surgery, ICU admission, mechanical ventilation, and use of deliriogenic medications. Cardiac surgery, aortic surgery, hip fracture surgery, and major abdominal procedures are especially high-risk contexts (4, 5, 7, 20). The pathophysiology is multifactorial and includes neuroinflammation, blood-brain barrier dysfunction, neurotransmitter imbalance, oxidative stress, impaired cerebral autoregulation, microembolisation, hypoxia, sleep deprivation, and medication effects. In CABG, cardiopulmonary bypass, aortic manipulation, embolic load, and cerebral hypoperfusion may add procedure-specific risk.

Prevention is more effective than treatment. Multicomponent non-pharmacological strategies remain central: orientation, early mobilisation, sleep promotion, pain control, hydration, avoidance of unnecessary catheters and restraints, optimisation of hearing and vision, family engagement, medication review, and minimisation of benzodiazepines and anticholinergic drugs. Pharmacological treatment should generally be reserved for severe agitation that threatens patient or staff safety and should not replace correction of underlying causes.

Perioperative Neurocognitive Disorders

Cognitive changes after surgery have historically been described using inconsistent terms such as postoperative cognitive dysfunction. More recent nomenclature recommends the broader term perioperative neurocognitive disorders (PND), which includes pre-existing neurocognitive disorder, postoperative delirium, delayed neurocognitive recovery, and postoperative neurocognitive disorder (2, 6).

This framework is particularly useful in older adults because many patients have cognitive vulnerability before surgery. Some have undiagnosed mild cognitive impairment or early dementia. Without preoperative

cognitive screening, postoperative decline may be incorrectly attributed solely to anaesthesia or surgery, while baseline impairment remains unrecognised (2, 6).

PND may affect memory, attention, processing speed, executive function, orientation, and daily functioning. The clinical significance depends not only on neuropsychological test scores but also on whether patients can manage medications, participate in rehabilitation, make decisions, avoid falls, and live independently (2, 6, 8, 11).

Risk factors overlap with delirium and include age, lower education, pre-existing cognitive impairment, depression, frailty, vascular disease, stroke history, sleep disturbance, longer surgery, intraoperative hypotension, postoperative complications, infection, and ICU stay. Cardiac and major vascular procedures may add embolic and perfusion-related mechanisms (2, 6). Routine preoperative cognitive screening is therefore important. Tools such as the Montreal Cognitive Assessment, Mini-Mental State Examination, Mini-Cog, or clock-drawing test can identify patients who require closer monitoring. Screening should not be used to deny surgery automatically; it should guide shared decision-making, risk communication, family involvement, delirium prevention, discharge planning, and follow-up.

Depression After Major Surgery

Depression is common among older surgical patients and is particularly important in cardiac surgery. In CABG populations, depression may be present before surgery as part of the burden of coronary artery disease, functional limitation, fear of death, and reduced quality of life. It may also emerge or worsen after surgery because of pain, sleep disruption, fatigue, loss of independence, physical limitations, ICU memories, and uncertainty about recovery (1, 3, 17, 19).

Postoperative depression is clinically important because it may reduce motivation for mobilisation, medication adherence, cardiac rehabilitation, nutritional recovery, and follow-up care. It may amplify pain perception and worsen sleep. In CABG populations, depression and anxiety have been associated with worse cardiac outcomes and poorer recovery (1, 3, 17, 19).

Older patients may not present with classic sadness. Instead, they may report fatigue, poor sleep, appetite loss, irritability, apathy, somatic complaints, or loss of interest in rehabilitation. These symptoms may be misattributed to normal postoperative recovery. As a result, depression may remain undiagnosed until it has already impaired recovery (1, 3). Screening can be performed using the Geriatric Depression Scale, PHQ-9, or Hospital Anxiety and Depression Scale. Screening should occur before major elective surgery when possible, and again after surgery in patients with prolonged hospitalisation, ICU admission, complications, poor rehabilitation participation, or persistent functional decline (1, 3, 10).

Anxiety and Fear Around Surgery

Anxiety before major surgery is expected, but clinically significant anxiety may worsen recovery. Older adults may fear death, anaesthesia, pain, stroke, cognitive decline, loss of independence, financial burden, or becoming dependent on family members. In CABG and vascular surgery, anxiety may be intensified by the perception of imminent life-threatening cardiovascular risk. Anxiety can increase sympathetic activation, worsen sleep, increase pain sensitivity, and reduce preoperative preparation. After surgery, anxiety may contribute to avoidance of mobilisation, fear of physical activity, poor adherence to rehabilitation, and repeated emergency visits for benign symptoms (3, 21).

The relationship between preoperative anxiety and postoperative delirium is less consistent than the relationship between depression and adverse outcomes. This uncertainty does not diminish the clinical importance of anxiety; rather, it highlights the need for better definition, standardised measurement, and targeted interventions (21). Assessment with tools such as GAD-7 or HADS can identify patients requiring support. Non-pharmacological approaches are particularly important in older adults because sedative medications may increase the risk of delirium and falls. Education, expectation-

setting, family involvement, relaxation techniques, breathing exercises, structured prehabilitation, and psychological support may reduce anxiety without excessive pharmacological risk (3, 10, 21).

Post-Traumatic Stress Symptoms and Post-Intensive Care Syndrome

Many older patients undergoing major surgery require ICU care. ICU exposure can be psychologically traumatic. Mechanical ventilation, invasive lines, alarms, immobility, hallucinations, delirium, inability to communicate, fear of death, and separation from family may produce distressing memories or fragmented recollections. Post-intensive care syndrome includes new or worsening impairments in physical, cognitive, or mental health status after critical illness. Its psychological components include depression, anxiety, and post-traumatic stress symptoms. Older adults may be particularly vulnerable because ICU-related decline occurs on top of frailty, multimorbidity, and limited physiological reserve (14, 18).

Post-traumatic stress symptoms after critical illness may include nightmares, intrusive memories, avoidance of hospitals, hypervigilance, panic symptoms, emotional numbing, and persistent fear. These symptoms can impair follow-up care, rehabilitation, sleep, and patient trust in medical settings (16). ICU diaries, family engagement, sleep promotion, early mobilisation, minimisation of sedation, and post-ICU follow-up clinics may help reduce or identify these problems. In surgical patients, especially after CABG, aortic surgery, major abdominal surgery, or prolonged ICU admission, structured post-discharge assessment should include mental health and cognition (14, 16, 18).

Sleep Disturbance: An Overlooked Driver of Brain and Mood Outcomes

Sleep disturbance is both a symptom and a cause of postoperative psychological and cognitive complications. Hospitals and ICUs disrupt sleep through noise, light, vital sign checks, pain, medications, anxiety, and unfamiliar environments. Sleep deprivation may contribute to delirium, depression, anxiety, impaired immune function, pain sensitivity, and delayed rehabilitation (12). Older adults already have reduced sleep efficiency and more fragmented sleep. After major surgery, this vulnerability increases. Evidence supports an association between sleep disturbance and postoperative delirium, although causality is difficult to prove. Regardless, sleep is a modifiable perioperative target (12).

Practical measures include nighttime noise reduction, clustering nursing care, reducing unnecessary alarms, daytime mobilisation, avoidance of excessive daytime naps, optimisation of pain control, reduction of benzodiazepines, light exposure during daytime, and circadian orientation. Sleep should be treated as a therapeutic component of recovery, not merely as a comfort measure (2, 4, 12).

Screening Before Surgery

Older adults scheduled for major surgery should undergo structured assessment of psychological and cognitive vulnerability**. A practical preoperative screening model should be feasible and applicable in routine clinical practice. Key domains for assessing psychological, cognitive, functional, and social vulnerability in older adults undergoing major surgery are summarised in Table 2.**

The goal of screening is not to exclude older adults from surgery. The goal is to identify modifiable risk, improve informed consent, personalize perioperative care, involve families, plan discharge, and prevent complications (2, 4, 5).

Prevention and Management Strategies

Preoperative phase

Preoperative counselling should include discussion of psychological and cognitive risks, not only surgical mortality and physical complications. Patients and families should be informed about delirium, cognitive changes, mood symptoms, sleep disturbance, and expected recovery. Patients with depression, anxiety, frailty, or cognitive impairment should be identified early (1–3, 6, 21). Prehabilitation may include physical

exercise, nutritional optimisation, sleep improvement, smoking cessation, medication review, sensory optimisation, and psychological preparation. For selected patients, cognitive training may be considered. Evidence from cardiac and non-cardiac surgical populations suggests that cognitive prehabilitation is promising, although larger pragmatic studies are needed before universal implementation (Table 3) (10, 13, 15).

Table 2. Patient-Centered Preoperative Screening Framework to Optimize Psychological, Neurocognitive, and Functional Outcomes After Major Surgery in Older Adults

Domain	Suggested tools or assessments	Why it matters
Cognition	MoCA, MMSE, Mini-Cog, clock drawing	Identifies baseline impairment, delirium risk, and need for family involvement.
Depression	Geriatric Depression Scale, PHQ-9, HADS	Predicts motivation, pain perception, rehabilitation participation, and recovery.
Anxiety	GAD-7, HADS, brief fear-of-surgery questions	May worsen sleep, pain sensitivity, and avoidance of mobilization.
Frailty	Clinical Frailty Scale, gait speed, Edmonton Frail Scale	Captures physiological vulnerability and predicts discharge needs.
Sleep	Brief sleep history, Insomnia Severity Index	Identifies modifiable risk for delirium, mood symptoms, and fatigue.
Medication risk	Benzodiazepines, anticholinergics, sedatives, opioids	Reduces preventable delirium, falls, and cognitive adverse effects.
Social support	Living alone, caregiver availability, family involvement	Guides discharge planning, orientation, and rehabilitation support.
Sensory impairment	Hearing and vision deficits; availability of aids	Reduces sensory deprivation and delirium risk.
Function	Baseline ADL/IADL, mobility, falls history	Clarifies patient-centered goals and realistic recovery planning.

Table 3. Practical perioperative pathway for older adults undergoing major surgery

Timing	Core actions	Responsible team
Before surgery	Screen cognition, mood, anxiety, frailty, sleep, medications, sensory impairment, function, and social support; discuss patient-centered goals.	Surgeon, anesthesiologist, geriatrician, psychiatrist/psychologist, nurse, family.
Prehabilitation	Optimize nutrition, mobility, sleep, smoking cessation, medications, pain expectations, psychological preparation, and caregiver plan.	Multidisciplinary preoperative clinic.
Intraoperative	Avoid hypotension, hypoxemia, excessive anesthetic depth, hypothermia, severe anemia, and deliriogenic medications where possible.	Anesthesia and surgical team.
Postoperative ward/ICU	Orientation, mobilization, sleep protection, pain control, hydration, sensory aids, family engagement, daily delirium screening.	Nurses, ICU team, physiotherapy, family, physicians.
Discharge and follow-up	Assess cognition, mood, sleep, function, caregiver burden, rehabilitation participation, and post-ICU symptoms.	Primary care, surgeon, geriatrician, psychiatry/psychology, rehabilitation team.

Intraoperative phase

Intraoperative care should aim to avoid extremes of blood pressure, hypoxaemia, excessive anaesthetic depth, prolonged hypotension, severe anaemia, hypothermia, and unnecessary deliriogenic medications. Regional anaesthesia and multimodal analgesia may reduce opioid exposure in selected procedures; however, no single anaesthetic technique fully eliminates the risk of delirium or neurocognitive complications (2, 4). Brain-friendly anaesthesia should be individualised. It includes haemodynamic vigilance, medication stewardship, pain control, avoidance of anticholinergic burden, and communication with the postoperative team regarding cognitive risk (Table 3) (2, 4).

Postoperative phase

Postoperative management should prioritise orientation, sleep, pain control, mobilisation, hydration, nutrition, sensory aids, and medication review. Families should be encouraged to participate in orientation and reassurance. Hearing aids, glasses, clocks, calendars, and familiar objects should be available. Catheters, restraints, and unnecessary lines should be removed as early as possible (4, 5, 14, 18). Delirium should be screened with validated tools such as CAM, CAM-ICU, 4AT, or other locally validated instruments. Depression and anxiety should be reassessed during recovery, especially in patients with prolonged hospitalisation, ICU admission, complications, or poor rehabilitation participation. ICU survivors may benefit from structured follow-up for post-intensive care syndrome (Table 3) (4, 5, 14, 18).

Redefining Surgical Success in Older Adults

The traditional surgical model emphasizes technical success and survival. In older adults, this is insufficient. A patient may survive CABG, aortic surgery, cancer resection, or hip fracture repair but lose independence, develop delirium, become depressed, experience persistent anxiety, or fail to return home. These outcomes matter deeply to patients and families (2, 4, 5, 7, 8).

Surgical success in older adults should therefore include:

Survival with preserved cognition.

Emotional stability and absence of disabling depression or anxiety.

Functional recovery and return to mobility.

Ability to participate in rehabilitation.

Maintenance of independence whenever possible.

Sleep recovery and adequate pain control.

Meaningful quality of life.

Reduced caregiver burden.

Achievement of patient-defined goals.

A recent surgical editorial similarly called for moving “beyond the scalpel” by integrating psychological screening, patient communication, pain control, and postoperative mental health support into routine surgical care. This view aligns with the present review’s argument that surgical success should include emotional recovery, cognition, function, and quality of life, not technical survival alone (23). This shift requires collaboration among surgeons, anesthesiologists, geriatricians, psychiatrists, psychologists, nurses, physiotherapists, intensivists, rehabilitation specialists, primary care clinicians, and families. Psychological and neurocognitive complications should not be considered outside the responsibility of perioperative care. They are part of surgical recovery (2).

Future Directions

Future research should move beyond simply identifying postoperative psychological and neurocognitive complications and focus on developing, testing, and implementing effective strategies to improve recovery after major surgery in older adults. One of the highest priorities is the identification of patient subgroups who are most likely to benefit from targeted preoperative interventions. Older adults with frailty, pre-existing cognitive impairment, multimorbidity, depression or anxiety symptoms, polypharmacy, sensory impairment, and previous intensive care exposure represent particularly vulnerable populations that should be prioritised for future intervention studies. Research efforts should initially focus on high-risk surgical settings where

the burden of postoperative cognitive and psychological complications is substantial, including cardiac surgery (CABG and valve procedures), aortic and major vascular surgery, major oncological surgery, thoracic surgery, and hip fracture repair.

Future trials should evaluate outcomes that reflect meaningful recovery for older adults, including cognitive trajectory, emotional well-being, sleep quality, functional independence, rehabilitation participation, caregiver burden, quality of life, and return to meaningful daily activities, rather than relying primarily on mortality and length of hospitalisation. Interventional research should evaluate multimodal approaches integrating geriatric assessment, cognitive and psychological preparation, prehabilitation, sleep optimisation, family engagement, and delirium prevention strategies. Emerging technologies, including digital health platforms, telemedicine-based psychological support, cognitive training programmes, wearable monitoring devices, and remote follow-up systems, may enhance accessibility and continuity of care. However, their effectiveness, feasibility, and cost-effectiveness require validation through adequately powered pragmatic clinical trials, particularly in diverse healthcare settings and resource-limited environments.

A major future challenge is implementation. Although several components of delirium prevention and geriatric perioperative care have demonstrated benefit, their incorporation into routine surgical pathways remains inconsistent. Barriers include limited staff resources, lack of interdisciplinary coordination, inadequate training, fragmented communication between hospital and community services, and variable access to digital infrastructure. Practical solutions may include standardised perioperative mental health and cognitive screening pathways, integration of geriatric specialists within surgical teams, structured family education programmes, electronic clinical decision-support systems, and development of scalable models adapted to local healthcare resources. Ultimately, the next phase of geriatric surgical research should not only aim to discover new interventions but also establish sustainable care models that make psychological, cognitive, and functional recovery recognised and measurable components of surgical success.

Conclusion

Major surgery in older adults is not only a physiological intervention but also a major psychological and neurocognitive stressor. The evidence synthesised in this review highlights that postoperative recovery is shaped by the interaction between patient vulnerability factors, including frailty, cognitive impairment, multimorbidity, and psychological status, and perioperative stressors such as anaesthesia, inflammation, pain, sleep disruption, and intensive care exposure. Although CABG and other major cardiac procedures provide well-established models of postoperative neurocognitive risk, similar challenges are observed across major vascular, abdominal, oncological, thoracic, and orthopaedic surgeries.

Delirium, perioperative neurocognitive disorders, depression, anxiety, sleep disturbance, post-traumatic stress symptoms, and post-intensive care syndrome are not isolated complications but interconnected determinants of recovery, rehabilitation potential, independence, and quality of life. Therefore, surgical success in older adults should no longer be defined solely by survival, technical completion, or length of hospitalisation. A more meaningful definition should incorporate preservation of cognition, emotional well-being, functional independence, and the ability to return to meaningful daily activities.

Integrating this broader perspective into clinical practice requires systematic preoperative risk assessment, early identification of vulnerable patients, multidisciplinary perioperative pathways, implementation of evidence-based delirium and psychological support strategies, and structured follow-up after discharge. The future of geriatric surgery should therefore be patient-centred, brain-centred, and psychologically informed,

recognising cognitive and emotional recovery as essential components of successful surgical care.

Declaration

Availability of data and materials

As the manuscript is a review article and does not involve the generation or analysis of original datasets, a separate data availability statement is not applicable.

Conflict of Interest

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Authors' contribution

Conceptualisation: SHH, GT, SKM.

Methodology: SHH, GT, DK, MB.

Literature search and investigation: GT, DK, MB.

Data interpretation and synthesis: SHH, GT, DK, MB.

Writing – original draft preparation: SHH, GT, DK, MB.

Writing – review and editing: SKM, SHH, GT, DK, MB.

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