NARRATIVE REVIEW ARTICLE

Prehabilitation for the Frailty Syndrome: Improving Outcomes for Our Most Vulnerable Patients

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Anesthetists are increasingly faced with the challenge of delivering perioperative care to frail older people. Patients with frailty undergoing surgical intervention are at a significantly increased risk of perioperative complications, mortality, and longer length of stay. Moreover, frailty is often associated with multimorbidity and a range of geriatric syndromes including functional dependency, cognitive impairment, and malnutrition which further increases risk and complexity of care. There is a growing body of evidence that prehabilitation—intervention delivered during the preoperative period to improve overall health and function—can improve postoperative outcomes for patients undergoing surgery. However, whether this vulnerable population stand to benefit from prehabilitation is less clear. We review the evidence for prehabilitation for patients with frailty including whether the risks associated with and outcomes from surgery can be modified through comprehensive geriatric assessment. (Anesth Analg 2020;130:1524–33)

GLOSSARY

6MWT = 6-minute walk test; **ACS** = American College of Surgeons; **CABG** = coronary artery bypass grafting; **CFS** = Clinical Frailty Scale; **CGA** = comprehensive geriatric assessment; **ERAS** = enhanced recovery after surgery; **GFI** = Groningen Frailty Indicator; **ISAR** = Identification of Seniors at Risk Tool; **LOS** = length of stay; **mFI** = modified Frailty Index; **NSQIP** = National Surgical Quality Improvement Program; **POPS** = Proactive Care of Older People Service; **SPPB** = Short Physical Performance Battery

Each year, the number of older people undergoing surgery increases, with the proportion of people over the age of 65 years rising substantially.[1] This growth in demand has been driven by multiple factors including an increase in life expectancy, changes in population demographics, and improved surgical and anesthetic techniques allowing patients to undergo less invasive surgery.[2] While these factors have allowed greater numbers of older people to undergo surgery, it also presents its own challenges with the need to operate on older people with complex health care needs including those who are frail.

This review will focus on people with frailty and how the surgical trajectory and associated outcomes can be altered through planning and intervention in advance of surgery.

FRAILTY

Frailty is a multidimensional risk state that confers increased vulnerability to physiological and pathological insults.[3] It is associated with an increased risk of poor outcomes in people undergoing surgical intervention including a greater risk of postoperative complications, longer length of stay (LOS), and mortality.[4] Evidence also supports a dose–response relationship with greater levels of frailty having a greater effect on mortality.[5]

The prevalence of frailty increases with age and is estimated to be between 4.1% and 37% in the older surgical population.[5–8] Geriatric syndromes such as cognitive impairment, malnutrition, and disability along with multimorbidity are more common in people with frailty, and there are higher direct and indirect costs associated with patients with frailty undergoing surgery.[3,9,10] However, frailty is not synonymous with aging, and younger people can also present with frailty.[6,11]

At a physiological level, frailty is associated with a range of changes that reduce the body's ability to respond to insults.[3] Patients demonstrate low levels of chronic inflammation that contribute to catabolism and sarcopenia.[3,12,13] The immune response is impaired, and the ability to effectively respond to infectious agents impacted.[14] Frailty is associated with insulin resistance and dysregulation of glucose metabolism.[12,15] Intraoperatively patients with frailty have been demonstrated to have impaired hemodynamic responses suggestive of autonomic dysregulation.[16]

Frailty is associated with an increased risk of medical complications including pneumonia, sepsis, deep venous thrombosis, acute renal failure, and stroke.[17]

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Similarly, frailty is associated with an increased risk of surgical complications including return to theater, surgical site infection, wound dehiscence, and poor wound healing.[17–19] The impact extends beyond the acute hospitalization, with frailty being associated with unplanned readmission to hospital, an increased rate of institutionalization after discharge, and functional decline.[17,20,21] Despite this well-documented association between frailty and poor postoperative outcomes, as well as multiple guidelines advocating the routine assessment in advance of surgery, frailty is still not routinely screened for preoperatively.[22–25] In part, one of the main barriers to undertaking screening appears to be lack of knowledge about frailty and confidence in undertaking frailty assessments in clinical practice.[22]

The majority of people identified as frail will get worse over time.[26] However, evidence exists within the nonsurgical population that frailty may be reversed, at least in part. Studies have demonstrated that multimodal interventions incorporating exercise, nutritional support, and falls prevention can improve longer-term outcomes in older people with frailty including preventing cognitive and functional decline and reducing mortality.[27–30] Most of these studies comprised interventions delivered over 6–12 months—a time period that would not be compatible with most elective surgical procedures—particularly oncological surgery. What is less clear at this point is whether frailty can be reversed or modified in the surgical population and whether by doing so, outcomes can be altered.

PREHABILITATION

Prehabilitation is the term generally considered to refer to any intervention delivered in advance of surgery that improves health, optimizes function, and/or potentially reduces postoperative risk.[23,31,32] Delivering the patient to the operating theater in a better physical state has the potential to lessen the impact of the physiological and functional insult of surgery. This may be achieved through several means—by improving aerobic capacity and level of function, reversing or treating conditions known to be associated with increased perioperative risk, and providing education that allows the patient to play an active role in that process. While the majority of research to date has focused on exercise-based interventions, there is increasing recognition of the need to incorporate nutritional, cognitive, and psychological support into prehabilitation programs.[33–35]

To date, the majority of evidence to support prehabilitation has included patients of all ages across a variety of surgical specialties. In this broader surgical population, prehabilitation reduces postoperative complications; improves postoperative pain control; and is associated with an improvement in function, nutrition, and quality of life.[36–41] Evidence also suggests that prehabilitation can improve patients initially considered not to be surgical candidates to a level where surgical intervention can be considered.[42] As a result, current guidelines for patients awaiting noncardiac surgery recommend prehabilitation where possible.[43] This should include exercise that improves aerobic capacity, strengthening, and inspiratory muscle training, and be delivered as part of a multimodal program that addresses other factors contributing to risk.[43] Interventions should be tailored to individuals and ideally take place for a duration of ≥4 weeks. Such interventions are associated with a reduced LOS and improved cost-effectiveness.[36,37,44] A recent Australian survey undertaken to explore the views of surgeons and anesthetists on prehabilitation demonstrates that only a minority of institutions have implemented prehabilitation programs despite the majority of surgeons being prepared to delay surgery in appropriate patients if deemed of benefit.[45] In part, this is likely to be due to the capacity of hospitals to provide resources to deliver this intervention but also due to a lack of assessment of functional status and access to services that may allow them to perform this formally, such as cardiopulmonary exercise testing.

Enhanced recovery after surgery (ERAS) protocols are now commonplace across the world.[46] Many aspects of prehabilitation and ERAS overlap in terms of what they provide to patients—in particular improving nutritional state, optimizing medical comorbidities, and providing education and psychological preparation in advance of surgery. Unlike prehabilitation, exercise protocols do not feature heavily, and a large part of the ERAS pathways focus on both intraoperative and postoperative care. There is clear potential for both of these processes to be integrated in a way that may improve outcomes further.[47]

Both ERAS and prehabilitation focus on important aspects of care for older surgical patients, although it should be noted that few ERAS protocols are designed specifically to address the needs of older patients and fewer still for those with frailty. Indeed, ERAS programs specifically emphasize the importance of using evidence to standardize care delivery and reduce variation based on the best possible evidence available. It is well documented that older patients are frequently excluded from clinical trials with little clinical justification for doing so.[48] As a result, these protocols include interventions that may be of clear benefit in younger fitter cohorts but also may introduce risk in older frail patients. Many ERAS protocols recommend the use of multimodal analgesia and multiple agents to prevent postoperative nausea and vomiting.[49,50] While this may limit opioid use and improve recovery, this must be balanced against the introduction of medications

that should be used with caution in older adults such as nonsteroidal anti-inflammatory drugs, gabapentinoids, and medications with anticholinergic effects such as those included in the Beers Criteria, as well as the propensity for drug–drug interactions.[51] Moreover, polypharmacy is a known risk factor for the development of postoperative delirium.[52] Hence, consideration should be given to whether aspects of protocolized care—be this through ERAS or prehabilitation—are appropriate for each individual as well provide further evidence of the need to incorporate frailty screening before their introduction, given their vulnerability.

PREHABILITATION FOR THE FRAILTY SYNDROME

Despite the clear association between frailty, reduced physiological reserve, and increased risk of poor postoperative outcomes, evidence demonstrating the benefit of prehabilitation for patients with frailty is limited. Recent systematic reviews highlight the paucity of evidence for prehabilitation in this important population.[53–57] It is possible that those at greatest risk of poor outcomes may be the very patients who stand to gain the most from prehabilitation.[58] This section will review the evidence for prehabilitation in people identified with frailty. It will cover interventions that alter the risk profile of the person and studies where postoperative outcomes are reported. Interventions will be classified as unimodal (single intervention), multimodal (>1 intervention offered to all participants), and comprehensive geriatric assessment and management (multidomain assessment and individualized intervention plan, CGA).

Unimodal Interventions

Three studies have examined whether preoperative exercise intervention can improve outcomes for older people with frailty undergoing surgery (Table). Two studies were undertaken in the Netherlands by Hoogeboom et al[59] and Oosting et al,[60] respectively. In the first study, patients were randomized to receive a supervised outpatient exercise program over a 3- to 6-week period or usual care.[59] The study faced challenges with recruitment of frail patients leading to a relaxation of the inclusion criteria from a Clinical Frailty Scale (CFS) score of 5 (indicative of mild frailty) to 2 (indicative of well individuals who are not frail), thus leading to the inclusion of patients who were not frail. Reasons for declining participation in this study included lack of access to transport and feeling fatigued. As a result, the overall proportion of patients deemed frail was 33%. Although the primary indication for the study was feasibility, outcomes including postoperative functional recovery and LOS were reported but did not demonstrate any statistically significant difference. Adherence was high (91%) without any reported adverse events.

As a means of addressing the perceived barriers to inclusion, the authors undertook a further pilot study exploring the feasibility of a home-based exercise program over a period of 3–6 weeks.[60] In this instance, the Identification of Seniors at Risk (ISAR) tool was used to detect frailty with patients randomized to receive either education alone (control) or a home-based supervised exercise program (intervention). Thirty patients were recruited, with 15 in each arm. Patients who received the home-based prehabilitation program had significant improvement in their preoperative 6-minute walk test (6WMT), while those who received education alone declined. There was no significant difference in postoperative outcomes; however, the study was not powered to assess this.

A third study by Waite et al[61] evaluated the impact of a home-based exercise intervention for patients awaiting coronary artery bypass grafting (CABG) or elective valve surgery (open or transcatheter). Although the study specified that patients with frailty were selected for inclusion, the mean CFS at baseline was 4.5 (with a CFS of 4 indicating vulnerability and 5 indicating mild frailty), suggesting that either a lower cutoff that included nonfrail patients was used or the mechanism of identifying frailty was not the CFS. Despite this, in this pilot study of 22 patients, 11 patients were noted to have improved their 6MWT (mean difference = 42.5 m, $P < .05$) before surgical intervention. The authors also noted a statistically significant reduction in CFS from a mean of 4.58–4.05, $P < .001$.

These 3 studies were all undertaken on the basis of feasibility of exercise-based therapies in advance of elective surgical intervention. As a result, each study had <30 participants in total and were not powered to detect outcomes such as rates of postoperative complications, mortality, and LOS. Based on these results, it would appear that exercise in advance of elective surgery in patients with frailty is feasible, safe, and may improve functional capacity in advance of major surgery. Whether this ultimately translates into better postoperative outcomes is uncertain.

In addition to preoperative exercise, current guidelines also recommend that inspiratory muscle training should be incorporated into prehabilitation interventions.[43] Although there is no specific evidence in patients with frailty and limited evidence in older patients, there is little to suggest adverse effects and the interventions seem to be well tolerated.[68] Of note, a recent randomized controlled trial by Boden et al[69] demonstrated that as a little as a single 30-minute physiotherapy session within 6 weeks of surgery can halve the rate of postoperative pulmonary complications. This intervention was also associated with a 12-month mortality benefit when the education was provided by an experienced physiotherapist.

Table. Prehabilitation Intervention for Frail Older People Undergoing Surgical Intervention

Source	Type of Study	Number of Participants	Population/Frailty Measure	Intervention	Outcome
Unimodal intervention					
Hoogeboom et al,[59] 2010, the Netherlands	Randomized controlled study	N = 21, 10 intervention and 11 usual care	Elective hip replacement 65+ y CFS ≥2	Supervised outpatient exercise program over 3–6 wk	No significant difference in postoperative function (time to functional independence 4 vs 4 d), median LOS (6 vs 6 d)
Oosting et al,[60] 2012, the Netherlands	Randomized controlled study	N = 30, 15 intervention and 15 usual care	Elective hip replacement 65+ y ISAR ≥2	Supervised home-based exercise program over 3–6 wk	Improvement in preoperative 6MWT[a] in +7 vs −25 m. No significant difference compared to postoperative period Postoperatively, no significant difference in mean LOS (5.1 vs 5.4 d) or complications (58% vs 71%)
Waite et al,[61] 2017, United Kingdom	Prospective single-arm pilot study	N = 22	Elective CABG or valve surgery 65+ y CFS, inclusion score not specified	Home-based exercise program over 6 wk	Increased preoperative 6MWT[a] (mean + 42.5 m), SPPB[a] (mean + 2.2) Reduction in preoperative mean CFS[a] (4.6–4.1)
Multimodal intervention					
Ellis et al,[62] 2012, United Kingdom	Before and after study	N = 313, 141 pre and 172 post	65+ y Elective surgery Red flags suggestive of frailty	Nurse-led preoperative assessment, occupational therapy review, discharge planning. Postoperative multidisciplinary review and care coordination	Reduction in surgery cancellation[a] (18% vs 5%) or delay[a] (10% vs 2%) Reduction in postoperative complications[a] (8.5% vs 2.3%) and in LOS[a] (8.9 vs 4.9 d)
Chia et al,[47] 2016, Singapore	Controlled before and after study	N = 117, 57 intervention, 60 control	Elective colorectal surgery 65+ y Fried frailty criteria	Education, home-based or day hospital exercise, nutritional support, in addition to ERAS during admission and postoperative rehabilitation	Reduction in LOS[a] (8.4 vs 11.0 d) Nonsignificant improvement in functional recovery (100% vs 95.7%) No difference in complications (5% vs 8%) or 30 d mortality (2% vs 3%)
Mazzola et al,[63] 2017, Italy	Controlled before and after study	N = 76, 35 pre and 41 post Matched on frailty status, diagnosis, and procedure to historical controls	Elective major gastrointestinal surgery mFI ≥2	Nutritional support, smoking cessation, incentive spirometry, motivational counseling 10 d before surgery	Reduction in mortality at 30 d[a] (0% vs 15%) and 3 mo[a] (0% vs 28%) Reduction in complications[a] (41% vs 74%)
Dworsky et al,[64] 2019, United States	Pilot study	N = 9	Veterans undergoing elective surgery Frailty measurement not specified	Tailored intervention of variable duration. Exercise therapy, nutritional support and psychological preparation	Actual outcomes compared to predicted risk more favorable: mean predicted risk of complication 17.9% vs actual 11% and mean predicted 30 d mortality of 1.3% and actual 0%
Comprehensive Geriatric Assessment					
Hempenius et al,[65] 2013, the Netherlands	Randomized controlled trial	N = 297 (randomized) with 260 included in final analysis after exclusion of those lost to follow-up. 127 intervention, 133 control	Elective surgery for a solid tumor 65+ y GFI ≥3	Preoperative CGA with individualized plan targeting delirium prevention. Daily review by geriatric nurse during admission	No significant difference in delirium (9% vs 14%), mortality (8% vs 3%), and median LOS (8 vs 8 d)
Indrakusuma et al, [66] 2015, the Netherlands	Controlled before and after study	N = 100 patients (50 matched pairs)	Elective colorectal surgery for colorectal cancer 70+ y ISAR ≥3	Preoperative comprehensive geriatric assessment	No significant difference in mortality, LOS, delirium, or postoperative complications
Partridge et al,[67] 2017, United Kingdom	Randomized controlled trial	N = 176 Intervention 85, control 91	Elective aortic aneurysm repair or lower limb revascularization 65+ y Frailty measurement not specified	CGA and tailored intervention 6 weeks before surgical intervention	Significantly reduced mean LOS[a] (3.3 vs 5.5 d), complications including delirium[a] (11% vs 24%), cardiac complications[a] (8% vs 27%), wound infections[a] (5% vs 14%), and bowel and bladder complications[a] (33% vs 55%)

Abbreviations: 6MWT, 6-minute walk test; CABG, coronary artery bypass grafting; CFS, Clinical Frailty Scale. CGA, comprehensive geriatric assessment; ERAS, enhanced recovery after surgery; GFI, Groningen Frailty Index; ISAR, Identification of Seniors at Risk; LOS, length of stay; mFI, modified Frailty Index; SPPB, short physical performance battery.

[a]Statistically significant $P < .05$.

A further unimodal exercise-based prehabilitative program is presently underway in Canada.[70] McIsaac et al[70] are undertaking a 3-week preoperative exercise-based intervention in patients deemed vulnerable or frail (CFS ≥4) awaiting elective intra-abdominal and intrathoracic cancer surgery. The intervention will consist of a home-based exercise program focusing on strength, aerobic, and flexibility components. While the primary outcome measure is postoperative 6MWT, secondary outcome measures include quality of life and postoperative complications.

Multimodal Intervention

While the evidence for unimodal prehabilitation interventions for frailty is limited, the evidence for multimodal prehabilitation interventions has demonstrated greater promise. Four studies have examined the capacity of multimodal interventions to address frailty in surgical populations incorporating a range of therapies including exercise, nutritional support, education, and psychological support.[47,62–64]

Ellis et al[62] utilized a nurse-led preoperative program incorporating screening for cognitive impairment and identifying functional impairment and barriers to discharge. Patients were eligible for inclusion if they were aged ≥65 years and were awaiting elective surgery. While no specific frailty measure was utilized for inclusion, the authors recruited patients if "red flags" suggestive of frailty were identified. Each patient received a tailored intervention with referral to occupational therapy as required and preemptive discharge planning. During the hospital stay, care coordination was facilitated by a broader multidisciplinary team, which is part of usual care. Using a before and after study design with a total of 313 patients, the authors noted that patients were significantly less likely to have their surgery cancelled or delayed as a result of the intervention. Furthermore, they noted a significant reduction in postoperative complications (8.5% vs 2.3%, $P < .05$) and LOS (8.9 vs 4.9 days, $P < .05$). This study is limited by the lack of use of a validated measure of frailty assessment; however, the red flags used to screen for patients at risk were indicative of geriatric syndromes known to frequently coexist with frailty and as a result are likely to be relevant to this population.

Chia et al[47] report on a novel model of care for older patients with frailty, identified using Fried frailty criteria, undergoing elective colorectal surgery at Khoo Teck Puat Hospital in Singapore. The "Start to Finish" program incorporates a 2-week period of prehabilitation in the community before intervention, focusing on education, mobility, and nutrition with domiciliary visits by a care coordinator. In this controlled before and after study, patients received either home-based exercise or day hospital prehabilitation dependent on their baseline level of function and mobility. Once admitted to hospital, patients also received ERAS and postoperative rehabilitation. Patients who received the prehabilitation intervention were noted to have a significant reduction in LOS (8.4 vs 11.0 days, $P = .03$). While a reduction in complications was noted in this group (5% vs 8%, $P = .51$), this was not statistically significant. This study comes from a group well versed in the care of older surgical patients, including a transdisciplinary geriatric surgical service for patients undergoing colorectal surgery that has been operating for more than a decade and has demonstrated improved outcomes for this population.[71–73]

Mazzola et al[63] describe a multimodal prehabilitative program focusing predominantly on nutritional optimization in patients with frailty in advance of elective major gastrointestinal surgical intervention. Patients were eligible for inclusion if they had a modified Frailty Index (mFI) of ≥2. Using a controlled before and after study design, intervention patients were matched by frailty status, diagnosis, and procedure to historical controls. The intervention group received prehabilitation in advance of surgery over a period of 10 days. This included nutritional support as well as counseling regarding smoking cessation, incentive spirometry, and the benefits of walking. Mortality was significantly reduced at both 30 days and 3 months, with no deaths recorded in the prehabilitation group compared to 10 patients (28%) in the control group at 3 months ($P < .001$). Some of this mortality benefit seems to stem from a reduction in severe complications (43%–17%, $P = .02$). Despite baseline differences in the relative rates of pancreatic and esophagogastric malignancies in each group, the authors concluded that the multimodal intervention was successful in improving outcomes for frail patients awaiting major gastrointestinal surgery.

A fourth study by Dworsky et al[64] piloted a multimodal prehabilitation program in older veterans with frailty undergoing elective surgery. Patients were selected based on their presumed risk of functional decline using indicators suggestive of frailty. However, the study did not specify whether a validated frailty measure was used as a means of identifying patients suitable for inclusion. This program aimed to improve exercise capacity, reverse malnutrition, and provide psychological preparation for surgery using a tailored intervention before surgery. The duration of intervention varied depending on the time to surgical intervention. Patient outcomes were compared to predicted National Surgical Quality Improvement Program (NSQIP) American College of Surgeons (ACS) risk prediction calculator score for complications, mortality, and LOS.[74] The majority of patients demonstrated favorable outcomes when compared to their individual NSQIP ACS risk

prediction. As a result, the authors concluded that the intervention was feasible for older veterans awaiting elective surgery; however, given the nature of the study (n = 9, pilot study) and the potential of risk prediction to lack accuracy in older adults, little further can be concluded from this study.

An additional study is presently underway in Canada evaluating a multimodal intervention for patients with frailty awaiting surgical intervention.[70,75] Stammers et al[75] are undertaking an 8-week multimodal prehabilitation program for elective cardiac surgery patients. Patients with CFS of ≥4 will receive exercise, nutritional support, and education regarding risk factor reduction with a focus on involving patients in shared decision-making. Outcomes will be measured over a period of 12 months and include LOS, complications, and quality of life.

CGA and Management

Increasingly the concept of recovery from surgery is understood to represent more than recovery of physiological capacity but return to premorbid health including functional, emotional, and cognitive recovery. Current guidelines emphasize the importance of multidisciplinary care along with care coordination and early discharge planning as a means of facilitating recovery and a smooth transition back to the community.[76] Of late, there has been particular focus on whether models of care that promote multidisciplinary collaboration between surgeons, anesthetists, and geriatricians can improve outcomes for older surgical patients.[77] While evidence is well established that CGA for some of the frailest older people admitted to hospital—those with hip fracture—improves postoperative outcomes including a reduction in mortality, institutionalization, and LOS, the evidence is less clear as to whether these benefits extend to other older surgical patients.[78]

CGA is a clinical tool utilized by geriatricians in which a comprehensive multidomain assessment is undertaken that takes into account an individual's comorbidity, function, cognition, and social situation, and results in the development of a tailored management plan taken in the context of that individual's goals and wishes.[79] When delivered to older emergently admitted patients, CGA is known to increase the likelihood of an older person being alive and at home at 12 months.[80] Many of the domains assessed through CGA are relevant to anesthetists and may have an impact on postoperative and intraoperative care alike including cognitive impairment, frailty, and undiagnosed comorbidity, which may not present typically in older individuals. This is best illustrated in a recent randomized clinical trial in which 63.4% patients randomized to preoperative CGA were found to have an undiagnosed comorbidity including 46.5% with undiagnosed cognitive impairment.[67] The proactive identification of these comorbidities, including the presence of frailty, provides opportunity for optimization of care. Furthermore, CGA is considered the gold standard for both assessment and management of frailty as outlined in the British Geriatrics Society Guidelines–Fit for Frailty.[24] The guidelines also emphasize the importance of collaborative care among anesthetists, surgeons, and geriatricians in providing care to older patients with frailty undergoing surgical intervention, however, recognize the need for further research in this area.

Besides frailty, patients with suspected cognitive impairment, functional decline, malnutrition, and decreased mobility may also benefit from preoperative CGA. These and other geriatric syndromes are also considered to be "high-risk" conditions indicating vulnerability in older surgical patients detailed in the American College of Surgeons Optimal Resources for Geriatric Surgery: 2019 Standards.[25] These standards form the basis of optimal care for older (75+) patients undergoing surgery, recommendations for improving outcomes, and emphasize the importance of measuring performance through the Geriatric Surgery Verification Quality Improvement Program. The standards include specialist geriatric review for frail and vulnerable older patients, particularly where multiple geriatric syndromes are present in advance of surgical intervention. The standards also highlight the importance of goal setting and shared decision making—all key components of CGA and the means by which this care would usually be delivered.

While there is clear evidence of benefit in CGA in the older medical population, the evidence in the older nonorthopedic surgical population is less well established. This is illustrated in a recent Cochrane review in which 7 of the 8 chosen randomized controlled trials included studies for hip fracture.[78] As a result, the authors concluded that there was not enough evidence to determine whether CGA was of benefit outside of the hip fracture population. However, evidence is beginning to emerge that CGA may have some role in the older nonorthopedic surgical population.

Partridge et al[67] undertook a randomized controlled trial in older patients (65+ years) undergoing elective lower limb revascularization or aortic aneurysm repair. Patients were randomized to receive a single CGA in advance of surgery or usual care. Over half score of those reviewed were found to have cognitive impairment, known to be particularly prevalent in the vascular surgical population.[81] Interventions included optimization of heart failure treatment, medication review and management, service provision, and allied health review. All patients had access to usual care including geriatrician review through the Proactive Care of Older People Service

(POPS) during admission.[82] Patients who underwent CGA had a significant reduction in a range of postoperative complications, including delirium, cardiovascular complications, and wound infection, as well as a significantly reduced LOS (3.3 vs 5.5 days, $P < .001$). Although a specific frailty measure was not specified, the prevalence of frailty in this cohort is known to be high.[83]

Hempenius et al[65] report on a multicenter randomized controlled trial performed in 3 hospitals in the Netherlands. Patients were eligible for inclusion if they were aged ≥65 years, awaiting elective surgery for a solid tumor, and had a score of ≥3 on the Groningen Frailty Indicator (GFI)—a 15-point frailty assessment tool. A total of 297 patients were randomized to either the control or intervention group, with a total of 260 ultimately being analyzed due to loss to follow-up. Those in the intervention arm received a preoperative CGA by a geriatrician along with a daily review by a geriatric nurse. There was no statistically significant difference in the rates of delirium, mortality, and median LOS.

Indrakusuma et al[66] undertook a retrospective matched cohort study evaluating the impact of preoperative CGA in older patients awaiting elective colorectal surgery. The ISAR tool was used to identify patients appropriate for preoperative CGA, with a score of 3 known to be associated with frailty. Using historical matched controls (based on gender, tumor node, metastasis staging, and American Society of Anesthesiologists physical status scoring system), a total of 50 matched pairs were analyzed. Although there was no statistically significant difference in postoperative outcomes, the authors concluded that differences in cohort groups, including higher rates of sensory impairment and higher mean age in the intervention group, may explain the relative lack of difference and thus potential benefit of preoperative CGA.

Beyond providing comprehensive assessment that may lead to the diagnosis and treatment of additional comorbid conditions, CGA also provides an opportunity for shared decision-making. In the setting of frailty, considering whether surgery is likely to achieve a person's stated goals and wishes is crucial to ensuring that they are most likely to end up with what they would consider a good outcome. Older people frequently rate incontinence, cognitive decline, and disability as worse than experiencing other complications and dying.[84] Furthermore, preoperative identification of frailty is likely to promote discussion and goal setting and is associated with reduced mortality when incorporated as a part of a risk assessment.[85] The Society for Perioperative Assessment and Quality Improvement guidelines emphasize the importance of multidisciplinary care including undertaking CGA for older people with frailty in advance of surgical intervention.[23] Hence, CGA provides the anesthesiologist with an individualized assessment of risk, how this risk may be reduced both pre- and postoperatively, and provides insight as to whether opportunities exist to improve their health status through tailored intervention in advance of surgery.

Although the above evidence is promising, high-quality evidence demonstrating overall benefit of intervention in improving outcomes in patients with frailty remains limited. Multimodal interventions addressing a range of factors contributing to frailty are likely to be of greatest benefit with some capacity to individualize interventions to ensure access and tolerability. While there is no evidence that exercise-based interventions are likely to cause harm, these interventions are not without significant resource implications. Further evidence of feasibility, impact, and cost is required before there is widespread adoption.

CONCLUSIONS

While there is a clear association between the presence of frailty and poor postoperative outcomes, there is limited evidence at this point in time to demonstrate the ability to reverse it through preoperative optimization or prehabilitation. Evidence is emerging to suggest that multimodal prehabilitation interventions incorporating a combination of exercise, nutritional support, and education may be effective in improving postoperative outcomes; however, adequately powered trials are still needed. Time remains a potential limitation, particularly where surgery is indicated in the setting of malignancy, although the presence of frailty should prompt a discussion regarding goals of care given that it is a clinical syndrome known to be associated with a limited life expectancy in its own right.

The surgical journey for an older person with frailty can be long and complex, and many opportunities exist along that entire pathway to enhance care and deliver better outcomes. Regardless of whether frailty status can be altered with prehabilitation, identification through routine screening in advance of surgical intervention is important so that evidence-based peri- and postoperative strategies can be used to prevent functional decline and geriatric syndromes including malnutrition, falls, and delirium. CGA is the gold standard for the management of frailty and should be undertaken promptly and routinely by a geriatrician when detected, allowing for a tailored management plan.[23] Further studies are required to determine the role of prehabilitation in the syndrome of frailty and the model most likely to deliver effective and cost-effective outcomes. From a pragmatic perspective, studies that include evidence-based approaches to interventions along the whole surgical journey are more likely to be effective and deliver outcomes

aligned to the wishes and expectations of this important and growing surgical population.

DISCLOSURES

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Contribution: This author helped write and edit the manuscript and prepare the tables.
Name: Jacqueline C. T. Close, MD.
Contribution: This author help conceptualize, write, and edit the manuscript.
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