Published in final edited form as:

Curr Surg Rep. 2016 June ; 4(6): . doi:10.1007/s40137-016-0140-7.

Postoperative Functional Outcomes in Older Adults

Zabecca Brinson, MD, Victoria L. Tang, MD, MAS, and Emily Finlayson, MD, MS

Department of Surgery (EF, ZB), Department of Medicine (EF, VT), Phillip R Lee Institute for Health Policy Studies (EF), 3333 California St, San Francisco, CA 94118; (415) 885-3606

Abstract

As the world's aging population grows, the surgical population is increasingly made up of older adults. Due to changes in physiologic function and increasing comorbidity burden, older adults are at increased risk of morbidity, mortality, and functional decline after surgery. In addition, decision to undergo surgery for the older adult may be based on the postoperative functional outcome rather than survival. Although few studies have evaluated an older adult's function as a postoperative outcome, surgeons are becoming increasingly aware of the importance of maintaining or regaining function in an older patient. Interventions to improve postoperative functional outcomes are being developed and show promising results. This review discusses existing literature on postoperative functional outcomes in older adults and recently developed interventions.

Keywords

older adults; geriatrics; elderly; functional outcomes

Introduction

Worldwide, the proportion of those aged 65 and over is expected to increase in all developed countries between now and 2030. The United States Census Bureau projects that the population aged 65 and older will total 83.7 million and surviving baby boomers will be over the age of 85. With the continued growth of the older adult population and advances in surgical innovation, the number of older adults who will undergo surgery will continue to increase. Currently, the number of older adults, aged 65 and older, who undergo non-cardiac surgery is expected to double from 7 million to 14 million by 2030.¹

As the surgical population is made up of a greater percentage of older adults, understanding postoperative functional outcomes in older adults is important. Over 70% of older adults place greater value in physical function ability over survival— they would not choose a treatment that caused severe functional impairment, even if survival were ensured [21]. Potential reasons may include a greater emphasis on the quality of life over quantity. Poorer functional status was found to predict higher levels of psychological distress and decreased

corresponding author: Emily.finlayson@uscf.edu.

¹Klopfenstein CE, Herrmann FR, Michel JP, et al. The influence of an aging surgical population on the anesthesia workload: a ten-year survey. *Anesthesia and analgesia* 1998;**86**(6):1165–70.

quality of life in this age group [22]. In addition, functional dependency confers greater risk for postoperative complications and risk of discharge to a post-acute care facility [20].

This review aims to define functional outcome in older adults and describe potential contributions to poor functional outcome, present research findings on postoperative functional outcomes in older adults, and discuss recently developed interventions that focus on improving postoperative functional outcomes in older adults.

Functional outcome in the Older Surgical Patient

Functional status of the older adult is measured in two manners: self-report and performance-based measures. Self-reported measures include basic and instrumental activities of daily living, overall level of physical activity, and self-assessment of physical health. Assessments of basic and instrumental activities of daily living, such as with the use of the Katz Index of Activities of Daily Living (ADL) [17] and Lawton's Instrumental Activities of Daily Living Scale (IADL) [18], are usually short questionnaires that can easily be administered in the clinical setting to determine an older adult's level of dependency (Table 1). Performance-based measures include evaluation of mobility, gait, walking capacity, and grip strength. Examples of performance tasks include the Timed Up and Go Test (mobility and gait), 6 minute walk test (gait and walking capacity), and the use of a handheld dynamometer (grip strength).

Functional outcomes primarily consist of comparing postoperative self-reported and performance-based measures to preoperative measures. Some studies use discharge to a non-home institution and length of stay in a nursing home or rehabilitation facility as surrogate markers for postoperative functional decline and postoperative functional recovery, respectively. Of all the activities of daily living, those most associated with mobility – use of stairs, ambulation, and transferring – may be most important to the older adult in terms of their health status [23].

Risk factors for poor postoperative function outcome

Poor preoperative function (i.e. “baseline function”) has been a well-studied risk factor of poor postoperative function. Specifically, patients who experienced preoperative functional decline are at higher risk for postoperative functional decline [28]. The results from a study examining older women who underwent surgery for prolapse suggest that preoperative functional limitations predict the risk of increased functional limitations following surgery [34]. Another study examining the functional recovery of older adults following cardiac surgery found that preoperative ADL impairment predicted poorer recovery to baseline 4–6 weeks postoperatively [35].

Frailty, a measure of physiologic vulnerability, has been consistently linked to poor functional outcomes [29, 36]. Frailty is a multifactorial issue linked to poor nutrition, strength, mobility, depression, multimorbidity, and cognitive impairment. Poor nutrition may contribute to sarcopenia, muscle weakness, and low energy level. Poor psychosocial well-being may contribute to poor engagement in one's own care and well-being, one of

which includes functional activity. Multiple domains of frailty may act synergistically to place individuals at increased risk for functional decline.

Functional recovery over time

Physical functional recovery in older adults who have undergone major surgery is slow and limited. In a landmark study, Lawrence *et al.* (2004) [27] performed a large prospective cohort study of those aged 60 years or older who underwent major abdominal surgery. In their study, it took patients 6 weeks to 3 months to recover basic ADLs but up to 6 months to recover their IADLs [27]. Patients who had better preoperative physical status had a shorter time to recovery in their IADLs. In the very frail, functional outcomes were far worse. In a national study of nursing home residents aged 65 years of age and older who underwent colectomy for cancer had sustained decline in functional status at one year [28]. Ronning *et al.* (2013) [29] found patients 70 years of age and older who had elective resection of colorectal cancer had significant decreases in their ADLs and IADLs up to 16–28 months postoperatively. Notably, these individuals demonstrated no significant changes on their Timed Up and Go or grip strength measures at follow-up.

Following surgery, decline in functional status may be protracted in the older adult. Kwon *et al.* (2012) [30] found that a significant number of patients aged 65 years or older who underwent major, non-emergent abdominal or thoracic surgery had functional decline up to 1 year following surgery, as measured by the clinically significant increase of Stanford Health Assessment Questionnaire-Disability Index (HAQ-DI) [31] score of 0.1 or greater. The HAQ assesses functional status in eight domains – dressing, arising, eating, walking, hygiene, reach, grip, and usual activities [31]. Those with higher functional status at baseline, measured by Duke Activity Status Index and physical function score (gait speed, grip strength, balance, and standing speed), were found to recover more quickly – with improvement of HAQ scores starting at 3 months – but neither group returned to baseline functional status at 1 year [30].

Operations, such as lower extremity revascularization and hip fracture repair, whose aim is to maintain function, have poor functional outcomes in the very frail. Among nursing home residents who undergo lower extremity revascularization procedures, over half were dead or non-ambulatory after 1 year [32]. After hip fracture, less than a quarter of residents who were functionally intact before surgery were alive and independent 6 months after surgery [33].

Interventions to Improve Postoperative Functional Outcomes in the Older Adult

The American College of Surgeons National Surgical Quality Improvement Program and the American Geriatric Society preoperative guidelines recommend that all older surgical patients should have an assessment of functional status, suggesting the use of a 4-item screening test that evaluates independence in transferring, dressing and bathing, making meals, and shopping; the answer of “No” for any of the items should prompt a full assessment of their ADL and IADL [24]. This comprehensive assessment identifies older

adults who are at higher risk of functional decline and who may benefit from interventions aimed at preserving function.

Pre-hospitalization Interventions

For elective surgical procedures, there is time during the preoperative period to address functional status dependency. Interventions to improve functional status during the preoperative period are commonly referred to as “prehabilitation.” Prehabilitation programs are usually composed of exercise programs that are initiated during the preoperative period. They may also employ adjunct interventions such as patient education about surgery and the recovery process, dietary counseling, protein supplementation, or anxiety and/or stress reduction. A recent systematic review and meta-analysis of 21 studies, 19 of which were randomized controlled trials, found that prehabilitation improved physical function, improved postoperative length of stay, and provided postoperative physical benefits in older surgical patients [47].

A single-center randomized controlled trial [48] found beneficial results with implementation of a prehabilitation exercise program in the preoperative period for those older patients undergoing elective colorectal surgery. Those who were able to improve their functional walking capacity preoperatively were more likely to return to their baseline walking capacity within 6 months postoperatively, reported better scores on the SF-36 in the areas of mental health, vitality, general health perception, and had improved cardiorespiratory fitness, as measured by the VO_{2peak} . Those who deteriorated during the prehabilitation period were at greater risk of surgical complications and intensive care management, suggesting that the intervention could itself serve potentially as an assessment tool for postoperative morbidity.

Another pilot study investigating the effect of prehabilitation on patients who underwent resection for colorectal cancer used the 6 minute walk test as their primary outcome [49]. The intervention, called the Peri Operative Program (POP), added nutritional counseling, protein supplementation, and anxiety reduction to moderate aerobic exercise and resistance training. Patients were able to improve their functional walking capacity prior to surgery and had better walking capacity 4 and 8 weeks postoperatively compared to the control group. A randomized controlled trial is currently ongoing at McGill University to further investigate the impact of the program.

An increasing number of healthcare systems have adopted some version of preoperative geriatric surgical care with potential to improve postoperative functional outcomes in older adults. Several models include the multi-disciplinary theme of physical therapy, occupational therapy, nutrition, and geriatric medicine. Each discipline contributes through evaluation and optimization of patient characteristics that may contribute to a poorer functional outcome (i.e. poor nutrition, reversible delirium risk).

An additional preoperative intervention that prevents poor postoperative functional outcomes is one that involves eliciting patient values and goals. With the understanding that many older adults value quality of life, which for many includes functional independence, over quantity of life, not undergoing an operation that likely leads to loss or decline of functional

independence may be one method of aligning intervention with patient-centered outcome. In such circumstances, patient engagement with palliative care may be offered.

Inpatient Interventions

A multicenter randomized controlled trial [50] of 1,388 hospitalized older patients on both medical and surgical units found that the implementation of an inpatient intervention with a focus on maintenance of the patient's functional status had significant improvements in activities of daily living ($p < 0.001$) and physical performance ($p < 0.001$) at discharge compared to usual care. In addition, patients who received the inpatient intervention self-reported significantly better scores on the Medical Outcomes Study 36-Item Short-Form General Health Survey (SF-36) in the areas of physical functioning ($p = 0.006$), general health ($p = 0.006$), and bodily pain ($p = 0.001$) at discharge compared to those who had usual care.

Other smaller scale studies have demonstrated the value of such inpatient interventions in the geriatric surgical population. Implementation of a modified Hospital Elder Life Program (HELP) intervention [51] that included ambulation or active range-of-motion exercise 3 times daily resulted in significantly less functional decline at discharge ($p < 0.001$) in older adults who had had abdominal surgery compared to usual care. Another inpatient intervention based on HELP called "CareWell in Hospital" (CWH) [52] showed a small improvement in ADLs in their geriatric surgical patients between discharge and 3 months post-discharge compared to pre-implementation (7.7 vs. 4.5, $p = 0.035$) but effects were influenced by a learning curve of the hospital staff slowing successful implementation.

A study of older adults who underwent open cardiac surgery and participated in an inpatient rehabilitation program [53] were able to improve their Functional Independence Measure scores from admission to discharge from 76.1 ± 17.1 to 96.7 ± 19.4 ($p < 0.001$). Improvement from admission to discharge in the subcategories of self-care (eating, grooming, bathing, dressing upper body, dressing lower body, going to the bathroom) of 25.1 to 33.9 ($p < 0.001$) and transfers (to bed, chair/wheelchair, toilet, and tub/shower) of 10.4 to 14.8 ($p < 0.001$) were also seen. Notably, these improvements were seen over a relatively short period of time – length of stay ranged from 2 to 25 days – but analysis of this change in functional status is limited by the lack of a control group for comparison.

A current model of care that is being developed in the hospital setting includes the mobile ACE unit. The Acute Care of Elders (ACE) model was initially developed for older adults hospitalized for an acute medical condition and was shown to improve a community dwelling older adult's likelihood of maintaining function and returning to their home versus admission to a nursing home. The mobile ACE unit, consisting of a geriatrician-led interdisciplinary team, is being developed in hopes to assist in decreasing functional loss from surgical hospitalization.

Post-discharge Interventions

Interventions implemented after discharge may also improve the functional status of the geriatric surgical patient. Preliminary data from a prospective study investigating the effect of a quality improvement program [54] found that ordering physical therapy consults and

home health nursing on discharge for those patients aged 65 or older who underwent general or vascular surgery operations and had a score of 3 or greater on the Vulnerable Elder Survey resulted in significantly better functional status 30 days after discharge in their post-intervention group ($p < 0.01$). Implementation of a 12-month high-intensity progressive resistance training program 6–8 weeks after hip fracture in the Hip Fracture Intervention Trial (HIPFIT) [55] resulted in significantly less decline in ADL toileting ($p < 0.05$) and transferring ($p = 0.04$) at one year than those who received usual care. Twelve weeks of progressive aquatic resistance training [56] resulted in improvement in the functional status of older adults after unilateral knee replacement, as measured by increases in habitual walking speed ($p = 0.005$) and decreased stair ascending time ($p = 0.006$).

Clinical Pathways

Interventions that span multiple components of the perioperative setting are being developed; yet, few have been studied. Proactive Care of Older People Undergoing Surgery (POPS) [57] for those adults aged 65 and older who underwent elective orthopedic surgery included pre-hospitalization, inpatient, and post-discharge multidisciplinary interventions was developed in 2008. Implementation of the program resulted in the reduction of dependent transfers on postoperative day 3 from 14.8% to 0% ($p = 0.003$), length of stay from 15.8 ± 13.2 to 11.5 ± 5.2 ($p = 0.028$), and delayed discharge due to slow rehabilitation from 13.0% to 7.4%. Another intervention called the Start to Finish (STF) program [58] utilized prehospitalization and inpatient interventions to successfully achieve shorter mean length of stay (8.4 vs. 11.0 days, $p = 0.029$) but achieved similar high rates of total functional recovery 6 weeks post-discharge (98.2% vs. 93.3%, $p = 0.189$).

Geriatric surgical care pathways that span the peri-operative period are being developed at different health systems. The intent of these care models are multi-fold, one of which includes maintaining functional independence in the older surgical adult. An example of several U.S. based pathways incorporates a preoperative intervention with a hospital intervention. “Geri-ERAS”, an ERAS protocol adapted for the geriatric population that has an emphasis on maintenance of function, is currently being piloted at our institution.

Conclusion

Postoperative functional status is an important patient-centered outcome. Living independently is one of the most important aspects in deciding to undergo surgery. While an important outcome, limited information is available about postoperative functional outcomes of major surgery. Risk factors for poor functional recovery include baseline frailty, functional disability and cognitive impairment. Innovative multi-component care pathways aimed at improving functional recovery in older adults are gaining traction globally.

As greater numbers of older adults choose to undergo surgery, it is increasingly important to be able to identify older surgical patients who are at greater risk for poor postoperative functional outcomes. Further research in postoperative functional outcomes of older adults is necessary to inform decision-making in this population. Lastly, more research is needed to determine evidence-based content of care pathways aimed at improving functional recovery after surgery.

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Table 1

Katz Index of Activities of Daily Living (ADL) and Lawton's Instrumental Activities of Daily Living (IADL)
[17, 18]

Activities of Daily Living: <ul style="list-style-type: none">• Functional mobility (i.e. transferring)• Bathing• Dressing• Self-feeding• Grooming• Toileting
Instrumental Activities of Daily Living: <ul style="list-style-type: none">• Housework• Preparing meals• Taking medications, as prescribed• Managing money• Shopping• Use of telephone• Transportation within the community