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Slower Walking Speed Forecasts Increased Postoperative Morbidity and One-Year Mortality Across Surgical Specialties

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Abstract

Objective—The purpose of this study was to determine the relationship between the timed up-and-go test and postoperative morbidity and one-year mortality, and to compare the timed up-and-go to the standard-of-care surgical risk calculators for prediction of postoperative complications.

Methods—In this prospective cohort study, patients 65 years and older undergoing elective colorectal and cardiac operations with a minimum of one-year follow-up were included. The timed up-and-go test was performed preoperatively. This timed test starts with the subject standing from a chair, walking ten feet, returning to the chair, and ends after the subject sits. Timed up-and-go results were grouped: Fast≤10 sec, Intermediate=11-14 sec, Slow≥15 sec. Receiver operating characteristic curves were used to compare the three timed-up-and-go groups to current standard-of-care surgical risk calculators at forecasting postoperative complications.

Results—This study included 272 subjects (mean age of 74±6 years). Slower timed up-and-go was associated with an increased postoperative complications following colorectal (fast-13%, intermediate-29% and slow-77%;p<0.001) and cardiac (fast-11%, intermediate-26% and slow-52%;p<0.001) operations. Slower timed up-and-go was associated with increased one-year mortality following both colorectal (fast-3%, intermediate-10% and slow-31%;p=0.006) and cardiac (fast-2%, intermediate-3% and slow-12%;p=0.039) operations. Receiver operating characteristic area under curve of the timed up-and-go and the risk calculators for the colorectal group was 0.775 (95% CI:0.670,0.880) and 0.554 (95% CI:0.499,0.609), and for the cardiac group was 0.684 (95% CI:0.603,0.766) and 0.552 (95% CI:0.477,0.626).

Conclusions—Slower timed up-and-go forecasted increased postoperative complications and one-year mortality across surgical specialties. Regardless of operation performed, the timed up-and-go compared favorably to the more complex risk calculators at forecasting postoperative complications.

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INTRODUCTION

Preoperative risk assessment helps patients, families, and clinicians make informed decisions about whether or not to proceed with elective operations. With more than one third of all inpatient operation in the United States being performed on individuals 65 years and older,[1] improving our ability to predict surgical risk of older adults is imperative.

Traditional surgical risk assessment utilizes chronic disease burden and single end-organ dysfunction to quantify postoperative risk. Using this strategy, surgical "risk calculators" have emerged as the new standard of care to predict postoperative risk.[2-3] These calculators allow clinicians to input variables typically available in the clinical chart and then output the predicted chance of complications or death. The risk calculators are constructed using statistical regression models that weight variables based on their association with an outcome.

Recent reports suggest quantifying characteristics of frailty may be a more powerful way to define an older adult's risk for adverse postoperative events.[4-7] Frailty describes physiologic vulnerability of older adults to health stressors and predisposes to disability.[8] Quantifying frailty is accomplished by performing a "geriatric assessment" which measures clinical characteristics relevant to the older adult including function, cognition, mobility, nutrition, depression, and polypharmacy. An abnormal preoperative geriatric assessment is closely related to the occurrence of adverse postoperative outcomes including complications,[6, 9] need for discharge to an institutional care facility, [5, 6, 10] and mortality.[10]

The timed up-and-go has been proposed as a single measurement to identify frail older adults who are at high risk for adverse health outcomes.[11] A slower timed up-and-go predicts health decline, cognitive decline, and falls in community-dwelling older adults.[12-15] The relationship between the timed up-and-go and postoperative outcomes is not known. The purpose of this study was to determine the relationship between the timed up-and-go and postoperative morbidity and one-year mortality, and to compare the timed up-and-go to standard-of-care surgical risk calculators at forecasting postoperative complications.

METHODS

This was a prospective cohort study of patients 65 years and older undergoing elective colorectal and cardiac operations. Colorectal and cardiac operations were chosen to study because these are two of the five most common inpatient operations performed on adults aged 65 and older.[16] Exclusion criteria were colorectal resections with combined additional procedures (e.g., combined liver resection or pelvic exenteration) and emergent (clinical conditions that mandate surgery within 12 hours of admission or cardiac catheterization) or urgent (clinical conditions that mandate surgery between 12 and 72 hours of admission or cardiac catheterization) operations. Clinical variables were collected prospectively. This study included operations performed at the Denver VA Medical Center and was approved by the Colorado Multiple Institutional Review Board (COMIRB 08-1071). Enrollment occurred from January 2007 to October 2011. Follow-up was obtained through November 2012. All patients had a minimum of one year follow-up.

The two predictor variables were the timed up-and-go test and the Veteran Affairs (VA) mortality risk calculator. First, the timed up-and-go is a timed test, which begins when the subject stands without the aid of their arms from a chair, walks 10 feet, returns to the chair and then ends when the subject sits back down in the chair.[17] The timed up-and-go was performed prior to the surgery but within 30 days of the operative date. The average time required to complete the timed up-and-go was less than one minute. The time up-and-go measurement was recorded in seconds and is reported as an ordinal variable (Fast ≤ 10

seconds, Intermediate = 11 to 14 seconds, and Slow ≥ 15 seconds). Second, the VA 30-day mortality calculator, currently used as the standard of care to define preoperative risk, provides an estimate of the risk of 30-day mortality for each patient.[18] Preoperative clinical variables were input including Current Procedural Terminology (CPT) codes (which provide uniform information for a planned procedure for analytical purposes) and the presence of a variety of co-morbidities (e.g., creatinine level, ischemic heart disease, diabetes, chronic obstructive pulmonary disease, etc.). The colorectal surgery calculator required the input of 34 clinical variables and the cardiac surgery calculator required the input of 24 clinical variables. The average time required to complete the online risk calculator was 10 minutes per patient. The percent risk of 30-day mortality was broken into tertiles to reflect lowest surgical risk (lowest tertile), intermediate surgical risk (middle tertile), and highest surgical risk (highest tertile).

Baseline characteristics reported include chronic diseases and biomarkers (albumin and hematocrit) which have been previously shown to be closely related to adverse surgical outcomes in the VA population. [19-20] Baseline characteristics were defined as present or absent using VA Surgical Quality Improvement Program (VASQIP) definitions for cerebrovascular disease, insulin dependent diabetes, congestive heart failure, ischemic heart disease, hypertension, and chronic obstructive pulmonary disease. See online Table 1 for detailed list of VASQIP identifiers used to define these variables. Other preoperative variables recorded include the American Society of Anesthesiology (ASA) Classification,[21] which assess the physical status of the patient; the Charlson Index,[22] which is a co-morbidity score weighted on the risk of one year mortality ranging from 0 (no co-morbidities, lowest risk) to 19 (highest co-morbidities, greatest risk); the Mini-Cog,[23] which is a commonly used cognition screening tool that combines a three item recall and clock drawing task (impaired cognition was defined as a Mini-Cog score ≤ 3 based on previous reports[24-25]); the Katz index,[26] which measures independence in activities of daily living (dependence was considered present if there was dependence in one or more of the activities of daily living: bathing, dressing, toileting, transferring, continence, and feeding); and the history of one or more unexpected falls in the six-months prior to the operation (falling is an important geriatric syndrome[27] which has been linked to adverse surgical outcomes[28]).

Operative clinical variables recorded included: site of colorectal operation (right colectomy included right and extended right colectomies, left colectomy included left colectomy, low anterior resection and abdominal perineal resection, and subtotal colectomy which both the left and right colon were resected), type of cardiac operation (coronary artery bypass, cardiac valve replacement, or combined coronary artery bypass and valve replacement), time of operation in minutes, estimated blood loss in milliliters (no estimated blood lose is reported for cardiac cases due to the use of the cardiopulmonary bypass machine), and number of intra-operatively transfused units of packed red blood cells. For colorectal operations, the stage of malignancy was determined following postoperative histologic analysis.[29]

Recorded postoperative outcomes met criteria of a moderate or severe complication (mild complications were not included) by the Accordion Severity Classification.[30] Outcomes were defined using VASQIP definitions and included: cardiac complication, respiratory complication, renal complication, neurologic complication, postoperative infection, sepsis, deep vein thrombosis, and re-operation within 30-days. See online Table 1 for detailed list of VASQIP identifiers used to define these variables. Re-admission to any hospital within 30-days of the operation was defined as a complication. A complication was defined as present if it occurred during the initial hospital stay or during the first 30 days following discharge. One or more of the complications listed in addition to hospital mortality was considered positive for the presence of one or more complication. The presence of post-

discharge institutionalization was defined as discharge to a nursing home, transitional care facility, or acute care facility in a patient who previously lived at home. Subjects with inpatient deaths were excluded from post-discharge institutionalization analysis.

Statistical analysis performed compared the slow timed up-and-go group to the combined intermediate and fast groups. For categorical data, Chi-square and Mantel-Haenszel Chi-square for trend were conducted when the expected values were >5, otherwise Fisher exact test was used. For continuous variables, the nonparametric Kruskall-Wallis test was used to compare the slow group to the combined intermediate and fast groups. The diagnostic accuracy at predicting one or more postoperative complications was compared between the time up-and-go and the risk calculator. The diagnostic accuracy of each predictor variable was determined by a receiver operating characteristic (ROC) area under the curve with 95% confidence intervals. For this analysis, the timed up-and-go test was used to group patients into fast, intermediate, and slow groups and the risk calculator group was used to group patients by tertile into the low, intermediate, and high risk groups. Kaplan-Meier cumulative survival analysis was performed to determine long-term survival. All statistical tests were two-tailed and significance established at 0.05. SAS version 9.3 (SAS Institute Inc., Cary, NC) was used.

RESULTS

A total of 272 patient (colorectal operations n=98 and cardiac operations n=174) were studied. Figure 1 shows the enrollment of all participants. The average age of all patients was 74±6 years. Females accounted for 2% (n=6) of the total group which included 4% (n=4) in colorectal group and 1% (n=2) in cardiac group. One or more postoperative complications occurred in 30% (n=82) which included 37% (n=36) in the colorectal group and 26% (n=46) in the cardiac group. Thirty-day mortality occurred in 2% (n=5) which included 2% (n=2) in the colorectal group and 2% (n=3) in the cardiac group.

Baseline characteristics comparing the slow timed up-and-go group to the combined intermediate and fast groups are reported in Tables 1 and 2. In the colorectal group, characteristics associated with the slow timed up-and-go group included: older age, history of chronic obstructive pulmonary disease, lower albumin, lower hematocrit, an ASA score ≥3, impaired cognition, dependence in one or more activity of daily living, and a positive fall history. In the cardiac group, characteristics associated with the slow timed up-and-go group included: older age, higher creatinine, lower albumin, lower hematocrit, impaired cognition, dependence in one or more activity of daily living and a positive fall history.

Intra-operative variables comparing the slow timed up-and-go group to the combined intermediate and fast groups are reported in Tables 1 and 2. The intra-operative variables were similar in both the colorectal and cardiac operation groups.

Postoperative outcomes comparing the slow timed up-and-go group to the combined intermediate and fast groups are reported in Table 3. In both the colorectal and cardiac surgery groups, the slow timed up-and-go group had higher rates of one or more complications, 30-day readmission, need for discharge to an institutional care facility, and one-year postoperative mortality. Kaplan-Meier cumulative long-term survival is graphed for the colorectal (Figure 2) and cardiac (Figure 3) groups. The slow timed up-and-go group had significantly lower cumulative survival in comparison to the intermediate and fast groups in both the colorectal (log rank p=0.002) and cardiac (p<0.001) groups.

The diagnostic accuracy of the timed up-and-go versus the standard of care surgical risk calculator was compared using receiver operating characteristic area under the curve statistic. The timed up-and-go was superior to the risk calculator in the colorectal group and

compared favorably in the cardiac group at predicting one or more postoperative complications following both colorectal and cardiac operations. (see Table 4)

DISCUSSION

This study examined the relationship of a preoperative timed up-and-go score and postoperative outcomes in individuals 65 years and older undergoing elective colorectal and cardiac operations. A timed up-and-go score of 15 seconds or longer was associated with a significantly increased occurrence of one or more postoperative complication, 30-day readmission, need for discharge to an institutional care facility, and one-year mortality. Importantly, this finding was consistent regardless of whether colorectal or cardiac operation was performed. The group with a slow timed up-and-go score consistently displayed poorer performance in other baseline geriatric characteristics indicative of frailty, such as poorer cognition, higher dependence in activities of daily living, and increased occurrence of preoperative falls across both surgical groups. Thus, the timed up-and-go may provide a useful screening indicator for frailty in older surgical patients. The current study also compared the diagnostic accuracy of the timed up-and-go to the more complex standard of care surgical risk calculator at forecasting the occurrence of one or more postoperative complications. The timed up-and-go's risk prediction was superior for patients undergoing colorectal operations and compared favorably for patients undergoing cardiac operations to that of the risk calculator following both colorectal and cardiac operations.

The timed up-and-go was initially described as an objective means of following an older adult's functional change over time.[17] The stated benefit of the timed up-and-go in this initial report was that "the test is quick, requires no special equipment or training, and is easily included as part of the routine medical examination."[17] Since the initial report, multiple studies have found the strong correlation between a prolonged timed up-and-go and poorer health,[12] worse functional status,[31] impaired cognition,[13] and falls.[15, 32] There is no single timed up-and-go score that is accepted as a standard cut-point for poor performance. However, a score longer than 13 seconds has been used previously in community-dwelling older adults. For example, Shumway-Cook and colleagues found the timed up-and-go cutoff value of ≥13.5 seconds identified older adults prone to falls with 80% sensitivity and 100% specificity.[15]

A unique feature of the timed up-and-go is that it detects multidimensional clinical deficits of the older adult, capturing the broader concept of frailty. The best example of this concept is that a slower timed up-and-go is closely related with impaired cognition. Donoghue and colleagues[13] performed a prospective cohort study on 4,998 community-dwelling adults 50 years and older and found that a slower timed up-and-go was independently associated with poorer memory, attention, letter fluency, and cognitive reaction time. Katsumata and colleagues[14] found a timed up-and-go score of ≥14 seconds in independently living adults 80 years and older was associated with decline in global cognitive function at 3 years. These authors went on to suggest that the timed up-and-go may be useful as a tool for early detection of cognitive impairment. The fact that the timed up-and-go can reflect reduced cognitive function in addition to reduced mobility suggests that an older adult's timed up-and-go score may reflect multi-dimensional clinical deficits.

The ability of the timed up-and-go to predict health outcomes may be similar to measurement of walking speed alone. Walking speed, or gait speed, is a characteristic of phenotypic frailty.[33] In community-dwelling older adults, slower walking speed is closely related to decreased survival, poorer health, and reduced function.[34-36] Viccaro and colleagues[12] found the timed up-and-go was similar to gait speed at predicting health decline, functional decline, and falls in community-dwelling adults 65 years and older. In

surgical patients, Afilalo and colleagues[37] compared postoperative outcomes in patients 70 years and older undergoing a cardiac operation who had a 5-meter timed walk test of ≥6 seconds or <6 seconds. This study found that slow gait speed independently predicted the occurrence of postoperative complications (odds ratio 3.05: 95% confidence interval 1.23, 7.54). Additionally, patients with slow gait speed also had higher mortality (1% versus 10%; p=0.047).

The timed up-and-go represents a simple, quick, and more powerful alternative for stratifying preoperative risk in older persons. This study is important for two reasons. First, the timed up-and-go represents a single test which may be used in the place of longer, more comprehensive geriatric or frailty assessments. The benefits of the timed up-and-go not only include superior ability to predict adverse outcomes but also a ten-fold time savings. One barrier to the implementation of any newly proposed preoperative assessment method is the extra time required to complete the assessment. The timed up-and-go may represent a simplified assessment in comparison to more extensive geriatric assessments. A unique characteristic of the timed up-and-go is that poor performance on this test correlates well with impairment in other geriatric assessment characteristics (e.g., cognition, mobility, function),;a fact that suggests stand-alone use of the timed up-and-go may be reasonable. Savva and colleagues[11] found that a timed up-and-go of 15 seconds or long predicted the presence of phenotypic frailty with 100% sensitivity. However, it must be recognized the timed up-and-go alone does not accurately capture the full frailty syndrome, which also includes grip strength, low physical activity level, weight loss, and exhaustion.[11] Second, to our knowledge this is the first report directly evaluating the relationship of the timed up-and-go test and surgical outcomes. The timed up-and-go is commonplace in geriatric-centered clinical settings but is not routinely used in the preoperative setting.

It is important to consider whether the timed up-and-go can improve the preoperative care of the older adult. Improving care is conceptually different than a comparison of diagnostic accuracy of two preoperative risk assessment strategies (the timed up-and-go and the risk calculator) reported in our study. To improve a patient's care suggests that some clinical status or parameter can be modified to improve outcomes. To date, there is no evidence that suggests measurement of a preoperative timed up-and-go can improve outcomes. However, the logical intervention to implement resultant from a slow timed up-and-go would be to improve mobility through physical therapy either pre- or postoperatively. Data for the effectiveness of preoperative physical therapy, or "prehabilitation", suggests that improved function and decreased length of hospital stay can be achieved but this strategy has not shown the ability to reduce complications or mortality.[38-39, 40] A single study found a prolonged timed up-and-go score to be associated with increased risk of deep venous thrombosis.[41]

The main limitations of this study are twofold. First, the VA surgical risk calculator was designed to forecast the risk of 30-day mortality, not the other outcomes examined in our study (psostoperative complications and longer-term mortality). This study compared the timed up-and-go to the risk calculator in terms of postoperative complications, but not 30-day mortality because only 2% of study participants died within 30-days. By using postoperative complications for comparison, the ability of the risk calculator to be optimally accurate is compromised. However, we justify this strategy because the risk calculator is current standard of care for preoperative risk counseling in VA medical centers and we use it to broadly stratify surgical risk by low, intermediate, and high tertiles. Second, the vast majority of patients in this study were male. While acknowledging that this reflects the gender distribution of a veteran's affairs medical center and not selection bias, this finding does preclude the robust examination of the impact of gender on our results. Future studies

to extrapolate our findings to other settings that include more women will be an important next step.

In summary, the timed up-and-go test used preoperatively in older adults forecasts postoperative complications and one-year mortality across surgical specialties. Using a test such as the timed up-and-go in preoperative risk assessment represents a paradigm shift from current preoperative risk assessment strategies in which co-morbidity burden is used to forecast postoperative outcomes. Future directions of this work include screening older adults prior to an operation with the timed up-and-go and providing preoperative prehabilitation (e.g., physical therapy aimed to improve mobility, gait, balance, and transfers) to determine whether the increased risk associated with a slow timed up-and-go can be modified.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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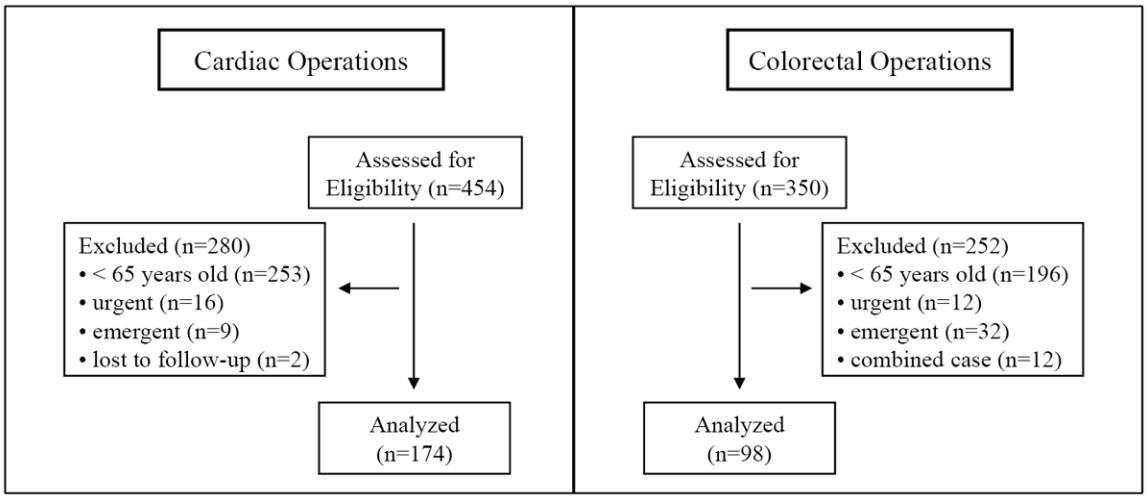

Figure 1. Participant Flow Diagram

Combined operations excluded in the colorectal group included the planned resection of additional structures: pelvic exenteration (n=6), hepatectomy (n=5) and nephrectomy (n=1).

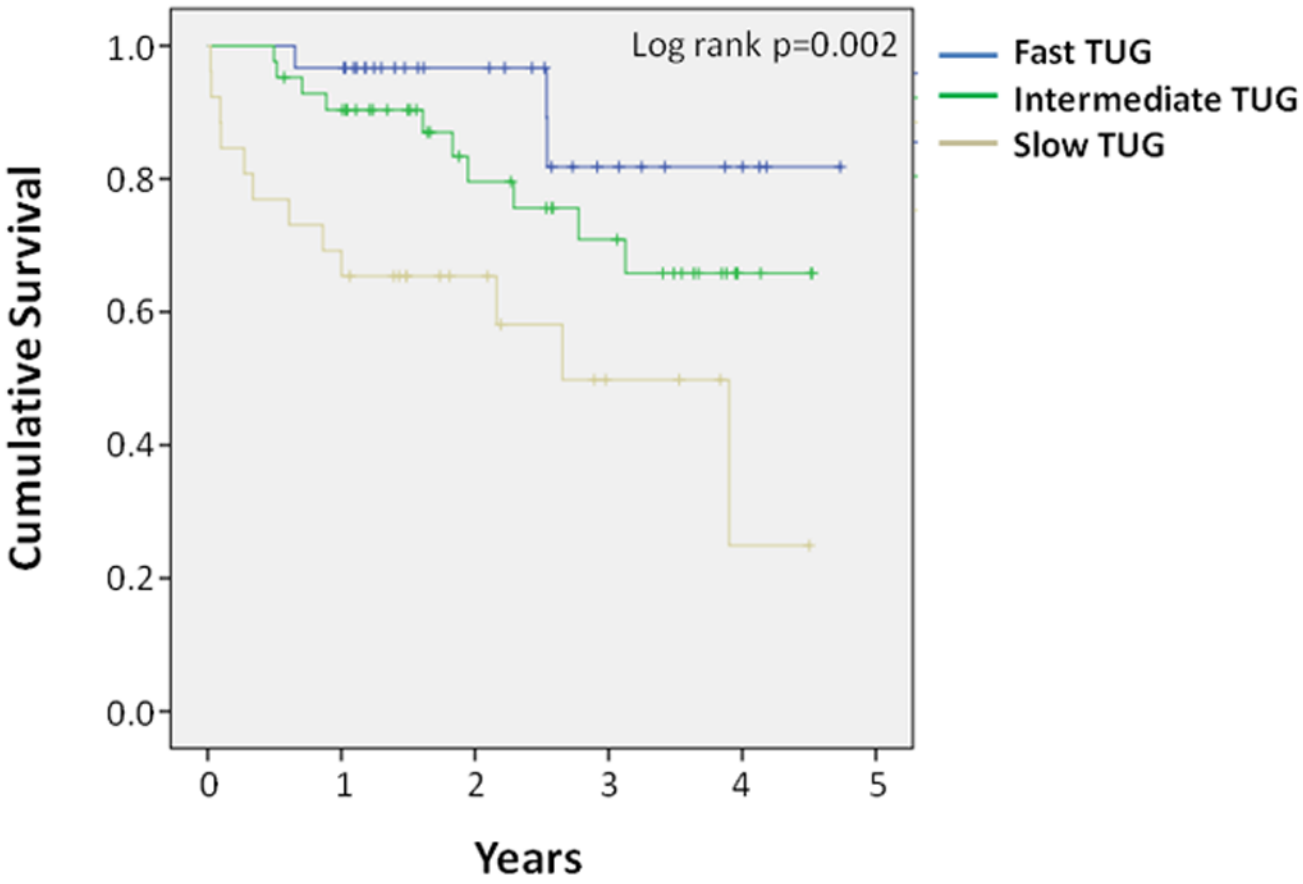

Figure 2. Cumulative Survival – Colorectal Group

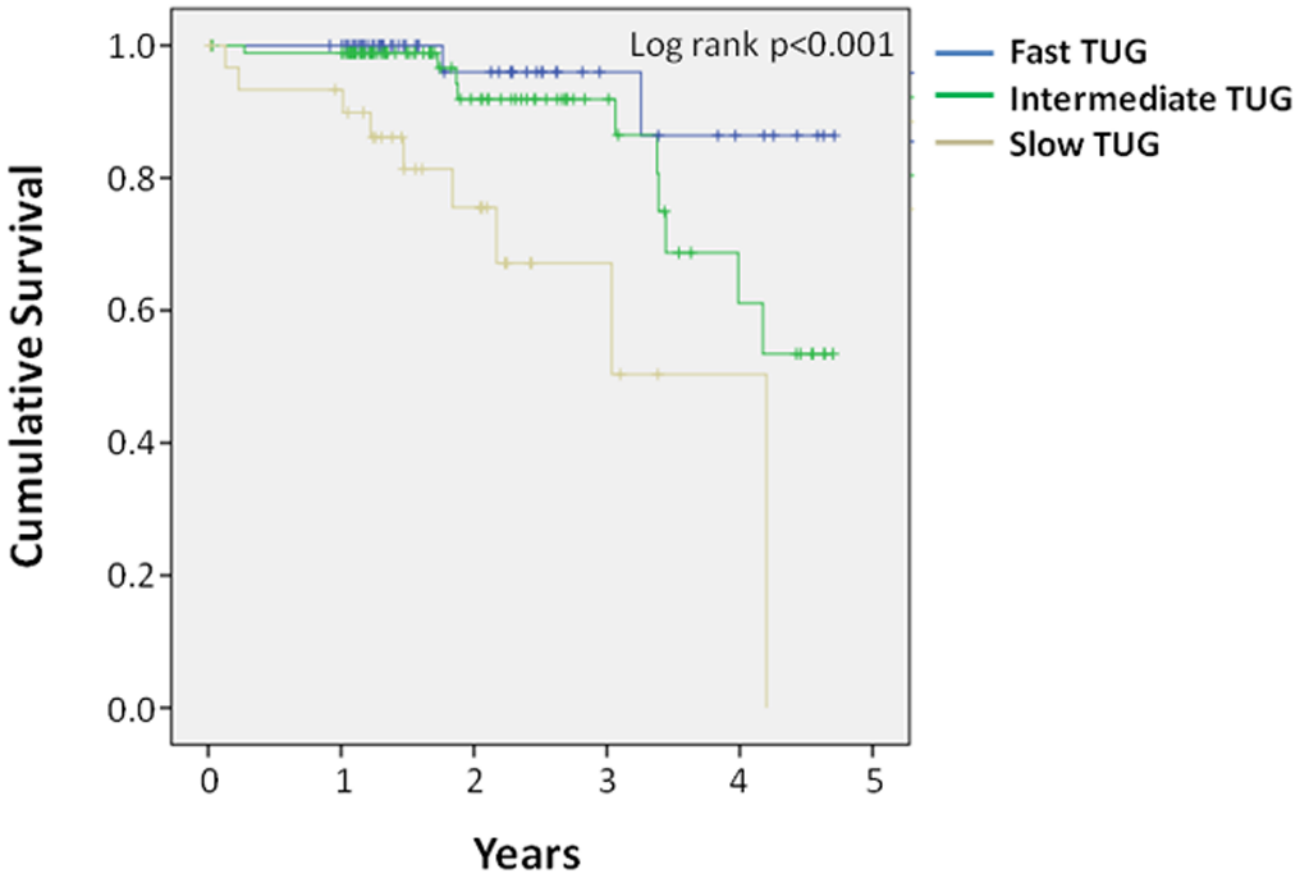

Figure 3. Cumulative Survival – Cardiac Group

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Table 1

Baseline Characteristics of Patients and Operations – Colorectal Surgery Group

		Time Up-and-Go			
	Total Group (n=98)	**Fast (≤10 seconds) (n=30)**	**Intermediate (11-14 seconds) (n=42)**	**Slow (≥15 seconds) (n=26)**	**p-value**
Baseline Preoperative Variables					
Age (years)	74±7	70±5	74±7	79±8	<0.001
Cerebrovascular Disease	9% (9)	3% (1)	14% (6)	8% (2)	1.000
Insulin Dependent Diabetes	7% (7)	7% (2)	5% (2)	12% (3)	0.377
Congestive Heart Failure	10% (10)	7% (2)	12% (5)	12% (3)	0.722
Ischemic Heart Disease	15% (15)	7% (2)	5% (2)	12% (3)	0.377
Hypertension	74% (72)	67% (20)	77% (32)	77% (20)	0.647
COPD	19% (19)	13% (4)	14% (6)	35% (9)	0.022
Creatinine (mg/dL)	1.2±0.5	1.1±0.2	1.1±0.3	1.5±0.7	0.097
Body Mass Index	26±5	27±4	26±6	25±4	0.234
Albumin (gm/dL)	3.6±0.5[a]	3.7±0.5	3.7±0.4	3.4±0.6	0.033
Hematocrit (%)	40±6	42±6	40±5	36±6	0.005
ASA Score (≥3)	77% (75)	63% (19)	76% (32)	92% (24)	0.038
Baseline Geriatric Assessment Variables					
Impaired Cognition	43% (42)	3% (1)	41% (17)	92% (24)	<0.001
Dependence in ≥1 ADL	31% (30)	3% (1)	14% (6)	89% (23)	<0.001
Having fallen in past 6 mon.	34% (33)	7% (2)	21% (9)	85% (22)	<0.001
Intra-Operative Variables					
Type of Operation					
Right Colectomy	32% (31)	40% (12)	31% (13)	23% (6)	0.787
Left Colectomy	65% (64)	60% (18)	67% (28)	69% (18)	0.811
Subtotal Colectomy	3% (3)	0	2% (1)	8% (2)	0.171
Laparoscopic (not open)	46% (45)	43% (13)	50% (21)	42% (11)	0.796
OR Time (minutes)	177±51	177±58	182±49	167±45	0.308
Blood Loss (mL)	173±152	167±165	183±160	162±126	0.752
Blood Transfusion (unit)	0.1±0.5	0.3±0.5	0.1±0.5	0.1±0.4	0.851

		Time Up-and-Go			
	Total Group (n=98)	**Fast (≤10 seconds) (n=30)**	**Intermediate (11-14 seconds) (n=42)**	**Slow (≥15 seconds) (n=26)**	**p-value**
Diagnosis					
Benign	34% (33)	43% (13)	31% (13)	27% (7)	0.599
Stage 1	17% (17)	10% (3)	14% (6)	31% (8)	0.066
Stage 2	26% (25)	30% (9)	24% (10)	23% (6)	0.800
Stage 3	20% (20)	13% (4)	26% (11)	19% (5)	1.000
Stage 4	3% (3)	3% (1)	5% (2)	0	0.563

Acronyms: COPD = chronic obstructive pulmonary disease; ASA = American Society Anesthesiology;

[a] n=96 because two patients did not have a baseline albumin measurement.

Table 2

Baseline Characteristics of Patients and Operations – Cardiac Surgery Group

		Time Up-and-Go			
	Total Group (n=174)	**Fast ≤10 seconds (n=53)**	**Intermediate 11-14 seconds (n=88)**	**Slow ≥15 seconds (n=33)**	**p-value**
Baseline Preoperative Variables					
Age (years)	73±6	71±5	74±5	76±6	<0.001
Cerebrovascular Event	9% (16)	6% (3)	10% (9)	12% (4)	0.500
Insulin Dependent Diabetes	20% (34)	17% (9)	17% (15)	30% (10)	0.064
Congestive Heart Failure	20% (35)	19% (10)	19% (17)	24% (8)	0.784
Ischemic Heart Disease	65% (112)	55% (29)	65% (57)	79% (26)	0.073
Hypertension	91% (159)	89% (47)	93% (82)	91% (30)	1.000
COPD	29% (50)	26% (14)	26% (23)	39% (13)	0.227
Creatinine (mg/dL)	1.4±0.7	1.2±0.4	1.4±0.9	1.5±0.5	0.031
Body Mass Index	29±5	29±5	28±5	28±6	0.757
Albumin (gm/dL)	3.7±0.5[a]	3.9±0.4	3.8±0.4	3.4±0.6	<0.001
Hematocrit (%)	41±5	42±4	41±4	37±4	<0.001
ASA Score (≥3)	95% (165)	93% (49)	94% (84)	97% (32)	0.712
Baseline Geriatric Assessment Variables					
Impaired Cognition	41% (72)	11% (6)	48% (42)	73% (24)	<0.001
Dependence in ≥1 ADL	24% (42)	2% (1)	22% (19)	67% (22)	<0.001
Having fallen in past 6 mon.	28% (49)	6% (3)	23% (20)	79% (26)	<0.001
Intra-Operative Variables					
Type of Operation					
Coronary Artery Bypass	59% (102)	57% (30)	60% (53)	58% (19)	1.000
Valve Replacement	31% (53)	32% (17)	31% (27)	27% (9)	0.834
Coronary Bypass & Valve	11% (19)	11% (6)	9% (8)	15% (5)	0.365
OR Time (minutes)	314±82	317±77	317±82	300±93	0.365
Blood Transfusion (unit)	1±2	1±2	1±2	1±2	0.380

Acronyms: COPD = chronic obstructive pulmonary disease; ASA = American Society Anesthesiology;

[a] n=172 because two patients did not have a baseline albumin measurement

Table 3

Outcomes

		Time Up-and-Go			
	Total Group	**Fast ≤10 seconds**	**Intermediate 11-14 seconds**	**Slow ≥15 seconds**	**p-value**
Colorectal Surgery Group	n=98	n=30	n=42	n=26	
One or more Complications	37% (36)	13% (4)	29% (12)	77% (20)	<0.001
Cardiac	4% (4)	0	0	15% (4)	
Respiratory	11% (11)	0	2% (1)	38% (10)	
Renal	3% (3)	0	0	12% (3)	
Neurologic	0	0	0	0	
Infection	30% (29)	10% (3)	26% (11)	58% (15)	
Sepsis	14% (14)	3% (1)	7% (3)	38% (10)	
DVT	2% (2)	0	0	8% (2)	
Re-Operation	9 (9%)	3% (1)	0	31% (8)	
30-Day Re-Admission	7% (7)	0	5% (2)	19% (5)	
Institutionalization	26% (25)[a]	0	24% (10)	58% (15)	<0.001
Mortality					
Hospital Mortality	2% (2)	0	0	8% (2)	0.068
6-month Mortality	6% (6)	0	0	23% (6)	<0.001
1-year Mortality	12% (12)	3% (1)	10% (4)	31% (8)	0.006
Cardiac Surgery Group	n=174	n=53	n=88	n=33	
One or More Complications	26% (46)	11% (6)	26% (23)	52% (17)	<0.001
Cardiac	3% (5)	0	2% (2)	9% (3)	
Respiratory	4% (7)	0	5% (4)	9% (3)	
Renal	3% (5)	0	1% (1)	12% (4)	
Neurologic	2% (3)	0	1% (1)	6% (2)	
Infection	14% (23)	8% (4)	13% (11)	24% (8)	
Sepsis	2% (4)	0	5% (4)	0	
DVT	1% (2)	2% (1)	0	3% (1)	
Re-Operation	5% (9)	4% (2)	5% (4)	9% (3)	

	Total Group	Time Up-and-Go			
		Fast ≤10 seconds	**Intermediate 11-14 seconds**	**Slow ≥15 seconds**	**p-value**
30-Day Re-Admission	12% (21)	4% (2)	13% (11)	24% (8)	0.030
Institutionalization	40% (69)[a]	23% (12)	41% (35)	67% (22)	<0.001
Mortality					
Hospital Mortality	2% (3)	0	2% (2)	3% (1)	0.457
6-month Mortality	3% (6)	0	3% (3)	9% (3)	0.079
1-year Mortality	5% (8)	2% (1)	3% (3)	12% (4)	0.039

[a] patients who died during their hospital stay were not considered in the discharge institutionalization analysis

Table 4

Diagnostic Accuracy of Timed Up-and-Go versus Risk Calculator at Forecasting One or More Postoperative Complications

Receiver Operating Characteristic Area Under Curve (AUC)			
	AUC Timed Up-and-Go	**AUC Risk Calculator**	**p value**
COLORECTAL	0.775 (95% CI: 0.670, 0.880)	0.554 (95% CI: 0.499, 0.609)	0.006
CARDIAC	0.684 (95% CI: 0.603, 0.766)	0.552 (95% CI: 0.477, 0.626)	0.058