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The Impact of a Frailty Education Module on Surgical Resident Estimates of Lobectomy Risk

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Abstract

Background—Frailty is a risk factor for adverse events after surgery. Residents' ability to recognize frailty is underdeveloped. We assessed the influence of a frailty education module on surgical residents' estimates of lobectomy risk.

Methods—Traditional track cardiothoracic surgery residents were randomized to take an on-line short course on frailty (experimental group) or to receive no training (control group). Residents read a clinical vignette, made an initial risk estimate of major complications for lobectomy, and rated clinical factors on their importance to their estimates. They viewed a video of a standardized patient portraying the patient in the vignette, randomly selected to exhibit either vigorous or frail behavior, and provided a final risk estimate. After rating 5 vignettes, they completed a test on their frailty knowledge.

Results—Forty-one residents participated (20 in the experimental group). Initial risk estimates were similar between the groups. The experimental group rated clinical factors as "very important" in their initial risk estimates more often than did the control group (47.6% vs 38.5%; $p < 0.001$). Viewing videos resulted in a significant change from initial to final risk estimates (frail: $50 \pm 75\%$ increase, $p = 0.008$; vigorous: $14 \pm 32\%$ decrease, $p = 0.043$). The magnitude of change in risk estimates was greater for the experimental group (10.0 ± 8.1 vs 5.1 ± 7.7 ; $p < 0.001$). The experimental group answered more frailty test questions correctly (93.7% vs 75.2%; $p < 0.001$).

Conclusions—A frailty education module improved resident knowledge of frailty and influenced surgical risk estimates. Training in frailty may help educate residents in frailty recognition and surgical risk assessment.

Keywords

Geriatric; education; lung cancer surgery; surgery; complications

Introduction

Accurate assessment of operative risk is essential in appropriate selection of patients for surgery, patient and family counseling, and pre-, intra-, and post-operative management. Most conventionally used risk factors for lung resection are related to respiratory and cardiac function and co-morbidities [1]. Knowledge of these factors alone does not result in accurate prediction of lobectomy outcomes [2]. Instead, risk estimation is a complex cognitive process that relies on learned patterns, specific knowledge, and unconscious processing of information that cannot occur without direct interaction between the surgeon and the patient [3].

There is growing interest in frailty as a risk factor for surgical complications. Frailty is defined as low physiologic reserve with increased susceptibility to complications and reduced ability to recover from such complications. It has been associated with an increased risk of complications in cardiothoracic [4,5] and general surgery [6–8] and has been demonstrated to predict complications in a manner that is complementary and additive to standard risk scores.

Frailty can be recognized in part by slow gait, reduced strength, fatigue, low levels of physical activity, and weight loss [9]. Experienced thoracic surgeons, on visual inspection, have an ability to recognize frail characteristics similar to that of geriatricians [10]. Surgeons in practice are better than surgical residents at recognizing frailty and at incorporating factors associated with frailty in their surgical risk estimates [11]. Whether frailty recognition and incorporation into surgical risk estimation can be taught to residents, or whether that ability only arises as a result of accumulated experience, is not known.

The current study was designed to assess whether frailty recognition can be taught to surgical residents, and how knowledge of frailty influences their estimates of surgical risk.

Methods

Subjects participating in this study were cardiothoracic residents in traditional 2- or 3-year training programs. They were contacted through e-mail using addresses provided by the Thoracic Surgery Directors' Association, and were provided \$50 in remuneration when they completed the study. Subjects provided their contact information, age, sex, year of cardiothoracic training, and comfort level with performing a lobectomy (novice, learner, competent, expert). The study was approved by the University of Chicago Institutional Review Board and written consent was waived; implicit consent from each subject was assumed as reflected in their decision to “opt in” for participation.

Clinical vignettes were abstracted from histories of patients who underwent lobectomy for management of lung cancer, as previously described [2,11]. Patient vignettes were assigned risk scores based on Charlson comorbidity index [12] and EVAD [13] values. Based on their combined risk scores (range 2 to 15), they were classified as low risk (2 vignettes; score 4 or 5), average risk (1 vignette; score 8), and high risk (2 vignettes; score 11) for major complications after lobectomy. The risk scores were not shared with the subjects.

Videos of standardized patients were created to portray “somewhat vigorous” and “somewhat frail” behavior, hereafter referred to as “vigorous” and “frail” videos, as previously described [10,11]. The videos were silent, and depicted the standardized patient walking into an exam room, sitting in a chair, rising from the chair, walking to an exam table, and climbing onto the table. The standardized patients were middle-aged, Caucasian, and similarly dressed in wardrobe (dark pants, light colored long-sleeved shirts) purchased for the videos. They were trained to depict ranges of physical behaviors related to aspects of frailty including gait speed, strength, fatigue, and weight loss. Each standardized patient’s “vigorous” and “frail” videos were paired with a single clinical vignette.

Subjects were informed they were participating in “a study evaluating surgical risk assessment” and were not aware that the study involved randomization. They were randomly assigned to take a short on-line course on frailty (experimental group) or not (control group; Figure 1). Subjects in the experimental group took a 5-question pre-test regarding their basic knowledge of frailty and its impact on surgical outcomes (Appendix 1) and then completed the short course. The on-line short course instructed subjects on frailty definitions, components, assessment, and relationship to surgical outcomes. After the experimental group completed the short course, they began reading the clinical vignettes. The control group did not take the pre-test or short course and began by reading the clinical vignettes.

All subjects read a clinical vignette, estimated the risk of major postoperative complications on an anchored Likert-like scale (0% to 100%; initial risk estimate), and indicated on a 13 item list of factors the relative importance (5-category scale from “very important” to “not important at all”) of each factor in assessing risk for that vignette. Subjects then viewed a video of the standardized patient paired with the vignette, randomly selected to either the “vigorous” or the “frail” video. Subjects then again estimated the surgical risk associated with the vignette and video (final risk estimate). The experimental group ranked the importance of the video and of each element of frailty portrayed in the video (age, weight loss, gait speed, strength, fatigue) on a 5-category scale (“very important” to “not important at all”) to their final risk estimate. Five vignettes, each with a paired video, were evaluated by each subject. Control group subjects did not rate video or video element importance to avoid sensitizing them to the aspects of frailty being investigated. All subjects then completed a 5 question post-test on their understanding of frailty and its impact on surgical outcomes, which was identical to the pre-test that the experimental group took at the beginning of the exercise (Appendix 1).

All data were collected and managed using REDCap (Research Electronic Data Capture) hosted at The University of Chicago [14]. Categorical variables were compared with chi-squared statistics. Continuous variables were compared using paired- or un-paired t-tests, as

appropriate. Analysis of variance was used to compare means among groups. Effect size was assessed by calculating Cohen's *d* (medium effect = 0.5, large effect = 0.8). Means are expressed as $\pm$ SD. All analyses were performed using Minitab 16 (Minitab, Inc).

Results

A total of 204 residents were invited via e-mail to participate, and 41 (20%) completed the study. Other than year of training, no data were collected regarding the residents who chose not to participate. The study subjects' mean year of training was 1.76 ± 0.70 , compared to 1.73 ± 0.70 for the residents who elected not to participate ($p=0.86$). Twenty subjects were randomized to the experimental group and 21 subjects were in the control group. There were no differences between the experimental and control groups other than a significantly larger percentage of women in the experimental group (Table 1).

The experimental group scored 78.0% overall accuracy on the pre-test, with the highest percentage of correct answers for questions covering an overall understanding of frailty and the lowest accuracy for questions aimed at specific components or evaluation of frailty (Table 2). The experimental group significantly improved their overall accuracy to 93.7% on the post-test ($p=0.002$). The control group had an accuracy percentage on the post-test similar to that of the pre-test score for the experimental group (75.2%; $p=0.641$), and this was significantly worse than the post-test results of the experimental group ($p<0.001$). There was no difference between men and women in initial testing accuracy (75% vs 80%; $p=0.529$).

The mean initial risk estimate for all subjects was 24.0 ± 18.4 ($n=189$). There was no difference between the experimental and control groups in their overall initial risk estimates (24.2 ± 18.1 vs 23.7 ± 18.8 ; $p=0.847$). Risk estimates were well calibrated to the level of risk in the vignettes (Figure 2; $p<0.001$ by ANOVA; correlation coefficient for risk estimate relative to calculated composite risk score 0.445; $p<0.001$). There was no difference between the experimental and control groups in their initial risk estimates according to vignette risk level, which were also well calibrated to the level of vignette risk ($p<0.001$ by ANOVA for each; correlation coefficient for experimental group 0.485, $p<0.001$; correlation coefficient for control group 0.413, $p=0.002$).

Among all subjects, the clinical factors most often considered "very important" to surgical risk estimation included, in order of frequency: performance status, diffusing capacity, spirometry, smoking status, cardiac status, overall impression, and cancer stage (Table 3). Participation in the pre-test and short course appeared to influence the ratings of the experimental group subjects, who considered renal function, obesity, smoking status, and peripheral vascular disease as "very important" significantly more often than did the control group. Overall, the experimental group rated significantly more clinical variables as "very important" including all vignettes than did the control group.

There was no difference between the experimental and control groups in their overall changes from initial to final risk estimates (1.30 ± 0.97 vs 2.10 ± 12.70 percentage points; $p = 0.631$). Risk estimates for vignettes paired with frail videos increased $50.0 \pm 75.0\%$

($p=0.008$), whereas estimates for vignettes paired with vigorous videos decreased $14.0 \pm 32.2\%$ ($p=0.043$); the effect size for this was $d = 1.21$. The experimental group estimated risk for vignettes paired with vigorous videos lower than did the control group (effect size $d = 0.54$), whereas they estimated risk for vignettes paired with frail videos higher than did the control group (effect size $d = 0.32$); these differences were not statistically significant (Figure 3).

The change in risk estimates varied the most among vignettes paired with vigorous videos. When there was concordance (low risk vignettes paired with vigorous videos) there was minimal change in estimated risk. When there was discordance (high risk vignettes paired with vigorous videos) a substantial decrease in estimated risk was observed, especially for the experimental group (Figure 4). In contrast, changes in risk estimates associated with frail videos were more consistent across the range of vignette risk categories; experimental group subjects tended to estimate risk higher for vignettes paired with frail videos. The magnitude of change in risk estimates was greater for the experimental group and was higher for higher risk vignettes, whereas changes for the control group were inconsistent among the vignette risk categories (low risk: 5.10 ± 10.20 vs 4.90 ± 11.10 , $p=0.923$; average risk: 7.06 ± 6.52 vs 2.42 ± 3.19 , $p=0.009$; high risk: 11.10 ± 11.60 vs 4.25 ± 6.29 , $p=0.005$). The overall magnitude of change in risk estimates was greater for the experimental group (9.98 ± 8.12 vs 5.12 ± 7.72 ; $p<0.001$); the effect size for this was $d = 0.59$.

Videos were rated by the experimental group as “very important” in making final risk estimates 73% of the time. This rating frequency was unrelated to the type of video ($p=0.211$) or the risk level of the clinical vignette ($p=0.859$). The frailty elements portrayed in the videos were ranked by the experimental group as “very important” to risk estimation 43% of the time (Table 4). The frailty elements that influenced risk estimates the most were gait speed, weakness, and fatigue. There were no significant differences between ratings of elements in the vigorous versus frail videos except for a higher frequency of rating gait speed as “very important” in frail videos. Overall, the frequency of rating any frailty element as “very important” was higher for frail videos ($p=0.031$). The level of risk in vignette content did not influence ratings of individual video characteristics. However, the frequency of rating any frailty element as “very important” was lower for low risk vignettes than for average or high risk vignettes (40.2%, 54.5%, 56.5%, respectively; $p=0.003$).

Comment

Frailty has been demonstrated to be an important risk factor for adverse outcomes after major surgery and is increasingly being used as a way to risk stratify older and multi-morbid patients [6,8]. However, surgeons’ understanding of frailty and application of findings of frailty to surgical risk estimation are often intuitive and unsophisticated [15]. Surgical residents’ abilities to recognize signs of frailty and incorporate them in making surgical risk estimates are underdeveloped [11]. To the authors’ knowledge, no widely available tool for training surgical residents on frailty and risk currently exists. We sought to determine whether a short course in frailty could improve surgical residents’ understanding of frailty and modify their surgical risk estimates accordingly.

We found that an education module on frailty, including a short course combined with reinforcing text and videos, significantly improved cardiothoracic residents' knowledge of frailty. Residents estimated risk in clinical vignettes similarly when they had no frailty instruction and no benefit of viewing a video representing the patient in the vignette. However, after viewing such videos, the experimental group (subjects who participated in the short course) modified their risk estimates to a significantly greater magnitude than did the control group. The experimental group reduced risk estimates to a greater degree in response to viewing a vigorous video, and increased their risk estimates to a greater degree in response to viewing a frail video than the control group. Experimental group subjects also incorporated more clinical factors in making their risk estimates.

Our overall findings related to the effects of standardized patient videos on risk estimation are similar to what we previously reported [11]. In that study we also found that residents' ability to estimate risk was different than that of practicing surgeons, and surmised that it may be possible to educate residents to think more like practicing surgeons. The current study demonstrated that a frailty education module did help residents behave more like practicing surgeons in making estimates of surgical risk.

Having instruction in components of frailty and seeing them demonstrated in sample videos likely enhanced the experimental group's ability to identify specific elements contributing to risk in the videos that the control group participants may have noted only subliminally. Factors related to frailty were listed only for the experimental group after each of the videos, reinforcing to the experimental group the importance of these elements first described in the short course. This reinforcement may have amplified the confidence of the experimental group in the relative importance of the videos over the vignette content in increasing or decreasing the risk for that video/vignette combination. It is also likely that the short course sensitized the experimental group to any potential risk factors, as they ranked more clinical variables as "very important" in making their risk estimates than did the control group. The behavior of the experimental group in ranking clinical factors was similar to that exhibited by practicing thoracic surgeons in a prior study using the same vignettes, videos, and analytic techniques [11]. The experimental group in this study rated clinical factors as important more often than did the control group (12 of 13 categories), whereas practicing surgeons rated the clinical factors as important more often than trainees in the prior study (8 of 13 categories).

It was interesting that gait speed appeared to be the strongest single indicator of risk in this experimental setting. It is the most objective parameter visible in the videos, and in clinical frailty screening it is the most easily observed characteristic. Others have identified gait speed alone as a significant determinant of overall survival, cardiovascular death, and postoperative complications, reinforcing the unique and influential role that this parameter has on outcomes [16–19].

We are unaware of other studies documenting benefits of training in frailty directed at surgical residents or of frailty-specific short courses for surgical trainees. The subjects in this study not only increased estimates of risk in the light of perceived frailty, but also decreased estimates of risk in the face of perceived vigor; this was particularly true for the

experimental group. The experimental group appeared to recognize both frail and vigorous behavior more accurately than the control group. We concluded that the experimental group was better able to consciously recognize physical performance characteristics, both positive and negative, and incorporate them into their risk estimates.

There are important limitations of this study. The number of resident participants was relatively small, and the study had limited statistical power. The number of ratings required for each vignette/video pairing was large, which led to apparent participant fatigue and inability/unwillingness to complete the study. The clinical vignettes contained actual patient data, but were paired with videos of standardized patients rather than actual patients. Although the standardized patients mimicked components of frail behavior accurately, their apparent age was a little younger than what was listed in the vignettes.

In conclusion, an education module on frailty, including a short course reinforced by videos and frailty factor reminders, improved surgical residents' knowledge of frailty. It was associated with a greater use of clinical data in making risk estimates based on vignettes alone, and influenced residents to make greater changes in their risk estimates after viewing patient videos than did a control group. The behavior of the residents who completed the module was more similar to that of practicing surgeons. Training in frailty may help educate residents in frailty recognition and surgical risk assessment.

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Appendix 1. Pre-test questions

1. Frailty is defined as:
 - a. Being at an advanced age
 - b. Increased susceptibility to stressors**
 - c. Having decreased bone density
 - d. The physical equivalent of senility
2. Frailty is associated with all of the following EXCEPT:
 - a. Sex**
 - b. Disability
 - c. Medical comorbidities
 - d. Age
3. Phenotypic components of frailty include:
 - a. Tremor**

- b. Diminished eyesight
 - c. Difficulty hearing
 - d. **Slow gait**
- 4. Assessment of frailty requires:
 - a. Exercise testing
 - b. Testing for dementia
 - c. **Measurement of grip strength**
 - d. Evaluation of serum markers
- 5. Frailty is associated with each of the following after surgery EXCEPT:
 - a. Increased length of stay
 - b. **Decreased patient satisfaction**
 - c. Increased risk of complications
 - d. Decreased rate of discharge to home

Figure 1.
Schema for study design.

Figure 2.
Initial risk estimates according to vignette risk level.

Figure 3.
Final risk estimates according to vignette risk level and video type.

Figure 4.
Differences in risk estimates according to vignette risk level and video type.

Table 1

Demographic data for subjects.

Variable	Overall (41)	Short course group (20)	No short course group (21)	P value
Age ^a	34.20 ± 2.85	34.60 ± 3.23	33.80 ± 2.42	0.38
Years of cardiothoracic training	1.76 ± 0.70	1.85 ± 0.67	1.67 ± 0.73	0.41
Male sex ^b	31 (77.5%)	19 (95%)	12 (60%)	0.008
Comfort level with lobectomy				n/a
Naïve	1	1	0	
Learner	16	7	9	
Competent	24	12	12	
Master	0	0	0	

^aOne subject did not provide information on age^bOne subject did not provide information on sex

Table 2

Pre-test and post-test results

Question	Experimental group Pre-test correct (%)	Experimental group Post-test correct (%) ^a	Control group Post-test correct (%)
Frailty is defined as:	95.0	89.5	81.0
Frailty is associated with all of the following EXCEPT:	90.0	100	81.0
Phenotypic components of frailty include:	65.0	84.2	71.4
Assessment of frailty requires:	45.0	94.7	52.4
Frailty is associated with each of the following EXCEPT:	95.0	100	90.5
All questions combined	78.0	93.7 ^b	75.2 ^{c,d}

^a One subject did not complete the post-test;^b $p = 0.0018$ vs pre-test;^c $p = 0.6406$ vs experimental group pre-test;^d $p = 0.0004$ vs experimental group post-test

Table 3

Clinical variables rated as “very important” in making initial risk estimates.

Variable	Number rated	Overall (%)	Experimental group (%)	Control group (%)	P value
Age	199	18 (8.9%)	10 (10.0%)	8 (8.1%)	0.330
Cardiac status	205	133 (64.9%)	67 (67.0%)	66 (62.9%)	0.519
Performance status	205	164 (80.0%)	79 (79.0%)	85 (81.0%)	0.940
Renal status	201	38 (18.9%)	29 (30.2%)	9 (8.6%)	<0.001
Obesity	193	33 (17.1%)	24 (25.0%)	9 (9.3%)	0.007
Spirometry	199	134 (67.3%)	68 (69.4%)	66 (65.3%)	0.063
Diffusing capacity	201	151 (75.1%)	74 (77.1%)	77 (73.3%)	0.269
Smoking status	199	133 (66.8%)	72 (73.5%)	61 (60.4%)	0.049
Diabetes mellitus	189	54 (28.6%)	32 (34.0%)	22 (23.2%)	0.113
Hypertension	197	20 (10.2%)	13 (13.3%)	7 (7.1%)	0.084
Cancer stage	199	95 (47.7%)	55 (55.0%)	40 (40.4%)	0.054
Peripheral vascular disease	195	31 (15.9%)	21 (22.8%)	10 (9.7%)	0.035
Overall impression	205	108 (52.7%)	60 (60.0%)	48 (45.7%)	0.104
Overall ratings combined	2,587	1,112 (43.0%)	604 (47.6%)	508 (38.5%)	<0.001

Table 4

Ranking of video characteristics as “very important” related to video type.

Video characteristic	Number rated	Overall (%)	Vigorous videos (%)	Frail videos (%)	P value
Age	99	12 (12.1%)	5 (10.4%)	7 (13.7%)	0.614
Weight loss	99	42 (42.4%)	20 (41.7%)	22 (43.1%)	0.882
Gait speed	99	71 (71.7%)	28 (58.3%)	43 (84.3%)	0.004
Weakness	98	72 (73.5%)	32 (68.1%)	40 (78.4%)	0.246
Fatigue	98	70 (71.4%)	32 (68.1%)	38 (74.5%)	0.482
All characteristics combined	493	277 (54.2%)	117 (49.2%)	150 (58.8%)	0.031