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ScienceDirect

EJSO 41 (2015) 844–851

EJSO the Journal of Cancer Surgery

www.ejso.com

Screening for predictors of adverse outcome in onco-geriatric surgical patients: A multicenter prospective cohort study

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Accepted 24 February 2015
Available online 13 April 2015

Abstract

Aims: The aim of this study was to investigate the predictive ability of screening tools regarding the occurrence of major postoperative complications in onco-geriatric surgical patients and to propose a scoring system.

Methods: 328 patients ≥70 years undergoing surgery for solid tumors were prospectively recruited. Preoperatively, twelve screening tools were administered. Primary endpoint was the incidence of major complications within 30 days. Odds ratios (OR) and 95% confidence intervals (95% CI) were estimated using logistic regression. A scoring system was derived from multivariate logistic regression analysis. The area under the receiver operating characteristic curve (AUC) was applied to evaluate model performance.

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http://dx.doi.org/10.1016/j.ejso.2015.02.018
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Results: At a median age of 76 years, 61 patients (18.6%) experienced major complications. In multivariate analysis, Timed Up and Go (TUG), ASA-classification and Nutritional Risk Screening (NRS) were predictors of major complications ($TUG_{>20}$ OR 3.1, 95% CI 1.1–8.6; $ASA_{\geq 3}$ OR 2.8, 95% CI 1.2–6.3; $NRS_{impaired}$ OR 3.3, 95% CI 1.6–6.8). The scoring system, including TUG, ASA, NRS, gender and type of surgery, showed good accuracy (AUC: 0.81, 95% CI 0.75–0.86). The negative predictive value with a cut-off point >8 was 93.8% and the positive predictive value was 40.3%.
Conclusions: A substantial number of patients experience major postoperative complications. TUG, ASA and NRS are screening tools predictive of the occurrence of major postoperative complications and, together with gender and type of surgery, compose a good scoring system.
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Keywords: Geriatric assessment; Risk assessment; Aged; Postoperative complications; Screening; Oncology

Introduction

The International Agency for the Research on Cancer forecasts that the number of new cancer cases will increase from 12.4 million in 2008 to 20 or even 26 million in 2030.[1] The majority of cancer patients are over 64 years of age.[2] As surgery is still the most efficient treatment modality for many solid tumors, the share of onco-geriatric patients presenting for surgery will continue to increase. Though the majority of the onco-geriatric patients is fit for surgery and might have a better quality of life after surgery,[3] a substantial part is at increased risk for adverse short-term postoperative outcomes, like complications and mortality.[4,5]

Next to the severity of the surgical procedure itself,[6,7] multiple patient related factors in the physical, mental and environmental domain are supposed to be associated with these adverse postoperative outcomes. Restricted basic or instrumental activities of daily living (ADL or IADL), decreased cognitive function, impaired mobility or nutritional status, fatigue and increased number of comorbidities are associated with adverse postoperative outcomes in elderly surgical patients in multiple prospective studies.[5,7–11] To identify patients at risk for these adverse postoperative outcomes, impairments in the above mentioned domains can be identified through a standardized geriatric assessment (GA) as well as by the application of well-known and validated geriatric screening tools.[4,5,7–14] As a state of the art but time-consuming standardized GA is not indicated nor feasible for every onco-geriatric patient, frequently a selection of geriatric screening tools is preferred.[12,15]

Despite the increasing number of studies reporting on the use of screening tools in onco-geriatric surgical patients, a consensus has so far been lacking as to which tool best predicts postoperative outcomes.[13–16] This is mainly due to the lack of comparability between different studies, with a huge variation across the tools, the cohorts and the measure of the reported outcomes.[13,15] The aim of the current study is to investigate the ability of well-known geriatric screening tools in predicting the occurrence of major postoperative complications in a relatively large cohort of onco-geriatric surgical patients and to propose a scoring system.

Patients and methods

Design

An international multicenter cohort study was designed to investigate screening tools for Preoperative Risk Estimation for Onco-geriatric Patients (PREOP) with regard to 30-day postoperative outcomes. This study was approved by the appropriate ethics committees and is registered at the Dutch Trial register (Trial ID: NTR1567) and United Kingdom register (Research Ethics Committee reference: 10/H1008/59). All patients gave written informed consent in accord with the ethical standards of the local ethics committees.

Patients and centers

Cancer patients aged ≥70 years who were candidate for elective surgery for a solid tumor under general anesthesia were invited to take part by the local coordinator. Patients requiring emergency surgical management and patients who were unable to give written informed consent, were not included in this study.[17]

Recruitment took place in seven different countries at 14 medical centers between September 2008 and October 2012, where not all centers participated actively during the entire period. To reduce the possibility of selection bias and the influence of intercenter variability, medical centers including less than ten patients were excluded from present analysis.

Screening tools

Within two weeks prior to surgery patients were tested with a battery of preoperative well-known screening tools by either a trained resident, nurse practitioner or medical student (Table 1). As this took approximately 30 min, the patients were screened on the surgical ward, or at the preoperative assessment clinic. Functional status was assessed with the Timed Up and Go (TUG), ADL, IADL

Table 1
Components of PREOP.

Test	Acronym	Purpose	Cut-off value for adverse results	Range of possible scores
Timed Up and Go[18,a]	TUG	A walking test to measure functional status	>20 s[b]	Not applicable
Vulnerable Elders Survey[19]	VES-13	A self-reported function-based screening tool to identify vulnerable elderly	≥3	0–10
Groningen Frailty Index[20]	GFI	To estimate frailty by a 15-item questionnaire	≥4	0–15
Activities of Daily Living[21]	ADL	Depicts dependency regarding bathing, dressing, toileting, transfer, continence and feeding	>0	0–12
Instrumental Activities of Daily Living[22]	IADL	A questionnaire regarding 8 items needed to perform independently to maintain independence in the community	<8	0–8
Eastern Cooperative Oncology Group performance status[23]	ECOG PS	A physician's perspective of a patient's functional status; ranging from 0 to 4	>1	0–4
Mini Mental State Examination[24]	MMSE	A test consisting of 11 questions to assess cognitive function	≤26	0–30
Geriatric Depression Scale[25]	GDS	A 15-item self-rating depression screening scale for elderly populations	>5	0–15
Brief Fatigue Inventory[26]	BFI	A 9-item questionnaire to report on fatigue severity in cancer patients	>3	0–10
American Society for Anesthesiologist scale[27,c]	ASA	To quantify preoperative physical status and estimate anesthetic risk	≥3	1–5
Nutritional Risk Screening[28]	NRS	Nutritional status based on recent weight loss, overall condition and reduction of food intake	Impaired nutritional status was compared to normal nutritional status	Normal to severely impaired nutritional status

[a] Patients performed the TUG two times and for each patient, the mean of the two time measurements was calculated.
[b] Based on literature and the distribution of the mean values in the current study population, a score of less than or equal to 20 s on the TUG was considered a low score.[29]
[c] The ASA-classification was determined by an anesthesiologist.

and the Eastern Cooperative Oncology Group Performance Status (ECOG PS). The Vulnerable Elders Survey (VES-13) incorporates age, self-rated health and functional limitations or disabilities to identify vulnerable elderly. The Groningen Frailty Index (GFI) is a multidimensional questionnaire assessing frailty in elderly. Cognitive function was assessed with the Mini Mental State Examination (MMSE). Mood and level of fatigue were assessed with the Geriatric Depression Scale (GDS) and Brief Fatigue Inventory (BFI) respectively. The American Society for Anesthesiologist scale (ASA) was determined by the anesthesiologist to quantify preoperative physical status and estimate the anesthetic risk. Nutritional status was assessed with the Nutritional Risk Screening (NRS), which classifies patients as either with a normal nutritional status or with a mildly impaired nutritional status (weight loss greater than 5% in three months or a food intake below 50–75% of normal requirement in the preceding week), a moderately impaired nutritional status (weight loss greater than 5% in two months or a body mass index (BMI) between 18.5 and 20.5 kg/m^2 and impaired general condition or a food intake below 25–50% of normal requirement in the preceding week) or a severely impaired nutritional status (weight loss greater than 5% in one month or a weight loss greater than 15% in three months or a BMI less than 18.5 kg/m^2 and an impaired general condition or a food intake below 25% of normal requirement in the preceding week).

Data collection and handling

Preoperative living situation, preoperative hemoglobin level and comorbidities were retrieved from the patients' files. Type and number of comorbidities were recorded and a dichotomous variable was created based on the median number of comorbidities (>3). Data on tumor stage were retrieved from the pathologists' reports and patients' files. Surgical procedures were defined as minor surgery (e.g. procedures performed for tumors located at the extremities or superficially) and major surgery (e.g. procedures for intra-abdominal tumors).

Data were collected by local institutions and sent in batches to the coordinating center (University Medical Center Groningen, The Netherlands), where they were checked, cleaned and entered into an electronic database for statistical analysis.

Endpoint

The primary endpoint was the incidence of any major 30-day complications, according to the Clavien-Dindo classification (Clavien-Dindo grade ≥3).[30] Major complications include complications requiring surgical, endoscopic or radiological intervention (grade three), life-threatening complications requiring Intensive Care management (grade four) and death of a patient (grade five). In most cases, delirium was considered a minor complication as treatment of

Table 2
Agreement between geriatric screening tools.[a]

Test[b]	TUG	VES-13	GFI	ADL	IADL	ECOG PS	MMSE	GDS	BFI	ASA	NRS	Comorbidities
TUG												
VES-13	73.2%											
GFI	59.1%	67.1%										
ADL	79.6%	70.4%	60.7%									
IADL	72.6%	78.7%	66.2%	73.2%								
ECOG PS	85.1%	72.0%	58.5%	79.9%	72.0%							
MMSE	67.4%	65.5%	59.1%	67.4%	68.3%	66.5%						
GDS	80.2%	73.8%	68.9%	74.7%	69.2%	77.1%	67.7%					
BFI	69.5%	72.0%	66.8%	64.3%	66.8%	70.4%	62.8%	72.3%				
ASA	59.8%	57.0%	55.5%	58.2%	57.9%	61.6%	56.4%	55.5%	60.1%			
NRS	66.5%	62.5%	62.5%	66.2%	63.1%	71.0%	60.1%	66.2%	59.1%	58.8%		
Comorbidities	69.5%	67.1%	61.0%	64.9%	63.7%	64.6%	59.8%	64.0%	64.9%	66.5%	61.3%	

[a] The agreement between the dichotomized results on the geriatric screening tools was considered.
[b] The meaning of the acronyms of the tests are shown in Table 1.

delirium frequently involved pharmacological treatment only, which is classified as a grade 2 complication. During hospital admission complications were recorded prospectively. To complete the 30-days morbidity registration, patients' files were checked on the occurrence of complications. This endpoint was analyzed as a dichotomous variable: major versus no/minor 30-day complications.

Power analysis

Based on the results of the PACE study, 30% postoperative morbidity in this study population was to be expected.[7] The hypothesis was that all tests had equal predictive value. A 10% difference in predictive value of the different questionnaires and tests was accepted. With an α of 0.05, a power of 0.7, and considering a drop-out rate of 10%, 326 patients needed to be recruited.

Statistical analysis

Baseline characteristics and outcomes were described as median and range or first and third quartiles for quantitative variables and absolute numbers and percentages for qualitative variables. The results on the geriatric screening tools were dichotomized based on predefined, literature based cut-off points (Table 1). To analyze the predictive ability of the geriatric screening tools with regard to any major 30-day complications, for every screening tool a for statistically significant confounders adjusted odds ratio (OR) and 95% confidence interval (95% CI) was estimated using logistic regression analyses. To check for collinearity, the agreement between geriatric screening tools was considered (Table 2). If >80% agreement between geriatric screening tools existed, one of the two geriatric screening tools was excluded from the multivariate logistic regression analysis. For major versus no/minor complications, backwards stepwise multivariate logistic regression analysis was performed to assess which combination of screening tools had the highest predictive ability. Based on the ORs in this model, a scoring system was composed. The receiver operating characteristic (ROC) and the area under the curve (AUC) were calculated to evaluate the model performance.

Missing values per geriatric screening tool ranged from 0.3% to 4.9%, and resulted in 13.7% missing cases in the multivariate analysis. As the missing values were missing at random or missing completely at random, multiple imputation was performed for the total scores on the questionnaires irrespective of whether values were missing at item- or variable level.[31] Multiple imputation was based on available results on the screening tools, age, gender, living situation, preoperative hemoglobin level, type of tumor, tumor stage, type of surgery and number of comorbidities. The reported results on the screening tools were pooled values, which were average values calculated from the five imputed datasets.

Data analysis was performed using IBM SPSS Statistics 22. P-values $\leq$0.05 were considered statistically significant.

Results

Patients

In total 362 patients were assessed in this study. Of these, 32 patients were excluded from analysis as they derived from one of the six medical centers that included <10 patients and two patients were excluded from analysis as they were diagnosed with a lymphoma. Data of 328 patients were analyzed.

The median age in this cohort was 76 years (Table 3). Almost all patients were community-dwelling at the time of inclusion (n = 323; 99.4%). The majority of patients underwent major surgery (n = 223; 68.0%) and the most prevalent conditions were colorectal and breast cancer.

Major complications

Complications occurred in 167 patients (50.9%). A total of 61 patients (18.6%) experienced major complications

Table 3
Characteristics of 328 patients ≥70 years from eight medical centers undergoing surgery for a solid tumor.

Variable		Value
Age, y[a]		76 (70–96)
Age categories	70–74	120 (36.6%)
	75–79	103 (31.4%)
	80–84	72 (22.0%)
	≥85	33 (10.1%)
Gender, female		203 (61.9%)
Living situation		
Independent/family		323 (99.4%)
Residential care/nursing home		2 (0.6%)
Comorbidities (n)[b]		3 (2–4)
Hemoglobin level		
≥12 g/dl		198 (64.3%)
<12 g/dl		110 (35.7%)
Surgery		
Minor		105 (32.0%)
Major		223 (68.0%)
Cancer site[c]		
Breast		81 (24.5%)
Colorectal		121 (36.7%)
Gastric		22 (6.7%)
Gynecological		19 (5.8%)
Pancreas and biliary tract		34 (10.3%)
Remaining		12 (3.6%)
Renal and bladder		23 (7.0%)
Soft tissue and skin		18 (5.5%)
Tumor stage[d]		
Stage 0 or other benign diagnoses		19 (5.8%)
Stage 1		75 (22.9%)
Stage 2		83 (25.3%)
Stage 3		65 (19.8%)
Stage 4		53 (16.2%)
Unknown		33 (10.1%)

[a] Median age and range.
[b] Median and first and third quartiles.
[c] Two patients were operated on two different malignancies; for tumor staging and subsequent analyses the most severe disease was analyzed.
[d] The most common pre-malignant and benign diseases were situated in the pancreas (serous cystadenomas, n = 2; cystic tumors, n = 2; chronic inflammation, n = 2), colon (dysplastic polyps, n = 4) and breast (ductal carcinoma in situ, n = 4).

within 30 days postoperatively. Of these, 56 (91.8%) underwent major surgery. Wound related complications and respiratory complications were the most frequent occurring major complications (n = 31 and n = 13 respectively). Mortality, classified as a grade five complication, occurred in 11 patients (3.4%).

ECOG PS and GDS were excluded from the multivariate logistic regression analysis, as the agreement between the dichotomized geriatric screening tool results was above 80% between the TUG and ECOG PS and GDS (Table 2). In a multivariate logistic regression analysis corrected for gender and type of surgery, the TUG, ASA and NRS were predictors of major complications ($TUG_{>20}$ OR 3.1, 95% CI 1.1–8.6; $ASA_{\geq 3}$ OR 2.8, 95% CI 1.2–6.3; $NRS_{impaired}$ OR 3.3, 95% CI 1.6–6.8; $gender_{male}$ OR 3.0, 95% CI 1.4–6.4; $type\ of\ surgery_{major}$ OR 3.9, 95% CI 1.2–12.7) (Table 4). In the complete case analysis (i.e. the original dataset without imputed values) similar ORs were found ($TUG_{>20}$ OR 2.9, 95% CI 1.0–8.1; $ASA_{\geq 3}$ OR 2.5, 95% CI 1.0–6.0; $NRS_{impaired}$ OR 3.1, 95% CI 1.5–6.7; $gender_{male}$ OR 3.0, 95% CI 1.4–6.7; $type\ of\ surgery_{major}$ OR 4.0, 95% CI 1.1–14.0). Age was not a predictor of major complications (OR 1.0; 95% CI 0.98–1.11). The absolute risks for major complications for the screening tools that were included in the multivariate logistic regression analysis were $47.2\%_{TUG>20}$ compared to $13.1\%_{TUG\leq 20}$, $24.5\%_{ASA\geq 3}$ compared to $13.8\%_{ASA<3}$ and $35.7\%_{impaired\ NRS}$ compared to $9.7\%_{normal\ NRS}$ (Table 4).

The scoring system derived from the multivariate logistic regression analysis was as follows: gender + type of surgery + TUG + ASA + NRS. The weights of the individual risk score components are shown in Table 5. The AUC for this individual risk score was 0.81, 95% CI 0.75–0.86. Based on the ROC a cut-off point was set at >8, with a sensitivity of 78.7% and a specificity of 73.4%. A total 36.3% of the patients (n = 119) had a risk score >8, of which 48 experienced major complications (positive predictive value: 40.3%). The negative predictive value was 93.8%.

Discussion

A total of 18.6% of the patients experienced major complications postoperatively. An individual risk score comprising the TUG, ASA, NRS, gender and type of surgery showed a good accuracy regarding the occurrence of major versus no/minor 30-day complications (AUC 0.81, 95% CI 0.75–0.86). The scoring system derived from the multivariate logistic regression analysis was as follows: gender + type of surgery + TUG + ASA + NRS (Table 5). The optimal cut-off point of >8 resulted in a moderate positive predictive value (40.3%) and a good negative predictive value (93.8%), which is desirable for a screening method as there are few false negative cases.

The high number of patients experiencing adverse outcomes is consistent with other studies,[4,32] and emphasizes the need for preoperative screening for risk for adverse outcomes in onco-geriatric patients.[12] Especially as short-term complications increases the risk for long-term mortality.[33]

The TUG gives an assessment of basic functional mobility, coordination and muscle strength in people who are able to walk on their own. In the current cohort, the TUG showed to be a good component to predict the risk for major complications, which underlines the importance of simple performance tests in the preoperative setting when it comes to risk stratification. This is in agreement with other studies finding gait speed as an important risk stratification method in the elderly.[34,35] Similarly, in patients ≥75 years undergoing major abdominal surgery, $TUG_{>20}$ and $ASA_{\geq 3}$ have been shown to be independent risk factors for postoperative delirium (hazard $ratio_{TUG>20}$ (HZ) 4.8, 95% CI 1.5–15.6; $HZ_{ASA\geq 3}$ 3.3, 95% CI 1.2–9).[29] In a cohort of mainly male patients ≥65 years

Table 4
Geriatric screening tools as predictors of major complications within 30 days postoperatively (n = 328).

Test		Major complications within 30 days N (%[a])	Adjusted OR (95% CI)[b]	Multivariate adjusted OR (95% CI)[b]
TUG	≤20.0 s	36 (13.1%)	1	1
	>20.0 s	25 (47.2%)	**4.1 (1.6–10.5)**	**3.1 (1.1–8.6)**
VES-13	<3	26 (13.1%)	1	
	≥3	35 (27.1%)	1.8 (0.9–3.6)	
GFI	<4	21 (12.9%)	1	
	≥4	40 (24.2%)	1.8 (0.9–3.6)	
ADL	0	32 (12.7%)	1	
	>0	29 (38.2%)	**3.4 (1.6–7.1)**	
IADL	8	24 (12.0%)	1	
	<8	37 (28.9%)	1.6 (0.8–3.2)	
ECOG PS	≤1	41 (14.9%)	1	
	>1	20 (37.7%)	**2.4 (1.1–5.2)**	
MMSE	>26	27 (13.3%)	1	
	≤26	34 (27.2%)	**2.2 (1.1–4.4)**	
GDS	≤5	31 (12.9%)	1	
	>5	30 (34.5%)	**2.4 (1.1–5.3)**	
BFI	≤3	24 (12.0%)	1	
	>3	37 (28.9%)	**2.6 (1.3–5.2)**	
ASA-score	<3	25 (13.8%)	1	1
	≥3	36 (24.5%)	**3.7 (1.7–8.1)**	**2.8 (1.2–6.3)**
NRS	Normal	21 (9.7%)	1	1
	Impaired	40 (35.7%)	**3.9 (1.9–7.9)**	**3.3 (1.6–6.8)**
Comorbidities	<4	27 (12.8%)	1	
	≥4	34 (29.1%)	**2.7 (1.3–5.4)**	

Bold statistically significant ($p \leq 0.05$).
[a] Absolute risk for major complications within 30 days.
[b] Corrected for center, gender and type of surgery (minor/major).

undergoing major surgery (mainly abdominal and cardiac surgery), a $TUG_{>15}$ predicted postoperative complications, one-year mortality and discharge to an institutional care facility ($AUC_{complications}$ 0.78, 95% CI 0.67–0.88; $OR_{discharge\ institutionalization}$ 13.0, 95% CI 5.1–33.0).[5,36,37] The TUG was analyzed as a single screening tool,[5] and as part of a multi domain assessment.[36,37] A contrasting result was found in a retrospective cohort study among patients ≥65 years undergoing elective surgery (not only for oncological diagnoses): the TUG-score, analyzed as a continuous measure, was not significantly different between the home discharge and the in-hospital death or post-discharge institutionalization groups (17.3 and 16.8 s respectively, $p = 0.588$).[9] Comparison with the above mentioned studies is difficult because of different study designs, cohort characteristics, and likely therefore varying cut-off points. The cut-off point in the current study was based on the distribution of mean values in the current study, and on the study predicting postoperative delirium, as this cohort most resembled the PREOP cohort.[29] However, external validation of the $TUG_{>20}$ should be considered for future research.

Table 5
Scoring system for major 30-day postoperative complications.

Gender	Female = 0
	Male = 3
Type of surgery	Minor = 0
	Major = 4
TUG	≤20 = 0
	>20 = 3
ASA	<3 = 0
	≥3 = 3
NRS	Normal = 0
	Impaired = 3

An impaired nutritional status according to the NRS was observed in 34.1% of the patients. The high prevalence of malnutrition can be explained by the characteristics of the population under study, as the prevalence of malnutrition increases with age and is higher in cancer patients, especially when diagnosed with intra-abdominal tumors or advanced disease.[38] Nutritional status has been shown to be associated with in-hospital death or post-discharge institutionalization in a retrospective cohort study among patients ≥65 years undergoing elective surgery.[9] Prevalence of malnutrition, assessed with the Mini Nutritional Assessment (MNA), was 53.1% in the 'death or post-discharge institutionalization'-group versus 21.1% in the 'home discharge'-group. In patients ≥70 years undergoing surgery for colorectal cancer, the MNA was incorporated in a GA, based on which patients were classified as fit, intermediate or frail.[4] Frailty was an independent predictor of severe complications (OR 3.1; 95% CI 1.7–5.9). However, in the same cohort, a multivariate analysis of the separate screening tools did not identify the MNA as a predictor of severe complications.[39] Contrastingly, severe

comorbidity and poor performance status were predictors of severe complications in the backwards stepwise logistic regression analysis.

The MNA has been validated in elderly and is frequently used to assess nutritional status in research studies.[4,9] Comparing the NRS, used in the current study, to the more frequently used MNA is not self-evident, because the NRS is probably less sensitive as it only includes questions regarding body mass index, amount of food intake and amount of weight loss. However, in patients ≥65 years undergoing major abdominal surgery, weight loss ≥10% as a measure of malnutrition is an independent predictor for prolonged hospital stay and discharge to a skilled nursing facility (OR 4.0; 95% CI 1.1−14.4 and OR 6.5; 95% CI 1.4−29.8 respectively), substantiating the current results and thus the use of NRS as a geriatric screening tool.[32]

A strength of the PREOP-study is its prospective and comprehensive design. To our knowledge, the current study is the first to analyze all components recommended in a GA in one relatively large cohort of onco-geriatric surgical patients with varying malignancies.[15] This enhances comparability between the screening tools and between other studies including onco-geriatric surgical patients. Results are broadly generalizable to the onco-geriatric surgical population as the current study included patients with a wide range of malignancies. A large number of medical centers participated, which further enhances the generalisability of the results. The relatively long duration of this study is explained by the fact that centers did not participate actively during the entire study period and that only a few physicians per center recruited patients. Although patients from low volume centers (<10) were excluded and center was included as a confounding factor, selection bias remains a limitation of the current study as inclusion of a consecutive series of patients cannot be guaranteed. Furthermore, cultural differences could have influenced the reporting of results and answers to questionnaires. Considerations for future research include 1) reporting long-term results and patient reported outcome measures, such as quality of life and functional outcome; 2) investigating the effects of preoperative improvement of physical, functional and nutritional status on postoperative outcomes.

The results of the current study show that preoperative estimation of the risk for adverse postoperative outcomes is essential, as a substantial number of patients experience major postoperative complications. The TUG, ASA and NRS are simple and short screening tools that provide clinicians with accurate risk estimations. The scoring system can easily be implemented into daily practice as a screening measure, to support the judgment of the clinician. The high negative predictive value indicates that the scoring system can exclude the fit elderly from further evaluation, whilst a positive score might indicate that a more comprehensive assessment by a geriatrician or by means of a multidisciplinary meeting is indicated.

Funding or other sources of support

None.

Conflict of interest statement

We have no conflicts of interests to declare.

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