

“Gerontosurgery”: Evaluation of Multidimensional Assessment Scales for Elderly Patients Undergoing Major Abdominal Surgery. What Is the Best Prediction Model?

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Abstract

Background/Aim: The aging population poses unique challenges in oncogeriatric surgery, particularly regarding risk stratification and postoperative outcome prediction. The impact of frailty on surgical decision-making reports should be noted. Geriatric assessment scales are recommended for preoperative objective evaluations to optimize surgical outcomes, but their accuracy remains unclear. This study evaluates the effectiveness of five multidimensional geriatric assessment scales – Charlson Comorbidity Index (CCI), APACHE II, Cumulative Illness Rating Scale (CIRS), Identification of Seniors at Risk (ISAR), and G8 – in predicting postoperative complications in elderly patients undergoing major oncological surgery. **Patients and Methods:** A retrospective observational study was conducted on 69 patients aged ≥ 75 years who underwent major abdominal surgery for neoplastic conditions between December 2018 and July 2020. Preoperative assessments using the five scoring systems were performed, and postoperative complications were classified according to the Clavien-Dindo system. The study compared the predictive validity of each scale through correlation analysis with postoperative outcomes.

Results: The study found weak correlations between predictive scores and postoperative complications. The G8 scale showed the strongest association with Clavien-Dindo scores ($\rho=0.267$, $p=0.027$), while other scales exhibited limited

continued



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predictive value. Despite the widespread use of these scales in clinical practice, none of them accurately predicted postoperative morbidity in this cohort of patients.

Conclusion: This study highlights the limitations of existing geriatric assessment scales in predicting postoperative complications for elderly patients undergoing major oncological surgery. Among the evaluated tools, only the G8 score showed an association with complications. However, the results suggest a need for more tailored risk stratification models that incorporate comorbidities, frailty, nutritional status, and physiological reserves. Further research with larger sample sizes is necessary to validate these findings and improve preoperative decision-making in geriatric oncologic surgery.

Keywords: Geriatric surgery, geriatric oncology, frailty, prediction model, post-operative complication.

Introduction

Global demographic landscape is undergoing a significant transformation, marked by a noteworthy increase in the aging population. With advancements in healthcare and improvements in living conditions, individuals are living longer than ever before. While this is a testament to human progress, it also brings to the forefront a unique set of challenges, particularly in the realm of surgical interventions. As people get older, an increase in the number of comorbidities of a patient scheduled for surgery has been described. Having multiple comorbidities is common in elderly patients and is estimated to be 80% in octogenarians (1). Comorbidities are a risk factor for the occurrence of postoperative morbidity and mortality due to a decrease of functional reserve. Moreover, advanced age and comorbidities significantly contribute to surgical refusal among melanoma patients, with clear repercussions on survival outcomes (2). However, the aging process is associated with physiological changes that can impact how elderly individuals respond to surgery, potentially leading to distinct postoperative outcomes (1, 3-8). The use of a careful multidimensional geriatric assessment scale (MGAS) in the treatment of the elderly patient has been suggested by most important national and international oncology associations such as the Italian Association of Medical Oncology (AIOM), the European Society for Medical Oncology (ESMO), the American Society for Clinical Oncology (ASCO) and the International Society for Geriatric

Oncology (SIOG) who recommend its use before embarking on active medical oncology treatment and before undergoing major surgery (9-12). A pre-operative multidisciplinary assessment of elderly patients *via* MGAS administration and relative preventive measures may reduce postoperative complications and consequently the hospitalization time, contributing not only to an improvement in quality of life (QoL), but also to a reduction in hospitalization costs. However, in everyday clinical practice multidisciplinary assessment through MGAS administration is still not widely adopted because it is time-consuming, and it requires the presence of adequately trained and specialized personnel (13-16). This paper delves into the significance of MGAS in the evaluation of geriatric patients undergoing surgery, highlighting their role in enhancing risk stratification, personalized care, and postoperative outcomes. The aim is to compare the scores to identify the most accurate one in the prediction of the patient's survival rate and risk assessment (17). As a secondary outcome, the analysis also aims at assessing which risk parameters are most frequently altered to deduce which are the most important fields of investigation to which the geriatric patient should be subjected in the preoperative assessment phase.

Patients and Methods

Design of the study. This is an observational, retrospective, single center study investigating the role and the accuracy

of MGAS in the preoperative assessment of elderly patients (>75 years old) undergoing major abdominal surgery. A total of 69 patients over 75 years old who underwent major abdominal surgery for neoplastic reasons were included in the study. Patients who were unable or refused to sign informed consent, lacking histological neoplastic confirmation, or with incomplete clinical data were excluded.

The study was conducted in our department between December 2018 and July 2020. All patients underwent surgery at the General Surgery Unit of Sant'Andrea Hospital, a large teaching hospital in Rome, performed by experienced digestive surgeons. All patients enrolled in the study underwent successful general oncological surgery, *i.e.*, resection of the neoplastic mass, normal postoperative course and subsequent discharge of the patient in fair general condition. Clinical and surgical data were extracted from electronic medical records. The selected subjects were geriatric patients who underwent surgery for a variety of malignant tumors, specifically those affecting the abdominal cavity, such as cancers of the gastrointestinal tract, pancreas, gallbladder, and bile ducts.

Of the 69 patients examined, 11 had metastases at other sites treated surgically or with radio/chemotherapy. All patients underwent laparotomy surgery according to standard clinical practice (anesthesia-related factors, extent of the disease, radicality of the resection).

The study received the Institutional Review Board (IRB) approval of the Department of Translational Medicine and Surgical Science of Sant'Andrea Hospital of Rome. All patients gave their written informed consent for data analysis for educational and research reasons.

Demographics, medical history, surgical and follow-up details of patients were collected from their medical records and gathered into an Excel database. From them Charlson Comorbidity Index (CCI), the APACHE II score, the CIRS, G8, and the ISAR were calculated and compared (18-22). These scores were compared to actual postoperative complications classified using the Clavien-Dindo grading system (23).

Statistical analysis. Due to the retrospective and observational nature of the study, a descriptive statistical analysis was conducted on the 69 included patients. Data are expressed as mean±standard deviation (SD) or median (interquartile range, IQR), unless otherwise specified. Normality was assessed *via* the inspection of frequency histograms. To assess the relationship between each geriatric assessment scale and postoperative complications, a Pearson correlation analysis (Pearson's ρ) was performed between the predictive scores (CCI, APACHE II, CIRS, ISAR, and G8) and the Clavien-Dindo classification of complications. All tests were two-sided, and a p -Value <0.05 was considered statistically significant. Statistical analysis was performed using Python 3.9.

Results

The study population consisted of 69 patients with a median age of 77.3 years (IQR=75-81). These patients underwent major surgeries, predominantly gastroenterological and oncological. Predictive scores yielded a median CCI of 6 (IQR=5.5-9), which corresponded to a calculated preoperative average chance of survival of 11.2%±13.9 based on CCI. The APACHE II registered a median score of 11 (IQR=9-14.5), while the CIRS score of 11 (IQR=9-14). Twenty-five patients (36.2%) out of 69 showed a moderate risk on the ISAR score (score=2-3), with the majority of the population (63.7%) being at low risk (44/69), and none of the patients was at high risk. Concerning the G8 score, more than half of the patients (72.5%) demonstrated characteristics of frailty (50 patients out of 69). The mean Clavien-Dindo score was 2 (SD=1.41), with 52.2% of the population showing no postoperative complications (36 patients out of 69), 43.5% of population showing mild complications scored as Clavien-Dindo II, 2 patients (2.9%) with a severe complication (CD IV) and one postoperative death (1.4%). Details are reported in Table I and Table II. The correlation analysis revealed no statically significant correlation between Clavien-Dindo and any of the scores taken into analysis.

The correlation between CCI and the Clavien-Dindo score revealed a weak positive correlation ($\rho=0.107$,

Table I. Baseline characteristics of the study population. Values are reported as median with interquartile range (IQR) or mean with standard deviation (SD), as appropriate. The table summarizes the demographic and clinical features of the 69 geriatric patients included in the study.

Patient characteristics	N (% otherwise specified)
Age	77.3 (IQR 6)
BMI	25.8 (IQR 6.5)
ASA	2.1±0.4 SD
Active smokers	15 (21.7)
Arterial hypertension	38 (55)
Cardiovascular disease	53 (76.8)
COPD	20 (28.9)
Diabetes Mellitus	17 (24.6)

BMI: Body Mass Index; ASA: American Society of Anesthesiologists; COPD: Chronic Obstructive Pulmonary Disease.

Table II. Surgical procedures performed in the study population. The table summarizes the types of major abdominal oncologic surgeries performed on the 69 patients included in the study.

Surgical details	N (%)
ADR+UGIS	1 (1.5)
HBS	5 (7.2)
KS	1 (1.5)
LBR	41 (59.4)
OER	2 (2.9)
PS	7 (10.1)
RSS	4 (5.8)
SBR	2 (2.9)
UGIS	4 (5.8)
UGIS+SPLEENECTOMY	2 (2.9)

ADR: Adrenal surgery; UGIS: upper gastrointestinal tract surgery; HBS: hepatobiliary surgery; KS: kidney surgery; LBR: large bowel resection; OER: esophageal resection; PS: pancreatic surgery; RSS: retroperitoneal sarcoma surgery; SBR: small bowel surgery.

$p=0.383$) while the APACHE II showed no correlation at all with the Clavien-Dindo score ($\rho=0.063$, $p=0.607$). The G8 score showed the strongest correlation among the scores with $\rho=0.267$ and a statistically significant p -value of 0.027. However, CIRS and ISAR Pearson's ρ was not statistically significant. Details are reported in Table III.

Discussion

The results of this study highlight that the analyzed predictive scores do not exhibit strong correlations with

Table III. Distribution of geriatric assessment scores and correlation with postoperative complications (Clavien-Dindo classification).

Score	N (%)	Pearson correlation with CD
Clavien-Dindo		
Not reported complications	36 (52.2)	
Cd=2	30 (43.5)	
Cd=4	2 (2.9)	
Cd=5	1 (1.4)	
Charlson comorbidity index		$p=0.383$
Cci 0-2	1 (1.4)	
Cci 3-4	6 (8.7)	
CCI >5	62 (89.9)	
APACHE II		$p=0.607$
0-9	20 (28.9)	
10-19	49 (71.0)	
>20	0 (0)	
CIRS		$p=0.436$
0-6	8 (11.6)	
7-14	48 (69.6)	
15-20	11 (16.9)	
>20	2 (2.9)	
G8		$p=0.027^*$
0	19 (27.5)	
1	50 (72.5)	
ISAR		$p=0.246$
0-1	44 (63.7)	
2-3	25 (36.3)	
>4	0 (0)	

CD: Clavien-Dindo; CCI: Charlson Comorbidity Index; APACHE II: Acute Physiology and Chronic Health Evaluation II; CIRS: Cumulative Illness Rating Scale; G8: Geriatric 8; ISAR: Identification of Seniors at Risk. *Statistically significant.

postoperative complications classified according to the Clavien-Dindo system. This may reflect some intrinsic limitations of the scores, particularly in the context of major surgery. For instance, the CCI, designed to evaluate comorbidities, might not adequately capture age-related physiological factors that influence surgical outcomes.

Although APACHE II shows a weak positive correlation with postoperative complications, its utility as a predictive tool for this specific population may be limited. Furthermore, the CIRS score, while widely used to assess comorbidity severity, may not be sufficient to predict postoperative outcomes.

This study underscores the need to develop more specific and multidimensional predictive models that

integrate not only comorbidities but also factors such as age, physiological reserves, and nutritional status. Nutritional status also emerged as a key determinant of outcomes in elderly oncologic patients, as shown by Kinoshita *et al*, who identified the Geriatric Nutritional Risk Index (GNRI) as an independent prognostic marker for survival in elderly patients with small-cell lung cancer (1). Additionally, further prospective studies with larger samples are essential to validate these findings and improve preoperative risk stratification in geriatric patients.

Frailty is a concept frequently linked to elderly patients, largely due to the complex and multifactorial aspects of their clinical presentation and care. Defined as a clinical syndrome marked by diminished physiological reserves, frailty substantially impacts an individual's capacity to tolerate stressors like surgery. Indeed, it is increasingly recognized as a key factor in predicting surgical outcomes, particularly in older adults. Frailty is associated with a higher risk of complications, prolonged hospital stays, and increased mortality following surgery. Preoperative frailty assessments can help identify patients at high risk, enabling tailored perioperative management to improve outcomes. Common indicators of frailty include weakness, unintentional weight loss, slow gait, and exhaustion. Frail patients may require modifications in surgical planning, such as less invasive procedures or enhanced recovery protocols. Research suggests that interventions like physical therapy, nutritional support, and optimizing comorbidities can mitigate some of the risks associated with frailty in surgery. Moreover, frailty should be assessed in combination with other factors like age and comorbid conditions to accurately predict surgical risk. Given its importance, frailty assessment is now becoming standard practice in preoperative evaluations for high-risk patients (24, 25).

This study aimed to identify the rating scale most effective at predicting post-operative risk in geriatric patients undergoing abdominal oncological surgery. The screening instruments chosen for this purpose, though presenting notable differences in variable count and data types, share the common goal of assessing comorbidity,

which has been identified as the main negative predictor of post-operative outcome in this patient population. Similarly, Okada *et al*. demonstrated that higher mFI-5 frailty scores were significantly associated with Clavien–Dindo grade \geq III complications in elderly patients undergoing laparoscopic colorectal surgery, supporting the predictive value of concise frailty tools in abdominal oncologic procedures (26-28).

Considering the selected sample of 69 geriatric patients undergoing abdominal oncological surgery, the results obtained in terms of average risk of post-operative mortality for each scale showed discordant results. The CCI reported an average chance of survival of 11%, with a maximum post-operative mortality rate of 100%, which means that according to this survey instrument, almost all patients in our sample were at very high risk of developing post-operative complications. However, it should be borne in mind that the CCI gives a 10-year post-operative mortality risk rate, *i.e.*, a very long-time span for a patient in the age range we considered and in a health condition complicated by neoplastic pathology. We then compared these data with the surgical outcome of the patients in the sample and found that all patients had a normal postoperative course and had been discharged in a stable general condition.

It can be deduced at this point that this type of rating scale, although widely used for the study of geriatric patients, was less effective in our investigation, as it makes a long-term prognostic assessment in relation to the average life expectancy of the patients studied and this makes the risk percentage mathematically less reliable. Furthermore, the CCI score is decisively influenced by two factors: advanced age and the presence of moderate or severe comorbidity: if these two factors coexist, the calculated 10-year survival rate drops dramatically. As all patients in this study were geriatric and affected by neoplastic pathology, the decision was made to uniformly consider their severity index at the level of maximum post-operative risk, thereby not differentiating their individual conditions.

The CIRS, on the other hand, a comprehensive score from 0 to 56, yielded an average of 11.4 in our study. This score

proved definitely more favorable than the predictions based on CCI, which is noteworthy given that CIRS, like CCI, mainly focuses on identifying comorbidities that worsen the general condition of cancer patients. The ISAR presents a mathematically similar risk, however this test investigates a very limited number of items compared to the other three assessment methods and this partly compromises its ability to form a complete picture of the patient's condition. In fact, the ISAR focuses mainly on the presence of psychophysical disabilities and polypharmacotherapy and these data are indirect indicators of the preoperative condition of patients. It should not be regarded as a definitive diagnostic indicator, but as a warning sign that helps healthcare professionals identify elderly patients who could benefit from a multidisciplinary approach or continuous monitoring. However, a study conducted in Italy by AIFA's Osservatorio sull'Impiego dei Medicinali, highlighted the wide diffusion of polypharmacy in the geriatric population in Italy, with more than 1,300,000 individuals (11.3%) receiving a simultaneous prescription of 10 or more drugs. This figure is particularly significant, and the age group found to be exposed to the highest drug load is that between 75 and 84 years of age, with 55% of individuals treated with 5-9 drugs and 14% with 10 or more drugs (29). In our study sample, the value related to the intake of more than three drugs was the most relevant component of the ISAR score. This finding prompts a question about the usefulness of this data for calculating postoperative risk percentage. Support for this observation can be found in the 2017 Dutch study entitled 'Risk stratification for surgical outcomes in older colorectal cancer patients using ISAR-HP and G8 screening tools' (30). The ISAR and G8 questionnaires were used to identify geriatric patients undergoing surgical treatment for colorectal cancer who were at risk of adverse outcomes. Out of 139 patients, 32 patients were found to be weak on analysis with ISAR, 68 on analysis with G8 and 20 with both. Subjects identified as weak on ISAR were at risk of complications 30 days after surgery, with new hospitalizations, cardiopulmonary complications and prolonged hospitalization, whereas for patients found to be weak on both tests the following risks were prolonged up to 6 months after surgery. From this

analysis, it was deduced that the predictive value of ISAR was of higher reliability if it was combined with another risk score that broadened its field of investigation (30, 31).

Given the lack of statistical significance observed in the correlation analysis, it is important to clarify that no assessment scale can be considered definitively superior to others. Although the literature suggests that the APACHE II score may offer a better predictive value, particularly in terms of mortality risk, our findings do not provide strong enough evidence to support this conclusively. While the APACHE II scale shows a tendency to align more closely with the postoperative outcomes in our sample, it is important to emphasize that the sample size is limited, and further prospective studies are needed to confirm or refute these results.

In our study, the APACHE II scale appeared to yield a mortality risk percentage that was the most optimistic among the four scales and exhibited the least statistical variability. This was particularly evident when the risk of postoperative mortality was calculated, with nearly half of the patients having a risk of less than 10%. In comparison, the values from other scales, such as CCI, ISAR, and CIRS, indicated a higher mortality risk, which could suggest a more positive prognostic view based on APACHE II.

However, it is crucial to note that the results do not establish a definitive superiority of APACHE II over other scales. A U.S. study conducted between 2002 and 2003 found that APACHE II was an accurate tool for predicting hospital mortality in high-risk patients, but the authors also emphasized the necessity for periodic updates to maintain the accuracy of the method (32). Thus, while the APACHE II score shows potential in our sample, additional prospective studies with larger sample sizes are required for more robust conclusions.

It is necessary to consider certain limitations for this retrospective single-center study. Firstly, the number of subjects was small, and the nature of the study was retrospective, and secondly, the scales described were selected because they are widely used in scientific research for the assessment of post-operative mortality in general and for studies on the outcome of geriatric cancer patients;

however, they have considerable differences between them, which have already been explained in the discussion. These differences make comparisons of these assessment scales complex, although they have in fact enabled us to study the patients' conditions in a comprehensive manner.

Lastly, the patients selected for this study underwent abdominal oncological surgery of varying degree and extent; this parameter was not assessed by the scales considered, but as shown in numerous studies, the type of surgery and the extent of the tumor have a significant impact on the post-operative mortality of the geriatric cancer patient (3-5, 7, 8, 33-35).

Conclusion

This study underscores the significant challenges in accurately predicting postoperative complications among elderly patients undergoing major oncological surgery, highlighting inherent limitations in the predictive capacity of existing geriatric assessment scales. While some instruments, such as the G8, demonstrated a comparatively stronger association with outcomes in our cohort, the findings collectively suggest that current approaches may not fully capture the multifaceted risk profile of this vulnerable population. The results therefore strongly advocate for the development of more comprehensive and tailored risk stratification models. These models should move beyond merely enumerating comorbidities to explicitly incorporate dynamic factors like frailty phenotype, detailed nutritional status, and objective measures of physiological reserve, which are crucial determinants of resilience in the face of surgical stress. Ultimately, robust validation of these insights through larger-scale prospective studies is essential to pave the way for implementing improved preoperative decision-making strategies and enhancing outcomes in geriatric oncologic surgery.

Conflicts of Interest

The Authors do not have any relevant conflicts of interest to disclose.

Authors' Contributions

Marta Goglia: Conceptualization, Formal analysis, Data curation, Methodology, Investigation, Writing - Original draft preparation; Andrea de Zanna: Formal analysis, Methodology, Investigation, Review-Editing; Arianna Cicolani: Investigation; Gaetano Gallo: Formal Analysis, Methodology, Investigation, Reviewing-Editing; Diana Ronconi: Investigation; Francesco Maria Carrano: Investigation, Methodology; Matteo Pavone: Review-Editing; Niccolò Petrucciani: Investigation; Francesco D'Angelo: Supervision, Review-Editing; Giuseppe Nigri: Conceptualization, Supervision; Paolo Aurello: Conceptualization, Supervision. All Authors approved the final version of the manuscript for submission.

Artificial Intelligence (AI) Disclosure

During the preparation of this manuscript, a large language model (ChatGPT 4.0 OpenAI) was used solely for language editing and stylistic improvements in select paragraphs. No sections involving the generation, analysis, or interpretation of research data were produced by generative AI. All scientific content was created and verified by the authors. Furthermore, no figures or visual data were generated or modified using generative AI or machine learning-based image enhancement tools.

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