Evaluation of The Comprehensive Geriatric Assessment (CGA) Tool As A Predictor of Postoperative Complications Following Major Oncological Abdominal Surgery in Older Patients

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Research Article

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Abstract

Purpose: The concept of frailty extends beyond chronological age. Identifying frailty using a two-step approach, starting with the use of a screening tool (G8) followed by complete geriatric assessment (CGA), may be useful for guiding treatment decisions and follow-up.

This study evaluated the association between geriatric screening and individual components of the tCGA with the risk of 90-day postoperative complications in oncogeriatric patients.

Methods: Data on patients with major oncological abdominal surgery were retrospectively collected from hospital records (2016-2019). Patients with G8 and CGA geriatric screening in those identified by an altered G8 screening score were included. Postoperative complications were classified by Clavien-Dindo grade and the Comprehensive Complication Index (CCI).

Results: One hundred and twelve patients aged ≥ 70 years surgically treated with curative intent for cancer were included. Seventy-six (67.9%) presented with an altered G8. Of these, sixty-six (58.9%) had a CGA. In univariate analysis, only altered nutritional status assessed by the Mini-Nutritional Assessment-Short Form was associated with higher total complication rate ($p = 0.01$). Patients with impaired G8 had significantly more complications and higher 1-year mortality rates than patients with normal G8. Fifteen patients (13.4%) had grade III-IVb complications. A CCI > 50 was recorded in 16 patients (14.3%). All-cause 90-day postoperative mortality was 10.7%.

Conclusions: Identifying altered preoperative nutritional status as part of the CGA in patients screening positive for frailty is a potentially modifiable risk factor that can influence preoperative management and treatment decision making. G8 may be a predictive factor for postoperative complications.

Introduction

The age distribution of a population greatly affects its burden of disease and disability, including cancer incidence, morbidity, and mortality [1]. With the sharp increase in life expectancy observed in both men and women, virtually every country in the world is experiencing growth in the size and proportion of older people in their population. Over the next three decades, the global number of older people is projected to more than double, reaching over 1.5 billion by 2050, with the share of the population aged 65 years or over expected to reach 16 percent [2].

Although the relationship between ageing and cancer is complex and far from understood, the incidence of cancer increases with age in humans and in laboratory animals alike [3]. As global epidemiologic and demographic transitions continue, they signal an ever-growing cancer burden over the next few decades, with over 20 million new cases expected annually as early as 2025. With surgical intervention continuing to be the principal treatment for many solid tumors, the number of older patients undergoing surgery as part of their cancer treatment is also expected to rise [4].

These older patients are often considered at increased risk for complications after major surgery but chronological age alone is not a reliable predictor of postoperative complications [5]. As an isolated factor, it is insufficient to capture the physiologic heterogeneity prevalent in this population [6]. The concept of frailty extends beyond chronological age and is one of the most serious global health challenges to be faced in the coming century. Frailty can be defined as “a complex clinical condition characterized by a decline in physiological capacity and reserve across several organ systems, with a resultant increased susceptibility to stressors” [7]. Older patients considered fit for surgery might do as well as younger patients but frail and vulnerable patients are at an increased risk of adverse postoperative outcomes [8]. The usual method used to identify frailty is to evaluate an older patient’s general condition and risk of adverse outcomes using the evidence-based process of comprehensive geriatric assessment (CGA). Through a battery of standardized and validated assessment instruments, CGA evaluates nutrition, cognition, functional status, comorbidities, and geriatric syndromes to identify at-risk patients and to possibly guide management, treatment, and follow-up [9].

Since administering a complete geriatric assessment is time-consuming, the International Society of Geriatric Oncology (SIOG) recommends a “two-step approach”. This strategy starts with the use of a screening tool to identify patients in need of further evaluation by CGA. Screening can be done with the Geriatric 8 (G8), a screening tool that includes seven items from the Mini Nutritional Assessment (MNA) and an age-related item (< 80, 80–85, or > 85 years). Final scores range from 0 to 17, with a score below 14 indicating a geriatric risk profile [10]. Some components of the CGA have been found to be consistently associated with adverse postoperative outcomes; however, based on current evidence, it is not possible to reach a consensus as to how an optimal geriatric assessment (GA) should be conducted and recommendations vary based on patient age, type of surgery (i.e., minor versus major), and other risk factors [8, 11]. Moreover, geriatric screening using the G8 assessment tool has been reported to be a powerful outcome predictor in surgical oncogeriatric patients in terms of hospital stay, rate of postoperative delirium, and 1-year mortality rates [12].

The purpose of this study was to identify independent predictors of postoperative complications in older surgical patients undergoing major oncological abdominal surgery based on components of the comprehensive geriatric assessment. The secondary aim of our study was to investigate differences in postoperative outcomes between patients identified as frail and those with a normal G8 score.

Materials And Methods

Study design & objectives

This was a monocentric retrospective study including patients ≥ 70 years old treated for abdominal cancer with surgery with a curative intent at Institut J. Bordet (IJB) between January 2016 and December 2019. The study protocol was reviewed and approved by the Ethics Committee of the IJB (CE3277). For the retrospective review of electronic medical records, written informed consent was not needed.

The primary objective of the study was to identify whether some components of the CGA are independent predictors of postoperative complications in oncogeriatric patients.

The secondary objective was to evaluate the predictive value of G8 in postoperative complications between patients identified as frail due to an altered G8 score and those with a normal G8 score.

Data sources

We retrospectively researched the hospital's records of all surgical interventions performed during the study period. Major surgical interventions were defined based on the extent of dissection: major body cavity opened (e.g. peritoneal cavity) and as oncological surgeries with major-to-severe tissue trauma (e.g. resection of an organ or part of it and/or digestive anastomosis). Inclusion criteria included patients 70 years or older, scheduled for major oncological abdominal surgery, such as: hepatectomy (open or laparoscopic), colectomy (open or laparoscopic), abdomino-perineal resection, cytoreductive surgery with or without hyperthermic intraperitoneal chemotherapy (HIPEC), rectal resection, small bowel resection, exploratory laparotomy, esophagectomy, and gastrectomy. Further inclusion criteria among those patients were: pre-operative geriatric 8 (G8) screening as well as a comprehensive geriatric assessment in those scoring below or equal to 14 when evaluated by the G8 screening tool, performed at least 3 months prior to surgical intervention. All other patients were excluded (e.g. emergency surgeries).

The institutional electronic medical record system (Oribase) was used as the data source. Among different components of the CGA, we retained a set of seven validated scores and questionnaires:

- Katz's activities of daily living (ADL) and Lawton's instrumental activities of daily living (IADL) scales to assess functional status [13, 14]
- Mini-Mental State Examination (MMSE) to assess cognitive status [15]
- Geriatric Depression Scale (GDS) to assess depression status [16]
- Mini-Nutritional Assessment Short Form (MNA-SF) to assess nutrition status [17]
- Hospital Anxiety and Depression Scale (HADS-A HADS-D) to assess the symptom severity of anxiety disorders and depression [18]

Patients with missing values on one or more instruments were also included.

Postoperative complications obtained from medical records were defined as any event requiring treatment occurring in a 90-day period after the intervention. Severity of complications were classified by the primary investigator according to the Clavien-Dindo classification scale (grades I to V) [19]. Grades I and II were considered minor complications whereas grades IIIa to IVb were recorded as major complications. Grade V meant death of the patient. For complications requiring more than one treatment method, the highest severity grade was noted. In case of multiple complications in a patient, each was recorded and graded separately and, additionally, the Comprehensive Complication Index (CCI) was calculated and reported on an interval scale from 0 to 100 to summarize all (minor and major) complications [20]. Postoperative mortality was defined as death within 90 days. Data for age, gender,

cancer type, histology, type of intervention, CGA results, and complications were obtained from the institutional medical records system (Oribase).

Statistical Methods

Descriptive analysis of clinical and demographic variables was performed. All categorical variables are described using numbers (N) and percentages (%) whereas continuous variables are described using means.

Geriatric Assessment

In the subgroup of patients scoring below or equal to 14 at G8 survey and having received a complete geriatric assessment, patients were divided into two groups based on median values of continuous variables for each score and questionnaire. Dichotomized outcome variables for 90-day postoperative complications were created according to Clavien-Dindo: no complications versus any complications. The impact of the collected variable (assessment tool of the comprehensive geriatric assessment) upon the variable of dependent interest (postoperative complications) was explored by univariate analysis and by fitting logistic regression models using the six subscales of the geriatric assessment.

G8 screening tool

Development of complications was compared between patients with a $G8 \leq 14$ and a $G8 > 14$. This study investigated postoperative outcomes using binary measures: 1. Any morbidity (grade I-V) within 90 days of surgery, 2. Major morbidity (grade $> II$) within 90 days of surgery, 3. Major CCI score ($CCI > 50$) 4. Death (grade V) within 90 days of surgery.

To test the significance of each variable in relation to the outcomes, univariate analyses were performed using the chi-square test or Fisher's exact test. Statistical information was encoded anonymously into a database using Microsoft Excel spreadsheets. A value of $p < 0.05$ was considered to be statistically significant. All analyses were done using the Statistical Package for the Social Sciences (SPSS, version 27.0, New York, US).

Results

Baseline patient characteristics

A total of 1377 patients underwent an elective abdominal surgery in the inclusion period. Of these, 1156 patients were excluded as they had *minor* surgeries. This included non-oncological surgeries (e.g. cholecystectomy, umbilical or inguinal hernias) and oncological surgeries with a minimal or low amount of tissue trauma and limited extent of dissection (e.g. digestive stoma). A total of 571 were excluded because the patients were younger than 70 years of age at the time of surgery.

From the 221 interventions for oncological abdominal surgery remaining, 69 (31.2%) were further excluded because no G8 screening was performed. Of the remaining 152, 40 (26.3%) were excluded for not having an appropriate G8 performed; screening was either performed after the intervention or more than 3 months prior. An overview of the flow of patient inclusion into the study is provided in Figure 1.

Among the 112 patients we retained for analysis, the median age was 74 years and 46 were male (41.1%). The two most common tumor sites were colorectal (59, 52.7%) and ovarian (15, 13.4%) and the most common histology type was adenocarcinoma (95, 84.8%). The majority of surgeries (82, 71.4%) were open surgeries and the most frequent types of intervention were colectomy (29, 25.9%) and cytoreductive surgery (20, 17.9%). Malignancies classified as “other” included unknown primaries, endometrial tumors, biliary tract cancers, pancreato-biliary cancers, retroperitoneal cancers and breast, lung, and skin cancers metastatic to the abdomen. A majority of patient cancers (42, 37.5%) were classified as grade II. Details of baseline clinical variables are summarized in Table 1. G8 was altered in 76 patients (67.9%) and normal in 36 patients (32.1%). When we compared the characteristics of the two groups according to sex, cancer type, tumor histology, type of intervention, and surgical approach, we did not find significant differences except for cancer grade (p value 0.04).

Comprehensive Geriatric Assessment

Among the 76 patients with an altered G8, the median age was 76 years (70-92 years). Ten of these patients were not evaluated by CGA at all. Preoperative CGA scores among the remaining 66 patients were ADL > 6 in 33.3%, IADL $\leq$ 7 in 50.8%, MMSE $\leq$ 28 in 57.9%, GDS > 3 in 50.0%, HADS-A > 6 in 42.9%, HADS-D > 4 in 46.4%, and MNA-SF $\leq$ 9 in 39.4%.

Postoperative outcomes

Out of all included patients (N=112), 77 developed at least one complication. The majority of patients (43, 38.4%) experienced a grade II complication and in 15 patients (13.4%) a major complication was reported. Sixteen patients (14.3%) had a CCI score > 50. Respectively, twelve patients (10.7%) died within the 90-day follow-up period from all causes and from postoperative complications. Postoperative Clavien-Dindo scores are displayed in Table 2.

Association between CGA and complications

We analyzed the impact of each component of the GA upon the development of complications. In univariate analysis, the short form of the Mini-Nutritional Assessment was the sole prognostic factor of complications ($p=0.03$). There were no associations between the other assessment tools analyzed and complications. Results are shown in Table 3.

Association between G8 and complications

Table 4 provides an overview of the univariate analysis for predictors of complications, higher CD-score, higher CCI score, and mortality. A G8 score below or equal to 14 was significantly associated with the development of complications within 90 days of surgery. Patients who screened positive for frailty had significantly more complications than patients who screened negative, 52% versus 17% ($p < 0.05$), respectively. However, altered G8 was not associated with the occurrence of major complications or higher CCI score. Additionally, no association was reported between altered G8 and 90-day mortality but it was, however, significantly associated with a higher 1-year mortality (p value 0.01).

Discussion

The primary aim of our study was the identification of independent predictors of postoperative complications based on components of the CGA. In our population, 67.9% of the patients were identified by an altered G8 as being at risk for frailty. Among those patients, 26 scored below or equal to 9 when evaluated by the short form of the Mini-Nutritional Assessment for nutritional status. Our main finding was the strong association between this nutrition-based evaluation tool and the occurrence of any complications during the 90-day postoperative course. In this group of patients with an abnormal G8 score, no association was found between other components of the CGA and postoperative complications. This relationship has been increasingly investigated in the field of surgical oncology but with inconsistent results. In patients with colorectal cancer, ADL, IADL, MMSE, GDS, and MNA were inconsistently associated with postoperative complications [9]. Huisman et al. found impaired nutrition to be associated with major postoperative complications but nutrition status was evaluated by Nutritional Risk Screening (NRS) in that study [8]. For patients undergoing surgery for gastric cancer resection, other malnutrition screening tools have been validated and found to be associated with peri-operative and postoperative morbidity and complications [21].

Our findings indicate the importance of preoperative nutritional assessment in major oncological abdominal surgery in order to provide valuable patient information, to assess surgical risk-benefit ratio, and to possibly provide individualized nutritional therapy by multidisciplinary teams even though the impact of normalization of potentially reversible factors on postoperative complications is still under investigation [22]. However, despite recommendations on geriatric assessment in older patients with cancer published in 2005 by the SIOG, there is no consensus regarding which specific instruments should be included in a CGA [12]. Inclusion of nutritional impairment screening is of high interest as this reversible factor seems to be an indicator of increased postoperative morbidity. Heterogeneity among patient selection and surgical intervention makes comparison difficult and indicates the need for further studies with larger populations using identical screening tools and cut-off values.

Another important finding in our study was the significant difference in postoperative outcomes between patients with a $G8 \leq 14$ and patients with a $G8 > 14$. We identified an association between altered G8 screening and the development of at least one complication. Several studies investigating this

relationship have provided contradictory results. A recent study on preoperative frailty assessment in 114 patients found the G8 tool to not be significantly associated with the risk of adverse events [23]. Another study found similar results in 139 older patients treated surgically for colorectal cancer. The authors did not find isolated G8 to be of any predictive value on postoperative outcomes. They did, however, find that a combination of the G8 and the Identification of Seniors at Risk-Hospitalized Patients (ISAR-HP) screening tool resulted in a high predictive value [24]. Another combination was recently investigated. Bessems et al. indicated that frailty screening by G8 in association with the 4-meter gait speed test predicts postoperative complications in colorectal cancer patients undergoing elective surgery [25]. Additionally, in another study, de Vries et al. found G8 to be a strong predictor of postoperative complications in a population of patients undergoing surgery for cutaneous head and neck cancer [26].

Our study did not find a relation between altered G8 and major complications (defined as Clavien-Dindo grade > II). When investigating this same relationship in 143 patients of the same age group, requiring surgery for a suspected solid malignancy, Bruijnen et al., found no difference in the occurrence of major 30-day complications [27]. However, three studies did describe an association between G8 and the occurrence of major Clavien-Dindo complications. One study included grade II complications and found this association in 78 patients who underwent surgery for colorectal cancer [9], while another in 184 patients who underwent emergency abdominal surgery (including non-oncological patients) [28] and a third in 71 patients treated for hepatocellular carcinoma [12] confirmed these findings.

Furthermore, in these studies, no association was found between altered G8 and a higher 1-year mortality rate. We found altered G8 to not be predictive of 90-day mortality in our population. It was, however, associated with increased 1-year mortality. This may be explained by significantly higher cancer grades in this group.

The predictive value of the G8 on postoperative complications in surgical oncology and practice remains unclear and further trials of larger populations are needed to complete our understanding of this screening tool and its place in diagnostic algorithms. This is in contrast to studies done in non-surgical oncological patients, in whom altered G8 has been shown to provide helpful information through prediction of complications in patients receiving chemotherapy and/or radiotherapy [29]. Furthermore, it is imperative to mention that the G8 was initially developed as a frailty screening tool for predicting deficits in the CGA. It was not intended to be used as a prognostic tool.

Direct comparison between these study results and our results should be approached with caution. The above-mentioned studies focused mostly on homogenous populations with a single malignancy or surgical intervention whereas our study included a variety of tumor types and surgeries. Heterogeneity remains among patient characteristics between studies, definitions of frailty, cut-off values for screening and assessment tools but also in the definition of adverse postoperative outcomes.

The present study had several limitations. First, although the inclusion criteria limited our population to patients undergoing 'major' oncological abdominal surgery, heterogeneity affecting risk of complications remained. For example, Kothari et al. recently showed that within each of their frailty cohorts,

laparoscopic colectomy provided better outcomes when compared to an open approach in all domains, including cardiac/vascular, pulmonary, and wound complications [30]. Additionally, this study did not account for differences in tumor characteristics, such as stage, treatment course, or intensity. Another limitation is the monocentric nature of our study since variations in postoperative complications are influenced by technical skill scores of surgeons and quality of care by medical staff [31, 32]. Other limitations lie in the fact that postoperative outcomes were collected retrospectively. As a result, some minor complications may have been underreported. Moreover, 31% of patients ≥ 70 years were not evaluated because they did not undergo G8 screening and this could have created bias in the analyses. Despite these limitations, the study also had some strengths. Our study was unique as our study population was composed of only older patients admitted for major oncological abdominal surgery not centered around a single malignancy or surgical approach.

In conclusion, this study suggests that the MNA-SF is a valuable asset in preoperative risk assessment for complications that have the potential to impede recovery and its use could be beneficial in the everyday practice of surgical abdominal oncology. Evaluation of nutritional status as part of the comprehensive geriatric assessment in patients identified as frail seems essential as nutrition is a potentially modifiable factor influencing preoperative management and treatment modalities. G8, besides its role as a screening tool for impairment in the CGA, shows potential as a predictor of postoperative complications. This finding corroborates well with the MNA's predictive potential since all the questions of the G8 – except for age – are derived from the MNA.

Declarations

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Availability of data and material: at request to authors

Code availability: NA

Author's contributions: Gabriel Liberale designed the study. Yoon Penning & Julie Raspé collected the data. Yoon Penning wrote the manuscript. Lissandra Dal Lago and Thierry Pepersack have participated to the G8 and GA evaluation (prospectively), Antoine El Asmar & Michel Moreau performed the data analysis. Donckier, Gabriel Liberale, Lissandra Dal Lago and Thierry Pepersack reviewed and edited the manuscript.

Ethics approval: The study protocol was reviewed and approved by the Ethics Committee of the IJB (CE3277).

Consent to participate: For the retrospective review of electronic medical records, written informed consent was not needed.

Consent for publication: For the retrospective review of electronic medical records, written informed consent was not needed.

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Tables

Table 1
Clinical and Demographic Variables

Variable	N	%	<i>p</i> value
Age-median (Range)	74 years (70–92)		
Gender	66	58.9	0.62
Female			
Male	46	41.1	
Cancer Type	59	52.7	0.88
Colorectal			
Ovary	15	13.4	
Liver	6	5.3	
Stomach	9	8.0	
Small Bowel	2	1.8	
Esophagus	5	4.46	
Other	16	14.29	
Histology Adenocarcinoma	95	84.8	0.59
Hepatocarcinoma	5	4.7	
Soft tissue sarcoma	2	1.8	
Cholangiocarcinoma	2	2.8	
Epidermoid Carcinoma	3	2.7	
Other	5	4.5	
Type of intervention	29	25.9	0.53
Colectomy (open or laparoscopic)			
Cytoreductive Surgery	20	17.9	
Hepatectomy (open or laparoscopic)	16	14.3	
Anterior Resection of Rectum	12	10.7	
Exploratory Laparotomy	10	8.9	
Cytoreductive Surgery with HIPEC	5	4.5	
Abdominoperineal Amputation	8	7.1	
Gastrectomy	6	5.3	

Variable	N	%	<i>p</i> value
Esophagectomy (total or subtotal)	3	2.7	
Small Bowel Resection	3	2.7	
Cancer grade	29	25.9	0.04
I			
II	42	37.5	
III	28	25.0	
Unknown	13	11.5	
Type of surgery			0.2
Open	82	71.4	
Laparoscopic	32	28.6	

Table 2
Postoperative Clavien-Dindo scores

	0	I	II	IIIa	IIIb	IVa	IVb	V
G ≤ 14 (N = 76)	18	5	33	6	3	1	0	10
G8 > 14 (N = 36)	17	2	10	3	2	0	0	2
Total	35	7	43	9	5	1	0	12

Table 3
Univariate Analysis for Predictors of Postoperative Complications

		Complications		
		Yes	No	<i>p</i> value
Score	Total (N - %)	N - %	N - %	
ADL				0.35
≤ 6	44–66.7%	33–75%	11–25%	
> 6	22–33.3%	19–86.4%	3–13.6%	
IADL				0.44
≤ 7	33–50.8%	27–81.8%	6–18.2%	
> 7	32–49.2%	24–73.5%	8–24.2%	
MMSE				0.20
≤ 28	33–57.9%	28–84.8%	5–15.2%	
> 28	24–17.1%	17–70.8%	7–29.2%	
GDS				0.48
≤ 3	36–59.0%	30–83.3%	6–16.7%	
> 3	25–50.0%	19–76.0%	6–24.0%	
HADS-A				0.57
≤ 6	32–57.1%	26–81.3%	6–18.8%	
> 6	24–42.9%	18–75.0%	6–25.0%	
HADS-D				0.32
≤ 4	30–53.6%	25–83.3%	5–16.7%	
> 4	26–46.4%	19–73.1%	7–26.9%	
MNA-SF				0.03
≤ 9	26–39.4%	24–92.31%	2–7.7%	
> 9	40–60.6%	28–70%	12–30%	

Table 4

Univariate Analysis for Predictors of Complications, Higher CD-Score, Higher CCI Score, 90-Day and 1-year mortality

Variable	Complications				Minor vs. Major Complications				Higher CCI score			
	Yes	No	<i>p</i>	value	≤ II	III-IVb	<i>p</i>	value	≤ 50	> 50	<i>p</i>	value
Screening			0.01				0.95				0.21	
G8 ≤ 14	58	18			56	10			63	13		
G8 > 14	19	17			29	5			33	3		
Variable	90-day mortality (Grade V)				1-year mortality							
	Yes	No	<i>p</i>	value	Yes	No	<i>p</i>	value				
Screening			0.18				0.01					
G8 ≤ 14	10	60			23	53						
G8 > 14	2	34			3	33						

Figures

Figure 1

Flowchart of patient inclusion in the study