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The Comprehensive Geriatric Assessment and the multidimensional approach. A new look at the older patient with gastroenterological disorders

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Abstract

The Comprehensive Geriatric Assessment (CGA) is a multidimensional, usually interdisciplinary, diagnostic process intended to determine an elderly person's medical, psychosocial, and functional capacity and problems with the objective of developing an overall plan for treatment and short- and long-term follow-up. The potential usefulness of the CGA in evaluating treatment and follow-up of older patients with gastroenterological disorders is unknown. In the paper we reported the efficacy of a Multidimensional-Prognostic Index (MPI), calculated from information collected by a standardized CGA, in predicting mortality risk in older patients hospitalized with upper gastrointestinal bleeding and liver cirrhosis. Patients underwent a CGA that included six standardized scales, i.e. Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), Short-Portable Mental Status Questionnaire (SPMSQ), Mini-Nutritional Assessment (MNA), Exton-Smith Score (ESS) and Comorbidity Index Rating Scale (CIRS), as well as information on medication history and cohabitation, for a total of 63 items. The MPI was calculated from the integrated total scores and expressed as MPI 1 = low risk, MPI 2 = moderate risk and MPI 3 = severe risk of mortality. Higher MPI values were significantly associated with higher short- and long-term mortality in older patients with both upper gastrointestinal bleeding and liver cirrhosis. A close agreement was found between the estimated mortality by MPI and the observed mortality. Moreover, MPI seems to have a greater discriminatory power than organ-specific prognostic indices such as Rockall and Blatchford scores (in upper gastrointestinal bleeding patients) and Child-Plugh score (in liver cirrhosis patients). All these findings support the concept that a multidimensional approach may be appropriate for the evaluation of older patients with gastroenterological disorders, like it has been reported for patients with other pathological conditions.

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Keywords

Comprehensive Geriatric Assessment; Mortality; Multidimensional-Prognostic Index

The Comprehensive Geriatric Assessment

The Comprehensive Geriatric Assessment (CGA) is a multidimensional, usually interdisciplinary, diagnostic process intended to determine an elderly person's medical, psychosocial, and functional capacity and problems with the objective of developing an overall plan for treatment and short- and long-term follow-up. It is particularly useful in dealing with frail elderly, since such patients are likely to have multiple and interacting problems that interfere with daily functioning and complicate treatment, all of which can be better understood and addressed through the comprehensive assessment process. The process of geriatric assessment can range in intensity from a limited assessment by primary care physicians or community health workers focused on identifying an older person's functional problems and disabilities (screening assessment), to more complete evaluations of these problems usually coupled with therapeutic plans by a multidisciplinary team with geriatric training and experience (Comprehensive Geriatric Assessment) [1].

Methodology of the CGA

Comprehensive assessment methodologies are believed to be particularly suited for evaluating older people that suffer from multiple illnesses and significant disabilities. Since in older subjects the occurrence of negative outcomes, such as institutionalization, hospitalization, or mortality, results from a combination of biological, functional, psychological, pathological and environmental factors, tools that effectively identify older high-risk patients should take a multidimensional approach.

Standardized approaches to assess the multidimensional aspects of elderly people are widely diffuse. Indeed, several tools that evaluate the multidimensional impairment and calculate the risk for negative outcomes in old age have been developed and validated in different settings, such as community-dwelling older individuals [2], institutionalized [3] and hospitalized subjects [4].

A typical assessment schedule of CGA includes the administration to the older subject a number of evaluation instruments that focus on relevant clinical and functional areas to establish individual impairments or risk factors that may improve with specific interventions. Widely diffuse in the geriatric practice, these instruments proved to be clinically useful for evaluating functional disabilities in the Activities of Daily Living (ADL) [5] and the Instrumental Activities of Daily Living (IADL) [6], the cognitive status for dementia screening (by the Mini Mental State Examination, MMSE [7] or the Short-Portable Mental Status Questionnaire, SPMSQ [8]), the risk or the presence of depression (by the Geriatric Depression Scale, GDS [9]), the nutritional status (by the Mini-Nutritional Assessment, MNA [10]) or the risk of pressure sores [11] in patients at high risk of immobilization or bed-ridden (by the Exton-Smith scale, ESS). Moreover, the CGA includes a careful evaluation of comorbidities by Comorbidity Illness Rating Scale, CIRS [12], or other tools

[13], as well as of medication use for the evaluation of the appropriateness of prescriptions [14] and the risk for adverse drug reactions [15].

These individual instruments have been validated in older subjects of different settings; require relatively short training programs by the health staff, are easy to perform at bed-side and need few time for their execution by trained personnel. Moreover, the use of standardized instruments of CGA have created a common language among clinicians and can provide data for comparisons of case mix analyses, quality monitoring, and care plannings.

The potential weakness of the assessment based on individual instruments of CGA is a lack of proven utility of the instruments across care settings. Moreover, since each instrument has been developed and validated for evaluating specific domains (functional disability, cognitive status, depression, nutrition, etc.), there is the potential for repetition of data in different format in each instrument and gaps that may occur in relation to some clinical domain for which appropriate instruments are not available. Assessment schedules that adopted a more integrated approach have been suggested [16,17]. Their complexity of both collection and analysis of data, however, limited their diffusion in clinical practice, especially in those operative settings that need rapidity and simplicity of use in order to obtain shortly prognostic information useful for clinical management decisions.

The Multidimensional Prognostic Index (MPI)

Recently, a Multidimensional-Prognostic Index (MPI) for 1-year mortality from information collected in a standardized Comprehensive Geriatric Assessment (CGA) was developed and validated in two independent cohorts of older patients hospitalized for acute diseases or a relapse of chronic diseases [18]. The MPI was calculated by aggregating data from six specific questionnaires, i.e. ADL, IADL, SPMSQ, CIRS-CI, MNA, EES as well as data on number of medications and cohabitation status, for a total of eight domains, that included 63 items [18]. For each domain a tripartite hierarchy was used, i.e. 0 = no problems, 0.5 = minor problems, and 1 = major problems, based on conventional cut-off points derived from the literature for the SPMSQ, MNA, ESS and ADL/IADL or by observing the frequency distribution of the patients at various levels to identify points of separation for comorbidities and number of medications. The specific thresholds used to define the three categories are shown in Table 1. The sum of the calculated score from the eight domains was divided by 8 to obtain a final MPI score between 0 and 1. For analytical purposes, absolute values of MPI were not considered and we expressed MPI as low (MPI value $\leq$ 0.33), moderate (MPI value between 0.34 and 0.66) and severe risk (MPI $>$ 0.66) of mortality. The approximate time required for collecting data for the CGA was 20 min (range from 15 to 25 min per person); further 3–5 min were needed to include data in the software www.operapadrepio.it/content/view/1091/976/.

Further details on mathematical methods used to identify the best MPI cut-off points have been previously reported elsewhere [18].

The MPI in the older patient with gastroenterological disorders

The excellent prognostic accuracy of the MPI was initially reported in older patients hospitalized for an acute disorder or relapse of a chronic disease independently from the diagnosis [18]; other further studies demonstrated that the MPI was also effective in older patients with a diagnosis of pneumonia [19], dementia [20] and heart failure [21].

Indeed, this MPI has potential usefulness in clinical practice. Since this MPI accurately stratifies hospitalized elderly patients into groups at varying risk of mortality, the implementation of the multidimensional approach by using the MPI can be useful in evaluating both high- and low-risk patients, so that specific interventions may be more or less care. This could be important particularly for identifying those low-risk elderly patients who can benefit from cancer screening and/or chronic disease prevention programs and who are actually excluded due to merely the old age. Conversely, the MPI is useful in identifying those high-risk patients for whom appropriate advance care assistance programs could be appropriate and cost-effective. With the aim of evaluating the potential clinical usefulness in older patients also with gastroenterological disorders we applied this MPI in patients affected by two clinical conditions, as examples, that are completely different in both clinical approach and prognostic outcome. i.e. upper gastrointestinal bleeding and liver cirrhosis.

Upper gastrointestinal bleeding

Upper gastrointestinal bleeding remains a significant cause of hospital admission with mortality rates up to 14%. Several scoring systems have been developed to identify those individuals at high risk of rebleeding and/or mortality who are candidates to be hospitalized and intensively treated with transfusions and/or endoscopic or surgical interventions. Conversely the use of prognostic systems may be useful for identifying patients at low risk of complications and mortality who could be discharged early from the hospital or even be treated as outpatients.

Based on age (<60, 60–79 and >80 years), clinical parameters (heart rate, blood pressure), comorbidity (presence of heart, renal and/or liver failure and ischaemic heart disease) and endoscopic stigmata of recent haemorrhage, the Rockall score [22] predicts the potential for rebleeding and mortality associate with upper gastrointestinal bleeding. A non homogeneous predictive value, however, was reported by different Authors [23,24] who used this instrument. More recently, Blatchford et al described a prognostic index that could be used pre-endoscopy [25]. Based on clinical parameters (blood pressure, heart rate, presentation with syncope or melena), comorbidity (liver and cardiac failure) and laboratory test (haemoglobin and urea levels), this score seems to have an high sensitivity for identifying high-risk patients (almost 100%) but poor specificity (13%) [26]. This finding has been recently confirmed in a large study from Canada by using a modified-version of this instrument [27]. Other scoring systems, based on clinical parameters and laboratory tests have been described for specific uses in patients who need surgical interventions [28].

Very recently, a multicenter study carried out at four hospitals in the UK reported that the Blatchford score was superior to Rockall score for prediction of need for surgery or death in

676 patients with upper gastrointestinal bleeding [29]. The relatively low median age of patients, however, (54 years with a range from 43 to 72 years) suggests that the study may give little information for older people. Indeed, a recent large study carried out on 9123 cases of upper gastrointestinal haemorrhage occurred in subjects aged 66 years or older demonstrated that, although patients were selected for out-patient management based on clinical criteria, the overall mortality remained considerable and suggested that in old age a more optimal selection of candidates for in- or out-patients management was needed [30].

Unfortunately, none of above mentioned prognostic instruments included a multidimensional approach. Indeed, an older patient presenting with a severe gastroenterological problem, such an upper gastrointestinal bleeding, typically has a multitude of other conditions and age-related disorders that complicate the diagnostic and care options and make the comprehensive assessment approach particularly valuable [31].

With the aim of evaluating the prognostic usefulness of the Multidimensional-Prognostic Index (MPI) based on a standard CGA in older people, a previous study was carried out in patients aged 65 years or more (mean age of 82.8 ± 7.9 years, range from 70 to 101 years) hospitalized with upper gastrointestinal bleeding due to endoscopically diagnosed gastric and duodenal ulcers or erosive gastritis [32]. At hospital admission, patients underwent a standard CGA including information on ADL, IADL, SPMSQ, MNA, CIRS, EES, drug use and social status for calculating the MPI as above reported. In these patients, higher MPI grades were significantly associated with progressively higher 2-year mortality rates, i.e. MPI 1 =12.5%, MPI 2=41.6% and MPI 3= 83.3% ($p= 0.001$). Adjusting for age and sex, the prognostic efficacy of the MPI for defining the risk of mortality was confirmed and was highly significant (OR= 10.47, 95% CI =2.04–53.6). The findings of this preliminary study demonstrated the importance of considering multidimensional impairment in prognostic systems for elderly hospitalized patients with upper gastrointestinal bleeding. Indeed, the MPI was calculated from conventional CGA data easily available from hospitalized elderly patients and that particularly characterize hospitalized elderly patients, such as disability, malnutrition, cognitive impairment, immobility, comorbidity and the number of medications taken.

Further study was then carried out in order to explore the prognostic value of the MPI for short-term (one month) mortality risk in elderly patients with upper gastrointestinal bleeding. The study evaluated 91 patients aged 65 years and older (males= 49, females =40, mean age 79.9 ± 8.9 years, range from 65 to 100 years) with an endoscopic diagnosis of non-variceal upper gastrointestinal bleeding. At hospital admission, all patients underwent a standard CGA and the MPI was calculated.

Overall, 49 patients (53.8%) were included in the MPI grade 1 low-risk group, 19 patients (20.8%) in the MPI grade 2 moderate-risk group and 23 patients (25.3%) in the MPI grade 3 high-risk for mortality. The overall mortality rate at 1-month was 13.2%. Higher MPI grades were significantly associated with progressively higher mortality: MPI 1 =4.1% mortality, MPI 2 =15.7% mortality and MPI 3 =30.4% ($p= 0.001$). Interestingly, in this population no significant differences among the three groups were observed in haemoglobin levels (9.4 ± 2.8 vs 9.1 ± 2.1 vs 9.6 ± 2.5 g/dl, $p= ns$), urea blood levels (25.4 ± 14.1 vs 41.2 ± 31.2 vs

30.3 $\pm$ 22.2 mmol/l, p =ns), NSAID use (28.9% vs 13.3% vs 26.3%, p =ns) and the percentages of patients who needed transfusions (51% vs 41% vs 43%, p =ns). To test the hypothesis that the prognostic value of the aggregated MPI was superior to the prognostic value of its single components considered individually, logistic model was applied on individual parameters of the CGA. The analyses demonstrated that the MPI was significantly associated with 1-month mortality rates (odd ratio = 3.321, 95% CI = 1.15–9.53); standardized beta coefficients showed that the prognostic value of the MPI was higher compared with the prognostic value of the individual parameters (Table 2).

The discrimination of the model was assessed by calculating the area under the receiver operating characteristic (ROC) curve for the MPI and comparing it with the ROC curves calculated for both the Rockall and Blatchford models. The analyses carried out by using the C test demonstrated that in this population of older patients MPI had a significant greater discriminatory power than Rockall and Blatchford scores (Area Under the ROC Curves=0.76, 0.58–0.94 vs 0.57, 0.40–0.74 vs 0.61, 0.42–0.80, respectively) (Fig. 1).

Liver cirrhosis

The prognosis of older patients with liver disease also may be influenced by a combination of biological, functional, pathological and environmental factors. Indeed, several tools that effectively identify high-risk patients have been described, but none of these used a multidimensional approach. The Child-Plugh score is widely accepted and validated as a grading system for determining the prognosis of patients with cirrhosis and esophageal varices [33]. Although it was originally used to predict mortality during surgery, it is now used to determine the prognosis, as well as the required strength of treatment and the necessity of liver transplantation. The score employs five clinical measures of liver disease (Encephalopathy, Ascites, Bilirubin, Albumin and INR). The Model for End-Stage Liver Disease (MELD) score [34] was initially developed to predict survival in patients with complications of portal hypertension; now, it is the standard on which most decisions regarding liver transplantations are made. Indeed, clear advantages of MELD over Child-Plugh have not yet been clearly demonstrated [28].

In order to evaluate the prognostic usefulness of the CGA-based MPI, we studied 154 patients aged 65 years or more (mean age of 75.64 $\pm$ 6.4 years, range from 65 to 92 years) discharged from the hospital with a diagnosis of liver cirrhosis. At admission patients underwent a standard CGA and the MPI was calculated. Higher MPI grades were significantly associated with progressively higher mortality rates both after 1-month (MPI 1=0%, MPI 2=4.8% and MPI 3=27.6%, p =0.0001) and 1-year (MPI 1=14.5%, MPI 2=31.0% and MPI 3=41.4%, p =0.002) of follow-up. Adjusting for age and sex, the prognostic value of the MPI for mortality was confirmed and was highly significant both at 1-month (OR= 10.561, 95% CI=2.56–43.6, p =0.001) and 1-year (OR= 1.904 95% CI= 1.16–3.12, p =0.01). Fig. 2 shows the survival curves of patients divided for different grades of MPI: patients with higher MPI demonstrated a significantly higher mortality rate (p =0.001). As shown in Table 3, a close agreement was found between the estimated mortality and the observed mortality after both 1-month and 1-year of follow-up.

In 129 patients a Child-Plugh score was also calculated and its short-term prognostic value was compared with that of the MPI. The area under the ROC curve calculated for the MPI was significantly higher compared to the area under the ROC area for the Child-Plugh score (0.90, 95% CI 0.85–0.96 vs 0.70, 95% CI 0.52–0.88, $p = 0.03$) suggesting that in this population of older patients MPI had a significant greater discriminatory power than Child-Plugh score.

Conclusion

The CGA is a useful approach for evaluating older patients with gastroenterological disorders, including upper gastrointestinal bleeding and liver cirrhosis. Moreover, a CGA-derived Multidimensional-Prognostic Index (MPI) is effective for stratifying older patients into groups at different grades of short- and long-term mortality risk. In most of cases, the prognostic accuracy of the MPI was superior to the prognostic value of indices that were mainly constructed considering organ-specific instead of multidimensional impairments. This multidimensional approach has been successfully used in hospitalized elderly patients for clinical [18–21,32] and even for administrative purposes [35]. Indeed, a significant correlation was found between multidimensional impairments assessed by the CGA criteria and the all-patients-refined-(APR)-DRG system, which is an administrative tool useful in identifying elderly inpatients at high risk of high health-resource consumption. All these findings support the concept that a multidimensional approach is appropriate for the older patients with gastroenterological disorders such as upper gastrointestinal bleeding and liver cirrhosis.

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Fig. 1. Receiver Operating Curves (ROC) for Multidimensional-Prognostic Index (MPI), Rockall score and Blatchford score at 1-month of follow-up in older patients with upper gastrointestinal bleeding.

Fig. 2. Survival Curves at 1-year, adjusted for age and gender, in older patients with liver cirrhosis divided for different grades of the Multidimensional-Prognostic Index (MPI).

Table 1

Multidimensional-Prognostic Index score assigned to each domain based on the severity of the problems.

ASSESSMENT	PROBLEMS		
	NO (VALUE =0)	MINOR (VALUE= 0.5)	SEVERE (VALUE= 1)
Activities of Daily Living (ADL) ^a	6–5	4–3	2–0
Instrumental IADL (IADL) ^a	8–6	5–4	3–0
Short-Portable Mental Status Questionnaire (SPMSQ) ^b	0–3	4–7	8–10
Comorbidity-Index (CIRS-CI) ^c	0	1–2	3
Mini-Nutritional Assessment (MNA) ^d	24	17–23.5	<17
Exton-Smith Scale (ESS) ^e	16–20	10–15	5–9
Number of Medications	0–3	4–6	7
Social Support Network	Living with Family	Institutionalized	Living Alone

^aNumber of active functional activities.

^bNumber of errors.

^cNumber of diseases.

^dMNA score: 24, satisfactory nutritional status; 17–23.5, at risk of malnutrition; <17, malnutrition.

^eESS score: 16–20, minimum risk; 10–15, moderate risk; 5–9 high risk of developing scores.

Table 2

Risk factors for 1-month mortality in older patients with upper gastrointestinal bleeding.

Risk factors	1-month		
	OR [95% CI]	P value	Standardized Beta Coefficients
Multidimensional-Prognostic Index	3.067 [1.142–8.239]	0.02	2.223
Age	0.990 [0.914–1.072]	0.80	–0.245
Sex (male)	2182 [0.539–8831]	0.27	1.094
ADL	1.345 [0.983–1.839]	0.06	1.854
IADL	1.175 [0.920–1.500]	0.19	1.293
SPMSQ	1.126 [0.879–1.443]	0.34	0.941
CIRS-CI	1.364 [0.953–1.953]	0.09	1.696
MNA	1.106 [0.995–1.230]	0.06	1.860
Exton-Smith Scale	1.256 [1.037–1.521]	0.02	2.130
No. of drugs	1.036 [0.770–1.395]	0.81	0.236

Abbreviation: MPI, Multidimensional-Prognostic Index; ADL, Activities of Daily Living; IADL, Instrumental Activities of Daily Living; SPMSQ, Short-Portable Mental Status Questionnaire; CIRS-CI, Cumulative Illness Rating Scale – Comorbidity-Index; MNA, Mini-nutritional assessment.

Table 3

One-month and one-year estimated and observed mortality rates in older patients with liver cirrhosis divided by MPI grades.

MPI grade	Time	Estimated mortality HR (95% CI)	Observed mortality
1	1 month	0 (0)	0
(Low risk)	12 months	15.5 (7.9–23.1)	14.5
2	1 month	4.8 (4.4–14.4)	4.8
(Moderate risk)	12 months	32.0 (18.9–45.1)	31.0
3	1 month	30.3 (14.1–46.2)	27.6
(High risk)	12 months	41.0 (24.3–57.7)	41.4

Abbreviation: MPI, multidimensional-Prognostic Index; HR, hazard ratio.