Physiological and operative severity score for the enumeration of mortality and morbidity, frailty, and perioperative quality of life in the elderly

ABSTRACT

Background: Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM) is a validated instrument used to predict morbidity. The aim of our study was to evaluate the performance of the POSSUM score system on predicting perioperative frailty and quality of life (QOL) in elderly surgical patients.

Patients and Methods: An observational prospective study was conducted during 3 months. POSSUM was used to determine operative morbidity risk. Patients with a POSSUM score ≥26 were considered as having a high POSSUM (PHP). WHODAS 2.0, EuroQOL-5 dimensions (EQ-5D), Charlson score, and the Clinical Frailty Scale were used to assess the QOL and frailty. Chi-square, Fisher's exact, or Mann–Whitney tests were used for comparisons.

Results: Two hundred and thirty-five patients were included. Median age was 69 years; 58% were ASA I/II and 42% ASA III/IV. Frailty was present in 53 patients (23%). Median POSSUM score was 26. Patients PHP were older (median age 71 vs. 68, $P = 0.008$), more frequently ASA III/IV ($P = 0.001$), had higher median Charlson scores (7 vs. 5, $P = 0.006$) and were more frail (49% vs. 26%, $P < 0.001$). PHP presented more problems in EQ-5D dimensions preoperatively (mobility: 59% vs 41%, $P = 0.008$; care: 41% vs. 25%, $P = 0.013$; activity: 52% vs. 32%, $P = 0.002$; pain: 59% vs. 45%, $P = 0.041$) but not anxiety ($P = 0.137$). Three months after surgery, PHP patients presented more problems in mobility: 63% vs. 38%, $P < 0.001$; care: 48% vs. 31%, $P = 0.009$; activity: 58% vs. 44%, $P = 0.036$; pain 59% vs. 37%, $P = 0.001$ and anxiety: 54% vs. 50%, $P = 0.025$.

Conclusions: Patients PHP were frailer and had worse perioperative QOL.

Key words: Aged; frailty; health status; quality of life; risk assessment

Introduction

Due to the growing proportion of elderly population, there is an increasing prevalence of older patients in the perioperative setting.[1,2] Thus, more and more surgical procedures are being performed on patients with multiple morbidities[3] and progressive functional decline,[2] a reality which might not be adequately evaluated by the general perioperative risk assessment measures.[4]

Our study aimed to evaluate the correlation between Physiological and Operative Severity Score for the

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Enumeration of Mortality and Morbidity (POSSUM) with perioperative quality of life (QOL), frailty, and other related outcomes in a population of elderly patients.

Patients and Methods

The current prospective observational study was conducted for 3 months at a University Hospital after obtaining approval by the ethics institutional committee. All participants signed the informed consent after being properly informed about the purpose, procedures, and expected duration of the study. Patients were considered to be old if they were over 60 years old.

Two hundred and thirty-five old patients scheduled to undergo elective procedures under general, regional, or combined anesthesia for general, urological, gynecological, plastic, vascular, or orthopedic surgeries were enrolled in the study. Patients who were (i) admitted to the intensive care unit (ICU) immediately after surgery, (ii) submitted to emergency or urgent surgery procedures, (iii) unable to speak or understand the Portuguese language, or (iv) incapable of signing the informed consent were excluded from the present study. This selection was carried out up to 14 days before the day of the surgery.

Data collected at the preoperative visit (T0) included physical status classification of the American Society of Anaesthesiologists (ASA), the validated Portuguese version of EQ-5D-5L questionnaire[5,6] for health-related QOL assessment, the WHO Disability Assessment Schedule 2.0 (WHODAS 2.0), the Charlson Index, and the Clinical Frailty Scale. Patients were classified as disable if their score was above 25% in the WHODAS scale and as frail if they scored ≥5 on the Clinical Frailty Scale. The Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (P-POSSUM) proposed by Prytherch *et al.* was used to determine mortality.[7] The intraoperative parameters required for the Operative Severity part of the POSSUM score were obtained through surgical records.

Patients having POSSUM scores higher than the median of the considered population were considered as having high POSSUM (PHP).

Postoperative disability and reintervention rates were evaluated at 30 days (T1) and quality of life and frailty at 3 months of (T3) follow-up.

Patient-reported QOL was evaluated through the Portuguese version of the EQ-5D-5L questionnaire at T3 and compared with the results registered at T0 through Chi-square testing. Patients having any grade of problems in a particular dimension were considered to have problems in that dimension.

Chi-square, Fisher's exact, or Mann–Whitney tests were used for comparisons. A *P* value <0.05 was considered significant. All statistical analyses were performed using SPSS 22.0.

Results

At the baseline, 244 patients were eligible for the study. Of these, six were excluded for lack of data, making up a final cohort of 235 patients. The median age was 69 years old, with ages ranging from 60 to 91 years. The median Charslon score was 6, and the preoperative frailty was present in 53 patients (23%). Fifty-eight percent (*n* = 136) of the patients were ASA I or II; 42% (*n* = 98) were ASA III or IV.

As the median POSSUM score was 26, patients with POSSUM scores ≥26 were considered as having high POSSUM (PHP). Of the total 235 patients, 140 were PHP (60%). Both the demographic profile and the type of surgical procedures are summarized in Table 1. PHP were frailer at T0 [Table 2].

In-hospital mortality was 2.6% (*n* = 6) and 30-day (T1) mortality was 3.8% (*n* = 9). P-POSSUM predicted mortality

Table 1: Baseline patient characteristics

Variable	Non-PHP (*n*=95; %)	PHP (*n*=140; %)	*P*
Age, median	68	71	0.008
Gender, *n* (%)			0.658
Female	53 (41,7)	74 (58,3)	
Male	42 (38,9)	66 (61,1)	
ASA, *n* (%)			0.002
I/II	69 (72,6)	68 (48,6)	
III/IV	26 (27,4)	72 (51,4)	0.001
Charslon, median	5	7	0.006
Disability, %	31	69	0,023
Type of surgery, *n* (%)			0,344
General	37 (38,5)	59 (61,5)	
Vascular	7 (31,8)	15 (68,2)	
Gynecological	7 (63,6)	4 (36,4)	
Orthopedics	11 (31,4)	24 (68,6)	
Plastic	7 (50)	7 (50)	
Urological	26 (45,6)	31 (54,4)	

PHP: Patients with higher POSSUM scores; ASA: American Society of Anaesthesiologists classification

Table 2: Frailty at T0

	Non-PHP (*n*=95; %)	PHP (*n*=140; %)	*P**
Frailty, *n*			
Yes	70 (74)	72 (51)	<0.001
No	25 (26)	68 (49)	

*Pearson Chi-square

was 3.0% (*n* = 7). There was no significant difference between P-POSSUM predicted and observed in-hospital and 30-day mortality (*P* = 1.0). Patients who died in the hospital had similar POSSUM scores (29 vs. 26, *P* = 0.464). The AUROC of P-POSSUM was 0.563 for 30-day mortality.

The remaining patients were assessed for postoperative disability, frailty, and QOL.

In all cases, the comparison of EQ-5D-5L questionnaire at T0 vs. T3 revealed a deterioration in the QOL after surgery. This worsening was manifested in all the categories: mobility (19% vs. 80%, *P* < 0.001), care (11% vs. 69%, *P* < 0.001), activity (16% vs. 69%, *P* < 0.001), pain (30% vs. 77%, *P* < 0.001) and anxiety (46% vs. 87%, *P* < 0.001). The prevalence of frailty increased at T3 vs. T0 (70% vs. 39%).

When comparing the two groups, PHP patients had more disability at T1 (52% vs. 35%, *P* = 0.010) [Table 3] and a prolonged median length of hospital stay (6 vs. 4 days, *P* = 0.027). Rate of reinterventions was also higher for PHP patients at T1 [Table 4]. PHP presented more problems in almost all EQ-5D dimensions at T0 and T3 [Tables 5 and 6]. PHP were associated with a lower prevalence of frailty at T3 (65% vs. 83%, *P* < 0,001).

Discussion

Like the POSSUM system, the vast majority of surgery-related scoring systems are designed to predict postoperative mortality, which remains the most commonly assessed outcome.[8] In fact, the main purpose of POSSUM is to provide a numerical prediction of 30-day morbidity and mortality rates, considering both the physiological status of the patient and intraoperative information.[9] However, patients can have other significant concerns regarding the surgical intervention, such as the postoperative quality of recovery, length of hospital stay, functional capacity, or QOL.[10,11] Although the POSSUM system has been validated to assess and compare surgery-related morbidity and mortality,[9] there is a lack of research regarding its capacity to foresee these highly-valued patient goals.

Elder patients with comorbidities were previously described to have poorer functional status, health outcomes, and QOL.[12-14] Several studies have shown an inverse relationship between the number of comorbidities and both the QOL and frailty,[15-19] a condition often defined as an increased vulnerability to stress factors.[2] Frailty-related risk is of particular importance in the elderly population being an independent predictive factor for morbidity and mortality.[20]

Table 3: Disability at T1

	Non-PHP (*n*=92; %)	PHP (*n*=134; %)	*P**
Disability, *n*			0.010
Yes	32 (35)	70 (52)	
No	60 (65)	64 (48)	

*Pearson Chi-square

Table 4: Reintervention rates at T1

	Non-PHP (*n*=94)	PHP (*n*=138)	*P**
Reintervention, *n* (%)			
Yes	6 (40.0)	9 (60.0)	0.002
No	88 (40,6)	129 (59,4)	

*Pearson Chi-square

Table 5: Comparing PHP and Non-PHP at T0. Problems for each EQ-5D dimension

EQ-5D domain	Non-PHP (*n*=95; %)	PHP (*n*=140; %)	*P**
Mobility	41	59	0.008
Care	25	41	0.013
Activity	32	52	0.002
Pain	45	59	0.041
Anxiety	68	77	0.137

EQ-5D: Euro QoL5 dimensions; PHP: Patients with a high POSSUM, *Mann-Whitney U-test

Table 6: Comparing PHP and Non-PHP at T3. Problems for each EQ-5D dimension

EQ-5D domain	Non-PHP (*n*=92; %)	PHP (*n*=134; %)	*P**
Mobility	38	63	0.001
Care	31	48	0.009
Activity	44	58	0.036
Pain	37	59	0.001
Anxiety	50	54	0.025

EQ-5D: Euro QoL5 dimensions; PHP: Patients with a high POSSUM. *Mann-Whitney U-test

In our study, patients with higher POSSUM scores (PHP) were frailer before surgery [Table 2]. The prevalence of frailty increased after surgery; however, at T3, PHP were less frail. This may reflect immediate changes after surgery that have a positive impact on frailty in individuals with higher POSSUM. To our knowledge, this correlation has not been yet described in the literature, although there have been some reports on the association between frailty and postoperative morbidity.[21,22]

Closely interrelated with frailty and increasing with age is the state of disability.[11,23] When assessing this parameter, we observed more disability in PHP patients, both in the pre and postoperative period. This had already been verified by Amemiya *et al.* in patients after elective surgery for gastric and colorectal cancers.[24] POSSUM was found to be useful in predicting protracted disability, measured by the

Katz index.[25] McGirt *et al.* recently concluded that, among other indicators, both age and higher ASA scores could be predictors of disability after lumbar spine surgery.[26]

As expected, the PHP had higher Charslon scores, older age and higher rates of reintervention. In a previous report of patients over 70 years old after noncardiac surgery, these indicators (comorbidities, age, and new hospitalization after discharge) were found to be the most important independent predictors for long-term QOL and functional status.[27] Our rate of reintervention at T1 was 6% ($n = 15$), higher than described in literature, which can be explained by the inclusion of a wider range of surgical specialties in our study.[28]

Howes *et al.* showed that ASA score and POSSUM were positively correlated with prolonged length of stay following emergency laparotomy, which is consistent with the results of this study.[29] Longer initial hospital stay and early readmission have also been previously associated with reduced long-term functional recovery.[30]

QOL is becoming an important method to evaluate outcomes after surgery,[31] particularly in the elderly population.[4,10] Health-related quality of life (HRQOL) can be defined as the perceived functional effect of a medical status (both physical and mental) on a given individual.[32] Several methods have been proposed and used to evaluate HRQOL, given its multidimensional aspects and their intrinsic subjectivity.[32,33] However, despite the increasing relevance given to these measures, there is still a lack of predictive models to assist decision-making in the perioperative setting.

Ideally, the assessment of postoperative patient-centered outcomes in daily clinical practice should always include a comparison with the patient's own preoperative status, whereas standard threshold population values should be used only in exceptional cases of absence of baseline patient data.[30,34] The EQ-5D-5L is a validated, revised version of the EuroQoL-5D scale and is currently the most widely used instrument of patient-reported outcome assessment.[33,35] It inquires patients on problems in five dimensions of health – mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.[36] This scale has already been proved an useful and reliable measure in a wide range of medical conditions and interventions,[33] and its inclusion in the standard perioperative outcome assessment should be considered.

Our study showed a worsening of QOL in elderly patients 3 months after surgery (T3). Literature results diverge on this matter. In line with our findings, Maillard *et al.* observed a postoperative decrease of HRQOL 30 days after major surgery.[37] Fierens *et al.*, however, showed no significant improvement in QOL in the elderly submitted to hip fracture surgery.[38] In contrast, Rønning *et al.* evaluated QOL in elderly patients 3 months after surgery for colorectal cancer and concluded that QOL may be improved, even in frail patients.[39] Mangione *et al.* also observed a sustained gain of QOL at 6 and 12 months after surgery in patients over 50 years old.[10] The diverging findings between this study and ours may result from the fact that, 3 months after the procedure, patients might still be recovering from the surgical stress and the potential improvement in QOL may not be yet perceived. Available data on this subject suggests this recovery process might be longer and more eventful in the elderly population, considering the higher prevalence of frailty and disability.[2,40-44] We assessed the patients' QOL after 3 months with the main intent of limiting the dropout rate, and because this time mark is commonly used when assessing this parameter. Comparison of perioperative changes in HRQOL may be impaired by the different time frames and questionnaires used in the literature for assessing the outcome. The different types and extent of surgical procedures considered in the literature might also limit comparison. We included a wide range of surgeries to offer stronger support for the generalization of our findings to several surgical settings. As the POSSUM score contains intraoperative information, the differences between the procedures were included in perioperative risk determination.

Postoperative morbidity has been suggested to be a source of anxiety among patients, and anxiety represents a critical dimension of self-perceived postoperative quality of life.[45] We found that rates of anxiety-related problems were not higher for PHP at T0, whereas at T3 those rates were significantly higher in the PHP group of patients, according to literature findings. However, the number of studies addressing the correlation between morbidity and patient-reported quality of life is unexpectedly low, given the increasing proportion of patients with multiple morbidities, typically represented by the elderly population.

PHP had poorer quality of life, supporting our hypothesis that POSSUM score is associated with QOL outcomes in the elderly after elective surgery. In fact, the postoperative morbidity predicted by POSSUM scores translated into lower quality of life scores in elderly patients. To our knowledge, this was the first study to suggest this association, as we found no previous evidence in the literature on this issue.

Our study has some limitations. First, the selection of a cohort of patients over 60 led to the analysis of a higher-risk group in itself. Moreover, there is still no consensus in the literature

concerning the definition of "older age," which remains somewhat arbitrary and prevents an accurate interpretation and comparison of studies' results. The sample was also relatively small, and, consequently, β errors may be the reason for the lack of statistical significance in some endpoints. In addition, surgical risk stratification was not conducted. In fact, higher risk could be associated with surgery and not with the patient itself.

Our conclusions suggest the POSSUM score, currently applied almost exclusively as an indicator of postoperative morbimortality, could potentially be a tool in the determination of which patients may profit from a more comprehensive physical and mental care in the perioperative period.

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Conflicts of interest
There are no conflicts of interest.

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