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Internal medicine consultation for high-risk surgical patients: reflection on hospital mortality and readmission rates in a low-income country

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SUMMARY

OBJECTIVE: The objective of this study was to assess the impact of internal medicine consultation on mortality, 30-day readmission, and length of stay in surgical patients.

METHODS: This is a retrospective descriptive study developed in a public Brazilian teaching hospital with 850 beds.

RESULTS: A total of 70,245 patients were admitted from 2010 to 2018 to the surgery departments. The main outcomes measured were patients' mortality, 30-day readmission, and length of stay. Mortality of high-risk patients was lower when followed by internal medicine consultation: patients with ASA≥3 (RR 0.89 [95% confidence interval (95%CI) 0.80–0.99], p=0.02), patients with ASA≥3 plus≥65 years (RR 0.88 [95%CI 0.78–0.99], p=0.04), patients with ASA≥3 plus high-risk surgery (RR 0.86 [95%CI 0.77–0.97], p=0.01), and patients with ASA≥4 plus age ≥65 years (RR 0.83 [95%CI 0.72–0.96], p=0.01). The 30-day readmission of high-risk patients was lower when followed by internal medicine consultation: patients with ≥65 years (RR 0.57 [95%CI 0.37–0.89], p=0.01) and patients with high-risk surgery (RR 0.63 [95%CI 0.46–0.57], p=0.005). The Poisson multivariate regression with adjustment in variances showed that all the variables (namely, age, ASA, morbidity index, surgery risk, and internal medicine consultation) were associated with higher mortality of patients; however, internal medicine consultation was associated with a reduction of mortality in high-risk patients (RR 0.72 [95%CI 0.65–0.84], p=0.02) and an increase of mortality in low-risk patients (RR 1.55 [95%CI 1.31–1.67], p=0.01).

CONCLUSION: High-risk surgical patients may benefit from perioperative internal medicine consultations, which probably decrease hospital mortality and 30-day hospital readmission.

KEYWORDS: Hospital medicine. Internal medicine. Perioperative care. Hospital surgery department.

INTRODUCTION

The global burden of diseases is increasing[1], and surgical procedures are expected to have a greater impact on health systems in the coming years[2]. Older subjects, patients with multiple comorbidities, and fragile people will increasingly undergo more complex surgical procedures and will be admitted to receive care as inpatients[3]. Therefore, appropriately designing models of care for this growing population of patients is a part of the current health agenda. Internal medicine consultation (IMC) is mostly requested by surgical services, mainly for the most sick and severe patients[4-6], with the main reasons being medical management/co-management and preoperative evaluation[7].

Surgical co-management is the shared responsibility, authority, and accountability of surgical and medicine teams for patient care[3,8,9]. However, some authors suggest that this model should be adopted selectively and not as a widespread strategy[10,11], showing better inpatient outcomes[12,13], especially in high-risk patients[3,10]. Traditionally, the approach of patients by consultant physicians followed some principles, focusing on the specific requirements of the assisting physician[14]. However, with this paradigm shift, promoted by the advent of co-management by

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hospitalists, the tendency is for IMC teams to address all the patient's complexity and optimize their comorbidities, aiming to improve perioperative outcomes. In the Latin American literature, the hospitalist movement is still incipient, with some references from Cuba[15], Colombia[16], and Chile[17] describing the actuation of IMC departments with generalist practices that assume central roles in their hospitals.

Therefore, the objective of this study was to assess the effect of IMC on surgical patient mortality, 30-day readmission rates, and length of stay (LOS) in a hospital, and our hypothesis was that a greater benefit would be observed in the most severe patients.

METHODS

Internal medicine consultation description

The study was developed in Nossa Senhora da Conceição Hospital (NSCH), which is an 850-bed tertiary center and the largest public hospital in southern Brazil. The Department of Internal Medicine has worked on an expansion project that increased its inpatient responsibility and caused it to assume a central role in hospital dynamics. The team operates with an internist trained in perioperative medicine tutoring second-year and senior internal medicine residents. It provides preoperative evaluation, medical advice, and co-management as requested by the assisting teams. Thus, for the patients cared for under this model, the internal medicine team writes daily notes, orders tests, prescribes medications as appropriate, manages acute decompensations, and, when necessary, proactively participates in ICU transfers.

Characteristics of patients and internal medicine consultations

The following data from all surgical patients admitted to the hospital from 2010 to 2018 were obtained: age, gender, LOS, surgeries performed with the corresponding American Society of Anesthesiologists (ASA) physical status, and Charlson comorbidity index (CCI), which is used in our institution as a measure of patient's level of severity[18].

Patient characteristics were analyzed in three groups: patients who did not receive IMC, defined as the control group; patients who received consultations, defined as the consultation group; and patients who received internal medicine co-management, defined as the co-management group. Each patient was accounted once. Patients receiving co-management and consultation were known to have more complex and severe conditions. Considering that IMC was a growing intervention over the study period, we knew that we would find high-risk patients without this intervention in the cohort. High-risk surgical patients were considered based on the inclusion criteria: (a) patients with ASA≥3, (b) patients aged over 65 years, and (c) patients submitted to a high-risk surgery[19].

Outcomes

The main outcomes evaluated were hospital mortality, hospital LOS, and 30-day readmission in the same hospital. For the outcomes analysis, we considered the consultation and co-management groups to be the IMC group. Our data did not contain other important outcomes such as ICU LOS, mechanical ventilation parameters, percentage of acute kidney injury, or need for renal replacement therapy.

Statistical analysis

Continuous variables were evaluated by the median and interquartile range, as they were all asymmetric. Age was stratified by under 65 or ≥65 years, and ASA physical status was stratified by under 3 or ≥3 and 4 or ≥4. Mortality and 30-day readmission rates were compared using chi-square analysis, for which we defined a relative risk with a 95% confidence interval (95%CI). LOS was compared between groups using the Kruskal-Wallis nonparametric test. Variables associated with perioperative mortality were analyzed using Poisson multivariate analysis with adjustment of variances, and IMC was included as a variable in the model. High-risk patients were predefined, and individual and combined risks were used for analysis, based on (a) ≥65 years, (b) ASA≥3, (c) ASA≥4, (d) high-risk surgery, I ASA≥3 plus≥65 years, (f) ASA≥3 plus high-risk surgery, (g) ASA≥4 plus≥65 years, and (h) ASA≥4 plus high-risk surgery. Other combinations were not possible due to the sample size. The analysis of hospital mortality rate and hospital LOS was adjusted by age, CCI, ASA, and surgery risk. The analysis of the 30-day readmission rate was adjusted by age, CCI, ASA, ICU stay, and surgery risk. Finally, two charts were made comparing the mortality rate in patients with and without IMC. First, we analyzed mortality per ASA physical status classification (from 1 to 5) in patients with and without IMC (patients with both co-management and consultation were in the consultation group). Second, the same data were analyzed but restricted to patients with ICU admission during hospitalization. In all analyses, P-values were considered statistically significant when p≤0.05.

RESULTS

From 2010 to 2018, 124,666 patients were admitted to the hospital surgical departments. Surgical specialties that received

IMC consultation for ≤2.0% of patients were obstetrics (0.2%), plastic surgery (0.4%), and cardiac surgery (0.5%). Therefore, 70,245 patients were enrolled in the study.

The characteristics of the control and IMC groups are shown in Table 1. Compared with the patients evaluated by the IMC that received only consultation and with the control group, patients evaluated by the IMC that received co-management were older (≥65 years: 55.4, 48.5, and 22.5%, p<0.01), more comorbid (ICC: 4 [3-5], 4 [2-5], and 3 [2-4], p<0.01 and ASA≥3: 65.1, 38.6, and 19.3%, p<0.01), and submitted more frequently to high-risk surgeries (54.0, 39.6, and 16.6%, p<0.01), respectively. Surgical teams that received more consultations were general surgery (20.9%) and urology (32.0%). Vascular surgery patients received co-management for 32.7% of patients.

Outcomes

After adjustments, the mortality of surgical high-risk patients was lower when followed by IMC: patients with ASA≥3 (RR 0.89 [95%CI 0.80–0.99], p=0.02), patients with ASA≥3 plus ≥65 years (RR 0.88 [95%CI 0.78–0.99], p=0.04), patients with ASA≥3 plus high-risk surgery (RR 0.86 [95%CI 0.77–0.97],

Table 1. Characteristics of the patients with and without internal medicine consultation.

	Control group	Internal medicine consultation group		p-value*
		Patients with consultation	Patients with co-management	
Number of patients	65,145	3,507	2,040	–
Age, median	51 [27.2]	64 [18.6]	66 [17.6]	<0.01 ł
≥65 years	22.5%	48.5%	55.4%	<0.01 ǂ
Male gender	42.4%	51.2%	54.7%	<0.01 ǂ
Charlson comorbidity index	3 [2–4]	4 [2–5]	4 [3–5]	<0.01 ł
Patient risk				
ASA ≥3	19.3%	38.6%	65.1%	<0.01 ǂ
ASA ≥4	1.9%	5.0%	15.0%	<0.01 ǂ
Surgery risk				<0.01 ǂ
Low risk	64.0%	38.4%	30.0%	
Intermediate risk	19.4%	24.7%	16.0%	
High risk	16.6%	39.6%	54.0%	
Surgery department				ns
General surgery	22,849 (94.6%)	733 (3.0%)	565 (2.3%)	
Digestive surgery	786 (66.4%)	357 (30.2%)	41 (3.5%)	
Thoracic surgery	3,036 (89.4%)	248 (7.3%)	111 (3.3%)	
Vascular surgery	8,995 (91.5%)	174 (1.8%)	662 (6.7%)	
Bariatric surgery	550 (96.5%)	7 (1.2%)	13 (2.3%)	
Gynecology	14,797 (96.6%)	390 (2.5%)	125 (0.8%)	
Oncologic surgery	2,992 (93.9%)	51 (1.6%)	142 (4.5%)	
Proctology	2,841 (83.3%)	428 (12.6%)	122 (3.6%)	
Urology	8,299 (85.8%)	1,119 (11.6%)	259 (2.7%)	
Hospital length of stay (days)	4.0 [1.0–11.0]	20.0 [12.0–34.0]	22.0 [13.0–37.0]	<0.01 ł
ICU admission need	5.7%	20.1%	40.0%	<0.01 ǂ
Hospital mortality	2.4%	6.9%	18.1%	<0.01 ǂ

ASA: patients with American Society of Anesthesiologists physical status. ICU admission: percentage of patients with intensive care admission during hospitalization. Surgery risk is stratified according to the guidelines. Control group: patients without internal medicine consultation. Continuous variables are all displayed in medians with the interquartile range in brackets. Dichotomous variables are displayed in absolute and relative frequencies. ǂP-value of the chi-square test. łP-value of the Kruskal-Wallis test. *Differences between the control and internal medicine consultation groups. No statistical differences were found between patients with consultation and patients with co-management.

p=0.01), and patients with ASA ≥4 plus age ≥65 years (RR 0.83 [95%CI 0.72–0.96], p=0.01). The 30-day readmission of high-risk patients was lower when followed by IMC: patients with ≥65 years (RR 0.57 [95%CI 0.37–0.89], p=0.01) and patients with high-risk surgery (RR 0.63 [95%CI 0.46–0.57], p=0.005) (Table 2). Patients with IMC had a significantly longer hospital LOS (21.0 [12.3–25.8] days vs. 4.0 [1.0–11.0] days, p<0.01), higher ICU need (28.4 vs. 5.7%, p<0.01), and higher crude mortality (11.2 vs. 2.4%, p<0.01) (Table 1).

The Poisson multivariate regression with adjustment in variances showed that all the variables (namely, age, ASA physical status, CCI, surgery risk, and IMC) in the model were positively associated with higher mortality of patients (Table 3). IMC was associated with reduction of mortality in high-risk patients (RR 0.72 [95%CI 0.65–0.84], p=0.02) and increase of mortality in low-risk patients (RR 1.55 [95%CI 1.31–1.67], p=0.01).

DISCUSSION

In this observational study analyzing over 70,000 surgical admissions in the largest-volume tertiary hospital in southern Brazil, we found that high-risk patients can be benefitted from IMC. Depending on the subgroup analyzed, the mortality reduction ranged from 10 to 13%, and the 30-day readmission rate reduction ranged from 37 to 46%. However, a longer hospital LOS was associated with patients receiving medical consultation, as well as an increase of mortality in low-risk surgical patients.

Co-management of surgical patients is a phenomenon that is well described in the literature. By evaluating 694,806 hospital surgical admissions, Sharma et al.[20] showed an increase of 11.4% per year in co-management by generalist physicians (from 33.3% in 1996 to 40.8% in 2006 [p<0.01]), while Chen et al.[21], analyzing fee-for-service Medicare patients, showed variation in medical consultation for patients undergoing colectomy (interquartile range (IQR) 50–91%) and total hip replacement (IQR 36–90%), with greater use for patients with postoperative complications (IQR 90–95%). For patients hospitalized for colorectal surgery, de Vries et al.[22] showed that 27.6% of patients were co-managed, with a great variation between hospitals (1.9–83.2%). As more data on the benefits of co-management for quality of care, postoperative complications, hospital LOS, total care cost reduction, and other outcomes continue to be published, it is rational that hospitals will organize their

Table 2. Evaluation of adjusted hospital mortality*, hospital length of stay**, and 30-day readmission*** in patients of control and internal medicine consultation groups in higher-risk surgical patients.

	Hospital mortality		Hospital length of stay		30-day readmission	
	IMC vs. CG (p-value)	RR (95%CI)	IMC vs. CG	p-value	IMC vs. CG (p-value)	RR (95%CI)
≥65 years	33.3 vs. 37.2% (p=0.06)	0.90 (0.80–1.01)	31 [18–49] vs. 20.5 [11–35]	<0.001	4.5 vs. 8.0% (p=0.01)	0.57 (0.37–0.89)
ASA ≥3	35.0 vs. 39.4% (p=0.02)	0.89 (0.80–0.99)	37 [23–60] vs. 23 [13-38]	<0.001	6.3 vs. 8.8% (p=0.06)	0.7 (0.49–1.03)
ASA ≥4	47.0 vs. 50.5% (p=0.27)	0.93 (0.82–1.96)	35 [22–39] vs. 2 [6–22]	<0.001	8.1 vs. 6.8% (p=0.55)	1.19 (0.67–2.11)
High-risk surgery	29.2 vs. 28.5% (p=0.70)	1.02 (0.91–1.15)	36 [23–56] vs. 22 [12–36]	<0.001	6.1 vs. 9.7% (p=0.005)	0.63 (0.46–0.57)
ASA ≥3 + ≥65 years	41.5 vs. 47.2% (p=0.04)	0.88 (0.78–0.99)	35 [20–55] vs. 21 [12–38]	<0.001	4.2 vs. 7.5% (p=0.07)	0.56 (0.30–1.06)
ASA ≥3 + high-risk surgery	26.6 vs. 19.6% (p<0.001)	1.36 (1.21–1.52)	32 [19–52] vs. 17 [9–28]	<0.001	7.0 vs. 9.0% (p=0.07)	0.78 (0.59–1.02)
ASA ≥4 + >65 years	50.5 vs. 58.3% (p=0.06)	0.87 (0.74–1.01)	33 [18–53] vs. 14 [8–27]	<0.001	5.7 vs. 8.3% (p=0.39)	0.68 (0.28–1.66)
ASA ≥4 + high-risk surgery	51.1 vs. 60.5% (p=0.01)	0.85 (0.74–0.96)	43 [21–63] vs. 20 [10–34]	<0.001	8.5 vs. 5.5% (p=0.26)	1.53 (0.73–3.25)

ASA: patients with American Society of Anesthesiologists physical status. High-risk surgery: patients who underwent high-risk surgery according to the guidelines classification. *The analysis of hospital mortality rate was adjusted by age, Charlson comorbidities index, ASA, and surgery risk. **The analysis of hospital length of stay was adjusted by age, Charlson comorbidities index, ASA, and surgery risk. ***The analysis of hospital 30-day readmission was adjusted by age, Charlson comorbidities index, ASA, ICU stay, and surgery risk. Comparisons of mortality and 30-day readmission are made by the chi-squared test. Comparisons of relative risk, 95% confidence interval in parentheses, and p-values are displayed. Median lengths of stay are compared through the Kruskal-Wallis test and are displayed with the interquartile range in brackets and the p-values.

Table 3. Multivariate analysis for mortality

Variable	Relative risk (95%CI)	p-value
Age (years)	1.03 (1.02–1.03)	<0.001
ASA		
ASA 1	1.00	–
ASA 2	2.11 (1.43–3.15)	<0.001
ASA 3	8.75 (5.83–13.12)	<0.001
ASA 4	22.35 (14.8–33.8)	<0.001
ASA 5	30.91 (19.81–48.17)	<0.001
Charlson comorbidities index		
Charlson comorbidities index <2	1.00	–
Charlson comorbidities index ≥2	6.75 (4.82–10.01)	<0.001
Surgical risk		
Low-risk surgery	1.00	
Intermediate-risk surgery	1.42 (1.22–1.71)	<0.001
High-risk surgery	2.21 (1.93–2.54)	<0.001
Internal medicine consultation	1.11 (1.01–1.21)	0.01
Internal medicine consultation in low-risk patients	1.55 (1.31–1.67)	0.01
Internal medicine consultation in high-risk patients*	0.72 (0.65–0.84)	0.02

ASA: American Society of Anesthesiologists physical status. Surgery risk was analyzed according to the guidelines classification. ICU admission: patients with ICU admission during hospitalization. *High-risk surgical patients were considered: patients with ASA ≥3, patients aged over 65 years, patients submitted to a high-risk surgery, and any combination of these three variables.

services so that a higher proportion of surgical patients receive this care, as it is a cost-effective intervention[13,23,24].

Mortality benefits have been previously shown in cardiothoracic (8.1–2.5% [p=0.01]), vascular (1.56–0.0008% [p=0.003]), and many other surgical patients[21,25]. In one of the first studies on the subject, comparing results with those of a historical cohort, Fisher et al.[25] showed a mortality reduction from 7.7 to 4.7% (p<0.01) for patients aged 60 years or older admitted with hip fracture. Besides that, patients with more complex cases and greater severity of disease tend to receive the most benefit from co-management[3,10].

Consultation is usually requested for the most severe surgical patients. In our study, the median Charlson index of all patients was 3 (IQR 2–4), compared with the median of patients who received IMC, 4 (IQR 2–5), and that of those who received co-management, 4 (IQR 3–5), a statistically significant difference. Because of this, it is expected that those with IMC would probably have worse outcomes for all surgical patients. This finding reinforces the need for high-risk subpopulation analysis in this type of study. In our study, even after adjustment for covariates by regression analysis, IMC was associated with a higher mortality risk, with an RR of 1.12 (95%CI 1.02–1.24; p=0.01). These findings confirm those of previous studies. Wijeysundera et al.[5] found a higher risk of 30-day mortality with an RR of 1.16 (95%CI 1.07–1.25), and Auerbach et al.[6] found a longer adjusted LOS and adjusted costs associated with medical consultation.

Our study has some strengths. First, this is one of the largest studies on co-management and IMC to date. Additionally, as our study had a long period and the intervention was performed in a progressively greater proportion of patients, we found many severe and complex patients without IMC. Finally, the data were derived directly from the hospital's electronic medical records, which decreases the probability of collection bias. However, our study has some weak points that must be addressed. First, it was an observational study, we could not exclude the possibility of unmeasured factors as a potential source of bias, and it is not possible to establish causality. Second, this study utilized the retrospective nature of the data collection. Finally, we did not analyze the medical records individually. Additionally, the generalizability of our findings may interfere with the results of this single-center study. The register bias is another factor to be considered as medical electronic records were the data source.

In summary, IMC for surgical patients is now a current practice and is expected to increase as more sick patients will be eligible for surgical procedures. Our study findings suggest that, in patients with higher morbidity and hospital complexity admitted by surgical teams, those who received care from internal medicine teams had lower mortality.

AUTHORS' CONTRIBUTIONS

PRMR: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft. **MFS:** Conceptualization, Supervision, Validation, Visualization, Writing – review & editing. **CT:** Conceptualization, Formal Analysis, Investigation, Methodology, Supervision, Validation, Visualization, Writing – review & editing. **LR:** Data curation, Investigation, Writing – review & editing. **MASG:** Data curation, Investigation, Writing – review & editing. **MSB:** Data curation, Investigation, Writing – review & editing.

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