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ORIGINAL ARTICLE

Operative and prognostic parameters associated with elective versus emergency surgery in a retrospective cohort of elderly patients

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Abstract

Aim To evaluate operative and prognostic parameters associated with elective versus emergency surgery in a retrospective cohort of elderly patients.

Methods A total of 533 geriatric patients (aged ≥ 65 years, median age: 73.0 years, 50.7% were females) who underwent either elective surgery ($n = 285$) or emergency surgery ($n = 248$) were included in this study. Data on patient demographics, co-morbid disorders, type of surgery and anesthesia, American Society of Anesthesiologists (ASA) physical status (PS) classification, length of hospital stay, length of ICU stay, hospitalization outcome, prognosis (survivor, non-survivor) were obtained from medical records.

Results Emergency surgery group was associated with higher prevalence of ASA-PS III (48.8 vs. 25.6%, $p < 0.001$) and ASA-PS IV (19.0 vs. 0.4%, $p < 0.001$) categories and higher mortality rates (20.6 vs. 4.9% vs. $p < 0.001$) when compared to the elective surgery group. ASA-PS IV category was associated with oldest patient age (median 82.0 vs. 71.0 years for ASA-PS I and II, $p < 0.001$ for each and versus 75.0 years for ASA-PS III, $p < 0.05$) and highest mortality rate (35.4 vs. 3.4% for ASA-PS I, 6.0% for ASA-PS II and 16.5% for ASA-PS III, $p < 0.001$) as compared with other categories.

Conclusion In conclusion, our findings in a retrospective cohort of elderly surgical patients revealed high prevalence of co-morbidities, predominance of ASA-PS II or ASA-PS III classes and an overall in-hospital mortality rate of 12.2%. Emergency as compared with elective surgery seems to be associated with older age, male gender, ASA-PS III and IV classes, higher likelihood of postoperative ICU transfer and higher mortality rates.

Keywords Elderly · Surgery · Emergency · Elective · Anesthesia · Co-morbidity · ASA class · Mortality

Introduction

Due to increase in longevity and advances in surgical and anesthetic techniques, the number of elderly patients presenting for surgery is increasing at a rate faster than the aging of the population [1–6].

Increased postoperative mortality, higher rates for in-hospital adverse events, prolonged length of hospital stay (LOS), and post-discharge institutionalization are amongst the poor surgical outcomes reported in elderly patients as compared to younger patients [4, 7, 8].

Given the high prevalence of co-morbidities, polypharmacy, functional and cognitive impairment, the recognition of poor prognostic factors for postoperative outcome via a multidisciplinary approach is considered of critical importance in the management of elderly surgical patients [1, 8, 9].

Elderly surgical patients are considered to be exposed to high risks of morbidity and mortality when undergoing both elective and emergency surgery [1, 2]. Anesthesia and perioperative care in elderly population has, therefore, become the main the focus of investigation in the past decade, in terms of preoperative assessment for identification of poor prognostic factors to enable optimal care and an improved clinical outcome [10, 11]. However, when compared to more

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extensive body of research available addressing the outcome of elective surgery, there are limited data on the outcome of emergency surgery among elderly population [4, 12].

This study was, therefore, designed to evaluate operative and prognostic parameters associated with elective versus emergency surgery in a retrospective cohort of elderly patients.

Methods

A total of 533 geriatric patients (aged ≥ 65 years, median age: 73.0 years, 50.7% were females) who underwent either elective surgery ($n = 285$) or emergency surgery ($n = 248$) in a tertiary care center between July 2016 and July 2017 were included in this retrospective study.

The study was conducted in full accordance with local Good Clinical Practice guideline and current legislations, while the permission was obtained from our institutional ethics committee for the use of patient data for publication purposes.

Study parameters

Data on patients demographics (age, gender), co-morbid disorders, type of surgery (elective, emergency, anatomical region) type of anesthesia (general anesthesia, central or peripheral nerve blockade), intraoperative needs for inotropic agents and blood products, American Society of Anesthesiologists (ASA) physical status (PS) classification category (ASA-PS I–IV), postoperative transfer unit (ward, ICU), length of hospital stay (LOS), length of ICU stay, hospitalization outcome (discharge, transfer to other ward, death), prognosis (survivor, non-survivor), were obtained from medical records. Study variables were compared in elective versus emergency surgery groups as well as with respect to ASA-PS categories.

ASA-PS classification

ASA-PS classification is a grading system based on a simple categorization of a patient's preoperative physical physiological status to predict the operative risk before selecting the anesthetic or performing surgery. Physiological status is classified in six categories including ASA PS I (normal healthy patients with no organic, physiologic, or psychiatric disturbance), ASA PS II (patients with mild systemic disease with no functional limitations), ASA PS III (patients with severe systemic disease and some functional limitation), ASA PS 4 (patients with severe systemic disease that is a constant threat to life with at least one severe disease that is poorly controlled or at end stage), ASA PS 5 (moribund patients who are not expected to survive without the operation) and ASA PS 6 (a declared brain-dead patient whose organs are being removed for donor purposes) [13, 14].

Statistical analysis

Statistical analysis was made using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY). Pearson Chi-Square, Fisher Exact and Fisher–Freeman–Halton tests applied with Monte Carlo simulations were used for the comparison of categorical data, while numerical data were analyzed using Mann–Whitney U and Kruskal–Wallis tests together with Monte Carlo resampling procedures and post hoc Dunn's test. Data were expressed as "mean (standard deviation; SD)", median (minimum–maximum) and percent (%) where appropriate. $p < 0.05$ was considered statistically significant.

Results

Patient demographics and baseline characteristics in emergency versus elective surgery groups

Median age was 73.0 years, while females comprised 50.7% of this retrospective cohort of operated geriatric patients. Hypertension (39.2%), cardiovascular disease (31.3%) and respiratory disease (30.4%) were the three most common comorbidities in the overall study population. Most of patients were either in ASA-PS II (43.5%) or in ASA-PS III (36.4%) category (Table 1).

Overall, 53.5% of patients underwent elective surgery and 46.5% underwent emergency surgery. Considering demographic and baseline characteristics in emergency versus elective surgery groups, emergency surgery group was associated with older age (median(min–max) 77.0 (65.0–97.0) years versus 72.0 (65.0–100.0) years, $p < 0.001$), higher percentage of males (55.2 vs. 44.2%, $p = 0.012$), lesser likelihood of co-morbid hypertension (29.0 vs. 48.1%, $p < 0.001$), whereas higher likelihood of co-morbid renal (16.1 vs. 1.4%, $p < 0.001$) and respiratory (45.2 vs. 17.5%, $p < 0.001$) diseases as well as higher prevalence of ASA-PS III (48.8 vs. 25.6%, $p < 0.001$) and ASA-PS IV (19.0 vs. 0.4%, $p < 0.001$) categories as compared with elective surgery group (Table 1).

Operative and prognostic parameters in emergency versus elective surgery groups

Overall, the most common type of anesthesia was general anesthesia (75.4%) as followed by central nerve blockade (19.3%), while open abdominal surgery (33.6%) and extremity surgery (27.2%) were the most common operations.

Table 1 Patient demographics and baseline characteristics in elective versus emergency surgery groups

	Total ($n=533$)	Elective surgery ($n=285$)	Emergency surgery ($n=248$)	p value[a]
Patient demographics				
Age (year), median (min–max)	73.0 (65.0–100.0)	72.0 (65.0–100.0)	77.0 (65.0–97.0)	**<0.001**[b]
Gender, n (%)				
Female	270 (50.7)	159 (55.8)	111 (44.8)	**0.012**
Male	263 (49.3)	126 (44.2)	**137 (55.2)**	
Co-morbid diseases, n (%)				
Hypertension				
No	324 (60.8)	148 (51.9)	176 (71.0)	**<0.001**
Yes	209 (39.2)	**137 (48.1)**	72 (29.0)	
Diabetes mellitus				
No	419 (78.6)	215 (75.4)	204 (82.3)	0.057
Yes	114 (21.4)	70 (24.6)	44 (17.7)	
Coronary artery disease				
No	379 (71.1)	201 (70.5)	178 (71.8)	0.774
Yes	154 (28.9)	84 (29.5)	70 (28.2)	
Cardiovascular disease				
No	366 (68.7)	193 (67.7)	173 (69.8)	0.640
Yes	167 (31.3)	92 (32.3)	75 (30.2)	
Thyroid dysfunction				
No	505 (94.7)	267 (93.7)	238 (96.0)	0.251
Yes	28 (5.3)	18 (6.3)	10 (4.0)	
Renal disease				
No	489 (91.7)	281 (98.6)	208 (83.9)	**<0.001**
Yes	44 (8.3)	4 (1.4)	**40 (16.1)**	
Hematologic disorder				
No	523 (98.1)	281 (98.6)	242 (97.6)	0.526
Yes	10 (1.9)	4 (1.4)	6 (2.4)	
Electrolyte imbalance				
No	529 (99.2)	285 (100.0)	244 (98.4)	**0.046**
Yes	4 (0.8)	0 (0.0)	4 (1.6)	
CNS disease				
No	511 (95.9)	274 (96.1)	237 (95.6)	0.828
Yes	22 (4.1)	11 (3.9)	11 (4.4)	
Respiratory disease				
No	371 (69.6)	235 (82.5)	136 (54.8)	**<0.001**
Yes	162 (30.4)	50 (17.5)	**112 (45.2)**	
ASA-PS category				
I	59 (11.1)	51 (17.9)	8 (3.2)	**<0.001**
II	232 (43.5)	160 (56.1)	72 (29.0)	
III	194 (36.4)	73 (25.6)	121 (48.8)	
IV	48 (9.0)	1 (0.4)	47 (19.0)	

ASA-PS American Society of Anesthesiologists Physical Status Classification

Significant values are in bold

[a]Pearson Chi-Square test (Exact-Monte Carlo)- Fisher Exact Test (Exact)

[b]Mann–Whitney *U* Test (Monte Carlo)

Median operative time was 100 min along with intraoperative need for inotropic support and blood product in 9.8 and 26.3% of patients, respectively. Postoperatively, 51.2% of patients were transferred to an ICU and 48.8% to a ward for a median 3.0 and 8.0 days, respectively. Overall survival rate was 87.8 and 79.5% of survivors were discharged with improvement (Table 2).

General anesthesia in the emergency surgery group (80.7 vs. 70.9%), whereas central nerve blockade in the elective surgery group (24.2 vs. 13.7%) were more commonly applied types of anesthesia ($p = 0.009$) (Table 2).

Open abdominal surgery (43.1 vs. 25.3%, $p < 0.001$), urogenital surgery (9.3 vs. 2.8%, $p = 0.002$) and neurosurgery (5.2 vs. 1.1%, $p = 0.009$) were more common in the emergency surgery group, whereas neck, thoracic and abdominal wall surgery (28.1 vs. 10.9%, $p < 0.001$) and thoracic and cardiac surgery (10.9 vs. 2.8%, $p < 0.001$) were more commonly performed under elective than emergency conditions (Table 2).

No significant difference was noted between emergency and elective surgery groups in terms of intraoperative need for inotropic support and blood products. Significantly higher percentage of patients in the emergency surgery group was transferred to ICU postoperatively as compared with those in the elective surgery group (62.9 vs. 41.1%, $p < 0.001$) (Table 2).

Emergency surgery was associated with significantly longer ICU stay [median(min–max) 4.0 (0.0–70.0) versus 1.0 (0.0–50.0) days, $p < 0.001$], shorter LOS [7.0 (0.0–80.0) versus 8.0 (1.0–54.0) days, $p = 0.015$] and shorter operative time [95.0 (5.0–750.0) min versus 110.0 (10.0–300.0) min, $p = 0.023$] when compared to elective surgery (Table 2).

Discharge rates were significantly higher (94.7 vs. 62.1%, $p < 0.001$) and mortality rates were significantly lower (4.9 vs. 20.6%, $p < 0.001$) in the elective surgery group as compared with the emergency surgery group (Table 2).

No significant difference was noted between survivors and non-survivors in terms of usage of general anesthesia (75.4% for each) or central nerve blockade (20.3 vs. 12.3%, respectively), whereas use of peripheral nerve blockade was significantly more common among non-survivors than in survivors (12.3 vs. 4.3%, $p = 0.016$) (Table 2).

Demographic, operative and prognostics characteristics according to ASA-PS categories

ASA-PS IV category was associated with oldest patient age (median 82.0 vs. 71.0 years for ASA-PS I and II, $p < 0.001$ for each, and versus 75.0 years for ASA-PS III, $p < 0.05$) and highest mortality rate (35.4 vs. 3.4% for ASA-PS I, 6.0% for ASA-PS II and 16.5% for ASA-PS III, $p < 0.001$) as compared with other categories. Both ASA-PS III and IV categories were associated with more frequent need for intraoperative inotropic support (19.1 and 18.8 vs. 2.6% for ASA-PS II, $p < 0.001$), higher rate of postoperative transfer to ICU (69.1 and 85.4 vs. 22.0% for ASA-PS I and 36.6% for ASA-PS II, $p < 0.001$) and longer ICU stay (median 4.0 vs. 0 days for ASA-PS I and II, $p < 0.001$), while ASA-PS III category was associated with longest LOS (10 vs. 6.0 days for AA-PS I) and 7.0 days for ASA-PS II and IV, $p < 0.05$ for each) and longest operative time (140.0 vs. 85 min for ASA-PS I, 90 min for ASA-PS II and 77.5 min for ASA-PS IV, $p < 0.01$ for each) as compared with other ASA-PS categories (Table 3).

Discussion

Our findings in a retrospective cohort of elderly surgical patients revealed high prevalence of co-morbidities, predominance of ASA-PS II or ASA-PS III classes, higher likelihood of receiving general anesthesia and undergoing open intraabdominal surgery along with an overall in-hospital mortality rate of 12.2%.

High prevalence of co-morbidities including hypertension, cardiovascular disease and respiratory disease and of ASA-PS III and IV classes in our cohort support the consideration of elderly people as a heterogeneous population at increased risk of functional limitations and with multiple co-morbidities (i.e., hypertension, respiratory disease, diabetes, hypothyroidism, and heart failure) superimposed on age-dependent anatomical and physiological alterations [12, 15–17].

Almost half of patients in our cohort underwent emergency surgery, supporting the growing increase in the number surgical emergency admissions among elderly patients due to demographic shift and drastic decrease in elective surgical interventions after the age of 75 years [15].

Open abdominal surgery was the most frequent type of surgery in our cohort of elderly patients, and more commonly performed under emergency than under elective conditions. This seems notable given the association of emergency gastrointestinal surgery with the highest complication and mortality rates in geriatric surgery patient population [1, 18].

Older age, male gender, presence of renal and respiratory co-morbidities and ASA-PS III and IV categories were associated with higher likelihood of undergoing emergency rather than elective surgery in our cohort. This seems also consistent with our findings on the association of emergency surgery with higher likelihood of postoperative ICU transfer, lower rate of hospital discharge and higher mortality rates (20.6 vs. 4.9%) as compared with elective surgery.

Past studies in elderly surgical patients revealed factors such as emergency operation, increased ASA classification and a increment of operative duration to predict increased risk of in-hospital mortality [4, 12], while postoperative morbidity and mortality were also shown to increase progressively with increasing age [2, 4].

Table 2 Operative and prognostic parameters in elective versus emergency surgery groups

	Total ($n=533$)	Elective surgery ($n=285$)	Emergency surgery ($n=248$)	p value[b]
Type of anesthesia, n (%)				
General anesthesia	402 (75.4)	202 (70.9)	200 (80.6)	**0.009**
Central nerve blockade	103 (19.3)	69 (24.2)	34 (13.7)	
Peripheral nerve blockade	28 (5.3)	14 (4.9)	14 (5.6)	
Type of surgery, n (%)				
Open abdominal surgery				
No	354 (66.4)	213 (74.7)	141 (56.9)	< **0.001**
Yes	179 (33.6)	72 (25.3)	107 (43.1)	
Neck, thoracic, and abdominal wall surgery				
No	426 (79.9)	205 (71.9)	221 (89.1)	< **0.001**
Yes	107 (20.1)	80 (28.1)	27 (10.9)	
Extremity surgery				
No	388 (72.8)	206 (72.3)	182 (73.4)	0.845
Yes	145 (27.2)	79 (27.7)	66 (26.6)	
Thoracic and cardiac surgery				
No	495 (92.9)	254 (89.1)	241 (97.2)	< **0.001**
Yes	38 (7.1)	31 (10.9)	7 (2.8)	
Urogenital surgery				
No	502 (94.2)	277 (97.2)	225 (90.7)	**0.002**
Yes	31 (5.8)	8 (2.8)	23 (9.3)	
Neurosurgery				
No	517 (97.0)	282 (98.9)	235 (94.8)	**0.009**
Yes	16 (3.0)	3 (1.1)	13 (5.2)	
Other[a]				
No	505 (94.7)	268 (94.0)	237 (95.6)	0.445
Yes	28 (5.3)	17 (6.0)	11 (4.4)	
Intraoperative needs, n (%)				
Inotropic support				
No	481 (90.2)	256 (89.8)	225 (90.7)	0.771
Yes	52 (9.8)	29 (10.2)	23 (9.3)	
Blood products				
Not received	393 (73.7)	213 (74.7)	180 (72.6)	0.622
Received	140 (26.3)	72 (25.3)	68 (27.4)	
Postoperative unit, n (%)				
Ward	260 (48.8)	168 (58.9)	92 (37.1)	< **0.001**
Intensive care unit	273 (51.2)	117 (41.1)	156 (62.9)	
Time-related parameters	Median (min–max)	Median (min–max)	Median (min–max)	p value[c]
Length of ICU stay (day)	3.0 (0.0–70.0)	1.0 (0.0–50.0)	4.0 (0.0–70.0)	< **0.001**
Length of hospital stay (day)	8.0 (0.0–80.0)	8.0 (1.0–54.0)	7.0 (0.0–80.0)	**0.015**
Operative time (min)	100.0 (5.0–750.0)	110.0 (10.0–300.0)	95.0 (5.0–750.0)	**0.023**
Hospitalization outcome, n (%)				
Discharge	424 (79.5)	270 (94.7)	154 (62.1)	< **0.001**
Transfer to other wards	44 (8.3)	1 (0.4)	43 (17.3)	
Death	65 (12.2)	14 (4.9)	51 (20.6)	
Final prognosis, n (%)				
Survived	468 (87.8)	271 (95.1)	197 (79.4)	< **0.001**
Died	65 (12.2)	14 (4.9)	51 (20.6)	

Table 2 (continued)

Type of anesthesia, *n* (%)	Survivor	Non-survivor	
General anesthesia	353 (75.4)	49 (75.4)	**0.016**[d]
Central nerve blockade	95 (20.3)	8 (12.3)	
Peripheral nerve blockade	20 (4.3)	8 (12.3)	

Significant values are in bold

[a]ophthalmic, ear-nose-throat, foreign body, aspiration surgery

[b]Pearson Chi-Square test (Exact), Fisher Exact Test (Exact)

[c]Mann–Whitney U Test (Monte Carlo)

[d]Pearson Chi-Square Test (Monte Carlo)

Table 3 Demographic, operative and prognostic characteristics according to ASA-PS categories

	Total (*N* = 533)	ASA-PS I (*n* = 59)	ASA-PS II (*n* = 232)	ASA-PS III (*n* = 194)	ASA-PS IV (*n* = 48)	p value[a]
Age (year), median(min–max)	73.0 (65.0–100.0)	71.0 (65.0–93.0)[*,q]	71.0 (65.0–97.0)[*,q]	75.0 (65.0–100.0)[qq]	82.0 (66.0–88.0)	**< 0.001**
Gender, *n* (%)						
Female	270 (50.7)	27 (45.8)	128 (55.2)	89 (45.9)	26 (54.2)	0.223
Male	263 (49.3)	32 (54.2)	104 (44.8)	105 (54.1)	22 (45.8)	
Inotropic support						
No	481 (90.2)	59 (100.0)	226 (97.4)	157 (80.9)	39 (81.3)	**< 0.001**
Yes	52 (9.8)	0 (0.0)	6 (2.6)[*,q]	37 (19.1)	9 (18.8)	
Hospitalization outcome, *n* (%)						
Discharge	424 (79.5)	55 (93.2)[*,q]	212 (91.4)[*,q]	142 (73.2)[q]	15 (31.3)	**< 0.001**
Transfer to other wards	44 (8.3)	2 (3.4)[q]	6 (2.6)[*,q]	20 (10.3)[q]	16 (33.3)	
Death	65 (12.2)	2 (3.4)[q]	14 (6.0)[*,q]	32 (16.5)[q]	17 (35.4)	
Prognosis, *n* (%)						
Survived	468 (87.8)	57 (96.6)	218 (94.0)	162 (83.5)	31 (64.6)	**< 0.001**
Died	65 (12.2)	2 (3.4)[q]	14 (6.0)[*,q]	32 (16.5)[q]	17 (35.4)	
Type of anesthesia, *n* (%)						
General anesthesia	402 (75.4)	42 (71.2)	167 (72.0)	156 (80.4)	37 (77.1)	0.392
Central nerve blockade	103 (19.3)	15 (25.4)	51 (22.0)	28 (14.4)	9 (18.8)	
Peripheral nerve blockade	28 (5.3)	2 (3.4)	14 (6.0)	10 (5.2)	2 (4.2)	
Postoperative transfer unit, *n* (%)						
Ward	260 (48.8)	46(78.0)[*,q]	147 (63.4)[*,q]	60 (30.9)	7 (14.6)	**< 0.001**
Intensive care unit	273 (51.2)	13 (22.0)[*,q]	85 (36.6)[*,q]	134 (69.1)	41 (85.4)	
Time related parameters, median(min–max)						*p* value[b]
Length of ICU stay (day)	3.0 (0.0–70.0)	0 (0.0–17.0)[*,q]	0.0 (0.0–50.0)[*,q]	4.0 (0.0–70.0)[qq]	4.0 (0.0–24.0)	**< 0.001**
Length of hospital stay (day)	8.0 (0.0–80.0)	6.0 (2.0–29.0)[**]	7.0 (1.0–54.0)[**]	10.0 (0.0–80.0)	7.0 (0.0–43.0)[**]	**0.004**
Operative time (min)	100.0 (5.0–750.0)	85.0 (15.0–220.0)[***]	90.0 (10.0–300.0)[***]	140.0 (15.0–750.0)	77.5 (5.0–250.0)[***]	**< 0.001**

ASA-PS American Society of Anesthesiologists Physical Status Classification

Significant values are in bold

[a]Pearson Chi-Square test (Exact) Fisher Freeman Halton Test (Monte Carlo)

[b]Independent samples Kruskal Wallis test

[**]$p < 0.05$, [***]$p < 0.01$ and [*]$p < 0.001$; compared to ASA-PS III

[qq]$p<0.05$ and [q]$p<0.001$; compared to ASA-PS IV

Accordingly, in our cohort, ASA-PS IV class was associated with oldest age and highest mortality (35.4%); ASA-PS III class was associated with longest LOS and longest operative time, whereas both ASA-PS III and IV classes were associated with higher rate of postoperative transfer to ICU and longer ICU stay. This seems consistent with the data from past studies indicated poor functional status in older people to be associated with prolonged postoperative LOS, adverse postoperative outcomes and postoperative discharge to a higher level of care [1].

Hence, higher mortality rates in emergency than in elective surgery patients in our cohort seems to be associated with higher prevalence of ASA-PS III and IV categories in our emergency than in elective group of patients, emphasizing the role of existing functional limitations in the postoperative outcome in elderly patients.

ASA IV class was also shown to be associated with the highest mortality rate (33.0%) in a past study of elderly general surgery population, while evaluation of ASA class has been considered useful for surgeons to set realistic goals as well as to give estimates of morbidity and mortality to patients and their caregivers, preoperatively [12, 15].

Accordingly, our findings support the utility of ASA-PS classification system in elderly for preoperative risk stratification and management not only by anesthesia providers, but also by surgeons [1, 12]. This seems notable given that inability to perform preoperative interventions for identification of baseline health, mental and social status and co-morbidities and planning care accordingly in emergency conditions is considered to exacerbate the vulnerability of elderly patients undergoing emergency surgery [12, 18, 19].

Although physicians are considered likely to be reluctant to refer patients for surgical treatment due to risk of advanced age and co-morbidities, neither chronologic age nor the number of co-morbidities were shown to be associated with postoperative morbidity or mortality in elderly patients, suggesting that age per se should not be the limiting factor for surgical referral or treatment [12].

In our cohort, operative time and LOS were longer in patients undergoing elective surgery as compared with those in the emergency surgery group. This seems notable given that increased geriatric operative time (≥ 120 min) is considered to play a major role in the development of postoperative complications [20].

Although clinical perceptions and theoretic considerations suggest regional anesthesia should be safer than general anesthesia in elderly patients, current studies indicate no difference in outcomes [21]. Studies involving regional versus general anesthesia have demonstrated a significant impact on perioperative outcomes such as LOS and ICU utilization in patients receiving regional anesthesia [22]; however, randomized studies and a meta-analysis of several randomized clinical trials have shown little evidence of improved outcome and reduced post-operative morbidity and mortality via regional anesthesia [23, 24].

No significant difference was noted between ASA-PS classes in terms of selected anesthesia in our cohort, while use of general anesthesia was more common in the emergency versus elective group and peripheral nerve blockade was more commonly applied among non-survivor versus survivors.

Past studies among elderly surgical patients revealed no difference between peripheral nerve blocks and general anesthesia in terms of mortality and complication rates, while also emphasize a dramatic increase in implementation of peripheral nerve blocks among elderly patients with no additional increase in mortality, due to advances in anesthetic techniques as well as postoperative care over time [25].

Anesthesia choice and management is of critical importance among elderly surgical patients and based on the patient's preference, co-morbidities, potential postoperative complications and the clinical experience of the anesthesiologist [22, 26]. Nonetheless, the overall therapeutic approach in elderly surgical patients has been suggested to be determined jointly by the surgeon, the geriatrician and the anesthesiologist through a multidisciplinary approach [27].

While the management of elderly patients undergoing surgery is challenging, the provision of proactive preoperative assessment coupled with patient-centered multidisciplinary targeted interventions has been shown to improve outcomes such as LOS, rates of institutionalization and readmission, and functional status in elective surgery [15, 17, 18, 28]. Although performing preoperative interventions is not possible in emergency conditions due to the urgent nature of operative intervention, early identification of patients at a high risk of developing adverse outcomes is considered to be associated with more appropriate allocation of resources in these patients [18].

Certain limitations to this study should be considered. First, due to retrospective single center design, establishing the temporality between cause and effect as well as generalizing our findings to overall elderly surgical population seems difficult. Second, lack of data on concomitant treatments and postoperative complications is another limitation which otherwise would extend the knowledge achieved in the current study. Nevertheless, despite these certain limitations, providing data on emergency versus elective surgery in relation to ASA-PS class in a large scale cohort of elderly surgical patients from a broad spectrum of disciplines, our findings represent a valuable contribution to the literature.

In conclusion, our findings in a retrospective cohort of elderly surgical patients revealed high prevalence of co-morbidities, predominance of ASA-PS II or ASA-PS III classes, higher likelihood of receiving general anesthesia and undergoing open intraabdominal surgery along with an overall in-hospital mortality rate of 12.2%. Emergency as compared with elective surgery seems to be associated with older age, male gender, ASA-PS III and IV classes, higher likelihood of postoperative ICU transfer, lower rate of hospital discharge and higher mortality rates. Our findings emphasize the utility of ASA classification system as an available and robust tool for estimating postoperative in-hospital mortality and setting realistic expectations in elderly patients. There is a need for future high quality prospective studies addressing the utility of risk stratification models in preoperative intervention for elderly surgical patients to be able to set realistic goals and to develop most effective strategies for optimization of postoperative outcome.

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Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The design and protocol of this retrospective study were approved by our institutional review board (Date: 19 July 2017, Decision Number: 01).

Informed consent All patients provided consent for their medical records to be used in a scientific study.

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