Perioperative factors predicting poor outcome in elderly patients following emergency general surgery: a multivariate regression analysis

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Background: Older adults (≥ 65 yr) are the fastest growing population and are presenting in increasing numbers for acute surgical care. Emergency surgery is frequently life threatening for older patients. Our objective was to identify predictors of mortality and poor outcome among elderly patients undergoing emergency general surgery.

Methods: We conducted a retrospective cohort study of patients aged 65–80 years undergoing emergency general surgery between 2009 and 2010 at a tertiary care centre. Demographics, comorbidities, in-hospital complications, mortality and disposition characteristics of patients were collected. Logistic regression analysis was used to identify covariate-adjusted predictors of in-hospital mortality and discharge of patients home.

Results: Our analysis included 257 patients with a mean age of 72 years; 52% were men. In-hospital mortality was 12%. Mortality was associated with patients who had higher American Society of Anesthesiologists (ASA) class (odds ratio [OR] 3.85, 95% confidence interval [CI] 1.43–10.33, p = 0.008) and in-hospital complications (OR 1.93, 95% CI 1.32–2.83, p = 0.001). Nearly two-thirds of patients discharged home were younger (OR 0.92, 95% CI 0.85–0.99, p = 0.036), had lower ASA class (OR 0.45, 95% CI 0.27–0.74, p = 0.002) and fewer in-hospital complications (OR 0.69, 95% CI 0.53–0.90, p = 0.007).

Conclusion: American Society of Anesthesiologists class and in-hospital complications are perioperative predictors of mortality and disposition in the older surgical population. Understanding the predictors of poor outcome and the importance of preventing in-hospital complications in older patients will have important clinical utility in terms of preoperative counselling, improving health care and discharging patients home.

Contexte : La population qui connaît la croissance la plus rapide est celle des adultes âgés (≥ 65 ans). Ces personnes nécessitent un nombre croissant d'interventions chirurgicales urgentes. Or, la chirurgie d'urgence comporte souvent un risque de décès pour les patients âgés. Notre objectif était d'identifier les prédicteurs de la mortalité et d'une issue négative chez les patients âgés soumis à une chirurgie générale d'urgence.

Méthodes : Nous avons procédé à une étude de cohorte rétrospective chez des patients de 65 à 80 ans soumis à une chirurgie générale d'urgence entre 2009 et 2010 dans un centre de soins tertiaires. Nous avons recueilli les données démographiques, les comorbidités, les complications perhospitalières, la mortalité et les détails sur l'état général de santé des patients. Nous avons utilisé l'analyse de régression logistique afin de dégager les prédicteurs ajustés en fonction des covariables pour la mortalité perhospitalière et les congés hospitaliers des patients vers leur domicile.

Résultats : Notre analyse a regroupé 257 patients âgés en moyenne de 72 ans; 52 % étaient des hommes. La mortalité perhospitalière a été de 12 %. La mortalité a été associée à des patients qui se classaient dans une catégorie ASA (American Society of Anesthesiologists) plus élevée (rapport des cotes [RC] 3,85, intervalle de confiance [IC] de 95 % 1,43–10,33, p = 0,008) et présentaient plus de complications perhospitalières (RC 1,93, IC de 95 % 1,32–2,83, p = 0,001). Près des deux tiers des patients qui ont reçu leur congé pour retourner à la maison étaient plus jeunes (RC 0,92, IC de 95 % 0,85–0,99, p = 0,036), se classaient dans une catégorie ASA moins élevée (RC 0,45, IC de 95 % 0,27–0,74, p = 0,002) et avaient connu moins de complications perhospitalières (RC 0,69, IC de 95 % 0,53–0,90, p = 0,007).

Conclusion : La catégorie ASA et les complications perhospitalières sont des prédicteurs périopératoires de mortalité et d'état général de santé dans la population âgée soumise à la chirurgie. Comprendre les prédicteurs d'une issue négative et l'importance de prévenir les complications perhospitalières chez les patients âgés aura une importante utilité clinique pour les consultations préopératoires, l'amélioration des soins de santé et le retour des patients à la maison.

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With the expected increase of the elderly population to more than 20% in 2030, a better understanding of their special needs and outcomes while undergoing emergency surgery is required.[1] Correspondingly, in 2010 approximately 33% of hospital stays and 41% of hospital costs were attributed to patients older than 65 years.[2] With these statistics in mind, the demand for acute surgical care of elderly patients has also been increasing.

There have been a very limited number of studies investigating the perioperative risk factors associated with emergent general surgery in patients between 65 and 80 years old.[3,4] Seniors are a unique subset of patients with their own problems and vulnerabilities including the cumulative loss of physiologic reserve in almost every organ system,[5] otherwise known as frailty. Recent studies involving patients older than 80 years demonstrated that age and number of comorbidities did not accurately predict poor surgical outcomes,[6] and further studies have suggested that frailty measures are better overall predictors.[7,8]

The purpose of the present study was to characterize the subset of patients aged 65–80 years who underwent emergency general surgery and to examine their surgical outcomes, including in-hospital mortality and morbidity. We also examined factors associated with the ability to discharge patients back home without the need for in-patient rehabilitation or transfer to long-term care.

Methods

Study design and setting

The University of Alberta Human Research Ethics Board approved this research. We conducted a retrospective cohort study involving patients aged 65–80 years undergoing emergency general surgery at the University of Alberta Hospital, a tertiary care academic hospital in Edmonton, Alta., between 2009 and 2010. Data were collected from an extensive retrospective chart review. This study followed the STROBE guideline for reported retrospective cohort studies.[9]

Patients, variables and outcome measures

We included patients who had at least 1 emergency general surgical procedure during admission. Patient demographic characteristics, including age, sex, weight, height, prehospitalization medication use and comorbidities, were collected. Additionally, operative data, including anesthesiologist-assigned American Society of Anesthesiologists (ASA) class, operative procedure performed and surgical diagnoses, were collected. Clinical outcomes measured included in-hospital complications, length of hospital stay (LOS), in-hospital mortality and discharge disposition.

Statistical analysis

Data were collected using a Microsoft Access database, and we performed the statistical analysis using SPSS version 17.0. Frequencies and percentages were tabulated for categorical and ordinal variables; means and standard deviations were calculated for continuous variables. We used logistic regression analysis to identify covariate-adjusted factors associated with in-hospital mortality, complications and discharge of patients home. Age, sex, body mass index (BMI), number of prehospitalization medications, comorbidities, ASA class and number of in-hospital complications were chosen as covariates. We considered a p value < 0.05 to be evidence of an association not attributable to chance, therefore indicating statistical significance.

Results

Patient demographics, diagnoses and operative procedures

From 2009 to 2010 there were 257 patients between the ages of 65 and 80 years who underwent emergency general surgery at the University of Alberta Hospital. Mean age was 71.5 years, 52% were men, and the average BMI was 27.7 (Table 1). Comorbid illness was present in almost 95% of the included patients, with hypertension, coronary artery disease and diabetes being the most common (Table 2). In total, 93% of patients were on at least 1 medication before admission. Bowel obstruction (12.1%), cholecystitis (10.5%) and intestinal ischemia (8.6%) were the most common diagnoses (Table 3).

Complications

More than half of our patients (53%) experienced 1 or more complications during hospital admission. Surgical site infections (20.6%), cardiac events (20.2%), sepsis (12.1%) and postoperative bleeding (9.7%) were the most frequent complications (Table 4). Cardiac events included cardiac arrest (6.6%), myocardial infarction (5.8%) and arrhythmias (7.8%). Postoperative bleeding included the need for transfusion or operative intervention. Repeat visits to the operating room were required for 9 of the 25 patients with postoperative bleeding (3.5%). Other frequent complications identified were delirium (7.0%); pneumonia, including hospital-acquired pneumonia and aspiration (7.0%); and acute kidney injury, including any creatinine change resulting in concern by the attending physician or the need for renal replacement therapy (6.2%). Other complications, such as urinary tract infections, wound dehiscence, thromboembolic events and strokes, were less frequent.

In-hospital mortality

The overall in-hospital mortality was 12%. Patients with intestinal ischemia or gastric ulceration had the highest mortality (Fig. 1). We used logistic regression analysis to identify factors associated with in-hospital mortality (Table 5). The ASA class (odds ratio [OR] 3.85, 95% confidence interval [CI] 1.43–10.33, $p = 0.008$) and the number of complications (OR 1.93, 95% CI 1.32–2.83, $p = 0.001$) were significantly

Table 1. Patient demographic characteristics ($n = 257$)*

Characteristic	No. (%)
Age, yr	
65–69	102 (39.7)
70–75	96 (37.3)
76–80	59 (22.9)
Male sex	134 (52.1)
BMI ($n = 246$)	
Underweight	9 (3.5)
Healthy	74 (28.8)
Overweight	91 (35.4)
Class I obesity	44 (17.1)
Class II obesity	16 (6.2)
Class III obesity	12 (4.7)

BMI = body mass index.
*Unless otherwise indicated.

Table 2. Patient clinical characteristics — comorbidities and medication use

Characteristic	No. (%)
No. of comorbidities	
None	14 (5.4)
1–2	75 (29.2)
3–5	127 (49.4)
> 5	41 (15.9)
Type of comorbidity	
Hypertension	153 (59.5)
Coronary artery disease	75 (29.2)
Diabetes	58 (22.6)
Thyroid disease	53 (20.6)
Respiratory disease (including COPD)	53 (20.6)
GERD	49 (19.1)
Smoking history	36 (14.0)
No. of home medications	
None	18 (7.0)
1–2	43 (16.7)
3–5	103 (40.1)
> 5	93 (36.1)
Home medication use	
Statin	100 (38.9)
Diuretic	95 (37.0)
Proton pump inhibitor	90 (35.0)
Anti-platelet	82 (31.9)
ACE inhibitors	82 (31.9)
β-blockers	79 (30.7)
ASA class	
1	4 (1.5)
2	50 (19.3)
3	96 (37.1)
4	86 (33.2)
5	10 (3.9)

ACE = angiotensin-converting enzyme; COPD = chronic obstructive pulmonary disease; GERD = gastroesophageal reflux disease.

Table 3. Patient clinical characteristics — most common diagnoses and procedures performed

Characteristic	No. (%)
Primary diagnosis	
Bowel obstruction	31 (12.1)
Cholecystitis	27 (10.5)
Soft tissue infection	22 (8.6)
Colorectal cancer	22 (8.6)
Intestinal ischemia	22 (8.6)
Other	27 (10.5)
Operative procedure	
Cholecystectomy	31 (12.1)
Colon resection with primary anastomosis	26 (10.1)
Colon resection with ostomy	23 (8.9)
Gastric resection/gastrostomy	18 (7.0)
Herniorraphy	17 (6.6)
Exporatory laparotomy	15 (5.8)
Other	35 (13.6)

Table 4. Patient outcomes — complications following surgery

Outcome	No. (%)
No. of complications	
None	121 (47.1)
1–2	78 (30.4)
3–5	52 (20.2)
> 5	6 (2.3)
Type of complication	
Surgical site infections	53 (20.6)
Superficial incisional	16 (6.2)
Deep incisional	9 (3.5)
Organ/space	18 (7.0)
Anastomic leak	10 (3.9)
Cardiac	52 (20.2)
Cardiac arrest	17 (6.6)
Myocardial infarction	15 (5.8)
Cardiac arrhythmia	20 (7.8)
Sepsis	31 (12.1)
Postoperative bleeding	25 (9.7)
Observation	2 (0.8)
Transfusion	14 (5.4)
Repeat operation	9 (3.5)
Delirium	18 (7.0)
Pneumonia (including aspiration)	18 (7.0)
Acute kidney injury	16 (6.2)
UTI	15 (5.8)
Wound dehiscence	13 (5.0)
DVT/PE	6 (2.3)
Stroke	3 (1.2)

DVT = deep vein thrombosis; PE = pulmonary embolus; UTI = urinary tract infection.

associated with mortality. The operative diagnoses of intestinal ischemia and peptic ulcer disease were highly associated with mortality, but were not statistically significant on regression analysis (OR 1.14, 95% CI 0.99–1.31, $p = 0.06$). Importantly, chronologic age alone or the number of comorbidities did not correspond with mortality.

Length of stay and disposition

The median LOS was 13 days, with almost one-quarter of patients spending more than 30 days in hospital (Table 6). Nearly two-thirds of patients required additional support upon discharge, including home care services (24.4%), transfer to subacute hospitals or rehabilitation centres (23.3%) and advancement of care to assisted living or nursing home placement (2.7%; Table 6). To determine which patients were at risk of not returning home after admission, we performed a multivariate logistic regression analysis (Table 7). After controlling for confounding factors, ASA (OR 0.45, 95% CI 0.27–0.74, $p = 0.002$), advanced age (OR 0.92, 95% CI 0.85–0.99, $p = 0.036$) and the development of in-hospital complications (OR 0.69, 95% CI 0.53–0.90, $p = 0.007$) were associated with the inability to return home.

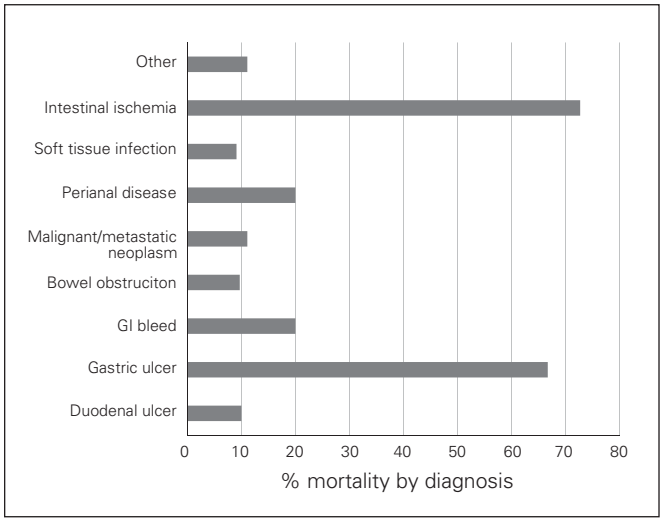

Fig. 1. Mortality based on operative diagnosis. GI = gastrointestinal.

Table 5. Mortality outcomes — logistic regression analysis

Covariates	β	SE	OR (95% CI)	*p* value
Female sex	–0.021	0.623	0.979 (0.289–3.321)	0.97
Total no. of operations	0.067	0.204	1.070 (0.718–1.595)	0.74
ASA	1.347	0.504	3.845 (1.431–10.330)	0.008
Age	0.048	0.065	1.049 (0.925–1.191)	0.46
BMI	–0.003	0.041	0.997 (0.921–1.079)	0.94
No. of medications	0.130	0.143	1.138 (0.861–1.505)	0.36
No. of comorbidities	0.057	0.178	1.059 (0.747–1.500)	0.75
No. of complications	0.659	0.195	1.932 (1.318–2.833)	0.001
Operative diagnosis	0.131	0.070	1.140 (0.994–1.308)	0.06
Operative procedure	–0.118	0.072	0.888 (0.772–1.023)	0.10

ASA = American Society of Anesthesiologists; BMI = body mass index; CI = confidence interval; OR = odds ratio; SE = standard error.

Discussion

Acute care surgery is being performed more frequently in frail elderly patients and can result in clinical, cognitive and functional deterioration. Our study shows that 95% of older patients present to hospital with 1 or more pre-existing comorbid illnesses. Mortality was 12%, and more than 50% of patients experienced an in-hospital complication — a very important finding since the number of in-hospital complications was significantly associated with mortality. Interestingly, chronologic age or the number of comorbidities did not correspond with mortality. More than two-thirds of the patients required additional resources on discharge from hospital. Some of the predictors associated with the inability to return home were advanced age, ASA class and the development of in-hospital complications. This knowledge can enhance perioperative counselling of patients and families about expected outcomes and assist with appropriate resource planning for patients.

Table 6. Patient outcomes — length of stay and disposition following surgery

Outcome	No. (%)
Length of stay, d	
0–7	83 (32.2)
8–29	116 (45.1)
> 30	58 (22.5)
Disposition	
Home	159 (60.8)
Without additional services	94 (36.4)
With homecare services	65 (24.4)
Rehabilitation/home hospital	60 (23.3)
Deceased	31 (12.0)
Assisted living/long-term care	7 (2.7)

Table 7. Discharge disposition — logistic regression analysis

Characteristic	β	SE	OR (95% CI)	*p* value
Female sex	–0.258	0.490	0.773 (0.296–2.019)	0.60
Height	0.110	0.072	1.116 (0.969–1.286)	0.13
Weight	–0.089	0.068	0.915 (0.800–1.046)	0.19
Length of Stay	–0.009	0.007	0.991 (0.979–1.004)	0.18
Total no. of operations	–0.198	0.238	0.821 (0.515–1.308)	0.41
ASA	–0.803	0.259	0.448 (0.269–0.744)	0.002
Age	–0.085	0.041	0.918 (0.848–0.994)	0.036
BMI	0.214	0.181	1.238 (0.869–1.765)	0.24
No. of medications	–0.121	0.090	0.886 (0.743–1.058)	0.18
No. of comorbidities	–0.102	0.115	0.903 (0.721–1.131)	0.37
No. of complications	–0.366	0.135	0.694 (0.532–0.904)	0.007
Operative diagnosis	–0.047	0.036	0.950 (0.889–1.024)	0.19
Operative procedure	0.037	0.040	1.036 (0.960–1.122)	0.36

ASA = American Society of Anesthesiologists; BMI = body mass index; CI = confidence interval; OR = odds ratio; SE = standard error.

Similar to other studies, we found that complications resulting from emergent surgeries can lead to worsened clinical status, additional hospital costs and, perhaps more importantly, decline in functional status requiring additional support or alternate level of care when leaving hospital.[10] A recent study by Sheetz and colleagues[11] reported a poor correlation between complications and mortality, but failure to rescue patients from in-hospital complications was significantly associated with mortality, and this association was greater in patients older than 75 years. In our study the most common complications were cardiac events, surgical infection/sepsis and postoperative bleeding. Cardiac events occurred in 1 of every 5 patients, which is a susbtantial number and suggests further studies are required to examine the use of postoperative telemetry in high-risk elderly patients. Delirium was documented in only 7% of patients in this study. However, we feel this event is significantly underreported owing to lack of recognition of delirium, particularly identification of hypoactive delirium states, and poor understanding of the importance of the diagnosis. Delirium has been found in other studies to be a common postoperative complication in older patients and is associated with important adverse outcomes, such as increased LOS, higher postoperative complication rates, falls, discharge to long-term care and death.[12,13] These and other complications are potentially preventable, and attention to these is paramount. Our study supports that a focus on preventing complications postoperatively can significantly impact outcomes in elderly patients.

A large proportion of the older patients in our study stayed more than 30 days in hospital and required additional support on discharge. Unfortunately, acute care models rarely take into account the special needs of this population; for example, proactive planning of services, such as rehabilitation, is seldom done.[14] Acute hospitals continue to be geared to provide care for those with single acute illnesses rather than those with multiple acute and chronic conditions. This can result in poor postsurgical outcomes, an increased requirement for care, reduced quality of life, increased dependency and increased health care resource utilization. Our centre will be exploring how to improve outcomes by examining new care models, such as acute care for the elderly (ACE) units applied to a surgical setting where there is a focus on screening for early identification of geriatric syndromes, family and caregiver involvement at all stages of care, interdisciplinary assessments and an environment supportive of discharge planning and community services.[15–17]

Our study reinforces that higher ASA class is associated with mortality following emergency general surgery in elderly patients. It should be mentioned that despite being a statistically significant variable, the ASA class had a wide CI, likely associated with our relatively small data set, and therefore we cannot accurately describe the direct magnitude of its effect on mortality. Three of the more common scoring systems to predict outcome are the Reported Edmonton Frail Scale (REFS), the Acute Physiology and Chronic Health Evaluation II (APACHE II) and the Physiologic and Operative Severity Score for the enUmeration of Morbidity and mortality (POSSUM). There are several reasons these are often not used in the acute surgical setting; the APACHE II score requires an extensive workup often not conducive to acute surgical situations,[18] the POSSUM scoring system may overestimate mortality in low-risk patients while underestimating the risk in elderly patients or those undergoing emergency surgery,[19–21] and the REFS scale uses more comprehensive subjective geriatric measures (v. physiologic),[22] which are not always possible to obtain quickly preoperatively. By contrast, ASA class can be quickly determined on admission.[23] While anesthesiologists often use this score, our study demonstrates the value of surgeons using ASA class for preoperative risk stratification and discussions.

Limitations

Our study is limited by its retrospective single-centre design and small sample size. Our statistical analysis did not take into account the severity of certain comorbidities, therefore it might be worthwhile to incorporate the Charlson Comorbidity Index[24] instead of the total number of comorbidities in future studies. In addition, this study focused on the elderly patients who underwent an operation but did not examine outcomes of the patients who had nonoperative management. For example, some patients may have been treated nonoperatively (i.e., medical management for acute cholecystitis) or as per end-of-life care goals or personal wishes to avoid surgery. This is an important cohort of patients who would benefit from studies in the future.

CONCLUSION

Older patients undergoing emergency surgery are at very high risk for in-hospital complications. The ASA class and the development of an in-hospital complication are independent predictors of mortality; these factors were associated with the inability to return home. Understanding the perioperative factors associated with adverse outcomes can allow for identification of at-risk patients to allow for development of tailored preventative strategies and resource planning to improve the outcome in elderly emergency surgical patients.

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Contributors: R. Khadaroo designed the study. M. Lees, S. Merani and K. Tauh acquired the data, which all authors analyzed. All authors wrote and reviewed the article and approved the final version for publication.

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Correction

In the article "Medical mentorship in Afghanistan: How are military mentors perceived by Afghan health care providers?" by Beckett et al. (*Can J Surg*. 2015;58(3 Suppl 3): S98–S103. doi: 10.1503/cjs.012214), the author Neill K.J. Adhikari's name was spelled incorrectly. We apologize for this error.