Predicting in-hospital mortality in older general surgical patients

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ABSTRACT

INTRODUCTION A significant number of emergency general surgical admissions occur in older patients. Clinical decision making in this group is challenging and current risk prediction tools extrapolate data from cohorts of younger patients. This is the first UK study to examine risk factors predicting in-hospital mortality in older acute surgical patients undergoing comprehensive geriatric assessment.

METHODS This was a prospective study of consecutive patients aged ≥ 75 years admitted non-electively to general surgery wards between September 2014 and February 2017 who were reviewed by an elderly medicine in-reach service.

RESULTS A total of 577 patients were included with a mean age of 82.9 years. There was a female predominance (56%). The majority were living at home alone or with carers (93%) and most were independent in basic activities of daily living (79%). Over two-thirds (69%) were mobile with no walking aids or use of a walking stick and over three-quarters (79%) had no cognitive impairment. Seventy-seven per cent of patients were managed non-operatively. The in-hospital mortality rate was 6.9%. Female sex ($p=0.031$), dependence in activities of daily living ($p<0.001$), cognitive impairment ($p<0.001$) and incontinence ($p<0.001$) were predictors of in-hospital mortality. ASA (American Society of Anesthesiologists) grade ≥ 3 was also associated with increased in-hospital mortality (odds ratio: 5.3, 95% confidence interval: 2.6–10.7).

CONCLUSIONS Older general surgical patients present a high level of complexity. This study highlights the predictive role of mobility, functional and cognitive impairment when assessing this population. Accurate risk stratification requires global assessment by teams experienced in care of the older patient rather than the traditional focus on co-morbidities.

KEYWORDS

Comprehensive geriatric assessment – Functional impairment – Emergency general surgery – Older people – Perioperative care

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The rate at which the global population is ageing is rapidly increasing. Between 2007 and 2017, the proportion of the UK population aged ≥ 65 years increased from 15.9% to 18.1% while the proportion of those aged ≥ 80 years increased from 4.4% to 4.9%.¹ It is well recognised that the need for emergency intervention for acute surgical conditions increases with age, as does the rate of morbidity and mortality.^{2–4} In the UK, a national report in 2017 found that over half of patients undergoing major emergency general surgical procedures were aged ≥ 65 years.⁵

In-hospital mortality in emergency general surgical admissions varies in the published literature between 7% and 38%.^{6,7} In the current era, with improved pharmacotherapy and intervention, age and multimorbidity are no longer clear contraindications to surgery.^{8,9} Impairments in mobility, function and cognition, and dependency in activities of daily living (ADLs) have been proved to influence survival in older patients attending the emergency department and/or being hospitalised with orthopaedic and/or medical conditions.^{10–15} Comprehensive geriatric

assessment (CGA) has become an established multimodal approach to evaluation of physical, psychological, functional and social issues in older people, and has been shown to improve outcomes.^{16–20}

Unfortunately, traditional risk stratification scoring systems used to predict mortality and morbidity rates in older surgical patients do not take into account such ‘geriatric’ parameters.^{21–25} This is the first study to report factors predictive of in-hospital mortality in a large cohort of older emergency general surgical patients undergoing CGA and conservative, interventional or surgical treatment of their presenting condition.

Methods

Salford Royal NHS Foundation Trust is an urban teaching hospital serving a population of 240,000. A prospective cohort study was conducted of all general surgical patients aged ≥ 75 years admitted on a non-elective basis between 9 September 2014 and 28 February 2017. All patients

underwent CGA by our elderly medicine in-reach service within 48 hours of admission to a general surgical ward during normal working hours. Overall responsibility for patients remained with the parent surgical team but patients underwent regular clinical review and multidisciplinary team discussion led by the elderly medicine in-reach service during their hospital stay.

Data were collected on baseline demographics, ASA (American Society of Anesthesiologists) grade, co-morbidities, surgical diagnoses, interventions and complications. Management of conditions was subdivided into medical, interventional or operative. Interventional management included endoscopic treatments, percutaneous radiologically guided drainage and chest drain insertion. Medical and surgical complications and geriatric syndromes (delirium, falls, immobilisation, constipation, incontinence, functional deconditioning, pressure sores) were recorded. Anaemia was defined as haemoglobin <130g/l in men and <120g/l in women. Hospital acquired pneumonia was defined as consolidation on a chest x-ray occurring 48 hours or more after admission.

Patient related information was gained from patients and/or their care givers, review of the electronic patient records and clinical assessment. Cognition, continence, place of residence, level of social support and the number of prescribed medications were recorded for each individual. Limitations in ADLs were established using the Katz index,²⁴ and in instrumental ADLs (IADLs) using the Lawton and Brody index.²⁵ Presence of delirium was assessed using the confusion assessment method.²⁶

Independence in ADLs/IADLs was classified as 0 (no help or help with one ADL/IADL) or 1 (help with two or more ADLs/IADLs). Similarly, mobility was described as 0 (no walking limitation or use of a walking stick) or 1 (use of a walking frame, wheelchair, help from one or more persons to mobilise, or bed ridden).

This study analysed data that were collected as part of our routine care. It was therefore deemed service evaluation by our institutional ethics committee and did not require ethical approval.

The primary outcome measure was inpatient mortality. No formal sample size calculation was performed as the study was exploratory, and all patients admitted during the study period were included and reported. Statistical analysis was performed using SPSS® version 15.0 (SPSS, Chicago, IL, US). Student's t-test was used for continuous variables and the chi-squared test for categorical variables. Univariate and multivariate logistic regression analysis was undertaken to identify factors predicting in-hospital mortality.

Results

A total of 577 patients aged ≥ 75 years were included in the study with a mean age of 82.9 years (standard deviation: 5.7 years). Over half (56.2%) were female. All patients were admitted by the acute general surgical service on a non-elective basis and proactively assessed by the elderly medicine in-reach service. Any patients who had more than one

hospital admission during the study period were included in data analyses once, based on their first episode of hospitalisation. The demographics of the study cohort and baseline characteristics at the time of admission are summarised in Table 1.

Participants

The vast majority of patients were living at home independently or with carers (92.9%) at the time of admission. Over three-quarters (78.6%) of patients were independent in basic ADLs, over two-thirds (69.2%) were mobile with no walking aids or use of a walking stick and over three-quarters (78.7%) had no cognitive impairment. Just under two-thirds of the study population (62.7%) was aged ≥ 80 years. Around a third (35.7%) of all patients were categorised as ASA grade ≥ 3 . Forty patients (6.9%) died during their admission. More female patients died during their acute admission than male patients (9.0% vs 4.3%, $p < 0.031$).

Diagnoses

Table 2 gives a breakdown of the presenting diagnoses. Nearly a third (29.1%) of all patients presented with hepatobiliary pathology, which was not found to be associated with an increased incidence of in-hospital mortality. The most common diagnoses in other patients were bowel related pathology (including obstruction, hernias and diverticulitis) and progression of intra-abdominal malignancy or perforation.

Intervention

Patients undergoing surgery made up almost a quarter (23.4%) of the total study cohort while 17.7% had an interventional procedure. Over half (58.9%) of the patients were managed without surgical intervention or interventional procedure. There was no significant difference in in-hospital mortality between patients undergoing surgical, interventional or medical management: 9 deaths (6.7%) occurred in the operative group, 2 (17.6%) in patients who were managed with a non-surgical intervention and 29 (8.5%) in individuals managed medically.

High ASA grade (≥ 3), being institutionalised (admitted from a residential or nursing home), dependency in ADLs (basic and instrumental), urinary and/or faecal incontinence and cognitive impairment were associated with in-hospital mortality ($p < 0.001$), as was reduced mobility ($p = 0.007$). Pre-existing heart failure and dementia were the only co-morbidities with a significant association with in-hospital mortality ($p = 0.007$ and $p < 0.001$ respectively, Table 3). Total number of medications and co-morbidities were not predictive of in-hospital mortality ($p > 0.05$). The development of some medical complications (specifically, hospital acquired pneumonia and acute kidney injury) was associated with increased in-hospital mortality ($p < 0.001$).

Multivariate logistic regression analysis identified that among the tested variables, ASA grade ≥ 3 was an independent prognostic factor of in-hospital mortality (odds ratio: 5.26, 95% confidence interval: 2.58–10.70).

Table 1 Demographic data and baseline characteristics at time of admission under acute surgical service					
Characteristic		Total (n=577)	Vital status at discharge		p-value
			Alive (n=537, 93.1%)	Dead (n=40, 6.9%)	
Sex	Female	324 (56.2%)	295 (91.0%)	29 (9.0%)	0.031
	Male	253 (43.8%)	242 (95.7%)	11 (4.3%)	
Mean age in years		82.9 (SD: 5.7)	85.2 (SD: 5.4)	82.7 (SD: 5.7)	0.009
Age group	<80 years	215 (37.3%)	209 (97.2%)	6 (2.8%)	0.005
	80–89 years	282 (48.9%)	258 (91.5%)	24 (8.5%)	
	≥90 years	80 (13.9%)	70 (87.5%)	10 (12.5%)	
Treatment received	Medical	340 (58.9%)	311 (91.5%)	29 (8.5%)	>0.05
	Procedure	102 (17.7%)	100 (98.0%)	2 (2.0%)	
	Surgical intervention	135 (23.4%)	126 (93.3%)	9 (6.7%)	
ASA grade ≥3		206 (35.7%)	204 (99.0%)	2 (1.0%)	<0.001
Nursing/residential home		64 (11.1%)	51 (79.7%)	13 (20.3%)	<0.001
Dependency	Basic ADLs	123 (21.4%)	102 (82.9%)	21 (17.1%)	<0.001
	Instrumental ADLs	274 (47.2%)	243 (89.7%)	28 (10.3%)	<0.001
	Mobility	178 (30.8%)	158 (88.8%)	20 (11.2%)	0.007
Cognitive impairment		108 (18.7%)	19 (17.6%)	89 (82.4%)	<0.001
Urinary incontinence*		80 (13.9%)	65 (81.2%)	15 (18.8%)	<0.001
Faecal incontinence**		39 (6.8%)	30 (76.9%)	9 (23.1%)	<0.001
Mean number of medications		8.4 (SD: 4.2)	8.4 (SD: 4.2)	8.4 (SD: 3.8)	>0.05
ADLs = activities of daily living; ASA = American Society of Anesthesiologists; SD = standard deviation					
*Not applicable in 22 cases (long-term urinary catheter)					
**Not applicable in 19 cases (stoma)					

Table 2 Presenting diagnosis of acute surgical condition				
Diagnosis	Total (n=577)	Vital status at discharge		p-value
		Alive (n=537, 93.1%)	Dead (n=40, 6.9%)	
Liver and biliary conditions	168 (29.1%)	161 (95.8%)	7 (4.2%)	>0.05
Bowel obstruction/perforation (cancer, adhesions)	74 (12.8%)	64 (86.5%)	10 (13.5%)	>0.05
Cancer (progression)	50 (8.7%)	42 (84.0%)	8 (16.0%)	0.008
Cancer (curative intent)	17 (2.9%)	17 (100%)	0 (0%)	>0.05
Hernia with obstruction or gangrene	47 (8.1%)	44 (93.6%)	3 (6.4%)	>0.05
Diverticulitis	45 (7.8%)	44 (97.8%)	1 (2.2%)	>0.05
Bowel ischaemia	13 (2.3%)	11 (84.6%)	2 (15.4%)	>0.05
Gastrointestinal ulcer	8 (1.4%)	7 (87.5%)	1 (12.5%)	>0.05
Rectal prolapse	8 (1.4%)	8 (100%)	0 (0%)	>0.05
Peritonitis	6 (1.0%)	3 (50.0%)	3 (50.0%)	<0.001
Other	141 (24.4%)	136 (96.5%)	5 (3.5%)	>0.05

Table 3 Co-morbidities at time of admission under acute surgical service

Co-morbidity	Total (n=577)	Vital status at discharge		p-value
		Alive (n=537, 93.1%)	Dead (n=40, 6.9%)	
Mean number of co-morbidities	5.5 (SD: 2.6)	5.5 (SD: 2.6)	5.7 (SD: 2.7)	>0.05
>4 co-morbidities	349 (61.9%)	321 (92.0%)	28 (8.0%)	>0.05
Hypertension	373 (64.6%)	27 (7.2%)	346 (92.8%)	>0.05
Ischaemic heart disease	174 (30.2%)	15 (8.6%)	159 (91.4%)	>0.05
Atrial fibrillation	140 (24.3%)	13 (9.3%)	127 (90.7%)	>0.05
Chronic pulmonary disease	136 (23.6%)	13 (9.6%)	123 (90.4%)	>0.05
Active cancer	118 (20.5%)	9 (7.6%)	109 (92.4%)	>0.05
Chronic kidney disease	110 (19.1%)	8 (7.3%)	102 (92.7%)	>0.05
Diabetes	105 (18.2%)	5 (4.8%)	100 (95.2%)	>0.05
Stroke	92 (15.9%)	6 (6.5%)	86 (93.5%)	>0.05
Anaemia	81 (14.0%)	4 (4.9%)	77 (95.1%)	>0.05
Heart failure	78 (13.5%)	11 (14.1%)	67 (85.9%)	0.007
Dementia	69 (12.0%)	13 (18.8%)	56 (81.2%)	<0.001
Thyroid disease	68 (11.8%)	5 (7.4%)	63 (92.6%)	>0.05
Osteoporosis	57 (11.6%)	5 (7.0%)	66 (93.0%)	>0.05
Depression	41 (7.1%)	5 (12.2%)	36 (87.8%)	>0.05
SD = standard deviation				

Discussion

This study is the first to evaluate factors predictive of in-hospital mortality in patients aged ≥ 75 years undergoing CGA after emergency admission to a general surgical ward. Our data confirmed the heterogeneity of this group, with differing levels of mobility, functional ability, cognition, medication use and co-morbidity. It is therefore of paramount importance that we maintain a holistic and personalised approach to clinical assessment and decision making. In this setting, structured and continued involvement by experienced geriatricians supports surgeons, patients and their caregivers in setting realistic goals, and can help to avoid futile care or unnecessary procedures.²⁷ The requirement for further training in managing this vulnerable patient group has been acknowledged among surgical specialties.²⁸

While ASA grade remains widely reported as a good predictor of outcome and in-hospital mortality in older surgical patients,^{16,20} polypharmacy and number of co-morbidities¹⁶ do not have a significant effect on outcome in and of themselves. Heart failure has been reported previously to be a poor predictor of outcome in older surgical patients²⁰ and this is supported by the results of the present study. Although innovations in perioperative care have led to a rise in surgical procedures performed in older patients with complex medical needs, the majority (77%) of our patients were managed non-operatively. Incontinence and cognitive

impairment are highlighted as independent predictors of in-hospital mortality. Anecdotally, these are not routinely quantified or formally assessed by surgeons when admitting older surgical patients. This underlines the importance of a holistic, multidisciplinary approach in decision making in order to optimise outcomes for all older surgical patients, particularly those presenting as an emergency.

Identifying patients at risk of in-hospital mortality and developing tailored preventative interventions should be encouraged, and may improve outcomes in older surgical patients. The findings of this study should aid clinical decision making as to the appropriateness of surgical interventions. While operative intervention is an option for many older surgical patients, the identification of potential risk factors predictive of in-hospital mortality have clinical value in appropriate patient selection and judicious clinical care in the acute setting. The role of a geriatrician-led service for non-operatively managed acute surgical patients with surgical in-reach has not yet been reported in the published literature. Further multicentre studies and randomised trials are needed to ascertain the full potential of such a service in improving outcomes in this vulnerable patient group.

Study limitations

This study was carried out in a teaching hospital serving an urban catchment area, and the results may not apply to patients treated in other hospitals and clinical units. In

addition, older emergency general surgical patients represent a heterogeneous cohort with multiple diagnoses receiving different treatments and our sample size was relatively small; consequently, the results should be interpreted with this caveat.

The high numbers of older patients discharged from hospital alive after acute surgical intervention in this study cohort is encouraging; however, it is not known how many of these patients were discharged to their preadmission residence with return of baseline functional status. Discharge data have not been reported in any other published studies and this is an area for future research for informing treatment strategies in older acute surgical patients.

Conclusions

Older acute surgical patients are a highly heterogeneous and complex group of patients with significant levels of multimorbidity, polypharmacy, and functional and cognitive impairment. Further studies are required to determine which interventions aimed at improving these non-surgical factors can have a positive impact on morbidity and mortality in this patient group.

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