Short and medium-term outcomes for general surgery in nonagenarian patients in a district general hospital

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ABSTRACT

INTRODUCTION Surgeons are increasingly performing surgery on older patients. There are currently no tools specifically for risk prediction in this group. The aim of this study was to review general surgical operations carried out on patients aged over 90 years and their outcome, before comparing these with predictors of morbidity and mortality.

METHODS A retrospective review was carried out at our district general hospital of all general surgery patients aged over 90 years who underwent a general surgical operation over a period of 14 years. Information collected included demographics, details of procedures, P-POSSUM (Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity), complications and outcomes.

RESULTS A total of 119 procedures were carried out, 72 involving entry into the peritoneal cavity. Overall, 14 patients (12%) died within 30 days and 34 (29%) died within one year. Postoperative complications included infection (56%), renal failure (24%), need for transfusion (17%) and readmission within 30 days (11%). Logistical regression analysis showed that the P-POSSUM correlated well with observed mortality and infection was a significant predictor of in-hospital mortality ($p=0.003$).

CONCLUSIONS The P-POSSUM correlates significantly with outcome and should be used when planning major elective or emergency surgery in patients over 90 years of age. Infective complications appear to be a significant predictor of postoperative mortality. This study supports operative intervention as an option in this extreme age group but we emphasise the importance of appropriate patient selection and judicious clinical care.

KEYWORDS

Nonagenarian – Elderly – Morbidity – Mortality – P-POSSUM

Accepted 29 August 2015

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An aging population throughout the developed world means that surgeons are increasingly being asked to consider performing surgery on older, higher risk patients. This was highlighted by The Royal College of Surgeons of England (RCS) report on emergency surgery.¹ While age should not be used as an isolated factor for exclusion, this group has more chronic health problems, and represents greater risks in anaesthesia, the procedure itself and also recovery.^{2–15} The POSSUM (Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity) is a tool that can be used to predict postoperative morbidity and mortality.¹⁴ Concerns of overprediction of mortality led to the development of the P-POSSUM (Portsmouth POSSUM) and CR-POSSUM (POSSUM for colorectal surgery), which use the same variables but an amended regression equation and correlate well with in-hospital mortality.^{15,16} To date, validity for extremes of old age has not been adequately established.

A number of reports have described high rates of mortality in patients over the age of 90 years following emergency or elective surgery; however, these studies were underpowered. In Canada, 145 patients undergoing abdominal surgery had an in-hospital mortality rate of 15.6% while at 1 year, the mortality rate was 27.8% among patients having elective procedures and 49.1% for emergencies.¹⁷ Both the POSSUM and P-POSSUM were unreliable in this group, and both over-predicted mortality. In a retrospective UK series of 49 consecutive nonagenarians presenting with an acute abdomen, the in-hospital mortality rate was 16% even though only 4% of the patients underwent surgery.¹⁸ The majority of the survivors were discharged back to their existing residence.

The primary purpose of this study was to review the short and medium-term outcomes for nonagenarians and centenarians who underwent abdominal surgery in our district general hospital. We also sought to evaluate the ability of the P-POSSUM to predict mortality in this group.

Methods

This retrospective observational study was undertaken at a district general hospital in central England following approval by the trust clinical governance and ethics review board. Our county is known to have a higher life expectancy than that of the general UK population (83.4 vs 83.9 years for men, 85.9 vs 86.7 years for women).¹⁹ All general surgical procedures undertaken between January 1999 and December 2012 on patients aged 90 years and over were identified from discharge coding. All electronic and written case notes were reviewed to enable completion of a study specific proforma, which included patient demographics, type of operation, intraoperative and postoperative complications, and survival outcomes. Public health records were accessed to establish the validity of the data and cause of mortality where required.

Statistical analysis

Multivariate regression analysis was used to adjust for multiple risk factors as well as the size and significance of their interactions. Binary logistic regression analysis was performed for 30-day and 1-year mortality. Standardised coefficients were used to allow comparison between the effect size of binary and continuous factors in the regression model. The Hosmer–Lemeshow statistic evaluated goodness of fit (ie the model's ability to assign the correct outcome probabilities to individual patients). Model discrimination (the ability to assign higher probabilities of one-year mortality for older patients) was measured with the coefficient of determination. Values exceeding 0.8 represent good discrimination. Odds ratios were employed to express the impact of variables with a *p*-value of <0.05 and non-overlapping 95% confidence intervals were regarded as significant. Analyses were performed using SPSS® version 22.0 (IBM, New York, US).

Results

Over the 14-year study period, 119 procedures were carried out on 112 patients aged over 90 years. The oldest patient was 102 years old and 71 (63%) were female (Table 1). The procedures included 72 (61%) designated as major surgery (Table 2). Figure 1 displays the age distribution of these cases. Major surgery was classified as operations involving general anaesthesia, division of the peritoneum and entrance into the abdominal cavity; these comprised bowel resection with anastomosis (31.9%), bowel resection with stoma (6.9%), perineal full-thickness bowel resection and anastomosis (for rectal prolapse) (9.7%), other laparotomy/laparoscopy (30.6%) for sepsis, bleeding and bowel obstruction, and major hernia repair (20.8%). The remaining operations included minor hernia repair (29%) and minor perineal surgery (9%) where entry into the abdominal or pelvic cavity was not undertaken.

For the entire group, the mortality rates were 12.6% during the relevant hospital admission, 11.8% within 30 days and 28.6% within 1 year. The mortality rates for those undergoing major surgery were higher at 16.7% within 30

Table 1 Patient characteristics

<i>Whole cohort (n=112)</i>	
Mean age in years	92.2 (SD: 2.4)
Age range in years	90–102
Female sex	71/112 (63%)
<i>Major surgery cases only (n=72)</i>	
Mean age in years	92.2 (SD: 2.5)
Age range in years	90–102
Female sex	54/72 (75%)
Previous myocardial infarction	17/70 (24.3%)
Previous stroke	4/70 (5.7%)
Hyperlipidaemia	10/70 (14.3%)
Hypertension	28/71 (39.4%)
Cardiac failure	7/69 (10.1%)
Atrial fibrillation	18/70 (25.7%)
Diabetes	5/70 (7.1%)
Malignant pathology	25/72 (34.7%)
ASA grade	
1–2	17/67 (25.4%)
3	40/67 (59.7%)
4–5	10/67 (14.9%)
General anaesthesia	66/72 (91.7%)
Elective	26/72 (36.1%)
Curative intent	63/68 (92.6%)
Operation	
Open	67/72 (93.0%)
Laparoscopic	5/72 (7.0%)
SD = standard deviation; ASA = American Society of Anesthesiologists	

days and 36.1% at 1 year. Procedures and outcomes are summarised in Tables 2 and 3.

Postoperative complications included infection (56.3%; Table 3 gives source of infection), renal failure (25.9%), need for blood transfusion (16.9%) and readmission within 30 days (11.3%). Almost a third (27%) of the patients were admitted to the intensive care unit postoperatively, which was planned in all of these cases.

There was a significant difference between mortality rates for patients undergoing major and minor procedures at 1 year (37.5% vs 14.9% respectively; $X^2=5.31$, $df=1$, $p=0.047$) but not at 30 days. There were no differences between mortality at 30 days or 1 year for those with malignant versus benign pathology, for emergency versus elective procedures or for men versus women (Table 4).

Among those undergoing major surgery, the P-POSSUM was a statistically significant predictor of in-hospital mortality in logistic regression ($X^2=1.36$, $p=0.048$, $r^2=0.54$), with a

Table 2 Characteristics and outcomes of the major procedures performed

Procedure	<i>n</i>	30-day mortality	1-year mortality
Bowel resection with anastomosis	23 (31.9%)	3/23 (13.0%)	8/23 (34.8%)
Bowel resection with stoma	5 (6.9%)	0/5 (0%)	1/5 (20.0%)
Perineal full-thickness bowel resection and anastomosis (for rectal prolapse)	7 (9.7%)	1/7 (14.3%)	3/7 (42.9%)
Other laparotomy / laparoscopy	22 (30.6%)	7/22 (31.8%)	8/22 (36.4%)
Major hernia surgery	15 (20.8%)	1/15 (6.7%)	6/15 (40.0%)
Total	72 (100%)	12/72 (16.7%)	26/72 (36.1%)

good fit according to the Hosmer–Lemeshow test. Figure 2 illustrates the poorer outcome observed in patients following high risk stratification by P-POSSUM. Further regression was carried out for all individual variables making up the P-POSSUM and postoperative complications. The only variable to emerge as statistically significant at predicting in-hospital mortality was postoperative infection ($X^2=8.50$, $p=0.003$, $r^2=0.11$).

Figure 1 Patient age distribution for major cases**Table 3** Complications in major cases

Complication	<i>n</i>
Chest infection	18/71 (25.4%)
Urinary tract infection	17/71 (23.9%)
Wound infection	15/71 (21.1%)
Renal failure	17/71 (23.9%)
Transfusion required	12/71 (16.9%)
Positive blood culture	5/71 (7.0%)
Raised serum troponin	4/71 (5.6%)
Readmission	8/71 (11.3%)
Anastomotic leak	1/30 (3.3%)
Stroke, venous thromboembolism	0 (0%)

Discussion

This study showed high rates of mortality among patients undergoing general surgery aged over 90 years. Rates for major surgery are equivalent to those for emergency surgery from all age groups nationally.²⁰ There was a difference in one-year survival between those undergoing major versus minor procedures. Each case must therefore be considered carefully before offering surgery to this demographic group. Prediction of in-hospital mortality by P-POSSUM was helpful and the data suggested that postoperative infection may be an independent predictor of mortality.

The success of P-POSSUM prediction of mortality in this study is somewhat at odds with previous research, where this was not reliable.¹⁷ However, both samples were relatively small. In order to obtain clear validation for the P-POSSUM in extremes of age, much larger samples would be necessary. The only other UK study in this area showed that nonagenarians were less likely to receive surgery when presenting with an acute abdomen and more likely to die in hospital than younger patient groups.¹⁸ The data presented here suggest that while mortality rates were high for these older patients, use of the P-POSSUM may well benefit clinicians in deciding whether to operate.

This was a retrospective case note review with limited numbers. Significant predictors of mortality may not have been identified as a result of type II error in the small sample. Nevertheless, our study represents one of the largest series of patients in this age group undergoing abdominal surgery and provides a valuable insight into surgical outcomes for the very elderly in the UK.

Conclusions

This study highlights the feasibility of safely performing general surgical procedures in a highly selected robust group of patients aged over 90 years. Despite the limitations, it provides evidence that risk prediction for outcomes in surgery is possible using the P-POSSUM.

Table 4 ORs for mortality for all patients in the study

Variable	30-day mortality		1-year mortality	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Procedure (major vs minor)	2.65 (0.70–10.04)	0.15	3.43 (1.35–8.73)	0.047
Pathology (malignant vs benign)	0.67 (0.16–2.77)	0.58	1.52 (0.56–4.11)	0.41
Operating list (emergency vs elective)	1.63 (0.17–2.25)	0.46	1.44 (0.55–4.22)	0.72
Sex (male vs female)	1.25 (0.39–3.98)	0.71	1.13 (0.50–2.56)	0.77

OR = odds ratio; CI = confidence interval

Figure 2 P-POSSUM (Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity) risk prediction versus observed admission outcome

Furthermore, given the poor physiological reserve in very elderly patients, surgeons may wish to consider routine admission to the intensive care unit, coupling this with effective clinical care bundles recommended by the RCS to prevent, recognise and treat postoperative complications (particularly infection).^{1,21–25} This could be especially valuable for emergency laparotomy patients, who (after surviving the first 30 days) had an excellent probability of 1-year survival.

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