ORIGINAL ARTICLE

Colorectal cancer surgery of octogenarians in Hong Kong: who will survive?

CME

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Objective To assess the accuracy of the Association of Coloproctology of Great Britain and Ireland scoring system in predicting the 30-day mortality after surgery for colorectal cancer in Hong Kong elderly (aged 80 years or more) patients.

Design Early mortality outcome audit in a historical cohort.

Setting Queen Elizabeth Hospital, Hong Kong.

Patients All Chinese patients (aged 80 years or more) who underwent elective or emergency surgery for colorectal cancer in the Department of Surgery between January 2005 and December 2009.

Main outcome measures Receiver operating characteristic curve analyses were used to estimate the predictive ability of the score.

Results In all, 180 patients with colorectal cancer were included in this review. The overall 30-day and hospital mortality rates were 29/180 (16%) and 31/180 (17%), respectively. The Association of Coloproctology of Great Britain and Ireland score was significantly higher among patients who died within 30 days (4.2 vs 3.1, P=0.0001), and was the only independent predictor for 30-day mortality by logistic regression (P=0.009; odds ratio=2.555; 95% confidence interval, 1.277-4.932). The mean score of this study population was 3.22 (median, 3.10), giving a predicted 30-day mortality rate of 16.0 to 17.4%, which corresponded with an observed 30-day mortality of 16.1% encountered in this study. The score had a significantly larger area under the curve for the 30-day mortality rates (odds ratio=0.811; 95% confidence interval, 0.722-0.849) as compared to the American Society of Anesthesiologists score (0.664; 0.589-0.735) [P=0.0001].

Conclusion The Association of Coloproctology of Great Britain and Ireland scoring system can accurately predict the 30-day mortality rate of elderly Hong Kong Chinese patients (aged 80 years or more) operated on for colorectal cancer.

New knowledge added by this study

- This is the first external validation of the Association of Coloproctology of Great Britain and Ireland score in predicting 30-day postoperative mortality in Chinese elderly (Hong Kong) patients with colorectal cancer who underwent colorectal surgery.

Implications for clinical practice or policy

- It will supplement or even replace the current preoperative assessment score such as the American Society of Anesthesiologists class for patients with colorectal cancer who will undergo colorectal surgery. It will give the physician in-charge to counsel the patients preoperatively, and performing audit activities and health care resource allocation.

Key words
Aged, 80 and over; Colectomy; Colorectal neoplasms; Survival rate

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Introduction

Colorectal cancer is the second commonest cause of cancer-related death in western countries and the most common malignancy in patients aged 70 years or older.[1,2] In Asia, colorectal cancer is now the third most common malignant disease in both men and women, and mortality from it is increasing.[3] According to the Hong Kong Hospital Authority Cancer Registry, its incidence has increased from 40 cases per 100 000 men in 1992 to 60 cases per 100 000 men in 2002.[4] In 2011, the median age of the population of Hong Kong was 40.7

years, of whom 12.8% were aged 65 years or above. Additionally, recently estimated life expectancy was 80 years for males and 86 years for females, compared to 79 years for males and 85 years for females (in 2005). As the population grows older, the number of patients aged 80 years or above afflicted with colorectal cancer is also expected to increase. Scoring systems for predicting early outcomes after surgery are valuable, especially for elderly preoperative counselling, resource allocations, and audits. In 2003, the Association of Coloproctology of Great Britain and Ireland (ACPGBI) developed their own scoring system for surgical patients with colorectal cancer.[5] The aim of the current study was to review the early patient outcomes and to assess the validity of the ACPGBI mortality-prediction model in Chinese patients with colorectal cancer who were 80 years old or older, and had undergone colorectal surgery.

八十歲以上老年人的大腸癌手術：誰將會生存？

目的 評估英國與愛爾蘭結直腸協會（ACPGBI）結直腸癌評分系統對於預測八十歲或以上香港老年人進行大腸癌手術後30天死亡率的準確性。

設計 歷史隊列研究的早期死亡率審核。

安排 香港伊利沙伯醫院。

患者 2005年1月至2009年12月期間所有於本院外科部進行擇期或急診手術的八十歲或以上華籍老年人。

主要結果測量 利用ROC曲線估計ACPGBI分數的預測能力。

結果 共180名病人被納入研究範圍。30天總死亡率為16%（29/180），總醫院死亡率為17%（31/180）。30天內死亡的病人的ACPGBI分數明顯較高（4.2比3.1，P=0.0001），邏輯回歸分析亦顯示ACPGBI分數是唯一一個30天死亡率的獨立預測因子（P=0.009；比數比=2.555；95%置信區間1.277-4.932）。本研究的病人的平均ACPGBI分數3.22，中位數3.10，得出的30天死亡率預測值為16.0%至17.4%，與觀察得到的30天死亡率16.1%吻合。與美國麻醉學家學會（ASA）評分比較（比數比=0.664；95%置信區間0.589-0.735），ACPGBI分數的30天死亡率在曲線下之區域明顯較大（比數比=0.811；95%置信區間0.722-0.849）；P=0.0001。

結論 ACPGBI結直腸癌評分系統可以準確預測八十歲或以上香港老年人進行大腸癌手術後的30天死亡率。

Methods

This was a retrospective study of data collected from all Chinese patients aged 80 years or above, who underwent elective or emergency surgery for colorectal cancer in the Department of Surgery at Queen Elizabeth Hospital, which is the major acute general hospital in Kowloon, Hong Kong. Although not a teaching institution, it is the largest acute hospital in Hong Kong. It has 1850 beds and 13 clinical departments, and a total staff force of 4600. It serves a population of about 900 000 inhabitants, and deals with about one-third of all cancer patients in Hong Kong. The hospital has a full complement of services, including: 24-hour accident and emergency as well as most categories of specialist services. Data regarding patients' elective or emergency presentations, demographics, co-morbidities, American Society of Anesthesiologists (ASA) preoperative investigations, operative treatment, histopathological findings, preoperative and postoperative complications are all recorded. Patients who present with acute symptoms and are hospitalised without scheduled investigations or treatment are defined as emergency cases. If these patients underwent surgery without standard preoperative preparation, they were classified as receiving emergency operations. Resection of the cancerous colon segment was classified as a major procedure. Postoperative mortality was defined as death that occurred within 30 days of the operation. Tumour stages were classified according to the International Union Against Cancer tumour, node and metastasis categories. The tumour was defined as right-sided when located between the caecum and the left part of the transverse colon, and defined as left-sided when located in the descending colon or more distally. Splenic flexure tumours were defined as right-sided if a right colectomy was performed and left-sided when a left colectomy was performed.

In this study, a palliative procedure was defined as one with the intent to alleviate symptoms or distress but not to cure (due to suboptimal preoperative or intra-operative conditions) or disease factors (locally advance tumour). It was our policy not to employ the laparoscopic approach for emergency surgery of colorectal cancer. For elective cases too, we did not use the laparoscopic approach.

Postoperative complications, including infections, were classified as major surgical complications or major general complications. Major surgical complications were defined as anastomotic leakage or any event for which a relaparotomy was performed. Major general complications included cardiovascular events such as myocardial infarction, cardiac rhythm disturbance warranting treatment, heart failure, cerebral infarction, pulmonary embolism, respiratory failure, and renal failure. Infectious complications included pneumonia and sepsis. Postoperative mortality was defined as death that occurred within 30 days after the operation.

We calculated ACPGBI scores in accordance with the original model published in the *British Medical Journal*,[6] utilising the on-line system (www.riskprediction.org.uk/index-crc.php). The score consists of five variables that included patient age (<65, 65-74, 75-84, 85-94, or ≥95 years), the ASA class

TABLE 1. Univariate analysis of preoperative factors associated with 30-day mortality*

Preoperative parameters	Alive†	Death†	P value
Palliative surgery	25.8%	48.3%	0.019
Emergency surgery	56.9%	86.2%	0.011
Sex (male:female)	88.8%	93.3%	0.901
Activity of daily living — dependent	13.5%	38.1%	0.014
Old-age home resident	13.5%	38.1%	0.014
Inter-departmental consultation	3.0%	26.1%	<0.001
Previous laparotomy	15.2%	10%	0.287
Fever	11.1%	11.5%	0.995
Shock	3.4%	26.1%	<0.001
Presented with intestinal obstruction	9.2%	17.2%	0.201
History of malignancy	6.9%	19.8%	0.094
Medical co-morbidity	76.8%	75.9%	0.911
Left-sided tumour vs right-sided tumour	43%	44%	0.859
Procedure			
Right hemicolectomy	47.0%	44.8%	0.490
Left hemicolectomy	18.5%	17.2%	
Sigmoidectomy	2.0%	3.4%	
Partial colectomy	5.3%	6.9%	
Transverse colectomy	4.0%	3.4%	
Transverse colostomy	8.6%	10.3%	
Sigmoid colostomy	2.0%	3.4%	
Ileotransverse bypass	2.0%	10.3%	
Rectal cancer vs colonic cancer	6.6%	4.2%	0.554
Age (years)	84.4 ± 3.7	86.4 ± 4.6	0.012
Urea (mmol/L)	6.7 ± 3.8	10.8 ± 7.5	<0.001
Haemoglobin (g/L)	111 ± 21	113 ± 19	0.741
White cell count (x 10^9 /L)	8.6 ± 3.8	9.3 ± 4.2	0.402
Albumin (g/L)	35.6 ± 5.6	29.6 ± 7.3	<0.001
Creatinine (μmol/L)	86.6 ± 36.0	123.3 ± 106.9	0.001
Stage			
A	10	0	0.049
B	54	9	
C	56	7	
D	37	12	
Operation performed by specialist	64%	55.1%	0.369
Presence of heavy soiling	6.0%	13.8%	0.023
Resection of more than one organ required	7.3%	6.8%	0.392
Presence of anastomosis	66.9%	37.9%	0.017
Perioperative complication	32.5%	51.7%	0.061
Blood loss (mL)	150 ± 62	126 ± 49	0.207
Operating time (mins)	169 ± 116	209 ± 131	0.049
ACPGBI score	3.1 ± 0.9	4.2 ± 0.8	<0.001
ASA class	2.5 ± 0.6	3.0 ± 0.7	0.001

* ACPGBI denotes Association of Coloproctology of Great Britain and Ireland, and ASA American Society of Anesthesiologists

† Data are shown in No. of patients, % of patients, or mean ± standard deviation

1,2,3 or 4/5,[7] urgency of procedure (emergency, urgent, scheduled, or elective) according to the classification of the National Confidential Enquiry into Perioperative Deaths,[8] the Dukes' stage[9] and whether the cancer was resected or not. A score was assigned for each individual category selected. Finally the total score (ranging from 0-6.7) was calculated and translated into a predicted 30-day mortality (range, 0.7-86.3%). We then validated the scores by receiver operating characteristic (ROC) curve analyses to estimate the predictive ability of ACPGBI scores and the ASA classifications for assessing postoperative mortality. The area under the curve (AUC) of the ROC curve indicates the probability of concordance between the predicted probability of postoperative morbidity (or mortality) and the actual postoperative outcome. The areas range between 0.50 (chance occurrences) and 1.00 (perfect prediction). The AUCs of each scoring system were compared using MedCalc statistical software (version 11.4.4 for Windows). Regarding the univariate analysis to identify risk factors for 30-day mortality, either Student's *t* test or the Chi squared test were performed to compare continuous and categorical variables between the groups. For multivariate analyses, logistic regression by "Enter", ie the default method was used to identify any independent predictor of 30-day mortality. Any P value of less than 0.05 was considered statistically significant. Data were analysed using the Statistical Package for the Social Sciences (Windows version 13.0; SPSS Inc, Chicago [IL], US).

Results

During the study period, a total of 215 patients aged 80 years or more underwent colorectal operations at our institution, from which 180 with colorectal cancers were included in this review. Their mean age was 85 (range, 80-99) years, and the male-to-female ratio was 95:85. In these patients, the overall rate of stoma creation was 37; 64% of the operations were performed in an emergency setting. In all, 30% (54/180) of these procedures were palliative. In this series, the proportion of patients with Dukes' stage A, B, C or D tumours were 11/180 (6%), 66/180 (37%) , 62/180 (34%), and 41/180 (23%) , respectively.

In all, 15% (27/180) of the patients were older than 90 years, and their 30-day mortality was 29%. Patients were classified as either ASA class 1 (4/180), class 2 (63/180), class 3 (105/180), or class 4 (8/180). Overall complication rate was 35% (63/180) and comprised 19% (34/180) with medical complications, 10% (18/180) with surgical complications, and 6% (11/180) with combined medical and surgical complications. Overall mean blood loss was 176.2 mL (standard deviation [SD], 153.6 mL). The overall mean operating time was 147 minutes (SD, 61 minutes). The overall mean admission rates to the Intensive Care Unit (ICU) and High Dependency Unit (HDU) were 14% (26/180) and 18% (33/180), respectively. Patients having emergency operations were much more likely to be admitted to the ICU; 45% versus only 13% for elective operations (odds ratio=5.5, 95% confidence interval [CI], 2.5-12.0). The mean length of stay in the ICU was 2.1 days (SD, 1.7 days; range, 0-25 days). The overall 30-day and hospital mortality rates were 29/180 (16%) and 31/180 (17%), respectively. Right hemicolectomies were the most commonly performed procedures (Table 1). The highest 30-day mortality rates were for ileotransverse bypasses (33%), partial colectomies (30%), and colostomies (25%). According to the univariate analyses, significantly more patients died within 30 days following emergency surgery or surgery with a palliative intent (Table 1). The ACPGBI scores were significantly higher for patients who died within 30 days (4.2 vs 3.1; P=0.0001), and constituted the only independent predictor of 30-day mortality by logistic regression (P=0.009; hazard ratio=2.555; 95% CI, 1.277-4.932) [Table 2]. In this study population, the mean ACPGBI score was 3.22 (median, 3.10) and corresponded to a predicted 30-day mortality of 16.0 to 17.4% that compared the observed rate of 16.1%.

TABLE 2. Multivariate analysis for predictors of 30-day mortality

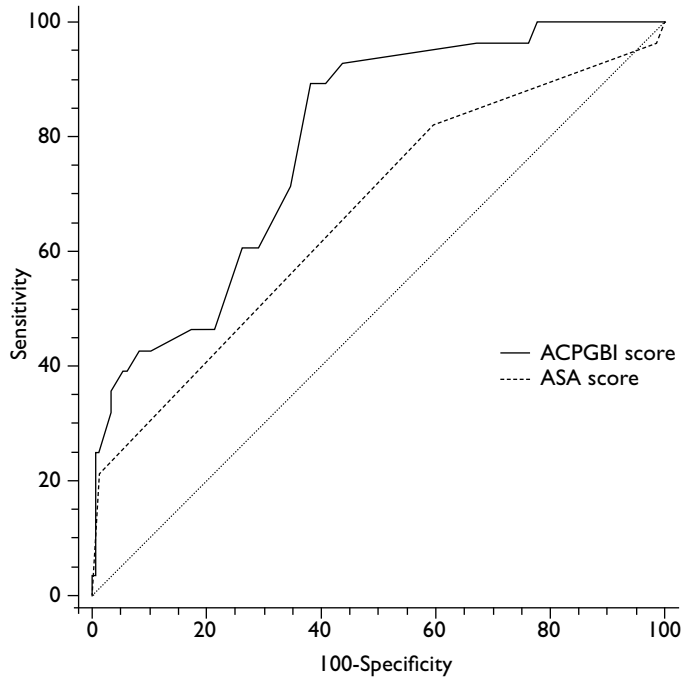
Predictor*	P value	Odds ratio	95% confidence interval for hazard ratio	
			Lower	Upper
Interdepartmental consultation	0.539	0.539	0.075	3.875
ADL dependent	0.355	1.952	0.473	8.053
Old-age home resident	0.478	1.686	0.398	1.739
Shock on admission	0.863	1.181	0.180	7.758
Urea level on admission	0.515	1.047	0.911	1.024
Albumin level on admission	0.055	0.888	0.819	1.102
Creatinine level on admission	0.210	1.010	0.995	1.025
ACPGBI score	0.009	2.555	1.277	4.932
Contamination	0.459	0.480	0.069	3.534

* ADL denotes activities of daily living, and ACPGBI Association of Coloproctology of Great Britain and Ireland

TABLE 3. Better area under the curves (AUCs) demonstrated for ACPGBI score than ASA class in predicting 30-, 60-, and 90-day mortality*

Mortality	Score	P value	AUC	95% CI
30-Day	ASA	0.004	0.664	0.589-0.735
	ACPGBI	<0.001	0.811	0.722-0.849
60-Day	ASA	0.004	0.660	0.553-0.776
	ACPGBI	<0.001	0.783	0.702-0.864
90-Day	ASA	0.009	0.636	0.533-0.739
	ACPGBI	0.004	0.762	0.687-0.852

* ACPGBI denotes Association of Coloproctology of Great Britain and Ireland, ASA American Society of Anesthesiologists, and CI confidence interval



	Area under the curve	Standard error	95% Confidence interval
ACPGBI score	0.811	0.0429	0.722-0.849
ASA score	0.664	0.0531	0.589-0.735
ACPGBI score vs ASA score			
Difference between area		0.126	
Standard error		0.0451	
95% Confidence interval		0.0376-0.214	
z Statistic		2.795	
Significance level		P=0.0052	

FIG. Comparison of receiver operating characteristic curve of ACPGBI score versus ASA score for the prediction of 30-day mortality

ACPGBI denotes Association of Coloproctology of Great Britain and Ireland, and ASA American Society of Anesthesiologists

Thus, the ACPGBI scores had yielded a significantly larger AUC for the 30-day mortality (0.811; 95% CI, 0.722-0.849) than the ASA scores (0.664; 95% CI, 0.589-0.735) [P=0.0001; Fig], and maintained their discriminatory power for 30-, 60-, and 90-day mortality rates (Table 3).

Discussion

Life expectancy in the western world is increasing, and as a result, the elderly represent a rapidly growing sector of the population in industrialised countries.[10,11] This is also the case in Asia; countries such as Japan, as well as some mainland cities, such as Shanghai, are coping with an increasingly ageing population. In Hong Kong, in the year 2023, the projected life expectancies of males and females are 82 and 87 years, respectively.[12] Consequently there will be a rapidly expanding cohort of octogenarians. In an Italian study of data from 985 surgically managed colorectal cancer patients over 10-year period at one institution, there was a significant increase in patient age (patients aged >74 years increased from 19 to 29%, and those aged >84 years doubled from 3 to 6%).[13] Therefore, the medical and societal burdens of colorectal cancer will only increase over the coming decades. Elderly patients form a very heterogeneous group with respect to their general physical status and they commonly have co-morbidities. Clinical auditing has become an important tool in surgery and is currently utilised in the process of accreditation by many health care systems. It can also been used for analysing and objectively comparing clinical activity outcomes.

We agree that clinical auditing is an essential procedure and also support the use of 30-day mortality rates as one of the most accepted endpoints in surgical performance evaluation.[14] In a recent, small retrospective study of patients aged older than 80 years with colonic cancer who underwent right hemicolectomies, 30% had emergency operations (compared to 59% in our series) and had a 30-day mortality rate of 10% (compared to 18% in our series).[15] Another retrospective review from Italy reported that 30-day mortality rates of patients 75 to 84 years of age were 6% (6/99) and that for patients older than 85 years, the rate was 20% (7/35).[16] A large, nationwide study from the Netherlands on 2765 octogenarians with colorectal cancer reported an overall 30-day mortality rate of 11%.[17] The major limitation of these 30-day mortality evaluations was that they did not take into account the patients' pathophysiological status or the complexity of surgical procedures undertaken. A risk-adjusted prediction model is needed to take account of such variations.

The ASA physical status classification system is a model for assessing the patient fitness for surgery. In 1963, the ASA adopted the five-category physical status classification system, which places normal, healthy patients on one end of the scale, and moribund patients unlikely to survive (with or without the proposed operation) at the other end. The classification system is simple to use by anaesthetists, who must assess patients peri-operatively on a daily basis. For surgical patients however, the limitations are obvious and are due to high interobserver variation, ignoring the influence of age, and inability to define systemic disease. Apart from the ASA classification, many scoring systems are now available for predicting mortality after surgical procedures. The Acute Physiology and Chronic Health Evaluation (APACHE) system is used for classifying patients in the ICU, but is considered too complex for general surgical use.[18] The Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM),[19] and its variant

Portsmouth POSSUM (P-POSSUM),[20] was devised to predict outcomes in general surgical patients. However, both of these tend to over-predict mortality after colorectal surgery.[21] Discrepancies in these models have led to the introduction of a specialty-specific POSSUM known as ColoRectal POSSUM (CR-POSSUM).[22]

In 2003, Tekkis et al[22] and the ACPGBI developed and published the ACPGBI colorectal cancer score, which has been internationally adopted and validated in a wide range of patients suffering from colorectal cancer.[6,23,24] The score was developed from data prospectively collected by the colorectal cancer study of the ACPGBI from 73 hospitals. The contributing hospitals reported a total of 8077 new cases of colorectal cancer over a 12-month period between 1 April 1999 and 31 March 2001. The primary outcome was operative mortality, defined as death occurring within 30 days of an operative procedure from whatever its cause. On multivariate analysis, the patient's age, ASA grade, urgency of the procedure, the tumour's Dukes' stage, cancer excision, and the product of ASA grade and cancer excision (interaction term) were found to be independent predictors of outcome. The derived ACPGBI colorectal cancer model is a simple additive score and results in a corresponding probability for 30-day operative mortality.[22] Its limitation was that it was based on data carefully and voluntarily collected from hospitals throughout the United Kingdom. Because the hospitals were self-selected, inferences cannot be made about how representative the outcomes might be for all hospitals. Although the model was internally validated for the study population, it still requires external validation by further prospective testing on cases in different hospitals. We choose this scoring system because it was disease specific and easy to use. Our study represents the first external validation in elderly Chinese patients. We confirmed the validity of this scoring system for predicting the early mortality for patients with colorectal cancer who undergo surgery. When compared to the ASA classification, ACPGBI was superior as a means for early mortality prediction, as shown by the AUCs of the ROC curves for 30, 60, and 90 days. Another observation was that its accuracy was preserved for up to 90 days post-surgery, which has not been reported previously.

A recent case control study by Teeuwen et al[25] compared the predictive mortality accuracy of different POSSUM scores in surgery performed for malignancies, inflammatory bowel diseases and diverticulitis in acute and elective settings. They also compared these to the ACPGBI scores for malignancies. They showed that all POSSUM, P-POSSUM, and CR-POSSUM scores were higher in patients with carcinoma than in those with diverticulitis, while the observed mortality rates were comparable. The ACPGBI scoring was determined to be superior in predicting mortality after colorectal cancer treatment for both elective and acute interventions. This finding is consistent with the current literature.[26,27]

Nevertheless there were a number of limitations in this study. First, there was a certain degree of overlapping of prognostic factors analysed and ACPGBI score. Hence we deliberately excluded the five factors from ACPGBI score from our logistic regression analysis. Moreover, the Pearson correlation coefficient between the ACPGBI and ASA scores was +0.667 $P<0.001$. Second, being a retrospective study, variables like histopathological details and smoking habits of all patients could not be retrieved from the hospital notes. Third, there were only 29/180 (16%) who died, for which reason statistical power was obviously inadequate to examine more than two covariates in the multivariate analysis, which also explains the very wide CIs in Table 2.

According to their official website, the ACPGBI scoring system was updated in 2010, but the corresponding data have yet to be published in a peer-reviewed journal. In the future, comparison of the old and new system in a larger, multi-centre population-based audit in Hong Kong would be of interest.

In conclusion, the ACPGBI scoring system can accurately predict the 30-day mortality of elderly Chinese patients in Hong Kong who undergo surgical treatment for colorectal cancer. Additionally, it appears that the system's use extends beyond the initial 30 days.

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