EUROPEAN JOURNAL OF CANCER 43 (2007) 2285–2294

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The United Kingdom National Bowel Cancer Project – Epidemiology and surgical risk in the elderly

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ARTICLE INFO

Article history:
Received 8 May 2007
Received in revised form 13 June 2007
Accepted 20 June 2007
Available online 2 August 2007

Keywords:
Surgical risk
Colorectal cancer
Elderly

ABSTRACT

Objective: To evaluate the epidemiology and risk of surgery in the treatment of colorectal cancer in the elderly.

Methods: Patients undergoing colorectal cancer surgery were identified from the Association of Coloproctology of Great Britain and Ireland (ACPGBI) bowel cancer database, comprising 47,455 patients treated over a 5-year period. Demographic characteristics and outcomes were compared between patients aged <75 and those 75 or above. The primary endpoint was 30-day mortality. Secondary endpoints were the length of hospital stay, abdominoperineal excision (APER) rates and lymph node harvest.

Results: Elderly patients were likely to be female and have higher American Society of Anaesthesiology (ASA) grade, while Dukes' stage was lower. They underwent surgery less often (81% versus 88%, $p < 0.001$), but more frequently needed urgent or emergency procedures ($p < 0.001$) and non-excisional surgery (7.7% versus 6.6%, $p < 0.001$). Operative mortality was significantly higher for the older age group (10.6% versus 3.8%, $p < 0.001$), and their median length-of-stay was 2 days longer ($p < 0.001$). Mortality has improved over time for elderly patients with ASA grade III, and Dukes' stage A and D disease, but not for other subgroups.

Conclusion: Significant differences in the demographic characteristics and operative risk-factors between under-75s, and those aged 75 or above exist. These variations are reflected in the inferior outcomes experienced by elderly patients.

1. Introduction

Colorectal cancer is among the most common malignancies in Europe,[1] and is the third most commonly diagnosed cancer and third leading cause of cancer-related deaths (for both genders) in the United States.[2] The incidence of colorectal cancer (CRC) increases with advancing age, with more than 90% of patients being diagnosed after the age of 55.[3] As a result of an aging population in developed countries the management and outcome of CRC in the elderly population is becoming an increasingly important issue.

When assessed as a potential predictor of outcome, age has not been shown to have an effect on the long-term cancer-specific survival of patients with CRC.[4,5] However, postoperative morbidity and mortality following surgical resection for CRC have been shown to be significantly higher in those over 70 years of age compared with younger patients.[6] In another study, in-hospital mortality for patients over 85

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0959-8049/$ - see front matter
doi:10.1016/j.ejca.2007.06.009

years of age was shown to be nine-times as high as that for those aged 65 and under.[7] Additional factors that were previously identified to have significant bearing on colorectal cancer mortality include American Society of Anesthesiology (ASA) grade, operative urgency (emergency or elective), metastatic disease, no cancer excision versus resection,[8] existing chronic obstructive airway disease and past history of thromboembolic disease.[9]

Survival is frequently considered to be the most important end-point of studies addressing patients with CRC.[10] However, functional results after surgery, as well as quality of life (QoL) have gained prominence in recent years. Many studies have suggested that the QoL of stoma patients is worse than that for non-stoma patients,[11,12] while others suggested the converse to be true[13,14] or identified no difference.[15,16] The nature of the operative procedure performed may therefore be important in QoL, as well as oncological in terms.

The purpose of the present study was to examine the epidemiology and risk of surgery for elderly patients undergoing colorectal surgery by reviewing data over a five-year period across hospitals in Great Britain and Ireland.

2. Methods

2.1. Data source

Data on newly diagnosed patients with colorectal cancer were extracted from the Association of Coloproctology of Great Britain and Ireland (ACPGBI) bowel cancer database, comprising information from patients with bowel cancer diagnosed between March 31st, 2000 and April 1st, 2005. Participation in this multicentre study was voluntary and its conduct has been described previously.[17] Data were collected locally by data managers dedicated to colorectal cancer or by participating surgeons, using the standardised ACPGBI Dataset[18] on all new patients presenting locally with a new diagnosis of colorectal cancer. Electronic media were used to submit data centrally and information was recorded on a Microsoft® Access 2000 database (Microsoft® Corporation, Seattle, USA). This proforma-style entry system minimised the potential for variability in the submissions. Data submitted were extensively checked for missing values, and values which were out of range or inconsistent between data fields.

2.2. End-points

The primary endpoint considered was the 30-day mortality rate and represents the proportion of patients dying within 30 days of the date of their surgery from all causes, whether death occurred as an inpatient or following discharge. Secondary endpoints compared were[1] the length of post-operative hospital stay (defined as the number of days between the date of surgery and the date of hospital discharge),[2] the abdominoperineal excision (APER) rate (the number of APERs performed divided by the sum of APERs, anterior resections and Hartmann's procedures for tumours located in the rectum or rectosigmoid junction), and[3] the proportion of excised cancers in which the reported lymph-node yield was 12 or more. APER rate and lymph node yield have been identified as surrogate end-points by the National Institute for Clinical Excellence (NICE), UK, in their guidelines for improving the outcomes in colorectal cancer surgery.

2.3. Risk factors and definitions

Patients were divided into two age groups,[1] those younger than 75 years of age at the time of surgery and[2] those aged 75 or above. Risk factors for operative mortality following colorectal cancer surgery, which have previously been identified in relation to the general population[17] and specifically in elderly patients,[8] were compared between the two age-groups overall, and for the subgroup of those undergoing APER, anterior resection (AR) or Hartmann's procedure (HP) for rectal and rectosigmoid cancer. The impact of 'the year' in which surgery was performed on the demographic characteristics and operative mortality, stratified by operative risk factors, was assessed for elderly patients. Comorbidity was assessed by the American Society of Anaesthesiology (ASA) grade,[19] tumour stage defined by the Turnbull modification to Dukes' classification,[20] and operative urgency classified into elective, urgent and emergency according to the National Confidential Enquiry into Perioperative Death (NCEPOD).[21] Postoperative (pathological) staging was used in patients who underwent surgery, while the stage for those not undergoing surgery was clinical/radiological. In comparing the procedure performed between the two age groups of interest, operations for all tumours up to the splenic flexure were considered as a single group and termed 'right-sided' resections.

2.4. Statistical analysis

Categorical data such as gender were compared between groups using the χ^2 test or Fisher's exact test as appropriate. The length of post-operative hospital stay was compared using the Mann–Whitney U test and trends within ordered categorical data, and over time, were assessed using the χ^2 test for trend (γ correction). Multivariate logistic regression analysis was undertaken to identify those factors that may be significant predictors of 30-day mortality, and length of hospital stay (categorised into normal and extended hospital stay with the cut-off point set at the 75th centile for each operative procedure across the study population).

2.5. Statistical software

The following software packages were used for the statistical analysis: Statistical Package for the Social Sciences, version 14 for Windows (SPSS®, Chicago, Illinois, USA) and Microsoft® Excel (Microsoft® Corporation, Seattle, USA).

3. Results

There were 47,455 patients extracted from the ACPGBI colorectal cancer database diagnosed with colorectal cancer between April 2000 and March 2005. Of these 21,030 (44%) were aged 75 or above. The rate of patients undergoing surgery of any kind for their cancer was significantly higher for patients below 75 compared to those aged 75 and above (88% versus 81%, $p < 0.001$). Overall 40,349 patients (85%) underwent surgery. Further analysis considered only those patients undergoing surgery for colorectal cancer.

3.1. Overall comparisons

There were significant differences in the demographic characteristics and operative risk-factors between those aged less than 75 years, and those aged 75 or above (Tables 1 and 2). The proportion of female patients undergoing surgery in the elderly group was significantly higher, as was the comorbid status of elderly patients assessed by the ASA grade, with 39% of older patients being classified as ASA III compared to 21% of younger patients ($p < 0.001$). Male patients were less likely to undergo major surgery for colorectal cancer. Generally, the stage of disease for elderly patients undergoing surgery was lower than that of younger patients, and those with metastatic disease (Dukes' D) made up 15% of the younger patient group compared with 13% of the elderly ($p < 0.001$). Older patients were, however, more likely to undergo urgent or emergency surgery ($p < 0.001$) and also more likely to undergo a procedure in which the primary cancer was not excised (7.7% versus 6.6%, $p < 0.001$). There were statistically significant differences between the two age groups for all operations apart from palliative bypass ($p = 0.065$). Right-sided resection, Hartmann's procedure, transanal endoscopic microsurgery (TEM), tranasanal resection of tumour (TART), colonic stenting and defunctioning stoma formation were all more common for elderly patients ($p < 0.001$ for each), while other procedures including abdominoperineal exision of rectum and anterior resection formed a larger part of the surgical workload for younger patients.

When overall outcome measures were compared between the two groups, 30-day mortality was found to be significantly higher for the older age group (10.6% versus 3.8%, $p < 0.001$). The median (25th, 75th centile) length of stay for patients aged 75 and above undergoing surgery for colorectal cancer was 12[9,19] days compared to 10[8,14] for those <75 years ($p < 0.001$) and when patients undergoing excision of their cancer were considered, the proportion found to have a lymph-node yield of 12 or more was significantly higher for younger, compared with older patients (46% versus 41%, $p < 0.001$).

When trends in demographic characteristics and outcomes were assessed over time for those aged 75 or above, no significant variation in gender ($p = 0.176$), ASA grade (0.222) or Dukes' stage ($p = 0.139$) was demonstrated. A trend towards a higher rate of emergency surgery was identified with the proportion of urgent or emergency procedures increasing from 23.6% in 2000–2001 to 25.1% in 2004–2005 ($p < 0.001$), while the number of cases in which the cancer was not excised rose over the same period from 6.6% to 9.7% ($p < 0.001$). In terms of operative outcomes, the mortality rate for elderly patients fell from 11.4% to 9.6% ($p = 0.035$) while the proportion of excised tumours for which the lymph-node yield was 12 or more rose from 43% to 46% ($p < 0.001$).

Trends in mortality rates are highlighted in Table 3. As would be expected from the mortality prediction models, the mortality rate rose significantly with increasing stage of disease, ASA grade and as the surgery became more urgent within each year of analysis. Significant falls in 30-day mortality were identified for patients with Dukes' A (6.7–3.2%, $p = 0.004$) and Dukes' D disease (21.7–13.2%, $p = 0.005$) but not other stages. Only those classed as ASA grade III benefited

Table 1 – Comparison of demographic and outcome data between those patients under 75 years and those aged 75 and above undergoing surgery for colorectal cancer 2000–2005

	Age <75 ($n = 23,232$)	Age >/=75 ($n = 17,117$)	p Value
Gender			**<0.001**
Male	13,631 (59)	8455 (50)	
Female	9355 (41)	8366 (50)	
Missing	246	296	
ASA grade			**<0.001**[a]
I	4065 (25)	793 (7)	
II	8554 (52)	5280 (46)	
III	3402 (20)	4489 (39)	
IV/V	505 (3)	830 (8)	
Missing	6706	5725	
Dukes' stage			**<0.001**[a]
A	2835 (14)	1912 (13)	
B	7025 (35)	5984 (42)	
C	6996 (35)	4790 (33)	
D	3056 (16)	1826 (12)	
Missing	3320	2605	
Mode of surgery			**<0.001**[a]
Elective	16,636 (81)	11,494 (76)	
Urgent	2045 (10)	1806 (12)	
Emergency	1895 (9)	1721 (12)	
Missing	2656	2096	
Operation			
Right-sided	5980 (26.8)	6020 (36.6)	**<0.001**
Left hemicolectomy	1490 (6.7)	980 (6.0)	**0.002**
Sigmoid colectomy	2102 (9.4)	1467 (8.9)	**0.049**
Anterior resection	6733 (30.1)	3539 (21.5)	**<0.001**
APER	1868 (8.4)	961 (5.8)	**<0.001**
Hartmann's	1136 (5.1)	1106 (6.7)	**<0.001**
(Sub)total colectomy	728 (3.3)	435 (2.6)	**<0.001**
TEMS/TART	265 (1.2)	308 (1.9)	**<0.001**
Stent	68 (0.3)	98 (0.6)	**<0.001**
Bypass	146 (0.7)	130 (0.8)	0.065
Stoma only	711 (3.2)	632 (3.8)	**<0.001**
Other	1124 (5.0)	776 (4.7)	0.080
Missing	881	665	
Cancer excised?			**<0.001**
Yes	20,588 (93)	14,998 (92)	
No	1444 (7)	1254 (8)	
Missing	1200	865	
Thirty day mortality?			
Yes	865 (4)	1762 (11)	**<0.001**
No	21,739 (96)	14,902 (89)	
Missing	628	453	
Length of stay			
Median (25th, 75th centile)	10 (8, 14)	12 (9, 19)	**<0.001**[b]
LN yield >/=12	7469 (46)	4940 (41)	**<0.001**

Values represent numbers of patients with percentages in parentheses.
p values represent Fisher's exact test unless stated.ASA, American Society of Anesthesiologists; APER, abdominoperineal excision of rectum; TEMS, transanal endoscopic microsurgery; TART, transanal resection of tumour; LN, lymph node.
a χ^2 test.
b Mann–Whitney U test.

Table 2 – Demographic characteristics over time for patients aged 75 or over undergoing surgery for colorectal cancer 2000–2005

	Year of surgery					*p* Value[a]
	2000–2001 *n* = 3087	2001–2002 (*n* = 3736)	2002–2003 (*n* = 3975)	2003–2004 (*n* = 3650)	2004–2005 (*n* = 2669)	
Gender						
Male	1433 (51)	1884 (51)	1997 (50)	1840 (51)	1301 (49)	0.176
Female	1393 (49)	1826 (49)	1973 (50)	1806 (49)	1368 (51)	
Missing	261	26	5	4	0	
ASA grade						
I	203 (9.9)	159 (5.9)	168 (6.2)	159 (7.0)	104 (6.2)	0.222
II	953 (46.6)	1223 (45.5)	1235 (45.5)	1086 (47.8)	783 (46.9)	
III	742 (36.3)	1098 (40.8)	1101 (40.6)	890 (39.2)	658 (39.3)	
IV/V	147 (7.2)	210 (7.8)	210 (7.7)	135 (5.9)	128 (7.7)	
Missing	1042	1046	1261	1380	996	
Dukes' stage						
A	313 (12.1)	458 (13.9)	450 (13.4)	370 (12.5)	321 (13.8)	0.139
B	1033 (40.0)	1392 (42.3)	1316 (39.3)	1283 (43.2)	960 (41.3)	
C	878 (34.0)	1077 (32.8)	1107 (33.1)	978 (32.9)	750 (32.2)	
D	359 (13.9)	360 (11.0)	474 (14.2)	338 (11.4)	295 (12.7)	
Missing	504	449	628	681	343	
Mode of surgery						
Elective	2222 (76.4)	2687 (77.8)	2730 (78.0)	2165 (74.6)	1690 (74.8)	**<0.001**
Urgent	578 (19.9)	355 (10.3)	345 (9.9)	304 (10.5)	224 (9.9)	
Emergency	108 (3.7)	412 (11.9)	424 (12.1)	433 (14.9)	344 (15.2)	
Missing	179	282	476	748	411	
Tumour excised?						
Yes	2721 (93.4)	3397 (93.3)	3528 (92.9)	3055 (91.0)	2297 (90.3)	**<0.001**
No	193 (6.6)	243 (6.7)	270 (7.1)	302 (9.0)	246 (9.7)	
Missing	173	96	177	293	126	
Thirty day mortality?						
Yes	352 (11.4)	406 (10.9)	401 (10.3)	361 (10.6)	242 (9.6)	**0.035**
No	2735 (88.6)	3330 (89.1)	3505 (89.7)	3040 (89.4)	2292 (90.4)	
Missing	0	0	69	249	135	
Excised tumours with LN yield >/=12	629 (43)	951 (36)	1278 (41)	1099 (41)	983 (46)	**<0.001**

Values represent numbers of patients with percentages by year in parentheses.
ASA, American Society of Anesthesiologists; LN, lymph node.
a χ^2 test for trend (γ correction).

from a fall in 30-day mortality over time (16.4–12.5%, $p = 0.014$) while mortality for other grades did not vary significantly. Improvements in 30-day mortality for elderly patients operated on electively (8.5–5.4%, $p = 0.001$) were not matched by improvements for those requiring urgent or emergency surgery.

3.2. *Surgery for rectal and rectosigmoid cancer*

Similar variations in gender, ASA grade, Dukes' stage and mode of surgery were observed between young and elderly patients as those seen for the overall comparisons (for colorectal cancers) when only those with rectal and rectosigmoid cancer were considered (Table 4). The proportion in whom Hartmann's procedures were performed was almost twice as high in the elderly group compared to the patients aged under 75 (19.7% versus 11.7%, $p < 0.001$) with the number of anterior resections and APERs being proportionately lower in the elderly group. The 30-day mortality rate was significantly higher for elderly patients (9.1% versus 2.6%, $p < 0.001$) and there were marked differences in postoperative length of stay with the median (25th, 75th centile) length of stay being 11[9,15] days for those aged less than 75 compared to 18[14,34] for the elderly ($p < 0.001$).

There was no significant variation in gender, ASA grade and Dukes' stage over time for elderly patients undergoing surgery for rectal and rectosigmoid cancer (Table 4) while the proportion of elective procedures fell from 85% in 2000–2001 to 82% in 2004–2005 ($p = 0.004$). Mortality in 2004–2005 (7.1%) was significantly lower than that in 2000–2001 (10.7%, $p = 0.009$). The amount of missing data also increased over time, with 135 missing entries from the 2004–2005 period, compared with none in 2000–2001. As a proportion of the overall data, however, the number of missing data entries was not significant and should not have affected the analysis.

When the mortality, stratified according to operative risk factors, over time following rectosigmoid excision was analysed (Table 5) the trends were similar to those for the overall

Table 3 – Thirty-day mortality by Dukes stage, ASA grade and mode of surgery by year for patients aged 75 or above undergoing colorectal cancer surgery (patients with missing data excluded)

	Year of surgery					*p* Value[a]
	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	
Dukes' stage						
A	21 (6.7)	39 (8.5)	15 (3.3)	18 (5.1)	10 (3.2)	**0.004**
B	96 (9.3)	120 (8.6)	127 (9.7)	127 (10.5)	78 (8.5)	0.686
C	91 (10.4)	123 (11.4)	106 (9.6)	102 (11.0)	75 (10.4)	0.880
D	78 (21.7)	64 (17.8)	78 (18.8)	51 (15.8)	36 (13.2)	**0.005**
(*p* value within year)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	
ASA grade						
I	11 (5.4)	7 (4.4)	4 (2.5)	10 (7.4)	2 (2.0)	0.569
II	64 (6.7)	87 (7.1)	61 (5.1)	69 (6.6)	41 (5.4)	0.219
III	122 (16.4)	150 (13.7)	157 (14.5)	100 (11.6)	79 (12.5)	**0.014**
IV/V	53 (36.1)	67 (31.9)	61 (29.0)	46 (35.7)	41 (33.6)	0.857
(*p* value within year)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	
Mode of surgery						
Elective	188 (8.5)	216 (8.0)	169 (6.3)	162 (7.7)	90 (5.4)	**0.001**
Urgent	119 (20.6)	72 (20.3)	79 (23.5)	53 (17.7)	48 (21.4)	0.913
Emergency	31 (28.7)	97 (23.5)	99 (23.6)	80 (23.5)	69 (26.7)	0.872
(*p* value within year)	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	

Values represent number of patients dying within 30 days of surgery from any cause, with percentages in parentheses.
ASA, American Society of Anesthesiologists.
a χ^2 test for trend (γ correction).

group, with improvements seen between 2000–2001 and 2004–2005 for Dukes' A (7.7–1.8%, $p < 0.001$) and Dukes' D patients (25.0–7.4%, $p = 0.009$), those classified as ASA III (18.4–9.3%, $p = 0.026$) and elective surgery (8.9–4.1%, $p = 0.003$). Other risk-factor subgroups demonstrated no significant reduction in mortality rates. Although there appeared to be a trend towards a reduced mortality rate over time for AR, APER and elective Hartmann's procedures (Table 5), these failed to achieve statistical significance, while the mortality following urgent or emergency Hartmann's procedures in elderly patients remained poor across the period of study at around 25%.

APER rate did not differ significantly between elderly and younger patients over the period of study (Table 6), with the overall ratio between AR and APER being maintained, while the proportion of Hartmann's procedures rose for elderly patients (Table 4). In both age groups, though, falls in APER rates over time were identified (Table 6) with a fall of 25.0–18.5% seen for younger patients ($p < 0.001$) and a reduction from 28.8% to 17.0% for those aged 75 or above ($p < 0.001$). APER rates are regarded as a marker of the quality of resection in colorectal cancer, with inferior oncological outcomes from APERs having been reported,[22] and better training leading to a reduction in the number of APERs performed.[23]

3.3. *Risk factors affecting mortality and length of stay (Table 7)*

Multivariate analysis of risk factors affecting 30-day mortality in patients having surgery for colorectal cancer identified age, urgency of surgery, Dukes' D cancer versus Dukes' A cancer, whether or not cancer excision was attempted during surgery and increasing ASA grade as significant predictive factors. For length of stay, age, urgency of surgery and increasing ASA grade were found to be significant predictors of prolonged post-operative stay.

4. Discussion

In examining 47,455 patients over a 5-year period, this study has illustrated how patients aged 75 and older were less likely to undergo surgery at all, and excision of the primary tumour in particular, compared with their younger counterparts. A greater number of the elderly patients were classified ASA III or IV. The stage of disease was also lower compared with younger patients, with Dukes' A and B tumours making up the majority of resections. This is likely to reflect a selection process, with a lower tendency to operate on patients who are very elderly, with significant co-morbidities and higher stage disease, and as a result, a greater risk of in-hospital mortality[24,8,25–27] The risk associated with radical surgery may be regarded as unacceptable, not least in a group in whom surgery for metastatic disease is unlikely to be offered, with greater emphasis being placed on alternatives such as medical and radiological palliation as well as colonic stenting procedures. These alternatives have been shown to be effective and offer reasonable function and quality-of-life (QoL).[14,15,27–30] Colonic stenting in particular may be a useful 'bridge to surgery' in those presenting acutely with obstructing disease, whose acute physiological and biochemical states may be amenable to medical management and optimisation for later consideration of excisional surgery, should full staging investigations prove favourable.

The present study also suggested that patients under 75 years of age were more likely to undergo elective surgery for colorectal cancer (CRC) than over-75s. Over 75s are signifi-

Table 4 – Comparison of demographic characteristics and outcomes between patients <75 years and those 75 and above undergoing AR, APER or Hartmann's procedure for rectal and rectosigmoid cancer between 2000 and 2005

	Age < 75 (n = 9737)	Age < 75 (n = 5606)	p Value
Gender			**<0.001**[a]
Male	6139 (64)	3055 (55)	
Female	3485 (36)	2452 (45)	
Missing	113	99	
ASA grade			**<0.001**
I	1956 (26.6)	321 (8.0)	
II	3922 (53.4)	1993 (49.8)	
III	1309 (17.8)	1469 (36.7)	
IV/V	163 (2.2)	217 (5.4)	
Missing	2287	1606	
Dukes' stage			**<0.001**
A	1692 (19.2)	951 (18.4)	
B	2907 (32.9)	1977 (38.3)	
C	3251 (36.8)	1795 (34.8)	
D	978 (11.1)	439 (8.5)	
Missing	909	444	
Mode of surgery			**<0.001**
Elective	1999 (89.4)	4350 (84.3)	
Urgent	499 (5.6)	403 (7.8)	
Emergency	451 (5.0)	408 (7.9)	
Missing	788	445	
Operation performed			**<0.001**
AR	6733 (69.1)	3539 (63.1)	
APER	1868 (19.2)	961 (17.1)	
Hartmann's procedure	1136 (11.7)	1106 (19.7)	
Thirty day mortality?			**<0.001**[a]
Yes	244 (2.6)	499 (9.1)	
No	9253 (97.4)	4981 (90.9)	
Missing	240	126	
Length of stay			
Median (25th, 75th centile)	11 (9, 15)	18 (14, 34)	**<0.001**[b]

Values represent numbers of patients with percentages by year in parentheses.
p = values represent χ^2 test except.ASA, American Society of Anesthesiologists; AR, anterior resection; APER, abdominoperineal excision of rectum.
a Fisher's exact test.
b Mann–Whitney U test.

cantly more likely to undergo emergency operations ($p < 0.001$). Existing co-morbidities may make radical/curative surgery a risky undertaking, taking into account the 10.6% 30-day mortality in this age group. Over-75s have been shown to be less likely to undergo preoperative irradiation and neo-adjuvant chemotherapy,[25] potentially reducing the likelihood of a successful curative resection. In addition, in the event that elderly patients should require management in Intensive Care (ITU) postoperatively, it has been noted that their risk of additional complications such as anastomotic leakage is significantly higher.[31] Radical surgery may not be the treatment of choice in this age group, with post-operative function and QoL, rather than cancer cure, being of relatively greater importance.[32–35] If medical palliation, expectant management and colonic stenting for CRC are performed in favour of surgery, then this patient group will inevitably present as emergencies should their disease progress, and this may in part be reflected in the present results. One study has suggested that very elderly patients are themselves likely to request less radical surgery and decline chemo/radiotherapy.[36] Many of these patients who decline surgery may not present again to surgical teams, rather, being cared for (by their own choice) by palliative care physicians who can address their need for blood transfusions, analgesia and other holistic care.

Some studies have suggested that age alone is not the primary influence on the outcome after surgery for colorectal cancer, but rather that comorbid status and an impaired physical capacity to recover from adverse events that may occur before, during and after surgery play an important role.[4,5,34,37–39] In fact, 5-year cancer-specific survival is similar regardless of age group[25,40–43] (Table 8). Age, however, has been shown to be an independent predictor of operative and in-hospital mortality,[7,17,24,39,44] especially in the emergency setting.[45,46] This is also evidenced in this study by an almost threefold increase in 30-day mortality when comparing under-75s to over-75s (3.8% versus 10.6%; $p < 0.001$). The choice of operation may also be influenced by this knowledge, with fewer abdomino-perineal resections (APERs) and anterior resections (ARs) performed in over-75s compared with under-75s, but more Hartmann's procedures performed ($p < 0.001$). Such management strategies may reflect a perception of a reduced ability of elderly patients to withstand potential complications such as anastomotic leakage following restorative surgery.

Apart from achieving surgical cure, management of colorectal cancer must also take into account patient wishes and expectations, as well as functional outcome and QoL. In one study performed in Austria,[30] patients were asked what they felt was most important should they have CRC. Those aged 70 to 80 cited 'a complete cure' as the most important, followed by 'avoidance of stoma' and 'reliable control of defecation'. Patients aged above 80 cited 'avoidance of stoma' as most important, followed by 'a complete cure' and 'reliable control of defecation'. These were consistently the top three expectations in this age group for CRC and illustrate how the patients' expectations and priorities must be of prime concern when managing their disease, and how these priorities may vary over time.

Elderly patients often suffer with poor rectal continence following surgery.[47] Poor functional outcomes in elderly patients following low anterior resection have been attributed to low anastomoses, preoperative radiotherapy and anastomotic leaks.[48] Some degree of sphincter function impairment exists with low anterior resection.[49] Fortunately, the majority of sphincter functions improve 12–18 months after surgery.[50] Additionally, continence improves over time postoperatively, as well as the amount of minor faecal leakage, as patients learn to cope with their condition. Studies of functional outcomes following low anterior resection in elderly patients have described complete postoperative continence as ranging from 46–87%.[50–53] Elderly patients undergoing curative major surgery for CRC have been shown to more often receive a permanent stoma,[35] and these results are confirmed by the present study, in which although the overall ratio of anterior

Table 5 – Thirty-day mortality by Dukes stage, ASA grade, mode of surgery and operation by year for patients aged 75 or above undergoing AR, APER or Hartmann's procedure for rectal or rectosigmoid cancer (patients with missing data excluded)

	Year of surgery					*p* Value
	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	
Dukes' stage						
A	12 (7.7)	26 (10.7)	6 (2.9)	8 (4.7)	3 (1.8)	**<0.001**
B	35 (9.6)	41 (8.7)	40 (9.5)	38 (9.8)	24 (7.8)	0.704
C	27 (8.5)	32 (7.9)	35 (8.0)	33 (10.1)	24 (8.8)	0.536
D	24 (25.0)	12 (13.2)	19 (15.8)	9 (12.9)	4 (7.4)	**0.009**
(*p* value within year)	**0.011**	0.741	**0.003**	**0.043**	**0.010**	
ASA grade						
I	5 (7.6)	2 (2.7)	1 (1.5)	5 (10.6)	0 (0)	0.326
II	25 (6.7)	37 (8.0)	22 (5.0)	20 (5.5)	15 (4.9)	0.102
III	45 (18.4)	47 (12.9)	50 (14.5)	39 (13.2)	18 (9.3)	**0.026**
IV/V	13 (31.7)	16 (34.8)	16 (23.9)	7 (20.6)	7 (25.9)	0.193
(*p* value within year)	**<0.001**	**<0.001**	**<0.001**	**0.002**	**<0.001**	
Mode of surgery						
Elective	75 (8.9)	81 (8.1)	70 (6.8)	63 (8.1)	26 (4.1)	**0.003**
Urgent	23 (19.3)	15 (17.9)	18 (23.7)	9 (11.9)	6 (10.7)	0.141
Emergency	11 (37.9)	23 (24.7)	18 (20.0)	16 (18.6)	19 (31.1)	0.654
(*p* value within year)	**<0.001**	**<0.001**	**<0.001**	**0.013**	**<0.001**	
Operation						
AR	51 (8.2)	64 (8.2)	53 (6.4)	56 (8.3)	30 (5.4)	0.110
APER	16 (8.2)	14 (5.6)	10 (4.4)	11 (7.0)	3 (2.7)	0.133
Harmann's (elective)	17 (16.0)	17 (14.8)	14 (12.1)	10 (10.0)	7 (9.1)	0.078
Hartmann's (urgent/emergency)	25 (27.5)	29 (25.9)	30 (25.6)	17 (17.0)	18 (24.7)	0.235
(*p* value within year*)	**<0.001**	**<0.001**	**<0.001**	**0.028**	**<0.001**	

Numbers represent number of patients dying within 30 days of surgery from any cause, with percentages in parentheses.
p Value represents χ^2 test for trend (γ correction) except for * which denotes χ^2 test.ASA, American Society of Anesthesiologists; AR, anterior resection; APER, abdominoperineal excision of rectum.

Table 6 – APER rates by year comparing patients less than 75 years with those aged 75 or above

	Year of surgery					*p* Value
	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	
APER rate (%)						
Age < 75	25.0	22.0	22.8	20.2	18.5	**<0.001**
Age > /=75	23.8	24.2	21.7	19.7	17.0	**<0.001**
p Value within year*	0.276	0.088	0.250	0.212	0.220	

p Values represent the χ^2 test for trend (γ correction) except for * which denotes Fisher's exact test.
p Values represent the χ^2 test for trend (γ correction) except for * which denotes Fisher's exact test.APER, abdominoperineal excision of rectum.

Table 7 – Results of multivariate analysis comparing factors for (a) 30-day mortality and (b) length of stay in elderly patients undergoing surgery for colorectal cancer

	Odds ratio	95% CI	*p* Value
(a) Multivariate analysis – mortality			
Age	2.62	2.13–3.22	<0.001
Urgency of surgery	3.17	2.55–3.94	<0.001
Dukes 'C/D' versus 'A/B'	1.32	1.09–1.59	0.004
Cancer excision	0.72	0.55–0.94	0.018
ASA IV/V versus I/II	2.03	1.70–2.43	<0.001
(b) Multivariate analysis – length of stay			
Age	1.77	1.60–1.95	<0.001
Urgency of surgery	1.81	1.48–2.22	<0.001
Duke's stage	1.01	0.87–1.17	0.913
Cancer excision	0.89	0.69–1.15	0.369
ASA IV/V versus I/II	1.52	1.32–1.76	<0.001

Table 8 – Results of other studies comparing demographic characteristics and outcomes of surgery between young and elderly patients undergoing surgery for (colo)rectal cancer

Author	Year	Age groups	*n*	Location	Gender (%)	Stage	Palliative surgery (%)	Comorbidity	Emergency presentation (%)	Thirty-day mortality (%)	Morbidity (%)	5YS (%)	CSS (%)
Colorectal													
Payne et al.[41]	1986	<75	710	None	–	NSD	–	–	**4.1**	**3**		**42**	**55**
		>/=75	310						**7.4**	**9**	[b]	**30**	**50**
Irvin[33]	1988	<70	135	None	–	NSD	NSD	–	NSD	3	–	[b]	–
		>/=70	171							9			
Arnaud et al.[43]	1991	<80	1571	None	–	NSD	NSD	–	**5.8**	**5**	–	**46.2**	49.5
		>/=80	163						**17**	**15.3**		**35**	41.2
Kashtan et al.[54]	1992	</=70	114	–	–	–	–	–	–	1.8	–	–	–
		>70	170							2.4			
Mulcahy et al.[4]	1994	<70	287	–	–	NSD	NSD	–	11	3	–	45[a]	–
		>/=70	225						18	6		52	
Demetriadis et al.[55]	2004	</=75	115	None	–	NSD	–	–	–	–	–	77.5	–
		>75	21									35	
Rectal													
Puig-La Calle et al.[5]	2000	<75	174	–	–	[b]	All curative	–	–	0.6	36	**66**	71
		>/=75	157							1.3	34	**51**	69
Vironen et al.[40]	2004	<75	199	–	F = 51	NSD	NSD		3	0.5	25	**65**	70
		>/=75	95		F = 61			[b]	5	3.5	32	**43**	60
Endreseth et al.[35]	2006	65–74	2086	–	–	NSD	**23**	–	–	**3**	–	**51**	–
		75–79	1223				**28**			**3**		**38**	
		80–84	949				**34**			**7**		**28**	
		>/=85	617				**53**			**8**		**14**	
Law et al.[42]	2006	</=75	479	–	**F = 37**	NSD			–	NSD	30.1	**70.1**	75.4
		>75	133		**F = 52**			[b]			36.8	**47.7**	67.5
Shahir et al.[6]	2006	<70	182	–	**F = 36**	NSD			NSD	–	**51**	**70**	–
		>/=70	244		**F = 50**			[b]			**65**	**44**	

NSD, no significant difference; 5YS, 5-year survival; CSS, 5-year cancer specific survival.
Bold type indicates statistically significant difference in the original paper.
a Result standardised for age/gender.
b Demographic characteristic/outcomes of interest significantly higher in indicated group.

resections to APERs was maintained over time and between younger and older patients, the rate with which Hartmann's procedures was performed was significantly higher for the 75 and over group. Studies on QoL after stoma creation in elderly patients have yielded mixed results. Avoidance of a stoma is certainly one of the main considerations in surgery for CRC. Whether the presence of a stoma is preferable to semi-continence or a high frequency of bowel movements is open to question, and may depend largely on patients' pre-morbid state of health, especially with regards to eyesight, hand-eye coordination and mobility.

This study presents demographic and outcome data of 47,455 patients with colorectal cancer in the United Kingdom between 2000 and 2005. Comparison with previous studies shows the present demographic characteristics and short term outcomes to be consistent with previously published results (Table 8) but, due to the short period of the existing follow-up from the ACPGBI National Bowel Cancer Audit, comparisons of survival and local recurrence cannot currently be made. In addition, since participation in this study was voluntary, selection bias could have been introduced to the results. Up to 30% of entries did not report ASA grade, and although this improved significantly by 2004–2005, this affects our knowledge of patient co-morbidity in this audit, and thus potentially the analyses. This may reflect the uncertainty of a patients' ASA grade as assessed by the anaesthetists. It may be helpful to assess and enter co-morbidities by the system in future.

5. Conclusion

Elderly patients are less likely to undergo major surgery for colorectal cancer, especially if they are male. In over-75s, Dukes' C and D cancers are less likely to be resected, and more likely to undergo emergency surgery. More Hartmann's procedures are performed in over-75s than in younger patients. The 30-day mortality in patients over 75 being three times as high. Although this study did not contain long-term survival data, the review of the literature suggests no difference in cancer-specific survival in either age group. Functional outcome and QoL must be considered with surgical cure in managing CRC in the very elderly.

Conflict of interest statement

None declared.

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