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Management of colorectal cancer in three South Thames District Health Authorities

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This study describes the management of colorectal cancer, diagnosed in 1988, of residents in three South Thames Districts.

Of the 328 cases identified as having being diagnosed in 1988, case notes were retrieved on 263 (80%) including 62 registered by death certificate only. There were 159 cases (61%) of colon cancer and 104 cases (39%) of rectal cancer. Of these, 172 cases (68%) were admitted electively and 90 (32%) as emergencies. Patients subsequently diagnosed with colon cancer had a relative risk of being admitted through emergency (relative to rectal cancer patients) of 1.39 (95% C.I.: 1.16, 1.67). Elective admissions varied significantly by district of residence ($P < 0.0001$) ranging from 36–65% for colon cancers and from 63–92% for rectal cancers across the three districts. Dukes' stage was recorded in only 143 (54%) sets of case notes, with significant variation by district of residence in the proportion of elective patients for whom a Dukes' stage was indicated ($P < 0.01$).

Two-hundred and thirty-six (90%) cases received treatment. Of the treated cases, 233 patients received surgery with 29 cases of colon cancer (18%) and 32 cases of rectal cancer (31%) receiving adjuvant therapy. The proportions of anterior resection, AP resection and colostomies given, varied by district. Patients presenting for elective surgery were more likely to be treated by a consultant than patients presenting on emergency: the relative risks were 2.58 (95% C.I.: 1.74, 3.82) for colon cancer patients and 4.93 (95% C.I.: 2.20, 11.06) for rectal cancer patients. In 44 (26%) colon cancer cases and 21 (22%) rectal cancer cases it was explicitly stated that the tumour had not been fully resected.

For colon tumours the five year relative survival rates were 35% (95% C.I.: 21%, 50%), 52% (95% C.I.: 34%, 70%), and 14% (95% C.I.: −2%, 30%) in districts A, B and C respectively. The corresponding figures for rectal tumours were 45% (95% C.I.: 27%, 64%), 62% (95% C.I.: 41%, 83%) and 24% (95% C.I.: −1%, 50%).

There were wide variations in the representation, management of and survival from colorectal cancers across the three districts. Differences were significant at the level of district of residence, mode of presentation and surgical grade. More assiduous recording of Dukes' stage is imperative if consensus is to be achieved on effective management. Further work is also warranted on district differences in diagnostic and referral protocols.

Keywords: cancer; colorectal; survival; therapy

Introduction

In 1990 we used Thames Cancer Registry (TCR) data to carry out an epidemiological study of all cases of colorectal cancer diagnosed in South Thames between 1982 and 1988 ($n = 23228$).[1] The two- and three-fold district variations in survival we described were not associated with differences in incidence, indicating that there may be variation in the quality of care. To pursue this hypothesis, we conducted a retrospective case note study of the management of colorectal cancer in three of the districts, the results of which we now present.

When this study was carried out, there was no national consensus on the management of colorectal cancer. But the importance of health care factors in outcomes has long been established. Heald and Ryall[2] have demonstrated that the quality of surgical resection is associated with survival from rectal cancers. McArdle and Hole[3] found large and significant differences in patient outcome (as measured by postoperative complications, morbidity, mortality and survival) among patients treated by consultant surgeons with no special interest in colorectal cancer surgery or surgical oncology. There is conflicting evidence as to whether grade of surgeon (consultant or trainee) is associated with peri-operative complications.[4,5] Radiotherapy and chemotherapy have been shown to improve survival and prevent local recurrence of rectal cancers in recent clinical trials.[6–9] And it has also been reported that patients undergoing emergency surgery are less likely to have their tumours fully resected.[10]

Our study had two aims: (i) to describe the management of colorectal cancer in the districts under review; (ii) to test whether differences in management (investigations and treatments) and outcome (survival) were associated with district of residence, mode of admission (emergency or elective) and surgical grade (consultant or trainee).

Methods

Three South Thames districts were chosen on the basis of having recorded the highest and the lowest cumulative, relative five-year survival rates for colorectal cancer between 1982 and 1988. 1988 was selected because, when the study began in 1991, it was the most recent year for which the TCR held complete data.

Following ethics committee approval, the Thames Cancer Registry was used to identify residents of the three districts who had been diagnosed with a first primary diagnosis of colorectal cancer (ICD-9 153 and 154) occurring between 1 January and 31 December 1988 ($n = 328$) and treated within their district of residence. 94

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cases (27%) had been registered by the TCR from death certificate information alone ('DCO' registrations). We thought it unlikely that in all DCO cases there had been no contact with the hospital services and therefore requested case notes relating to these patients from hospitals within the patient's district of residence.

A structured proforma, devised in consultation with senior pathologists, clinicians and Cancer Registry staff, was used to extract the data and each set of case notes was checked twice by two doctors. Tumour site was defined by reference to the ninth revision of the international Classification of Diseases. Tumours to any area of the colon, including unspecified areas, were classified as colon tumours. Rectal tumours included tumours to the rectum, the rectosigmoid junction and non-skin tumours to the anus. Data items classified from case notes are listed in Box 1. Treatment was extracted in five categories: surgery, chemotherapy, radiotherapy, adjuvant therapy (surgery combined with chemotherapy and/or radiotherapy) and no treatment. Surgical procedures were recorded.

Box 1 Data item extracted from clinical case notes

District Health Authority of residence
Sex
Date of Birth
Date of first hospital admission in which the tumour was diagnosed
Mode of admission
Diagnostic investigations
Duke's stage
Tumour site
Morphology
Surgical procedure
Completeness of tumour resection
Colostomy/ileostomy
Chemotherapy
Radiotherapy
Survival

Retrieved cases were grouped by district of residence, tumour site (colon or rectum), mode of admission (in-patient emergency admissions were defined as such either by GPs, A and E departments or outpatients; all others were elective) and grade of operating surgeon (consultant or trainee). Evidence of district variation in the proportions of patients falling into the last three of these categories was tested using a simple chi-square test. In all cases, the null hypothesis was that there would be no differences between the groups and the test was deemed to have failed when $P < 0.05$. Further chi-square tests were carried out to measure association between these groups and measures of care (investigations, staging and treatment). For binary variables (mode of admission and surgical grade), a relative risk was used to express the magnitude of differences between groups.

Survival analysis was undertaken using the Hakulinen computer programme[11] to derive cumulative relative five-year survival rates. Relative survival is the ratio of the survival observed in a group of cancer patients to the survival expected if they were subject only to the general (all cause) mortality in the standard population. It is widely used in cancer epidemiology because it adjusts for deaths in the incident group from causes other than cancer. 95% confidence intervals were calculated.

Results

Case notes were retrieved on 263 out of 328 (80%) cases. Table 1 shows case note retrieval by district of residence and final source of registration. There was significant variation in the proportions of case notes retrieved from each district ($P < 0.001$). Retrieved cases were aged between 18 and 97 y at diagnosis, with 81% aged 60 y or over (not shown in a table). The median age at diagnosis for retrieved cases was 70.8 y (A), 70.9 y (B) and 71.4 y (C). The ratio of males to females was 0.83 (A), 0.80 (B and 1.23(C).

Table 2 lists the district of residence, mode of admission (elective or emergency) and primary tumour site of all retrieved cases. There were 159 cases (61%) of colon cancer and 104 cases (39%) of rectal cancer; the proportions of colon and rectal cancer patients were similar in all three districts, with district B showing a slightly higher percentage of rectal cancer cases (42% compared with 38% in the other two districts). 172 cases (68%) were admitted electively and 90 cases (32%) were admitted as emergencies. Most emergency admissions were subsequently diagnosed with colon cancer: the relative risk of a colon cancer patient being admitted through emergency (relative to a rectal cancer patient) was 1.39 (95% C.I.: 1.16, 1.67). Mode of admission also varied significantly by district of residence ($P < 0.0001$): the proportion of patients admitted electively ranged from 36–65% for colon cancers and from 63–92% for rectal cancers across the three districts.

Investigations

Table 3 lists diagnostic investigations by district of residence and mode of admission. Chest radiography was carried out on 183 patients (70%) and 170 (65%) patients received colonoscopy and/or barium enema. Liver ultra-

Table 1 Retrieval of case notes in DHAs A, B and C: All colorectal cancer cases listed by the TCR, 1988. By district of residence and final source of registration

DHA	Case notes		Death certs		Total retrieved	
	Retrieved	*n*	Retrieved	*n*	Retrieved	%
A	94	106	27	40	121	83
B	77	86	15	18	92	88
C	30	42	20	36	50	64
All	201	234	62	94	263	80

Table 2 Number (%) of retrieved cases. By tumour site and mode of admission

DHA	Colon		Rectum	
	Elective	Emergency	Elective	Emergency
A	49 (65)	26 (35)	32 (71)	13 (29)
B	32 (60)	21 (40)	36 (92)	3 (8)
C	11 (36)	20 (65)	12 (63)	7 (37)
All	92 (58)	67 (42)	80 (78)	23 (22)

Note: 1 patient diagnosed with rectal cancer is excluded from this table because we were unable to ascertain mode of admission.

Table 3 Colorectal cancer in three South Thames districts, 1988. Diagnostic investigations; by mode of admission and DHA of residence

Investigation	Mode of admission	A	B	C	All	P^*
Chest radiography	Elective	61 (75)	56 (82)	16 (70)	133 (77)	NS
	Emergency	23 (59)	20 (84)	16 (59)	50 (56)	NS
P^{**}		NS	NS	NS	NS	
Colonoscopy, sigmoidoscopy or barium enema	Elective	60 (71)	53 (78)	18 (78)	131 (76)	NS
	Emergency	17 (44)	11 (46)	11 (41)	39 (43)	NS
P^{**}		< 0.002	0.004	< 0.008	< 0.0001	
Liver ultrasonography	Elective	10 (12)	14 (21)	9 (39)	33 (19)	< 0.02
	Emergency	6 (7)	4 (17)	9 (33)	19 (21)	NS
P^{**}		NS	NS	NS	NS	
Dukes' stage recorded	Elective	48 (59)	35 (52)	18 (78)	101 (59)	< 0.01
	Emergency	21 (54)	9 (38)	12 (44)	42 (47)	NS
P^{**}		NS	NS	< 0.02	NS	

*The P value in this column is the result of a chi square test for differences between the three districts in the use of each investigation.
**The P value in this row is the result of a chi square test for differences by admission status in the use of each investigation.

Table 4 Number (%) of patients treated; by treatment modality and tumour site

Type of treatment	Colon cancer patients				Rectal cancer patients			
	DHA of residence				DHA of residence			
	A	B	C	All	A	B	C	All
Adjuvant therapy	9 (12)	13 (25)	7 (23)	29 (18)	9 (20)	17 (44)	6 (32)	32 (34)
Chemotherapy or radiotherapy	0 (0)	1 (2)	0 (0)	1 (1)	1 (2)	0 (0)	0 (0)	1 (1)
No treatment	9 (12)	3 (6)	4 (13)	16 (10)	5 (11)	1 (3)	5 (26)	11 (12)
Surgery only	57 (76)	36 (68)	20 (65)	113 (71)	31 (67)	21 (54)	8 (42)	60 (64)
All categories	75 (100)	53 (100)	31 (100)	159 (100)	46 (100)	39 (100)	19 (100)	94 (100)

sonography was carried out in only 33 (19%) elective cases and 19 (21%) emergency cases.

The most important outcome of investigation for colorectal cancers, Dukes' stage, was recorded in only 143 (54%) sets of case notes. We found significant variation by district of residence in the proportion of elective patients for whom a Dukes' stage was indicated ($P < 0.01$), with proportions ranging from 52% in district B to 78% in district C (Table 3). The proportions of emergency patients for whom a Dukes' stage was indicated did not vary across districts (Table 3). In total, 101 (59%) elective patients and 42 (47%) emergency patients had a Dukes' stage recorded, a difference which failed to achieve significance at the 5% level ($P = 0.06$). There was no difference by surgical grade in the recording of a Dukes' stage and tumour site was not associated with differences in the proportion of staged cases either at district level or by admission status (not shown in a table).

Treatment

Table 4 describes treatment modality by district of residence for colonic and rectal tumours respectively. A total of 236 (90%) cases received treatment; significant variations were found by district in the proportion of cases not receiving treatment ($P < 0.0001$) with the highest proportion occurring in district C for both colon and rectal tumours.

Two-hundred and thirty-three patients received surgery (Table 4). Adjuvant therapy was given in 29 (18%) cases of colon cancer and 32 (31%) cases of rectal cancer (Table 4):

Table 5 Number (%) of cases receiving surgical procedures. By surgical procedure and DHA of residence

Surgical procedure	A	B	C
Cases receiving surgery	106 (88)	87 (95)	40 (80)
Right hemicolectomy	26 (25)	22 (25)	11 (28)
Segmental colectomy or left hemicolectomy	18 (17)	16 (18)	8 (20)
Total colectomy	1 (1)	3 (3)	1 (3)
Anterior resection	9 (9)	21 (24)	8 (23)
Abdomino-perineal resection	17 (16)	8 (9)	2 (5)
Hartmann's procedure	5 (5)	10 (12)	5 (13)
Endoscopic polypectomy	2 (2)	1 (1)	) (0)
Other specified resections	2 (2)	5 (6)	2 (3)
Resection not otherwise specified	5 (5)	1 (1)	1 (3)
Palliative surgery without tumour resection	22 (21)	5 (6)	5 (13)
Colostomy or ileostomy	50 (47)	26 (30)	15 (38)

Note 1: Percentage calculations (in parentheses) use cases receiving surgery (either on its own or as part of adjuvant therapy) as denominators.
Note 2: Percentages do not total 100 as some patients received more than one surgical procedure.

chemotherapy was administered as a component of adjuvant therapy in 19 (12%) cases of colon cancer and 11 (12%) cases of rectal cancer; the corresponding figures for radiotherapy were 15 (10%) and 28 (39%) respectively (not shown in a table). The proportions of patients

Table 6 Number (%) of patients receiving surgery operated on in the presence of a consultant. By tumour site

Surgical grade	Colon cancer cases				Rectal cancer cases			
	DHA of residence				DHA of residence			
	A	B	C	All	A	B	C	All
Consultant	45 (67)	25 (50)	22 (81)	92 (64)	33 (85)	30 (81)	11 (85)	74 (83)
Trainee	21 (31)	24 (49)	5 (19)	50 (35)	6 (15)	7 (19)	2 (15)	15 (17)
Unknown	1 (1)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	
Total	67 (100)	50 (100)	27 (100)	144 (100)	39 (100)	37 (100)	13 (100)	89 (100)

receiving adjuvant therapy ranged from 12–25% for colon tumours and from 20–44% for rectal tumours and in both cases, district A had the lowest proportion and district B had the highest (Table 4). When colon and rectal tumours were combined, the proportion of patients receiving adjuvant therapy varied significantly by district of residence ($P < 0.009$; not shown in a table); but no significant differences were found when colon and rectal tumours were analysed separately. We found no evidence of preoperative radiotherapy in the treatment of rectal tumours. Among treated patients, only 3 (1%) did not receive surgery; each of these received a combination of chemotherapy and radiotherapy.

Table 5 compares surgical treatment patterns across districts. Surgery was undertaken in 88%, 95% and 80% of cases in Districts A, B and C respectively. Anterior resection, Hartmann's resection and palliative surgery showed the most district variation: district A recorded the lowest percentage of anterior resections and Hartmann's procedures but the highest percentage of abdomino-perineal (AP) resections. 40 colon cases (28%) and 51 rectal cases (57%) received colostomy or ileostomy. In 11 (8%) colon cases and 7 (8%) rectal cases, there was no information available on colostomy or ileostomy. Where evidence of colostomy or ileostomy was found, it was frequently unclear whether it was given as a temporary or permanent treatment: in 13 (9%) colon cases and 24 (27%) rectal cases, there was no information on this variable.

Surgical grade

Table 6 shows the numbers of treated cases by grade of surgeon, tumour site and mode of admission. Of the 144 colon cancer cases receiving surgery, 92 (64%) were operated on by a consultant (in 2 cases surgical grade was unknown); 74 (83%) rectal cancer cases were treated by a consultant. There were significant differences ($P < 0.02$) by district of residence in the proportions of colon cases treated by a consultant (67%, 50% and 81%) for treatment centres A, B and C respectively) but no significant differences were found for rectal cancer cases.

Patients presenting for emergency surgery were more likely to be treated by a trainee surgeon than patients presenting electively: the relative risks were 2.58 (95% C.I.: 1.74, 3.82) for colon cancer patients and 4.93 (95% C.I.: 2.20–11.06) for rectal cancer patients. The relative risk for colon cancer cases of being operated on by a trainee surgeon (relative to rectal cancer cases) was 1.40 (95% C.I.: 1.16, 1.69). This figure was reduced to 1.14 (95% C.I.: 1.00, 1.31) when we calculated a Mantel-Haenszel weighted relative risk, weighting for admission status (not shown in a table).

Table 7 Cumulative, relative 5-year RSR% (95% C.I.) for treated cases only. By tumour site, admission status and surgical grade

Category	Colon		Rectum	
	n	RSR (%)	*n*	RSR (%)
Elective				
Consultant	67	46 (30,61)	64	66 (51,82)
Trainee	16	58 (25,91)	7	21 (−18,61)
Emergency				
Consultant	24	26 (5,47)	8	0 (0,0)
Trainee	34	27 (7,47)	11	12 (−11,35)
All consultant	91	41 (28,54)	72	59 (44,73)
All trainee	50	37 (19,55)	18	15 (−5,36)
Total	141	39 (28,50)	90	51 (37,64)

Tumour resection

In 44 (26%) colon cancer cases and 21 (22%) rectal cancer cases it was explicitly stated that the tumour had not been fully resected. The proportions by district of residence were: 28% (A), 24% (B) and 52% (C) for colon cancers and 28% (A), 16% (B) and 31% (C) for rectal cancers (not shown in a table). In a further 34 (24%) colon cases and 30 (24%) rectal cancer cases, we could not determine whether the tumour had been fully resected or not, either because the data in the surgeon's report were inconclusive or because a surgeon's report was not found with the case notes.

Clinical trials

Only 5% of patients had been entered into a clinical trial (6 colon cancer patients and 19 rectal cancer patients). In 34 cases (23 colon and 11 rectum) a previous cancer was recorded.

Survival by district

For colon tumours the five year relative survival rates were 35% (95% C.I.: 21%, 50%), 52% (95% C.I.: 34%, 70%), and 14% (95% C.I.: −2%, 30%) in districts A, B and C respectively. The corresponding figures for rectal tumours were 45% (95% C.I.: 27%, 64%), 62% (95% C.I.: 41%, 83%) and 24% (95% C.I.: −1%, 50%).

Survival is computed for treated cases only by tumour site, mode of admission and surgical grade in Table 7.

Discussion

We report striking differences in the presentation and management of colorectal cancers in these three districts. In addition to the association with district of residence, elective admissions were also associated with better access to investigations, more treatments, more assiduous recording of stage and with consultant-led care. There are no previous studies of district differences in management with which to compare our findings. But our results can be placed in context of hospital-based studies and of the three existing consensus statements on the management of colorectal cancer.[4,5,10,12–14]

The Royal College of Surgeons of England and the Association of Coloprotology of Great Britain and Ireland have recently produced a set of guidelines for the management of colorectal cancer.[14] These include: a barium enema or a colonoscopy for all patients with suspected colorectal cancers; surgery to be performed by experienced surgeons only; an overall curative resection rate of greater than 60% (subject to tumour stage at diagnosis); adjuvant chemotherapy containing fluorouracil for patients with Dukes' stage C tumours; and short term preoperative radiotherapy for patients with clinically operable rectal cancer. The 1993 Consensus Conference of the Royal College of Surgeons of Edinburgh (published in 1996) called for a pre-operative work-up that would include a barium enema or a colonoscopy for all patients with suspected colon cancers. We report variation on this variable with districts recording between 55–73% on colon cases receiving at least one of these investigative procedures. We could not investigate whether surgeons' experience varied by district as no data on this variable was given in the case notes. Our data were too incomplete to estimate with confidence the curative resection rate. Adjuvant chemotherapy was given to all but one Dukes' C patients; but in district A, it was recorded for only 4 out of 30 (13%) Dukes' C patients. We found no evidence of pre-operative radiotherapy for rectal patients.

The 1990 King's Fund Consensus Statement recommendations included better referral, diagnosis and treatment of colorectal cancer but was unable to set quantitative standards or targets for care at local level.[12] In our study 34% of cases presented as emergency. This compares with 36% in the prospective study by Anderson *et al*,[10] 20% in a five year retrospective study of admissions in a DGH in Bath[5] and 40% in the eight year follow up study in Nottingham.[15]

The relationship between tumour site and mode of admission is also in line with that reported by other workers. 42% of colon cases and 21% of rectal cancer cases were admitted as emergencies. This tallies with McArdle's and Hole's figures of 44% for colon cancers and 22% for rectal cancers. Colon cancer accounted for 74% of all emergency admissions; this is slightly lower than, though comparable to, the 77% in the Chester and Britton study and the 88% found in the study by Anderson *et al.*[10]

The King's Fund Consensus Statement recommended that each district should have at least one surgeon with a special interest in colorectal cancer. The CEPOD report stated that many operations were undertaken by surgeons too junior and too inexperienced to do the job, highlighting the need for reductions in unsupervised out-of-hours work.[16] We found that 82% of patients presenting electively were treated by a consultant compared with 47% patients presenting as emergency (not shown in a table). This is higher than the proportion reported by Chester and Britton[5] who found that 74% of all elective cases were treated by a consultant compared with only 20% of emergency presentations. 27% of all operations and 50% of all emergency operations were undertaken by a junior grade surgeon (compared with the 51% and 40% respectively found by Anderson *et al*[10].

We found no survival advantages for patients seen by consultants that could not also be explained by mode of admission. (We did not look at differences in grade among junior surgeons, nor were we able to ascertain whether procedures carried out by junior grade surgeons were under consultant supervision because case notes did not provide that level of detail). The disproportionate share of emergency patients seen and operated on by trainees suggests that they were not given easier patients in any systematic way.

The King's Fund Consensus Statement also recommended that referral and treatment protocols be developed for elective and emergency colorectal surgery. It drew attention to the possibility that some patients are receiving colostomy unnecessarily; the wide variation in colostomy rates reported here suggests that this warning is well founded.

Anderson *et al*[10] found poorer outcomes in all patients presenting through emergency but did not analyse colon and rectal tumours separately. Although Anderson *et al*[10] also reported higher proportions of tumour resections for cases presenting on emergency, incomplete data meant that we were unable to test for significant differences by admission in the proportion of fully resected tumours. Because of the possibility of selection bias in the unretrieved cases, we were unable to carry out any significance tests on relative survival rates.

The greatest obstacle to evaluating district variations in management is the absence of staging data in 46% of case notes. This funding accords with other case note studies. A study of breast cancer management in South East England by Chouillet *et al*[17] found that three-quarters of all notes had no stage indicated. National standards now exist for colorectal cancer staging issued in 1989 by the United Kingdom Coordinating Committee on Colorectal Cancer.[18] Local guidelines could ensure their implementation and monitoring.[19]

For those cases where stage was recorded we reviewed treatment across the three districts. In spite of the fact that early trials of adjuvant therapy (radiotherapy or chemotherapy) have indicated benefit for colorectal cancer since the early 1980s, we found a lack of consistency in its use across centres. (It was not generally accepted, however, until the late 1980s.) It was not clear from the notes when adjuvant therapy was indicated and for what stage of disease. Data on stage and treatment would facilitate the setting of standards for adjuvant therapy.

Sources of differences reported in this study

The differences in presentation, investigation and survival reported here may result from differences in the quality of health care at primary and secondary levels (GP referral, diagnosis, surgery) or from biological differences (in stage at presentation, tumour site). Artefactual differences might result from selection bias in the cases retrieved or from district differences in the assiduity with which procedures were recorded in hospital case notes. We will consider these in turn.

True sources of difference

Although we do not have adequate data on stage, the pattern of care found in district C is consistent with the hypothesis that a higher proportion of patients from this district present for diagnosis with more advanced tumours than their counterparts elsewhere. A significantly higher proportion of patients was admitted through emergency, irrespective of tumour site. More patients received liver ultrasonography, an investigation that is particularly urgent when metastases to the liver are suspected. And more patients went untreated, in spite of having been seen by the hospital services. Further work is warranted to examine whether stage at presentation does vary by district and to consider whether existing diagnostic and referral procedures are adequate.

Artefactual sources of differences

It is impossible to estimate the exact proportion of cases retrieved for this study. It is at least 80% (263 out of 328) but the true figure is probably higher. The difficulty arises with DCO cases. It is likely that some patients in this category were diagnosed only after death and therefore had no contact with the hospital services: as a consequence there would be no case notes to retrieve. The number of DCO cases in each district varied significantly by district and, as might be expected, there was a strong negative correlation ($P < 0.01$) between retrieval and DCO proportions. Less predictably, a significant negative correlation was also found between the proportion DCO cases retrieved and the contribution of DCOs to the total number of cases in each district: in district B where DCOs to just 3 (3%); in districts A and C, where they accounted for 25% and 42% respectively, the reductions achieved were smaller (13 (8%) in district A and 16 (19%) in district C). This gradient may indicate that the factors associated with DCO registration prevail to a different degree in each of the three districts. We have demonstrated elsewhere that DCO registration in the Thames regions is significantly associated not only with district of residence but also with old age, high tumour severity and dying at home.[20] Adapting this hypothesis to our present findings, it may be that district C's denominator has been artificially inflated by DCO cases diagnosed after death on whom no notes were available; in which case, district Cs retrieval rate would be higher than 64%.

It was not possible to estimate with precision the extent to which differences reported here were produced by retrieval bias. We cannot determine the meaning of the differences until adequate staging data is available.

Conclusion

We have shown evidence of wide variation in the management of colorectal cancer in three South Thames districts. We have also suggested ways in which these differences might be linked to survival. Accurate data on staging and treatment is needed if cross district audits and comparisons of care are to be achieved. Further research is warranted on referral mechanisms within districts.

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