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Results of treatment of distal rectal carcinoma since the introduction of total mesorectal excision: a single unit experience, 1994–2003

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Abstract *Background and aims:* This study reviewed the results of surgery for distal rectal cancer (where the tumour was within 6 cm of the anal verge) following the introduction of total mesorectal excision for rectal cancer in one institution. *Patients and methods:* One hundred and fifty-three patients who had undergone elective curative surgical resection of rectal cancer within 6 cm of the anal verge were included. The demographic, operative and follow-up data were collected retrospectively. Comparisons were made between patients who had different surgical procedures. *Results:* The overall operative mortality rate was nil, and the morbidity 41%. With a mean follow-up of 37 months (range 5–100 months), local recurrence occurred in 18 of the patients. The 5-year actuarial local recurrence rates for double-stapled anastomosis, low-strength anastomosis and abdominoperineal resection (APR) were 39, 17 and 11% respectively. The local recurrence rate was significantly higher for double-stapled low anterior resection than for the other types of operation (P=0.007). On multivariate analysis type of surgery (P=0.025) and tumour stage (P=0.043), were associated with local recurrence, but only stage was a significant prognosticator of overall survival (P=0.0006). *Conclusion:* With the practice of total mesorectal excision, APR was still necessary in 40% of patients with rectal cancer within 6 cm of the anal verge. The local recurrence rate was lower in patients treated with APR than in those with double-stapled low anterior resection; however, survival rates were similar in these two groups.

Keywords Rectal cancer · Surgery · Total mesorectal excision · Recurrence · Survival

Introduction

Total mesorectal excision (TME) has become the "gold standard" in rectal cancer surgery [1]. Many major published series across the world have demonstrated comparatively low rates of local recurrence in both randomised [2] and non-randomised studies [3] with good postoperative genitourinary function [4] and a high rate of sphincter preservation [2, 5, 6]. Local recurrence has, however, continued to be a problem in the management of rectal cancer and a significant cause of morbidity [7], with up to one-third of patients dying of locoregional recurrence without evidence of systemic metastatic disease [8]. In the 1980s and early 1990s, local recurrence rates of 20–30% were reported [9]. The importance of the mesorectum in local recurrence has recently been re-emphasised [10], where, following TME in trained hands, local recurrence rates of less than 5% have been reported, with a distal mural margin of ≤1 cm, provided that the mesorectum can be excised as a complete lymphovascular package [11]. This technique has been successfully taught as a standard procedure and translated to other colorectal surgical environments with reproducible cancer-specific outcomes [12].

Abdominoperineal resection (APR) is now reserved only for distal rectal cancers where anastomosis is not deemed possible. Since the introduction of endoanal staplers and the double (or triple)-stapled techniques for restorative proctectomy in rectal cancer [13, 14], the overall incidence of APR has shown a marked downward trend in most institutions. TME has become the standard treatment for rectal cancer in the authors' department since 1994. In this study, the outcomes of patients who had undergone resection of distal rectal cancers were analysed to compare the range of restorative operations for the treatment of rectal tumours at levels that might otherwise previously have necessitated sphincter ablation.

Materials and methods

Between June 1994 and December 2003, 164 consecutive patients underwent surgery with curative intent for distal rectal cancer (tumours located within 6 cm of the anal verge). Transanal operations were performed in 11 cases. One hundred and fifty-three patients (of whom 81 were male, 72 were female with an overall mean age of 61 years, range 28–86 years) were treated with elective TME and are the subject of this analysis. Data concerning clinicopathological staging and postoperative course were collected retrospectively using a hospital tracking system based on ICD coding for rectal cancer, with all cases included being measured on rigid proctosigmoidoscopy and confirmed histologically. Preoperative staging was performed using abdominal ultrasound, thoraco-abdominal CT scan, abdominal magnetic resonance imaging and endoscopic ultrasound as single modalities or in combination depending on their availability and the surgeon's preference. All patients had at least one form of preoperative imaging for staging purposes.

At surgery, rectal mobilisation was carried out by sharp dissection under direct vision, keeping the fascia propria of the mesorectum intact in accordance with the technique described by Heald et al. [1]. End-to-end anastomosis was considered possible when a distal resection margin of at least 1 cm clear of the tumour could be obtained, utilising a hand insertion of a distal and a proximal purse string. The double-stapled technique was employed in patients in whom the level of the tumour precluded comfortable placement of the distal purse string suture by hand for end-to-end anastomosis. In the initial period (up until 1999), a policy of selective faecal diversion for high-risk anastomoses was adopted, with loop ileostomy being the preferred mode of proximal diversion. A loop transverse colostomy was constructed when patients had evidence of radiation enteritis or an ileal conduit was being constructed as part of a restorative pelvic exenteration. Following anterior resection of the rectum, colonic continuity was re-established by colorectal or coloanal anastomosis using a circular stapling device (Autosuture, US; Surgical, Norwalk, CT, USA). At completion of the anastomosis, the bowel edges excised by the circular stapler were examined to assess resection margins. In all patients the neorectum was intraoperatively tested for anastomotic leakage with the pneumatic test [15]. In cases of transanal–coloanal anastomosis, the perineal surgeon completed the transanal excision at the dentate line, performing a handsewn single-layer interrupted anastomosis via the transanal route. A diverting stoma was constructed routinely in this group of patients. APR was performed in patients with tumours at a level at which the anal sphincter musculature could not be spared. A standard synchronous, combined approach was routinely used with abdominal mobilisation of the rectum being carried out in the same manner as in low anterior resection (LAR) using the TME technique. All operations were performed by the same surgical team (BA, RB, AC, FL, SP), each of whom had undergone postgraduate specialist training in colorectal surgery.

Patients with locally advanced tumours (T3, T4, or N positive) defined by preoperative staging investigations, received bifractionated accelerated radiotherapy for a maximum of 41.6 Gy or conventional radiotherapy for a total of 50.4 Gy and concomitant chemotherapy (clinical studies with a regimen containing 5-fluorouracil, folinic acid, oxaliplatin, methotrexate or raltitrexed). The unit policy was to provide those patients with pT3/4 N1 or pT1N1/2 tumours with preoperative adjuvant therapy; however, there were some patients who did not receive this treatment and who subsequently underwent postoperative chemoradiation. For patients undergoing Mayo Clinic or Machover regimens for six cycles a "sandwich" regimen was employed (two cycles CT→RT→four cycles CT). Patients

with a central venous system underwent continuous infusion chemotherapy with 5-FU concomitant to radiotherapy. The treatment lasted for 4–6 months. Adjuvant chemotherapy regimens as described were employed for patients who underwent preoperative bifractionated radiotherapy.

Wound complications were defined as wound infection (any redness or tenderness of the surgical wound as well as discharge of pus) and wound dehiscence (any dehiscence of the wound edges and/or fascia >3 cm). Anastomotic leakage was considered to have occurred if pus appeared per anum, if faecal material was discharged from the drain or if a pelvic abscess developed; each with radiological evidence of a leak at the anastomosis site using water-soluble contrast medium (Gastrografin; Schering, Berlin, Germany). Contrast examination of the anastomoses was employed on the 8th day postoperatively in all patients. Pneumonia was defined as an abnormal chest radiograph with fever (>38°C) and a white blood cell count exceeding 12,000 cells/μl with a positive culture of sputum or at bronchoalveolar lavage.

Tumours were staged histopathologically and clinically according to the UICC system [16]. Histopathologic resection margins were assessed on fixed resection specimens in accordance with the guidelines of the Association of Coloproctology of Great Britain and Ireland in 2001, with assessment of doughnuts <30 mm from the cut edge of the main specimen and recording of the presence or absence of tumour. The presence or absence of tumour in the distal cut end of the resection specimen and at the circumferential resection margin (after preliminary marking of the specimen edge), on axially sliced specimens at 3- to 4-mm intervals was routinely performed with a selection of blocks where the tumour margins were closest. Measurement of the minimum distance between the tumour and the circumferential resection margin was recorded in millimetres. Initial surgery was regarded as 'resection for cure' when no tumour was left behind macroscopically or microscopically at the resection margin. Morbidity and mortality were documented within 30 days of surgery. Patients were followed at 3- to 6-month intervals during the first 3 years and at annual intervals for 5 years thereafter. Follow-up included clinical history, physical examination and determination of serum carcinoembryonic antigen levels along with computed tomography (or abdominal ultrasonography) and colonoscopy on an annual basis or when there was a suspicion of recurrence. When locoregional recurrence was suspected, positron emission tomography (PET) scanning was used when available. Locoregional recurrence was defined as histologically or radiologically proven disease presenting within the field of previous surgery.

Analyses were performed using an advanced model statistical software package (SPSS, Chicago, IL, USA). Comparison of variables was performed with the Chi-square test and the Student's *t*-test for categorical and continuous variables respectively. Actuarial local recurrence and survival were analysed using the Kaplan–Meier method, and comparisons between groups were made with the log-rank test. Multivariate analysis was performed using the Cox proportional hazard model where *P* values <0.05 were considered to be significant.

Results

The mean level of the most distal tumour margin overall was 3.9 cm (range: 0.2–6 cm) from the anal verge. The types of operations for the different time periods are shown in Table 1. The APR rate reduced from 45.7% in the interval between 1994 and 1998 to 37.4% in the period 1999–2002 (not significant).

Overall, amongst patients who had an LAR, end-to-end anastomosis was performed in 73 cases (79.3%), a double-stapled anastomosis was performed in 16 patients (17.4%) and a coloanal anastomosis in 3 patients (3.3%). Temporary proximal faecal diversion was used in 32 patients (34.8%). Thirteen patients (8.5%) received preoperative radiotherapy alone, 32 cases (20.9%) preoperative neoadjuvant therapy and 40 patients (26.1%) postoperative radiation. Table 1 shows a significant increase in the use of preoperative irradiation and chemoradiation in the latter half of the analysis along with a more standardised use of postoperative radiotherapy alone or systemic chemotherapy. This

Table 1 Types of operations, and neoadjuvant and adjuvant treatments used in 153 patients with distal rectal cancer. *LAR* low anterior resection, *APR* abdominoperineal resection, *CT* chemotherapy, *RT* radiotherapy

	June 1994 to December 1999 (%)	January 1999 to December 2002 (%)	Total (%)	*P*
LAR	25 (54.3)	67 (62.6)	92 (60.1)	0.34
APR	21 (45.7)	40 (37.4)	61 (39.9)	
Neoadjuvant therapies				
None	40 (87)	50 (46.7)	90 (58.8)	–
CT	0	1 (0.9)	1 (0.17)	<0.001
RT	6 (13)	31 (29.0)	37 (24.2)	–
RT + CT	0	25 (23.4)	25 (16.3)	–
Adjuvant therapies				
None	19 (41.3)	45(41.1)	64 (41.8)	–
CT	8 (17.4)	38 (35.5)	46 (30.1)	0.014
RT	0	3 (2.8)	3 (2.0)	–
RT + CT	19 (41.3)	21 (19.6)	40 (26.1)	–
Tumour stage (UICC)				
I	14 (30.4)	42 (39.3)	56 (36.6)	–
II	12 (26.1)	23 (21.5)	35 (22.9)	0.75
III	19 (41.3)	39 (36.4)	58 (37.9)	–
IV	1 (2.2)	3 (2.8)	4 (2.6)	–
Total	46 (100)	107 (100)	153 (100)	–

increase was not related to a higher prevalence of tumours at more advanced stages in the latter group (Table 1).

Significant perioperative morbidity (as defined in the Materials and methods section), occurred in 64 patients (41%). Details of these complications are shown in Table 2. Anastomotic leakage was demonstrated in 13 patients, all of whom were in the straight anastomosis group (P=0.001), with conservative management being possible in 9 cases (69.2%). Three of these presented with the appearance of pus per anum, and 6 patients with discharge of faecal material from the drain. Three patients were reoperated (2 of them for diffuse peritonitis, and 1 of them for a pelvic abscess). The perioperative (in-hospital and 30-day) mortality for the entire patient cohort was 0%. A comparison of the patient characteristics between those undergoing LAR and those having an APR is shown in Table 3. The mean level of the tumours was significantly lower in patients who underwent APR vs. LAR (2.4 vs. 4.9 cm respectively; P<0.001) and there was no difference in the T stage of cases between the groups.

Locoregional recurrence

With a mean follow-up of 37 months (median 33 months; range 5–100 months) local recurrence was confirmed in 18 asymptomatic patients undergoing the strict follow-up protocol. Local recurrence occurred in 14 patients who underwent LAR, 5 having a double-stapled anastomosis and 9 an end-to-end anastomosis. Four patients developed local recurrence following an APR. In 2 patients undergoing end-to-end LAR, the rectal doughnut contained histologic evidence of infiltrative carcinoma and both of these patients developed recurrence at 15 and 42 months respectively. The 3- and 5-year total actuarial local recurrence rates were 12 and 17% respectively. No recurrence occurred in the 3 patients who underwent handsewn coloanal anastomoses after a mean follow-up period of 30 months. For double-stapled LAR, end-to-end anastomosis and APR, the actuarial local recurrence rates were 39, 17 and 11% respectively, with a significant difference between double-stapled LAR and APR (P=0.005) and between double-stapled LAR and end-to-end anastomosis (P=0.008). This is shown graphically in Fig. 1.

Table 4 shows a univariate analysis of factors potentially affecting local recurrence rates, where significant factors included the type of surgical procedure performed and the UICC tumour stage. In a multivariate analysis matching tumour stage with operative procedure, both factors proved significant (P=0.043 and P=0.025 respectively). In these groups there were 16 patients (9 males) who underwent double-stapled LAR (mean age 64 years; range 46–86 years). Their mean tumour level was 4.5 cm from the anal verge and these tumours were not more distal than those of patients undergoing end-to-end anastomoses (mean tumour level 5 cm). In 3 cases, the distal resection margin was reported as within 1 mm of the tumour limit and 2 of these patients experienced local recurrence; both occurring 14 months postoperatively. Five patients developed local

Table 2 Postoperative complications after curative resection of distal rectal cancer

Complication	Number of patients (%)
Pneumonia	2 (2.3)
Anastomotic leak	13 (14.1)[a]
Wound-related complications	40 (26.1)
Arrhythmia	1 (0.6)
Delirium	1 (0.6)
Urine retention	3 (2.0)
Urinary tract infection	6 (3.9)
Central venous catheter infection	6 (3.9)
Small bowel obstruction or prolonged ileus	2 (1.3)
Pneumothorax	1 (0.6)

[a]Among LAR patients

Table 3 Comparison of patients undergoing APR and LAR

	LAR, n=92	APR, n=61	P
Sex ratio (M:F)	48:44	33:28	0.87
Mean age (years)	61.0	61.4	0.82
Mean level of tumour	4.9 (range 3–6 cm)	2.4 (range 0.2–6 cm)	<0.001
Radiotherapy	68 (73.9%)	35 (57.4%)	0.033
Preoperative	37	25	–
Postoperative	31	10	–
Chemotherapy	63 (68.4%)	31 (50.8%)	–
Preoperative	4	4	–
Postoperative	47	21	0.028
Preoperative and postoperative	12	6	–
Tumour stage			
I	27 (29.3%)	29 (47.5%)	–
II	25 (27.2%)	9 (14.8%)	0.08
III	36 (39.1%)	22 (36.1%)	–
IV	4 (4.3%)	1 (1.6%)	–
Histologic differentiation			
Well	7 (8%)	13 (21.2%)	–
Moderate	65 (71%)	41 (66.7%)	0.14
High	20 (21%)	7 (12.1%)	–
Number of lymph nodes examined			
Mean (±SD)	16.1±9.4	16.1±8.7	0.99
Median (range)	15 (3–68)	15 (3–40)	–
Node status			
N−	53 (34.6%)	38 (24.8%)	0.62
N+	39 (25.5%)	23 (15.1%)	–
Morbidity	31 (33.7%)	33 (54.1%)	0.012
Mortality	0	0	–

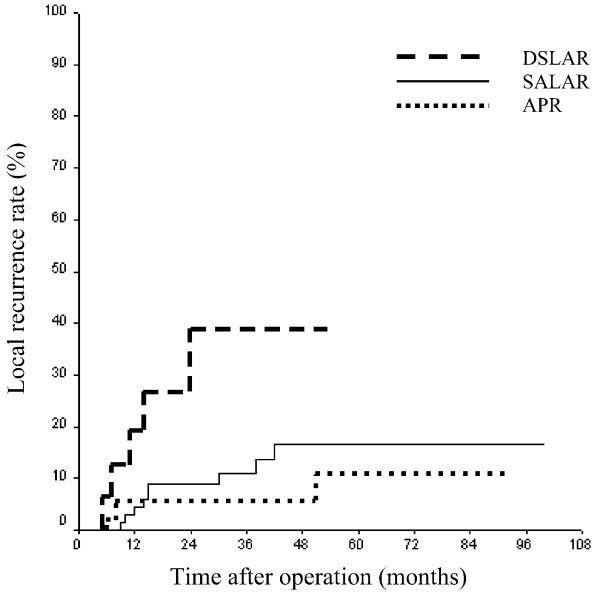

Fig. 1 Local recurrence following different types of operation for distal rectal cancer. *APR* abdominoperineal resection, *DSLAR* double-stapled low anterior resection, *SALAR* straight anastomosis low anterior resection. P=0.005 (DSLAR vs. APR); P=0.008 DSLAR vs. SALAR; log rank test)

recurrence after a mean of 12 months (range 5–24 months), all of which were confirmed on a PET scan. Three of these patients underwent salvage APR operations whilst a further patient with pulmonary metastases was treated with brachytherapy for a maximum of 15 Gy and died 12 months after LAR. The other patient is still alive 24 months after the anterior resection with hepatic and nodal metastatic disease. All 3 patients undergoing salvage APR are alive, 2 of whom have no evidence of disease at 44 and 19 months' follow-up respectively. Of patients undergoing end-to-end anastomosis, 4 underwent salvage APR for local relapse (3 of them died of the disease, 12, 30 and 38 months after APR respectively; 1 of them is alive with relapsing disease 10 months after APR) resulting in a total salvage rate of APR following all post-LAR recurrence of 7.6% (7 out of 92 cases).

Cancer-specific survival

The overall 5-year cancer-specific survival rate was 77% with a 5-year survival of 64% and 95% for patients undergoing LAR and APR respectively (not significant). The 5-year overall survival for patients undergoing double-stapled LAR was 93% and 64% for those having an end-to-end

Table 4 Univariate analysis on 3- and 5-year local recurrence rate assessing different variables. *K–G* Knight–Griffen anastomosis, *SA* straight anastomosis

	Number of patients	Three-year local recurrence rate (%)	Five-year local recurrence rate (%)	P
Sex				
Male	81	15	21	0.15
Female	72	8	13	–
Age (years)				
<65	97	15	18	0.45
≥65	56	8	14	–
Type of surgery[a]				
LAR (K–G)	16	39	39	–
LAR (SA)	73	11	17	0.007
Miles	61	5	11	–
Surgeon				
BA	45	14	23	–
RB	39	10	21	0.85
AC	26	12	13	–
FL	26	5	18	–
SP	17	7	11	–
Preoperative RT				
No	91	9	16	0.34
Yes	62	7	17	–
UICC stage				
I	56	4	10	–
II	34	15	15	0.044
III	58	14	22	–
IV	5	50	50	–
Histologic differentiation				
Well	20	0	17	0.5
Moderate	106	8	15	–
Poor	27	21	21	–
Tumor level (cm)				
<4	62	14	19	0.65
≥4	91	10	16	–
Period (years)				
1994–1998	46	7	13	0.29
1999–2002	107	15	18	–
Surgical margin (cm)[b]				
<1	33	7	31	0.13
≥1	59	9	13	–
Preoperative blood transfusion				
No	124	10	14	0.10
Yes	29	21	29	–

[a]Excluding the 3 patients undergoing LAR followed by coloanal anastomosis
[b]Excluding patients undergoing Miles operation

Table 5 Univariate analysis on 5-year overall survival and 3-year survival after recurrence (local or distant) assessing different variables

	Number of patients	Three-year overall survival (%)	Five-year overall survival (%)	P	Number of patients with local or distant recurrence	Three-year post-recurrence overall survival (%)	P
Sex							
Male	81	96	80	0.95	21	40	0.42
Female	72	96	62	–	15	50	–
Age (years)							
<65	97	94	70	0.63	24	47	0.72
≥65	56	98	72	–	12	37	–
Type of surgery[a]							
LAR (K–G)	16	93	93	–	7	83	0.16
LAR (S A)	73	97	63	0.15	17	26	–
Miles	61	95	95	–	12	79	–
Surgeon							
BA	45	95	84	–	15	35	–
RB	39	92	72	0.72	10	40	0.68
AC	26	97	80	–	3	70	–
FL	26	89	68	–	5	60	–
SP	17	100	66	–	3	80	–
Preoperative RT							
No	91	96	74	0.96	19	27	0.08
Yes	62	96	88	–	17	78	–
UICC stage							
I	56	100	100	–	5	100	–
II	34	96	83	0.006	10	58	0.006
III	58	92	51	–	19	39	–
IV	5	75	75	–	2	50	–
Histologic differentiation							
Well	20	100	63	–	4	79	–
Moder-ate	106	94	77	0.55	21	87	0.67
Poor	27	84	67	–	11	74	–
Tumor level (cm)							
<4	62	91	88	0.45	14	56	0.52
≥4	91	98	65	–	22	47	–
Period (years)							
1994–1998	46	97	83	0.078	13	63	0.09
1999–2002	107	93	77	–	23	20	–
Surgical margin (cm)[b]							
<1	33	100	72	0.68	16	60	0.33
≥1	59	93	80	–	20	33	–
Preoperative blood transfusion							
No	124	95	77	0.63	27	40	0.67
Yes	29	96	78	–	9	63	–
Type of recurrence							
Local	15	91	40	–	15	39	–
Distant	18	87	49	0.004	18	34	0.20
Local + distant	3	50	0	–	3	0	–

[a]Excluding the 3 patients undergoing LAR followed by coloanal anastomosis
[b]Excluding patients undergoing Miles operation

anastomosis (not significant). Univariate analysis of factors affecting cancer-specific overall survival showed that only UICC stage was a significant variable (Table 5). Patients who experienced local recurrence had a significantly worse survival after diagnosis of recurrence than patients without recurrence (32 vs. 87%; $P<0.001$) and following the diagnosis of local recurrence the 5-year overall survival was only 27%. Of those patients with distant recurrence, the 5-year survival was still 44%; however, the overall 5-year survival of patients with combined local and distant recurrence, once diagnosed, was 0%. Table 5 also shows the univariate analysis of factors affecting survival once recurrence (local or distant) has appeared, where initial stage as well was the only significant prognosticator after post-recurrence survival.

Discussion

This study is a retrospective analysis of the cancer-specific impact and safety of TME for a range of surgical procedures in low rectal cancer that was introduced in 1994 as a standard rectal cancer treatment in a specialist colorectal cancer unit. Within the time frame of the study, there was a marked reduction between the two major time periods in the performance of AP,R, with an increased use of preoperative adjuvant and neoadjuvant therapies. Multivariate analysis showed that the type of operation and the UICC tumour stage were significant factors in confirmed locoregional recurrence, where double-stapled LAR was associated with the highest incidence of local recurrence compared with end-to-end stapled anastomosis, hand-sutured coloanal anastomosis and APR. Although the numbers were small, APR could be used as a salvage procedure after LAR for recurrence in some patients with long-term survival. Analysis showed that only the UICC T stage of the tumour at presentation was a significant variable in actuarial cancer-specific survival where the lowest survival was evident in patients undergoing double-stapled anastomosis. Once local recurrence occurred, overall cancer-specific survival was significantly affected, with no long-term survivors when there was combined local and systemic relapse. We accept that this was a retrospective assessment of the outcome of TME in a single institution amongst experienced colorectal surgeons rather than a comparison of TME with historical controls performed without TME. As a consequence, it is hard to be dogmatic concerning the superiority of the TME technique in reducing locoregional recurrence rates for restorative and non-restorative resections.

The finding in this study that the rate of APR performance for low rectal cancers has reduced over time has previously been reported by other colorectal units with a specialist interest in rectal cancer. Comparison of the mean height from the anal verge of patients undergoing APR showed significantly lower tumours than those undergoing restorative proctectomy in our series, and this, along with an understanding that extensive distal intramural spread in rectal cancer is rare and that distal margins ≤1 cm may be resected without survival compromise [17], has led to the prevailing worldwide view that sphincter preservation is possible in the majority of lower third rectal cancers [18]. In this respect, Heald and colleagues have shown that three-quarters of unselected patients with carcinoma of the lower third of the rectum can be offered sphincter-conserving surgery [19].

Locoregional recurrence after curative rectal cancer resection is an indicator of the success of care and also reflects the level within an institution of the specialisation of rectal cancer surgery [20]. The causes of local recurrence are multifactorial, including T stage, tumour fixity, histologic differentiation, operation type, distal margin involvement, extramural venous invasion, surgical experience and the use of adjuvant therapies. This has been extended to those cases where there is circumferential margin involvement, which has been reported as affecting survival more [21], and, more recently, to confirmed perioperative anastomotic leakage [22]. Most dedicated rectal cancer units have reported a local recurrence rate of about 10% (or less) with the introduction of the TME technique [1, 23]. Our series showed a comparatively high overall local recurrence rate during a mean follow-up of 37 months, with a significantly higher recurrence rate in those patients undergoing double-stapled LAR compared with either end-to-end LAR (or coloanal anastomosis) or APR ($P=0.005$ and $P=0.008$ respectively). We compared only those patients with distal rectal cancers and this relatively high rate of local recurrence may potentially be offset if upper- and mid-rectal cancers were also included in the LAR data for analysis. In this regard, it is at present somewhat unclear whether TME is necessary for higher rectal lesions [24, 25].

Several papers appear to agree with our findings regarding stapled LAR, whereas others are contradictory. Nymann and colleagues noted a comparatively high local recurrence rate (27%) following all stapled anastomoses compared with 10% after handsewn LAR [26], and Amato et al. [27] found an increased risk of local pelvic recurrence for LAR (compared with APR) when all cancers were matched for stage and when mid- and upper rectal tumours were included in the analysis. In general, the evidence appears to suggest that local recurrence is a reflection of the initial tumour biology (stage, lymphovascular invasion and histologic grade) rather than the type of procedure initially performed [28, 29]. In contradistinction to these studies, Heald's group have produced such a low local recurrence rate that these factors do not appear to be significant; [19] a finding echoed by some other authors [30, 31]. In our series, there was a trend for cancer-specific survival to be dependent on procedure, where patients undergoing a double-stapled LAR fared worse (although this was not statistically significant) than those who underwent either an end-to-end anastomosis (stapled or handsewn) or APR. This may reflect the level of the primary tumours included in our ana-

lyses, where most reports have failed to show a survival disadvantage for LAR compared with APR [32, 33].

The reasons for our findings are speculative. One issue that may account for an enhanced local recurrence with the double-stapled technique is the finding of viable tumour cells in the distal rectal stump [34], a phenomenon reduced by repeated saline and cytocidal washout [35]. This technique was not part of our normal extirpative procedure during the conduct of the study and it should be remembered that although insufficient tumour clearance may occur (in part through transsection of the mesorectal 'holy plane' or through the migration of tumour cells into lymphatics) malignant cells have been recovered from stapler and doughnut washings that have the potential for anastomotic implantation [36]. Again, these factors are more tumour dependent where exfoliated cancer cell implantation is more likely when the primary growth is advanced on presentation, demonstrates extramural spread, is distally located and has close resection (or radial resection) margins.

During the period of our study, there was a substantial increase in the use of pre- and postoperative chemoradiation. Our study does not formally assess the effectiveness of downstaging where it has been shown that T- and N-level downstaging and complete pathological response in advanced cases (defined as the absence of tumour in the definitively resected specimen) reduce recurrence and improve disease-free survival [37]. This effect on overall cancer-specific survival has also been reported in the selective postoperative adjuvant setting when comparing radiation alone with chemoradiation [38]. There are considerable limitations to our retrospective study. Although there are no statistical differences in the use of radio- or chemotherapy between the LAR and APR groups or in univariate analysis of their effects on local and distant recurrence rates or on survival, given this collation of data, it is somewhat hard to draw steadfast conclusions regarding the impact of such policy changes in their utilisation between the two time periods. Although we had very small numbers, salvage abdominoperineal resection for recurrence following LAR is a feasible option with potentially curative results. This has been confirmed by others [39], where an attempt at surgical recurrence removal appears to provide improved survival over radiation alone, provided that the re-resection margins are histologically clear [39, 40].

Conclusion

Refinements of the TME technique, as initially developed by Heald, have resulted in reported reductions in the incidence of locoregional pelvic recurrence after restorative and non-restorative rectal resection, highlighting the value of surgical technique and definitive expertise as an integral part of rectal cancer care. This has been coupled in several series with an improved cancer-specific survival directly attributed to the performance of TME itself [41] although a low local recurrence rate has been reported in expert hands without formal mesorectal excision [42]. In the present age, it appears unlikely that a prospective, randomised, controlled clinical trial comparing rectal excision with or without TME will be performed, whereas non-randomised comparisons with historical controls in both the Dutch TME Study of 1,748 patients [43] and the Swedish Rectal Cancer Trial [44] have shown a substantial improvement in survival with diminished local pelvic recurrence over time. In this regard, however, it is not possible to dissect the effects of unit modifications in tumour staging, improvements in histologic precision in the definition of nodal involvement, the so-called stage-migration effect [45] and variations in the utilization of adjuvant strategies from the changes imposed by surgical standardisation. This study, like many others, fails to definitively prove that the TME technique is superior and it is likely that improved definition of the use and selection of adjuvant chemoradiation will further enhance outcome results in the context of optimal standardised surgery.

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