Original article

Long-term results in patients with T2–3 N0 distal rectal cancer undergoing radiotherapy before transanal endoscopic microsurgery

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Background: **Local excision after radiotherapy for node-negative low rectal cancer may be an alternative to radical excision. This study evaluated the results of local excision in patients with small (less than 3 cm in diameter) T2 and T3 distal rectal tumours following neoadjuvant therapy.**

Methods: **One hundred patients with rectal cancer (54 uT2 and 46 uT3 uN0 tumours) were enrolled. All patients underwent preoperative radiotherapy followed by local excision by means of transanal endoscopic microsurgery.**

Results: **Definitive histological examination revealed nine pT1, 54 pT2 and 19 pT3 tumours. A complete response (R0) or microscopic residual tumour (R1mic) was found in three and 15 patients respectively. Minor complications occurred in 11 patients and major complications in two. At a median follow-up of 55 (range 7–120) months, the local failure rate was 5 per cent and metastatic disease was found in two patients. The cancer-specific survival rate at 90 months' follow-up was 89 per cent, and the overall survival rate 72 per cent. Salvage abdominoperineal resection was performed in three patients, two of whom were disease free at 15 and 19 months.**

Conclusion: **Treatment of small uT2 and uT3 uN0 rectal cancers with preoperative high-dose radiotherapy followed by transanal endoscopic microsurgery is an acceptable alternative to conventional radical resection.**

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Introduction

Colorectal cancer continues to be a challenging clinical problem. In the UK there are approximately 29 000 new cases each year, with 18 000 deaths resulting from the disease. Standard treatment for distal rectal cancer is currently low anterior resection or abdominoperineal resection[1–4]. Local recurrence rates of 3·7–12·7 per cent[1–5] and significant morbidity rates have been reported after these two procedures. Furthermore, a considerable number of patients require a protective ileostomy or colostomy.

As an alternative to radical resection, some authors have suggested local excision as curative therapy in patients with localized disease. In general, local excision has been considered only in high-risk patients to avoid complications of major surgery. However, recent studies suggest that the early-stage (T1), well and moderately well differentiated adenocarcinoma has a low risk of regional spread and, consequently, may be treated by local excision[1–4,6].

Preoperative radiotherapy reduces the incidence of local recurrence after open radical surgery for rectal cancer[7]. In selected patients, neoadjuvant therapy offers the opportunity for tumour downstaging, both to improve local control and survival, and to enhance quality of life after surgery by preserving the anal sphincter[1,8–10].

High-dose preoperative radiation and full-thickness local excision appears to be a promising option in the management of selected patients with distal rectal cancer,

even in those at average risk[1–3,11]. Compared with radical resection, local excision for distal cancer avoids pelvic dissection, permanent or temporary colostomy, and laparotomy.

The aims of the present study were to evaluate whether high-dose radiotherapy combined with local excision in selected patients with T2 or T3 N0 distal rectal cancer is a valid alternative to major surgery, and to analyse whether tumour size reduction and downstaging can be considered as prognostic factors. To this end, attention was focused on the effect of preoperative radiochemotherapy on tumour stage, morbidity, local recurrence and long-term survival.

Patients and methods

Between May 1992 and November 2002, 296 patients with T2–3 extraperitoneal rectal cancer received neoadjuvant therapy. A total of 100 consecutive patients (68 men and 32 women) were enrolled in this study; patients enrolled in other trials were excluded. Median age was 65 (range 31–95) years; four patients were aged less than 45 years.

Criteria used in the selection of patients are outlined in *Table 1*. The patient population included high-risk patients with American Society of Anesthesiologists (ASA) grade 3 and 4 status, as well as patients who had refused conventional resection. The study design was approved by the ethics committee and all patients gave informed consent concerning the oncological risk of local excision, possible intraoperative and postoperative complications (bleeding, suture dehiscence, temporary incontinence, conversion to laparotomy with colonic resection and colostomy), and need for close postoperative follow-up, in accordance with the study protocol.

Fifty-four patients with T2 and 46 with T3 tumours were enrolled. In 32 patients the lesion occupied approximately 10 per cent of the circumference of the rectum, in 40 patients about 20 per cent and in 28 patients about 30 per cent. The lesions were ulcerated in 32 patients, exophytic in 55 and flat in 13.

Preneoadjuvant treatment staging

Case history, routine laboratory test results including tumour markers, and accurate clinical findings were recorded prospectively for each patient. Preoperative staging examinations are shown in *Table 2*. For adequate histological assessment, rigid biopsy forceps were employed to obtain specimens larger than 8 mm in diameter (referred to as a macrobiopsy). The macrobiopsy was examined by three separate morphologists to assess the grade. Parameters established for grading were cell differentiation (well (G1), moderately well (G2) or poorly (G3) differentiated), and lymphatic and/or vessel and perineural infiltration.

Lymph node status was determined according to the following imaging criteria: diameter of lymph node (less than 0·8 cm), circular shape and vascularization at colour Doppler ultrasonography, hypoechogenic lymph nodes at endorectal ultrasonography, and lymph node diameter (less than 0·8 cm) and circular shape at computed tomography (CT) or magnetic resonance imaging (MRI). All imaging studies were evaluated by three radiologists; ultrasonography was performed by a surgeon with 13 years' experience in transanal ultrasonography. In the event of disagreement between radiologists, or between CT or MRI and ultrasonographic findings, the higher level of staging was adopted.

Table 1 Inclusion criteria

T2 and T3 rectal cancers
Tumour within 8 cm of anal verge located in extraperitoneal portion of rectum
Diameter < 3 cm
Negative lymph nodes (N0)
No signs of systemic or metastatic disease

Table 2 Preoperative staging examinations

Total colonoscopy
Rigid rectoscopy (with macrobiopsies of tumour, to measure distance, to evaluate circumferential position of tumour and to select position on operating table)
Transanal endosonography
Magnetic resonance imaging or computed tomography (with 3-mm abdominal and pelvic sections)
Bone scintigraphy
Chest radiography
Digital examination (to evaluate tumour fixation)
Routine endoscopic biopsies (1 cm around tumour in apparently normal mucosa to assess the excisional area)
Tatooing performed on site of each negative biopsy using indian ink spotting

Neoadjuvant therapy

All patients underwent radiotherapy according to techniques described by Marks *et al.*[7]. The total dose was 50·4 Gy, in 28 fractions over 5 weeks. The anus, rectum, mesorectum, regional and iliac lymph nodes were irradiated.

From January 1997, 25 patients aged less than 70 years and with good performance status underwent preoperative radiochemotherapy with a continuous infusion of 5-fluorouracil (200 mg per m^2 per day).

Postneoadjuvant treatment staging

Staging of the rectal lesion by means of endoscopy and evaluation of tumour diameter by transanal ultrasonography, MRI or CT, with 3-mm abdominal and pelvic sections and digital examination, were carried out 40 days after completion of radiotherapy.

After comparison of pre-neoadjuvant and post-neoadjuvant treatment staging, together with definitive histological findings, the effects of radiotherapy were classified, according to tumour (T) stage, as follows. Tumours were considered as downstaged if all imaging studies (ultrasonography and CT or MRI) and definitive histology revealed a lower T stage. All tumours that were not downstaged at definitive histological examination were classified in terms of the reduction in tumour diameter: greater than 50 per cent, 30–50 per cent, less than 30 per cent or no reduction. Patients with no evidence of macroscopic or microscopic tumour were defined as having R0 disease. Those with microscopic evidence of tumour were considered to have an R1mic lesion.

Patient preparation

Preoperative colonic washout and short-term antibiotic prophylaxis were undertaken in all patients. Transanal endoscopic microsurgery (TEM) was performed under general anaesthesia in 95 per cent of patients; spinal anaesthesia was used in five high-risk patients (ASA grade 4).

Surgical techniques

The surgical technique has been reported in detail elsewhere[2,12–14].

Postoperative follow-up

All patients were evaluated 1 month after discharge by means of clinical examination, digital rectal exploration and endoscopy. For the first 3 years, they were monitored every 3 months by clinical examination, rectoscopy with multiple biopsies of scar tissue and any suspicious area, and endoscopic ultrasonography, MRI or CT, then every 6 months for 3–5 years, and thereafter annually. The length of follow-up ranged from the day of TEM to 1 September 2003.

Statistical analysis

Data for continuous variables are presented as median (range) values. The cumulative probability of local or metastatic recurrence, and of survival, were estimated with the Kaplan–Meier method. The 95 per cent confidence interval (c.i.) of survival curves was based on the gaussian approximation to the binomial distribution. Fisher's exact test was used to analyse the association between response to radiotherapy and grading, and was evaluated separately in patients classified clinically as having T2 or T3 disease. SAS software®, version 8.2 (SAS Institute, Cary, North Carolina, USA) was used for all statistical analyses.

Results

At pre-neoadjuvant treatment staging, a discrepancy was observed between ultrasonographic and CT or MRI staging in ten patients (eight understaged and two overstaged by CT/MRI). Two patients were classified by CT or MRI as having T3 disease, in disagreement with uT2. According to the study protocol, these two patients were included in the T3 group. When post-neoadjuvant treatment staging was compared with definitive histological findings, an imaging understaging (T2 instead of T3) was found in only six patients, whereas overstaging was observed in ten (T3 instead of T2). No positive nodes were detected at definitive histological examination.

Neoadjuvant treatment response

Of the 54 patients staged as having a T2 lesion before radiotherapy, definitive histology showed downstaging in 16 patients. No downstaging was observed in the remaining 38 patients, although tumour diameter was reduced by 30 per cent or more in 31 of these patients (*Table 3*). Of the 46 patients staged as having a T3 tumour before radiotherapy, definitive histology showed downstaging in 27 patients. In 15 of the remaining 19 patients a tumour mass reduction or 30 per cent or more was obtained (*Table 3*).

Overall, serial histological examination of 18 patients with no evidence of macroscopic tumour demonstrated the presence of microfoci of cancer cells in the muscle layer or perirectal fat in 15 (R1mic). No disease progression (tumour volume or stage) occurred in the interval between neoadjuvant treatment and TEM.

Comparison of grading before neoadjuvant treatment with downstaging (assessed by definitive histology) or tumour mass reduction (assessed by imaging) failed to show any statistically significant relationship in patients with either T2 or T3 tumours (*Table 4*).

Side-effects of radiotherapy involved skin erythema in 66 patients and diarrhoea in 22. All patients completed the course of radiotherapy.

Table 3 Response to radiotherapy in 100 patients

Pre-neoadjuvant treatment stage	Downstaged (definitive histology)		Not downstaged (definitive histology)		
			> 50% reduction*	30–50% reduction*	< 30% or no reduction*
T2 ($n = 54$)	R0	3	12	19	7
	R1mic	9			
	R1 pT1	4			
	Total	16			
T3 ($n = 46$)	R0	0	7	8	4
	R1mic	6			
	R1 pT1	5			
	pT2	16			
	Total	27			

*Reduction in tumour diameter.

Table 4 Correlation between response to neoadjuvant therapy and grading in patients with T2 and T3 rectal cancer

Grade*	Down-staged	Not downstaged			*P*‡
		> 50% reduction†	30–50% reduction†	< 30% or no reduction†	
T2					1·000
G1 ($n = 8$)	2	2	3	1	
G2 ($n = 40$)	12	9	14	5	
G3 ($n = 6$)	2	1	2	1	
Total ($n = 54$)	16	12	19	7	
T3					0·881
G1 ($n = 6$)	3	1	1	1	
G2 ($n = 34$)	21	5	6	2	
G3 ($n = 6$)	3	1	1	1	
Total ($n = 46$)	27	7	8	4	

*Assessed on pre-neoadjuvant treatment macrobiopsies. †Reduction in tumour diameter. ‡Fisher's exact test.

Short-term results

No death occurred within 30 days of operation. There were no complications during surgery, and no conversion to another surgical procedure was necessary. Median operating time was 105 (range 60–210) min. Pain in the first 5 days after surgery was negligible, and only eight patients required an analgesic (ketorolac 30 mg; Roche, Milan, Italy), a single dose, in the first 48 h.

Patients were allowed to drink liquids on the first postoperative day and to eat on the following day. All patients were walking freely within 6 h of operation. Median hospital stay was 4 (range 3–9) days.

Minor complications occurred in 11 patients, including suture dehiscence in eight patients (complete suture dehiscence in three and partial suture dehiscence, limited to 30–40 per cent of the suture line, in five patients), stool incontinence in two and rectal haemorrhage in one patient on the eighth postoperative day. All suture dehiscences were treated by local therapy (metronidazole 0·5 g/100 ml (PTH Pharma, Milan, Italy) and lidocaine 200 mg/10 ml (Bioindustrial L.I.M., Novi Ligure (AL), Italy) in a single solution enema every day) and total parenteral nutrition. Stool incontinence was treated by physiotherapy and anal sphincter biofeedback. Symptoms resolved in all patients within 2 months of surgery.

Two patients had major complications. A small urethral lesion occurred in a man during wide anterior dissection of the prostatic capsule. The lesion was recognized and promptly repaired during the TEM procedure. The patient was discharged with a urinary catheter *in situ*, which was removed 3 weeks later. The second major complication was a perianal phlegmon, treated by temporary laparoscopic ileostomy, in a patient who had received preoperative chemoradiotherapy.

Long-term results

Median follow-up was 55 (range 7–120) months. No recurrence or cancer-related death was observed in patients with R0, R1mic or R1 pT1 rectal cancer.

Local recurrence occurred in five patients. Three patients with R1 pT2 tumours presented with recurrence at 30, 12 and 6 months; all underwent laparoscopic abdominoperineal resection. The first patient died from metastatic disease 4 months after reoperation, and the other two were alive and disease free at 19 and 15 months' follow-up respectively. In two patients with R1 pT3 tumours, classified as high risk (ASA grade 4), local recurrence was found after 15 and 20 months' follow-up. Recurrences were treated by supplemental radiotherapy (35·0 Gy with field limited to the local recurrence), but the patients died from metastatic disease at 24 and 11 months respectively after diagnosis of recurrence.

The cumulative probability of local recurrence at 90 months' follow-up was 5 per cent (*Fig. 1*). Two patients developed a single distant metastasis. One patient with an R1 pT2 tumour developed liver metastasis at 26 months of follow-up; this patient underwent hepatic resection and died 13 months later from systemic disease. The other patient (R1 pT3) developed lung metastasis 3 years later and had a pulmonary resection. No other distant lesions were detected.

The cumulative probability of distant recurrence at 90 months was 2 per cent. It is notable that, of the five patients who developed local recurrence, the three with T2 tumours and one of the two patients with a T3 tumour

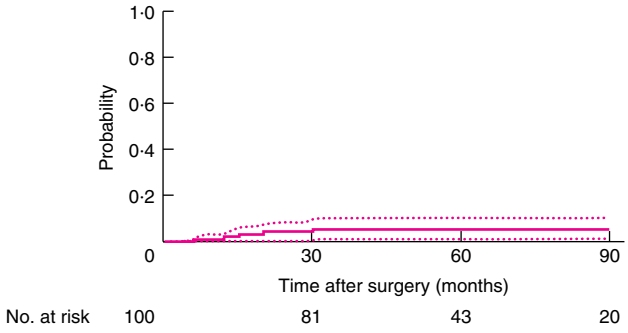

Fig. 1 Cumulative probability of local failure in patients with T2 and T3 tumours. Dotted lines show 95 per cent confidence intervals

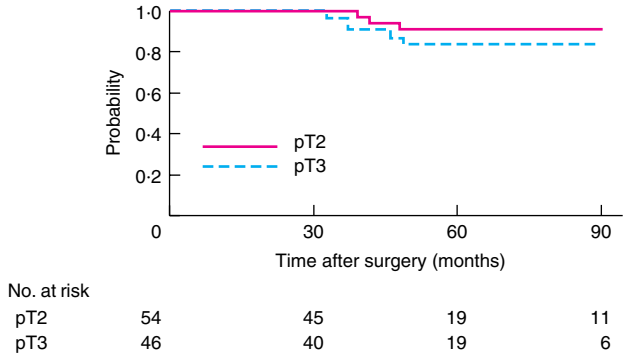

Fig. 2 Probability of rectal cancer-specific survival in patients with pT2 and pT3 tumours ($P = 0{\cdot}339$; log rank test)

had responded poorly to neoadjuvant therapy (reduction in tumour diameter less than 30 per cent, or no reduction).

The predicted probability of rectal cancer-specific survival after 90 months' follow-up was 89 (95 per cent c.i. 81 to 96) per cent, and that for overall survival was 72 (95 per cent c.i. 60 to 84) per cent. The rectal cancer-specific survival rate in patients with R1 pT2 disease was 92 (95 per cent c.i. 83 to 100) per cent and that in patients with R1 pT3 disease 85 (95 per cent c.i. 73 to 93) per cent (*Fig. 2*).

Discussion

Local excision of rectal tumours preserves anal continence and bladder and sexual function, but when used alone is associated with a high recurrence rate. For this reason, local excision has been used only in patients at high risk for major surgery. These results, however, were obtained using classical transanal surgical techniques (Parks, Mason, Francillon, etc.), which do not provide an adequate view of the operative field and are generally performed as full-thickness excisions without significant excision of local perirectal fat. Over the past 20 years, local excision with curative intent was accepted only for patients who presented with T1 adenocarcinoma, with favourable prognostic features such as small size (less than 4 cm), mobile tumour and moderately or well differentiated histology without vascular, lymphatic or perineural invasion. In patients with T1 tumours, local excision is feasible as the reported cure rate is high (above 90 per cent) and the risk of recurrence low (less than 10 per cent). However, in patients with T2 and T3 rectal tumours the reported local recurrence rate after local excision alone is between 17 and 50 per cent[1,3,15]. This is partly explained by the higher incidence of lymph node metastasis in patients with more advanced disease, ranging from 15 per cent for tumours confined to the rectal wall to 60 per cent when extrarectal invasion is present[1].

Recent developments in radiation therapy have led to an improvement in local control of rectal cancer, with better functional results in selected patients. Preoperative radiotherapy offers several advantages, both biological (potential reduction of tumour seeding at operation) and functional (possibility of proceeding with local excision instead of coloanal resection or abdominoperineal excision). In patients with locally advanced disease not amenable to resection, radiotherapy may reduce the size of the tumour to allow surgical resection.

In a previous preliminary study by the present authors, the results of TEM combined with high-dose radiotherapy in patients with pT2 rectal cancer were similar to those for conventional surgery[2]. In the present series of patients with rectal cancer, comparison of the postradiotherapy stage by imaging with the T stage found at definitive histological analysis indicated understaging of the lesions in only 6 per cent of patients. After neoadjuvant therapy, a significant reduction of tumour mass was obtained in more than half of patients with uT2 tumours (30 per cent downstaged and 22 per cent with a tumour size reduction greater than 50 per cent) and in nearly three-quarters of those with uT3 tumours (59 per cent downstaged and 15 per cent with a reduction greater than 50 per cent). With this marked response to neoadjuvant therapy, local excision was much easier to perform and no significant side-effects were reported after radiotherapy. Radiotherapy did not increase the technical difficulty of dissection or suturing by TEM, or the risk of suture line dehiscence, in comparison with the results of open or laparoscopic surgery[2,12,13]. Others have reported similar findings after high-dose preoperative radiation (60 Gy) and conservative surgery, with no increase in mortality or morbidity compared with conventional surgery[16–18].

Suture dehiscence in the present series occurred only in the presence of suture line tension after wide full-thickness excision. This event occurred in eight of the 100 patients, but complete suture dehiscence was observed in only three patients; in five the suture dehiscence was partial and limited to 30–40 per cent of the suture line. In all patients, leakage healed with medical treatment and no diversion was necessary. No significant stricture of the rectal lumen occurred after healing. In clinical practice, suture dehiscence after TEM had a more favourable clinical outcome than dehiscence after conventional anterior resection, which requires a diverting colostomy in most patients.

In this series of 100 patients, five developed tumour recurrence (three R1 pT2, two R1 pT3). The rectal cancer-specific survival rate was 92 per cent in patients with T2 tumours and 85 per cent in those with T3 lesions. These results are similar to those reported for open or laparoscopic surgery[5,14,19,20]. Moreover, three of the five patients with recurrence underwent reoperation, and two were disease free at follow-up.

In the authors' experience, and as reported recently by others[21], indications for local excision of T2 and T3 rectal cancer should usually be limited to a selected group of patients with small tumours (less than 3 cm in diameter) and a significant response to radiotherapy. In the present series, no recurrence occurred in any patient with preoperative T2 or T3 disease that was downstaged or reduced in size by more than 50 per cent following radiotherapy. An interesting finding was that tumour size reduction after preoperative radiotherapy was the most reliable prognostic indicator of the success of local excision. In fact, most of the local as well as systemic failures were observed in patients with no or little response to radiotherapy. Of the five patients who developed local recurrence, four had a reduction in tumour diameter of less than 30 per cent or no reduction following radiotherapy, and five of the eight patients who died from systemic spread (three R1 pT2 and five R1 pT3) had a poor response.

Another interesting finding was that the grading classification was not predictive of tumour reduction and did not influence survival in patients undergoing preoperative radiotherapy.

At present, despite these favourable long-term results, the indications for local excision of T2 and T3 rectal cancers are limited to a highly selected group of patients. Before any further conclusions can be drawn, it is necessary to await the results of randomized trials; one such trial is presently ongoing.

TEM combined with preoperative radiotherapy may be considered an effective, minimally invasive, approach for the management of small T2 and T3 N0 rectal tumours that respond to neoadjuvant radiotherapy. The absence of mortality, the low perioperative morbidity rate and the good quality of life observed (unpublished data) demonstrate that TEM combined with radiotherapy may be a valid alternative to conventional rectal resection in a selected group of patients. In terms of local recurrence and survival, the results of this minimally invasive approach appear to be no less favourable than those reported for conventional surgery.

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References

1 Kim CJ, Yeatman TJ, Coppola D, Trotti A, Williams B, Barthel JS *et al*. Local excision of T2 and T3 rectal cancers after downstaging chemoradiation. *Ann Surg* 2001; **234**: 352–358.
2 Lezoche E, Guerrieri M, Paganini AM, Feliciotti F. Long term results of patients with pT2 rectal cancer treated with radiotherapy and transanal endoscopic microsurgical excision. *World J Surg* 2002; **26**: 1170–1174.
3 Varma MG, Rogers SJ, Schrock TR, Welton ML. Local excision of rectal carcinoma. *Arch Surg* 1999; **134**: 863–867.
4 Blair S, Ellenhorn JD. Transanal excision for low rectal cancers is curative in early-stage disease with favorable histology. *Am Surg* 2000; **66**: 817–820.
5 Poulin EC, Schlachta CM, Grégoire R, Seshadri P, Cadeddu MO, Mamazza J. Local recurrence and survival after laparoscopic mesorectal resection for rectal adenocarcinoma. *Surg Endosc* 2002; **16**: 989–995.
6 Winde G, Nottberg H, Keller R, Schmid KW, Bunte H. Surgical cure for early rectal carcinomas (T1). Transanal endoscopic microsurgery *vs*. anterior resection. *Dis Colon Rectum* 1996; **39**: 969–976.
7 Marks G, Mohiuddin M, Masoni L. The reality of radical sphincter preservation surgery for cancer of the distal 3 cm of rectum following high-dose radiation. *Int J Radiat Oncol Biol Phys* 1993; **27**: 779–783.
8 Rullier A, Laurent C, Vendrely V, Le Bail B, Bioulac-Sage P, Rullier E. Impact of colloid response on survival after preoperative radiotherapy in locally advanced rectal carcinoma. *Am J Surg Pathol* 2005; **29**: 602–606.
9 Valentini V, Coco C, Picciocchi A, Morganti AG, Trodella L, Ciabattoni A *et al*. Does downstaging predict improved outcome after preoperative chemoradiation for extraperitoneal locally advanced rectal cancer? A long-term analysis of 165 patients. *Int J Radiat Oncol Biol Phys* 2002; **53**: 664–674.

10 Marijnen CA, Glimelius B. The role of radiotherapy in rectal cancer. *Eur J Cancer* 2002; **38**: 943–952.
11 Ruo L, Guillem JG, Minsky BD, Quan SH, Paty PB, Cohen AM. Preoperative radiation with or without chemotherapy and full-thickness transanal excision for selected T2 and T3 distal rectal cancers. *Int J Colorectal Dis* 2002; **17**: 54–58.
12 Lezoche E, Guerrieri M, Paganini AM, Feliciotti F. Transanal endoscopic microsurgical excision of irradiated and nonirradiated rectal cancer. A 5-year experience. *Surg Laparosc Endosc* 1998; **8**: 249–256.
13 Lezoche E, Guerrieri M, Paganini AM, Feliciotti F, Di Pietrantonj F. Is transanal endoscopic microsurgery (TEM) a valid treatment for rectal tumors? *Surg Endosc* 1996; **10**: 736–741.
14 Lezoche E, Guerrieri M, Paganini AM, D'Ambrosio G, Baldarelli M, Lezoche G *et al*. Transanal endoscopic *versus* total mesorectal laparoscopic resections of T2-N0 low rectal cancers after neoadjuvant treatment: a prospective randomized trial with a 3-years minimum follow-up period. *Surg Endosc* 2005; (epub ahead of print).
15 Sengupta S, Tjandra JJ. Local excision of rectal cancer: what is the evidence? *Dis Colon Rectum* 2001; **44**: 1345–1361.
16 Rouanet P, Fabre JM, Dubois JB, Dravet F, Saint Aubert B, Pradel J *et al*. Conservative surgery for low rectal carcinoma after high-dose radiation. Functional and oncologic results. *Ann Surg* 1995; **221**: 67–73.
17 Mendenhall WM, Rout WR, Zlotecki RA, Mitchell SE, Marsh RD, Copeland EM III. Conservative treatment of rectal adenocarcinoma. *Hematol Oncol Clin North Am* 2001; **15**: 303–319.
18 Graham RA, Hackford AW, Wazer DE. Local excision of rectal carcinoma: a safe alternative for more advanced tumors? *J Surg Oncol* 1999; **70**: 235–238.
19 Read TE, Ogunbiyi OA, Fleshman JW, Binbaum EH, Fry RD, Myerson RJ *et al*. Neoadjuvant external beam radiation and proctectomy for adenocarcinoma of the rectum. *Dis Colon Rectum* 2001; **44**: 1778–1790.
20 Heald RJ, Moran BJ, Ryall RD, Sexton R, MacFarlane JK. Rectal cancer: the Basingstoke experience of total mesorectal excision, 1978–1997. *Arch Surg* 1998; **133**: 894–899.
21 Schell SR, Zlotecki RA, Mendenhall WM, Marsh RW, Vauyhey JN, Copeland EM III. Transanal excision of locally advanced rectal cancers downstaged using neoadjuvant chemoradiotherapy. *J Am Coll Surg* 2002; **194**: 584–591.