

Total mesorectal excision (TME) in the treatment of rectal cancer

Marek Bębenek, Kennet Smedh¹, Tomasz Bojarowski, Marek Pudełko

Rectal cancer remains one of the most common malignancies in many countries. For decades the "golden standard" treatment for rectal cancer was abdomino-perineal excision (APE) based on Miles' concept of rectal cancer spreading. This conventional surgery (manual or blind dissection) has been associated with local recurrence rates of 20 to 45% and a five-year disease-free survival rate of some 50%.

A new era for rectal surgery started in 1982 when Heald introduced the total mesorectum excision technique (TME). From this time we have seen great changes in surgical results for rectal cancer.

Patients undergoing only surgical treatment in the form of TME, local recurrence rates were between 3% and 8% and five-year disease-free survival rates were up to 85%. The main technical distinction between TME and conventional surgery is the use of sharp instrument dissection under direct vision, following a defined plane between the visceral and the parietal layers of the pelvic fascia.

The TME technique has now been well accepted worldwide due to its excellent results in lowering the rate of local recurrence and successful overall survival after rectal surgery. We postulate that the TME technique should be the standard procedure in rectal cancer surgery in Poland.

Całkowite wycięcie mezorectum (TME) w leczeniu raka odbytnicy

Rak odbytnicy jest jednym z najczęstszych nowotworów w wielu krajach. Złotym standardem w leczeniu tego nowotworu przez dziesięciolecia było brzuszno-kroczone odjęcie odbytnicy, bazujące na założeniach Miles'a, dotyczących dróg szerzenia się tego nowotworu. Ten tradycyjny sposób operowania (na tępo, bez kontroli wzroku) związany był z 20 do 45% nawrotów miejscowych i przeżyciami pięcioletnimi do 50%.

Nowy rozdział w chirurgii raka odbytnicy rozpoczął się w 1982 r. kiedy Heald przedstawił technikę całkowitego wycięcia mezorectum (TME). Od tego czasu obserwujemy znaczące postępy w wynikach leczenia operacyjnego raka odbytnicy.

U pacjentów poddanych wyłącznie leczeniu chirurgicznemu sposobem TME stwierdzono nawroty miejscowe wg różnych autorów od 3% do 8%, a pięcioletnie przeżycia do 85%.

Podstawowa różnica pomiędzy techniką TME a konwencjonalnym sposobem polega na operowaniu na ostro, pod kontrolą wzroku, pomiędzy ściśle zdefiniowanymi powierzchniami powięzi trzewnej i ściennej miednicy małej. Technika TME znalazła obecnie szerokie uznanie w świecie, w związku z doskonałymi wynikami, polegającymi na obniżeniu odsetka nawrotów miejscowych i poprawie całkowitego przeżycia po leczeniu chirurgicznym. W związku z tym postulujemy, by technika całkowitego wycięcia mezorectum stała się standardem w leczeniu chirurgicznym raka odbytnicy w Polsce.

Key words: rectal cancer, surgery, total mesorectal excision

Słowa kluczowe: rak odbytnicy, całkowite wycięcie mezorectum

Colorectal cancer is the leading type of cancer in most developed countries. In more than half of all patients with colorectal cancer, surgery alone or surgery combined with adjuvant therapy, is the main way of treating the disease. Carcinoma of the rectum constitutes approximately one-third of these and will alone affect more than 3842 persons in Poland annually. A debate concerning the surgical strategies for rectal carcinoma treatment has been held over the years. Many surgeons

agree that the technical component of operative treatment of rectal carcinoma is important for the outcome. Local control and overall outcome after treatment for rectal cancer are clearly related to the adequacy of the surgical procedure. Local recurrence rates of 3 to 43% are reported in various series for surgical treatment of rectal cancer. Surgeons all over the world have been trying to find the "golden" technical procedure to achieve the main goals in successful operative treatment: complete tumour resection, prevention of local and systemic metastasis, nerve-sparing and preservation of the postoperative bladder and sphincter as well as sexual functions. As documented,

Dolnośląskie Centrum Onkologii, Wrocław, Poland

¹ Central Hospital, Västerås, Sweden

these aims are not attainable using the older, conventional type of surgery, called blunt or manual dissection. Abdominoperineal excision (APE) is commonly used during blunt dissection. For many decades APE was the dominant surgical procedure and the “golden standard” treatment for rectal adenocarcinoma, particularly of the lower one-third of the rectum. APE has been performed on many millions of patients, and it has probably cured less than one-fourth of them. Heald and co-workers like to call APE an “endangered operation” [1]. This conventional surgery is based on the Miles concept of rectal cancer spread [2]. He considered the levators, the ischioanal fat, sphincters and the perianal skin, as tissues with tumor spread and suggested their resection. During the procedure the surgeon, without direct vision, inserts the hand into the loose areolar tissue by the rectosacral ligament – the fusion of the parietal and visceral layers of the pelvic fasciae – towards the mesorectum, the fatty layer surrounding the rectal bowel wall where visceral branches and regional lymph nodes are situated. The main focus is based on macroscopic tumor removal and the distal resection margin. However, less attention is paid to the preservation of mesorectal integrity and to careful dissection of lateral ligaments containing autonomic nerves. In general, as a consequence of the latter (nerve injury), postoperative sexual and bladder dysfunction is often reported by patients [3-5]. Moreover, inadequate resection of the mesorectum performed without definable tissue planes during blunt surgery causes a higher risk of further metastasis, first, because tumor cells extruding through the imperfectly occluded anus may inoculate [1], and, second, because the fragmented mesorectum left in the pelvis with its lymph nodes (often positive for metastatic spread) may serve as a source for further local recurrences approximately 18 months later [6]. Local failure rates after blunt dissection are as high as 20-45% [7-9].

A new era for rectal surgery started in 1982, when Heald first introduced the technique Total Mesorectal Excision (TME) [10], also called Circumferential Mesorectal Excision [6], Sharp Mesorectal Excision, Extrafascial Excision of the Rectum and Total Anatomical Dissection. Heald postulated that inadequate mesorectal excision is the cause of local recurrences and that all cancers of the middle and lower third rectum should be excised with the mesorectum left intact. Heald had demonstrated that not the pelvic fascia, which is an “almost impenetrable barrier to the spread of carcinoma” [11, 12], but the mesorectum is the main tissue for neoplastic spread in rectal cancer via lymphatic flow [10, 13, 14]. The visceral fascia envelopes the rectum and the mesorectum. The parietal fascia covers the musculoskeletal and vascular boundaries of the sidewalls, including the pelvic autonomic nerves and plexuses. Heald's concept was further supported by histopathological evaluations by Quirke's group. Quirke and other authors showed that the left circumferential margin carries a risk of local failure greater than 80% [15-17]. Lateral resection margin involvement with surgical

clearance of ≤ 1 mm in a single slice, assessed by histopathology, is considered unsatisfactory and is associated with a poor prognosis and the failure of surgery [18, 17]. As indicated, 29% of patients with a positive margin and only 8% of patients with a negative margin developed local recurrences [19]. The main attention paid by surgeons preceding TME is the removal of the whole visceral mesentery of the rectum without leaving a substantial circumferential and distal residue. The basic principles and the main differences between conventional surgery (APE) and TME are illustrated in Figure 1. The

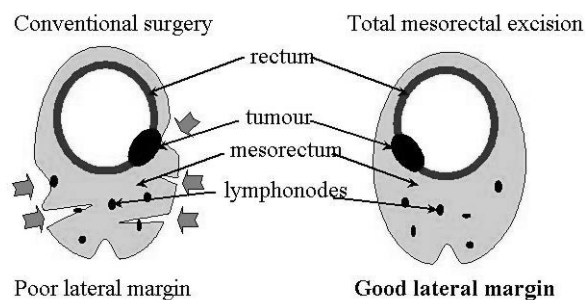


Figure 1. Postoperative specimen – crosssection

correct plane is definable and avascular, and sharp dissection without tearing the surface is performed with direct vision down into the pelvis around the area of the rectum with the tumor and along the surface of the fatty, lymphovascular mesorectum five cm below the tumor. Muscle margin may be reduced to one up to two cm [7, 14, 20, 21]. During the procedure every effort is made to preserve mesorectal integrity together with an awareness of the lateral rectal ligaments containing the pelvic autonomic nerve plexus, since damage to the latter may have drastic consequences on postoperative bladder and sexual functions. Besides the pelvic autonomic nerves, the following nerves should also be untouched: the superior hypogastric nerve and anterior nerve roots S2, S3 and S4. Lower local recurrences and a higher survival rate, better levator muscle and sphincter (anus) preservation together with pelvic autonomic and plexus preservation, as well as avoidance of sexual and urinary morbidity, are all main goals of modern rectal surgery achievable by TME, especially with use of low stapled anastomosis (the latter being used to maximize sphincter preservation) [5, 8, 22]. Local recurrence as low as 3-8% at five years and long-term survivals of over 80% after complete excision achieved without any additional adjuvant therapy were reported by several authors [7-9, 23-28] (Table I). These dramatic improvements are all attributable to the more complete resection accomplished by fundamental changes in the surgical technique. The technical distinction between TME and conventional surgery is the use of sharp instrument dissection under direct vision, following a defined plane between the visceral and the parietal layers of the pelvic fascia [8]. It should be stressed that the precision, skill and experience of the surgeon performing the procedure are no less

Table I. The effects of surgical treatment after conventional and TME approaches as presented from selected publications

Source	Number of patients	Local recurrences	Five-year disease-free survival rate
Conventional technique			
Arbman et al., 1996 [9]	134	24%	50%
LSCO*	270	24%	40%
TME			
Arbman et al., 1996 [9]	125	8%	70%
Bjerkset et al., 1996 [24]	81	4%	85%
Zaheer et al., 1998 [26]	514	7%	79%
Heald et al., 1998 [25]	405	3%	80%

*Lower Silesian Center of Oncology (own data)

important than the chosen technique. Hermanek and co-workers have reported a variation from 4% to 55% of local recurrences among 43 surgeons (594 patients) [29].

Notably, the technique routinely used by Japanese colleagues with extended pelvic lymphadenectomy in which both mesenteric and extramesenteric lymphatic tissues are removed is still unproven in Western countries [30]. A radical resection of the retroperitoneum between the ureters and laying bare the inferior vena cava and aorta and sacral nerve roots in the pelvis are performed. As documented, this extremely radical procedure is highly dangerous for the preservation of urinary and sexual functions since the autonomic nerves are damaged: 30% of patients had urinary problems and more than 70% experienced sexual dysfunction [31].

The other unsolved and very controversial surgical dilemma in rectal cancer continues to be the application of neoadjuvant therapy along with operation procedures. More retrospective or/and more new studies should be undertaken to evaluate and establish such a need. Especially now when the new surgical technique of TME has highly improved and dramatically lowered local failure even without the addition of adjuvant therapy, should recommendations for radiochemotherapy be reconsidered [32] (Table II). Zaheer concludes that although each successful surgery gives a low rate of local recurrences and good long-term survival, in some instances such as stage III disease, surgical treatment

Table II. Local and overall recurrence rates from TME and NCCTG (North Central Cancer Treatment Group) – Dukes B and C [7]

	Local recurrences	Overall recurrences
TME	5.0%	22.0%
Conventional surgery + radiation therapy	25.0%	62.7%
Conventional surgery + chemotherapy + radiation therapy	13.5%	41.5%

alone is probably not sufficient [26]. Presently there is a discussion about current standard treatments based primarily on applications of radiotherapy to all patients with stage II and III diseases as well as about preoperative intensive short-course radiation for all patients [33, 34]. One concept for future exploration concerns a multimodal treatment based on pathological/molecular features of an individual patient, sophisticated imaging approaches combined innovative surgical sphincter-preserving techniques (including TME), and improved radiation techniques as well as innovative schedules and combinations of chemotherapy. However, Heald postulates that instead of investments in money-consuming multimodal treatments, it would be more clever to invest in the improvement of surgical skills as these latter are the most beneficial both for patients and long-term costs of rectal cancer treatment [35, 36]. The skill of the surgeon is an important independent variable in preventing local recurrence and increasing survival. The rectum must be dissected anatomically under direct vision and not removed by manual extraction, which was common in the past [10, 14, 24].

The TME technique has now been accepted worldwide due to its excellent results in lowering the rate of local recurrence and successful overall survival after rectal surgery alone. In countries such as Norway, Sweden, Denmark and Holland, TME is the national standard; in Germany, France and the UK the TME concept is supported. The TME technique involves sharp excision with direct vision down into the pelvis around the area of the rectum with tumor and extirpation of the mesorectum by dissecting outside the mesorectum on the endopelvic fascia. In conclusion, we postulate that the TME technique should as well be the standard procedure in rectal cancer surgery in Poland.

Marek Bębenek MD, PhD
Dolnośląskie Centrum Onkologii
pl. Hirszfelda 12
53-413 Wrocław

References

1. Heald RJ, Smedh RK, Kald AD et al. Abdominoperineal Excision of the rectum – an endangered operation. *Dis Colon Rectum* 1997; 40: 747-51.
2. Miles E. Cancer of the rectum. The Lettsomian Lectures. London: Harrison & Sons, 1923.
3. Van Driel MF, Weymar Schultz WC, van de Wiel HB et al. Female sexual functioning after radical surgical treatment of rectal and bladder cancer. *Eur J Surg Oncol* 1993; 19: 183-7.
4. Petrelli NJ, Nagel S, Rodriguez-Bigas M et al. Morbidity and mortality following abdominoperineal resection for rectal adenocarcinoma. *Am Surg* 1993; 59: 400-4.
5. Havenga K, Enker WE, McDermott K et al. Male and female sexual and urinary function after total mesorectal excision with autonomic nerve preservation for carcinoma of the rectum. *J Am Coll Surg* 1996; 182: 495-502.
6. Enker WE. Designing the optimal surgery for rectal carcinoma. *Cancer* 1996; 78: 1847-50.

7. MacFarlane JK, Ryall RDH, Heald RJ. Mesorectal excision for rectal cancer. *Lancet* 1993; 341: 457-60.
8. Enker WE, Thaler HT, Cranor ML et al. Total mesorectal excision in the operative treatment of carcinoma of the rectum. *J Am Coll Surg* 1995; 181: 335-46.
9. Arbman G., Nilsson E., Hallbook O., Siodahl R. Local recurrence following total mesorectal excision for rectal cancer. *Br. J. Surg.* 1996; 83: 375-9.
10. Heald RJ, Husband EM, Ryall RDH. The mesorectum in rectal cancer: the clue to pelvic recurrence? *Br J Surg* 1982; 60: 613-6.
11. Karanja ND, Schache DJ, North WRS et al. "Close shave" in anterior resection. *Br J Surg* 1990; 77: 510-2.
12. Scott N, Jackson P, Al-Jaberi T et al. Total mesorectal excision and local recurrence. A study of tumor spread in the mesorectum distal to rectal cancer. *Br J Surg* 1995; 82: 1031-3.
13. Heald RJ. The "Holy Plane" of rectal surgery. *J Royal Society of Med* 1988; 81: 503-508
14. Heald RJ, Ryall RDH. Recurrence and survival after total mesorectal excision for rectal cancer. *Lancet* 1986; 28: 1479-8.
15. Quirke P, Durdey P, Dixon MF et al. Local recurrence of rectal adenocarcinoma due to inadequate surgical resection. Histopathological study of the later tumour spread and surgical excision. *Lancet* 1986; 2: 996-9.
16. Cawthorn SJ, Parums DV, Gibbis NM et al. Extent of mesorectal spread and involvement of lateral resection margin as prognostic factors after surgery for rectal cancer. *Lancet* 1990; 335: 1055-59.
17. Adam IJ, Mohamdee MO, Martin IG et al. Role of circumferential margin involvement in the local recurrence of rectal cancer. *Lancet* 1994; 344: 707-11.
18. Ng IOL, Path MRC, Luk ISC et al. Surgical lateral clearance in resected rectal carcinomas. *Cancer* 1993; 71: 1972-6.
19. Haas-Kock DFM, Baeten CGMI, Jager JJ et al. Prognostic significance of radial margins of clearance in rectal cancer. *Br J Surg* 1996; 83: 781-5.
20. Di Matteo G, Mascagni D, Lentini A et al. Advances in Rectal Cancer Surgery. *Dis Colon Rectum* 1994; 37: 50-3.
21. Kwok SPY, Lau WY, Leung KL et al. Prospective analysis of the distal margin of clearance in anterior resection for rectal carcinoma. *Br J Surg* 1996; 83: 969-72.
22. Maurer CA, Z'graggen K, Renzulli P et al. Total mesorectal excision preserves male genital function compared to conventional rectal cancer surgery. *Br J Surg* 1988; 11: 1501-5.
23. McCall JL, Cox MR, Wattchow DA. Analysis of local recurrence rates after surgery alone for rectal cancer. *Int J Colorectal Dis* 1995; 10: 126-32.
24. Bjerkeset T and Edna T-H. Rectal Cancer: The influence of type of operation on local recurrences and survival. *Eur J Surg* 1996; 162: 643-8.
25. Heald RJ, Moran BJ, Ryall RD et al. Rectal cancer: the Basingstoke experience of total mesorectal excision, 1978-1997. *Arch Surg* 1998; 8: 894-9.
26. Zaheer S, Pemberton JH, Farouk R et al. Surgical treatment of adenocarcinoma of the rectum. *Annals of Surg* 1998; 227: 800-11.
27. Carlsen E, Achlichting E, Guldvog I et al. Effect of the introduction of total mesorectal excision for the treatment of rectal cancer. *Br J Surg* 1998; 85: 526-9.
28. Dahlberg M, Glimelius B, Pahlman L. Changing strategy for rectal cancer is associated with improved outcome. *Br J Surg* 1999; 86: 379-84.
29. Hermanek P, Wiebelt H., Staimer D, Riedl S and the German Study Group Colo-Rectal Carcinoma (SGCRC). Prognostic factors of rectum carcinoma: experience of the German Multicentre Study SGCRC. *Tumori* 1995; suppl. 81: 60-64.
30. Scholefield JH and Northover JMA. Surgical management of rectal cancer. *Br J Surg* 1995; 82: 745-8.
31. Hojo K. Extended wide lymphadenectomy and preservation of pelvic autonomic nerves in the rectal cancer surgery. *G Chir* 1989; 10: 149-53.
32. Kapiteijn E, van de Velde CJH. European Trials with Total Mesorectal Excision. *Sem Surg Oncol* 2000; 19: 350-7.
33. Rodel C, Sauer R. Perioperative radiotherapy and concurrent radiochemotherapy in rectal cancer. *Sem Surg Oncol* 2001; 20: 3-12.
34. Marijnens CAM, Nagtegaal ID, Klein Kranenbarg E et al. No downstaging after short-term preoperative radiotherapy in rectal cancer patients. *J Clin Oncol* 2001; 19: 1976-84.
35. Heald RJ. Total mesorectal excision. *Acta Chir Jugosl* 2000b; 45: 37-8.
36. Heald RJ. Total mesorectal excision TME. *Acta Chir Jugosl* 2000a: 47 (4 Suppl.1): 17-8.

Paper received: 24 May 2002

Accepted: 13 November 2002