Transanal Endoscopic Microsurgery
I would like to dedicate this book to my family: To my mother, Anne Cataldo, who has taught me I can do anything if I put my mind to it, and to the memory of my father, Felix G. Cataldo, who continues to inspire me; to my wife, Eileen, and my daughters, Colleen and Anna, the reasons I wake up every morning. One final thanks to all my patients who challenge me, inspire me, and bring me satisfaction and gratification beyond measure.

Peter A. Cataldo
Cancer of the rectum continues to be a significant health problem in industrialized countries around the world. Relative 5-year survival rates in the USA for cancer of the rectum from 1995 to 2001 improved to 65%, a 15% improvement over 20 years (American Cancer Society, 2007). The reasons for this dramatic improvement include more accurate preoperative staging, aggressive neoadjuvant therapy and improved surgical technique as well as specialty-trained surgeons.

Despite advances in nonoperative techniques of radiation therapy, chemotherapy and immunotherapy, surgical extirpation continues to be the cornerstone of curative treatment of this potentially lethal disease. Radical cancer excision with total mesorectal excision has become the preferred surgical procedure for even early-stage cancers of the rectum. Over the past decade the enthusiasm for local excision (and other local treatments) has given way to persuasive (predominantly retrospective) evidence that the incidence of locoregional recurrence due to unsuspected lymphatic metastases and positive lateral margins is unacceptably high even for stage T1 tumors. Vigorous attempts to find characteristics of the tumor that would allow successful local treatments are ongoing.

Transanal endoscopic microsurgery (TEM) is a technique for the performance of local excision by way of a binocular magnified operating system developed in the early 1980s. Adoption of the technique was slow, due in part to the complexity of the operative procedure as well as the expense of the equipment. Early adopters of the procedure were few in number. As laparoscopic surgery became more widespread, basic ability to work from a flat screen in relatively small spaces became more commonplace and TEM seemed more feasible. More and more units around the world purchased the equipment and applied the techniques of TEM, particularly in patients with distal rectal cancers for whom radical cancer excision represented the creation of a permanent colostomy.

Peter Cataldo has collected contributions from internationally recognized experts in TEM as well as local excision of rectal cancer. Beginning with a frank discussion of the broad indications and potential problems with TEM, the book then presents a comprehensive pictorial atlas of equipment and setup and a candid presentation of how to get started with the procedure. Complications do occur and are frankly presented.

When one starts doing TEM, the most striking improvement over conventional local excision is the magnification and optical resolution that must result in a better local procedure. Repeatedly, this observation is made by the contributors to this book. One author presents a local recurrence rate for TEM in stage T1 and T2 cancers of 0%. All of the published comparative trials demonstrate significantly better oncologic results for rectal cancer treated by TEM than by conventional local excision.

Of interest is the fact that TEM has finally been adopted by the colorectal surgical community at the same time as the current majority opinion is that radical cancer excision is
much preferred for distal rectal cancer. Clearly, all of the returns regarding treatment of
distal rectal cancer are not in and much of what we do now will change in the near term as
techniques evolve.

Not surprisingly, creative individuals have applied TEM for other indications, including
benign rectal lesions, complex fistulas and rectourethral and rectovaginal fistulas and even
natural orifice transluminal endoscopic surgery (NOTES). As expertise and applications
expand, the only limit to the use of this technology (and subsequent improvements) is the
imagination of the users.

To my knowledge, this volume represents the first comprehensive description of TEM; it
is succinct yet comprehensive and will be a necessary partner in the development and
application of this relatively newly discovered procedure.

David J. Schoetz, Jr.
Professor of Surgery
Tufts University School of Medicine
Boston, MA, USA
Lahey Clinic
Burlington, MA, USA
Preface

Transanal endoscopic microsurgery (TEM) was developed in the early 1980s in Tübingen, Germany, by Gerhard Buess and the Richard Wolf Medical Instrument Company to remove large rectal polyps beyond the reach of standard transanal excision. It has blossomed into a valuable, state-of-the-art technology equal to any other technique in terms of reliably positive patient outcome. Its role has expanded beyond excision of colonoscopically unresectable polyps to include removal of select, early rectal cancers with or without adjuvant chemoradiation therapy, the treatment of anastomotic strictures, and repair of proximal, complex rectal fistulae. TEM was initially embraced more rapidly in Europe (particularly Germany and Italy), but is now becoming well established in the USA and Canada. TEM has been embraced by many of the leading teaching hospitals and highly respected colon and rectal clinics throughout the USA. The number of cases performed each year is increasing substantially, with an estimated 800 performed in 2007.

Transanal Endoscopic Microsurgery: Principals and Techniques is the first and only book solely dedicated to TEM and we are hopeful it will become the standard reference for the technique. It is our hope that the book will be well received and widely read so that all patients who can benefit from this technique will have that opportunity. Expert authors from around the world have dedicated their precious time and created outstanding chapters on all aspects of TEM. Special thanks to each of them. Gerhard Buess, the father and inventor of TEM, has worked countless hours creating an incredibly detailed DVD with outstanding video clips that clearly and beautifully demonstrate all the important technical aspects of this challenging procedure. He has been and continues to be a mentor to me and many other TEM surgeons. We are all profoundly grateful.

In addition, Tina Blais-Armell has worked tirelessly, without complaint, and with little thanks to coordinate the efforts of all involved; without her there would be no book. I owe her a great debt of thanks. Paula Callaghan and Lindsey Reilly from Springer have provided much needed help in moving this project along, prodding those who needed prodding and doing all the little things no one notices—thank you Paula and Lindsey!

Peter A. Cataldo
## Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Foreword</td>
<td></td>
<td>vii</td>
</tr>
<tr>
<td></td>
<td>Preface</td>
<td></td>
<td>ix</td>
</tr>
<tr>
<td></td>
<td>Contributors</td>
<td></td>
<td>xiii</td>
</tr>
<tr>
<td>1</td>
<td>Indications</td>
<td>Mark H. Whiteford</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Preoperative Preparation</td>
<td>Garnet J. Blatchford and N. Anh Tran</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Equipment and Operative Set-up</td>
<td>Lee E. Smith</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Pelvic Anatomic Considerations for Transanal Endoscopic Microsurgery</td>
<td>Peter A. Cataldo</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>Getting Started</td>
<td>Patricia L. Roberts</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>Partial-Thickness Excision</td>
<td>Peter A. Cataldo and Neil J. Mortensen</td>
<td>41</td>
</tr>
<tr>
<td>7</td>
<td>Full-Thickness Excision</td>
<td>Emanuele Lezoche, Mario Guerrieri, Maddalena Baldarelli and Giovanni Lezoche</td>
<td>47</td>
</tr>
<tr>
<td>8</td>
<td>Advanced Surgical Techniques</td>
<td>Prakash Gatta and Lee L. Swanstrom</td>
<td>59</td>
</tr>
<tr>
<td>9</td>
<td>Complications</td>
<td>K.S. Khanduja</td>
<td>75</td>
</tr>
<tr>
<td>10</td>
<td>Comparison with Traditional Techniques</td>
<td>Matthew R. Dixon and Charles O. Finne</td>
<td>85</td>
</tr>
</tbody>
</table>
11 Full-Thickness Local Excision ........................................... 109
Lauren A. Kosinski, John H. Marks, and Gerald J. Marks

12 Oncologic Outcomes .................................................... 117
Joel E. Goldberg and Ronald Bleday

13 Clinical Trials ............................................................. 125
Kim F. Rhoads and Julio E. Garcia-Aguilar

14 Future Directions ......................................................... 135
Mark Choh and Theodore J. Saclarides

Index .................................................................................. 141
Contributors

Maddalena Baldarelli, MD
Clinica di Chirurgia Generale e Metodologia Chirurgica, Università Politecnica delle Marche, Ospedali Riuniti di Ancona, Ancona, Italy

Garnet J. Blatchford, MD
Creighton University, Omaha, NE, University of Nebraska Medical Center, Omaha, NE, USA

Ronald Bleday, MD
Section of Colorectal Surgery, Brigham and Women’s Hospital, Harvard Medical School, Boston, MA, USA

Gerhard F. Buess, MD, FRCS
Eberhard Karls Universitaet Tuebingen, Tuebingen, Germany

Peter A. Cataldo, MD, FACS, FASCRS
University of Vermont College of Medicine, Burlington, VT, USA

Mark Choh, MD
Rush Medical College, Rush University Medical Center, Chicago, IL, USA

Matthew R. Dixon, MD
Department of Surgery, Kaiser Permanente, Oakland, CA, USA

Charles O. Finne, MD
University of Minnesota, Minneapolis, MN, USA

Prakash Gatta, MBBS
Department of Surgery, University Hospital, University of Cincinnati, Cincinnati, OH, USA

Julio E. Garcia-Aguilar, MD
University of California, San Francisco, San Francisco, CA, USA

Joel E. Goldberg, MD
Brigham and Women’s Hospital, Harvard Medical School, Boston, MA, USA

Mario Guerrieri, MD
Clinica di Chirurgia Generale e Metodologia Chirurgica, Università Politecnica delle Marche, Ospedali Riuniti di Ancona, Ancona, Italy
Contributors

K.S. Khanduja, MD, FACS, FASCRS
Mount Carmel Health System, The Ohio State University Medical Center, Columbus, OH, USA

Lauren A. Kosinski, MD, MS
Lankenau, Bryn Mawr, and Paoli Hospitals, Wynnewood, PA, USA

Emanuele Lezoche, MD
Dipartimento di Chirurgia Paride Stefanini, La Sapienza Universita’ Di Roma, Policlinico Umberto I, Rome, Italy

Giovanni Lezoche
Dipartimento di Chirurgia Paride Stefanini, La Sapienza Universita’ Di Roma, Policlinico Umberto I, Rome, Italy

Gerald J. Marks, MD
Drexel University, Philadelphia, PA, Marks Colorectal Surgical Associates, Lankenau Hospital, Wynnewood, PA, USA

John H. Marks, MD
Lankenau, Bryn Mawr, and Paoli Hospitals, Wynnewood, PA, USA

Neil J. Mortensen, MD, FR
John Radcliffe Hospital, Oxford, UK

Kim F. Rhoads, MD, MS, MPH
Mt. Zion Cancer Center, University of California, San Francisco, San Francisco, CA, USA

Patricia L. Roberts, MD
Tufts University School of Medicine, Boston, MA, Lahey Clinic, Burlington, MA, USA

Theodore J. Saclarides, MD
Rush Medical College, Rush University Medical Center, Chicago, IL, USA

Lee E. Smith, MD, FACS
Georgetown University, Colon and Rectal Surgery, Washington Hospital Center, Washington, DC, USA

Lee L. Swanstrom, MD
Minimally Invasive Surgery, Legacy Health System and Oregon Clinic, Portland, OR, USA

N. Anh Tran, MD
Creighton University Medical Center, Omaha, NE, USA

Mark H. Whiteford, MD, FACS, FASCRS
Oregon Health and Science University, Legacy Portland Hospitals, Portland, OR, USA
Chapter 1
Indications

Mark H. Whiteford

Transanal techniques have long been used for management of rectal diseases. Transanal local excision of rectal tumors was popularized by Parks et al. in the 1950s and is well suited for the management of selected low rectal lesions. Removal of lesions in the middle and upper rectum presents a more challenging problem owing to the limited accessibility and inadequate exposure afforded by standard instrumentation. These more proximal lesions have traditionally been managed by low anterior, abdominoperineal, transsacral, and transsphincteric resections. The transanal endoscopic microsurgery (TEM) operating system now offers a low morbidity and often outpatient alternative to these more radical surgical options.

TEM allows greater versatility and options for the operating surgeon. In addition to extending the surgeon’s reach up to the distal sigmoid colon, the four ports of access allow for synchronous use of an illuminated camera, forceps, cautery, suction as well as the freedom to use common laparoscopic techniques such as suturing, ultrasonic dissectors, and bipolar and other energy sources.

TEM is used to treat a variety of disease processes, both benign and malignant. Table 1.1 illustrates the diverse indications reported in several large series and registries. Still others have described repair of high suprarelevator fistulas, rectourethral fistulas, drainage of pelvic collections, and excision of extrarectal masses [3, 7]. By far, the most common uses of TEM are for resection of colonoscopically unresectable rectal adenomas and carefully selected rectal cancers. It should be stressed that even though TEM extends the reach of conventional transanal resections, it should not change the stringent indications for resection, especially in regard to rectal cancer.

Resection of rectal and distal sigmoid adenomas is the most appealing indication for TEM. These are benign lesions in which patients can be spared the morbidity of an unnecessary mesorectal dissection. Smaller adenomas without evidence of high-grade dysplasia may be removed by submucosal dissection. Larger adenomas or those with high-grade dysplasia are at high risk of harboring invasive adenocarcinoma and should be excised full thickness with a 10-mm resection margin. Still others recommend full-thickness resection with en bloc removal of the adjacent mesorectum when resecting cancer with curative intent [8]. When there is suspicion but not confirmation of a malignant rectal polyp in a patient unfit for or unwilling to undergo major abdominal surgery, TEM can be useful in resecting the entire lesion in one piece for complete histologic assessment. Prompt radical surgery, if indicated, can be performed without significantly increasing morbidity.
TEM may also be useful as a palliative tool in patients with extensive metastatic disease or those medically unfit to withstand radical surgery. Neoadjuvant radiation therapy, when used in conjunction with resection either for cure or palliation, does not appear to increase complications following TEM [8].

The limited access and visibility afforded by traditional transanal retractors has restricted their use to resection of rectal polyps and cancers which are mobile, less than 8–10 cm from the anal verge, are smaller than 3–4 cm, and occupy less than 40% of the rectal circumference [9, 10]. The TEM technique permits access to the entire rectum, including lesions with a proximal margin located 20 cm from the anal verge. Resections of larger or more proximal lesions are technically more demanding, but with experience, these, as well as circumferential sleeve resections, can be performed safely [4, 11].

The inferior limit for effective use of the TEM instrument is the upper anal canal, approximately 3–4 cm proximal to the anal verge. When the surgeon is operating this low, the aperture of the operating proctoscope is prone to slipping downward and out of the anal canal. This results in escape of the CO$_2$ pneumorectum, collapse of the operative field, and loss of adequate exposure of the target lesion. Low rectal lesions, however, are good opportunities for surgeons to gain TEM operative experience, for if the TEM experience does not proceed as planned, excision can be performed with conventional transanal techniques [11]. The TEM learning experience and confidence should first be gained operating on small, distal lesions with subsequent progression to larger then more proximal lesions. Most resections can be performed through the shorter (120-mm-length) proctoscope. The longer (200-mm) TEM proctoscope has reduced degrees of freedom for instruments, is more prone to instrument conflict, and therefore is harder for the novice to operate through than the shorter proctoscope.

Resection of anterior rectal lesions requires special attention. Full-thickness excision of the anterior and even lateral rectum carries the risk of inadvertent dissection into the vagina, urethra, or bladder. Failure of adequate closure may lead to a rectourethral or rectovaginal fistula. There is little mention of this complication in the literature, suggesting its occurrence is rare.

| Table 1.1 Indications for transanal endoscopic microsurgery reported by disease process |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Adenoma                        | 1,411           | 82              | 77              | 236             | 28              | 71              |
| Carcinoma                      | 435             | 54              | 23              | 98              | 43              | 23              |
| Carcinoid                      | 5               | 7               | 2               | 1               |                 |                 |
| Rectal prolapse                | 22              | 1               |                 | 7               | 2               | 1               |
| Rectal ulcer                   | 1               |                 |                 | 2               |                 |                 |
| Non-Hodgkin’s lymphoma         |                 |                 |                 |                 |                 | 1               |
| Angiodysplasia                 |                 |                 |                 |                 | 1               |                 |
| Diverticulum                   |                 |                 |                 |                 | 1               |                 |
| Epithelioid cell granuloma     |                 |                 |                 |                 | 1               |                 |
| Hyperplastic polyp             |                 |                 |                 |                 | 1               |                 |
| Stricture                      |                 |                 |                 |                 |                 | 3               |
| Rectal stump excision          |                 |                 |                 |                 | 1               |                 |
| Endometrioma                   |                 |                 |                 |                 | 3               |                 |
| Enterovaginal fistula          |                 |                 |                 |                 | 2               |                 |

M.H. Whiteford
In an interesting in vitro anatomical study, Najarian et al. [12] documented the mean distance from the anal verge to peritoneal reflection (Table 1.2). This information should be considered in preoperative planning for TEM as intraperitoneal access, while unusual, may occur during full-thickness resection of more proximal rectal lesions.

Intraperitoneal entry carries a risk of injuring intraabdominal structures, bacterial and potential cytologic contamination, and anastomotic leak. Initially regarded as a complication, with experience, intraperitoneal excision with secure closure of the rectal defect can be performed without increased short-term morbidity [13]. If there is concern about the adequacy of an intraperitoneal closure, the patient may be observed overnight for signs of a leak and undergo a water-soluble contrast enema the following morning.

Bulky lesions such as large pedunculated or circumferential polyps can be challenging to manage with any transanal technique, including TEM. These larger specimens can be difficult to see around and are prone to fragmentation and bleeding. Hemorrhage under these circumstances may be particularly difficult to isolate and control. Fragmentation may theoretically lead to cytologic dissemination and increased recurrence rates.

Colorectal anastomotic and short postinflammatory strictures are infrequent occurrences but are particularly amenable to endoscopic management. Most published reports describe colonoscopic management in combination with pneumatic dilatation, Nd:YAG laser, argon beam coagulation, or electrocautery stricturoplasty [14–16]. There are also reports of transanal stricturoplasty using an operating urologic rectoscope [17]. There is a paucity of similar reports on the use of these techniques in combination with the TEM equipment [2, 18]. Nonetheless, this would be an appropriate indication for TEM provided the stricture is 5–15 cm from the anal verge. Strictures less than 5 cm from the anal verge will not allow insertion of the 40-mm-diameter TEM proctoscope.

Contraindications for TEM are few. These include patients unfit for general or regional anesthesia, uncorrected coagulopathy, rectal varices, and anal stenosis. A careful history of prior surgery with pelvic mesh placement should also be sought as this may hinder access of the operating proctoscope. Caution should also be taken in patients with a remote history of high-dose pelvic radiation therapy for gynecologic or urologic malignancies. Chronic radiation-induced changes are known to predispose patients to decreased rectal compliance, stenosis, friability, and impaired wound healing.

The surgeon’s personal skills and experience will also determine some of the limitations of TEM. The disease processes treated by TEM, namely, colonoscopically unresectable rectal polyps and early cancers, are far less common in clinical practice than those disease processes treated by abdominal laparoscopic operations. This limits any single surgeon’s or institution’s volume and operative experience. The TEM instrumentation can lead to a variety of new challenges for operating surgeons. Long, modified laparoscopic instruments are introduced and manipulated in a parallel fashion through a narrow proctoscope. This

| Table 1.2 Average mean anterior, lateral, and posterior length measurements from the anal verge to the peritoneal reflection. (From Table 3 in Najarian et al. [12] with kind permission of Springer Science+Business Media) |
|-----------------|-----------------|-----------------|
|                 | Women           | Men             | p    |
| Anterior (cm)   | 9 (5.5–13.5)    | 9.7 (7–16)      | NS   |
| Lateral (cm)    | 12.2 (8.5–17)   | 12.8 (9–19)     | NS   |
| Posterior (cm)  | 14.8 (11–19)    | 15.5 (12–20)    | NS   |

Ranges are in parentheses.

NS not significant.
can lead to instrument conflict, difficult tissue exposure, suboptimal traction and countertraction, and the technical hurdle of suturing closed a transverse defect using longitudinally oriented instruments.

Several factors have caused a rebirth of enthusiasm for TEM in the USA and abroad. First is the recently rekindled controversy surrounding increased local recurrence rates following standard transanal resection of favorable early rectal cancers. TEM offers some theoretic advantages over standard transanal excision of neoplasms. These include better visualization of the surgical field and tumor margins, gentler tissue handling with potentially less tumor fragmentation and dissemination, and better ability to perform an en bloc resection of the adjacent, potentially tumor bearing, mesorectum [8, 19]. Second, more and more surgeons are being trained with advanced, two-handed, laparoscopic skills. These skills are required to be facile with and take full advantage of the TEM equipment, advance through the learning curve, and not succumb to frustration, which can lead to abandonment of the technique.

The future may reveal a third potential use of TEM as a portal to the peritoneum for natural orifice translumenal endoscopic surgery (NOTES). Transgastric endoscopic peritoneoscopy, cholecystectomy, appendectomy, and tubal ligation are now active areas of basic science and clinical research. Transrectal (or transvaginal) access to the peritoneum via TEM may permit application of larger, more versatile instruments, removal of larger organs, maintenance of pneumoperitoneum, in-line instead of retroflexed views of upper abdominal organs, and secure suture closure of the proctotomy. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the American Society for Gastrointestinal Endoscopy (ASGE) have collaborated to form a NOTES working group and the Natural Orifice Surgery Consortium for Assessment and Research (NOSCAR) in an effort to facilitate research and safe clinical introduction of this emerging field [20].

References