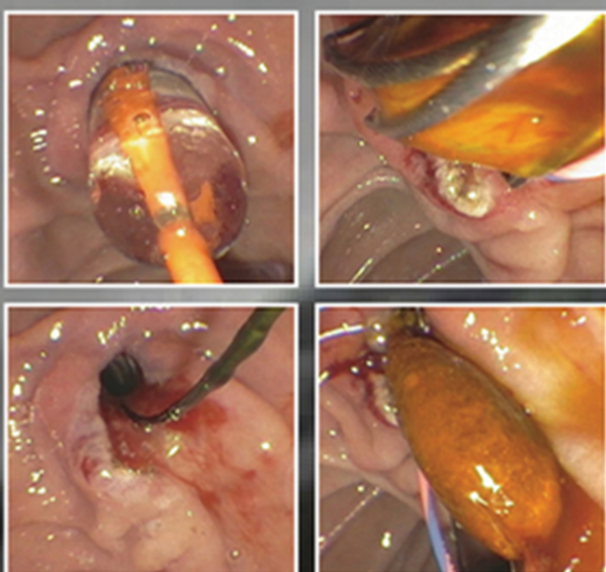
THIRD EDITION

ERCP

THE FUNDAMENTALS



Edited by
Peter B. Cotton
Joseph W. Leung

WILEY Blackwell

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Edited by

Peter B. Cotton, MD, FRCP, FRCS
Digestive Disease Center
Medical University of South Carolina
Charleston, SC, USA

Joseph W. Leung, MD, FRCP, FACP, MACG, FASGE
Department of Gastroenterology and Hepatology
University of California Davis School of Medicine
Sacramento, CA, USA;
Section of Gastroenterology
VA Northern California Health Care System
GI Unit, Sacramento VAMC
Mather, CA, USA

WILEY Blackwell

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Contents

List of Contributors

Lars Aabakken, MD, PhD, BC
Professor of Medicine
Chief of Gastrointestinal Endoscopy
Oslo University Hospital, Rikshospitalet
Oslo, Norway

Majid A. Almadi, MB, BS, MSc, FRC
Division of Gastroenterology
King Khalid University Hospital
King Saud University
Riyadh, Saudi Arabia

Alan Barkun, MD, CM, MSc, FRCPC
Division of Gastroenterology
Montreal General Hospital, McGill University
Montreal, Quebec, Canada

Todd H. Baron, MD, FASGE
Director of Advanced Therapeutic Endoscopy
Professor of Medicine
Division of Gastroenterology & Hepatology
University of North Carolina
Chapel Hill, NC, USA

Catherine Bauer, RNBS, MSN, MBA, CGRN, CFER
Director of Digestive Health
University of Virginia Medical Center
Charlottesville, VA, USA;
Society of Gastroenterology Nurses and Associate President 2018–2019

Benjamin L. Bick, MD
Indiana University School of Medicine
Indianapolis, IN, USA

Michael Bourke, MD, PhD
Clinical Professor of Medicine
University of Sydney
Sydney;
Director of Gastrointestinal Endoscopy
Westmead Hospital
Westmead, Australia

Gregory A. Coté, MD, MS
Professor of Medicine
Medical University of South Carolina
Charleston, SC, USA

Peter B. Cotton, MD, FRCP, FRCS
Professor of Medicine
Digestive Disease Center
Medical University of South Carolina
Charleston, SC, USA

John T. Cunningham, MD
Professor Emeritus of Medicine
Section of Gastroenterology and Hepatology
University of Arizona
School of Medicine
Tucson, AZ, USA

B. Joseph Elmunzer, MD, MSc
The Peter B. Cotton Endowed Chair in Endoscopic Innovation
Professor of Medicine and Endoscopic Innovation
Division or Gastroenterology and Hepatology
Medical University of South Carolina
Charleston, SC, USA

Evan L. Fogel, MD
Indiana University School of Medicine
Indianapolis, IN, USA

Erin Forster, MD, MPH
Department of Medicine
Division of Gastroenterology and Hepatology
Medical University of South Carolina
Charleston, SC, USA

Andres Gelrud, MD, MMSc
Gastro Health and Miami Cancer Institute
Miami, FL, USA

Moises Guelrud, MD
Gastro Health and Miami Cancer Institute
Miami, FL, USA

Sundeep Lakhtakia, MD, DM
Asian Institute of Gastroenterology
Hyderabad, India

John G. Lee, MD
H. H. Chao Comprehensive Digestive Disease Center
University of California at Irvine Medical Center, Irvine, CA, USA

Joseph W. Leung, MD, FRCP, FACP, MACG, FASGE
Emeritus Professor of Medicine
Department of Gastroenterology and Hepatology
University of California Davis School of Medicine
Sacramento, CA;
Chief of Gastroenterology
Section of Gastroenterology
VA Northern California Health Care System
GI Unit, Sacramento VAMC
Mather, CA, USA

Wei-Chih Liao, MD, PhD
Associate Professor
Department of Internal Medicine
National Taiwan University Hospital
National Taiwan University College of Medicine
Taipei, Taiwan

Phyllis Malpas, MA, RN, CGRN
Digestive Disease Center
Medical University of South Carolina
Charleston, SC, USA

Derrick Martin, FRCR, FRCP, Mb, CHb
Radiology Department
Wythenshawe Hospital
Manchester, UK

Robert A. Moran, MD
Medical University of South Carolina
Charleston, SC, USA

Zaheer Nabi, MD, DNB Gastroenterology
Consultant Gastroenterologist
Asian Institute of Gastroenterology
Hyderabad, India

D. Nageshwar Reddy, MD, DM, DSc, FRCP
Chairman and Chief of Gastroenterology
Asian Institute of Gastroenterology
Hyderabad, India

Stuart Ashley Roberts, MD
Radiology Department
University Hospital of Wales
Cardiff, UK

Joseph Romagnuolo, MD, MSc, FRCPC
Department of Medicine
Division of Gastroenterology and Hepatology
Medical University of South Carolina
Charleston, SC, USA

Stuart Sherman, MD
Indiana University School of Medicine
Indianapolis, IN, USA

Paul R. Tarnasky, MD
Digestive Health Associates of Texas
Program Director Gastroenterology
Methodist Dallas Medical Center
Dallas, TX, USA

Shyam Varadarajulu, MD
Center for Interventional Endoscopy
Florida Hospital
Orlando, FL, USA

John J. Vargo, II, MD, MPH
Cleveland Clinic
Cleveland, OH, USA

Hsiu-Po Wang, MD
Department of Internal Medicine
National Taiwan University Hospital
National Taiwan University College
of Medicine
Taipei, Taiwan

Andrew Yen, MD, FACG, FASGE
Chief of Endoscopy and Associate Chief of
Gastroenterology
Section of Gastroenterology
VA Northern California Health Care System
GI Unit, Sacramento VAMC
Mather, CA, USA

Introduction: Developments in ERCP over 50 Years

The History

Attempts at endoscopic cannulation of the papilla of Vater were first reported in 1968. However, the method was put on the map shortly afterward by Japanese gastroenterologists working with instrument manufacturers to develop appropriate long side-viewing instruments. The name "ERCP" (endoscopic retrograde cholangiopancreatography) was agreed at a symposium at the World Congress in Mexico City in 1974. The technique gradually became established worldwide as a valuable diagnostic technique, although some were skeptical about its feasibility and role, and the potential for serious complications soon became clear. It was given a tremendous boost by the development of the therapeutic applications, notably biliary sphincterotomy in 1974 and biliary stenting 5 years later.

It is difficult for most gastroenterologists today to imagine the diagnostic and therapeutic challenges of pancreatic and biliary medicine 50 years ago. There were no scans. The pancreas was a black box and its diseases diagnosed only at a late stage. Biliary obstruction was diagnosed and treated surgically with substantial operative mortality.

The period of 20 or so years from the mid-1970s was a "golden age" for ERCP. Despite significant risks, it was quite obvious to everyone that ERCP management of bile duct stones, strictures, and leaks was easier, cheaper, and safer than available surgical alternatives. Percutaneous transhepatic cholangiography (PTC) and its drainage applications were also developed during this time but were used (with the exception of a few units) only when ERCP failed or was not available.

The situation has evolved progressively in many ways during recent decades. There are some new techniques (such as expandable and biodegradable stents, simpler cholangioscopy, balloon sphincteroplasty, pseudocyst debridement, and laparoscopic- and endoscopic ultrasound [EUS]-guided cannulation) and improvements in safety (e.g. pancreatic stents, nonsteroidal anti-inflammatory drugs [NSAIDs], anesthesia, and carbon dioxide [CO_2]).

Other important changes in ERCP practice have been driven by improvements in radiology and surgery and the increasing focus on quality.

Radiology

Imaging modalities for the biliary tree and pancreas have proliferated. High-quality ultrasound, computed tomography (CT), EUS, and magnetic resonance scanning (with magnetic resonance cholangiopancreatography [MRCP]) have greatly facilitated the noninvasive evaluation of patients with known and suspected biliary and pancreatic disease. As a result, ERCP is now almost exclusively used for treatment of conditions already documented by less-invasive techniques. There have also been some improvements in interventional radiology techniques in the biliary tree, which are useful adjuncts when ERCP is unsuccessful or impractical.

Surgery

There has been substantial and progressive reduction in the risks associated with surgery as a result of minimally invasive techniques and better perioperative and anesthesia care. It is no longer correct to assume that ERCP is always safer than surgery. Surgery should be considered as a legitimate alternative to ERCP and not only when ERCP is unsuccessful.

Patient Empowerment

Another relevant development in this field is the increased participation of patients in decisions about their care. Patients are right in demanding information about their potential interventionists and the likely benefits, risks, and limitations of all of the possible approaches to their problems.

The Quality Imperative

The term ERCP is now inaccurate. It was invented to describe a method for obtaining radiographs of the biliary and pancreatic trees. It is now a broad therapeutic platform, like laparoscopy. It may be better remodeled as “Ensuring Really Competent Practice,” because quality is now the main challenge. We have to make sure that the right things are done and in the right way. There is increasing attention on who should be trained and to what level of expertise. How many ERCPists are really needed? Previously, most gastroenterology trainees did some ERCP and continued to dabble in practice. Now the focus is on ensuring that there is a smaller cadre of properly trained ERCPists with sufficient numbers to maintain and enhance their skills and to be able to address the more complex cases. These issues come into clearest focus where the role of ERCP is still not firmly established (e.g. in the management of recurrent acute and chronic pancreatitis and of possible sphincter of Oddi dysfunction). Such issues are being addressed by increasingly stringent research.

This Book

This is the third edition of this book devoted to ERCP. The first, *Advanced Digestive Endoscopy: ERCP* was published on gastrohep.com in 2002 and printed by Blackwell in 2006 and again in 2015. This edition owes much to its predecessors, but the title *ERCP: The Fundamentals* emphasizes our attempt to provide core information for trainees and practitioners, rather than a scholarly review of the (now) massive literature. Note that we have largely separated the technical aspects (how it can be done) from the clinical aspects, to allow the authors of the latter chapters to review the complex questions of when they might be done (and when best not).

We greatly appreciate the efforts of all the contributors and look forward to constructive feedback.

Peter B. Cotton, MD, FRCS, FRCP
Joseph W. Leung, MD, FRCP, FACP, MACG, FASGE
April 2020

Section 1

Preparation

1

Training and Assessment of Competence (Preparing the Endoscopist)

Joseph W. Leung[1,2] *and Peter B. Cotton*[3]

[1] *Department of Gastroenterology and Hepatology, University of California Davis School of Medicine, Sacramento, CA, USA*
[2] *Section of Gastroenterology, VA Northern California Health Care System, Sacramento VAMC, Mather, CA, USA*
[3] *Digestive Disease Center, Medical University of South Carolina, Charleston, SC, USA*

Key Points

- ERCP includes a range of mainly therapeutic procedures of different levels of complexity.
- Training involves both clinical and technical aspects.
- Hands-on apprenticeship dominates, but various simulators can help.
- Competence should be assessed objectively, and the data made available to patients.

Background

ERCP is the most complex common endoscopic (digestive) procedure. It has great potential for benefit, but it also carries significant risk of failure, adverse events [1], and medicolegal jeopardy [2]. Clearly it must be done as well as possible, and there has been more focus on quality recently. The key questions are:

- Who should be trained?
- What should be taught, and how?
- Who should teach?
- How are training and competence assessed?
- What level of performance is acceptable?

Who Should Be Trained?

ERCP training is usually a part of the postgraduate training of selected gastroenterologists and a few surgeons. The number needed has fallen with the widespread use of magnetic resonance cholangiopancreatography (MRCP) (and also endoscopic ultrasound [EUS]). In the structured British National Health System, the number of training positions is now

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tailored to the projected population needs. In many countries, and especially in the United States, there is no such limitation, with the result that some trainees are short-changed, and some have marginal volumes in ongoing practice. It is incumbent on training programs to ensure that those they train are able to reach an acceptable level of competence for safe independent practice. To limit training to less but produce more qualified trainees in the United States, some gastrointestinal (GI) programs have limited advanced endoscopy (ERCP and EUS) to a 4th year of training.

What Should Be Taught, and How?

While we focus here mainly on the difficulties involved in teaching the necessary technical skills, it is essential to realize that optimal ERCP requires that practitioners are knowledgeable about pancreatic and biliary medicine and the many alternative diagnostic and therapeutic approaches, as well as being skilled in the basic tenets of patient care. These important aspects should be well covered in basic GI training programs, such as the three-year fellowships in United States. Hands-on training is an integral part of ERCP practice and is done under close supervision by the trainer in a progressive manner to avoid mistakes that can be detrimental or may have a negative impact on outcome.

Levels of Complexity

ERCP is not a single procedure. The term encompasses a large spectrum of interventions performed (mainly) through the papilla. The concept of levels of complexity or difficulty, introduced by Schutz and Abbot, has recently been updated by a working party of American Society for Gastrointestinal Endoscopy (ASGE) [3]. (Table 1.1). Levels 1 and 2 together include the standard (mostly biliary) procedures, which are needed at relatively short notice at the community level. The more complex level 3 (“advanced”) and 4 (“tertiary”) procedures are mainly performed by relatively few highly trained endoscopists in referral centers.

These distinctions are clearly relevant to training. No one should be trained to less than competence at level 2. Although some practitioners will gradually advance those skills in practice (with mentoring, self-study, and courses), there are increasing numbers of advanced positions (e.g. 4th year in the United States), providing training in the more complex procedures.

Progressive Training

Like other endoscopy procedures, basic ERCP training involves lectures, study courses, didactic teaching, and the use of books, atlases, and videos in addition to hands-on supervised clinical practice [4–6]. Clinical teaching includes the elements of a proper history and physical examination with pertinent laboratory tests. Overall management will include work with in- and outpatients with pancreaticobiliary problems, with discussion on the various diagnostic and treatment options, and the assessment and mitigation of risk. This

Table 1.1 Complexity levels in ERCP.

Basic, levels 1 and 2
Deep cannulation of duct of interest and sampling
Biliary stent removal or exchange
Biliary stone extraction <10 mm
Treatment of biliary leaks
Treatment of extrahepatic benign and malignant strictures
Placement of prophylactic pancreatic stents
Advanced, level 3
Biliary stone extraction >10 mm
Minor papilla cannulation and therapy
Removal of internally migrated biliary stents
Intraductal imaging, biopsy, and needle aspiration
Management of acute or recurrent pancreatitis
Treat pancreatic strictures
Remove pancreatic stones mobile and <5 mm
Treatment of strictures, hilar and above
Management of suspected sphincter dysfunction (±manometry)
Tertiary, level 4
Removal of internal migrated pancreatic stents
Intraductal guided therapy (PDT, EHL)
Pancreatic stones impacted or >5 mm
Intrahepatic stones
Pseudocyst drainage and necrosectomy
Ampullectomy
Whipple, Roux-en-Y, or bariatric surgery

Adapted from Cotton et al [3].
EHL, electrohydraulic lithotripsy; PDT, photodynamic therapy.

is best achieved in a multidisciplinary environment, with close cooperation particularly with surgeons and radiologists.

After a period of observation, technical training begins with learning the proper technique of scope insertion and positioning. Despite that trainees may have performed many upper endoscopy and colonoscopy procedures, handling and manipulating a side-viewing duodenoscope requires a different skill set. It takes 20 to 30 cases before the novice endoscopist can master the basic skills of handling the side-viewing scope.

Selective cannulation of the desired duct (usually initially the bile duct) is the key challenge in ERCP because it is essential for therapeutic interventions. Incompetence in this aspect causes failure and increases the risk of postprocedural pancreatitis. Deep cannulation allows passage of guidewires to support sphincterotomy, stenting, and balloon dilation. Training in these basic steps should be delivered in stages. The trainer demonstrates the technique and then gives verbal instructions to guide the hands-on trainee. In difficult cases, the trainer may take over part of the procedure to complete the more difficult steps and then allow the trainee to continue. The trainees will acquire basic ERCP experience by learning the different steps, although not necessarily in a systematic manner. However, the trainee will be able to assimilate the experience and eventually be able to complete the entire procedure independently.

The extent to which a trainee can learn more complex skills will depend on many factors, not least the length of time available and the case mix in the training center.

It is also important for trainees to learn about all of the equipment that can be used during ERCP, including important aspects of radiology safety. In most centers, there may not be a dedicated radiology technician to assist with the operation of the fluoroscopy unit (usually a portable C-arm). The trainee should receive appropriate training and certification to operate the fluoroscopy unit to ensure patient safety. Similarly, the correct interpretation of X-rays is crucial to determine the next step in therapeutic intervention, and trainees should receive teaching in image interpretation to guide subsequent therapy. ERCP is a team event, and it is necessary to appreciate the importance of well-trained and motivated staff.

Simulation Training

The relative shortage of cases in many institutions and the risks involved in training have naturally encouraged the development of adjunctive alternatives to hands-on experience. Simulation practice provides trainees an opportunity to handle the scope and accessories and get familiar with the procedure before performing on patients. Preliminary data indicates that simulation practice can improve the clinical performance of novice trainee ERCPists [5].

In recent years, credentialing and governing bodies have recommended or mandated the use of simulation in training as part of residency education, and simulators have been used extensively in surgery. The essence of simulation in ERCP training is to provide trainees with the opportunities to understand the basic anatomy, become familiar with the equipment (accessories), and learn the basic techniques of scope handling, manipulation of accessories, and coordination with the assistant without involving a patient. Unless the alternative practice method offers the opportunity to use a real scope and accessories with hands-on experience, trainees may not be able to reap the benefits of additional or supplemental training.

Different simulators are available for learning and practicing ERCP technique. Therefore, the IDEAL simulator/simulation training should provide trainees with the learning opportunity to *I*mprove their basic skills, *D*emonstrates realism to help trainees understand the anatomy and motility, *E*ase of incorporating into a training program (i.e. inexpensive and portable system that allows repeated practices without special setup), *A*pplication in training including teaching therapeutic procedures, and *L*earning with real scope and accessories including use of simulation fluoroscopy [7].

Although ERCP practice on a live anesthetized pig offers the closest resemblance to the human setting, it is rarely used because it is expensive, labor-intensive, difficult to organize without special facilities, and carries potential ethical concerns. In general, three types of simulators are available: computer simulators, ex-vivo porcine stomach models, and mechanical simulators (Table 1.2). Computer simulators (e.g. GI Mentor II) are useful for learning the anatomy, including duodenal motility and basic orientation for cannulation [8]. However, the computer simulator uses special probes instead of real accessories, and this lacks realism and does not offer the tactile sensation when it comes to the manipulation of the "scope and accessories" for therapeutic ERCP.

A more commonly used training model is the ex-vivo porcine stomach model with attached biliary system that allows trainees to practice with a real scope and accessories [9]. However, the anatomical variation (i.e. close proximity of the papilla to the pylorus in the porcine model) makes scope positioning and cannulation more difficult. Besides, there are separate biliary and pancreatic ductal openings, making it suboptimal to practice selective cannulation. To facilitate the practice of biliary papillotomy, the porcine model is further improved by attaching a chicken heart (Neopapilla model) to a separate opening created in the second portion of the duodenum, which corrects for the anatomical difference and allows multiple (up to three) papillotomy practices to be performed on each chicken heart (artificial papilla) [10].

Another form of supplemental simulation training involves the use of mechanical simulators, namely the ERCP mechanical simulator (EMS) or the X-vision ERCP simulator [11, 12]. Both use a rigid model with special papillae adapted to a mechanical duodenum. Selective cannulation can be achieved using injection of a color solution (X-vision) or using a guidewire with the help of a catheter or papillotome (EMS). The X-vision model allows practice papillotomy to be performed on artificial papillae made of a special molded material [13]. The EMS allows practice papillotomy using a foamy papilla soaked with a special conducting gel [14]. In addition, dilation of stricture, brush cytology, and stenting as well as basket stone extraction and mechanical lithotripsy can be performed using the EMS. There are also mechanical models used by equipment companies for practicing special accessories, but no data are reported in the literature. Despite different simulators being available to supplement clinical ERCP training, and two prospective trials showing their value in improving the basic skills of trainees [15, 16], their use has been largely restricted so far to special teaching workshops. As part of teaching workshops, trainees and trainers were asked to evaluate the different simulators available for learning ERCP. A head-to-head comparison was conducted between the EMS and computer simulator and another one compared the EMS and modified pig stomach model (PSM) in terms of their ease and efficacy for ERCP practice. The EMS and PSM were both considered useful for ERCP practice because they used a real scope and accessories [17]. The EMS was rated better than the computer simulator for the same reason [18].

Who Should Teach?

A skilled endoscopist may not necessarily be a good teacher. The trainer needs to be able to recognize and correct the errors (mistakes) made by the trainee both in terms of technical operation and in clinical judgment and to do it in a supportive and nonpunitive manner. The "Train the trainer" courses have been beneficial in highlighting the key elements. In the British system, attendance at such courses is now mandated, and trainees are required to assess their teachers in the e-portfolio system.

Table 1.2 A comparison of different simulator models for advanced ERCP training.

	Mechanical Simulator	Computer Simulator	Animal Tissue Model	
	EMS and X-vision	GI Mentor II	Live animal	Ex-vivo porcine stomach model
References	7, 11, 13–17	8	5	9,10
Preprogrammed	No	Yes	No	No
Demonstrates anatomy	Simulated	Simulated	Yes*	Yes*
Demonstrates motility	No	Simulated	Yes	No
Basic equipment	Scope and diathermy	Probes and software	Scope and diathermy	Scope and diathermy
Real scope and accessories	Yes	No Modified probes	Yes	Yes
Papillotomy	Yes (artificial)	Simulated	Yes	Yes (Neopapilla‡)
Learning experience				
Tactile sensation	Very good	Good	Very good	Very good
Coordination/teamwork	Yes	Maybe	Yes	Yes
Supervised training	Yes	Maybe	Yes	Yes
Scoring of experience	Yes (manual)	Yes (computerized)	Yes (manual)	Yes (manual)
Clinical benefits	Yes (EMS†)	Maybe	Maybe	Maybe
Technical support				
Anesthesia/technician	No/No	No/No	Yes/Yes	No/Yes
Assistant	Yes	No	Yes	Yes
Fluoroscopy (+timer)	Simulated	No	Yes	Trans-illumination
Estimated cost of model	$3–5K	$90K	$1K/animal	$250/set
Repeated practice	Yes	Yes	Yes (same day)§	Yes (same day)§
Special/animal lab dedicated scope	No	No	Yes	Yes
Varying level of difficulties	Yes	Yes (programmed)	No	No
Objective assessment	Yes	Computer report	Yes	Yes
Documentation	Manual	Computerized	Manual	Manual
Reproducibility	Yes	Yes	Maybe	Maybe
Part of routine training	Easy	Easy	Difficult	Maybe

EMS, ERCP mechanical simulator; RCTs, randomized controlled trials.
* Anatomical variation with pig stomach model; the papilla is close to the pylorus.
† EMS is only model with two published RCTs and one abstract with results showing improvement of trainees' clinical performance with coached simulation practice.
‡ Neopapilla modification allows for multiple papillotomy practices (up to three per "papilla").
§ Live-animal model allows for only one papillotomy per animal. Ex-vivo model allows for only one papillotomy unless modified using the Neopapilla.

How Are Training and Competence Assessed?

Whatever training methods are employed, the key issue clearly is how well the trainee can perform. Trainees should keep logs of their procedures (on simulators as well as patients), and some metrics are suggested in Tables 1.3, 1.4, and 1.5.

Table 1.3 Some suggested simulator practice score to evaluate trainees' practice performance.

Cannulation			
Position—Achieve proper orientation and axis	1	Failed cannulation	–2
Successful/deep cannulation of selected system	1	Number of attempts	
Wire manipulation			
Manipulate wire for cannulation and stricture	1	Loss wire or access	–1
Coordinated exchange of accessories	1	End of wire on floor	–1
Balloon dilation			
Proper preparation of insufflator	1	Excess air left in balloon	–1
Maintain position of balloon during dilation	1		
Cytology			
Control position of brush during cytology	1		
Document bare brush across stricture	1		
Stenting			
Able to measure stent length properly	1	Stent too short or too long	–2
Proper deployment of stent	1		
Deploy multiple stents in common duct	1		
Demonstrates how to deploy SEMS	1		
Basket			
Proper stone engagement and removal	1	Stone pushed into IHBD	–1
Demonstrate how to free impacted basket and stone	1		
Demonstrate skill with use of mechanical lithotripter	1		
Retrieval balloons			
Able to control balloon size	1		
Papillotomy			
Maintain good position during cut	1	Deviated cut	–2
Control tension on cutting wire	1		
Shaping wire position if indicated	1		
Perform stepwise cut	1		
Sizing the papillotomy	1		
Assistance from trainer			
Verbal instructions only	1	Hands-on assistance 25%	–1
		50%	–2
		75%	–3

IHBD, intrahepatic bile duct; SEMS, self-expandable metallic stent.

Table 1.4 Clinical assessment (to be filled in by trainer at completion of ERCP).

ERCP performance score			
Trainee performed procedures *without* trainer's hands-on assistance			
Selective cannulation	yes	no	NA
Biliary sphincterotomy	yes	no	NA
Pancreatic sphincterotomy	yes	no	NA
Biliary stone extraction	yes	no	NA
Balloon dilation	yes	no	NA
Brush cytology	yes	no	NA
Biliary plastic stent	yes	no	NA
Pancreatic plastic stent	yes	no	NA
Metal stent placement	yes	no	NA
Mechanical lithotripsy	yes	no	NA
(yes = 1, no = 0; actual ERCP performance score = sum/number of applicable categories, the score is used as a covariable for analysis)			
ERCP "error" score			
Did the following occur during this trainee performed ERCP?			
Failed cannulation	yes	no	NA
Introduce air into ducts	yes	no	NA
Overfilled (obstructed) ductal system	yes	no	NA
End of guidewire on floor	yes	no	NA
Loss wire/access	yes	no	NA
Inappropriate length (too short) stent used	yes	no	NA
Failed to document bare brush across stricture	yes	no	NA
Uncontrolled papillotomy cut	yes	no	NA
Stone being pushed into IHBD	yes	no	NA
Stone and basket impaction	yes	no	NA
(yes = 0, no = 1; actual ERCP "error" score = sum/number of applicable categories; this score is used as a covariable for analysis).			
Clinical performance assessment (excellent, good, poor, not assessed)			
Preparation of the patient before the procedure			
Care after the procedure			
Assessment of prior imaging			
Interpretation of ERCP radiographs			
Communication with the patient			
with the family			
with referrers			
Overall assessment of current competence in standard ERCP skills (%):			

IHBD, intrahepatic bile duct.

Table 1.5 Trainer assessment score of trainees' performance (five-point score).

5. (Excellent) Demonstrates good knowledge in operating the accessories, able to successfully complete procedure in >80% of cases, no iatrogenic-induced failure or complication, or performance as good as an attending
4. (Good) Demonstrates good knowledge, good skills, needs only occasional assistance from trainer
3. (Average) Understands the operation of accessories, demonstrates only reasonable knowledge in actual operation of accessory, average skills, requires assistance from trainer
2. (Fair) Can handle the side-viewing duodenoscope, understands the operation of accessories, unsure about actual operation or performance of accessories, requires >50% help from trainer
1. (Poor) Good control of upper gastrointestinal (GI) scope, struggles with side-viewing scope, some knowledge of accessories but does not understand the operation or control of accessories or wires, needs lot of attention and assistance from trainer

Objective assessment of performance is easier to document with practice on simulators (Table 1.2). Specific endpoints may include successful execution of the procedure and total procedure time taken, including the use of simulated fluoroscopy time during the practice [11]. Documentation during computer simulation training is more complete with tracking of the time taken and number of attempts made to perform a particular procedure. Adjustment or modification in training can be done by using different computer software programs with varying levels of complexity, whereas the mechanical simulator can incorporate different setup, including changing position of the papilla or level of the bile duct stricture. Such changes can cater for procedures with varying level of difficulties from basic cannulation to papillotomy and to the more advanced procedures such as multiple stents placement for a simulated bile duct stricture [19].

In general, trainer assessment is more subjective based on a summation of the overall clinical performance of the trainees (Tables 1.3 and 1.4), both technical and clinical. The Accreditation Council for Graduate Medical Education (ACGME) has devised objective endpoints for measuring the quality of ERCP training and success with the procedure, but strictly speaking, these endpoints cannot account for all of the different aspects of this technical procedure.

Numbers

The question "How many hands-on cases does a trainee need to become competent?" has dominated and confused the field for decades. The original guess by ASGE that 100 might be sufficient was shown to be seriously inadequate by the seminal study by Jowell et al that showed that their trainees were only approaching 80% competency after 180–200 procedures [20]. The ASGE recommends that trainees should have performed 200 ERCP procedures with 80% success of cannulation and more than half of the procedures being therapeutic before they are considered competent or ready for assessment of competency [21]. Australia has an even tougher criterion, which requires trainees to have performed 200 successful solo procedures without trainer involvement [22].

These assessments are usually made by a sympathetic trainer at "home base" and are a complex amalgam of subjective information. We usually think that the trainee is "reasonably

OK," but we do not know how they actually perform once in practice with less-experienced staff (and maybe unfamiliar equipment) and with some peer pressure to succeed.

The only important numbers (in practice and in training) are the actual outcomes, using agreed quality metrics, such as deep biliary cannulation success and pancreatitis rates. Thus, we have long recommended that practitioners collect these data (report cards) [23] and compare them with peers (benchmarking) [24]. These systems also include complexity levels, so that the spectrum of practice can be documented.

Because of the need for X-ray, ERCP is the one endoscopic procedure that is done only in hospitals. Hospitals have the responsibility for ensuring that their credentialing and privileging systems allow only competent endoscopists into their units. A survey of credentialing practice in the United States suggests that there is room for improvement [25].

How else can we move forward? The assessment at the end of training could be made by people other than their trainers by a combination of log books, videos, references, and observation of procedures (live and simulated) in their home environment or elsewhere. Ideally there should be some form of certification at a national level, incorporating the complexity levels.

What Level of Performance Is Acceptable?

There are significant variations in the quality of ERCP performance. Taking deep biliary cannulation as a key metric, we know that experts achieve greater than 95% success, but not all cases can or should be done by experts. So what is acceptable, and who decides? Professional societies have usually suggested 85% or 90% in general, but much depends on the clinical circumstances and setting. A less-expert endoscopist will be acceptable and may be lifesaving, in an emergency (e.g., acute cholangitis), but patients with more complex and elective problems may prefer (if given the option) referral to a tertiary center. Patients should not be afraid to quiz their potential interventionists about their experience and ask to see the report card [23]. These aspects are discussed further in Chapter 25.

Conclusion

ERCP now constitutes a variety of procedures, which require excellent clinical and technical skills with an experienced team in a supportive environment. The structures of training and practice are gradually being improved so as to raise the quality of ERCP practice worldwide, and patients are increasingly knowledgeable about the issues. We hope to see fewer, poorly trained, low-volume ERCPists in the future [26].

Appendix

Some examples of how to gauge trainees' performance during clinical practice