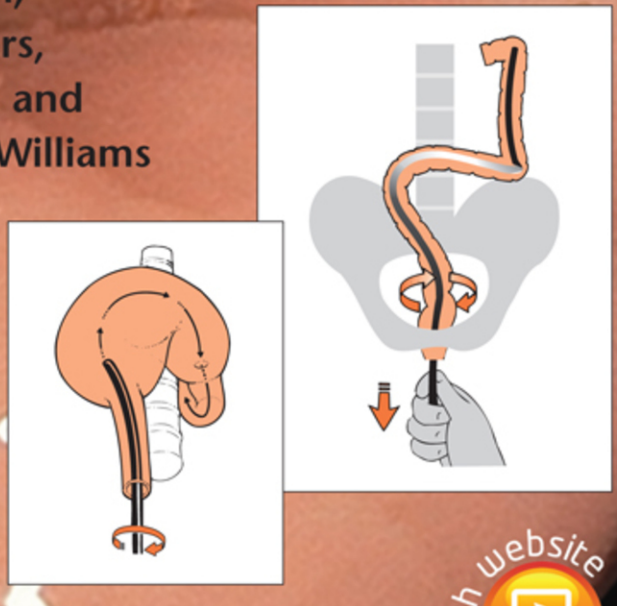
COTTON AND WILLIAMS'

Practical Gastrointestinal Endoscopy

The Fundamentals

SEVENTH EDITION

Adam Haycock,
Jonathan Cohen,
Brian P. Saunders,
Peter B. Cotton and
Christopher B. Williams



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List of Video Clips

Preface to the Seventh Edition

Gastrointestinal endoscopy continues to evolve and has seen a steady increase in demand, complexity, and innovation in what it is possible to do with an endoscope. It is now the undoubted investigation of choice for the GI tract, although there is no room for complacency. Parallel improvements in imaging capabilities such as MRCP and CT colonography are now impacting on the "diagnostic" endoscopy workload, and much of the current emphasis is on advancing endoluminal, transluminal, and hybrid therapeutic techniques.

The ongoing adoption of national bowel cancer screening programs has driven up standards for endoscopists across the board. Increasing recognition of the importance of identifying even small, subtle premalignant dysplastic lesions and the ability to provide complex therapeutic intervention in both the upper and lower GI tract has made the learning process even more lengthy and difficult for those new to the field. Accordingly, the "fundamentals" no longer refers solely to basic or simple procedures, if indeed it ever did. In this era of increasing complexity of endoscopy and increasing attention to quality performance, the fundamental skills that constitute the foundation of all endoscopic practice have never been more important to master.

In line with the last edition, we have limited this book to the most common diagnostic and therapeutic "upper" and "lower" GI procedures, reserving more advanced techniques such as ERCP and EUS for others to cover. What is new to this edition is acknowledgement of the enormous impact of the Internet and electronic "e-learning." This edition is supported by a selection of online multimedia images and clips, which are signposted in the text and referenced at the end of each chapter. To allow for greater use of mobile platforms, each chapter has been reconfigured into a more easily digestible "bite-sized" chunk with its own key learning points and searchable keywords. Multiple-choice questions (MCQs) are also available online to allow self-assessment and consolidate learning.

We also formally acknowledge with this edition what has been common parlance for years—that this book is "Cotton and Williams'" fundamentals of gastrointestinal endoscopy, sharing personal opinions, tips, and tricks gained over many years. Although this is the last edition in which these two pioneering authors will actively participate, this textbook will remain a practical guide squarely based on their practice and principles. It has been our privilege to work with them to produce this edition, and we are honored to have been asked to sustain this important effort in the future.

Practical Gastrointestinal Endoscopy: The Fundamentals aims to complement rather than replace more evidence-based recommenda-

tions and guidelines produced by national societies. It remains focused on helping those in the first few years of experience to move more quickly up the learning curve toward competency. We hope that it will inspire trainees to attain the levels of excellence represented by those individuals from whom the book takes its name.

Adam Haycock
Jonathan Cohen
Brian P Saunders

Preface to the First Edition

This book is concerned with endoscopic techniques and says little about their clinical relevance. It does so unashamedly because no comparable manual was available at the time of its conception and because the explosive growth of endoscopy has far outstripped facilities for individual training in endoscopic technique. For the same reason we have made no mention of rigid endoscopes (oesophagoscopes, sigmoidoscopes and laparoscopes) which rightly remain popular tools in gastroenterology, nor have we discussed the great potential of the flexible endoscope in gastrointestinal research.

Our concentration on techniques should not be taken to denote a lack of interest in results and real indications. As gastroenterologists we believe that procedures can only be useful if they improve our clinical management; clever techniques are not indicated simply because they are possible, and some endoscopic procedures will become obsolete with improvements in less invasive methods. Indeed we are moving into a self-critical phase in which the main interest in gastrointestinal endoscopy is in the assessment of its real role and cost-effectiveness.

Gastrointestinal endoscopy should be only one of the tools of specialists trained in gastrointestinal disease—whether they are primarily physicians, surgeons or radiologists. Only with broad training and knowledge is it possible to place obscure endoscopic findings in their relevant clinical perspective, to make realistic judgements in the selection of complex investigations from different disciplines, and to balance the benefits and risks of new therapeutic applications. Some specialists will become more expert and committed than others, but we do not favour the widespread development of pure endoscopists or of endoscopy as a subspecialty.

Skilful endoscopy can often provide a definitive diagnosis and lead quickly to correct management, which may save patients from months or years of unnecessary illness or anxiety. We hope that this little book may help to make that process easier and safer.

April 1979
P.B.C., C.B.W.

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The authors are grateful to the dedicated collaborators who have embellished or enabled the production of this book.

The skills of Steve Preston (steveprestonmultimedia@gmail.com) produced the web videos and imagery. The artistry and great patience of David Gardner (davidgardner@cytanet.com.cy) has allowed upgrading of the drawings and figures in this edition and several previous ones. At Wiley publishers, the guidance of Oliver Walter, backed by Rebecca Huxley's formidable editorial talents, has made the production process almost enjoyable.

The authors also wish to register indebtedness to their respective life-partners (Cori, Sarah, Annie, Marion and Christina) for their unending support—despite intrusions into personal and family time.

About the Companion Website

This book is accompanied by a website:

www.wiley.com/go/cottonwilliams/practicalgastroenterology

The website includes:

- 37 videos showing procedures described in the book
- All videos are referenced in the text where you see this logo 
- A clinical photo imagebank, consisting of an equivalent clinical photo for selected line illustrations
- An interactive "check your understanding" question bank (MCQs) to test main learning points in each chapter

CHAPTER 1

The Endoscopy Unit, Staff, and Management

Most endoscopists, and especially beginners, focus on the individual procedures and have little appreciation of the extensive infrastructure that is now necessary for efficient and safe activity. From humble beginnings in adapted single rooms, most of us are lucky enough now to work in large units with multiple procedure rooms full of complex electronic equipment, with additional space dedicated to preparation, recovery, and reporting.

Endoscopy is a team activity, requiring the collaborative talents of many people with different backgrounds and training. It is difficult to overstate the importance of appropriate facilities and adequate professional support staff, to maintain patient comfort and safety, and to optimize clinical outcomes.

Endoscopy procedures can be performed almost anywhere when necessary (e.g. in an intensive care unit), but the vast majority take place in purpose-designed "endoscopy units."

Endoscopy units

Details of endoscopy unit design are beyond the scope of this book, but certain principles should be stated.

There are two types of unit. Private clinics (called ambulatory surgical centers in the USA) deal mainly with healthy (or relatively healthy) outpatients, and should resemble cheerful modern dental suites. Hospital units have to provide a safe environment for managing sick inpatients, and also more complex procedures with a therapeutic focus, such as endoscopic retrograde cholangiopancreatography (ERCP). The more sophisticated units resemble operating suites. Units that serve both functions should be designed to separate the patient flows as far as possible.

The modern unit has areas designed for many different functions. Like a hotel or an airport (or a Victorian household), the endoscopy unit should have a smart public face ("upstairs"), and a more functional back hall ("downstairs"). From the patient's perspective, the suite consists of areas devoted to reception, preparation, procedure, recovery, and discharge. Supporting these activities are many other "back hall" functions, which include scheduling, cleaning, preparation, maintenance and storage of equipment, reporting and archiving, and staff management.

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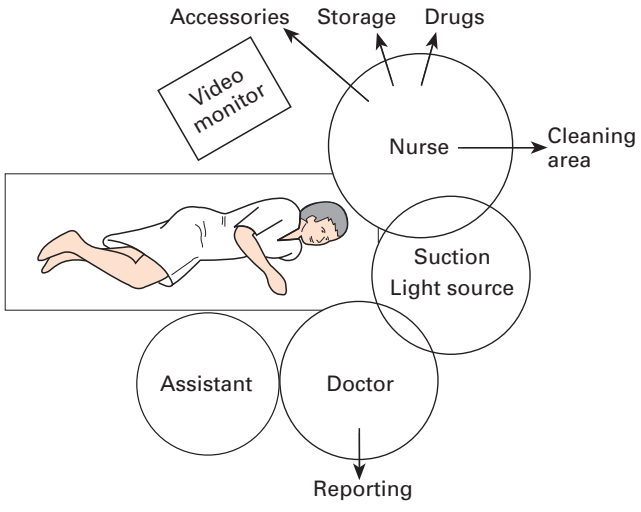

Fig 1.1 Functional planning—spheres of activity.

Procedure rooms

The rooms used for endoscopy procedures should:

- ***not be cluttered or intimidating***. Most patients are not sedated when they enter, so it is better for the room to resemble a modern dental office, or kitchen, rather than an operating room.
- ***be large enough*** to allow a patient stretcher/trolley to be rotated on its axis, and to accommodate all of the equipment and staff (and any emergency team), but also compact enough for efficient function.
- ***be laid out with function in mind***, keeping nursing and doctor spheres of activity separate (Fig 1.1), and minimizing exposed trailing electrical cables and pipes (best by ceiling-mounted beams).

Each room should have:

- ***piped oxygen and suction*** (two lines);
- ***lighting planned*** to illuminate nursing activities but not dazzle the patient or endoscopist;
- ***video monitors placed conveniently*** for the endoscopist and assistants, but also allowing the patient to view, if wished;
- ***adequate counter space*** for accessories, with a large sink or receptacle for dirty equipment;
- ***storage space for equipment required on a daily basis***;
- ***systems of communication*** with the charge nurse desk, and emergency call;
- ***disposal systems*** for hazardous materials.

Patient preparation and recovery areas

Patients need a private place for initial preparation (undressing, safety checks, intravenous (IV) access), and a similar place in which to recover from any sedation or anesthesia. In some units these functions are separate, but can be combined to maximize flexibility. Many units have simple curtained bays, but rooms with solid side

walls and a movable front curtain are preferable. They should be large enough to accommodate at least two people other than the patient on the stretcher, and all of the necessary monitoring equipment.

The "prep-recovery bays" should be adjacent to a central nursing workstation. Like the bridge of a ship, it is where the nurse captain of the day controls and steers the whole operation, and from which recovering patients can be monitored.

All units should have at least one completely private room for sensitive interviews/consultations before and after procedures.

Equipment management and storage

There must be designated areas for endoscope and accessory reprocessing, and storage of medications and all equipment, including an emergency resuscitation cart. Many units also have fully equipped mobile carts to travel to other sites when needed.

Staff

Specially trained endoscopy assistants have many important functions. They:

- ***prepare patients*** for their procedures, physically and mentally;
- ***set up*** all necessary equipment;
- ***assist*** endoscopists during procedures;
- ***monitor*** patients' safety, sedation, and recovery;
- ***clean***, disinfect, and process equipment;
- ***maintain quality control***.

Most endoscopy assistants are trained nurses, but technicians and nursing aides also have roles (e.g. in equipment processing). Large units need a variety of other staff, to handle reception, transport, reporting, and equipment management, including informatics.

Members of staff need places to store their clothes and valuables, and a break area for refreshments and meals.

Procedure reports

Usually, two reports are generated for each procedure—one by the nurses and one by the endoscopist.

Nurse's report

The nurse's report usually takes the form of a preprinted "flow sheet," with places to record all of the pre-procedure safety checks, vital signs, use of sedation/analgesia and other medications, monitoring of vital signs and patient responses, equipment and accessory usage, and image documentation. It concludes with a copy of the discharge instructions given to the patient.

Endoscopist's report

In many units, the endoscopist's report is written or dictated in the procedure rooms. In larger ones, there may need to be a separate area designed for that purpose.

The endoscopist's report includes the patient's demographics, reasons for the procedure (indications), specific medical risks and precautions, sedation/analgesia, findings, diagnostic specimens, treatments, conclusions, follow-up plans, and any unplanned events (complications). Endoscopists use many reporting methods—handwritten notes, preprinted forms, free dictation, and computer databases.

The paperless endoscopy unit

Eventually all of the documentation (nursing, administrative, and endoscopic) will be incorporated into a comprehensive electronic management system. Such a system will substantially reduce the paperwork burden, and increase both efficiency and quality control.

Management, behavior, and teamwork

Complex organizations require efficient management and leadership. This works best as a collaborative exercise between the medical director of endoscopy and the chief nurse or endoscopy nurse manager. The biggest units will also have a separate administrator. These individuals must be skilled in handling people (doctors, staff, and patients), complex equipment, and significant financial resources. They must develop and maintain good working relationships with many departments within the hospital (such as radiology, pathology, sterile processing, anesthesia, bioengineering), as well as numerous manufacturers and vendors. They also need to be fully cognizant of all of the many local and national regulations that now impact on endoscopy practice.

The wise endoscopist will embrace the team approach, and realize that maintaining an atmosphere of collegiality and mutual respect is essential for efficiency, job satisfaction, and staff retention, and for optimal patient outcomes.

It is also essential to ensure that the push for efficiency does not drive out humanity. Patients should not be packaged as mere commodities during the endoscopy process. Treating our customers (and those who accompany them) with respect and courtesy is fundamental. Always assume that patients are listening, even if apparently sedated, so never chatter about irrelevances in their presence. Never eat or drink in patient areas. Background music is appreciated by many patients and staff.

Documentation and quality improvement

The agreed policies of the unit (including regulations dictated by the hospital and national organizations) are enshrined in an *Endoscopy Unit Procedure Manual*. This must be easily available, constantly updated, and frequently consulted.

Day-to-day documentation includes details of staff and room usage, disinfection processes, medications, instrument and accessory use and problems, as well as the procedure reports.

A formal quality assessment and improvement process is essential for maximizing the safety and efficiency of endoscopy services. Professional societies have recommended methods and metrics. The American Society for Gastrointestinal Endoscopy (ASGE) has incorporated these into its Endoscopy Unit Recognition Program, and the benefit of concentrating on and documenting quality is well exemplified by the success of the Global Rating Scale project in the UK.

Educational resources

Endoscopy units should offer educational resources for all of its users, including patients, staff, and doctors. Clinical staff need a selection of relevant books, atlases, key reprints, and journals, and publications of professional societies. Increasingly, many of these materials are available online, so that easy Internet access should be available. Many organizations produce useful educational videotapes, CD-ROMs, and DVDs.

Teaching units will need to embrace computer simulators, which are becoming valuable tools for training (and credentialing).

Further reading

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Chapter video clip

Video 1.1 The endoscopy unit: a virtual tour

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CHAPTER 2
Endoscopic Equipment

Endoscopes

There are many different endoscopes available for various applications, and several manufacturers, but they all have common features. There is a control head with valves (buttons) for air insufflation and suction, a flexible shaft (insertion tube) carrying the light guide and one or more service channels, and a maneuverable bending section at the tip. An umbilical or universal cord (also called "light guide connecting tube") connects the endoscope to the light source and processor, air supply, and suction (Fig 2.1). Illumination is provided from an external high-intensity source through one or more light-carrying fiber bundles.

The image is captured with a charge-coupled device (CCD) chip, transmitted electronically, and displayed on a video monitor. Individual pixels (photo cells) in the CCD chips can respond only to degrees of light and dark. Color appreciation is arranged by two methods. So-called "color CCDs" have their pixels arranged under a series of color filter stripes (Fig 2.2). By contrast, "monochrome CCDs" (or, more correctly, sequential system CCDs) use a rotating color filter wheel to illuminate all of the pixels with primary color strobe-effect lighting (Fig 2.3). This type of chip can be made smaller, or can give higher resolution, but the system is more expensive because of the additional mechanics and image-processing technology.

"Electronic chromoendoscopy" systems are now standard in many endoscopes, allowing enhancement of aspects of the surface of the gastrointestinal mucosa. Narrow band imaging (NBI; Olympus Corporation) uses optical filters to select certain wavelengths of light, which correspond to the peak light absorption of hemoglobin, enhancing the visualization of blood vessels and certain surface structures. The Fuji Intelligent Chromo Endoscopy (FICE; Fujinon Endoscopy) and i-Scan (Pentax Medical) systems take ordinary endoscopic images and digitally process the output to estimate different wavelengths of light, providing a number of different imaging outputs. Autofluorescence imaging can detect endogenous fluorophores, a number of which occur in the gastrointestinal tract. Two systems now also allow magnification of the endoscopic image down to the cellular level: termed confocal microscopy (Pentax Medical, Mauna Kea Technologies). Blue laser

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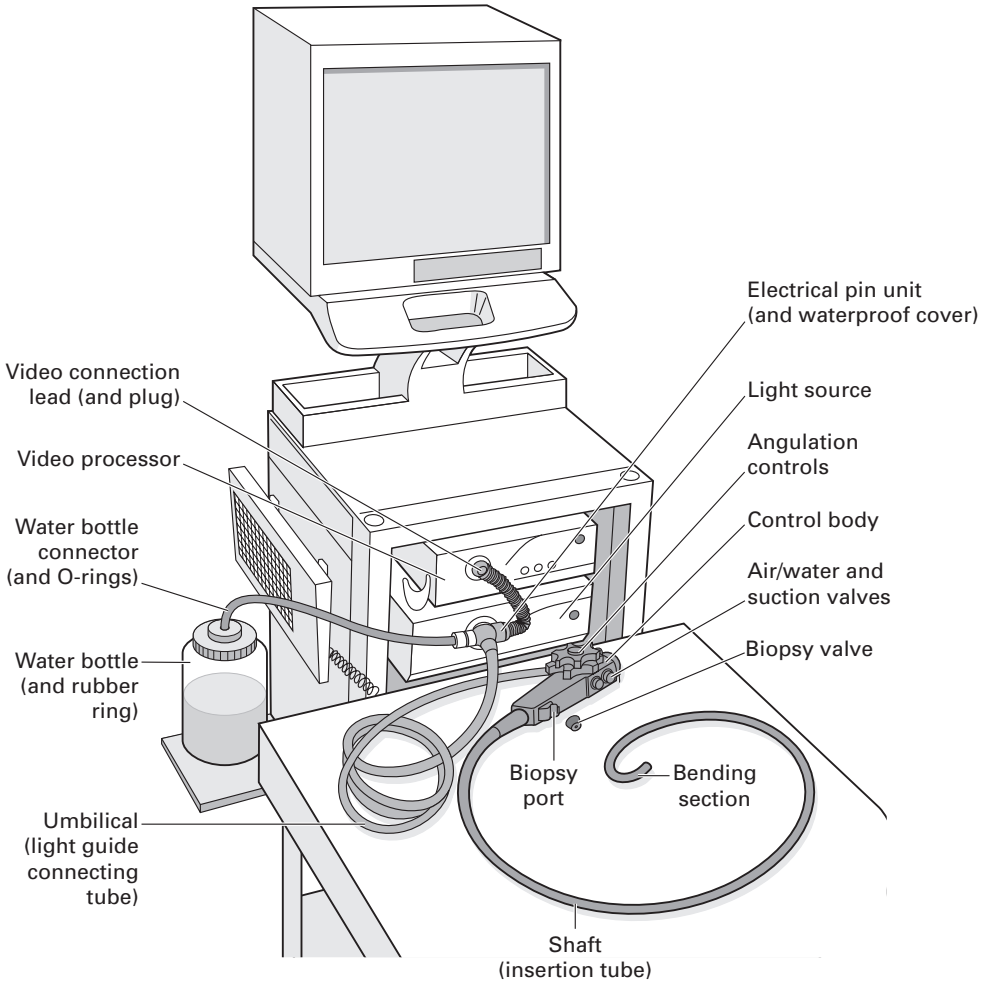

Fig 2.1 Endoscope system.

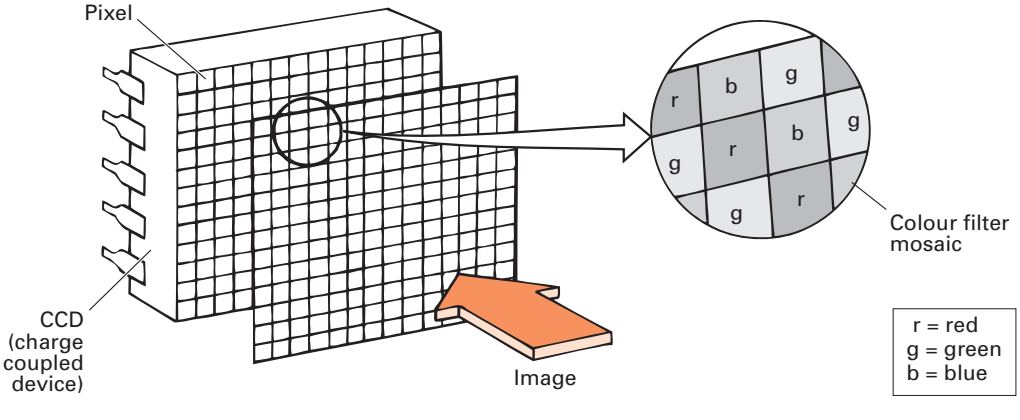

Fig 2.2 Static red, green, and blue filters in the "color" chip.

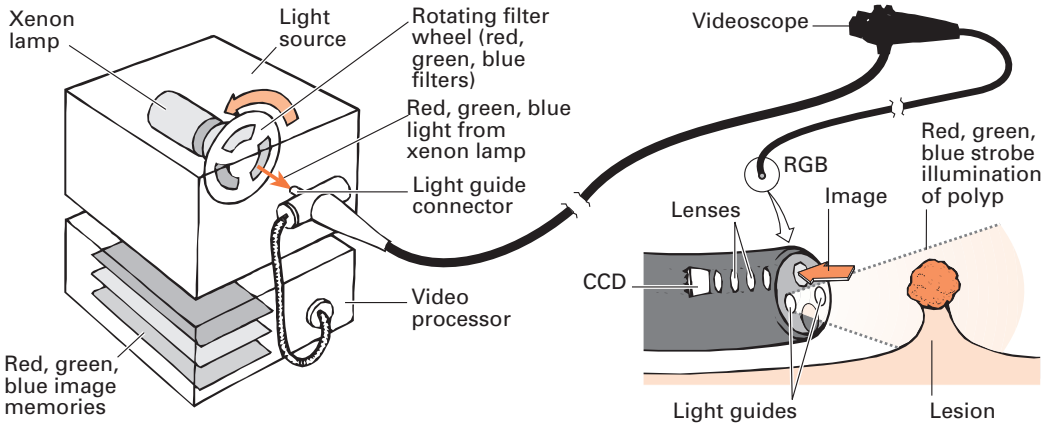

Fig 2.3 Sequential color illumination.

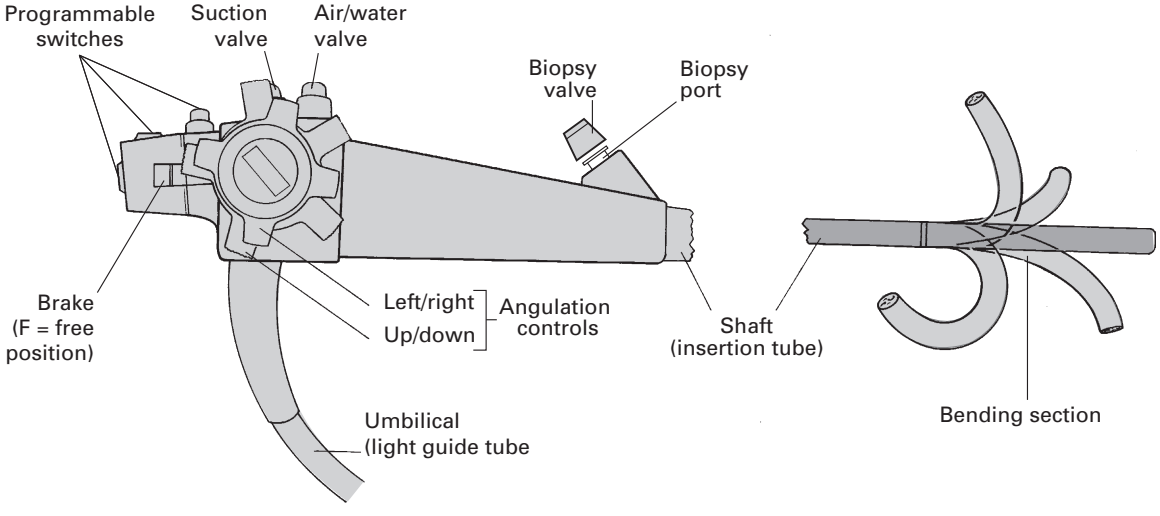

Fig 2.4 Basic design—control head and bending section.

light is focused on the desired tissue after injecting fluorescent materials, which become excited by the laser light and are detected at defined horizontal levels.

Tip control

The distal bending section (10 cm or so) and tip of the endoscope is fully deflectable, usually in both planes, up to 180° or more. Control depends upon pull wires attached at the tip just beneath the outer protective sheath, and passing back through the length of the instrument shaft to the two angulation control wheels (for up/down and right/left movement) on the control head (Fig 2.4). The wheels incorporate a friction braking system, so that the tip can be fixed temporarily in any desired position. The instrument shaft is torque stable, so that rotating movements applied to the head are transmitted to the tip when the shaft is relatively straight.

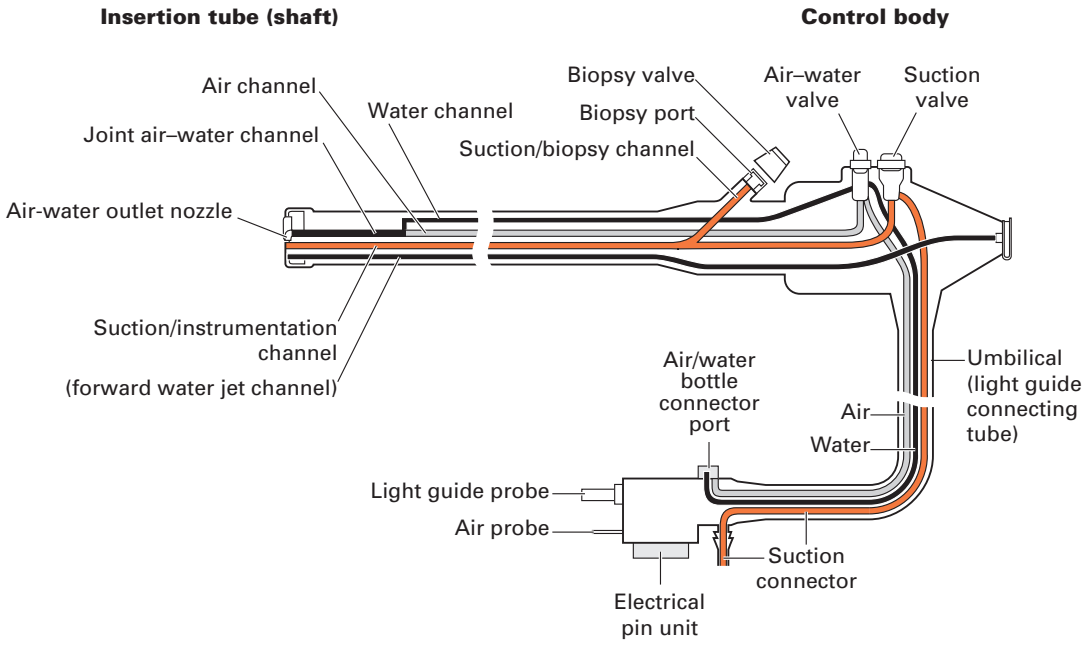

Fig 2.5 The internal anatomy of a typical endoscope.

Instrument channels and valves

The internal anatomy of endoscopes is complex (Fig 2.5). The shaft incorporates a biopsy/suction channel extending from the entry "biopsy port" to the tip of the instrument. The channel is usually about 3 mm in diameter, but varies from 1 to 5 mm depending upon the purpose for which the endoscope was designed (from neonatal examinations to major therapeutic procedures). In some instruments, especially those with lateral-viewing optics, the tip of the channel incorporates a deflectable elevator or bridge (see Fig 2.7), which permits directional control of forceps and other accessories independent of the instrument tip. This elevator is controlled by an additional thumb lever. The biopsy/suction channel is used also for aspirating secretions: an external suction pump is connected to the universal cord near to the light source, and suction is diverted into the instrument channel by pressing the suction valve. Another small channel allows the passage of air to distend the organ being examined. The air is supplied from a pump in the light source and is controlled by another valve. For colonoscopy, the air insufflation system can be modified to CO_2 rather than room air and has been shown to lessen abdominal distension and pain after colonoscopy. The air system also pressurizes the water bottle, so that a jet of water can be squirted across the distal lens to clean it.

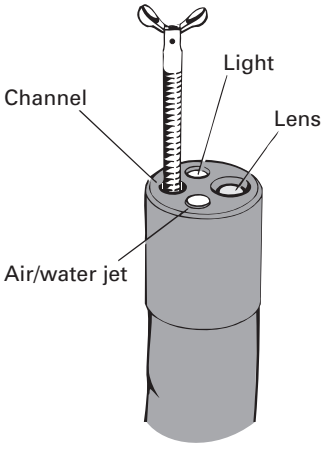

Fig 2.6 The tip of a forward-viewing endoscope.

Different instruments

The endoscopy unit must have a selection of endoscopes for specific applications. These may differ in length, size, stiffness, channel size and number, sophistication, and distal lens orientation. Most

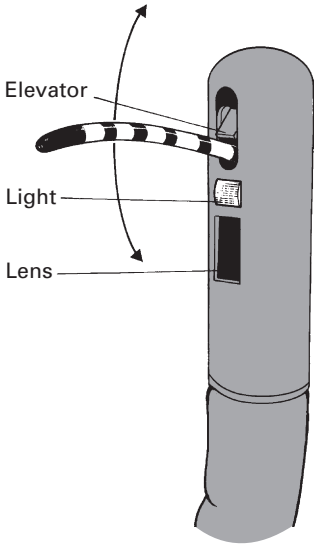

Fig 2.7 A side-viewer with a deflectable elevator.

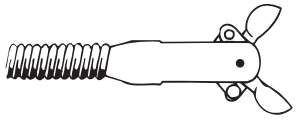

Fig 2.8 Biopsy cups open.

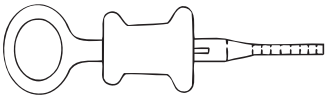

Fig 2.9 Control handle for forceps.

Fig 2.10 Cytology brush with outer sleeve.

endoscopies are performed with instruments providing ***direct forward vision***, via a wide-angle lens (up to 130°) (Fig 2.6). However, there are circumstances in which it is preferable to view ***laterally***, particularly for endoscopic retrograde cholangiopancreatography (ERCP) (Fig 2.7).

The overall diameter of an endoscope is a compromise between engineering ideals and patient tolerance. The shaft must contain and protect many bundles, wires, and tubes, all of which are stronger and more efficient when larger (Fig 2.5). A colonoscope can reasonably approach 15 m in diameter, but this size is acceptable in the upper gut only for specialized therapeutic instruments.

Routine upper endoscopy is mostly performed with instruments of 8–11 mm diameter. Smaller endoscopes are available; they are better tolerated by all patients and have specific application in children. Some can be passed through the nose rather than the mouth. However, smaller instruments inevitably involve some compromise in durability, image quality, maneuverability, biopsy size, and therapeutic potential.

Several companies now produce a full range of endoscopes at comparable prices. However, light sources and processors produced by different companies are not interchangeable, so that most endoscopy units concentrate for convenience on equipment from a single manufacturer. Endoscopes are delicate, and some breakages are inevitable. Careful maintenance and close communication, repair, and back-up arrangements with an efficient company are necessary to maintain an endoscopy service. The quality of that support is often a crucial factor affecting the choice of company.

Endoscopic accessories

Many devices can be passed through the endoscope biopsy/suction channel for diagnostic and therapeutic purposes.

- ***Biopsy forceps*** consist of a pair of sharpened cups (Fig 2.8), a spiral metal cable, a pull wire, and a control handle (Fig 2.9). Their maximum diameter is limited by the size of the channel, and the length of the cups by the radius of curvature through which they must pass in the instrument tip. When taking biopsy specimens from a lesion that can only be approached tangentially (e.g. the wall of the esophagus), forceps with a central spike may be helpful; however, these do present a significant puncture hazard for staff.
- ***Cytology brushes*** have a covering plastic sleeve to protect the specimen during withdrawal (Fig 2.10).
- ***Flexible needles*** are used for injections and for sampling fluids and cells.
- ***Fluid-flushing devices***. Most instruments have a flushing jet channel to keep the lens clean. Fluids can also be forcibly flushed through the instrumentation channel with a large syringe or a pulsatile electric pump, with a suitable nozzle inserted into the biopsy port. For more precise aiming, a washing catheter can be passed down the channel to clean specific areas of interest, or to highlight mucosal detail by "dye spraying" (using a nozzle-tipped catheter).

Ancillary equipment

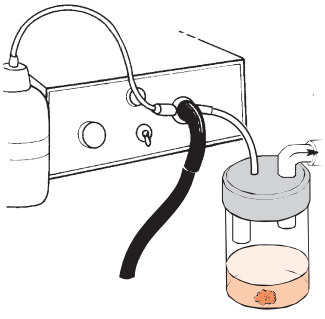

Fig 2.11 A suction trap to collect fluid specimens.

- ***Suction traps*** (fitted temporarily into the suction line) can be used to take samples of intestinal secretions and bile for microbiology, chemistry, and cytology (Fig 2.11; see also Fig 7.27).
- ***Biteguards*** are used to protect the patient's teeth and the endoscope. Some guards have straps, to keep them in place, and oxygen ports.
- ***Overtubes*** are flexible plastic sleeves that cover the endoscope shaft and act as a conduit for repeated intubations, or to facilitate therapeutic procedures such as the extraction of a foreign body and hemostasis (Fig 2.12).
- ***Caps*** of various shapes can be attached to the tip of the endoscope to facilitate various procedures, such as banding and mucosal resection, dissection, etc.
- ***Stretchers/trolleys***. Endoscopy is normally performed on a standard transportation stretcher. This should have side rails, and preferably allow height adjustment. The ability to tilt the stretcher head down may be helpful in emergencies.
- ***Image documentation***. Videoscopes capture images digitally, which can then be enhanced, stored, transmitted, and printed. Video sequences can be recorded on tape or digitally.
- ***Sedation and monitoring***. All patients require regular monitoring during an endoscopy with pulse oximetry as a minimum. Many units also have the facility for continuous blood pressure monitoring and electrocardiography, particularly for deeply sedated patients. Appropriate resuscitation equipment must be available, including oral airways, oxygen delivery systems, and wall suction.

Electrosurgical units

Any electrosurgical unit can be used for endoscopic therapy if necessary, but purpose-built isolated-circuit and "intelligent" units have major advantages in safety and ease of use. Units should have test circuitry and an automatic warning system or cut-out in case a connection is faulty or the patient plate is not in contact. Most units have separate "cut" and "coagulate" circuits, which can often be blended to choice. For flexible endoscopy, low-power settings are used (typically 15–50 W). However, an "auto-cut" option is increasingly popular. This uses an apparently higher power setting but gives good control of tissue heating and cutting, because the system automatically adjusts power output according to initial

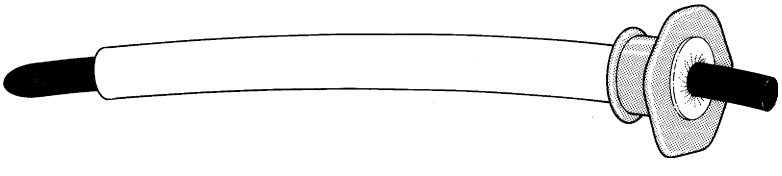

Fig 2.12 An overtube with biteguard over a rubber lavage tube.

tissue resistance and increasing resistance during coagulation and desiccation.

The type of current is generally less important than the amount of power produced, and other physical factors such as electrode pressure or snare-wire thickness and squeeze are more critical. High settings (high power) of coagulating current provide satisfactory cutting characteristics, whereas units with output not rated directly in watts can be assumed to have "cut" power output much greater than that of "coag" at the same setting. The difference in current type used is therefore often illusory. If in doubt, pure coagulating current alone is considered by most expert endoscopists to be safer and more predictable, giving "slow cook" effect and maximum hemostasis.

Lasers and argon plasma coagulation

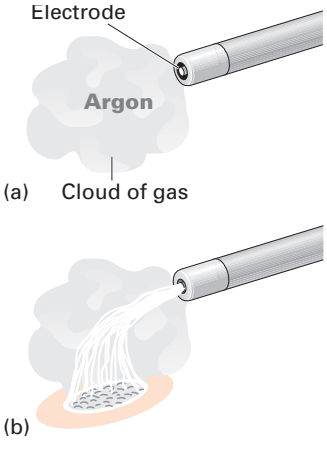

Fig 2.13 Argon plasma coagulation (APC).

Lasers (particularly the neodymium-YAG and argon lasers) were introduced into endoscopy for treatment of bleeding ulcers, and for tumor ablation, because it seemed desirable to use a "no touch" technique. However, it has become clear that the same effects can be achieved with simpler devices, and that pressure (coaptation) may actually help hemostasis.

Argon plasma coagulation (***APC***) is easier to use and as effective as lasers for most endoscopic purposes. APC electrocoagulates, without tissue contact, by using the electrical conductivity of argon gas—a similar phenomenon to that seen in neon lights. The argon, passed down an electrode catheter (Fig 2.13a) and energized with an intelligent-circuitry electrosurgical unit and patient plate, ionizes to produce a local plasma arc—like a miniature lightning strike (Fig 2.13b). The heating effect is inherently superficial (2–3 mm at most, unless current is applied in the same place for many seconds), because tissue coagulation increases resistance and causes the plasma arc to jump elsewhere. However, APC action alone may be too superficial to debulk a larger lesion, requiring preliminary piecemeal snare-loop removal, with APC to electrocoagulate the base.

Equipment maintenance

Endoscopes are expensive and complex tools. They should be stored safely, hanging vertically in cupboards through which air can circulate. Care must be taken when carrying instruments, as the optics are easily damaged if left to dangle or are knocked against a hard surface. The head, tip, and umbilical cord should all be held (Fig 2.14).

The life of an endoscope is largely determined by the quality of maintenance. Complex accessories (e.g. electrosurgical equipment) must be checked and kept in safe condition. Close collaboration with hospital bioengineering departments and servicing engineers is essential. Repairs and maintenance must be properly documented.

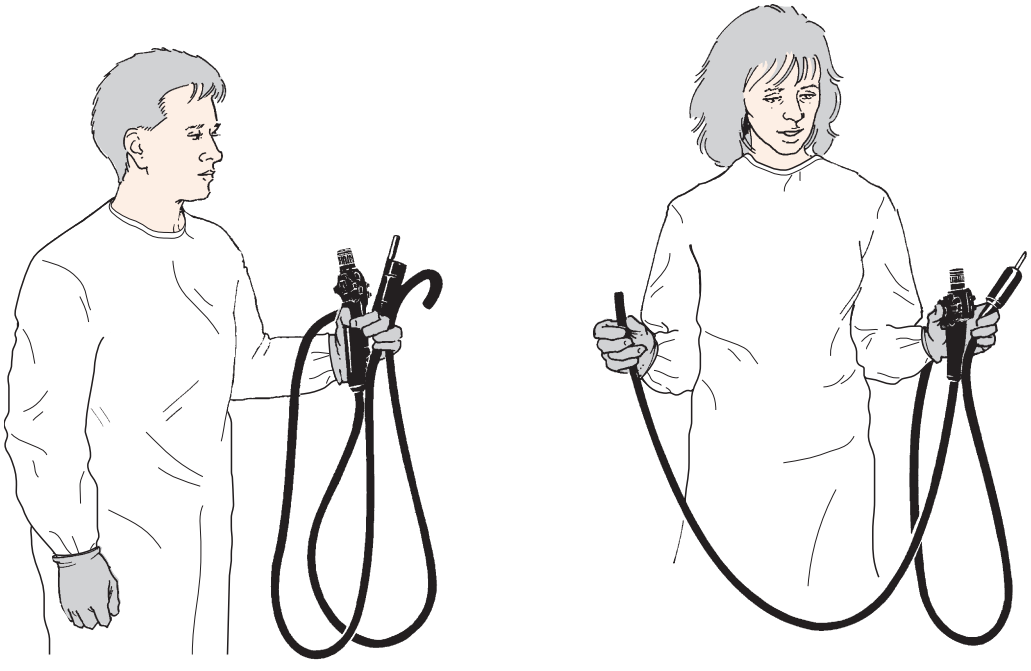

Fig 2.14 Carry endoscopes carefully to avoid knocks to the optics in the control head and tip.

Channel blockage

Blockage of the air/water (or suction) channel is one of the most common endoscope problems. Special "channel-flushing devices" are available, allowing separate syringe flushing of the air and water channels; they should be used routinely. When blockage occurs, the various systems and connections (instrument umbilical, water bottle cap or tube, etc.) must be checked, including the tightness and the presence of rubber O-rings where relevant. It is usually possible to clear the different channels by using the manufacturer's flushing device or a syringe with a suitable soft plastic introducer or micropipette tip. Water can be injected down any channel and, because water is not compressed, more force can be applied than with air. Remember that a small syringe (1–5 mL) generates more pressure than a large one, whereas a large one (50 mL) generates more suction. The air or suction connections at the umbilical, or the water tube within the water bottle, can be syringed until water emerges from the instrument tip. Care should be taken to cover or depress the relevant control valves while syringing. Another method for unclogging the suction channel is to remove the valve and apply suction directly at the port.

Infection control

There is a risk of transmitting infection in the endoscopy unit from patient to patient, patient to staff, and even from staff to patient.

Fig 2.15 Gowns, gloves, and eye protection should be worn.

Universal precautions should always be adopted. This means assuming that all patients are infectious, even if there is no objective evidence. Infection control experts and equipment manufacturers should be welcomed as partners in minimizing infection risk; they should be invited to participate in developing unit policies and in monitoring their effectiveness through formal quality control processes. Infection control policies should be written down and understood by all staff.

Staff protection

Staff should be immunized against hepatitis; tuberculosis checks are mandatory in some units. Splashing with body fluids is a risk for staff in contact with patients and instruments. Gowns, gloves, and eye protection should be worn for these activities (Fig 2.15).

Other measures to reduce the risk of infection include:

- ***frequent hand-washing***;
- ***use of paper towels*** when handling soiled accessories;
- disposal of ***soiled items*** directly into a sink or designated area (not on clean surfaces);
- ***separate disposal of hazardous waste***, needles, and syringes;
- ***covering skin breaks*** with a waterproof dressing;
- ***maintenance of good hygienic practice*** throughout the unit.

Cleaning and disinfection

There are three levels of disinfection:

1 ***Low-level disinfection*** (essentially "wipe-down") is adequate for ***non-critical accessories***, which come into contact with intact skin, e.g. cameras and endoscopic furniture.

2 ***Sterilization*** is required for ***critical reusable accessories***, which enter body cavities and vasculature or penetrate mucous membranes, e.g. biopsy forceps, sclerotherapy needles, and sphincterotomes. "Single-use" disposable items are pre-sterilized.

3 ***High-level disinfection*** is required for ***semi-critical accessories***, which come into contact with mucous membranes, e.g. endoscopes and esophageal dilators.

Endoscope reprocessing

Guidelines for cleaning and disinfecting endoscopes should be determined in each unit (and documented in the procedure manual) after consulting with manufacturers, infection control experts, and appropriate national advisory bodies. Endoscopists should be fully aware of their local practice, not least because they may be held legally responsible for any untoward event.

All advisory bodies require high-level disinfection of endoscopes and other equipment shortly after use.

How long a disinfected instrument remains fit for use after disinfection is an important issue, and still a matter for debate. Some authorities have recommended 4–7 days, but the reality depends on several factors. Endoscopes that contain retained moisture will rapidly become colonized by the rinsing water. Assiduous care must

be taken in the drying process, and specially designed drying cabinets are available commercially. Local policy should be guided by national recommendations and can be validated by microbiological monitoring.

Formal cleaning and disinfection procedures should take place in a purpose-designed area. There should be clearly defined and separate clean and dirty areas, multiple worktops, and double sinks as well as a separate hand washbasin, endoscopic reprocessors (washing machines), and ultrasonic cleaners. An appropriately placed fume hood is also desirable.

Mechanical cleaning

The first and vitally important task in the disinfection process is to clean the endoscope and all of its channels, to remove all blood, secretions, and debris. Disinfectants cannot penetrate organic material.

Initial cleaning must be done immediately after the endoscope is removed from the patient.

1 ***Wipe down*** with a cloth soaked in enzymatic detergent.
2 ***Suck water and enzymatic detergent*** through the suction/biopsy channel, alternating with air, until the solution is visibly clean.
3 ***Flush the air/water channel*** with the manufacturer's flushing device or by depressing the air/water button while occluding the water bottle attachment at the light source and holding the tip of the scope under water. This should be continued until vigorous bubbling is seen.
4 ***Attach the cap that protects the electrical connections***, and transfer the scope (in protective packaging to avoid contamination) to the designated cleaning area.
5 ***Remove all valves and biopsy caps***.
6 ***Test the scope for leaks***, particularly in the bending section, by pressurizing it with the leak-testing device and immersing the instrument in water. Angulate the bending section in its four directions while the instrument is under pressure to identify leaks in the distal rubber that are only obvious when it is stretched. Ensure all pressure is removed before disconnecting the leak tester.
7 ***Totally immerse the instrument*** in warm water and neutral detergent, and then wash the outside of the instrument thoroughly with a soft cloth.
8 ***Brush the distal end*** with a soft toothbrush, paying particular attention to the air/water outlet jet and any bridge/elevator.
9 ***Clean the biopsy channel opening and suction port*** using the port cleaning brush provided. Pass a clean channel-cleaning brush suitable for the instrument and channel size through the suction channel until it emerges clean (at least three times), cleaning the brush itself each time before reinsertion. Pass the cleaning brush from the suction channel opening in the other direction.
10 ***Place the endoscope into a reprocessor*** to complete cleaning and disinfection (or continue manually).
11 ***Clean all instrument accessories*** equally scrupulously, including the air/water and suction valves, water bottles, and cleaning brushes.

Manual cleaning

After brushing:

1 ***Attach the manufacturer's cleaning adapters*** to the suction, biopsy, and air/water channels. Ensure that the instrument remains immersed in the detergent fluid.

2 ***Flush each channel with detergent*** fluid, ensuring that it emerges from the distal end of each channel.

3 ***Leave in detergent*** for the time stated by the manufacturer of the detergent product used.

4 ***Purge detergent from the channels.***

5 ***Flush each channel with clean water*** to rinse the detergent fluid.

6 ***Rinse the exterior of the endoscope***.

7 ***Check that all air is expelled from the channels***.

Manual disinfection

Soak the instrument and accessories (such as valves) in the chosen disinfectant for the recommended contact time.

Disinfectants

Glutaraldehyde has been the most popular agent. It can destroy viruses and bacteria within a few minutes, is non-corrosive (to endoscopes), and has a low surface tension, which aids penetration. The length of contact time needed for disinfection varies according to the type of gluteraldehyde used, and the temperature. Guidelines vary between countries, but 20 minutes is commonly recommended. More prolonged soaking may be required in cases of known or suspected mycobacterial disease.

Glutaraldehyde does carry the risk of sensitization, and can cause severe dermatitis, sinusitis, or asthma among exposed staff. The risk increases with increasing levels and duration of exposure. Medical-grade latex gloves, or nitrile rubber gloves, should be worn, with goggles and/or a face mask to protect against splashes. Closed system reprocessors and fume hoods/extraction fans are important. Reprocessors should be self-disinfecting. The concentration of disinfectant should be monitored.

Peracetic acid, chlorine dioxide, Sterox and other agents have also been used for endoscope disinfection.

A ***sterile water supply*** (special filters may be needed) helps to reduce the risk of nosocomial infections.

Rinsing, drying, and storing

Following disinfection, reprocessors rinse the instruments internally and externally to remove all traces of disinfectant, using the all-channel irrigator. The air, water, and suction channels (and flushing and forceps elevation channels if fitted) are perfused with 70% alcohol and dried with forced air before storage. This must be done for all endoscopes processed either manually or by automated reprocessor (some reprocessors have this function as part of the cycle). Bacteria multiply in a moist environment, and the importance of drying instruments after disinfection cannot be overemphasized. Instruments should be hung vertically in a well-ventilated cupboard.

Accessory devices

Diagnostic and therapeutic devices (such as biopsy forceps) are critical accessories, and must be sterile. Many are now disposable. Reusable accessories, such as water bottles, are autoclaved or gas sterilized.

Quality control of reprocessing

Records should be kept of the disinfection process for every endoscope, including who cleaned it, when, and how. Records that link the endoscope with which the patient was examined should also be kept. Routine bacteriological surveillance of automatic disinfectors and endoscopes is recommended by some experts, but is not yet endorsed by the main national societies, and is not widely practiced. This should allow early detection of serious contaminating organisms such as *Pseudomonas* and atypical mycobacteria. Routine surveillance also allows the early detection of otherwise unrecognizable internal channel damage, reprocessing protocol errors, as well as any water and environmental contamination problems. The specter of prion-related disease may be raised in patients with degenerative neurological symptoms. As prion proteins are not inactivated by heat or current disinfection regimes, disposable accessories should be used with a back-up endoscope reserved for such suspect patients. Lymphoid tissue is a particular risk, so many units now advise against routine ileal biopsies, particularly of Peyer's patches, for fear of potential prion contamination of the instrument channels.

Remember, although most of the cleaning, disinfection, and maintenance activities are normally and appropriately delegated to the staff, it is the endoscopist who is responsible for ensuring that their equipment is safe to use. Endoscopists should know how to complete the process themselves, especially in some emergency situations where the usual endoscopy nurses may not be available.

Safety and monitoring equipment

It is now standard practice to monitor patients through the procedural process and to provide supplemental oxygen in many cases. The necessary equipment must be readily available in the procedure rooms and pre-recovery areas, along with an emergency resuscitation cart.

Further reading

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CHAPTER 3

Patient Care, Risks, and Safety

Skilled endoscopists can now reach every part of the digestive tract and its appendages, such as the biliary tree and pancreas. It is possible to take specimens from all of these areas, and to treat many of their afflictions. Many patients have benefited greatly from endoscopy. Unfortunately, however, in some cases it may be an unhelpful procedure, and can even result in severe complications. There are also some hazards for the staff. The goal must be to maximize the benefits and minimize the risks. We need competent endoscopists, working for good indications on patients who are fully prepared and protected, with skilled assistants, and using optimum equipment. The basic principles are similar for all areas of gastrointestinal endoscopy, recognizing that there are specific circumstances where the risks are greater, including therapeutic and emergency procedures.

Patient assessment

Endoscopy is normally part of a comprehensive evaluation by a gastroenterologist or other digestive specialist. It is mostly used electively in the practice environment or hospital outpatient clinic, but sometimes may be needed in any part of a health-care facility (e.g. emergency room, intensive care unit, operating room). Sometimes endoscopists offer an "open access" service, where the initial clinical assessment and continuing care are performed by another physician. In all of these situations it is the responsibility of the endoscopist to ensure that the potential benefits exceed the potential risks, and personally to perform the necessary evaluations to make appropriate recommendations for the patient.

The following sections refer primarily to upper endoscopy. Issues specific to colonoscopy are covered in chapters 6 and 7.

Is the procedure indicated?

Upper endoscopy is now the primary tool for evaluating the esophagus, stomach, and duodenum. It may be used for many reasons. Broadly speaking, the goal may be to:

1 ***make a diagnosis*** in the presence of suggestive symptoms (e.g. dyspepsia, heartburn, dysphagia, anorexia, weight loss, hematemesis, anemia);

2 ***clarify the status of a known disease*** (e.g. varices, Barrett's esophagus);

Cotton and Williams' Practical Gastrointestinal Endoscopy: The Fundamentals, Seventh Edition.
Adam Haycock, Jonathan Cohen, Brian P Saunders, Peter B Cotton, and Christopher B Williams.

Companion Website: www.wiley.com/go/cottonwilliams/practicalgastroenterology

3 ***take specimens*** (e.g. duodenal biopsy for malabsorption);
4 ***screen for malignancy*** and premalignancy in patients judged to be at increased risk of neoplasia (e.g. familial adenomatous polyposis);
5 ***perform therapy*** (e.g. hemostasis, dilatation, polypectomy, foreign body removal, tube placement, gastrostomy).

Several of the above indications may be combined: for example 1 and 5 (in acute bleeding), or 2 and 5 (e.g. retreatment of known varices).

Guidelines about the appropriate use of endoscopy are published by endoscopy organizations. The "strength" of the indication in each circumstance will depend upon likely benefit, the alternatives, and the perceived risks.

What are the risks? Unplanned events and complications

The vast majority of routine upper endoscopy procedures go according to plan, but there are exceptions. These may be generally categorized best as "unplanned events," which include technical failures (unable to reach the desired area) and clinical failures (no benefit from the treatment). Here we focus on adverse events. Some of these are relatively trivial, e.g. bleeding that stops without need for transfusion.

The term "complication" has unfortunate medicolegal connotations, so its use should be restricted to unplanned events of a certain defined level of severity. Over 15 years ago a group interested in the outcomes of endoscopic retrograde cholangiopancreatography (ERCP) proposed a definition that has been used widely ever since:

A complication is:

- an unplanned event;
- attributable to the procedure;
- that requires the patient to be admitted to hospital, or to stay longer than expected, or to undergo other interventions.

Levels of severity for complications

Complications can vary from relatively minor to life-threatening, so it is necessary to have some measure of severity. We use the degree of patient "disturbance" to stratify complications:

- ***mild***—events requiring hospitalization of 1–3 days;
- ***moderate***—hospital stay of 4–9 days;
- ***severe***—stay of more than 10 days, or the need for surgery, or intensive care;
- ***fatal***—death attributable to the procedure.

A multi-disciplinary working party of ASGE recently proposed a new lexicon for adverse events for all of the endoscopic procedures.

The new definition is: **An adverse event is an event that prevents completion of the planned procedure (not simply a technical failure or poor preparation or toleration), and/or results in a admission to hospital, prolongation of existing hospital stay, or another procedure (one requiring sedation/anesthesia), or subsequent consultation by another specialty**.

The working party also recommended allowing attribution to the events, (ie definite, probable, possible, unlikely).

Other publications from the working party included a detailed review of risk factors for events, and proposed new complexity scales for all endoscopic procedures.

Complication rates

Variable definitions and methods for data collection and a lack of community-based studies make it difficult to quote precise statistics about the risks of endoscopy, which obviously vary with the patient population and many other factors. However, large surveys suggest that the chance of suffering a severe complication (such as perforation or a major cardiopulmonary event) after ro utine upper endoscopy is less than 1 in 1000 cases. The risks are higher in the elderly and the acutely ill, and during therapeutic and emergency procedures. Inexperience, oversedation, and overconfidence are important factors.

Specific adverse events

- ***Hypoxia*** should be detected early by careful nursing surveillance, aided by pulse oximetry, and treated quickly.
- ***Pulmonary aspiration*** is probably more common than recognized. The risk is greater in patients with retained food residue (e.g. achalasia, pyloric stenosis), and in those with active bleeding.
- ***Bleeding*** may occur during and after endoscopy, from existing lesions (e.g. varices) or as a result of endoscopic manipulation (biopsy, polypectomy), or, occasionally, because of retching from a Mallory–Weiss tear. The risk of bleeding is greater in patients with coagulopathy, and in those taking anticoagulants and (possibly) antiplatelet agents.
- ***Perforation*** is the most feared complication of upper endoscopy. It is rare, most commonly occurs in the neck, and is more frequent in elderly patients, perhaps in the presence of a Zenker's diverticulum. The risk is minimized by gentle endoscope insertion under direct vision. Perforation beyond the cricopharyngeus is extremely unusual in patients who are not undergoing therapeutic techniques such as stricture dilatation, polypectomy, or mucosal resection. Perforation at colonoscopy is discussed in Chapter 7.
- ***Cardiac dysrhythmias*** are extremely rare. They require prompt recognition and expert treatment.
- ***Intravenous (IV) site problems***. Many patients have discomfort at the site of their IV infusion. Local thrombosis is not unusual or dangerous, but evidence of spreading inflammation should be treated promptly and seriously.
- ***Infection***. Patients with active infections can pose risks to the staff and to subsequent patients. Endoscopes (and accessories) are potential vehicles for the transmission of infection from patient to patient (e.g. *Helicobacter pylori*, salmonella, hepatitis, mycobacteria).

This risk should be eliminated by assiduous attention to detail in cleaning and disinfection. Endoscopy can provoke bacteremia, especially during therapeutic procedures such as dilatation. This may be dangerous in patients who are immunocompromised, and in some with diseased heart valves and prostheses. Endoscopy-induced endocarditis is extremely rare, but antibiotic prophylaxis is advised in certain circumstances (see below).

Assessing and reducing specific risks

Certain comorbidities and medications clearly increase the risk of endoscopic procedures. A *checklist* should be used to ensure that all of the issues have been addressed. Some of this information must be obtained when the procedure is scheduled, as action is required days ahead of the procedure (e.g. adjusting anticoagulants, stopping aspirin, etc.). Other aspects are dealt with when the patient arrives in the pre-procedure area.

- ***Cardiac and pulmonary disease.*** Patients with recent myocardial infarction, unstable angina, or hemodynamic instability are obviously at risk from any intervention. Expert advice should be sought from cardiologists. Endoscopy can be performed in patients with pacemakers and artificial implantable defibrillators, but the latter must be deactivated if diathermy is performed. Anesthetic supervision is essential if endoscopy is needed in such patients, and in others with respiratory insufficiency.
- ***Coagulation disorders.*** Patients with a known bleeding diathesis or coagulation disorder should have the situation normalized as far as possible before endoscopy (particularly if biopsy or polypectomy is likely). Anticoagulants can be stopped ahead of time, and (if clinically necessary) replaced by heparin for the period of the procedure, and early recovery. Certain antiplatelet drugs may need to be stopped also. There is little evidence that aspirin and nonsteroidal anti-inflammatory drugs (NSAIDs) increase the risk of adverse events. It is common practice, however, to ask about these drugs, and to recommend that they be discontinued for at least a week before endoscopic procedures.
- ***Sedation issues.*** Nervous patients and others who have had prior problems with sedation can pose challenges for safe endoscopy. Individuals who are at risk of airway obstruction (known sleep apnoea, obesity) or aspiration should undergo pre-endoscopy airway assessment. If in doubt, consider anesthesia support.
- ***Endocarditis.*** The risk of developing endocarditis after upper endoscopy procedures is extremely small, and there is no evidence that antibiotic prophylaxis is beneficial other than in percutaneous endoscopic gastrostomy (PEG) insertion and selectively for high-risk patients undergoing ERCP in which complete duct drainage is not successful. Current recommendations are made by national organizations (Table 3.1). The local policy should be documented in the endoscopy unit policy manual.
- ***Pregnancy.*** Endoscopy is generally safe to perform during pregnancy. Nonetheless, it should only be done when there is a strong indication and after consultation with an obstetrician. When possible, postponement to the second trimester is best.

Table 3.1 Antibiotic prophylaxis: policy at the Medical University of South Carolina. This is based on previous guidelines from the American Heart Association and the American Society for Gastrointestinal Endoscopy. Physician discretion is advised for other cardiac lesions (rheumatic valvular heart disease, acquired valvular dysfunction, mitral valve prolapse with insufficiency, hypertrophic cardiomyopathy, congenital malformations) and in patients having sclerotherapy or esophageal dilation. Special circumstances may justify other approaches. The final decision and responsibility rests with the endoscopist in each case

Endoscopies	Patient status	Regime	Alternative in case of allergy
All	Immunocompromised (neutrophils <1000, or transplant)	Cefotaxime 2 g IV	Clindamycin 900 mg IV and Aztreonam 1 g IV
Variceal treatment	Cirrhosis with ascites	Ofloxacin 200 mg IV over 1 h then 200 mg 12 hourly	–
PEG	All patients	Cefazolin 1 g IV	Vancomycin 1 g IV over 1 h

Table 3.2 ASA (American Society of Anesthesiologists) classification—anesthesia risk classes

Classification	Description	Example
Class I	Healthy patient	
Class II	Mild systemic disease—no functional limitations	Controlled hypertension, diabetes
Class III	Severe systemic disease—definite functional limitation	Brittle diabetic, frequent angina, myocardial infarction
Class IV	Severe systemic disease with acute, unstable symptoms	Recent myocardial infarction, congestive heart failure, acute renal failure, uncontrolled active asthma
Class V	Severe systemic disease with imminent risk of death	

The American Society of Anesthesiologists (ASA) score is used in many units to describe broad categories of fitness for procedures and sedation (Table 3.2). Many recommend anesthesia assistance for patients with ASA scores of 3 or greater.

Patient education and consent

Patients are entitled to be fully informed of the reasons why a procedure is recommended, the expected benefits, the potential risks, the limitations, and the alternatives. They also need to know exactly what will happen, and have the chance to ask questions.

Printed brochures can facilitate this education process and should be given (or sent) to patients well in advance of the procedure, so that they can be studied carefully and digested. Suitable brochures are available from national organizations, and on websites from expert centers (e.g. www.ddc.musc.edu). One example is shown in Fig 3.1. They can be adapted or developed for local conditions. Some centers use videotapes and web-based

Upper Endoscopy

Upper endoscopy is a test that lets your doctor see the lining of your upper digestive system. The upper digestive system includes the food tube (esophagus), the stomach and the first part of the small intestine (duodenum).

Upper endoscopy is the best way to find swelling (inflammation), ulcers or tumors of the upper digestive system.

Upper endoscopy can be used to treat some conditions present in the upper digestive system. Growths (polyps) and swallowed objects can be removed. Narrow areas can be stretched. Bleeding can be treated.

What is an Endoscope?

An endoscope is a long, narrow, flexible tube containing a tiny light and camera at one end.
This camera carries pictures of your upper digestive tract to a television screen. The doctor and nurse can see your esophagus, stomach, and small intestine better on this monitor. The pictures can also be recorded and printed.

How Do I Prepare?

Do not eat or drink for 6 hours before your test. Your stomach must be empty.

Tell your doctor if you...
- have any allergies, heart or lung problems.
- are or think you may be pregnant.
- have had endoscopy in the past and if you had problems with the medicines or dye used.
- take antibiotics before having dental work.

If you take medicine to thin your blood, (i.e. heparin or coumadin) or aspirin compounds tell your doctor. In general, you must stop taking these pills for several days, but in some cases you may continue to take them.

If you are a diabetic, please ask your doctor if you should take your insulin and/or pills before your test.

You may take blood pressure and heart medicine as usual the morning of your test.

If you take pills in the morning, drink only a small sip of water to help you swallow.

Do not take any antacids.

Bring with you all prescription and over-the-counter medicines you are taking.

Bring with you all medical records and X-ray films that relate to your current problem.

Make sure an adult can take you home. The medicines used during the procedure will not wear off for several hours. You will NOT be able to drive. If you travel by public transportation, such as by bus, van or taxi, you will still need an adult to ride home with you.

If you come alone, your test may have to be rescheduled.

Fig 3.1 MUSC patient education brochure (sedation is routinely used).

What Will Happen During My Upper Endoscopy?

1. When you come for the Upper Endoscopy, the doctor will talk to you about the test and answer any questions you have. You should know why you are having an Upper Endoscopy and understand the treatment options and possible risks.

2. You will put on a hospital gown. You will be asked to remove any eye glasses, contact lenses or dentures. An IV will be started and blood may be drawn for lab studies. You may receive antibiotics through the IV at this time.

3. You will be asked to sign a consent form which gives the doctor your permission to do the test.

4. You will be taken by stretcher to the procedure room. The nurse will help you get into the correct position, usually on your side, and make you comfortable. A medicine will be sprayed onto the back of your throat to make it numb. The medicine may taste unpleasant but it will stop any coughing during the test and the taste will go away quickly. A plastic guard will be placed in your mouth to protect your teeth during the test.

5. A blood pressure cuff will be put on your arm or leg. A small clip will be put on your finger. These will let the nurse check your blood pressure and heart rate frequently during the test.

6. If you require sedation, you will be given medicine through the IV. When you are relaxed and sleepy, the doctor will place a thin, flexible endoscope through the mouth guard and into your mouth. The endoscope has a small video camera on the end that lets the doctor see the inside of your esophagus.

7. The doctor will ask you to swallow. When you swallow, the endoscope will gently move down your esophagus, the same way food goes down when you are eating. You may feel like gagging, but you should not feel any pain. The endoscope will not interfere with your breathing.

8. The doctor will guide the endoscope through your stomach and into your small intestine. This will allow the doctor to see the lining of your upper digestive system and treat any problems that may be found.

9. When the test is done, the doctor will slowly take out the endoscope. Your Upper Endoscopy will last between 10 and 20 minutes.

What Will Happen Afterwards?

1. You will be taken to the recovery area. Your blood pressure and heart rate are watched while you rest. You will wake up in about 10 minutes to an hour if you have been sedated.

2. After removing your IV, the nurse will give you written instructions to follow when you go home. If you have any questions, please ask. The doctor will talk to you about your test before you leave.

3. Even if you feel awake, your judgment and reflexes will be slow. You may NOT be allowed to leave unless an adult takes you home. It is not safe for you to drive.

4. If treatments were done during your test, you may need to be observed overnight in hospital.

Fig 3.1 Continued.

5. If specimens were taken at your endoscopy, the results will be sent to you and the doctor who is providing your continuing care.

Over the Next 24 Hours....

You might need to take things quietly until the next day.

After the test, you may feel bloated and pass gas. This is normal and will go away in a few hours.

Your throat may be sore for a few days.

You may resume your regular diet and medications after the procedure.

Do not drive, operate machinery, sign legal documents or make important decisions.

Do not drink alcohol or take sleeping or nerve pills.

What are the Risks?

Upper Endoscopy is usually simple, but there are some risks, especially when treatments are done during the test.

A tender lump may form where the IV was placed. The lump may not go away for several weeks. You will need to call your doctor if redness, pain or swelling in this hand or arm lasts for more than two days.

The medicines may make you sick. You may have nausea, vomiting, hives, dry mouth, or a reddened face and neck.

Severe problems occur in less than one case in 500. These include chest and heart difficulties, bleeding, or tearing (perforation) of the digestive system. If any of these problems happen, you will have to stay in the hospital. Surgery may be needed.

Your doctor will discuss these risks with you.

Call the Doctor if You....

- have severe pain.
- vomit.
- pass or vomit blood.
- have chills and fever above 101 degrees.

If you have any problems, call your specialist. If it is after regular business hours, page the 'GI Doctor on Call' through the paging operator at ....
This information is provided as an educational service of the .....
The content is limited and is not a substitute for professional medical care.

Fig 3.1 Continued.

instructional materials. Patients must be given the opportunity to ask questions of the endoscopist before being invited to confirm their understanding and agreement to the procedure by signing the consent form. This document simply confirms that the patient truly understands and accepts what is being proposed, including the potential for harm.

The very simplicity and safety of upper endoscopy may tempt busy endoscopists to hurry the consent process, or to delegate it to others. That is not good medical practice, and carries medico-legal risk.

Physical preparation

Before upper endoscopy the patient should prepare by taking nothing by mouth for about 6 hours (usually overnight) and changing into a loose-fitting gown. A series of medical checks and actions to optimize the safety of the intervention are undertaken, including a general medical review, confirmation of current medication, assessment of vital signs and cardiopulmonary status, and attention to the many details concerning risks and risk reduction as detailed above. IV access should be established, preferably in the right arm or hand. Spectacles and dentures should be removed and stored safely. Consultation with a nurse is helpful with regards to adjustment of chronic medications the night before or on the morning of the procedure (e.g. insulin and antihypertensives).

Preparation for colonoscopy is covered in Chapter 6.

Monitoring

Although the endoscopist has overall responsibility, the endoscopy nurse is the practical guardian of the patient's safety and comfort. Nursing surveillance should be supplemented with monitoring devices, at least for pulse rate, blood pressure, and oxygen saturation. Supplemental oxygen is used routinely in many units, although some argue that this may mask hypoventilation, which is better detected by monitoring of carbon dioxide (capnography). Electrocardiographic monitoring is desirable for any patient with cardiac problems, and for prolonged complex procedures. Emergency drugs and equipment must be available nearby, and the endoscopist should be trained in resuscitation and life support.

Sedation and other medications are given by the endoscopist or by the nurse under supervision. The nurse should document this process carefully, along with the patient's vital signs, monitoring data and the patient's response.

Medications and sedation practice

Sedation practice varies widely around the world. In many countries, most routine (diagnostic) upper endoscopy is performed

without any sedation, using only pharyngeal anesthesia. Although the avoidance of sedation has obvious advantages in terms of safety and fast recovery (e.g. patients can drive themselves home), many patients in the developed world expect and receive some degree of sedation/analgesia. Chapter 7 includes some discussion of sedation in general and specifically for colonoscopy.

Conscious sedation is intended to make unpleasant procedures tolerable for patients, while maintaining their ability to self-ventilate, maintain a clear airway, and respond to physical stimulation and verbal commands. Endoscopists giving conscious sedation must be fully familiar with the techniques and dosing. Many centers mandate specific training, and credentialing, for conscious sedation. The training is given by anesthesiologists. In contrast to conscious sedation, in ***deep sedation*** the patient cannot be easily aroused, and there may be partial or complete loss of protective reflexes, including the ability to maintain a patent airway. This level of sedation requires anesthesia supervision.

Sedation/analgesic agents (Table 3.3)

Anxiolytics

Short-acting benzodiazepines are commonly administered by slow IV injection/titration. Midazolam (Versed®), with its fast onset of action, short duration of action, and high amnestic properties, makes an ideal choice. It is given in an initial dose of 0.5–2.0 mg, with increments of 0.5–1 mg every 2–10 minutes, to a maximum of about 5 mg. Doses are determined by the patient's age, weight, medical and drug history, and by the response. Diazepam (Valium®, or in emulsion as Diazemuls®) can be used instead.

Table 3.3 Commonly used medication agents. For sedation purposes 25–50% increments of the initial dose can be administered every 2–10 minutes. Dosages should be adjusted according to patient age, body weight, medical history, and concomitant drug use

Sedating/ analgesic agents	Initial IV dose	Onset	Duration of effect
Midazolam	0.5–2 mg	1–5 min	1–2 h
Diazepam	1–5 mg	1–5 min	2–6 h
Meperidine	25–50 mg	2–5 min	2–4 h
Fentanyl	50–100 µg	1 min	20–60 min
Diphenhydramine	10–50 mg	1–10 min	2–6 h
Droperidol	1–5 mg	5–10 min	2–4 h
Reversal agents			
Flumazenil (for benzodiazepines)	0.1–0.2 mg	30–60 s	30–60 min
Naloxone (for opioids)	0.2–0.4 mg (IV and IM)	1–2 min	45 min

Narcotics

Narcotic analgesics are often given with benzodiazepines, but the combination increases the risk of respiratory depression. Pethidine (meperidine) is given in an initial dose of 25–50 mg, with increments of 25 mg up to a maximum of 100 mg. Fentanyl (Sublimaze®) is a more potent opioid analgesic with a rapid onset of action and clearance and reduced incidence of nausea compared with meperidine. It is useful in patients intolerant to meperidine but does have an increased risk of respiratory depression.

Antagonists

Meperidine can be reversed by naloxone, given both intramuscularly (IM) and intravenously (IV). Benzodiazepines are reversed by flumazenil, given by slow IV injection. Both antagonists have shorter half-lives than the drugs they antagonize.

Anesthesia

Although the vast majority of standard upper endoscopy procedures can be performed with endoscopist-directed sedation (or with no sedation), there are circumstances in which the presence of an anesthesiologist is helpful, and sometimes even full anesthesia is required. Examples include young children, heavy drinkers, patients who are difficult to sedate, and patients with high-risk cardiopulmonary status. Propofol (Diprivan®) is a useful short-acting anesthesia agent that seems ideal for endoscopy procedures. It has a weak amnestic effect and no analgesic effect and therefore is often used in conjunction with a short-acting opiate and benzodiazepine. In most centers and countries this can be given only by anesthesiologists.

Numerous other sedation/anesthesia practices have been tested and used, such as patient-controlled nitrous oxide and acupuncture.

Other medications

Pharyngeal anesthesia (given by spray) is used in many units to suppress the gag reflex during endoscopy. The patient should not be asked to say "ah" when applying the spray because this exposes the larynx to the anesthesia, which may suppress the cough reflex. Some endoscopists avoid local anesthesia when using sedation, believing that it may increase the risk of aspiration.

Excessive intestinal contraction can be suppressed with intravenous injections of ***glucagon*** (increments of 0.25 mg up to 2 mg) or ***hyoscine butylbromide*** (Buscopan®) 20–40 mg in countries where it is available.

Silicone-containing emulsions—either swallowed beforehand or injected down the channel—can be used to suppress foaming.

Pregnancy and lactation

Although this area has not been extensively studied, meperidine alone is preferred for procedural sedation during pregnancy.

Midazolam, although listed as category D by the US Food and Drug Administration, can be used in small doses in combination with meperidine as needed. If deep sedation is required it should performed by an anesthesiologist.

Concentrations of sedatives and analgesics vary in breast milk after procedural administration. In general, breast-feeding may be continued after fentanyl administration, which is preferred over meperidine during lactation. Infants should not be breast-fed for at least 4 hours following maternal administration of midazolam.

Recovery and discharge

After the endoscope is removed, the assisting nurse checks on the status of the patient and then transfers care to the recovery area staff. Monitoring is continued until the patient is fully awake, usually 20–30 minutes after standard sedation. A longer period of observation may be necessary after deep sedation or full general anesthesia.

The patient will appreciate a drink after sedation once any pharyngeal anesthesia has worn off. When established discharge criteria have been met, the patient gets dressed and is then taken to an interview area to discuss the findings and further care. Endoscopy is not complete until the patient has been counseled about the findings, their implications, and resulting plans. If sedation has been given, it is essential that this process takes place in the presence of an accompanying person, because of the potential for significant delayed amnesia. In addition, the patient should be instructed to have a responsible person to escort them home. They should not be allowed to drive, make important medicolegal decisions, or operate heavy machinery.

Discharge instructions should be given in writing, including details of:

- resumption of diet and activities;
- medications to be restarted, stopped, and commenced;
- further appointments;
- how biopsy results will be communicated;
- symptoms to report (and who to contact), including severe pain, distension, fever, vomiting, or passing blood.

Some units also print out and provide patient education materials relevant to the specific endoscopic findings. This service will become automatic with fully integrated electronic endoscopy reporting and management systems.

Managing an adverse event

Careful attention to all of these safeguards and cautions will help to ensure that most procedures go smoothly. Nevertheless, unplanned events do occur, even in the best of hands and environments, and it is natural for endoscopists and staff to feel bad when things "go wrong," especially when they are severe or life-threatening.

The most important action is to prepare for and manage these situations appropriately. The well-informed patient (and relatives) will have been told and should know that bad things can happen. This is an integral and important part of the communication and consent process, so it is appropriate and correct to address complications in that spirit. For example: "It looks like we have a perforation here. We discussed that as a remote possibility beforehand, and I'm sorry that it has occurred. This is what I think we should do."

Your distress is understandable and worthy, and you need to be sympathetic, but it is important also to be professional and matter of fact. Excessive apologies may give the impression that some avoidable mishap has occurred. Never attempt to cover up the facts. Document what has happened and communicate widely—with the patient, interested relatives, referring doctors, supervisors, and your risk management office.

Act quickly. Delay in managing complications is foolish and can be dangerous, both medically and legally. Get appropriate radiographs and lab studies, expert advice, and a surgical opinion (from a surgeon who understands the issues) for anything that might remotely require surgical intervention. Sometimes it may be wise to offer transfer of the patient to a colleague or to a larger center, but if this happens try to keep in touch and to show continuing interest and concern. Patients (and relatives) do not like to feel abandoned.

Further reading

Guidelines on indications, sedation, risks and risk reduction can be found at www.asge.org, www.bsg.org.uk, www.gastrohep.com, and many other sources.

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