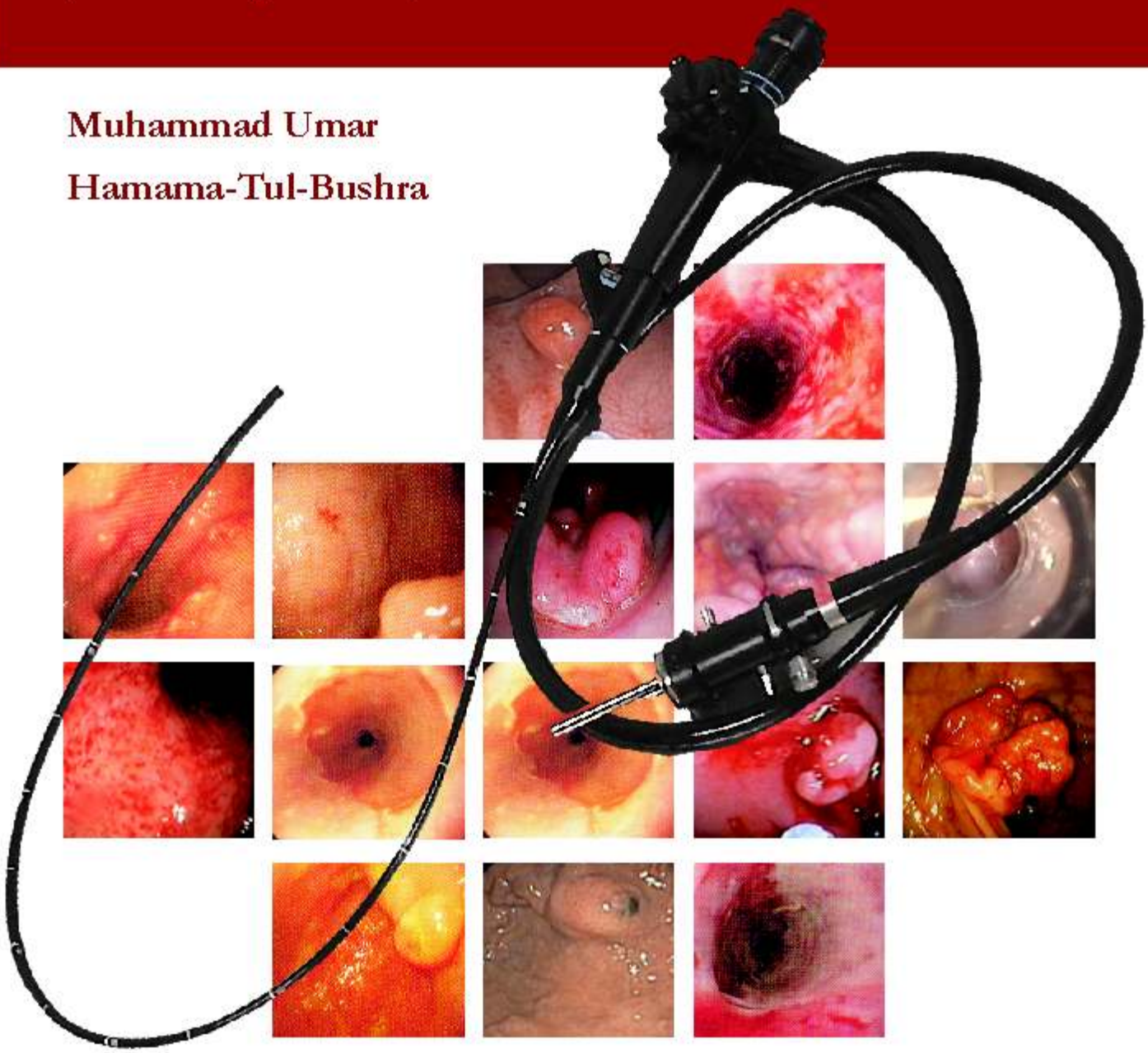
Basic Skills in
GASTROINTESTINAL ENDOSCOPY

(A Training Manual)

Muhammad Umar

Hamama-Tul-Bushra



Rawalians' Research Forum

on GI & Liver Diseases

Basic Skills in
GASTROINTESTINAL ENDOSCOPY
(A Training Manual)

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Basic Skills in GASTROINTESTINAL ENDOSCOPY - *A Training Manual*

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Foreword

It is nature of a human being to discover the undiscovered that's why he started attempting to look into human body orifices and body cavities date back from antiquity. Most of these efforts were fruitless because of lack of light source. In 1806, Philip Bozzini presented the theoretical idea of *Lichtleiter* (Light Conductor). This basic idea of light conduction was exclusively used in future developments in gastrointestinal, urological, gynecological endoscopies and eventually the laparoscopy.

While technological advances have made endoscopy one of the most common procedures for examining the gastrointestinal tract, learning how to maneuver the instruments and interpret the images can be frustrating for those without experience. This manual is specifically designed for beginners in endoscopy training. It has very illustrative and user friendly format, which comprehensively covers all aspects of basic skills in endoscopy.

- Clear descriptions and images of the instruments and how and when they are used
- Step-by-step instructions for handling the endoscope, such as insertion, air insufflation, irrigation, and more
- Useful checklists and tables that lay out the procedures from beginning to end, including preparations, necessary medication and anesthesia, required staff and supplemental equipment, potential risks and complications, etc.

The manual also encompasses a complete full-color atlas that illustrates the entire spectrum of both normal and pathological findings. In addition to detailed explanations of each finding, the authors provide

- The endoscopic criteria and the most important differential diagnoses for each disorder
- Series of images showing common variants, as well as comparison photographs of differential diagnoses
- Useful guidelines for proper documentation

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Graduated in 1981, with presidential gold medal from President of Pakistan from Rawalpindi Medical College Rawalpindi Pakistan, started his professional career as physician after obtaining membership (MCPS) and then fellowship (FCPS) of College of Physicians & Surgeons Pakistan in 1984 and 1985. He was awarded fellowships from American College of Gastroenterology (FACG) in 2003, Royal College of Physicians London (FRCP), Royal College of Physicians Glasgow (FRCP) in 2006, and American Gastroenterological Association (AGAF) in 2007. He was appointed *Assistant Professor*, then *Associate Professor* and currently the *Professor & Chair of Me*dicine and *Chief of Gastroenterology & Hepatology Division*.

He had keen zest for gastroenterology and specifically hepatology so he started pursuing his career in it. He started practicing gastroenterology by performing upper and lower GI procedures in general medical setting after formal training in endoscopy from CMH Rawalpindi and basic skills courses in the United States and the United Kingdom. He established GI & Liver Clinic, GI & Liver Learning Resource Centre, and Liver Research Clinic at Holy Family Hospital Rawalpindi.

He has contributed to gastroenterology by publishing more than 70 review and original research papers in various national and international journals, two books on hepatology; *Evidenced Based Approach to Hepatitis C Management* and *Hepatitis C in Pakistan*. Moreover, he published *National Hepatitis Practice Guidelines*. He was awarded *SJZ Research Award* from Pakistan Society of Gastroenterology & GI Endoscopy in 2004.

Currently, he is the *President* of Pakistan Society of Gastroenterology & GI Endoscopy, *General Secretary* of Pakistan Society of Hepatology, and *President* of Rawalians' Research Forum on GI & Liver Diseases.

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She graduated from Rawalpindi Medical College Pakistan with distinction in 1981. She obtained fellowship from College of Physicians & Surgeons Pakistan (FCPS) in 1985 and started her career. She was honored with fellowships from Royal College of Physicians Glasgow (FRCP) and American College of Gastroenterology (FACG) in 2007. She was appointed *Assistant Professor*, then *Associate Professor* and currently the *Professor of Me*dicine at Rawalpindi Medical College and Holy Family Hospital Rawalpindi Pakistan.

She had very strong interest in gastroenterology and specifically hepatology so she started pursuing her career in it. She started practicing gastroenterology and developed GI Wing and Endoscopy Suit at District Headquarters Hospital Rawalpindi.

She has a long list of publications including original and review papers, books, guidelines, and manuals. She has published about 80 research papers, two books on hepatology; *Evidenced Based Approach to Hepatitis C Management* and *Hepatitis C in Pakistan*. Moreover, she published *National Hepatitis Practice Guidelines*.

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Introduction

The word endoscopy is derived from the Greek word 'skopein' meaning 'to view' combining from prefix 'endo' meaning 'inside'. So Endoscopy means viewing inside the living body.

The endoscopes, which started as a simple, short, rigid, straight metallic tubes in 18th century went through a lot of innovation in last two centuries and now we have the long flexible fiberscope to video endoscopes. As the science and art of endoscopy evolved its role as purely a diagnostic tool has changed to a therapeutic armament.

Endoscopy has become an important investigation in the management of dyspepsia and upper duodenal pain; similarly it has an important diagnostic and therapeutic role in upper GI bleed. As the incidence and prevalence of liver disease and especially de-compensated liver disease increases day by day, the demand of endoscopy is proportionally increasing.

Gastrointestinal Endoscopy is a complex skill, requiring a period of formal training and experience with close supervision.

Only a skilled professional can provide the high standards of patient care, accuracy in diagnosis, and appropriate therapeutic interventions with avoidance of complications. It has been further recommended that doctors performing endoscopy should have a professional commitment to two or more endoscopy sessions weekly. So to acquire and maintain proficiency, close liaison with other experienced endoscopists ensures that training is a continuous process. Multidisciplinary interactions between endoscopists, radiologists, pathologists, physicians and surgeons contribute to effective training and skills.

Endoscopy Nurses

1. The main support to the endoscopist is given by nursing staff, although other properly trained health care workers can fit support roles. The specific role of the nurse in endoscopy is the care of patient before, during and after the procedure.

2. Training in patient monitoring and resuscitation techniques is essential for the nurse to cope with the unforeseen reactions and cardiorespiratory complications that may occur.

3. Endoscopes and their accessories are expensive and relatively delicate. Their incorrect maintenance and careless handling can damage them. Training in instrument handling and disinfection form an integral part of training of nurses and other endoscopy assistants and it is essential that all staff involved in endoscopy are kept up to date with ever-changing technology.

1 Endoscopic Equipment

Flexible endoscopes are complex. Basically they consist of control head and flexible shaft with a maneuverable tip. The head is connected to a light source via an umbilical cord, through which pass other tubes transmitting air, water and suction. The suction channel is used for the passage of diagnostic tools e.g. biopsy and therapeutic devices.

Fig 1.1 Fibreoptic endoscope system

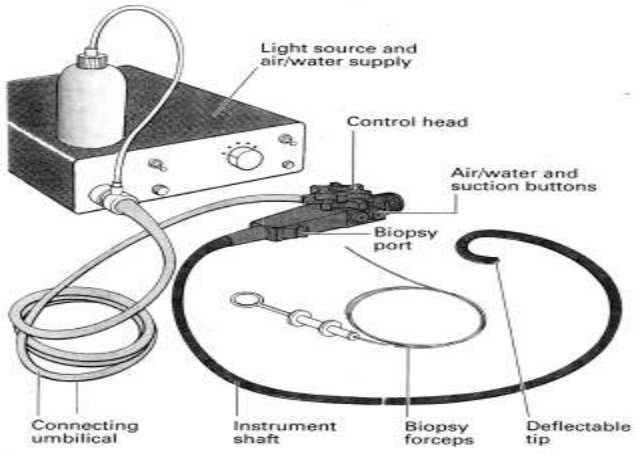


Fig. 1.1 Fibreoptic endoscope system.

Fiber optic instruments

These are based on optical viewing bundles, well described as a highly flexible piece of illuminated spaghetti. The viewing bundle of standard fiber endoscope is 2-3mm in diameter and contains 20,000-40,000 fine glass fibers, each close to 10µm in diameter. However, fiber optic bundles are extremely flexible and an image can be transmitted even when tied in a knot.

The distal lens which focuses the image on to the bundle is fixed. The image reconstructed at the top of the bundle is transmitted to the eye via focusing lens, adjusted to compensate for individual difference in refraction.

Video Endoscope

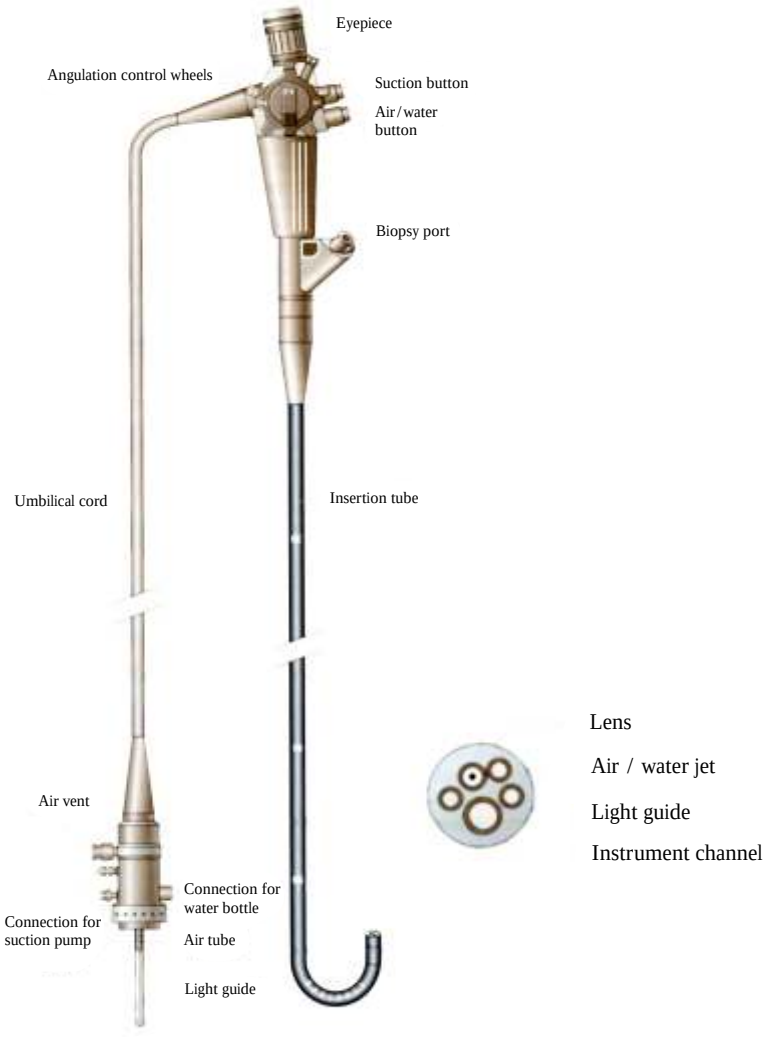
These are mechanically similar to fiber endoscopes, with a charged couple device (CCD) chip and supporting electronics mounted at the tip, to and from wiring replacing the optical bundle and further

electronics and switches occupying the site of the ocular lens on the upper part of the control head. Removing any need to hold the instrument close to the endoscopist's eye has hygienic advantages. The CCD chip is an array of 33,000-100,000 individual photon cells known as pixels. The number of pixels determines the resolution of the image. The screen image quality of present video endoscopes equals that of present fiberscopes in both colour and resolution.

Components of the endoscope

The endoscope consists of the supply plug, umbilical cord, control head, insertion tube (shaft), and bending section. A fiber optic endoscope has an eyepiece, while a video endoscope has remote control buttons for the video control unit.

Fig 1.2 Components of the Endoscope



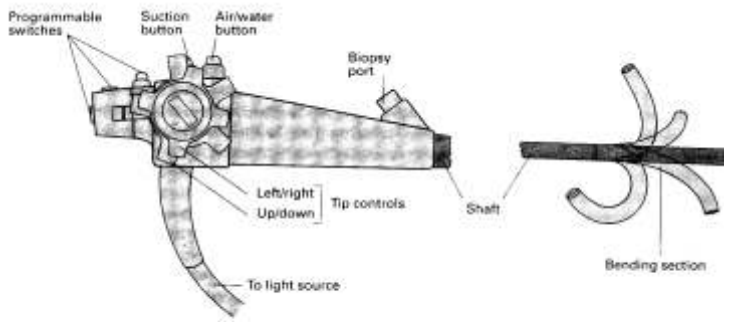
Supply plug and umbilical cord

The supply plug at the end of the umbilical cord has distal connectors for the light guide and air supply, side connectors for the water bottle and suction, and an air vent, which is not functional during endoscopy. The umbilical cord connects the supply plug to the control head.

Control head and insertion tube

Between the umbilical cord and insertion tube is the control head, which has control for air insufflation, irrigation, suction and for the bending section at the distal end of the scopes. At the intersection of the insertion tube and control head, there is a biopsy port for passing instruments down the endoscope shaft. The insertion tube has a distal bending section, whose tip carries the illuminating end of the light guide, air and water jets, the distal opening of the biopsy channel, and the lens of video chip.

Fig 1.3 *Basic Design - control head and bending section*



Fiber Optic vs. Video Endoscopy

In a fiber optic endoscope, light is conducted from the distal lens to the eyepiece by bundles of optical glass fibers. In a video scope the image is captured with a video chip at the distal end of the endoscope, transmitted electronically and displayed on a monitor.

Advantages and Disadvantages

Video endoscopy offers several advantages over fiber optic endoscopy: high resolution, the convenience of a monitor display, which permits others in the room to view the image, and easier handling of the endoscope during the procedure. In therapeutic procedures, the assistant can coordinate in a better way by viewing the procedure. The main disadvantage of video endoscopy is its high cost.

Illumination

This is provided from an external high intensity source through one or

more light carrying bundles. Because the light intensity is reduced at any optical interface, light bundles run uninterrupted from the tip of the instrument through its connecting umbilical cord directly to the point of focus of the lamp. These may be Xenon arc (300 w) or halogen-filled tungsten filament lamps (150 w).

Instrument Tip

Control of the instrument tip depends upon pull wires attached at the tip, just beneath its outer protective shaft, and passing back through the length of the instrument shaft to the angling controls in the control head.

Fig 1.4 The tip of a forward viewing endoscope.

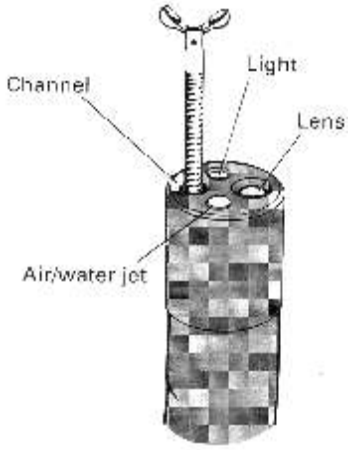
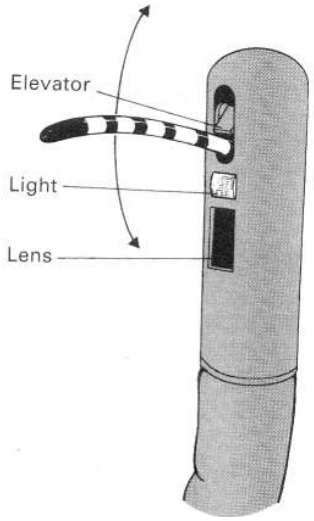


Fig 1.5 A side-viewer with cannula protruding from the elevator



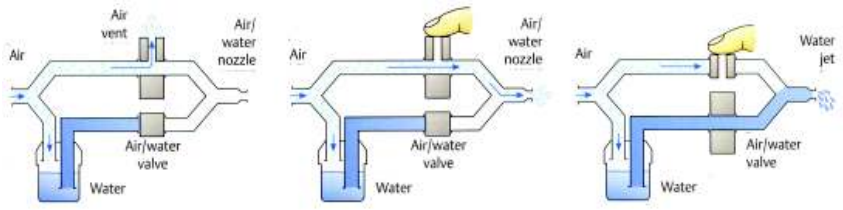
The two angling wheels/knobs (for up/down and right/left movement) incorporate a friction braking system, so that the tip can be fixed temporarily in any directed position. The instrument shaft is torque stable so that rotatory corkscrewing moments applied to the head are transmitted to the tip if the shaft is relatively straight at the time.

Instrument Channels

An operating channel (usually 2-4mm in diameter) allows the passage of fine flexible accessories (e.g. biopsy forceps, cytology brushes, sclerotherapy needles, diathermy snares) from a port on the endoscope control head through the shaft and into the field of view.

In some instruments (especially those with lateral viewing) the tip of the channel incorporates a small deflectable elevator or bridge which permits some directional control of the forceps and other accessories independent of the instrument tip, this elevator or bridge is controlled by a further thumb lever. The operating channel is also used for aspirations; an external suction pump is connected to the umbilical cord of the instrument near the light source and suction is diverted into the instrument channel by pressing the suction valve which has two positions, a neutral position and a suction position, the size varies with the instrument's purpose.

Fig 1.6 *Air insufflation and irrigation*

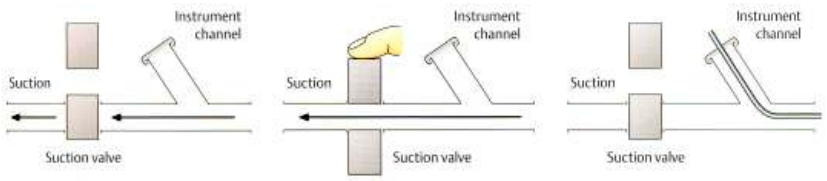


a Air/water valve in the neutral position. The air/water valve permits air to exit through a vent hole. The vented air can be felt by holding a finger over the hole. When this valve is not activated, it automatically assumes a position that blocks the water channel while allowing air to escape through the vent hole

b Air insufflation. Placing the finger lightly on the vent hole keeps the air from escaping and redirects it to the distal end of the endoscope. This does not involve activating the valve

c Irrigation. Pressing the valve button down closes off the air channel and redirects air pressure into the water bottle, causing water to be pumped from the bottle into the endoscope. The air and water channels converge at the distal end of the scope and open at the air/water nozzle

Fig 1.7 *Suction and instrumentation*



a Suction valve in the neutral position. When the suction valve is not activated, it automatically assumes the neutral position and blocks suction

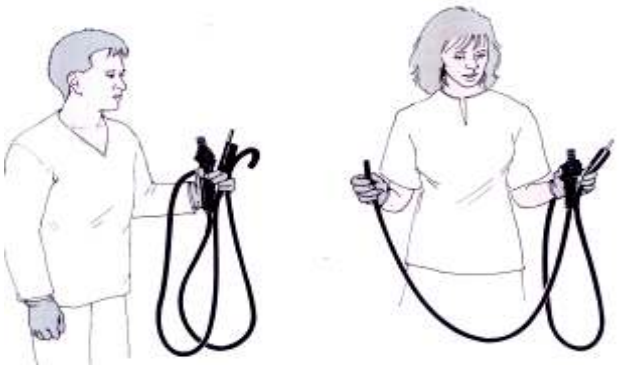
b Suction position. Pushing the valve button opens the suction channel, creating a negative pressure that draws air or fluid into the opening of the suction/instrument channel at the distal end of the scope. Because the proximal opening of the instrument channel communicates with the suction channel, this opening must be occluded with a valve

c Instrumentation. Instruments (injection needles, biopsy forceps, catheters) can be introduced through the instrument channel and passed down the endoscope. The instrument channel can be used to flush the suction channel if the latter becomes clogged, and it can be used for introducing large amounts of fluid (e.g., to irrigate a bleeding lesion)

An ancillary small channel transmits air to distend the organ being examined. The air is supplied from a pump in the light source and is controlled by another valve. The air system also pressurizes the water

bottle so that a jet of water can be squirted across the distal lens to clean it. In colonoscopies, there is a separate proximal opening for the water channel, to allow high pressure flushing with a syringe. The air/water valve has three positions (a) Neutral Position: no air insufflations, no water jet (b) Air insufflations (c) Irrigation (water jet).

Fig 1.8 *Carry endoscopes carefully to avoid knocks to the optics, control head and tip.*



Handling the Endoscope

The control head of the endoscope is held in the left hand. The index and middle finger activate the suction and air/water valves. Many examiners operate angulations control wheels with the right hand, but an endoscopist with large hands can also manage these controls with the left hand. This leaves the right hand free to manipulate the insertion tube. This is advantageous in certain situations.

2 The Endoscopy Suite, Facilities and Staff

Setting up and running an endoscopy unit is a complex topic, of particular interest to directors and nurse managers.

Staff and management

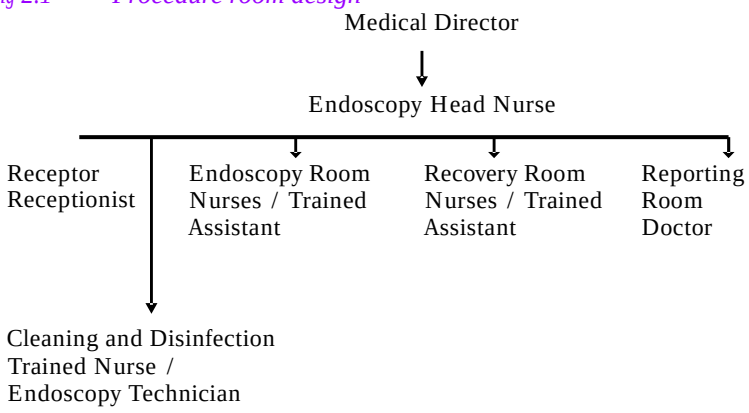
Endoscopy units nowadays are complex organizations with many people of different back grounds and training. Procedures are performed by many different types of doctors including gastroenterologists, surgeons, internists and radiologists. There are also many different types of supporting staff.

Most of the endoscopy assistants are nurses, whose primary role is to care for the patient's comfort and safety before, during and after the procedures. Nurses, nursing aides and technicians are responsible for cleaning, disinfection and maintenance of endoscopy equipment and accessories; other staff handles reception, documentation and billing duties. All of the staff needs to be specially trained and fully oriented.

The unit must have a designated medical director responsible for overall policies. The director is assisted by an endoscopy nurse manager (Head Nurse) who helps to formulate policies and is responsible for implementing them on day to day bases.

In the endoscopy room, a minimum of one qualified nurse and trained assistant will be required, with further nurse/endoscopy technician being responsible for cleaning and disinfection. The recovery area should have at least one qualified nurse and trained assistant to manage patients who are returning from the endoscopy room.

Fig 2.1 *Procedure room design*



The Endoscopy Unit

The endoscopy unit should have a smart public face and a more functional back hall. It certainly requires dedicated space, which should be suitable for out patients and inpatients, and be easily accessible both day and night.

Procedure Rooms

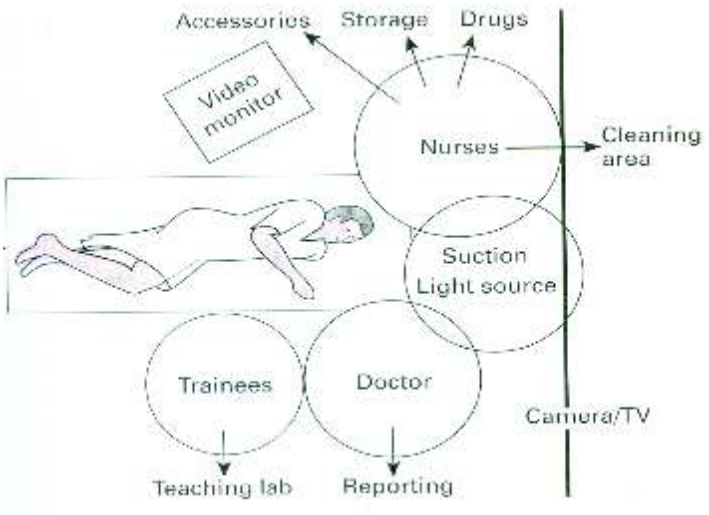
The number of endoscopy rooms required, depend on the volume and spectrum of procedures, sedation practices, quality of technical support and the presence or absence of trainees.

How many procedures a room can handle? Most endscopists say that they can complete simple upper GI procedures within 20 min, colons 45min and ERCPs in under an hour. The bulk of the work load is the 'standard' procedures (i.e. upper GI and colons). So, a routine procedure room can hold 1200 procedures per year. Six procedures can take a whole day, especially when teaching is involved.

Procedure Room Design

Endoscopy procedures vary in complexity, so do the procedure room requirements. However, all procedure rooms share many common design features. Rectangular rooms often work better than square ones. They must be wide enough to enable the trolley (Stretcher) to be spun around its axis. Functional planning of the endoscopy room with avoidance of cross-traffic is crucial to efficient work. Geographical sphere of activity should be defined for doctors, nurses and trainees, with their relative equipment in the appropriate sector.

Fig 2.2 *Procedure room design*



The room should contain large sinks to accommodate contaminated accessories, adequate work surfaces, storage cupboards and power points. The floor should be washable and smooth. Any windows should have blackout curtains and blinds. Central room light should be dimmable with spot light over the work tops. The endscopist and nurses should have an easy access to the alarm systems. Door opening should be 4ft wide to facilitate moving patients' stretchers and large pieces of equipment.

Procedure room should have a continuous supply of piped oxygen, always available suction (two outlets) and an alarm system. Fixed examination tables are unnecessary. Patient trolleys (stretchers) are convenient for examination and recovery. It should be possible to tilt the top into a head down position and it is convenient if the height of the trolley can be adjusted. There must be arrangements for maintaining a reasonable temperature and for extracting odors, both clinical and chemical.

Efficiency of utilization would be improved if all procedure rooms could be used for all types of procedures. There is no need to separate upper GI examinations from colonoscopies, since the room requirements are similar. However some procedures require sophisticated, heavy and expensive equipment which cannot be moved or duplicated (i.e. X-ray machines and lasers); thus it is usual to have several standard rooms and one high-tech room. A floor area of 15-20 square meters (50-65 square feet) is adequate for a standard procedure room.

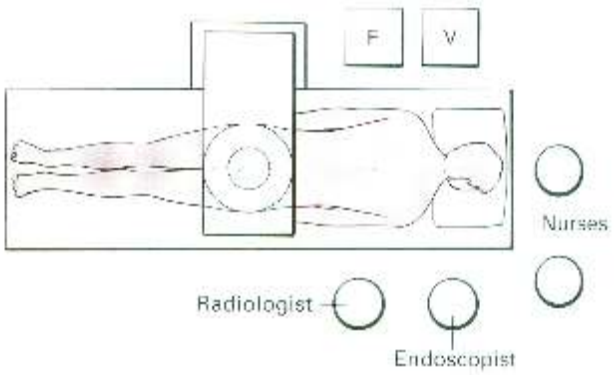
Specialized procedure rooms

Specialized rooms are usually large because of extra equipment for radiology, endoscopic ultrasound or laser. Fluoroscopic screenings must be available for many endoscopic procedures, especially dilatations.

X-ray procedure rooms are larger than routine rooms. Correct siting of the table is essential. It is convenient for the radiologist and the endscopist to work on the same side of the table. It is essential to mount the video and fluoroscopy monitors side by side, across from the endoscopist and radiology staff.

Rooms containing X-ray equipment need to be lead-lined with standard safety features. Rooms in which lasers are used must meet appropriate local safety standards for eye protection.

Fig 2.3 ERCP room layout. setup the fluoromonitor (F) and video scope monitor (V) side across the X-ray table from the endoscopist



Preparation and recovery areas

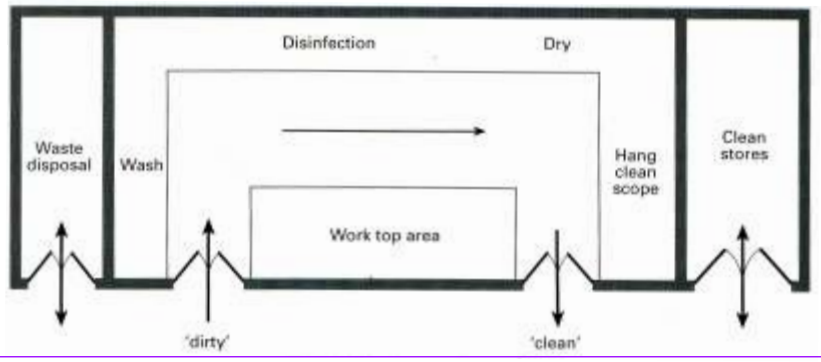
Procedure rooms are the heart of an endoscopy unit but patients and their relatives spend move time in waiting, preparation and recovery areas. The quality of the facilities and good attitude of the staff involved provide the main impression for the patients. Preparation consists of the preliminary interviews, teaching and consent process, undressing and setting up an intravenous line (best done with the patient lying down). After a sedated examination, the patient lies on the trolley on which procedure was done for period of 20-60 minutes. After dressing, the patient should be joined by relatives, have consultation with endoscopist or the nurse and then discharged.

Physical arrangement one requires are a waiting area for relatives, interview and undressing and preparation rooms. Lockers or a place should be available for valuables and clothes of the patient or such can be carried in a basket which can be stored underneath the examination stretcher.

Storage and cleaning space

Large areas are required for cleaning, disinfection and storage of endoscopes and their accessories. Instrument disinfection should be done in a restricted area with strong ventilation, because toxic chemicals are used (e.g. glutaraldehyde). A 'sequential' design is practical. Used instrument are brought through one door into a 'dirty zone' by passing through a series of cleaning / disinfection process, to end up hanging in the final clean zone, accessible through a second door.

Fig 2.4 Cleaning area 'sequential' plan.



A large work top is needed for packaging accessories.

Reporting areas

Reports are written, dictated or entered into computers immediately after procedures. A central reporting area should have arrangements for image management, video editing and record keeping.

3 Disinfection of Endoscopes

- Flexible endoscopes are complex, versatile instruments that require proper and specialized decontamination and disinfections. In addition to the external surface of endoscopes their internal channels for air, water, aspiration and accessories are all exposed to body fluids. Flexible endoscopes are heat labile and cannot be autoclaved.
- A guiding principle for decontamination is that of universal precautions. Any patient must be considered a potential infectious risk, and each endoscope and device must be reprocessed with the same rigor following every endoscopic procedure.
- Endoscopy induced infection is usually due to procedural errors in decontamination. Other potential risk factors for transmission of infection include the use of older endoscopes with associated surface and working channel irregularities and the use of contaminated water bottles or irrigation solutions using substandard disinfectant or inadequate drying or storage of endoscope.

Endoscopy related infections

Infections can spread from patient to patient or patient to healthcare worker or staff members if equipment is reprocessed inadequately. Bacterial infections have been acquired during endoscopy, such as salmonella and pseudomonas, viral disease, such as hepatitis B, and Hepatitis C have all been transmitted during endoscopy. There is generally no risk of transmission of helminths, nematodes, platyhelminths, ascaris or liver flukes. However, concerns have been raised with respect to the risk of transmission of Giardia lambliasis, cryptosporydium species and amoebas.

Patients with immune deficiency syndrome or severe neutropenia and those receiving immunosuppressive chemotherapy or those who have artificial cardiac valves have an increased risk of infection.

Diseases may be transmitted from patient to endoscopic personnel. Studies have suggested that endoscopes are potential vectors for the transmission of Helicobacter pylori. Another example is acquisition of

herpes simplex ophthalmitis following esophageal biopsy. Healthcare workers are also at potential risk of infection with blood-borne viruses transmitted via sharps, such as spiked biopsy forceps. So, protection from direct contact with the endoscopes and accessories is essential. Gloves and aprons should be worn and protective masks and eye protection goggles should be available to avoid exposure to blood or body fluids. Traditionally, patients harboring potentially infectious microorganisms are scheduled for the end of endoscopy list in order to minimize cross infection. However, if universal endoscope decontamination regime is followed, which premises that all patients are potentially infectious, there is no need to place the patients with known infections last on the list. Nonetheless prevailing infection control policies often schedule patients with Methicillin Resistant Staphylococcus Aureus (MRSA) at the end of list.

Staff known to be disease carriers should avoid duties that could transmit infection to patients. It is recommended that all staff be offered vaccination against hepatitis B.

Decontaminant of Endoscopes

Sterilization is defined as the complete destruction of all microorganism including bacterial spores. Sterilization is required for devices that are normally used in sterile areas of the body. Flexible endoscopes do not penetrate into the sterile areas of the body, but only have contact with mucosal membranes, so they only need a high level of disinfection rather than sterilization in order to kill bacteria, viruses, mycobacteria and some spores.

Reprocessing of Endoscopes

Before commencing with reprocessing of endoscopes and endoscopic accessories, protective clothing must be put on.

Manual Cleaning

a. As soon as the endoscope is removed from the patient, the air/water channel must be flushed for 10-15 seconds to eject refluxed blood and mucus.

b. Detergent solution should be sucked/aspirated through the suction/biopsy channel to remove secretion and debris.

c. The insertion tube should be wiped with discardable sponges or swabs to remove any blood, mucus or feces after conducting the leak testing.

d. The endoscope should be immersed in water and detergent, and cleaned externally. The distal end is brushed with a soft toothbrush especially targeting the air/water outlet nozzle. All valves are removed and washed. The biopsy channel opening and the suction part should be cleaned with a cotton bud.

e. Brushing through the suction/instrument channel and all accessible channels must be done using a cleaning brush. The brush must be passed through the channel several times until clean, and the brush itself must be cleaned with detergent using a soft toothbrush each time it emerges.

   Introduce the cleaning brush via the biopsy port through the shaft, until it emerges from the distal end at least three times.
   Pass the cleaning brush through the suction channel opening after removing the suction button and down the shaft until it emerges from the distal end at least three times.

   Pass the cleaning brush from the suction channel opening in the other direction through the umbilical cord, until it emerges from the suction connector at least three times.

   After the channels have been thoroughly brushed, either put the endoscope into the reprocessor to complete disinfection or follow the manual method.

Rinsing

Rinse the endoscope and valves under running tap water of drinking quality. Immerse the endoscope and irrigate all channels by flushing with water followed by air to expel as much air as possible prior to disinfection.

Disinfection

Manual disinfection:- Disinfection must be carried out in a separate room with proper ventilation. Protective gloves, eye protection and aprons must be used and splashing must be avoided. The instrument should be fully immersed in 2% glutaraldehyde or other chemical disinfectant of equally potency. All channels must be filled with disinfectant and soaked for not less than 10 minutes.

Rinsing of the instruments with water must be undertaken after disinfection, internally and externally to remove all traces of disinfectant. The water must be of drinking quality or alternatively, filtered water may be used for rinsing.

Dry the endoscope externally and flush each channel with air, wipe the eyepiece and light guide connector as well as the plugs before connecting the endoscope to the light source. Fit the air/water and suction valves and activate the air/water and suction channels. The endoscope is now ready for use again.

Washer Disinfector: After manual cleaning, the endoscope is placed in an automatic disinfector and all channel connectors attached. This ensures exposure of all internal and external surfaces to the disinfectant. If automatic reprocessing cycle is interrupted disinfection cannot be assumed and entire process should be repeated.

The advantages of automatic reprocessing are as follows.

a. The likelihood of an essential step being omitted is reduced.
b. All channels are properly irrigated.
c. Exposure of skin, eyes and respiratory tract to disinfectants is reduced.
d. Atmospheric pollution by the disinfectant is reduced.

Drying and Storage of Endoscope

Drying of endoscope prior to prolonged storage decreases bacterial colonization. Forced air can be used for drying.

a. Storage should be done by hanging the scopes in a vertical position to facilitate drying. Remove all caps, valves and other detachable components.
b. Uncoil insertion tube and umbilical cord.
c. Endoscopes should be placed in well-ventilated rooms or cabinets.
d. Clearly mark which endoscopes have been reprocessed.
e. It is important to avoid the contamination of disinfected endoscopes by contact with environment.

Endoscopic Accessories

The following steps are important for disinfection/sterilization of all reusable accessories.

i. Immediate washing in detergent solution.
ii. Dismantle as far as possible
iii. Brush with cleaning brush or tooth brush hollow
iv. Flushing of detergent through lumen of hollow components
v. Use an ultrasonic cleaner for all accessories
vi. Rinse thoroughly in water of drinking quality

vii. Sterilization can be achieved by either auto claving where recommended by the manufacturer, ethylene oxide gas can be used, and though it is time-consuming and expensive.
viii. Non-sterlizable accessories should be disinfected prior to use.
ix. Avoid the use of defective or damaged accessories because such instrument may not operate properly and may also damage the endoscope instrument channel

Disinfectants

The ideal disinfection is effective against wider range of organisms including viruses and prion proteins. It should be compatible with endoscopes and accessories and be non-irritant and safe for users.

Aldehyde based disinfectants

Glutaraldehyde (GA) and its derivative kill most bacteria and viruses, like HIV and HBV in less than 5 minutes. Mycobacterium is more resistant to 2% glutaraldehyde. So the endoscopes are immersed for more than 20 minutes at room temperature.

The standard method of disinfection is immersing for 20 minutes in a 2% glutaraldehyde solution. The maximum shelf life is 14 days.

The advantages of glutaraldehyde are that it is effective, relatively inexpensive and does not damage endoscopes and accessories. However it has irritant and sensitizing properties. So can lend to allergic problems and can cause dermatitis, conjunctivitis, nasal irritation and asthma in endoscopy staff. In patients residues of glutaraldehyde after insufficient rinsing can cause colitis, abdominal cramps and bloody diarrhea.

Glutaraldehyde can fix proteins and allows for biofilm creation.

Orthophthaldehyde (OPA)

It is a high level disinfectant. OPA completely destroys all viable common bacteria is 5 minutes of exposure. It is non irritant. High level disinfection is achieved in 12 minutes life span is 2 weeks.

Peracetic acid (PAA)

When compared peracetic acid has similar or better biocidal activity. A contact time of 5 minutes is recommended for the destruction of vegetative bacteria and viruses. The sporicidal activity requires immersion for 10 minutes (0.35 PAA), a contact time at 10-15minutes and a concentrations >0.09%.

PAA can remove hardened material in biopsy channels resulting from use of GA, Development of microorganism resistant has not been reported.

PAA is less stable than GA. Once prepared it requires replacement every 24 hours. PAA has corrosive abilities and has vinegar like order. Damage of flexible scope has been reported after some brands of PAA.

Personnel Protection during Endoscope Decontamination

1. Wear long-sleeved waterproof gowns. These should be changed between patients.
2. Use sterile gloves which are long enough to protect the forearms from splashes.
3. Goggles prevent conjunctival irritation and protect the wearer from splashes.
4. Disposable charcoal-impregnated face masks may reduce inhalation of vapour from disinfectants, but experience with them is not yet widespread.
5. An HSE-approved vapour respirator should be available in case of spillage or other emergencies. It should be stored away from disinfectants as the charcoal adsorbs fumes and respirators should be regularly replaced.

Steps in Endoscope Decontamination

As soon as possible after use:

1 Wipe down insertion tube
2 Flush air / water channels
3 Aspirate water through biopsy / suction channel
4 Dismantle detachable parts (e.g. valves)
5 Manually clean with enzymatic detergent followed by rinsing
6 Disinfect and rinse in an automatic reprocessor
7 Dry
8 Store appropriately

Table 3.1

	Microbicidal Activity					Inactivation			
Disinfectant	Spores	Mycobacteria	Bacteria	Viruses		Stable	by organic matter	Corrosive/ damaging	Irritant (I)
				Env.	Non Env.				
Glutaraldehyde 2%	Moderate 3 hours	Good 20 mins	Good <5 mins	Good <5 mins	Good <5 mins	Moderate (e.g. 14-28 days)	No (?xative)	No	I/S
Ortho-phthalaldehyde (0.55%)	Poor >6 hours	Good <5 mins	Good <5 mins	Good <5 mins	Good <5 mins	Moderate (30 days)	No (?xative)	No (staining)	I
Peracetic acid 0.2 - 0.35%*	Varies 10 – 20 mins	Varies 5 – 20 mins	Good <5 mins	Good <5 mins	Good <5 mins	No (1-3 days)	No	Slight	I
Alcohol (usually 70%)	None	Good <5 mins	Good <5 mins	Good <5 mins	Moderate Variable	Yes	Yes (?xative)	Slight (lens cements)	No
Chlorine dioxide	Good 10 mins	Good <5 mins	Good <5 mins	Good <5 mins	Good <5 mins	No (1-5 days)	Yes	Yes	I
Superoxidised water	Good 10 mins	Good <5 mins	Good <5 mins	Good <5 mins	Good <5 mins	No (< 1 day)	Yes	Yes	No

* activity varies with concentration of product

Endoscope Disinfection Process

Pre-cleaning (Step – 1)

* Clear gross debris by sucking water through the working channel (250 ml/min).
* Expel any blood, mucus or other debris.
* Flush the air/water channel and wipe down the insertion shaft.
* Check for bite marks or other surface irregularities.
* Detach the endoscope from the light source/videoprocessor.
* Transport in a closed container to the reprocessing room.

Cleaning (Step – 2)

* Conduct leak testing and block testing.
* Immerse the endoscope in detergent or a soap solution.
* Clean all surfaces, brush channels and valves with a clean dedicated brush and a clean swab or tissue.
* Follow the same procedures for all accessories as for endoscope processing

Rinsing (Step – 3)

* Rinse the endoscope and valves under running tap water (must be drinking water quality).
* Immerse the endoscope and irrigate all channels.
* Discard the rinse water after each use to avoid concentration of the detergent and the risk of reduced efficacy of the disinfectant solution.
* Clean and rinse the container before the next procedure.

Disinfection (Step – 4)

* Immerse the endoscope and valves in a disinfectant solution of proven efficacy (GA, PAA, OPA etc).
* Irrigate all channels with a syringe until air is eliminated to avoid dead spaces.
* Contact time with the solution should be according to the manufacturer's recommendation
* Disinfection solution should be removed by flushing air before rinsing.

Final Rinsing (Step – 5)

* Rinse the endoscope and valves in drinking-quality or boiled water by immersing the endoscope and irrigating all channels.
* Discard the rinse water after each use to avoid concentration of the disinfectant and thus damage to mucosa.

Drying (Step – 6)

* Ensure correct final drying before storage.
* Dry with compressed air or if not available inject air with clean syringe.

Storage (Step – 7)

* Disassemble the endoscope.
* Store in well ventilated storage cupboard.
* Ensure the valves are dry and lubricate if necessary.
v Store separately or store the endoscope in a clean closed box with the valves.

4 Quality Assurance in Reprocessing

Microbiological surveillance is an important means of evaluating the outcome quality of reprocessing procedures and is an instrument of regular quality control in gastrointestinal endoscopy, whether endoscopic procedures are performed in hospital, in private clinics or doctors offices. It is an instrument for detecting and redressing procedure, and for preventing the transmission of infections agents through endoscopy.

Table. 4.1 Weaknesses and deficiencies in endoscope reprocessing (modified from reference[12])

a. Inadequate reprocessing of endoscopes and accessories
- Inadequate cleaning (e. g. inadequate manual cleaning and brushing of endoscope channels)
- Contaminated cleaning accessories (e. g. cleaning brushes)
- Use of unsuitable or incompatible detergents and disinfectants
- Inadequate concentrations and contact time of agents
- Contaminated or time-expired solutions
- Contaminated rinsing water
- Fixed organic material (biofilm) in endoscopes, water pipes, containers, or washer-disinfectors
- Use of nonsterile accessories in invasive diagnosis and treatment (e. g. nonsterile biopsy forceps, polypectomy snares)
- Inadequate reprocessing of water bottles (e. g. no sterilization)
- Use of tap water in water bottles

b. Inadequate transport and storage of endoscopes
- Insufficient drying before storage (e. g. Pseudomonas spp.)
- Inappropriate storage conditions

c. Contaminated or defective washer-disinfector
- Contaminated pipes, containers, etc.
- Contaminated final rinsing water
- Mechanical/electronic defects of washer-disinfector
- Incorrect use of washer-disinfector (e. g. wrong connections)
- Lack of regular maintenance of washer-disinfector according to manufacturer's recommendations

d. Design limitations and damaged endoscopes
- Small lumina, branched channels, not accessible to cleaning brushes
- Damage to the surfaces (internal and external) of the endoscope, providing potential for contamination

e. Contaminated water in the endoscopy unit
- Contaminated main water pipes/supply
- Contaminated or inadequate water supply systems (filtration etc.)

Sample for routine tests

Endoscopes microbiological testing of endoscopes should cover

1. Channels
2. Outer surfaces
3. The connected water bottle.

Liquid samples from endoscope channels

Flash the appropriate channels with 20ml sterile saline and collect the liquid in a sterile container; the sample may be collected from all channels separately swabs from the outer surfaces of the endoscope saline swabs from the moistured distal end, valve parts and bridge elevators are taken and put in containers containing culture both.

Swabs from the outer surfaces of the endoscope

Saline moistened swabs from the distal end, valve ports, and bridge elevators are taken and put in containers containing culture broth.

Table. 4.2

Organisms identified in microbiological tests	Indication of origin	Troubleshooting
Escherichia coli, entero-cocci and Enterobacte-riaceae	A: Insufficient cleaning and/or disinfection procedures, e. g.: - No brushing - Inadequate concentrations or exposure times of process chemicals B: Mechanical or electronic defects of washer-disinfector,e. g.: - Incorrect amounts and/or concentration of processing chemicals - Design flaws of washer-disinfector, with dead volumes	A: Review whole reprocessing cycle with special emphasis on manual cleaning B: Initiate full maintenance of washer-disinfector
Pseudomonas aeruginosa and other gram-negative nonfermenters	A: - Insufficient final rinsing - Contamination of final rinsing water - Contamination of washer-disinfector due to mechanical or electronic defects - Contamination of filter systems - Design flaws of washer-disinfector with dead volumes B: Insufficient drying of endoscopes before storage	A: Review water supply systems and procedures: - Water quality - Manual and/or washer-disinfector rinsing - Initiate full maintenance of washer-disinfector and filtration systems - Initiate autodisinfection cycle according to manufac-turer's instructions (thermal disinfection is preferred) B: Review drying procedures before storage, and ventilation of storage facilities
Staphyloccus aureus, Staphylococcus epider-midis	Recontamination of endoscopes due to: - Inadequate storage and transport - Inadequate hand hygiene	Review of hygiene arrangement for storage, transport and of manual handling
	Contamination from sampling	Repeat sampling
Atypical mycobacteria Legionella organisms	Contamination of washer-disinfector and water system	Review water supply systems and procedures: - Manual and/or washer-disinfector rinsing - Initiate autodisinfection cycle according to manufacturer's instruction (thermal disinfection is preferred) - Initiate full maintenance of washer-disinfector and filtration systems

Liquid sample from water bottles

Two samples of 100ml are taken from the water bottle; ready for use should be tested. Adequate connectors should be used in order to take liquid samples from water bottles via the connection tube of the water bottle.

Final rinse water of washer-disinfectors

Two sample of 100ml water collected using a sterile syringe in sterile containers.

Water supply

Water sample should be taken from the top water. The samples should be sent to microbiologists for culture.

Interpretation of results and corrective measure in case of contamination

Total microbiological count

The maximum total count in liquid samples from endoscope channels should be < 20cful channel. Indicator organism should not be found at any time. Cultures taken from swabs should be focused on the growth of indicator organisms. The maximum count from water samples should be < 10/100 efu/ml. Indicator organism should not be found at any time.

5 Antibiotic Prophylaxis for Gastrointestinal Endoscopy

Bacteraemia occurring in a patient with a susceptible cardiac lesion may lead to infective endocarditis. Gastrointestinal endoscopy can infrequently give rise to transient bacteraemia but there is little evidence to suggest that endoscopic procedures have led to cases of endocarditis. Nevertheless, endoscopic procedures with a higher than average risk of bacteraemia in a patient with a susceptible cardiac lesion may carry a significant danger, and in these it is prudent to use antibiotic prophylaxis.

Apart from cardiac infections there are a number of other infectious complications that may be attributable to gastrointestinal endoscopic procedures. These include pancreato-biliary sepsis following endoscopic retrograde cholangiopancreaticography (ERCP), infection of orthopaedic and other non-cardiac prosthesis and wound infections secondary to percutaneous endoscopic gastrostomy.

The rate of bacteraemia after endoscopic procedures

1. Diagnostic upper gastrointestinal endoscopy and colonoscopy

   The bacteraemia rate is low, up to 4%. The risk of bacteraemia does not seem to increase with biopsy or polypectomy. Bacteria most often cultured after upper GI endoscopy are contaminants.

2. Esophageal dilatation and insertion of prosthesis

   This causes a significant bacteraemia reaching approximately 45%. Although mouth commensals are found most often following esophageal dilatation, oral decontamination with Clindamycin was not an effective prophylaxis. Disinfection of bougie dilators did however reduce post-procedural bacteraemia. The risk after balloon dilatation is probably small as this kind of dilator traverses the endoscope channel and has no contact with the oral cavity. However, no data is available to confirm or refuse these findings.

3. Injection sclerosis of esophageal varices

This is the second most important cause of bacteraemia associated with GI endoscopic procedures. Bacteraemia has been reported in up to 50% of patients under-going endoscopic sclerotherapy, but it has also been detected in up to 13% prior to diagnostic endoscopy.

Bacteraemia as a result of contamination of the injection needle catheter that passes through the suction channel of the endoscope probably cannot be eliminated altogether. The technique of submucosal injection is increasingly being used for polypectomy or resection of flat mucosal lesions. As the suction channel contaminants are those of the digestive tract, contamination during submucosal injection cannot be avoided by using disinfected endoscope, sterile needles and injection fluids. Using an aseptic injection needle protected from contamination by a covered tip may reduce bacteraemia.

4. Endoscopic band ligation of esophageal varices

This is considered a safe technique with a low risk of bacteraemia, ranging from 3-6%.

5. Laser therapy

This may cause significant bacteraemia depending upon the nature of the procedure. In the upper GI tract the rate of bacteraemia following laser therapy is 31-34%. In the lower GI tract the likelihood of bacteraemia is less, approximately 19%. Laser therapy is believed to mechanically irritate the tumor tissue or mucosa and promote invasion of bacteria.

6. Percutaneous endoscopic gastrostomy (PEG)

The most common infection is peristomal, which occurs in 30-34% of patients. Bacteria originating from two sources are involved depending on the techniques; esophageal in pull method and cutaneous in both push and pull method.

7. ERCP

Cholangitis and sepsis are the commonest causes of death following ERCP. The major risk factor is biliary obstruction, which increases the risk of bacteraemia to 11-16%. There are two potential pathways for developing bacteraemia; infection of the pancreatic biliary system by instrumentation, or dissemination of already existing organism in an obstructed biliary tree.

8. The risk of infectious complications

The majority of bacteraemia associated with gastrointestinal procedures are asymptomatic. As transient bacteraemia is unlikely to harm a normal individual, antibiotic prophylaxis is unnecessary unless there is susceptibility for endocarditis. There are only few endoscopic procedures, where the potential risk of infectious complications is significant.

Table. 5.1 Endoscopic procedures associated with higher risk of infectious complications.

- Oesophageal stricture dilation
- Endoscopic sclerotherapy for oesophageal varices
- Laser therapy in upper gastrointestinal tract
- Endoscopic placement of percutaneous feeding tube

Endoscopic retrograde cholangiopancreatography for known biliary obstruction or pancreatic pseudocyst

Sepsis is unlikely to follow upper gastrointestinal endoscopy. Endocarditis attributable to colonoscopy is infrequently reported. Incidence of post dilatation bacteraemia is 21%, entirely caused by Streptococcus viridans. Reported cases of bacterial endocarditis attributable to dilatation of esophageal stricture occurred in patients with mitral insufficiency and mitral valve prolapse. These data support the use of antibiotic prophylaxis prior to endoscopic dilation of esophageal stricture.

Bacteraemia associated with endoscopic

sclerotherapy for esophageal varices is well recognized and a number of septic complications such as septicemia, cerebral abscess, perinephric abscess and endocarditis have been reported. It has been shown that intravenous cefotaxime significantly reduces the frequency of bacteraemia after endoscopic sclerotherapy. Antibiotic prophylaxis should be instituted for individuals with a higher risk of endocarditis.

Infectious complications after submucosal injection for polypectomy are exceedingly rare post polypectomy leucocytosis and fever associated with pain one usually caused by burning syndrome or inflammatory response due to hot biopsy forceps.

Bacteraemia following laser therapy of the upper gastrointestinal tract is common and septic complications involving organisms commonly associated with endocarditis do occur. The risk therefore seems considerable and so antibiotic prophylaxis is recommended for high-risk patients. As the risk of bacteraemia following laser therapy in the colon is lower, the need for antibiotic prophylaxis is less clear.

The wound infection is quite common after percutaneous endoscopic gastrostomy and antibiotic prophylaxis with piperacillin, cefotaxime and amoxycillin / clavulanic acid has been shown to be effective in reducing the rate of early local infection.

Biliary sepsis is one of the major complications of ERCP, and although it occurs in only 0.4-

0.8%, it is associated with 8-20% mortality rate. Antibiotic prophylaxis is recommended for patients who are likely to undergo therapeutic ERCP if there has been previous biliary sepsis, bile duct obstruction or pancreatic pseudocyst.

9. Identification of high risk patients

The risk of endocarditis depends, largely on the nature of the cardiac condition. Cardiac and other clinical conditions have been divided into three groups according to their potential for the development of infectious complication.

Table. 5.2 *Conditions associated with a risk of endocarditis or symptomatic bacteraemia.*

- High risk:
  - Prosthetic heart valve.
  - Previous endocarditis.
  - Surgically constructed systemic-pulmonary shunt or conduit.
  - Synthetic vascular graft less than 1 year old.
  - Severe neutropenia (neutrophils $< 1 \times 10^3$ /l)

- The moderate, low or theoretical risk with:
  - Mitral valve prolapse with insufficiency.
  - Rheumatic valvular or congenital cardiac lesion.
  - Hypertrophic cardiomyopathy.
  - Ventriculo-peritoneal shunt.
  - Heart transplant.
  - Moderate neutropenia (neutrophils 1×10^3 /l)
  -

- And no increased risk with:
  - Mitral valve prolapse without insufficiency.
  - Uncomplicated secundum atrial septal defect.
  - Cardiac pacemaker.
  - Coronary artery bypass graft.
  - Implanted defibrillator.

All other patients.

The risk of developing endocarditis is also

dependent upon bacteraemia. Although bacteraemia is common following many invasive endoscopic procedures, only certain bacteria commonly cause endocarditis. Haemolytic streptococci and staphylococci are the most likely, comprising respectively 55% and 25% cases associated with native valve and 30% and 45% of vascular prosthesis infections. Streptococcus viridians is the commonest cause of endocarditis following esophageal high risk therapeutic procedures.

Antibiotic prophylaxis for bacterial endocarditis should be specifically directed against these organisms. It should be stressed that endocarditis hardly ever develops as a consequence of an endoscopic procedure.

10. Patients related risk factors

Infection of synthetic vascular graft has a serious and potentially fatal consequence. Complete endothelialization of the graft does not occur for a period of one year and bacteraemia is potentially dangerous. Antibiotic prophylaxis is therefore recommended over this period.

Existing evidence is insufficient to recommend antibiotic prophylaxis concerning the possibility of infection of orthopaedic, neurosurgical and other prosthesis.

Antibiotic prophylaxis for transplant recipients on immunosuppression is not recommended, as little data on the incidence of infectious complication is available. Nevertheless neutropenia appears to increase the risk of post endoscopic symptomatic bacteraemia.

Table *Recommendations of the antibiotic prophylaxis according to the procedure.*

Table. 5.3 *Recommendations of the antibiotic prophylaxis according to the procedure.*

Procedure	Patients risk group	Antibiotic prophylaxis
high risk procedures:	high risk patients	regimen A or B
oesophageal dilation	severe neutropenia	regimen A or B plus C
variceal sclerosis	moderate risk patients	not necessary
laser therapy in upper GI		regimen A or B
		may be considered
	low or average risk patients	not recommended
low risk procedures:	high risk patients	not necessary
		regimen A or B
		may be considered
	moderate or low risk patients	not recommended
ERCP	· all patients with: biliary occlusion pancreatic pseudocyst previous cholangitis or · therapeutic ERCP	regimen C
PEG	all patients	regimen D

Table. 5.4 *Recommended antibiotic regimens*

A. Patients not allergic to penicillin.
Adults:
1g amoxycyllin intramuscularly in 2.5ml 1% lignocaine hydrochloride plus 120 mg gentamicin intramuscularly just before start of the procedure, followed by 500 mg amoxycillin orally 6 hours later.
Children under 10 years:
500 mg amoxycillin intramuscularly in 2.5ml 1% lignocaine hydrochloride plus 2 mg/kg body weight gentamicin intramuscularly, followed by 250 mg (children 5 -9 years) or 125 mg (children 0-4 years) amoxycillin orally 6 hours later.

B. Patients allergic to penicillin or who have had penicillin more than once in the previous month.
Adults:
1g vancomycin in slow intravenous infusion over 100 minutes followed by 120 mg gentamicin intravenously 15 minutes before the procedure
or 400 mg teicoplanin intravenously followed by 120 mg gentamicin 15 minutes before the procedure
Children under 10 years:
20 mg/kg vancomycin by slow intravenous infusion followed by 2 mg/kg gentamicin intravenously
or 6 mg/kg teicoplanin intravenously followed by 2 mg/kg gentamicin intravenously

C. Prior to biliary procedures.
750 mg ciprofloxacin orally 60-90 minutes before the procedure
or 120 mg gentamicin intravenously just before the procedure
or a parenteral quinolon, cephalosporin or ureidopenicillin just before the procedure.

D. Prior to percutaneous endoscopic gastrostomy
2 g cefotaxime (or equivalent) parenterally 30 minutes before the procedure
or 4 g piperacillin/0.5 g tazobactam parenterally
or 1 g amoxycillin/clavulanic acid intravenously

E. Patients with severe neutropenia
Adults:
Add 7.5 mg/kg metronidazole intravenously to any of the above regimens
Children:
Add 7.5 mg/kg metronidazole intravenously to any of the above regimens

6 Safety and Sedation during Endoscopy

Preprocedure Assessment

Assessment of patients through a medical history and evaluation of their physical condition should be done before administration of intravenous sedation. Essential elements of medical history include the following:

i. Significant cardiac or pulmonary disease
ii. Neurological or seizure disorder
iii. Strider, snoring or sleep apnea
iv. History of adverse reaction to sedation or anesthesia
v. Current medications, drugs and allergies
vi. Alcohol or drug abuse
vii. Time of last oral intake

In addition to above assessments, a patient's overall disease risk should be classified according to the American Society for Anesthesiology (ASA) physical status classification.

Table 6.1 ASA Classification

Class	Description
I	The patient is normal and healthy
II	The patient has mild systemic disease that does not limit their activities (eg, controlled hypertension or controlled diabetes without systemic sequelae)
III	The patient has moderate or severe systemic disease, which does limit their activities (eg, stable angina or diabetes with systemic sequelae)
IV	The patient has severe systemic disease that is a constant potential threat to life (eg, severe congestive heart failure, end-stage renal failure)
V	The patient is morbid and is at substantial risk of death within 24 hours (with or without a procedure)
E	Emergency status: in addition to indicating underlying ASA status (1–5), any patient undergoing an emergency procedure is indicated by the suffix "E"

ASA Class I-III patients are appropriate candidates for administration of sedation by an endoscopist while administration of sedation in classes IV-V patients should be done by anesthesia specialists.

There are a variety of recommendations for fasting before procedural sedation. This reflects that there are no studies showing a direct relationship between fasting time and the risk of pulmonary aspiration.

The ASA guidelines indicate that patients should fast a minimum of 2 hours for clear liquids, and 6 hours for light meals, before sedation. In contrast the American College of Emergency Physicians does not endorse recent food intake as a contraindication for administering procedural sedation and analgesia.

The focused physical examination should include:

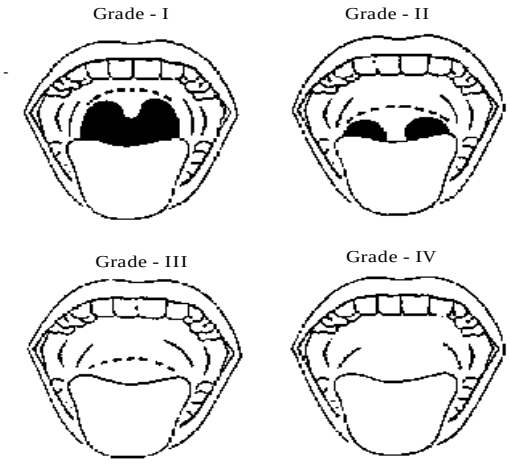
a. Vital signs and weight
b. Auscultation of heart and lungs
c. Level of consciousness

d. Assessment of airway

Airway Assessment / Evaluation

This is required to identify patients with anatomy that may make endotracheal intubations or positive pressure ventilation more difficult. This includes patients with obesity, short, thick neck, cervical spine disease, decreased hyoid-mental distance and structural abnormalities of the mouth, jaw and oral cavity. Examination of oral cavity can identify individuals with anatomy that is associated with more difficult intubations. Mallampati score is used to predict difficult intubations. Patient is asked to open the mouth maximally, if the faucial pillars and uvula cannot be adequately visualized (Mallampati III and IV), laryngoscopy and visualization of the glottis is likely to be more difficult.

Fig 6.1



Mallampati score used to predict difficult intubation. This system emphasizes the importance of the base of the tongue in predicting difficulty with laryngoscopy. If the faucial pillars and uvula cannot be adequately visualized on maximal mouth opening (Mallampati III and IV), visualization of the glottis is likely to be more difficult.

Pharmacology of Sedation

The goal of endoscopic sedation is to maximize patient comfort while minimizing the risk of drug related side effects. The drugs most widely used for endoscopic sedation are benzodiazepines and opioids.

Opioids:

The principal effects of the opioids are analgesia and sedation. In clinical practice, opioids are usually combined with a benzodiazepine for endoscopic sedation.

The pharmacological effects of benzodiazepines include anxiolysis, sedation, amnesia, anticonvulsant effects, muscle relaxation and anaesthesia. The amnestic effect may persist after sedation has worn off.

Diazepam

The initial induction dose for endoscopic procedure is 5-10mg intravenously over 1 minute. If required, additional doses may be administered at 5 minutes interval. Dose reduction is required in debilitated or elderly patients. In general, 10mg is sufficient for most endoscopic procedures, although up to 20mg may be necessary if a narcotic is not being co-administered.

The major side effect of diazepam is respiratory depression. This is dose dependent and results from depression of the central ventilatory response to hypoxia and hypercapnea.

Respiratory depression is more likely to occur in patients with underlying respiratory disease or those receiving combination of a benzodiazepine and an opioid.

Midazolam

Midazolam is a water soluble, short acting benzodiazepine. It is 1.5-3.5 times more potent than diazepam. Midazolam is distinguished from the other benzodiazepines by its more rapid onset of action and shorter duration of effect, the onset of effect for midazolam is 1-2 minutes and the peak effect occurs in 15-80 minutes. Midazolam clearance is reduced in the elderly, obese and those with hepatic and renal impairment. The bioavailibility of midazolam is increased by approximately 30% in patients using a hisamine (H2) receptor antagonist.

The initial intravenous dose in healthy adults younger than 60 years of age is l mg (or no more than 0.03mg/kg injected over 1-2 minutes.

Additional doses of 1mg may be admistered at 2-minutes intervals until adequate sedation is achieved. When midazolam is used with an opioid, a synergistic interaction occurs and reduction in the dose of midazolam may be indicated. Patients older than 60 years and those with ASA physical states III or greater require a dose reduction of 20% or more. A total intravenous dose greater than 6 mg is not usually required for routine endoscopic procedures.

The major side effect of midazolam is respiratory depression. In some cases apnea may last as long as 30 minutes after administration of the last dose of midazolam. Midazolam induced respiratory depression may be an administration related phenomenon, with more rapid administration resulting in greater number of apneic episodes. Cardiac dysrhythmia has been reported rarely after administration of midazolam.

Flumazenil

Flumazenil is a benzodiazepine specific antagonist. Flumazenil competitively antagonizes the central effects of benzodiazepines, reversing sedation, psychomotor impairment, memory loss and respiratory depression. Flumazenil is water-soluble and can be administered by either continuous or bolus infusion. The half life of Flumazenil after intravenous administration is 0.7-1.3 hours and average duration of antagonism is 1 hour.

Flumazenil has also been shown to reverse ventilatory depression in patients sedated with a combination of benzodiazepines and opioids. Midazolam induced reversal of respiratory depression occurs approximately 120 seconds after the intravenous administration of Flumazenil.

Propofol

Propofol is a hypnotic with minimal analgesic effect. At sub-hypnotic doses, propofol produces sedation and amnesia. Its duration of effect is 4-8 minutes. The presence of cirrhosis or renal failure does not significantly affect its pharmacokinetic profile. Co-administration of other central nervous system medications such as opioids potentates the sedative effect of propofol.

The cardiovascular effects of propofol include a decrease in cardiac output, systemic vascular resistance and arterial pressure. These effects respond rapidly to a dose reduction or interruption of drug infusion.

Combination Propofol

By combining small doses of several drugs that possess desirable pharmacologic actions it is possible to maximize the therapeutic actions of each while minimizing the likelihood of a dose related adverse reaction. This pharmacologic principle can be applied to procedural sedation. So, when propofol is combined with small doses of an opioid analgesic and a benzodiazepine, analgesia and amnesia can be achieved with sub-hypnotic doses of propofol, eliminating the need for deep sedation. Furthermore, precise dose titration is possible with smaller bolus doses of propofol (5-15mg) and the potential for reversibility is retained using Naloxone or Flumazenil.

The protocols for combination propofol include a pre-induction dose of either an opioid or a benzodiazepine or both. An induction dose of propofol is then administered (5-15mg), followed by additional boluses of (5-15mg). The average cumulative doses of propofol in a combination regimen are 65-100mg during colonoscopy and 35-70mg during upper GI endoscopy.

Ketamine

Ketamine possesses both analgesic and sedative properties. After intravenous administration ketamine has a rapid onset of action (<1minute) and short duration of effect (10-15min). Ketamine is easy to administer and in contrast to benzodiazepine/narcotic regimens, does not depress airway or cardiovascular reflexes. The dose of ketamine for endoscopic sedation has been studied predominantly in the pediatric settings.

Pharyngeal Anesthesia

Pharyngeal Anesthesia is often used to suppress the gag-reflex during procedures involving the upper gastrointestinal tract. Commonly used topical anesthetics include benzocaine and lidocaine. They are administered by aerosol spray or gargling. The effect lasts for up to an hour. It probably provides little benefit for most patients receiving intravenous sedation. It may be acceptable to use topical anesthesia for some patients, particularly if light or no conscious sedation is administered.

Patient Monitoring

Patient monitoring is an essential element of endoscopic sedation. This includes both visual assessment as well as the use of devices to measure physiological parameters. Before sedating the patient, all monitoring and resuscitation equipment required for the intended level of sedation should be present and functioning.

Staffing

When sedation is used for gastrointestinal endoscopic procedures, there must be a minimum of three appropriate staff present for endoscopy, the endoscopist, the assistant to the endoscopist and the person providing sedation and monitoring of the patient. For all sedation for gastrointestinal endoscopic procedures, a medical practitioner with specific training and experience in airway management and resuscitation must be involved in the sedation or procedure itself.

From the time of initiation of sedation a person with appropriate training must be present whose sole responsibility will be to monitor the patient's level of consciousness and cardio-respiratory status during the procedure and to assist in resuscitation if required. If major risk factors are identified or difficulties are anticipated, involvement of an anesthetist in administering sedation is recommended.

Facilities and Equipment

The procedure must be performed in a location, which is adequate in size and staffing and is equipped to deal with a cardiopulmonary emergency. A list of emergency resuscitation equipment and drugs is given in table.

Table 6.2 Emergency Resuscitative Equipment

- Assorted syringes, tourniquets, adhesive tape
- Intravenous access equipment including fluids
- Basic airway management equipment
- Oxygen supply
- Suction machine and catheter
- Nasal cannulae and face-masks[a]
- Bag-mask ventilation device
- Oral and nasal airways (all sizes)
- Advanced airway management equipment
- Laryngoscope handles and blades[a]
- Endotracheal tubes and stylets[a]
- Laryngeal mask airway[a]
- Cardiac equipment
- Pulse oximeter
- Cardiac defibrillator
- Emergency medications
- Atropine
- Diphenhydramine
- Epinephrine
- Ephedrine
- Flumazenil
- Glucose, 50%
- Hydrocortisone
- Lidocaine
- Naloxone
- Sodium bicarbonate

All appropriate sizes should be available.

The equipment stocked on an emergency cart should be tailored to the practice environment and the training of the sedation team. It is strongly recommended that a cardiac defibrillator be available on site. Equipment for providing positive-pressure ventilation must be immediately available. This includes oral and nasal airways and an Ambu-bag. Advanced airway management equipment including laryngoscopes and endotracheal tubes, or laryngeal mask airways should be available on the emergency cart.

Appropriate drugs for cardiopulmonary resuscitation and drugs for reversal of sedation due to benzodiazepines and opioids should be readily available. A pulse oximeter and cardiac monitor recording pulse, blood pressure and ECG should be attached to the patient.

Technique and Monitoring

All patients should have reliable venous access for endoscopic procedures requiring sedation. Dosage of benzodiazepines and opiates should be kept to a minimum to achieve sedation. Opioids should, whenever possible, be given before benzodiazepines and their effect observed before proceeding.

Most endoscopic practices recommend that 5mg of midazolam should usually be the maximum dose given and that elderly patients are given 1-2mg initially with a sensible pause to observe effect. Doses of pethidine in excess of 50mg or Fentanyl 100mcg are seldom required and elderly patients will receive dose reduction (usually below 50%) when these drugs are used. Oxygen should be given to all sedated patient throughout the procedure and recovery.

Clinical Monitoring

Pulse oximetry should always be used during endoscopy. Oxygen de-saturation can occur during the endoscopic procedure when sedation is used, especially when the patient has been over sedated. A reading below 90% SpO2 is dangerous and requires immediate intervention. Preoxygenation with oxygen enriched air (2 liters per minute) is safe even in chronic obstructive pulmonary disease and greatly diminishes or prevents hypoxemia. This should be used routinely in all at-risk patients. In the event of de-saturation, encouraging the patient to breathe deeply with supplemental oxygen, termination of the procedure, assisted ventilation and pharmacological reversal of either the benzodiazepine and/or the opioid may be required. Homodynamic parameters also provide important feed back during an endoscopic procedure. Tachycardia and hypertension may indicate that the patient is sedated inadequately, whereas bradycardia and or hypotension may be

an early indication of over-sedation. A base line blood pressure should be noted before the administration of sedation, and then at 3 – 5 minutes interval throughout the procedure. The use of continuous electrocardiography during routine endoscopic procedure in low risk patients is not required. High-risk patients (including those with a history of dysrythmias) receiving sedation should be considered for cardiac monitoring.

Continuum Sedation

Sedation and / or analgesic agents produce alteration in a patient's level of consciousness. These changes in consciousness occur along a continuum that ranges from anxiolysis to general anesthesia. Four stages of sedation have been defined by a stimulus response relationship.

Table. 6.3 Levels of Sedation and Analgesia

	Minimal sedation (anxiolysis)	Moderate sedation/analgesia (conscious sedation)	Deep sedation/analgesia	General anesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful[a] response to verbal or tactile stimulation	Purposeful[a] response following repeated or painful stimulation	Unarousable, even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

A patient level of consciousness should be assessed and documented, beginning before the initiation of Sedation and continuing through out the procedure and recovery period, until the patient is suitable for discharge.

Recovery And Discharge

After the completion of endoscopy, patients receiving intravenous sedation require observation and monitoring.

Standardized discharge criteria should be used to assess recovering from sedation. Several recovery scales have been developed. One such system is Aldrete scoring system, which evaluates 5 physiological parameters: respiration, oxygen saturation, blood pressure, consciousness and activity.

Table 6.4 Aldrete Scoring Systems

Respiration	
Able to take deep breath and cough	2
Dyspnea/shallow breathing	1
Apnea	0
Oxygen saturation	
S_aO_2 95% on room air	2
S_aO_2 90%–95% on room air	1
S_aO_2 90% even with supplemental O_2	0
Consciousness	
Fully awake	2
Arousable on calling	1
Not responding	0
Circulation	
BP 20 mm Hg baseline	2
BP 20–50 mm Hg baseline	1
BP 50 mm Hg baseline	0
Activity	
Able to move 4 extremities	2
Able to move 2 extremities	1
Able to move 0 extremities	0

NOTE. Monitoring may be discontinued and patient discharged to home or appropriate unit when Aldrete score is 9 or greater.

Monitoring may be discontinued and patient discharged to home when Aldrete score is 9 or greater. In addition to a physiological assessment, suitability for discharge includes an ability to dress and walk independently. All patients should receive verbal and written instructions for diet, activity, medications and follow up evaluation on discharge. A responsible individual should accompany the patient home.

Informed Consent

The philosophy behind the law of informed consent is that a patient has the right to make informed decisions about what happens to his or her body. Informed consent for endoscopic sedation requires that the patient understand the nature of the proposed sedations, the risks and benefits associated with it, the options (including no sedation) and the risks and benefits associated with the options. A direct face-to-face informed consent discussion also provides a good opportunity for the endoscopist to assess the patient's clinical sedation risks such as history of sedation reaction or difficult intubations and abnormal head and neck anatomy as well as the details and risks of the endoscopy procedure. All this should be documented in the form of a hand written note or signed pre-printed form.

7 Indications, Contraindications, Complications of Upper Gastrointestinal Endoscopy

Upper gastrointestinal endoscopy, also known as esophago gastroduodenoscopy (EGD) is the method of choice for examining the esophagus, stomach and duodenum. In one, sitting it permits the gross visual inspection of the upper gastrointestinal tract, the collection of tissue and fluid sample, as well as emergency and elective therapeutic interventions. It can be performed quickly and safely with good patient tolerance and without extensive preparation.

Indications

1. Dysphagia
2. Upper abdominal pain, heart burn, reflux
3. Nausea, vomiting, anorexia, fullness, weight loss, anemia, haematemesis
4. Diarrhea (tropical or non tropical sprue)
5. Portal hypertension
6. Unexplained aspiration, chronic cough

Contraindications

1. Corrosive ingestion
2. Perforation
3. Full stomach
4. Advance heart failure, acute myocardial infarction
5. Advanced respiratory failure

Risks and Complications

The rate of serious complication in upper GI endoscopy is small and is measured in tenths of a percent. Reports based on larger reviews show that mortality rate is less then 0.01%.

Table 7.1 Complication rates in upper GI endoscopy

Complication	Complication rate	Percentage of all complication
Cardiac	1: 2000	60%
Pulmonary	1: 4000	30%
Perforation, bleeding	1: 15000	9%
Infection	1: 50000	1%

Risk factors and high risk patient

1. Advanced age
2. NYHA class III-IV heat failure
3. Severe aortic stenosis
4. Severe pulmonary disease
5. Bleeding tendency, platelet count < 50,000 and markedly prolonged prothrombin time
6. Anaemia (hemoglobin < 8g / dl)
7. Emergency Procedures

Local Anesthesia

Anesthetic throat sprays have the potential to incite an allergic reaction, produce cardiac side effects and promote aspiration. The overall risk of complication from pharyngeal anesthesia is approximately once every 10,000 procedures.

Sedation and Analgesia

The principal risks are a fall in blood pressure and hypoxemia induced cardiac arrhythmia. Respiratory complications can range from hypoventilation to apnea. The most common problem is aspiration.

Cardiac Complications

Approximately 50% of the complications that occur in upper GI endoscopy are cardiac in nature. The most common arrhythmias are tachycardia and extra systoles, which have no clinical significance and are spontaneously reversible. Bradycardia is observed in less than 5%, occurring predominately in patients with coronary heart disease. This reflects silent myocardial ischemia, caused by arterial hypoxia due to increased cardiac workload.

Respiratory complications

Respiratory complications consist of hypoventilation, apnea and aspiration. Their overall incidence is low. The mortality is less than 1:50,000.

Gastrointestinal Complications

Perforation and Bleeding

Although perforation and bleeding from gastroscopy are the complications that patients fear the most, they account for less than 10% of all complications.

The most common sites of perforation in descending order of frequency are the esophagus, hypopharynx, duodenum and stomach. Predisposing factors

are diverticula, severe cervical spondylosis, and endoscopic interventions such as dilatation, prosthesis insertion and laser therapy. Severe post biopsy bleeding is quite rare.

Infection

The risk of clinically overt infection is extremely small, but does exist. The direct transmission of microorganisms from patient to patient by contaminated endoscopes has been described for Salmonellae, Mycobacteria, Helicobacter pylori, hepatitis B virus and other pathogens. Potential sources of infection are contaminated water bottles and the endoscope channel, which are more difficult to access and clean. Meticulous cleaning and disinfections after each endoscopy and before the first endoscopy of the day are essential elements of risk management.

Nature of the procedure

It is clear that procedures which inflict mucosal injuries are associated with a higher infection risk, such as dilatation, sclerotherapy, laser therapy etc.

Patient associated risk

Patient having cardiac anomalies, prosthetic valves and immunosuppression have increased risk of infection after upper GI endoscopy

Diagnosis and Treatment of Complications

Complications during examination

Restlessness, agitation, pain, coughing, gagging.

Table 7.2

Causes	Reasons for stopping the examination and withdrawing the endoscope
➢ Normal response to the examination ➢ Faculty examination technique (especially, poor intubation technique) ➢ Not enough verbal reassurance, inadequate preparation for the procedure ➢ Misdirected intubation, retroflexion in the pharynx ➢ Pain due to unfavorable patient position ➢ Paradoxical reaction to sedation ➢ Respiratory distress, pain, angina pectoris ➢ Preexisting illness: - Bronchial asthma, chronic obstructive lung disease - Alcohol abuse - Previous unpleasant endoscopy	➢ Serious preexisting illness ➢ Elderly patient ➢ Tachycardia > 140bpm, arrhythmia ➢ O_2 saturation < 90%, declining ➢ Uncooperative patient ➢ Angina pectoris
Brief assessment	**Reasons for pausing but leaving the instrument in place**
➢ Endoscope position (retroflexed? Misdirected?) ➢ Verbal responsiveness of patient, cooperativeness ➢ Heart rate	➢ No preexisting illness ➢ Young patient ➢ O_2 saturation > 90% ➢ Patient responsive to verbal commands ➢ Patient and endoscopist agree to continue
	Treatment
	➢ According to cause

Dyspnea

Table 7.3

Causes

- Psychogenic
- Obstructed nasal breathing
- Misdirected intubation, aspiration
- Cardiac decompensation

Brief assessment

- Respiratory rate, breath sound, cyanosis
- O_2 saturation
- Pulse

Reasons for stopping the examination and withdrawing the endoscope

- Elderly patient
- Pre-existing cardiopulmonary disease
- O_2 saturation < 90% declining
- Tachycardia > 140bpm

Reasons for pausing but leaving the instrument in place

- No preexisting illness
- Young patient
- Adequate O_2 saturation (>95%)

General treatment

- For significant dyspnea, treat according to the general rules for cardiopulmonary resuscitation:

A Clear the airway and keep it Open (suction of mucus, vomitus, etc).

B Ventilate (O_2 by mask or nasal catheter): intubate if response is poor.

C Maintain and stabilize the circulation, if necessary using external cardiac massage.

D Place an intravenous line, give specific pharmacotherapy

Specific treatments

- For **bronchoconstricion**
  - Theophylline, 200mg i.v.
  - Prednisolone, 100mg i.v.
  - Beta-2 mimetics by aerosol
  - Beta-2 mimetics s.c. (e.g, Bricanyl 0.5-1.0mgsc.)
- For **cardiac decompensation**
  - Nitroglycerine sublingual
  - Furosemide, 40-80mg i.v
  - With concomitant bronchospasm: theophylline, 200mg i.v.
  - Tratment of cardiac arrhythmias

Bleeding

Table 7.4

Causes

- Instrument tip contact (pharynx, upper esophageal sphincter, duodenal bulb)
- Varices (ulcerations in the esophagus, stomach, and duodenum)
- Mallory-Weiss syndrome
- Less common causes (see p. 155)
- Coagulation disorders, thrombocytopenia

Course of action

- Do not with draw the endoscope

Specific Treatment

- Treat for upper gastrointestinal bleeding (see p. 146)

Apnea

Table 7.5

Causes	Specific treatment
➢ Pharmacological: sedation, analgesia ➢ Cardiac: asystole, ventricular fibrillation, bradycardia ➢ Anaphylactic shock	➢ For antagonizing the effect of **benzodiazepines** - Flumazenil (Anexate). 0.5-1mg repeat after three minutes if necessary - Caution: half-life of flumazenil < half-life of midazolam <<half-life of diazepam ➢ For antagonizing the effect of **opiates** - Naloxone (Narcanti), 0.4-2mg, repeat after three minutes if necessary ➢ For a **cardiac cause** - Bradycardia: 0.5-1mg atropine i.v., may require temporary pacemaker - Asystole: precordial thump, 0.5-1mg epinephrine in 10mL NaCI i.v., temporary pacemaker - Ventricular fibrillation: cardioversion (200, 300, 360J), repeat after 1mg epinephrine in 10mL NaCI i.v. ➢ For **anaphylaxis** - Epinephrine, 0.25-0.5mg in 10mL NaCI i.v. - Prednisolone, 250mg i.v. - Antihistamine (e.g., 2mg clemastine i.v.) - Volume: 500-1000mL (e.g., crystalline or colloidal plasma substitute)
Course of action	
➢ Discontinue examination, withdraw endoscope	
Brief Assessment	
➢ Respiratory excursions, O_2 saturation ➢ Carotid pulse	
General treatment	
➢ Follow the general rules for cardiopulmonary resuscitation: **A** Clear the airway and keep it open (suction out mucus, vomitus, etc.). **B** Ventilate (O_2 by mask or nasal catheter): intubate if response is poor. **C** Maintain and stabilize the circulation, if necessary using external cardiac massage. **D** Place an intravenous line, give specific pharmacotherapy.	

Loss of Consciousness

Table 7.6

Causes	General Treatment
➢ Sedation or analgesia ➢ Hypoxia ➢ Asystole or ventricular fibrillation ➢ Anaphylaxis	➢ Follow the general rules for cardiopulmonary resuscitation: **A** Clear the airway and keep it open (suction out mucus, vomitus. etc.). **B** Ventilate (O_2 by mask or nasal catheter): intubate it response is poor **C** Maintain and stabilize the circulation, if necessary using external cardiac massage. **D** Place an intravenous line, give specific pharmacotherapy.
Course of action	
➢ Discontinue examination, withdraw instrument	
Brief Assessment	**Specific Treatment**
➢ Verbal responsiveness, response to painful stimuli. ➢ Respiratory excursions, O_2 saturation ➢ Carotid pulse	➢ Antagonize effects of benzodiazepines (see Apnea. P. 13). ➢ Antagonize effects of opiates (see Apnea, P.13). ➢ Treat for anaphylaxis (see Apnea, P.13.).

Complication immediately after the examination or after a complaint free interval

Pain

Table 7.7

Causes	General Treatment
➢ Neck: pharyngeal injury, esophageal perforation ➢ Chest: esophageal perforation, angina pectoris ➢ Abdomen: overdistention, perforation of the stomach or duodenum	➢ Radiographic findings - Plain film of the neck and chest (cutaneous emphysema? air in mediastinum?) - Standing abdominal plain film (free air?) - Abdominal plain film in LLD (free air?) ➢ ECG if a cardiac cause is suspected
Diagnosis	**Treatment**
➢ Clinical findings - Pharyngeal inspection, cutaneous emphysema, abdominal findings.	➢ NPO ➢ Further treatment according to cause

Esophageal Perforation

Table 7.8

Risk Factor	Diagnosis
➢ Uncooperative patient ➢ Diverticula (especially Zenker diverticula). Strictures, ulcers. ➢ Osteophytes ➢ Interventions ➢ Bougie or balloon dilation, sclerotherapy of verices	➢ Radiography findings - Plain film of chest and neck (free air?) - Contrast examination of the esophagus (with water-soluble medium)
Symptoms	**Treatment**
➢ Pain (neck, chest, back) ➢ Cutaneous emphysema ➢ Dysphagia	➢ Surgical treatment ➢ Conservative treatment only in selected cases ➢ NPO ➢ Antibiotic, proton pump inhibitor (PPI) i.v.

Perforation of the Stomach or Duodenum

Table 7.9

Risk Factor	Diagnosis
➢ Duodenal diverticula ➢ Interventions (polypectomy, laser therapy)	➢ Radiographic findings - Standing abdominal pain film (free air?) - Abdominal plain film in LLD (free air?)
Symptoms	**Treatment**
➢ Pain (epigastric, diffuse). Peritonism ➢ Diminished bowel sounds ➢ Fall in blood pressure, tachycardia, sweating ➢ Fever	➢ Surgical treatment ➢ Conservative treatment only in selected cases ➢ NPO nasogastric tube ➢ Antibiotic, PPI

Dyspnea

Causes	Diagnosis
➢ Aspiration ➢ Cardiac decompensation	➢ Auscultation ➢ Arterial blood gas analysis ➢ Chest radiograph ➢ ECG
Symptoms	**Treatment**
➢ Tachypnea? Cyanosis? Tachycardia?	➢ According to cause

Aspiration or Aspiration Pneumonia

Table 7.10

Risk Factor	Treatment
➢ Sedation, pharyngeal anesthesia ➢ Uncooperative patients, elderly patients ➢ Patients with swallowing difficulties, with multiple morbidity ➢ Emergency endoscopy	➢ Antibiotics (e.g., cefoxitin, tobramycin) ➢ Prednisolone, 250mg i.v ➢ O_2 by nasal catheter if no response, intubate and ventilate
Symptoms	**Complications**
➢ Dyspnea, cyanosis ➢ Tachycardia, fever	➢ Global respiratory failure ➢ Adult respiratory distress syndrome (ARDS) ➢ Abscess
Diagnosis	
➢ Auscultation - Fine of coarse rales ➢ Radiographs - May be negative (1), diffuse patchy infiltration	

Cardiac Decompenation

Table 7.11

Risk Factor	Diagnosis
➢ Elderly patients ➢ Preexisting cardiovascular disease ➢ Anemia	➢ Auscultation - Sometimes normal (1): moist rales, bronchospasm ➢ Radiography findings - Symmetrical hillar shadow, cardiac enlargement. Kerley B lines ➢ ECG - Ischemia? Arrhythmia?
Symptoms	**Treatment**
➢ Dyspnea, tachycardia, frothy sputum ➢ Acrocyanosis ➢ Cold sweats	➢ O_2 by nasal catheter ➢ Nitrates, furosemide ➢ Treatment of arrhythmia ➢ Antianginal therapy as required

Hepatemesis, Malena, Hypovolemia

Table 7.12

Risk Factor	Diagnosis
➢ Varices ➢ Gastric and duodenal ulcer ➢ Thrombopenia, coagulation disorders, anticoagulant therapy ➢ Interventions (polypectomy, mucosectomy)	➢ Endoscopy
Symptoms	**Treatment**
➢ Hematemesis ➢ Melena ➢ Symptoms of hemorrhagic shock	➢ See relevant chapters.

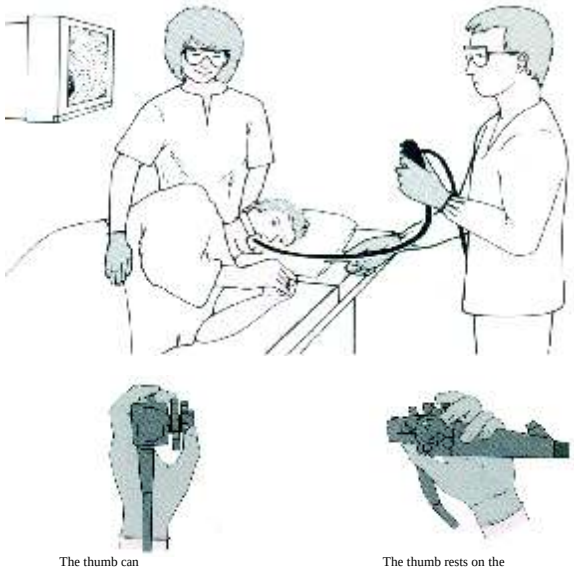
8 Upper Gastrointestinal Endoscopy

Examination Technique
Instrument Handling

The patient lies in left lateral position; the chin is tucked against the chest. The endoscopist should stand comfortably and the endoscope has to be held correctly. Its head should be placed in the palm of the left hand and gripped between the fourth and little fingers and base of the thumb, with the tip of the thumb resting on the up / down control. This grip leaves the first finger free to activate the air / water and suction button. The middle finger assists the thumb during major movements of the up / down control; with practice the left / right control can also be managed with the left thumb. The right hand thus remains free to push, pull and torque the instrument and also to control accessories such as the biopsy forceps, injection needle and diathermy snares etc. The right hand may be used intermittently to manage the left / right tip control and the brakes.

The basic left hand grip should be maintained throughout the examination. Acute rotation of the instrument should be effected by rotating the hand not by rotating the instrument in the hand.

Fig 8.1 *Instrument handling*



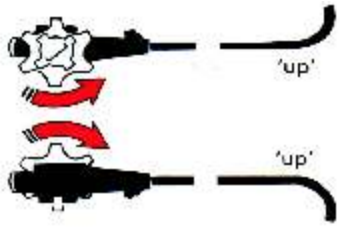
The thumb can reach across to the left / right control.

The thumb rests on the up / down control wheel, the forefinger on the air / water button and the middle finger can also assist.

Orientation

When referring to tip deflection it is convenient to use up/down and right/left in relation to the instrument view and the neutral position of the instrument head i.e. buttons up rather than to ceiling or floor, thus turning the up /down control anticlockwise as seen from the right (pushing the button of the wheel away from the endoscopist with the thumb) always moves the tip up relative to the field of view. This applies whatever the shaft rotation, if the hand and straight scope is rotated so that the buttons face the floor, 'up' deflection of the tip now points it towards the floor.

Fig 8.2 *Inversion of the endoscope and the 'up / down' convention*



Inserting the Endoscope

Pre-check the endoscope for proper functioning and lubricate the distal 20cms of the shaft just before inserting the endoscope through the mouth guard/bite guard, pre-rehearse up/down moments of the controls to ensure that the tip moves in the correct longitudinal axis to follow the pharynx, then pass the tip into the mouth guard. You will see a rough pale surface of the tongue in the upper part of the view. While advancing over the curve of tongue take care to stay in the mid line. The uvula is often seen projected upwards in the lower part of the view then as the tip advances the epiglottis and finally, the cricoarytenoid cartilage with the false vocal cords above it are visible in the upper part of the view. Due to the normal tonic contraction of the cricopharyngeal sphincter, the pharyngeal part of the esophagus is poorly seen except transiently during swallowing. At this point there will often be a 'red out' as the tip impacts into the cricopharyngeal sphincter; insufflate air, maintain gentle inward pressure and the instrument should slip into the esophagus. If necessary, ask the patient to swallow at this stage.

Fig 8.3 *Inversion of the endoscope and the 'up / down' convention*

a. Follow the centre of the tongue...

b. ..... past the uvula.....

c. ..... and the epiglottis.....

d. ..... to pass below the cricoarytenoid on either side.

If a Zenker diverticulum is present in this region there is a risk of perforation. If endoscope is misdirected towards the trachea the endoscope should be withdrawn at once.

The Routine Survey

Whatever the precise indication it is usually appropriate to examine the entire esophagus, stomach and duodenum. It is important to develop a systematic routine to reduce the possibility of missing any area. The instrument is always advanced under direct vision, using air insufflation and suction as required and delaying occasionally during active peristalsis. The two golden rules for endoscopic safety are:
Do not push if you cannot see and, If in doubt, inflate and pull back.

Esophagus

After the cricopharyngeal sphincter, other landmarks seen during esophagoscopy may include indentation from the left main bronchus and pulsation of the left atrium and aorta. The esophagogastric mucosal junction is clearly seen (at 38-40cm from the incisor teeth) where pale pink squamous esophageal mucosa abuts darker red gastric mucosa. This junction is often irregular and therefore is called the 'Z-line'. In normal patients the gastric mucosa is often seen 1cms above the diaphragm. Hiatus herniation is diagnosed if the Z-line remains move then 2cm above the hiatus.

Landmarks in Esophagus

Upper esophageal sphincter, approximately 14cm from the incisor teeth

1. Slit like lumen
2. Endoscope can be passed only during swallowing

Cervical esophagus

1. Approximately 16-20cm from the incisor teeth
2. Collapsed
3. Symmetrical round and delicate folds
4. Straight course

Mid Esophageal Constriction

1. Approximately 27cms from the incisor teeth
2. Indented by the aorta and left main bronchus

Retrocardiac esophagus

1. Approximately 30-38cm from the incisor teeth
2. Elliptical indentation from heart and aorta

3. Bowed posteriorly, then curves forward towards the diaphragm
4. Pulsations present

Lower esophageal constriction

1. Approximately 36-38cm from the incisor teeth
2. Venous Plexus
3. Longitudinal folds with concentric luminal narrowing

Stomach

After the instrument has passed through the esophageal hiatus, the interior of the stomach can be viewed. The first region that is seen after entry is the junction of the fundus and body of the stomach. Usually there is a small pool of juice, which should be carefully removed by suction to minimize the risk of reflux and aspiration to aid the subsequent inspection of the fundus.

The endoscope is then advanced towards the gastric body. The instrument tip is angled slightly forwards and towards the lesser curvature and the shaft is rotated slightly to the left. The endoscope is straightened, advanced and rotated slightly to the right (clockwise). The endoscope is then advanced with the tip angled slightly upwards passing below the ridge like annulus. The endoscope is then straightened, advanced and rotated slightly to the right; the pylorus is centered in the field of view and endoscope is advanced towards it.

The body appears as funnel shaped cavity that tapers down to a constriction at the angulus. Before air is insufflated it is in a collapsed state. Inspection in the collapsed state shows a seemingly random pattern of tortuous mucosal folds on the greater curvature side. When air is added the folds straighten out and may be effaced when the lumen is maximally distended. Smaller folds run along the lesser curvature and along the anterior and posterior walls into the deeper part of the stomach.

Marked tapering of the stomach is usually noted at the body on from junction. The typical curve of the angulus is visible in the distance. It provides a landmark for identifying the greater and lesser curves and anterior and posterior walls. The gastric folds generally give way to smooth mucosa as you proceed from the body of the stomach to the antrum. The antrum has the shape of a dome with the pylorus at the apex. The antral mucosal is smooth.

Retroflexions

Retroflexion is necessary to obtain a complete view of the cardia and fundus. The retroflexion maneuver consists of the following components.

- First the endoscope tip is directed upward in a U shape.
- The endoscope is simultaneously withdrawn and rotated towards the greater curvature.
- A combination of angling and twisting moments are used to inspect the cardia and fundus.

With this maneuver the shaft of the endoscope can be seen in the upper part of the retroflexed image. This view demonstrates the prominent fold of the cardiac notch and the dome of the fundus. Frequently, the Z-line can be identified. Center the cardiac in the image, then rotate the endoscope 180 clockwise and back counter-clockwise to inspect all portions of the cardia.

Relations of the Stomach

Table 8.1

Anterior wall		Posterior wall	
Cardiac Lesser curvature Angulus Pylorus	Fundus	Fundus	Body
Inferior surface of liver	Diaphragm Chest wall Abdominal wall	Spleen Diaphragm Heart	Pancreas Duodenum Spleen

Duodenum

The endoscope tip often passed swiftly into the duodenal bulb. The endoscope is advanced through the bulb to the superior duodenal angle. From this point the first valvulae conniventes can be seen to pass into the descending duodenum. The endoscope is advanced just until it abuts on the distal bulb wall. Now three things must be done simultaneously.

1. Retroflex the tip by turning the control wheels
2. Rotate Clockwise
3. Slightly advance

This has the following effects: The retroflexion maneuver raises the endoscope tip, rotating the shaft to the right angles, the deflected tip into the introitus of the descending duodenum and advancing the shaft moves the endoscope further down the descending limb. The duodenal bulb is relatively smooth and with air insufflation it is almost without

folds. The descending duodenum is a curved tunnel and typically has valvulae conniventes.

The anatomic locations recommended in order to optimize the endoscopic examination report are listed below.

Fig 8.4
Endoscopic views of different anatomic sites

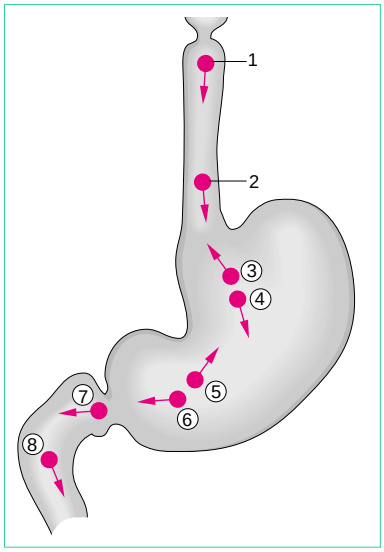


Image 1 Upper esophagus image taken about 20cm from the incisors to obtain a forward view of the esophagus.

Image 2 2cm above the squamocolumnar juction (Z line). This endoscopic appearance is particularly important for confirming that a careful study of this area has been carried out, and to locate anomalies accurately, particularly in the case of esophagitis or Barrett's esphagitis

Image 3 Cardia in inversion. An examination of the cardia in inversion allows visualization of the cardia and the totality of the upper part of the fundus in inversion.

Image 4 Upper part of the lesser curvature. This image provides good visibility after inflation of the upper part of the stomach (fundus).

Image 5 Angulus in partial inversion. Positioning the endoscope in front of the angulus provides confirmation that a complete examination of the antrum, angulus and fundus seen in inversion has been performed.

Image 6 Antrum the whole of the antrum is visualized with this image, assuming that the angulus has just been examined as described above.

Image 7 Duodenal bulb. The image should be taken with the endoscope positioned on the bulbar side of the pylorus in order to see the entire bulb.

Image 8 Second part of the duodenum. This confirms that a complete examination has been performed, with the end of the endoscope positioned near the papillary area.

1 -- 4

5 -- 8

9 Lower Gastrointestinal Endoscopy

Indications and Limitations

Colonoscopy is considered the gold standard for colonic examination. Flexible sigmoidoscopy, as regards logistics, safety and patient acceptability, has a significant role in clinically selected patients with minor symptoms. It can also be considered for population screening in countries with limited resources.

High Yield Indications

- Anemia / bleeding / occult blood loss
- Persistent diarrhea
- Inflammatory bowel disease
- Colorectal cancer screening in high risk patients with family history
- Abnormality on imaging
- Therapy

Low Yield Indications

- Constipation
- Flatulence
- Altered bowel habits
- Pain left iliac fossa

Limitations

- Incomplete examination can be due to inadequate bowel preparation, inadequate handling skills or an obstructing lesion.
- Errors in colonoscopic localization are possible, unless the ileo-cecal value is reached.
- Missing of lesions in blind spots in the cecum around acute bends and in the rectal ampulla.

Complications

Perforations: One perforation reported per 1700 colonoscopies in a series. The rate is more in unskilled endoscopist using heavy sedation or general anesthesia. It should not be considered a disgrace occasionally to abandon a difficult colonoscopy.

The perforations are more common in a severely ulcerated or necrotic colon. The instrument tip and shaft perforations are usually due to inexperience and the use of excessive force when pushing in or pulling out.

Air pressure perforations: This includes the blow out of diverticula, as they are thin walled and it is easy to confuse a large diverticulum with a bowel lumen.

Hypotension: Hypotensive episodes and even cardiac or respiratory arrest can be prevented by the combination of over distention and the vagal stimulus of forceful and prolonged colonoscopy. Hypoxia is particularly likely in elderly patients. All sedated patients should be given oxygen prophylactically.

Infections: Risk of infection has been mentioned in those with heart value replacement, previous infective endocarditis, recent vascular grafts and in immunosuppressed patients.

Safety during Colonoscopy:

The endoscopist must respect any protest from the patient. A mild groan in a sedated patient may be equivalent to a scream of pain without sedation; however, it is dangerous to give repeated doses of sedatives intravenously. Total colonoscopy is not always possible, even for experts. If there is a history of abdominal surgery or sepsis or if the instrument feels fixed and the patient is in pain the correct course is usually to stop.

Contraindications:

- Colonoscopy is contraindicated at least for 3 months after myocardial infection due to the risk of arrythmias.
- Pregnancy is not a contraindication; however it should not be done if there is a history of miscarriage.
- In any acute, severe inflammatory process (Ulcerative colitis, Crohn's disease or ischemic colitis) when abdominal tenderness is present colonoscopy should not be done due to increased risk of perforation.
- Colonoscopy is absolutely contraindicated during and for 2-3 weeks after an episode of acute diverticulitis, due to the risk of perforation from the localized abscess or cavity.

Bowel Preparation

Limited preparation alone is usually effective for limited colonoscopy or flexible sigmoidoscopy. Examination can be performed shortly after evaluation occurs usually within 10-15 minutes.

Diverticular disease or stricturing lesions require full bowel preparation even for limited examination.

Full Preparation

The object of full preparation is to clean the whole colon. Dietary restriction is a crucial part of preparation. Iron preparation and constipating agents should be stopped 1-2 days before but most other medication can be continued.

The patient should have no indigestible or high reside food for 24 hours before colonoscopy. Staying for 24hours on clear fluids is even better. Balanced electrolyte solution (i.e. oralyte) with a physiological gut activator or a prokinetic agent to speed transit can be used.

Balance electrolyte solution with polyethylene glycol solution (Peg-Electrolyte solution) is widely used. Mannitol is a disaccharide sugar for which the body has no absorptive enzyme. 1 liter of 10% mannitol followed by 1 liters of tap water is a useful way of achieving bowel preparation in 2-3 hours for those requiring urgent colonoscopy

10 Colonoscopy / Sigmoidoscopy Technique

Colonoscope are structurally similar to upper gastrointestinal endoscopes but are longer, wider diameter for better twist and torque control and have moveable flexible shaft. The bending section of the colonoscope tip is also longer and gently curved to avoid impaction in acute bends. The long colonoscopes are 165-180cm and intermediate length instruments are 130-145cms. Variable-stiffness colonoscopes have twist control on the shaft that forcibly compresses and rigidifies the scope.

Endoscopic Anatomy

The anal canal is 3cm long and it extends upto the squamo-columnar junction or dentate line. The rectum reaching 15cm proximal to the anal verge may have a capacious ampulla in its mid part as well as three or more prominent partial or semi-lunar folds (valves of houston) that create potential blinds spots, in any of which the endoscopist can miss significant pathology. Digital examination, direct inspection and if required rigid proctoscopy may be needed for compelete examination.

The distal colon has thick circular muscles. Transverse colon is triangular in out line. Hanstral folds segment the interior of the colon. The three external teniae coli or longitudinal muscle bundles are only seen distally if the colon is abnormally capacious, bulging outwards between them.

External structure can be seen the through the colonic wall typically as the blue, gray discoloration of the spleen or liver.
Ceacum is last 5cm above illeocecal valve.

Insertion

The patient lies in the left lateral position. A digital examination of rectum with well lubricated finger is mandatory before insertion. The instrument tip is then inserted through the well lubricated anus. Inflating air down the endoscope while pressing the tip into the anal canal gives direct vision and facilitates insertion.

Tight and tonic sphincter may take some time to relax, asking the patient to bear down may helps this.

After the scope has been inserted a red-out is the first view because the lens is pressed against the mucosa, insufflate air to distend the rectum and then rotate slightly or angulate or pull back, push in only when an adequate view has been obtained. The endoscope is torque-steer round the first few bends using up or down angulation and shaft twist alone to achieve most lateral movement rather then unnecessarily using the lateral angulation control.

Retroversion in rectum:

The rectal ampula is quite capacious so retroflexion is relatively easy. Choose the widest part of ampulla angulated both control fully and push entirely in ward to invert the tip toward the anal verge.

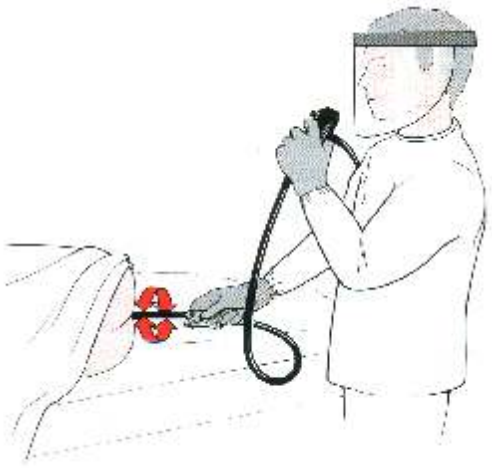
Colonoscope Handling:

Single handed approach

In single handed colonoscopy the endoscopist manages the Colonoscope controls with the left hand, leaving the right hand free to hold the shaft. The shaft should be griped 25-30cms away from the anus.

Right hand torque steering and twisting the shaft at the same time as angulating the tip up & down. The right hand can also feel whether the shaft tones easily (is straight) or there is resistance (due to looping). The shaft should always be held in the fingers. Rolling the shaft between fingers and thumb allows major steering rotations upto 360° whereas wrist-twist manages only 180°

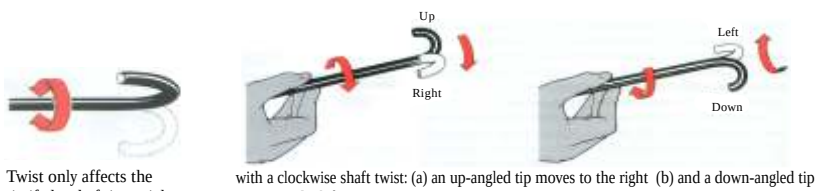
Fig 10.1 *Single handed maneuvering of the instrument shaft*



Colonoscope Steering:

Twisting (Torquing) the shaft only affects the tip when the shaft is straight when a loop is present in the shaft, twisting forces applied will be lost within the loop. When the shaft is straight, twist becomes an excellent way to torque or corkscrew around bends. This is particularly useful if the angle to be traversed is acute or fixed, because simply trying to push around will encounter severe resistance (often resulting in looping rather than progress).

Fig 10.2 *Single handed Steering*



Twist only affects the tip if the shaft is straight.

with a clockwise shaft twist: (a) an up-angled tip moves to the right (b) and a down-angled tip moves to the left.

Torque steering is affected by the direction in which the tip is angulated with up angulations, clockwise torque moves the tip to the right, whereas it moves to the left if angulation is down.

Steering with the lateral angulation control has least effect when the tip is already maximally angled (up and down). A fully angulated tip will not slide along the colon similarly an impacted tip cannot be steered and in this situation on attempted angulation the shaft moves instead.

Two handed one person technique

The two handed technique is mainly used by those with small hands, who may be unable to reach the lateral angulation control with the left thumb and may need to use right hand for this purpose. This means that briefly the instrument shaft will be left free while the angulation is made. So it is likely that endscopist is not torque steering efficiently.

Two person colonoscopy

Two person colonoscopy relies on an assistant to handle the shaft. The endoscopist control the body of the instrument with the left hand working the up/down control and air/water/suction valves and the right hand adjusting the right/left angulation control. The assistant pulls and pushes the endoscope according to the spoken instructions of the endoscopist. Unless endoscopist/assistant team work is skilled and interactive the two person approach to colonoscopy can be clumsy and illogical.

Insertion through the colon should be as quick as possible, become pushing and looping of the insertion phase is uncomfortable and stress full for the patient. Full inspection should be done on return journey. The over inflated sigmoid colon becomes long and tortuous. And form loops and acute bends but if shortened down and deflated it can be telescoped into a few centimeters. The comfortable and safe insertion depends upon the following principles.

- Suction air frequently and fluid infrequently.
- Whenever the colon is full distended or patient feels discomfort, suction of the excess air.
- So insufflate as little as possible.
- If there is no view pull back of once.
- Keep the scope as straight as possible.

Sigmoid Loops

The sigmoid colon is 40-70cm long when stretched by the scope; it will crumple down to only 30cms – 35cms when the instrument is straightened fully.

The sigmoid colon mesentery is inserted in a v-shape across the pelvic brim. It may often be modified by adhesions from previous inflammations or after hysterectomy the distal sigmoid colon may be angulated and fixed anteriorly into the space vacated by utrus.

The shape of the pelvis and the sacral curve cause the colonoscope to pass anteriorly and then looped back to pass into descending colon in the left paravertibral gutter. The result is an antero posterior, clockwise spiral loop. When the sigmoid to runs anteriorly against the abdominal wall it is possible partially to reduce or modify it by pressing the lower abdomen with hand.

The descending colon runs in affixed straight line, which is easy to pass with the colonoscope, except that there is usually an acute bend at the junction with the sigmoid colon. Some times when the sigmoid colon is long an alpha loop occurs, which avoids any angulation at the sigmoid descending junction. Pain is the commonest warning of loop formation. The loop can be recognized by loss of proportionate moment on pushing the shaft of the scope or paradoxical movement that the shaft sliding out as the shaft is pushed in.

If the instrument is felt “jammed up” as the shaft loops more and more it becomes progressively less responsive to manipulation.

How to avoid Sigmoid loops

Abdominal hand-pressure often helps a little during sigmoid insertion, since the sigmoid loop frequently loops anteriorly close to the abdominal wall. The assistant compresses non-specifically over the lower abdomen 20-30 seconds, when scope is pushed inward.

The sigmoid loop can be avoided by pushing little and slowly and pulling often and fastly.

Alpha loop straightening

Alpha loop is usually straighten out as soon as the upper descending colon is reached at about 90cms. Alpha loop straightening is achieved by combined withdrawal and strong clockwise de-rotation.

Sigmoid Descending Junction

Sigmoid descending junction is an acute bend at approximately 40-70cms. As soon as the scope tip is partially into or around the sigmoid-descending junction the following steps can be tried.

Pull back the shaft to reduce loop, the assistant pushes the left lower abdomen to compress the loop or reduce the abdominal space within which it can form. Deflate the colon to shorten it, then the tip being steered at the mucosa just before the inner angle so that on pushing in the tip slip pass the angle to point straight at the lumen of descending colon.

Changing the patient to the right lateral position can sometimes improve visualization of the sigmoid-descending junction and may sometimes also cause the distal descending colon to drop down into a more favorable configuration for passage. The descending colon is a 20cms long straight tube traversed in a few seconds.

Splenic flexure

The colon bends medially and anteriorly around the splenic flexure the following maneuvers can be done straighten the scope, pull back with tip hooked around the flexure until the instrument tip is 40-60cm from the anus. Over angulation of the tip should be avoided.

Deflate the colon slightly to shorten the flexure. Slowly push in the scope while twisting it clockwise, continued gentle inward pressure is needed.

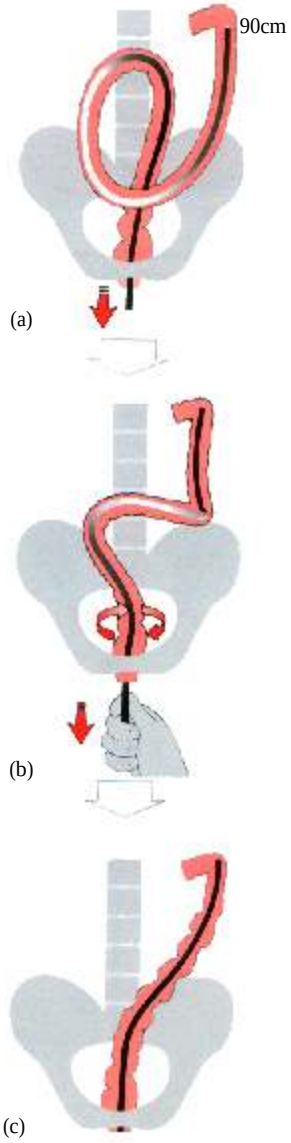


Fig 10.3 (a) An alpha loop (b) de-rotates with clockwise twisted and withdrawal (c) to straighten completely

How to pass the splenic flexure

- Pull back to strengthen the scope
- Avoid over angulation of the tip.
- Deflate the colon
- Apply assistant hand pressure
- Use clockwise torque on the shaft
- Push in but slowly
- Change position to back or right side and try again

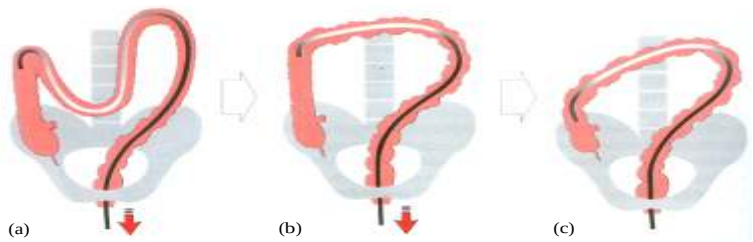
Transverse Colon

It is relatively easy to pass through the triangular mucosal folds of the transverse colon, when the tip is in the proximal transverse colon anticlockwise torque often helps it to advance towards the hepatic flexure.

Hepatic Flexure

Assess the correct direction around the flexure, after the tip reaches into it, asks the patient to breathe in and hold the breath, which lowers the diaphragm and often the flexure. Aspirate the air carefully from the hepatic flexure to collapse it toward the tip. Steer the tip blindly around the arch of the flexure. Since hepatic flexure is very acute, both angulation controls, can be used simultaneously to achieve full angulation. Aspirate air again once the ascending colon is seen, in order to shorten the colon and drop the colonoscope down towards the cecum.

Fig 10.3 (a) when around the hepatic flexure and viewing the ascending colon.. (b)... pull back to straighten ... (c) .... and aspirate to collapse the colon and pass toward the cecum.



Reaching the cecum

On seeing the ascending colon aspirate the air, the resulting collapse of the hepatic flexure and ascending colon will drop the tip downward toward the cecum.

The cecum can be voluminous with pronounced haustral in-floldings and tendency to spasm making it confusing to examine. The appendix orifice or ileo-cecal valve should be identified as landmarks, with or without imaging, also use right iliac fossa Trans-illumination or finger palpation indenting the cecal region to confirm location of the tip.

How to localize

Uncertainty in localization is one of the endoscopist's most serious problem. Distance of insertion of the instrument is inaccurate due to the elasticity of the colon, at 70cm the instrument may be on the sigmoid colon, the cecum or anywhere between. On withdrawal, the colon will shorten and straighten predictably so that measurement gives approximate localization. On withdrawal the cecum should be at 70-80cm the transverse colon at 60cms the splenic flexure at 50cms. The descending colon at 40cm and the sigmoid colon at 30cm.

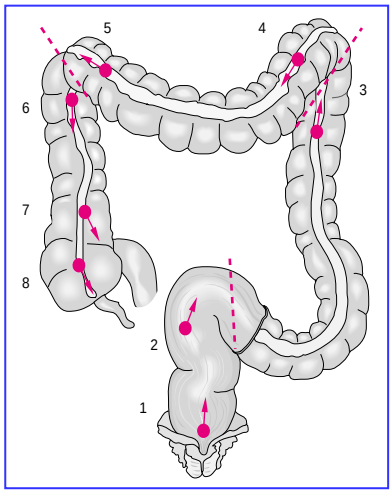
The internal appearance of the colon can be misleading. In the sigmoid and descending colon the haustra and the colonic outline one generally circular, whereas the longitudinal muscle strips or teniae coli cause the characteristic triangular cross-section often seen in the transverse colon. Visible evidence of extra colonic viscera normally occurs at the hepatic flexure where there is seen to be a bluish grey indentation from the liver, but a similar appearance may sometimes occur at the splenic flexure or descending colon.

The combination of an acute bend with sharp haustra and blue coloration is characteristic of the hepatic flexure and is a useful endoscopic land mark. Pulsation of adjacent arteries is seen in the sigmoid colon (left common-iliac artery) and transverse colon (right iliac). The ileo-cecal valve is the only definite land mark in the colon.

Trans-illumination of the abdominal wall by instrument with bright illumination can be very helpful if other imaging modalities are not available, but in obese patients may need a darkened room.
Finger indentation by palpation can be effective particularly in the ascending colon or cecum.

The anatomic locations recommended in order to optimize the endoscopic examination report are listed below.

Fig 10.4
Endoscopic views of different anatomic sites



The anatomic locations recommended in order to optimize the endoscopic examination report are listed below.

Image 1 The lower part of the rectum 2 cm above the anal line. This first image shows the whole of the lower rectum. Image 2 The middle part of the sigmoid. This illustrates the most common sigmoid diseases, particularly diverticulitis, while taking into account the fact that the site at which the image is taken will inevitably be fairly approximate.

Image 3 The descending colon below the splenic flexure (spleen seen by trans-illumination). This is a relatively fixed point, allowing assessment of the completeness of the examination of the descending colon as far as the splenic flexure.

Image 4 The transverse colon just after the splenic flexure. The left side of the transverse colon is seen.

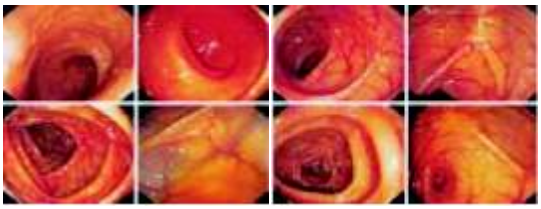
Image 5 The transverse colon before the hepatic flexure (liver seen by trans-illumination). The hepatic flexure is another reference point that is usually easily identified, confirming the examination of the colon up to this point.

Image 6 The ascending colon under the hepatic flexure. This image visualizes the ascending colon, seen with a forward view.

Image 7 The ileocecal valve. This is a fixed reference point situated on the ascending colon.

Image 8 The cecum, with visualization of the appendiceal orifice. The cecum image confirms that the examination is complete and that the portion situated below the ileocecal valve has been examined.

In upper gastrointestinal endoscopy the successive pictures taken are numbered according to the progression of the endoscope from 1 to 8: the highest number points to the most distant sector reached. The same policy is adopted for colonoscopy and the highest number also points to the most distant sector reached In this situation, the successive picture taken during the withdrawal of the endoscope will be numbered in decreasing order fro 1 to 8.

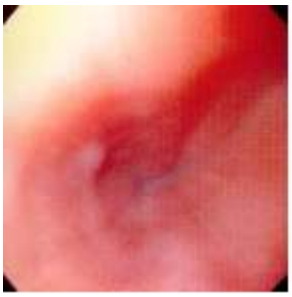


1 -- 4

5 -- 8

11 Normal Endoscopic Findings

Fig. 11.1 *Cervical Esophagus*

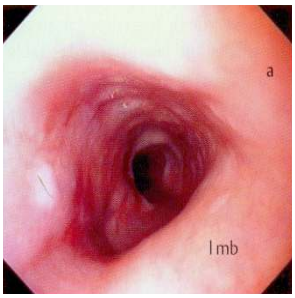


a. Without air insufflation, the cervical esophagus is collapsed

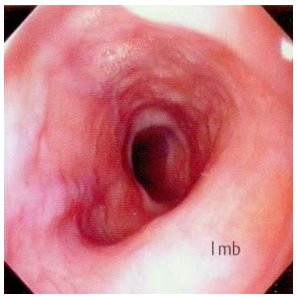
b. Slight air insufflation

c. More forceful insufflation distance the esophagus, and lumen appears round and symmetrical

Fig. 11.2 *Cervical Esophagus*



a. Level of the aortic arch. Notice that this section is still proximal to the tracheal bifuracation, and the esophagus is indented only from the side by the aortic arch. The Impression from the left main bronchus is seen distally in the esophagus image



b. Level of the left main bronchus. The esophagus is indented by the left main bronchus at this level

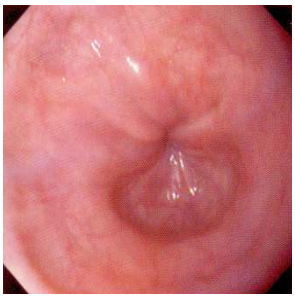
c. Below the left main bronchus. The esophagus is indented only by the spinal column. The cardiac impression is seen distally in the image

Fig. 11.3 *Distal esophagus*

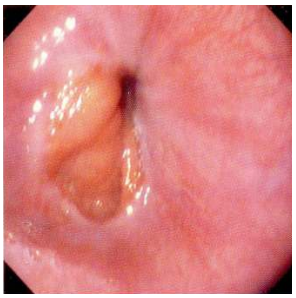
a. Views of the lower esophageal constriction

b.

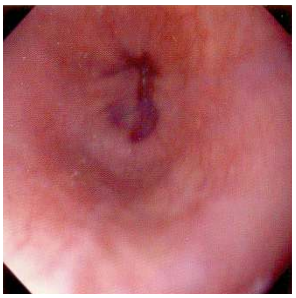
Fig. 11.4 *Gastroesophageal Junction*



a. The sphincter is closed and shows a typical rosette like appearance

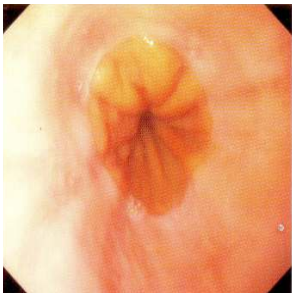


b. The sphincter is starting to open, exposing the Z-line in the lower part of the Sphincter region

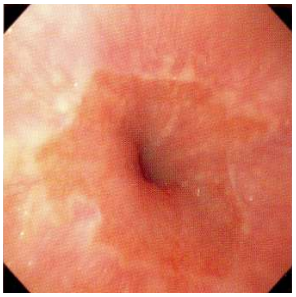


c. The sphincter is open, exposing the interior of the stomach. The areas proximal and distal to the Z-line can now be clearly evaluated

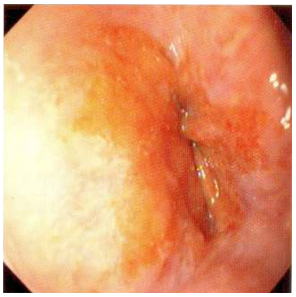
Fig. 11.5 *Shape of the Z-line*



a. Ring Shaped

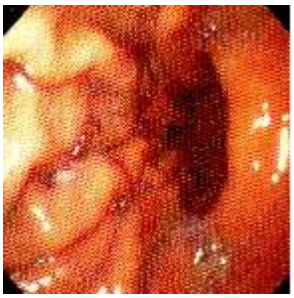


b. Jagged



c. Flame Shaped

Fig. 11.6 *Fundus-body junction and Gastric Body*

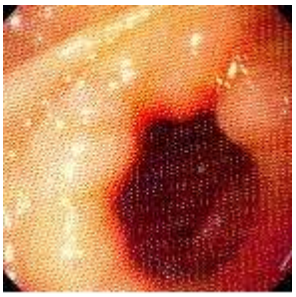


a. View of the Fundus-body junction

b. View of the Fundus-body junction

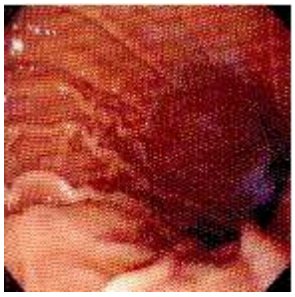
Fig. 11.7 *Pylorus*

a. View of the pylorus

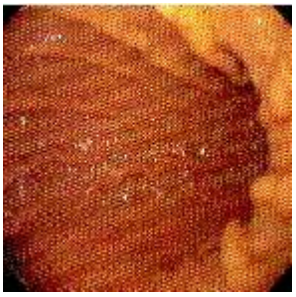


b. View of the pylorus

Fig. 11.8 *Body-Antrum Junction and Antrum*



a. Shape of the Body-antrum junction



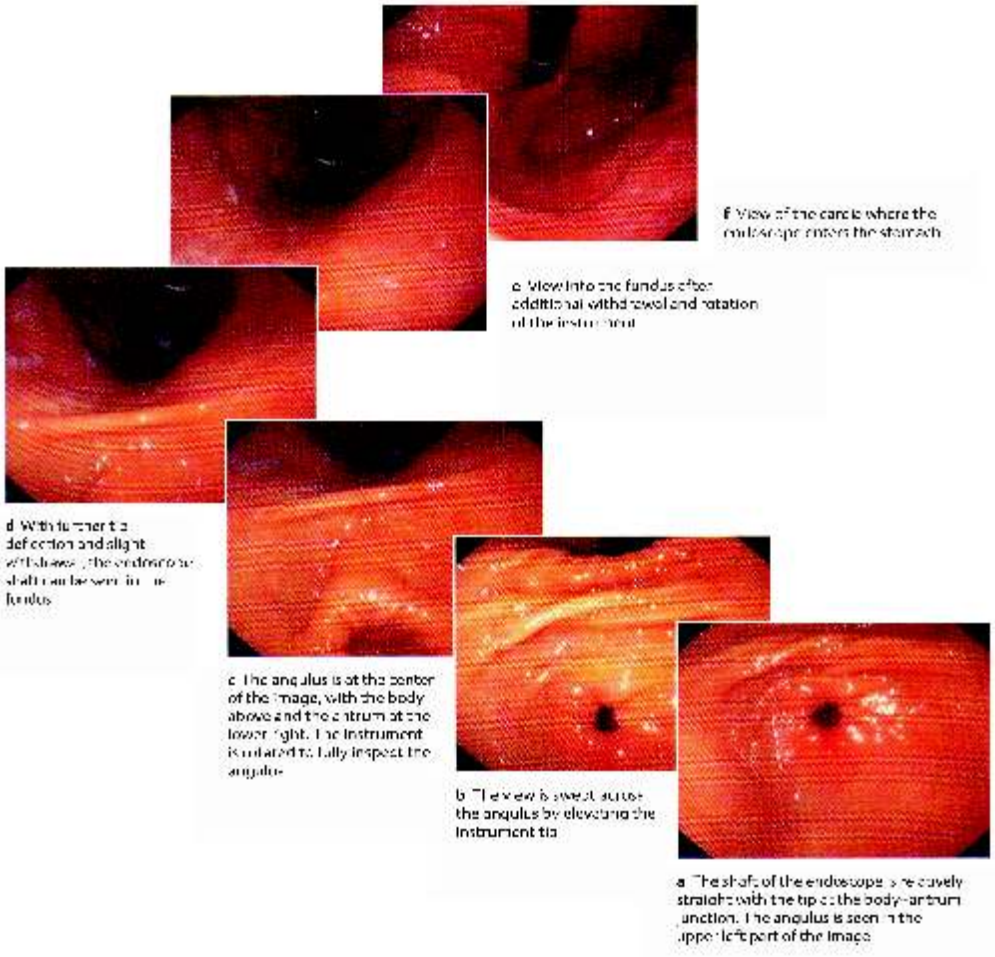
b. The angulus marks the transition to the antrum

b. The antrum is largely free to rugal folds

Fig. 11.9 *Antral Peristalsis*

a b c

Fig. 11.10 *Retroflexion across the angulus*



f View of the cardia where the endoscope enters the stomach

e View into the fundus after additional withdrawal and rotation of the instrument

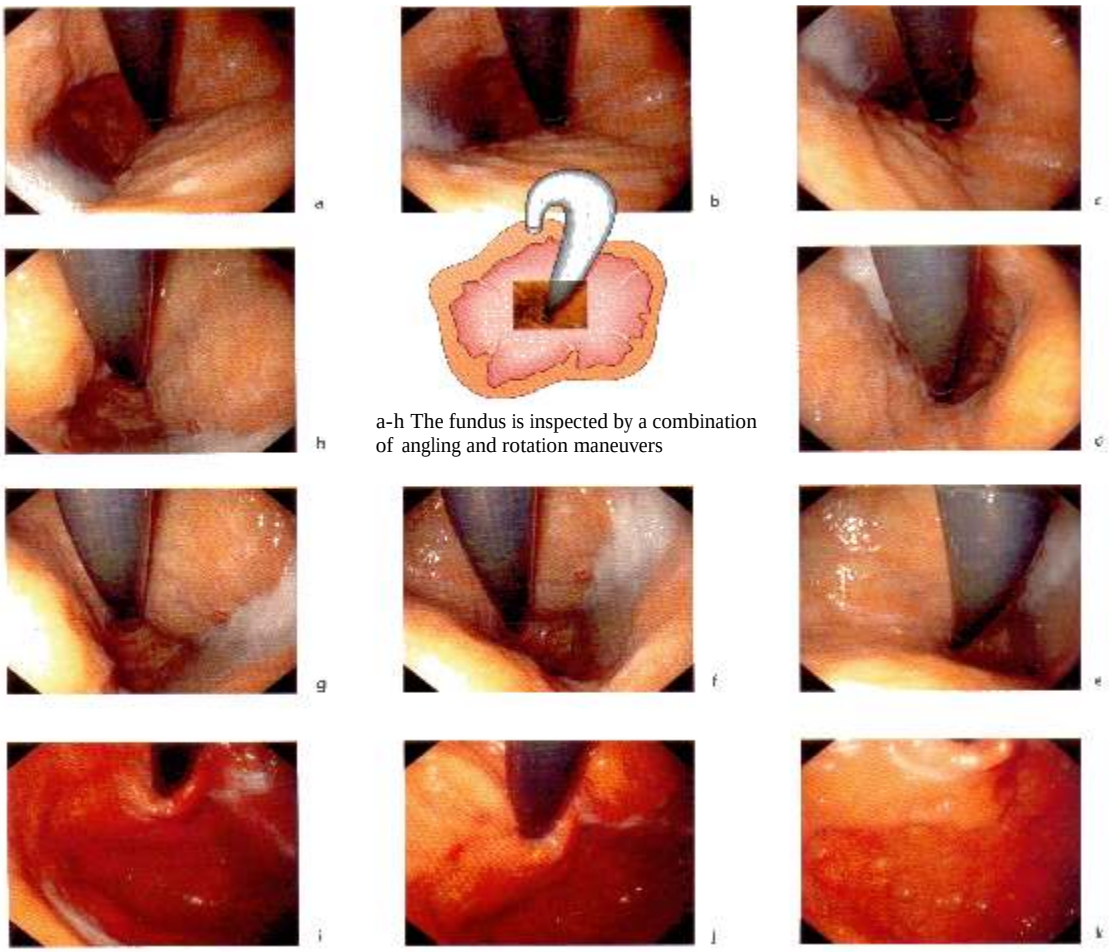
d With further deflection and slight withdrawal, the endoscope shaft can be seen in the fundus

c The angulus is at the center of the image, with the body above and the antrum at the lower right. The instrument is rotated to fully inspect the angulus

b The view is swept across the angulus by elevating the instrument tip

a The shaft of the endoscope is relatively straight with the tip at the body-antrum junction. The angulus is seen in the upper left part of the image

Fig. 11.11 *Maneuvering the endoscope*



a-h The fundus is inspected by a combination of angling and rotation maneuvers

i-k The fundus is approched by withdrawing the instrument

Fig. 11.12 *View into the duodenal bulb*

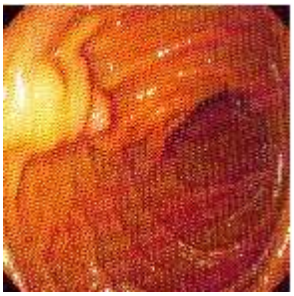
A small pool of fluid is visible at approximately the 11-o' clock position

Fig. 11.13 *Bulbar and proximal duodenum*

Anterior and posterior walls of the duodenal bulb

Entrance to the descending duodenum

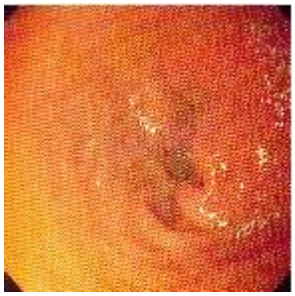
Fig. 11.14 *Descending Duodenum and Superior Duodenal Angle*



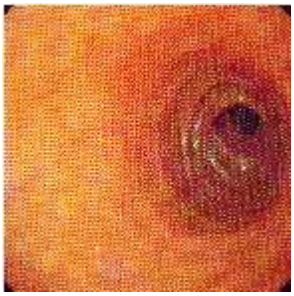
Descending duodenum

Junction of the bulbar and descending duodenum

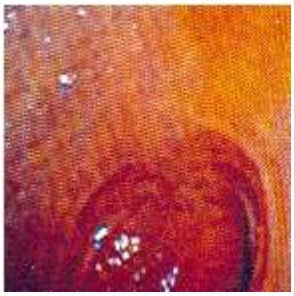
Fig. 11.15 *Duodenal Bulb*



Normal Duodenal bulb
Notice the rounded. oblong shape



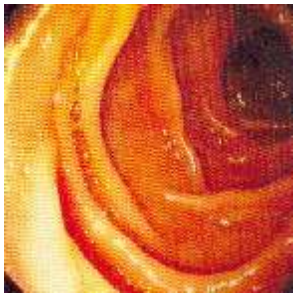
Normal Duodenal bulb
Notice the granular mucosal surface



Normal Duodenal bulb
The relatively coarse granular pattern of the mucosa is normal variant

Fig. 11.16 *Descending Duodenum*

Normal Descending Duodenum



Normal Descending Duodenum
Notice the fine granularity of the mucosal surface

Normal Descending Duodenum
Relatively coarse granular pattern of the mucosa

12 Lesion Recognition

Esophagus

Fig. 12.1 *Cardiac Incompetence*

Gaping Gastric inlet

Gastric Interior is visible

Several centimeters above the cardia

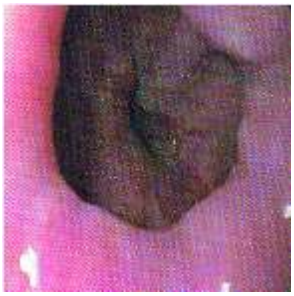


Fig. 12.2 *Hiatal Hernia, Sliding Hernia*

Double-ring configuration with an intervening, bell shaped dilatation.

The gastroesophageal boundary, Z-line is with the dilated segment, several centimeters above the esophageal hiatus.

Shortened distance between Z-line and incisor teeth.

On retroflexion, bell shaped dilatation over the cardia.

Ascent of the hernia during inspiration

Fig. 12.3 *Para-esophageal Hernia*

Visible only during retroflexion

Next to normal cardia is a second lumen with mucosal folds radiating into it.

Fig. 12.4 *Mallory Weiss Lesion*

Longitudinal blood stained or bleeding tear located at the gastroesophageal junction.

Fig. 12.5 *Reflux Esophagitis*

Involves the region from the distal esophagus to the Z line

Erythema, erosion, fibrin deposits

Ulceration

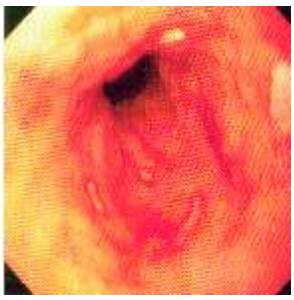


Fig. 12.6 *Barrett's Esophagus*

Reddened columnar epithelium during the full circumference of the esophagus

Squamo-columnar junction located at least 3cms above the esophageal hiatus.

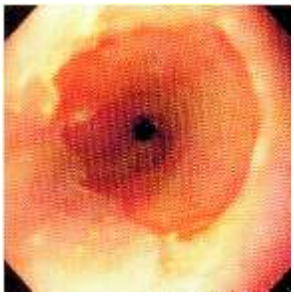


Fig. 12.7 *Peptic Stricture*

Concentric or eccentric narrowing

Surface alterations

Pseudo diverticulum proximal to the stricture

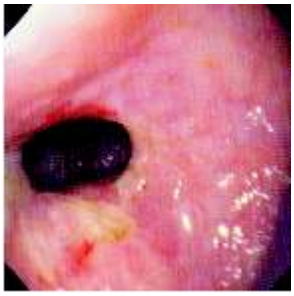


Fig. 12.8 *Candida Esophagitis*

Scattered, punctuate plaques, which

may be whitish, yellowish or cream colored

Fig. 12.9 *Herpes Simplex Esophagitis*

Vesicles

Sharply demarcated ulcers between the lesions

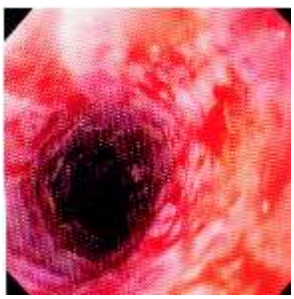


Fig. 12.10 *Chemical induced Esophagitis*

Erythema, bleeding

Psuedomembrane, ulcer

Fig. 12.11 *Grade I Esophageal Varices*

Distended veins at the level of the mucosa

Fig. 12.12 *Grade II Esophageal Varices*

Isolated straight varices that project into the lumen with no luminal narrowing

Fig. 12.13 *Grade III Esophageal Varices*

Large, tortuous varices that cause significant luminal narrowing

Fig. 12.14 *Grade IV Esophageal Varices*

Almost complete luminal obstruction

Fig. 12.15 *Achalasia*

Failure of cardia to open during prolonged observation

Fig. 12.16 *Esophageal Varices with red wale marking*

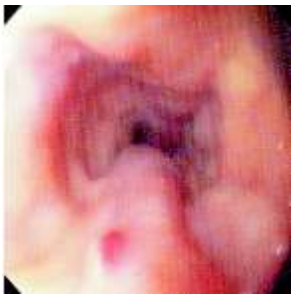


Fig. 12.17 *Esophageal Carcinoma*

Ulcerated growth at lower end of esophagus

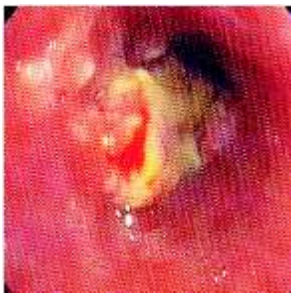


Fig. 12.18 *Esophageal Carcinoma*

Squamous cell carcinoma

Stomach

Fig. 12.19 *Chronic Gastritis*

Erythema in antrum

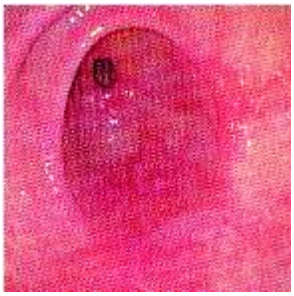


Fig. 12.20 *Fundal Varices*

Tortuous vessels seen on the retroflexion of scope

Fig. 12.21 *Gastric Polyp*

Fig. 12.22 *Gastric Ulcer*

Ulcer over lesser curvature

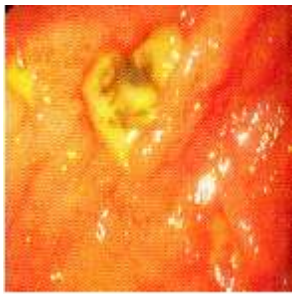
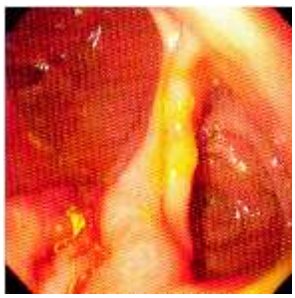


Fig. 12.23 *Anigo-dysplesia*

Fig. 12.24 *Gastric Erosions*



Gastric Lesion

Fig. 12.25 *Chronic Gastritis*

Prominent Vascular Pattern

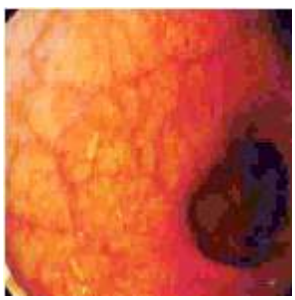


Fig. 12.26 *Gastric Ulcer*

Ulcer Located just proximal to the pylora

Fig. 12.27 *Gastric Polyp*

Polypoid was in Antrum

Fig. 12.28 *Gastric Carcinoma*

Retroflexed view showing tumor in cardiac region

Duodenal Lesion

Fig. 12.29 *Duodenal Ulcer*

Fig. 12.30 *Bulbitis*

Fig. 12.31 *Aspirin induced*

Duodenal ulcers with traces of hemotin

Fig. 12.32 *Multiple Villous adenomas in Duodenum*

Duodenal ulcers with traces of hemotin

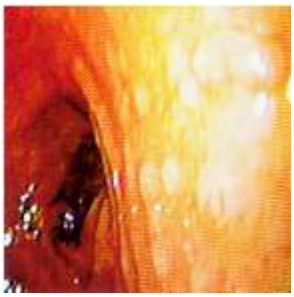


Fig. 12.33 *Necrotizing pancreatitis with marked inflammatory changes and hemorrhages in the duodenum*

Fig. 12.34 *Carcinoma of the pancreatic head infiltrating*

Colonic Lesion

Pathological Findings

Fig. 12.35

A case of antibiotic-associated colitis with multiple raised plaques (upper row) accompanied with hemorrhagic and edematous areas (lower row).

Fig. 12.36

Ceacum and Ileoceacal valve

Fig. 12.37

Colorectal Cancer

Fig. 12.38

Colorectal cancer with a flower-like appearance

Fig. 12.39

colorectal cancer with central excavation

Fig. 12.40

Multiple diverticula with luminal narrowing are seen at the left. At the right, an erythematous and swollen mucosa with narrowing of the lumen.

Fig. 12.41

Multiple diverticula with luminal narrowing are seen at the left. At the right, an erythematous and swollen mucosa with narrowing of the lumen. 2

Fig. 12.42

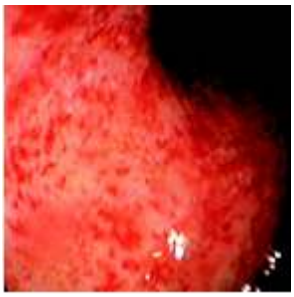
Malignant Polyp in a Patient with Ulcerative Colitis

Fig. 12.43

Rectal Polyp

Fig. 12.44

Ulcerated Colitis



Syllabus of
BASIC SKILLS IN GASTROINTESTINAL ENDOSCOPY COURSE

(Course Duration 2 Days)

Scope of Course Course Director

Module – I Endoscopy Equipment

Didactic Lecture – I

1. Fiber and Videoscope Structure
2. Operating Procedures
3. Accessories
4. Use and Maintenance

Module – II Endoscopy Unit and Staff

Didactic Lecture – II

1. Endoscopy Unit
2. Procedure Room
3. Preparation Room
4. Disinfection Room

Module – III Disinfection and Cleaning

Didactic Lecture – III

1. Disinfectants
2. Storage
3. Quality Assurance

Module – IV Preparation and Safety

1. Pre-procedural Assessment / Informed Consent
2. Sedation / Monitoring / Recovery

Module – V Antibiotics Prophylaxis

1. Antibiotics prophylactic role will be discussed in group discussion format.

Module – VI Hands on Training

Participants will be divided into three groups; two groups will be introduced with the structure of endoscope, its accessories and endoscopy room and the third group will be involved in self learning. All three groups will be rotated in each section of the *'hands on training'*

Module – VII Upper GI Endoscopy

Didactic Lecture – IV

1. Indications
2. Contraindications
3. Complications

Module – VIII Upper GI Endoscopy

Didactic Lecture – V

1. Instrument Handling
2. Passing the instrument
3. Routine Survey
4. Problems during endoscopy

Module – IX Lower GI Endoscopy (Sigmoidoscopy/Colonoscopy)

Didactic Lecture – VI

1. Indications, Limitations and Complications
2. Preparation

Module – X Lower GI Endoscopy (Sigmoidoscopy/Colonoscopy)

Didactic Lecture – VII

1. Techniques and Training

Module – XI — Hands on Training

Upper GI endoscopy room procedures — 80min

Module – XII — Hands on Training

Lower GI endoscopy room procedures

Module – XIII — Hands on Training

Self Learning using computer based videos, images from atlas and other material

Module – XIV — Documentation

1. Terminology and definitions
2. Reporting of procedure
3. Follow up

Module – XV — Evaluation

1. Self Evaluation
2. Evaluation of Program (Written, Verbal)

Consent Form

CONSENT FORM

DEPARTMENT OF ENDOSCOPY

RAWALPINDI MEDICAL COLLEGE HOLLY FAMILY HOSPITAL, RAWALPINDI

Age.....Sex..... Patient's Name.....

Name of proposed procedure or course of treatment

Upper GI Endoscopy, Sigmidoscopy, Colonoscopy, ERCP, Liver Biopsy

Statement of health professional (to be filled in by health professional with appropriate knowledge of proposed procedure, as specified in consent policy)

I have explained the procedure to the patient in particular, i have explained.

The intended benefits.....

Serious or frequently occurring risks.....

Any extra procedure which may be necessary during the procedure

Name _____

Signed_____ Date _____

مریض/مریضہ/لواحقین کی رضامندی کا فارم

میں نے ڈاکٹر کے بتائے ہوئے طریقہ علاج اور اس سے پیدا ہونے والی پیچیدگیوں کو اچھی طرح ہوش وحواس سے سمجھ لیا ہے۔ اور اسکی اجازت دیتا/دیتی ہوں۔

_____ مریض/مریضہ کا نام

_____ مریض/مریضہ کے دستخط

_____ لواحقین کے دستخط

_____ مریض/مریضہ سے رشتہ

Endoscopy Report

ENDOSCOPY REPORT

DEPARTMENT OF ENDOSCOPY
RAWALPINDI MEDICAL COLLEGE
HOLLY FAMILY HOSPITAL
RAWALPINDI

Date: **Name:** **Age:** **Gender:**

Allergies **Instrument Used:** ENDOSCOPE . CLV -160

SUGGESTION:

INDICATION & HISTORY

MEDICATIONS:

FINDINGS

Esophagus:

Stomach:

Duodenum:

IMPRESSIONS :

RECOMMENDATIONS:

BIOPSY: [Y] [N]

_____ Doctor

Sigmoidoscopy Report

SIGMOIDOSCOPY REPORT

DEPARTMENT OF ENDOSCOPY
RAWALPINDI MEDICAL COLLEGE
HOLLY FAMILY HOSPITAL
RAWALPINDI

Date: **Name:** **Age:** **Gender:**

Allergies **Instrument Used:** SIGMOIDOSCOPE

INDICATION & HISTORY:

SUGGESTION:

MEDICATIONS:

FINDINGS

P/R Examination:

Rectum:

Sigmoid Colon:

Descending Colon:

IMPRESSIONS :

RECOMMENDATIONS:

BIOPSY: [Y] [N]

_____ Doctor

Colonoscopy Report

COLONOSCOPY REPORT

DEPARTMENT OF ENDOSCOPY
RAWALPINDI MEDICAL COLLEGE
HOLLY FAMILY HOSPITAL
RAWALPINDI

Date: **Name:** **Age:** **Gender:**

Allergies **Nil** **Instrument Used:** COLONOSCOPE

Indication & History

SUGGESTION:

MEDICATIONS:

FINDINGS

P/R Examination:

Rectum:

Descending Colon:

Transverse Colon:

Ascending Colon:

Cecum:

Ileocecal Valve:

IMPRESSIONS : Normal Study

RECOMMENDATIONS: As per advice

BIOPSY: [Y] [N]

_____ Doctor

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