Principles of gastrointestinal endoscopy

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Abstract

Endoscopes, both rigid and flexible, are used in many surgical specialties. They allow for minimally invasive investigations of symptoms, diagnosis of pathology and application of directed therapies. Although the ability to see inside the human body has challenged pioneers of medical science for centuries, it is only in the last 100 years that technology has evolved to produce the advances in computers, fibreoptics and mechanics required for endoscopy.

This article provides an overview of rigid and flexible endoluminal endoscopy, focussing on the common examinations of the GI tract, namely oesophagogastroduodenoscopy (OGD), sigmoidoscopy and colonoscopy. Laparoscopy, the most common form of rigid endoscopy, is discussed elsewhere in this series.

Keywords Colonoscopy; complications; endoscopy; flexible endoscopy; history of endoscopy; oesophagogastroduodenoscopy; procedure; proctoscopy; rigid endoscopy; sigmoidoscopy

What is endoscopy?

The word 'endoscopy' comes from the Greek *Endon* = inside and *Skopeo* = to look at, therefore an endoscope is defined as an instrument that can be introduced into the body to view its internal parts. Endoscopy can be subdivided into rigid and flexible. This article discusses the basics of gastrointestinal (GI) flexible and rigid endoscopy.

A brief history of endoscopy

The first endoscope came from Bozzini, a German urologist in 1806. He used concave mirrors and candlelight to allow examination of the bladder through a hollow tube, called the 'Lichtleiter' (light conductor). Nitze later improved on Bozzini's work with the addition of an electric light. The first laparoscopy was performed in 1901 on a dog, by George Kelling who realized the importance of insufflating air into the abdomen and coined the term 'coelioscopy'. Human laparoscopy was first performed in 1910 by a Swedish surgeon called Jacobaeus. Technological advances in the post-war period of the 1950s saw the birth of fibreoptics and Hopkin's fibreoptic endoscope allowing flexible scopes suitable for use in the GI tract. Endoscopy was transformed in the 1980s by the invention of the video computer chip that enabled the image from the endoscope to be magnified and then displayed on a television screen. The advent of wireless technology revolutionized our ability to visualize the small bowel by way of capsule endoscopy, which allows 360-degree views as well as measurement of pH, temperature and pressure. Further innovations in instrumentation and technology are already being made, from high-definition and three-dimensional images, to single port access surgery and the use of robotics. Current types of endoscopy are listed in Table 1.

The flexible endoscope

Although there are many different applications for the flexible endoscope, the basic equipment is similar between all types of scopes. The main equipment includes the endoscope, stack and instrumental tools.

Endoscope:

- fibreoptic system to conduct light from a source through the scope to its tip
- chip camera positioned at tip and connector system to relay image back to screen
- plumbing systems with independent channels to allow irrigation of tip, suction and insufflation
- working channel for passage of instruments
- control body (Figure 1) that houses the outlets for the plumbing systems, ports for access to the working channel(s) and the control knobs which allow rotation of the distal tip in two planes.

Stack (Figure 2):

- light source
- insufflator system
- suction unit and water reservoir
- electrosurgical unit, including argon plasma system
- image recorder (video/digital recorder; photo-capture and printer).

Instruments/extras:

- biopsy forceps
- snares
- injecting needles
- electrosurgical probes
- dilating and stenting kits
- banding devices for variceal treatment & EMR (endoscopic mucosal resection).

Gastrointestinal flexible endoscopy

Joint Advisory Group on GI endoscopy (JAG)

"JAG" ensures the quality and safety of patient care by defining and maintaining the standards by which endoscopy is practised in the UK www.thejag.org.uk. JAG provides nationwide training for doctors and nurses through regional training and mentored assessment programmes, as well as running centralized basic and advanced skills courses. To practise independently as an endoscopist, JAG certification is needed and course attendance compulsory, although for surgical trainees this is not expected

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Types of endoscopy

Flexible endoscopy

Body system	Name of endoscopy	What is visualized/accessed
Gastrointestinal (GI) tract	Oesophagogastroduodenoscopy (OGD)	Oesophagus, stomach and duodenum
	Enteroscopy	Small intestine
	Colonoscopy	Large intestine (and terminal ileum)
	Sigmoidoscopy	Sigmoid colon, rectum
	Endoscopic ultrasound (EUS)	Upper GI tract and biliary tree
Biliary tree, hepatic ducts	Endoscopic retrograde cholangiopancreatography (ERCP)	Pancreas, common bile duct, hepatic ducts, gallbladder
	Choledocoscopy — intraoperative or peroral (Spyglass for example)	Access to bile ducts for biopsy and lithotripsy
Respiratory tract	Bronchoscopy/endobronchial ultrasound	Trachea, large and small bronchi
Ear, nose and throat	Rhinoscopy	Nose
	Laryngoscopy	Throat
Urological	Cystoscopy	Bladder, urethra
	Ureteroscopy	Ureters
Gynaecological	Hysteroscopy	Uterus
	Falloscopy	Fallopian tubes

Rigid endoscopy

Type of procedure	Speciality	Example of use
Laparoscopy	All subspecialities	Diagnostic
	Upper gastrointestinal surgery	Bariatric procedures
		Nissen fundoplication
		Cholecystectomy
		Splenectomy
	Lower gastrointestinal surgery	Appendicectomy
		Colectomy
	Gynaecology	Hysterectomy
		Salpingo-oophorectomy
		Bladder neck repair (incontinence)
Thoracoscopy	Vascular surgery	Cervical sympathectomy
	Thoracic surgery	Video-assisted thoracoscopic surgery (VATS)
Extraperitoneal laparoscopy	General surgery	Hernia repair (inguinal, femoral, obturator)
	Endocrine surgery	Thyroidectomy/parathyroidectomy
	Vascular surgery	Subfascial endoscopic perforator surgery (SEPS)
	Urology	Adrenalectomy
		Nephrectomy
		Prostatectomy
Endoluminal	Lower gastrointestinal surgery	Rigid sigmoidoscopy/proctoscopy
	Head and neck surgery	Rigid nasendoscopy/laryngoscopy/ oesophagoscopy
	Urology	Cystoscopy/ureteroscopy
		Trans-urethral resection of the prostate (TURP)
	Gynaecology	Hysteroscopy
Arthroscopy	Orthopaedic surgery	Diagnostic
		Removal of intra-articular loose bodies
		Trimming cartilage
		Anterior cruciate ligament reconstruction

Table 1