



CIRUGÍA ESPAÑOLA

www.elsevier.es/cirugia


Special article

The utility of intraoperative endoscopy in esophagogastric surgery

Rocío Pérez Quintero,^{a,*} Marcos Bruna Esteban,^b Diego Juzgado de Lucas,^c
Fernando Mingol Navarro^b

^a Unidad de Cirugía Esofagogastrica, Hospital Universitario Juan Ramón Jiménez, Huelva, Spain

^b Unidad de Cirugía Esofagogastrica y Carcinomas Peritoneal, Hospital Universitario y Politécnico La Fe, Valencia, Spain

^c Servicio de Aparato Digestivo, Hospital Universitario Quirónsalud, Pozuelo de Alarcón, Madrid, Spain

ARTICLE INFO

Article history:

Received 5 December 2022

Accepted 1 February 2023

Available online 23 April 2023

Keywords:

Flexible endoscopy
Upper gastrointestinal endoscopy
Esophagogastric surgery
Technical skill
Intraoperative endoscopy
Endoscopic training

A B S T R A C T

Flexible endoscopy (FE) plays a major role in the diagnosis and treatment of gastrointestinal disease. Although its intraoperative use has spread over the years, its use by surgeons is still limited in our setting. FE training opportunities are different among many institutions, specialties, and countries.

Intraoperative endoscopy (IOE) presents peculiarities that increase its complexity compared to standard FE. IOE has a positive impact on surgical results, due to increased safety and quality, as well as a reduction in the complications. Due to its innumerable advantages, its intraoperative use by surgeons is currently a current project in many countries and is part of the near future in others because of the creation of better structured training projects.

This manuscript reviews and updates the indications and uses of intraoperative upper gastrointestinal endoscopy in esophagogastric surgery.

© 2023 Published by Elsevier España, S.L.U. on behalf of AEC.

Utilidad de la endoscopia intraoperatoria en cirugía esofagogastrica

R E S U M E N

La endoscopia flexible (EF) es un procedimiento de gran utilidad para el manejo diagnóstico y terapéutico de lesiones del tracto digestivo superior. A pesar de que su uso intraoperatorio se ha extendido con el paso de los años, su empleo por parte de cirujanos es aún limitado en nuestro medio. Las oportunidades de capacitación en EF varían ampliamente entre instituciones, especialidades y países.

La endoscopia intraoperatoria (EIO) presenta ciertas peculiaridades que aumentan su complejidad respecto a la EF estándar. Su realización repercute positivamente en los resultados quirúrgicos aportándoles seguridad y calidad así como disminución de las complicaciones asociadas a estas técnicas. Debido a sus innumerables ventajas, su uso intraoperatorio por parte de cirujanos es actualmente un proyecto vigente en muchos países

Palabras clave:

Endoscopia flexible
Endoscopia digestiva alta
Cirugía esofagogastrica
Habilidades técnicas
Endoscopia intraoperatoria
Entrenamiento en endoscopia

* Corresponding author.

E-mail address: roc14589@hotmail.com (R.P. Quintero).

<http://dx.doi.org/10.1016/j.cireng.2023.04.009>

2173-5077/© 2023 Published by Elsevier España, S.L.U. on behalf of AEC.

y forma parte de un futuro próximo en otros, extendiéndose su uso dentro de la especialidad de Cirugía General gracias a la creación de proyectos de formación mejor estructurados.

En este manuscrito se realiza una revisión y puesta al día de las indicaciones y utilidades de la endoscopia digestiva alta intraoperatoria en la cirugía esofagogástrica.

© 2023 Publicado por Elsevier España, S.L.U. en nombre de AEC.

Introduction

Over the years, surgery has become a less invasive and safer discipline, and tools have been developed to optimize results. In this context, intraoperative flexible endoscopy (FE) is a technique that provides clear benefits when used to assist surgery.

In 1880, the Austrian surgeon Mikulicz¹ reported the use of a gastroscope to describe gastric cancer endoscopically. From these humble beginnings, flexible endoscopy has developed exponentially, and its use has spread to multiple procedures. In 2010 in Japan, peroral endoscopic myotomy (POEM) was described for the treatment of achalasia by the surgeon Haruhiro Inoue,² and today a large percentage of early gastric cancers are treated by endoscopic mucosal resection (EMR),³ endoscopic submucosal dissection (ESD) or the DEILO procedure recently described by Mochiki.⁴

Intraoperative endoscopy (IOE) may not only be very useful but essential to safely complete certain surgical procedures, even becoming an inseparable component of them. For instance, IOE can be used to establish resection limits, identify lesions that are difficult to view extraluminally, confirm the integrity of an anastomosis, or rule out intraoperative complications. The technique is currently relegated to use in certain emergency situations or for problem solving, and it is performed in most hospitals by specialized gastroenterologists.⁵

This manuscript reviews FE training in General Surgery and updates the indications and possible benefits of digestive endoscopy in esophagogastric surgery.

Intraoperative upper gastrointestinal endoscopy

Utility of IOE

The immediate availability of intraoperative endoscopy during the development of surgical procedures in the upper gastrointestinal tract contributes to improved safety by reducing operative times and potential complications associated with surgery.

A complete IOE examination includes inspection of the esophagus, stomach, and duodenum. Experts recommend a minimum exploration time of 7 min. In this regard, one study has shown that endoscopists who spent more time for IOE detected a greater number of premalignant gastric lesions (OR 2.5), cancer, and lesions with dysplasia (OR 3.42).⁶ During its intraoperative use, the technique can be more precisely directed, avoiding areas already explored in previous endos-

copies and instead focusing on the specific pathology and surgical procedure.

The advantages of and general indications for the use of IOE in esophagogastric surgery include:

- The ability to identify intraluminal anatomy and relate it to extraluminal findings during surgery.
- Adequate calibration of the organ before the excision of lesions or creation of anastomoses.
- Ability to identify lesions *in situ* and verify complete resections with safety margins, thereby avoiding unnecessarily extensive resections.
- Intraluminal evaluation of the surgical results once the procedure is finished.
- Ability to assess the anastomosis for leaks and rule out bleeding as well as possible iatrogenic injuries.

Peculiarities of IOE

To perform IOE, certain factors must be considered that differentiate it from the standard procedure.

IOE is performed on a patient under orotracheal intubation, so the degree of difficulty may be greater. Endotracheal tubes must be secured to the right side of the mouth to perform the examination, and a bite block is placed in conjunction with the airway device.⁷ The patient position will vary, and in some cases the patient will be in a supine, lateral, prone or semi-prone position, which sometimes makes access difficult. The placement of the tower and the equipment necessary to perform the endoscopy in the operating room must be adapted to the spatial arrangement, without overlooking the ergonomic needs of the specialist performing the IOE. In addition, the insufflation of excess air/CO₂ can hinder the surgical approach by distending the stomach and small intestine. In addition, the lumen of the laparoscope can sometimes hinder or reduce the quality of the endoscopic vision.

Most common scenarios for its use

Achalasia surgery

In the surgical treatment of achalasia, IOE is used to evaluate the quality and extension of the myotomy,⁸ allowing its length to be extended both cranially towards the esophagus and distally towards the stomach. It is also used to evaluate circular muscle fibers that have not been divided, which are more noticeable when the esophagus is distended and transilluminated with the endoscope (Fig. 1) (Video 1).

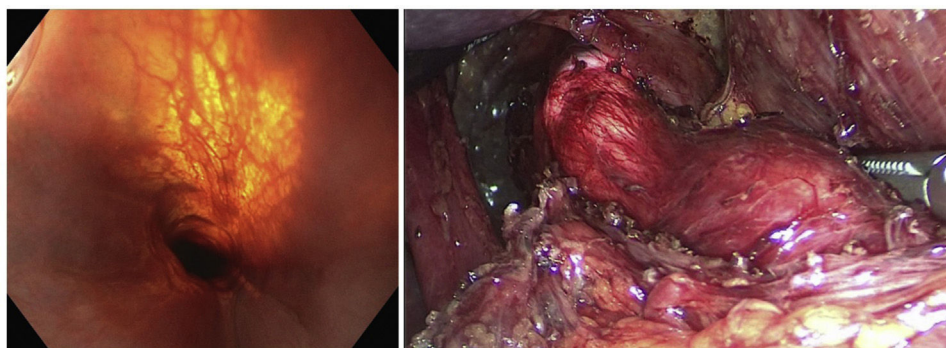


Fig. 1 – (A) Endoscopic view of the mucosa and transparency of the myotomy; (B) Laparoscopic view of the extension and quality of the myotomy.

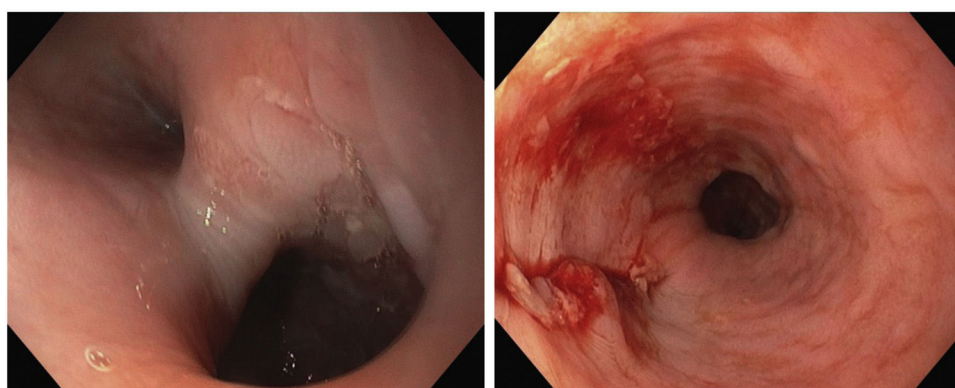


Fig. 2 – (A) Endoscopic view of the esophageal lumen and diverticular cavity; (B) Endoscopic view of the esophageal mucosa and the division line of the neck of the diverticulum.

In addition, IOE makes it possible to identify mucosal perforations that were overlooked during the performance of the myotomy⁹ so that these can be sutured. As a result, the safety of the procedure is improved.

In the same way, IOE can be used to evaluate the state of the esophagogastric junction (EGJ) before and after performing the recommended fundoplication in these patients to avoid gastroesophageal reflux, and this marks the difference in functional results compared to myotomy performed endoscopically (POEM). In comparative studies, the POEM technique and laparoscopic Heller myotomy present similar results in terms of efficacy, complications, and need for analgesia, reducing the procedure time in the case of POEM.¹⁰

In recent years, the incorporation of intraoperative manometry using the endoFLIP device makes it possible to assess the status of the myotomy and the esophagogastric junction. However, well-designed studies with a larger number of cases and evaluation of long-term results are necessary to determine its true performance.^{11,12}

Surgery for esophageal diverticula

The use of IOE during esophageal diverticula surgery is very useful to accurately diagnose the location of the diverticulum as it defines the beginning of the neck and assists in its identification by means of insufflation and transillumination

with the endoscope (Video 2). In addition to ruling out other possible lesions or associated alterations, IOE can detect food debris that may be retained in the fundus and diverticular neck, which can be cleaned out for easier diverticular neck division in tissue without debris that could interfere with stapling. In addition, it makes it possible to evaluate the complete resection of the diverticulum and verify that the esophageal lumen is not reduced after its division (Fig. 2), an important point in different types of surgeries that involve partial resections.¹³

As in achalasia surgery, IOE in these patients makes it possible to assess the extent of the myotomy up to the neck of the diverticulum and rule out possible mucosal perforations.¹⁴

In addition, endoscopy is currently used for therapeutic purposes in the management of Zenker's diverticulum, dividing the muscular septum with an endostapler¹⁵ or bipolar sealer.¹⁶ In selected cases, it has shown satisfactory results, with a symptom resolution rate close to 90%.¹⁷ POEM has also been described as a treatment for middle-third esophageal diverticula, although the publications are limited to short case series.^{18,19}

Surgery for submucosal tumors

Submucosal esophagogastric tumors are rare and represent less than 10% of all tumors located in this structure, while leiomyomas are the most frequent.²⁰



Fig. 3 – (A) Endoscopic view of a submucosal mass in the middle third of the esophagus (leiomyoma); (B) Endoscopic view of a GIST tumor located proximal to the esophagogastric union; (C) Endoscopic view of gastric adenocarcinoma located in the incisura angularis.

IOE has been used to intraoperatively identify the tumor (Fig. 3A), facilitate its enucleation, and evaluate the integrity of the mucosa after resection (Video 3).^{21,22}

Some groups describe the use and endoscopic placement of a balloon that, after endoluminal inflation, makes it easier for the tumor to protrude outwards, assisting in its safe thoracoscopic enucleation.²³

As in other types of esophageal lesions, an exclusively endoscopic approach has been described to resect the tumor by injecting a substance into the esophageal mucosa to separate the tumor from the submucosa for later excision.²⁴

In the case of GIST tumors, the intraoperative endoscopic approach is very useful to establish the exact location of the lesion (Fig. 3B). In selected cases, it can be used to perform combined transgastric or purely endoscopic resections, especially in locations that would require more aggressive surgery like the esophagogastric junction (Fig. 4A) or the antropyloric region.

Endoscopic resection (ER) includes different modalities, such as endoscopic mucosal resection (EMR), endoscopic submucosal dissection (ESD), endoscopic submucosal excavation (ESE), endoscopic full-thickness resection (EFTR), and submucosal tunneling endoscopic resection (STER).²⁵ ESD is considered an effective technique for GIST; however, for tumors originating in the deep muscularis propria, ESE and EFTR can be used.²⁶ STER is generally used to treat GIST of the cardia as it protects the integrity of the mucosa.²⁷ It is sometimes difficult to determine the limits of the tumor using laparoscopy, and in these cases a technique combining laparoscopic gastric resection with intraluminal endoscopy (laparoscopic and endoscopic cooperative surgery, or LECS) is recommended²⁸ (Fig. 4B and 4C).

Cancer surgery

IOE is very useful for identifying tumor lesions that are not palpable or visible by thoracoscopy or laparoscopy and have not been marked previously (Fig. 3C).

In the same manner, it allows specialists to evaluate the endoluminal tumor extension, guaranteeing macroscopic tumor-free proximal and distal edges. In the case of adenocarcinomas of the distal esophagus that settle on Barrett's esophagus, IOE helps identify the extension of the

metaplasia so that areas of possible involvement outside the area of surgical resection are not left unresected.

In lesions located in the mucosa without lymph node involvement and without risk factors, endoscopic resection techniques have been described and are applied with satisfactory oncological results and a low rate of complications. The most widespread is ESD, with a complete local remission rate ranging from 80% to 99%²⁹ and a disease-free survival rate ranging from 87% to 100%.³⁰ Associated complications such as bleeding, perforation (0%–2%) and stenosis are rare, and their endoscopic management is generally successful.³¹

After the resective part of this type of surgery, it is necessary to proceed with the reconstruction of the digestive tract by creating anastomoses. With the use of IOE, this type of anastomosis can be safely evaluated, ruling out the existence of a defect or detecting an air leak when introducing the endoscope and submerging the anastomosis in saline (Fig. 5). Several studies have shown that IOE reduces the risk of postoperative leaks and is considered the best test to examine the anastomosis intraoperatively.^{32–35} The use of IOE to assess the integrity of the anastomosis in colon surgery is associated with fewer complications.^{36,37}

In addition, the diameter of the anastomosis can be evaluated, ruling out possible stenosis as well as possible hemorrhagic foci along the staple line.^{34,38}

In the case of esophagectomies, IOE is also used to evaluate the mucosa of the tissue used for reconstruction, ruling out the presence of areas of ischemia or mucosal lesions, bleeding, or perforation both along the division line for the creation of the gastropasty, as well as in the pyloroplasty area if used. In addition, IOE makes it possible to rule out the presence of possible torsion of the graft caused during the pull up to the thorax or neck or kinking in redundant tissue.

Esophagogastric reflux surgery

In this type of surgery, IOE makes it possible to detect possible complications secondary to reflux or associated anatomical alterations, such as hiatal hernia.

Once the surgical dissection has been performed, the IOE allows us to verify the adequate esophageal length (ruling out

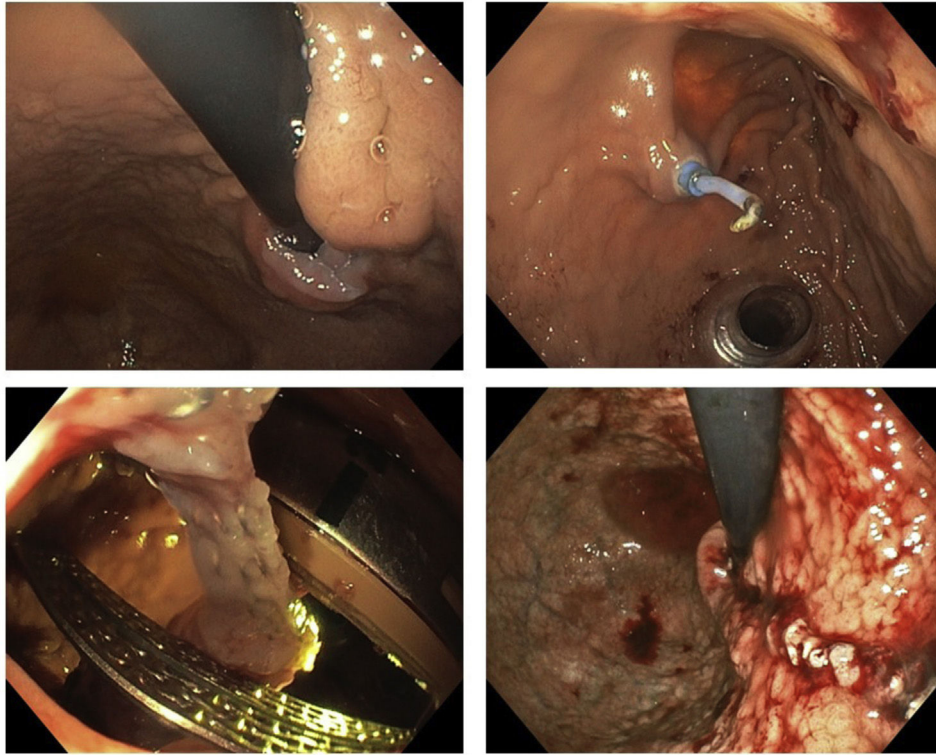


Fig. 4 – (A) Endoscopic view of a submucosal mass proximal to the esophagogastric union; (B) Endoscopic view of the gastrostomy and transgastric placement of the laparoscopy trocars; (C) Endoscopic view of the division with the endostapler; (D) Endoscopic view of the division line.

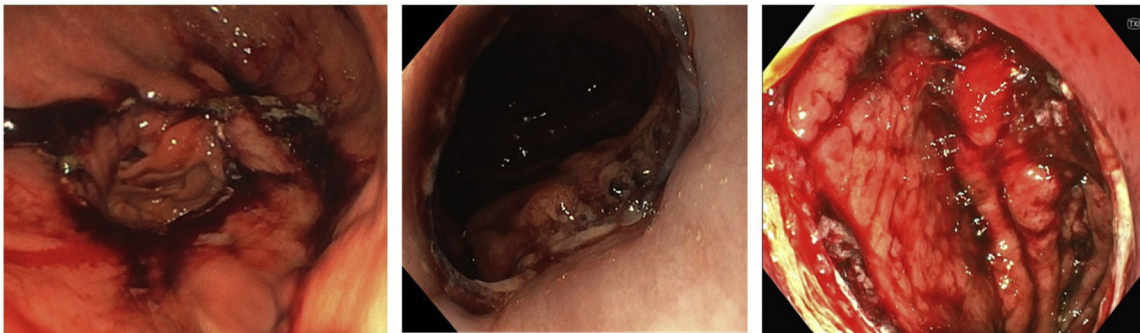


Fig. 5 – (A) Endoscopic view of a side-to-side mechanical gastrojejunal anastomosis; (B) Endoscopic view of a mechanical end-to-side esophagojejunal anastomosis with CEEA of 25 mm; (C) Endoscopic view of a mechanical end-to-side esophagogastric anastomosis with CEEA of 25 mm (in the cervical region).

a short esophagus), the presence of sufficient abdominal esophagus, and the exact location of the esophagogastric junction (by identifying the squamocolumnar junction) in order to perform the fundoplication in a correct position. Once this is completed, IOE is used to assess its competence (degree to which the fundoplication embraces the endoscope when performing retrovision) and to rule out high pressure (resistance when passing the endoscope through the esophagogastric junction), which may compromise postoperative results (Fig. 6) (Video 4).

With the intraoperative use of IOE, some series have reported corrections being made in 28% of procedures, while the type of fundoplication was changed in 2.5% to avoid stenosis or angulations.³⁹

Where IOE acquires greater importance is in revision surgery, where it is used to diagnose the problem that requires reintervention, identify the esophageal lumen by transillumination during adhesiolysis, and evaluate the quality of the new fundoplication, ruling out possible perforations or mucosal injuries.

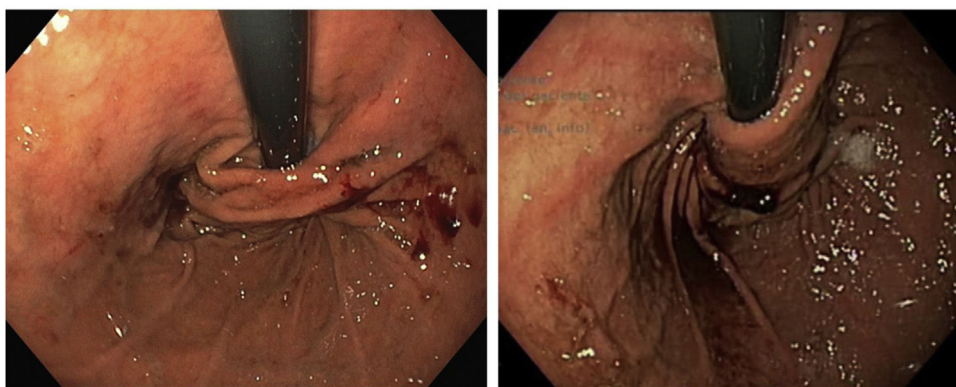


Fig. 6 – (A) Endoscopic view (in retrovision) of an anterior partial fundoplication (Dor type); (B) Endoscopic view of a total fundoplication (Floppy-Nissen type).

Surgery for caustic lesions

Esophagogastroduodenoscopy (EGD) is the best test to evaluate the mucosa of the esophagus, stomach and duodenum, and its role is crucial in the management of patients with caustic ingestion injuries. In these patients, mucosal alterations can be detected 6 h after ingestion. However, 48 h or more after ingestion, this test must be performed with caution due to the risk of perforation. The general recommendation is to perform the test early on because some 30% of patients will have no esophageal injury after caustic ingestion and can be discharged quickly.^{40,41} The test is not recommended in cases of airway obstruction or severe respiratory distress, severe lesions in the hypopharynx, perforation of the hollow viscus, or hemodynamic instability.

Despite the advantages that computed tomography (CT) scans offer in the diagnosis of possible complications and necrosis of the digestive tract,⁴² the use of IOE assists in situ evaluation of the location and severity of the lesions for decision-making regarding the extension and type of surgical resection needed.

During the follow-up of these patients, EGD can help assess the appearance of new lesions, stenosis or even neoplasms.

Endoscopic treatment of stenosis secondary to the ingestion of caustic substances is generally performed 3 weeks after ingestion and should not be delayed beyond 8 weeks, when scar tissue is fully formed and the results of endoscopic dilation are usually unsatisfactory.⁴³ Despite the wide variety of dilators, all seem to have a comparable success rate (25%–95%), depending on the severity of the stenoses,^{44,45} and a perforation rate of 0.1%–0.4%.⁴⁶

In the case of refractory strictures, other techniques have been used, such as electrocautery,⁴⁷ intralesional steroid injection,⁴⁸ mitomycin-C injection,⁴⁹ and esophageal stenting (success rate: 33%, migration rate: 40%).⁵⁰

Possible complications associated with IOE

Despite the described advantages of IOE, this procedure is not exempt from possible complications, such as bleeding, perforation, etc. To avoid them, the surgeon and operating

room staff must be adequately trained and educated in the use, care, maintenance, decontamination, and solution of possible equipment problems and commonly used tools.⁵¹

Employment, learning and accreditation

Flexible endoscopy (FE) training opportunities vary widely between institutions, specialties and countries. Although FE training is included in mandatory surgical residency training in countries such as North America, Australia and parts of Asia, surgeons in other parts of the world do not have access to FE practice during their training or later over the course of their professional career.^{52–54}

Current situation in Spain

At most hospitals in our country, FE is conducted by gastroenterologists specialized in endoscopy, and there are few medical centers where surgeons are responsible for performing this examination for diagnostic purposes.

Currently, the training programs for resident physicians in General and Digestive System surgery provide insufficient training in FE.

Due to the advantages offered by FE, access to training, accreditation and practical experience should be strongly endorsed by scientific and surgical societies. Steps toward a more uniform and appropriate training experience should include addressing current Accreditation Council for Graduate Medical Education (ACGME) policies, using available resources efficiently (including simulators), and instituting a standardized and validated training curriculum for endoscopy that incorporates the recommendations of the surgical and gastrointestinal medical societies.⁵⁵

In an attempt to expand its use and implement this technique in our operating rooms, the Spanish Association of Surgeons has designed a training program in intraoperative endoscopy for digestive surgeons. This program consists of 5 phases and was launched in December 2020. In a few years, we will be able to evaluate the results of this initiative and the degree of implementation of this procedure in our work routine.

Current situation in other countries

In Canada, endoscopic training is part of the core curriculum of general surgery residency, and general surgeons perform approximately 50% of all endoscopic procedures.⁵⁶ Despite this, in a survey conducted on endoscopy training, 47% of surgeons reported that current training in endoscopy is inadequate, and 39% of surgical residents felt unprepared to perform endoscopy due to deficient training.^{54,57}

In America, general surgeons perform both diagnostic and non-intraoperative therapeutic endoscopies. The American Board of Surgery (ABS) recognized the need to include endoscopy training in the General Surgery residency program, so in 1985 the Board recommended a minimum of 29 cases performed by residents during their training. This was later increased to 35 upper GI endoscopies (EGD) and 50 colonoscopies. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) developed the Fundamentals of Endoscopic Surgery (FES) program, which was launched in 2010 to standardize and evaluate endoscopic training.⁵⁸

In the European Union of Medical Specialists (UEMS), FE training is part of the General Surgeons's curriculum, although it is not comparable in all countries. In 2014, the Institute for Research against Digestive Cancer (IRCAD) participated in the development of a one-year university diploma program using advanced education methods to offer both surgeons and gastroenterologists high-quality training in flexible endoscopy. The curriculum combines online learning, clinical practice, and clinical follow-up.⁵⁹ In the United Kingdom, the EGD certification program is common for surgeons and gastroenterologists, which requires 200 procedures to obtain competence and before independent practice; access to certification is by through DOPS (Direct Observation of Procedural Skills).⁶⁰

In many Asian countries, training in endoscopy is part of residency training programs.⁶¹ However, there is still a lack of a standardized strategy for teaching,⁶² and general physicians perform most endoscopies.

Conclusion

IOE is a technique that provides significant advantages that improve the safety of surgical procedures in esophagogastric pathology and should be implemented by surgeons in their surgical activity.

Conflict of interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.cireng.2023.04.009>.

REFERENCES

- Smith M, Reid A, Whitehurst B, Mellinger J. The surgeon as endoscopist: a look back with a view to the future. *Tech Gastrointest Endosc.* 2018;20(4):154–7.
- Inoue H, Minami H, Kobayashi Y, Sato Y, Kaga M, Suzuki M, et al. Peroral endoscopic myotomy (POEM) for esophageal achalasia. *Endoscopy.* 2010;42(4):265–71.
- Tada M, Murakami A, Karita M, Yanai H, Okita K. Endoscopic resection of early gastric cancer. *Endoscopy.* 1993;25(7):445–50.
- Mochiki E, Yanai M, Toyomasu Y, Ogata K, Andoh H, Ohno T, et al. Clinical outcomes of double endoscopic intraluminal surgery for early gastric cancer. *Surg Endosc.* 2010;24(3):631–6.
- Noguera J, Cuadrado A, Olea J, García J, Sanfeliu G. Integración del endoscopio flexible en cirugía general. *Cir Esp.* 2012;90(9):558–63.
- Teh JL, Tan JR, Lau LJ, Saxena N, Salim A, Tay A, et al. Longer examination time improves detection of gastric cancer during diagnostic upper gastrointestinal endoscopy. *Clin Gastroenterol Hepatol.* 2015;13(3):480–7.
- Fanelli R, Fanelli S. Intraoperative endoscopy: An important skill for general surgeons. *Tech Gastrointest Endosc.* 2018;20(4):166–71.
- Fernandez A, Ruiz J, Diaz-Canell O, Martinez R, Garcet S, Pascual H, et al. Endoscopia transoperatoria en la Cirugía Laparoscópica de la Acalasia. *Rev Gastroent Perú.* 2001;21(1):31–5.
- Oliva OJ, Mata C, Chuc G, Cuevas V, Farell J, González M, et al. Puntos clave en el control endoscópico de la miotomía de Heller por vía laparoscópica. *Cir End.* 2013;14(2):73–7.
- Talukdar R, Inoue H, Nageshwar R. Efficacy of peroral endoscopic myotomy (POEM) in the treatment of achalasia: a systematic review and meta-analysis. *Surg Endosc.* 2015;29(11):3030–46.
- Holmstrom AL, Campagna RAJ, Alhalel J, Carlson DA, Pandolfino JE, Hungness ES, et al. Intraoperative FLIP distensibility during POEM varies according to achalasia subtype. *Surg Endosc.* 2021;35(6):3097–103.
- Campagna RAJ, Carlson DA, Hungness ES, Holmstrom AL, Pandolfino JE, Soper NJ, et al. Intraoperative assessment of esophageal motility using FLIP during myotomy for achalasia. *Surg Endosc.* 2020;34(6):2593–600.
- Chen IS, Tsai MS, Chen JH, Chen CY, Chen IL, Tai CM. The utility of intraoperative endoscopy to assist novice surgeons in the detection of gastric stenosis during laparoscopic sleeve gastrectomy. *BMC Surg.* 2022;22(1):323.
- Bloomston M, Brady P, Rosemurgy AS. Videoscopic Heller Myotomy with intraoperative endoscopy promotes optimal outcome. *JSLs.* 2002;6(2):133–8.
- Spiro SA, Berg HM. Applying the endoscopic stapler in excision of Zenker's diverticulum: a solution for two intraoperative problems. *Otolaryngol Head Neck Surg.* 1994;110(6):603–4.
- Bommakanti KK, Moss WJ, Weisman RA, Weissbrod PA. Zenker's diverticulotomy with bipolar tissue sealer: retrospective review of safety and short-term outcomes. *Am J Otolaryngol.* 2020;41(1):102325.
- Sharp DB, Newman JR, Magnuson JS. Endoscopic management of Zenker's diverticulum: stapler assisted versus Harmonic Ace. *Laryngoscope.* 2009;119(10):1906–12.
- Orlandini B, Barret M, Guillaumot MA, Léandri C, Leblanc S, Prat F, et al. Per-oral endoscopic myotomy for esophageal diverticula with or without esophageal motility disorders. *Clin Res Hepatol Gastroenterol.* 2020;44(1):82–9.

19. Zeng X, Bai S, Zhang Y, Ye L, Yuan X, Hu B. Peroral endoscopic myotomy for the treatment of esophageal diverticulum: an experience in China. *Surg Endosc.* 2021;35(5):1990-6.
20. Postlethwait RW. Benign tumors and cysts of the esophagus. *Surg Clin North Am.* 1983;63(4):925-31.
21. Luh SP, Hou SM, Fang CC, Chen CY. Video-thoroscopic enucleation of esophageal leiomyoma. *World J Surg Oncol.* 2012;10(52).
22. Pross M, Manger T, Wolff S, Kahl S, Lippert H. Thoracoscopic enucleation of benign tumors of the esophagus under simultaneous flexible esophagoscopy. *Surg Endosc.* 2000;14(12):1146-8.
23. Mafune K, Tanaka Y. Thoracoscopic enucleation of an esophageal leiomyoma with balloon dilator assistance. *Surg Today.* 1997;27(2):189-92.
24. Wehrmann T, Martchenko K, Nakamura M, Riphaus A, Stergiou N. Endoscopic resection of submucosal esophageal tumors: a prospective case series. *Endoscopy.* 2004;36(9):802-7.
25. Tan Y, Tan L, Lu J, Huo J, Liu D. Endoscopic resection of gastric gastrointestinal stromal tumors. *Transl Gastroenterol Hepatol.* 2017;2(115).
26. Sun M, Song J, Song X, Bingrong L. Endoscopic full-thickness resection for gastric subepithelial tumors originating from the muscularis propria: a 69-case series. *Surgical Laparosc Endosc Percutan Tech.* 2018;28(1):12-7.
27. Tan Y, Tan L, Lu J, Huo J, Liu D. Current status of submucosal tunneling endoscopic resection for gastrointestinal submucosal tumors originating from the muscularis propria layer (review). *Oncol Lett.* 2017;14(5):5085-90.
28. Tsujimoto H, Yaguchi Y, Kumano I, Takahata R, Ono S, Hase K. Successful gastric submucosal tumor resection using laparoscopic and endoscopic cooperative surgery. *World J Surg.* 2012;36(2):327-30.
29. Ell C, May A, Pech O, Gossen L, Guenter E, Behrens A, et al. Curative endoscopic resection of early esophageal adenocarcinomas (Barrett's cancer). *Gastrointest Endosc.* 2007;65(1):3-10.
30. Pech O, Behrens A, May A, Nachbar L, Gossner L, Rabenstein T, et al. Long-term results and risk factor analysis for recurrence after curative endoscopic therapy in 349 patients with high-grade intraepithelial neoplasia and mucosal adenocarcinoma in Barrett's oesophagus. *Gut.* 2008;57(9):1200-6.
31. Feczko A, Louie B. Endoscopic resection in the esophagus. *Thorac Surg Clin.* 2018;28(4):481-97.
32. Sakanoue Y, Nakao K, Shoji Y, Yanagi H, Kusunoki M, Utsunomiya J. Intraoperative colonoscopy. *Surg endosc.* 1993;7(2):84-7.
33. Lieto E, Orditura M, Castellano P, Pinto M, Zamboli A, De Vita F, et al. Endoscopic intraoperative anastomotic testing may avoid early gastrointestinal anastomotic complications. A prospective study. *J Gastrointest surg.* 2011;15(1):145-52.
34. Aly M, O'Brien JW, Clark F, Kapur S, Stearns AT, Shaikh I. Does intra-operative flexible endoscopy reduce anastomotic complications following left-sided colonic resections? A systematic review and meta-analysis. *Colorectal Dis.* 2019;21(12):1354-63.
35. Park JH, Jeong SH, Lee YJ, Kim T, Kim JM, Kim DH, et al. Safety and efficacy of post-anastomotic intraoperative endoscopy to avoid early anastomotic complications during gastrectomy for gastric cancer. *Surg Endosc.* 2020;34(12):5312-9.
36. Nachiappan S, Askari A, Currie A, Kennedy RH, Faiz O. Intraoperative assessment of colorectal anastomotic integrity: a systematic review. *Surg Endosc.* 2014;28(9):2513-30.
37. Sasaki K, Ishihara S, Nozawa H, Kawai K, Hata K, Kiyomatsu T, et al. Successful management of a positive air leak test during laparoscopic colorectal surgery. *Dig Surg.* 2018;35(3):266-70.
38. Sujatha-Bhaskar S, Jafari MD, Hanna M, Koh CY, Inaba CS, Mills SD, et al. An endoscopic mucosal grading system is predictive of leak in stapled rectal anastomoses. *Surg endosc.* 2018;32(4):1769-75.
39. Becerril G, Decanini C, Spaventa A, Farca A, Fournier F, Menéndez AL. Endoscopia transoperatoria en funduplicatura laparoscópica. *Cir Ciruj.* 2006;74:95-9.
40. Weigert A, Black A. Caustic ingestion in children. *Continuing Education in Anaesthesia Critical Care and Pain.* 2005;5(1):5-8.
41. Kluger Y, Ishay OB, Sartelli M, Katz A, Ansaloni L, Gomez CA, et al. Caustic ingestion management: world society of emergency surgery preliminary survey of expert opinion. *World J Emerg Surg.* 2015;10:48.
42. Gill M, Tee D, Chinnaratha MA. Caustic ingestion: has the role of the gastroenterologist burnt out? *Emerg Med Australas.* 2019;31(3):479-82.
43. Mechaste A, Lohsiriwat V. Role of endoscopy in caustic injury of the esophagus. *World J Gastrointest Endosc.* 2018;10(10):274-82.
44. -Tharavej C, Pungpaong SU, Chanswangphuvana P. Outcome of dilatation and predictors of failed dilatation in patients with acid-induced corrosive esophageal strictures. *Surg Endosc.* 2018;32(2):900-7.
45. Youn BJ, Kim WS, Cheon JE, Kim WY, Shin SM, Kim IO, et al. Balloon dilatation for corrosive esophageal strictures in children: radiologic and clinical outcomes. *Korean J Radiol.* 2010;11(2):203-10.
46. Scolapio JS, Pasha TM, Gostout CJ, Mahoney DW, Zinsmeister AR, Ott BJ, et al. A randomized prospective study comparing rigid to balloon dilators for benign esophageal strictures and rings. *Gastrointest Endosc.* 1999;50(1):13-7.
47. Hordijk ML, Siersema PD, Tilanus HW, Kuipers EJ. Electrocautery therapy for refractory anastomotic strictures of the esophagus. *Gastrointest Endosc.* 2006;63(1):157-63.
48. Nijhawan S, Udawat HP, Nagar P. Aggressive bougie dilatation and intralesional steroids is effective in refractory benign esophageal strictures secondary to corrosive ingestion. *Dis Esophagus.* 2016;29(8):1027-31.
49. Nagaich N, Nijhawan S, Katiyar P, Sharma R, Rathore M. Mitomycin-C: 'a ray of hope' in refractory corrosive esophageal strictures. *Dis Esophagus.* 2014;27(3):203-5.
50. Suzuki T, Siddiqui A, Taylor LJ, Cox K, Hasan RA, Laique SN, et al. Clinical outcomes, efficacy, and adverse events in patients undergoing esophageal stent placement for benign indications: a large multicenter study. *J Clin Gastroenterol.* 2016;50(5):373-8.
51. Fanelli RD. Intraoperative endoscopy: an important adjunct to gastrointestinal surgery. *Tech Gastrointest Endosc.* 2013;15(4):184-90.
52. Szold A, Kopelman D, Gefen R, Mintz Y. Flexible endoscopy in the hands of the surgeon-The Israeli surgeons point of view. *Harefuah.* 2019;158(4):248-52.
53. Tierney J, Baucom RB, Holzman MD, Poulouse BK, Pierce RA. Current trends in the practice of endoscopy among surgeons in the USA. *Surg Endosc.* 2017;31(4):1675-9.
54. Delisle M, Chernos C, Park J, Hardy K, Vergis A. Canadian general surgery residents' need formal curricula and objective performance assessments in gastrointestinal endoscopy training: a program director census. *Surg Endosc.* 2018;32(12):5012-20.
55. Bittner J, Marks J, Dunkin B, Richards W, Onders R, Millinger J. Resident training in flexible gastrointestinal endoscopy: a review of current issues and options. *J Surg Educ.* 2017;64(6):399-409.

-
56. Hilsden RJ, Tepper J, Moayyedi P, Rabeneck L. Who provides gastrointestinal endoscopy in Canada? *Can J Gastroenterol.* 2007;21(12):843-6.
 - [57] Skubleny D, Switzer N, Karmali S, Gara C. Endoscopy services and training: a national survey of general surgeons. *Can J Surg.* 2015;58(5):330-4.
 58. Winder J, Gaza R. Flexible endoscopy: surgical education. *Ann Laparosc Endosc Surg.* 2019;4:43.
 59. Mascagni P, Riva P, Guerriero L, Shlomovitz E, Dallemagne B, Marescaux J, et al. A curriculum to democratize and standardize flexible endoscopy fundamental knowledge and skills: a critical review of the first 5 years of a surgical endoscopy university diploma. *Surg Endosc.* 2021;35(6):2473-9.
 60. Martínez A, Fehervari M. Interés de la endoscopia diagnóstica intraoperatoria. En: editorial médica panamericana. Investigación e innovación en cirugía esofagogástrica. Diploma de especialización/posgrado en bases en cirugía esofagogástrica; 2022;1-10.
 61. Szold A, Kopelman D, Gefen R, Mintz Y. Flexible endoscopy in the hands of the surgeon-The Israeli Surgeons point of view. *Harefuah.* 2019;158(4):248-52.
 62. Soma T, Sakamoto Y, Matsuoka Y, Nakano T, Kamiuttanai M, Akiyama M. Short-term training of upper gastrointestinal endoscopy for resident doctors in Sotogahama Central Hospital in Aomori, Japan. *Adv Med Educ Pract.* 2013;9(4):127-31.