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LOYOLA UNIVERSITY HEALTH SYSTEM

Cutting-Edge Technologies For Gastrointestinal Therapeutic Endoscopy

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Disclosure

- I have no actual or potential conflict of interest in relation to this program/presentation.

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Learning Objectives

- Understand the growing use of endoscopy in therapeutic procedures in the GI lab.
- Understand why clinicians are moving endoscopy away from purely diagnostic use.
- Understand how our anesthetic can better help facilitate procedures such as POEMs, ESDs, and Necrosectomies.
- Understand the potential complications to monitor during these procedures.

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Growth of Nonoperating Room Anesthesia Care in the United States: A Contemporary Trends Analysis

Alexander Nagrebetsky, MD, MSc,* Rodney A. Gabriel, MD,† Richard P. Dutton, MD, MBA,§ and Richard D. Urman, MD, MBA‡

Table 2. Annual Numbers and Proportions of the Analyzed Anesthesia Cases by Subcategories

	Year									
	2010		2011		2012		2013		2014	
Location	n	%	n	%	n	%	n	%	n	%
OR	1,604,943	70.9	1,925,104	68.9	2,493,531	67.7	2,874,450	66.6	3,489,546	63.2
NORA unspecified	321,390	14.2	431,912	15.5	526,453	14.3	583,952	13.5	831,259	15.1
NORA cardiology	34,258	1.5	39,206	1.4	53,728	1.5	60,364	1.4	73,056	1.3
NORA gastroenterology	244,070	10.8	319,075	11.4	501,590	13.6	669,940	15.5	956,224	17.3
NORA radiology	32,416	1.4	40,712	1.5	53,107	1.4	62,238	1.4	95,003	1.7
Total	2,265,114		2,794,288		3,685,474		4,313,836		5,519,610	

NACOR- National Anesthesia Clinical Outcomes Registry as a retrospective analysis of NORA volume via the Anesthesia Quality Institute (AQI)

Interventional Gastroenterology is a rapidly expanding field at the cutting edge of innovation and novelty.

Growth of Nonoperating Room Anesthesia Care in the United States: A Contemporary Trends Analysis. Nagrebetsky, Alexander MD, MSc; Gabriel, Rodney A. MD; Dutton, Richard P. MD, MBA; Urman, Richard D. MD, MBA. Anesth Analg. 2017 Apr;124(4):1261-1267.

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Current Trends

- The global endoscopy devices market size is expected to reach $81 billion by 2030, according to a new report by Grand View Research, Inc.
- The market is expected to expand at a compounded annual growth rate (CAGR) of 7.4% from 2022 to 2030.
- Minimally invasive endoscopic procedures for the esophagus, colon, and stomach are some of the factors boosting the market growth.
- The fastest growing regional market is North America
  - Burden of cancer
  - Increasing favorable reimbursement
  - Growing obese population
  - Hospital buy in from leadership
- With the aging of the population, more attention will be directed toward therapeutic endoscopy for elderly patients, because it is less invasive.

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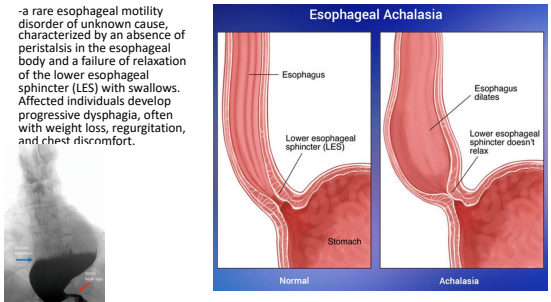
Achalasia

-a rare esophageal motility disorder of unknown cause, characterized by an absence of peristalsis in the esophageal body and a failure of relaxation of the lower esophageal sphincter (LES) with swallows. Affected individuals develop progressive dysphagia, often with weight loss, regurgitation, and chest discomfort.



Vaezi MF, Pandolfino JE, Vela MF. ACG clinical guideline: diagnosis and management of achalasia. Am J Gastroenterol 2013;108:1238-49.
Goldblum JR, Whyte RI, Orringer MB, et al. Achalasia. A morphologic study of 42 resected specimens. Am J Surg Pathol 1994;18:327-37.

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Peroral Endoscopic Myotomy (POEM)

- Traditionally, laparoscopic Heller myotomy (LHM) and pneumatic dilation (PD) were the two main modalities for the treatment of symptomatic achalasia patients.
- With the advent of third space endoscopy, per-oral endoscopic myotomy (POEM) was introduced (2008) a decade ago as an alternate minimally invasive approach for these patients. (90-100% effective)

Pasricha PJ, Hawari R, Ahmed I, et al. Submucosal endoscopic esophageal myotomy: a novel experimental approach for the treatment of achalasia. Endoscopy 2007;39:761-4.
Inoue H, Minami H, Kobayashi Y, et al. Peroral endoscopic myotomy (POEM) for esophageal achalasia. Endoscopy 2010;42:265-71.

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Treatment Of Achalasia

- POEM has been endorsed by the American Gastroenterological Association as a primary treatment option for achalasia types I and II and as the preferred therapy for patients with achalasia type III.
- Treatment of achalasia is aimed at lowering the resting pressure of the LES
- GOAL→improve food passage to the stomach and to prevent severe complications such as a megaesophagus.

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Anesthesia Preassessment

- No specific guidance or recommendations for anesthesia providers.
- Performed under GETA exclusively.
- Barium swallow, esophageal manometry and EGD to confirm/rule out other conditions (e.g., cancer).
- Workup can include an EKG (chest pain), and chest imaging (decreased respiratory function/chronic aspiration).

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Prevention Of Aspiration

- A liquid diet for at least 24h prior to POEM is required. A clear liquid diet of longer duration (i.e. 3–5 days) preferred. NPO for at least 12 hours.
- Perioperative PPI medications.
- RSI recommended to minimize regurgitation from the esophagus into the oropharynx.

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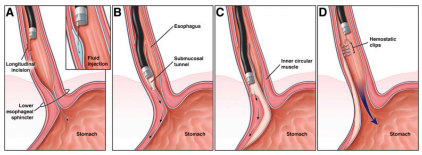
Intra-procedure



The four steps of PerOral Endoscopic Myotomy (POEM): mucosal incision and tunnel entry (A), submucosal tunneling (B), myotomy (C), and closure of mucosal entry (D).

https://www.gastrojournal.org/article/S0016-5085(19)41309-7/fulltext

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Anesthesia Considerations

- ASA standard monitors with +/- arterial line.
- Positioned in a supine or semi-left lateral decubitus position leaving the upper abdomen exposed (tension capnoperitoneum).
- Propofol, sustained neuromuscular blockade and inhalation/TIVA have been widely utilized.
- Scopolamine was used to inhibit abnormal spastic contraction of the esophagus.
- Emergency equipment, advanced care teams and ICU teams should be available.

Tanaka E, Murata H, Minami H, Sumikawa K. Anesthetic management of peroral endoscopic myotomy for esophageal achalasia: a retrospective case series. J Anesth. 2014;28:456–459.

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Complications During POEM

TABLE 4. Anesthesia and Surgery Related Events in 220 Patients During Peroral Endoscopic Myotomy

	n (%)
Preoperative	
Difficult intubation	1 (0.5)
Food retention	2 (0.9)
Vomiting	11 (5)
Aspiration	4 (1.8)
Aspiration pneumonia	1 (0.5)
Intraoperative	
Self-limited cervical emphysema	48 (21.8)
Tense capnoperitoneum (requiring evacuation)	66 (30)
Mucosal injury	1 (0.5)
Mucosal perforation	2 (0.9)
Hemorrhage	3 (1.4)
Ventilation difficulty, desaturation	1 (0.5)
Pneumothorax	1 (0.5)
Postoperative	
Bronchospasm (SpO_2 <90)	5 (2.2)
Reintubation	1 (0.5)
Nausea/vomiting	10 (4.5)
Additional analgesia requirements	58 (26)
With paracentesis	12 (18.2)
Without paracentesis	46 (29.9)

Rare tracheomalacia can occur, resulting from chronic pressure due to massive esophageal dilation.

Large quantities of CO2 are absorbed during POEM, which can in turn induce hypercapnia and acidosis.

The upper abdomen should be closely monitored for clinical signs such as abdominal distension, tympanic percussion sound, as well as subcutaneous emphysema.

Löser, Benjamin MD[a]; Recio Arias, Olga[a]; Saugel, Bernd MD[b]; Reuter, Daniel A. MD[a]; Zöllner, Christian MD[a]; Werner, Yuki B. MD[a]; Rösch, Thomas MD[a]; Petzoldt, Martin MD[a] Anesthesia for Patients Undergoing Peroral Endoscopic Myotomy Procedures: A Review of the Literature, Anesthesia & Analgesia: May 2020 - Volume 130 - Issue 5 - p 1331-1340 doi: 10.1213/ANE.0000000000004420

Turkish and Asian Surg Laparosc Endosc Percutan Tech. Volume 31, Number 6, December 2021 [Turkey]

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Endoscopic submucosal dissection (ESD)

- Endoscopic mucosal resection (EMR) consists of three steps: marking, lifting, and cutting. (reoccurrence)
- Endoscopic submucosal dissection (ESD) is a well-established treatment for early-stage malignant lesions of the stomach, esophagus, and colorectum with no risk of lymphatic metastasis.
- Developed for en bloc removal of large (usually more than 2 cm), flat GI tract/colorectal lesions.
- Alternative to surgery for lesions with superficially invasive cancer.

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ESD Technique

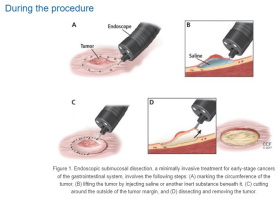

Figure 1. Endoscopic submucosal dissection, a minimally invasive treatment for early-stage cancers of the gastrointestinal system, involves the following steps: (A) marking the circumference of the tumor. (B) lifting the tumor by injecting saline or another inert substance beneath it. (C) cutting around the outside of the tumor margin, and (D) dissecting and removing the tumor.

Colorectal endoscopic submucosal dissection (ESD) Lorenzo Fuccio and Thierry Ponchon
Best Practice & Research: Clinical Gastroenterology, 2017-08-01, Volume 31, Issue 4, Pages 473-480 2017.
https://www.first-coastandclinic.org/a-minimally-invasive-treatment-for-early-gi-cancers/

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Challenges For The Technique

- ESD is a very challenging and risky procedure, and the most serious complications are perforation (5-10%) and bleeding (2-5%).
- Risk factors for ESD-related perforations have been identified, such as location in the colon, tumor size, the presence of submucosal fibrosis and also the endoscopists' expertise.

Colorectal endoscopic submucosal dissection (ESD) Lorenzo Fuccio and Thierry Ponchon
Best Practice & Research: Clinical Gastroenterology, 2017-08-01, Volume 31, Issue 4, Pages 473-480 2017.

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Choice Of Anesthesia

- Reducing the procedure time, aspiration risk and cost are the current major challenges in certain types of ESD procedures.
- Thickness of the dilated esophageal wall during insufflation is only 3 to 4 mm. (Upper vs Lower)
- The advantages of MAC vs CS are clearly established: fewer movements of the patient during ESD and faster recovery after the procedure because of the short half-life of propofol
- However, there is no consensus in the literature regarding the technique of anesthesia/sedation method for ESD procedures.

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CS vs General Anesthesia

Comparison of general anesthesia and conscious sedation in procedure-related complications during esophageal endoscopic submucosal dissection

Seung Hyun Kim[1] · Yong Seon Choi[2] · Sang Kil Lee[3] · Hanseul Oh[1] · Seung Ho Choi[2]

Received: 21 December 2019 / Accepted: 20 May 2020 / Published online: 26 May 2020

Table 3 Comparison of complications between conscious sedation group and general anesthesia group

	Conscious sedation group ($N = 83$)	General anesthesia group ($N = 75$)	p value
Acute complications, n (%)	8 (9.6)	0 (0.0)	0.007
Frank perforation	4 (4.8)	0 (0.0)	0.122
Bleeding requiring VDA	1 (1.2)	0 (0.0)	> 0.999
Cardiopulmonary adverse events	3 (3.6)	0 (0.0)	0.247
ESD failure, n (%),	4 (4.8)	0 (0.0)	0.122
Aspiration pneumonia, n (%)	7 (8.4)	0 (0.0)	0.014
Microperforation, n (%)	3 (3.6)	6 (8.0)	0.310
Hemoclip use during the procedure, n (%)	15 (18.1)	15 (20.0)	0.758
Hospital stay after the ESD, n (%)	3.9 ± 3.5	3.3 ± 1.8	0.170
Stricture requiring stent insertion, n (%)	6 (7.2)	13 (17.3)	0.051

Data were presented as mean ± SD for continuous variables and count (percentage) for categorical variables
ESD endoscopic submucosal resection, *VDA* vigorous diagnostic approach

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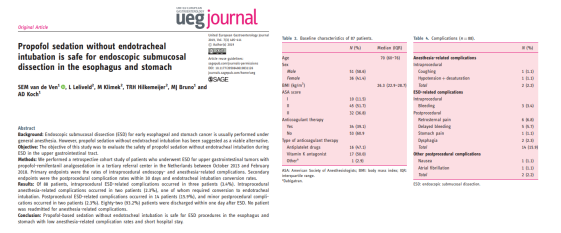
MAC vs General Anesthesia



Propofol sedation without endotracheal intubation is safe for endoscopic submucosal dissection in the esophagus and stomach

SEM van de Ven[1], L Lelivelt[2], M Klimek[2], TRH Hilkmeijer[2], MJ Bruno[2] and AD Koch[2]

Abstract

Background: Endoscopic submucosal dissection (ESD) for early esophageal and stomach cancer is usually performed under general anesthesia. However, propofol sedation without endotracheal intubation has been suggested as a viable alternative.

Objective: The objective of this study was to evaluate the safety of propofol sedation without endotracheal intubation during ESD in the upper gastrointestinal tract.

Methods: We performed a retrospective cohort study of patients who underwent ESD for upper gastrointestinal tumors with propofol-remifentanil analgesedation in a tertiary referral center in the Netherlands between October 2015 and February 2020. Patient characteristics, procedural details, and postprocedural outcomes were collected. Primary and secondary outcomes were the postprocedural complication rates within 30 days and endotracheal intubation conversion rates.

Results: Of 88 patients, intraprocedural ESD-related complications occurred in three patients (3.4%). Intraprocedural anesthesia-related complications occurred in two patients (2.3%), one of whom required conversion to endotracheal intubation. Postprocedural ESD-related complications occurred in 24 patients (15.9%), and minor postprocedural complications occurred in two patients (2.3%). Eighty-two (93.2%) patients were discharged within one day after ESD. No patient was readmitted for anesthesia related complications.

Conclusion: Propofol-based sedation without endotracheal intubation is safe for ESD procedures in the esophagus and stomach with low anesthesia-related complication rates and short hospital stay.

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MAC vs General Anesthesia

Propofol-Based Sedation Versus General Anesthesia for Endoscopic Submucosal Dissection

Derya Arslan Yurtlu, MD, Fatih Aslan, MD, Pinar Ayvat, MD, Yasemin Isik, MD, Nesli Karakas, MD, Bellis Ünsal, MD, and Mehmet Kiziltepe, MD

- The research demonstrated that the size of dissection per unit time was higher in group G compared with group S.
- Reported fewer anesthesia-related complications in patients receiving general anesthesia during ESD.
- Yurtlu et al., cough was observed more frequently during ESD in patients receiving propofol compared with general anesthesia (50% vs 5.4%).
- Likewise, desaturation occurred more often in the propofol sedation group (18.5% vs 2.7%).
- General anesthesia group reported no hypotension, desaturation or aspiration.

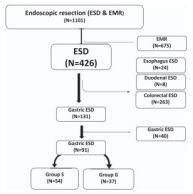

FIGURE 1. Flow chart showing the distribution of cases, which are applied with endoscopic submucosal dissection (ESD) and endoscopic mucosal resection (EMR), according to localization.

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MAC vs General Anesthesia

- Center experience, anesthesia provider comfort and endoscopist skill level predicate the eventual decision.
- Communication and upfront discussions are paramount to facilitating safe patient centered delivery of anesthesia.
- GA may prevent an increase in procedure time due to frequent breaks caused by gag reflex, cough, mobilization, and oropharyngeal suctioning needs of the patient, and thus reduce and minimize patient movement leading to the reduction of dissection time and intraprocedural complications.

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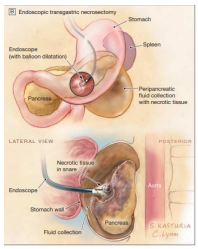
Acute Pancreatitis

- -is responsible for over 270,000 admissions annually. Approximately 20% of cases are complicated by pancreatic necrosis, and 30% of these become infected.
- Infected necrosis and associated systemic illness have a mortality rate approaching 100% without procedural intervention.
- Endoscopic necrosectomy is effective in the treatment of walled-off necrosis (WON), and is preferred to surgical approaches, however complication and mortality rates remain high with few centers regularly employing the technique.



Bakker OJ, et al. Dutch Pancreatitis Study Group. Endoscopic transgastric vs surgical necrosectomy for infected necrotizing pancreatitis: a randomized trial. JAMA. 2012 Mar 14;307(10):1053-61.

Peery AF, Dellon ES, Lund J, et al. Burden of gastrointestinal disease in the United States: 2012 update. Gastroenterology. 2012 Nov;143(5):1179-87. Beger HG, Rau B, Mayer J, et al. Natural course of acute pancreatitis. World J Surg. 1997;21:130-5. Banks PA, Freeman ML. Practice guidelines in acute pancreatitis. Am J Gastroenterol. 2006;101:2379–400.

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Endoscopic Necrosectomy

- Diseases of the pancreas, such as pancreatic lesions and pancreatitis, have traditionally been considered surgical diseases.
- Endoscopic drainage of pancreatic fluid collections with necrosectomy has become widely accepted as the superior first-line therapy.
- Potentially reduces the proinflammatory response and risk of procedure-related complications such as multiple organ failure in these already ill patients.

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Endoscopic Transgastric VS Surgical Necrosectomy

Endoscopic Transgastric vs Surgical Necrosectomy for Infected Necrotizing Pancreatitis

A Randomized Trial

Bakker OJ, et al. Dutch Pancreatitis Study Group. Endoscopic transgastric vs surgical necrosectomy for infected necrotizing pancreatitis: a randomized trial. JAMA. 2012 Mar 14;307(10):1053-61.

The JAMA Network

Table 2. Clinical End Points[a]

	Surgical Necrosectomy (n = 11)	Endoscopic Transgastric Necrosectomy (n = 10)	Risk Difference (95% CI)	P Value
Major complications or death, No. (%)[b]	8 (80)	2 (20)	0.60 (0.16 to 0.80)	.03
Death, No. (%)	4 (40)	1 (10)	0.30 (–0.08 to 0.60)	.30
Major complications, No. (%)				
New-onset multiple organ failure[c]	5 (50)	0 (0)	0.50 (0.12 to 0.78)	.03
Intra-abdominal bleeding requiring intervention	0 (0)	0 (0)		
Enterocutaneous fistula or perforation of a visceral organ requiring intervention	2 (20)	0 (0)	0.20 (–0.11 to 0.51)	.47
Pancreatic fistula	7 (70)	1 (10)	0.60 (0.17 to 0.81)	.02
Long-term complications, No. (%)[d]	(n = 6)	(n = 9)		
New-onset diabetes	3 (50)	2 (22)	0.28 (–0.17 to 0.63)	.33
Use of pancreatic enzymes	3 (50)	0 (0)	0.50 (0.07 to 0.81)	.04
Persisting fluid collections[e]	3 (50)	2 (22)	0.28 (–0.17 to 0.63)	.33
Health care utilization, No.	(n = 10)	(n = 10)		
No. of necrosectomies, endoscopic or surgical	1 (1 to 2)	3 (2 to 6)		.007
New ICU admission anytime after randomization, No. (%)	5 (50)	1 (10)	0.4 (–0.002 to 0.68)	.14
Days in hospital after randomization[f]	36 (17 to 74)	45 (12 to 69)		.91

[a] Continuous data are median and interquartile ranges.
[b] Multiple events in the same patient were considered as 1 end point.
[c] Only for patients without multiple organ failure at any time in the 24 hours before first intervention.
[d] Surviving patients were assessed 6 months after discharge from the index admission (readmission within 10 days was considered the same admission).
[e] Persisting fluid collections as seen on computed tomographic scans.
[f] Surviving patients only.

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Patient Selection

- Appropriate patient selection is crucial:
  1. Duration of fluid collection greater than four weeks
  2. Well-formed wall surrounding the collection
  3. WOPN accessible endoscopically
  4. Located within 1cm of the gastric wall
- Contraindications include:
  1. Presence of coagulopathy that cannot be corrected
  2. Endoscopically inaccessible sites
  3. Sterile necrosis
  4. Predominantly solid necrosis with minimal liquefaction.

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MAC vs General Anesthesia

- Extremely limited to no guidance resulting from literature searches.
- Ultrasound-guided drainage of small pancreatic cysts, including pseudocysts, may be performed under MAC.
- Large burden and necrosis which contain a large volume of fluid that will be released into the GI lumen would benefit from GETA thereby decreasing the risk of pulmonary aspiration.

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Summary

- The gastrointestinal endoscopy paradigm is rapidly changing, and technological advancements are largely responsible.
- We as anesthesia providers are expected to support the ever expanding needs and demands.
- The cases and challenges provided are becoming challenging. Complications are inevitable due to the complexity of the procedures seen.
- It is crucial for the anesthesia provider to have a good understanding of the techniques employed by the endoscopist in order to anticipate and appropriately manage many of the complications.
- Advanced GI endoscopic procedures continue to evolve and will continue to pose many unique challenges to the anesthesia provider.
- Communication is an essential tool in anticipating the difficult outcomes.
- Many mucosal and submucosal lesions that used to mandate surgical resection can now be resected using endoscopic techniques.

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