Minimally invasive surgery for gastric cancer-what does the data say?

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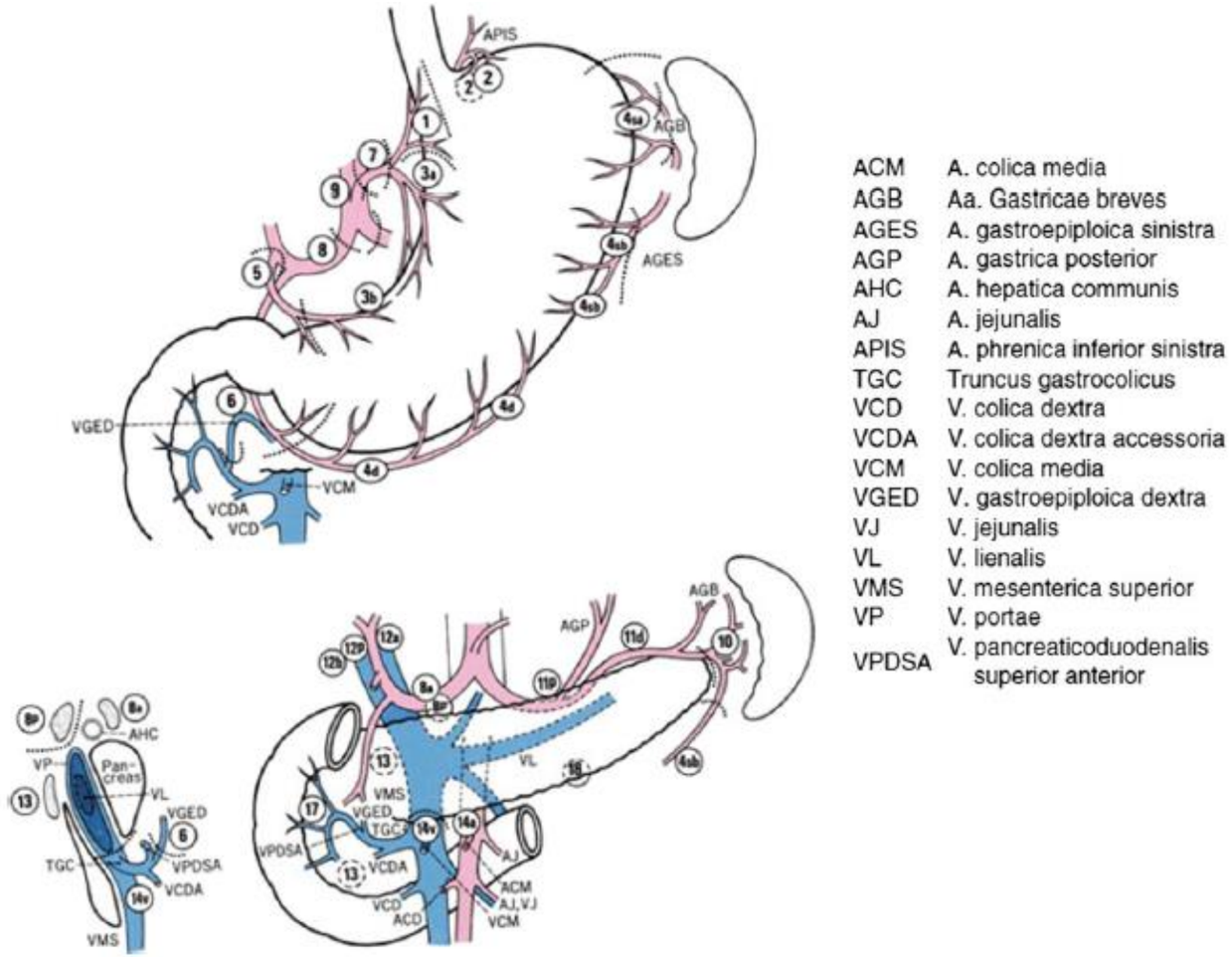
Keyhole surgery

"We've not met, but I'm your keyhole surgeon."

Goals of surgical resection for gastric cancer

- Remove all disease with negative histologic margins (R0) with minimal morbidity and mortality
- Perform appropriate lymphadenectomy
- Restore GI tract continuity that maximizes recovery and quality of life

Lymph node stations as determined by the Japanese classification of gastric carcinoma



ACM	A. colica media
AGB	Aa. Gastricae breves
AGES	A. gastroepiploica sinistra
AGP	A. gastrica posterior
AHC	A. hepatica communis
AJ	A. jejunalis
APIS	A. phrenica inferior sinistra
TGC	Truncus gastrocolicus
VCD	V. colica dextra
VCDA	V. colica dextra accessoria
VCM	V. colica media
VGED	V. gastroepiploica dextra
VJ	V. jejunalis
VL	V. lienalis
VMS	V. mesenterica superior
VP	V. portae
VPDSA	V. pancreaticoduodenalis superior anterior

For distal gastrectomy with D2, the lymph nodes stations to be dissected are stations No.1, 3, 4sb, 4d, 5, 6, 7, 8a, 9, 11p, and 12a.

Top 10 countries for cases of gastric cancer (2022)

ank	Country	New cases	ASR/100,000
	World	968,784	9.2
1	China	358,672	13.7
2	Japan	126,724	27.6
3	India	64,611	4.5
4	Russia	38,883	13.7
5	South Korea	29,267	27.0
6	US	25,554	4.1
7	Brazil	23,021	7.6
8	Iran	17,191	19.4
9	Vietnam	16,277	13.4
10	Germany	14,088	6.4

5th most common cancer worldwide, 4th most common COD

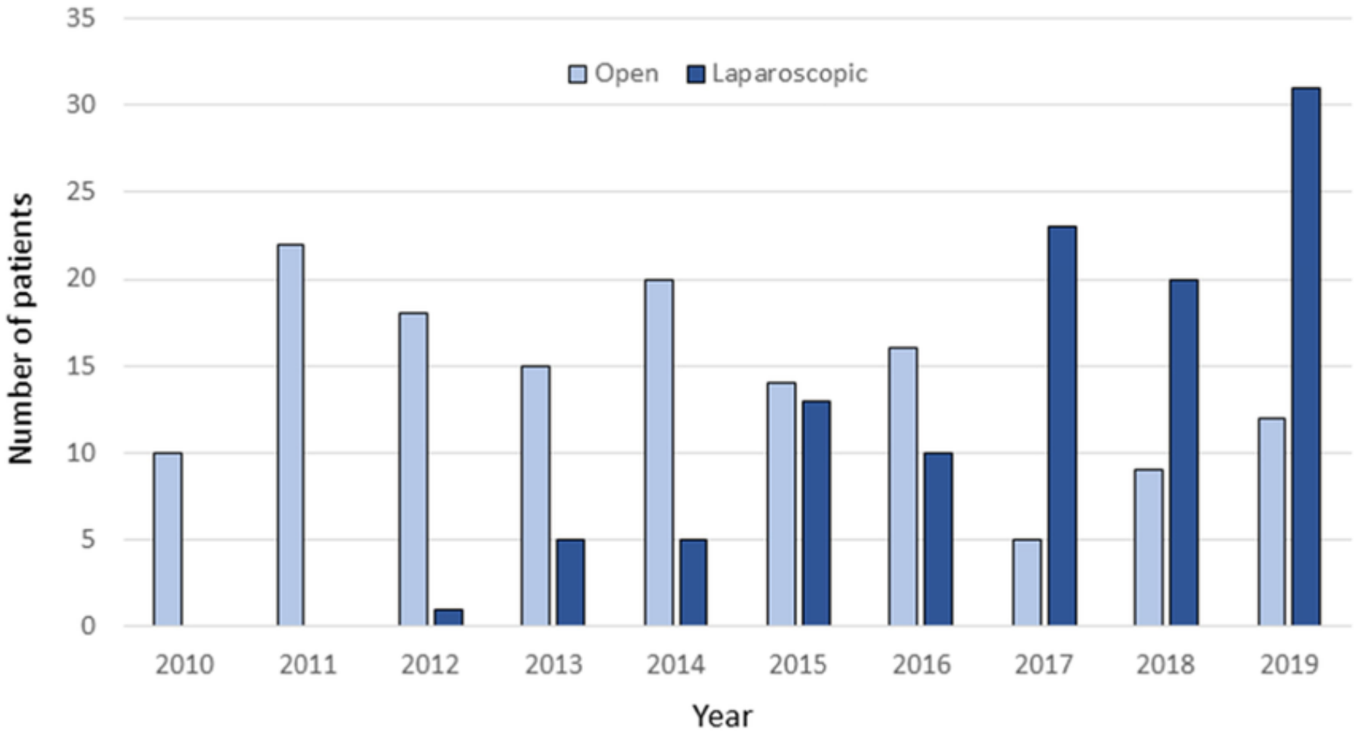
How much minimally invasive gastric surgery for cancer is being done? Asia

- Laparoscopic surgery for gastric cancer has evolved rapidly over the last two decades in the East and more slowly in the West
- Increase in early stage cancer in Asia and less obesity
- The KGCA and CSCO recommend laparoscopic surgery for all cases of EGC and AGC, except for T4b and bulky LN tumors
- These recommendations are supported by evidence from large-scale prospective RCTs, such as KLASS-01, COACT 0301, and JCOG0912
- Japan still recommends laparoscopic surgery for EGC, although their published trial in AGC showed no difference

Yang HK, Suh YS, Lee HJ. Minimally invasive approaches for gastric cancer-Korean experience. J Surg Oncol. 2013;107:277–281.

Etoh et al. JAMA Surgery. 2023 Mar 15;158(5):445–454

Annual number of laparoscopic gastrectomies performed in Japan (2010-2019)



Gastric cancer. 2024 Sep 28;28(1):1–11.

How much minimally invasive gastric surgery for cancer is being done? The West

- Slowly increasing
- A few limited randomized trials in Western patients has shown non inferiority for minimally invasive gastrectomy (Dutch and European trials)
- **United States: About 33% of gastrectomies performed via minimally invasive fashion in 2018.**

Van der Veen A. J Clin Oncol 2021, 978-989

Park J et al. Ann Surg Oncol 29: 2022

Morbidity and Mortality after Laparoscopy-Assisted and Open Distal Gastrectomy for Stage I Gastric Cancer: Results from a Multicenter Randomized Controlled Trial (KLASS-01--Korea)

- Started in 2006, 1,256 were eligible for analysis
- LADG: longer operation time, less blood loss, a shorter hospital stay, and a smaller number of retrieved lymph nodes.
- Complication rate was significantly lower in the LADG group (LADG vs. ODG; 13.0% vs. 19.9%, P = .001)
- Wound complication rate significantly lower in LADG than the ODG group (3.1% vs. 7.7%, P < .001).
- 5 year overall and relapse free survival was similar in both groups
- Similar results for randomized trial from Japan for stage 1 gastric cancer

Kim W. Ann Surg. 2016;263(1):28-35
Katai H Lancet Gastroenterol Hepatol. 2020;5:142–151

CLASS-02
Open vs laparoscopic total gastrectomy for stage 1 cancer

- 214 total patients
- Postoperative complication rate (17.4% vs. 18.1%)
- Mortality (0% vs. 1%)

Liu F et al JAMA Oncol. 2020;6:1590–1597

Randomized trials on laparoscopic distal gastrectomy for advanced gastric cancer (cT2-4a, N0-2)

	JLSSG0901	KLASS02	CLASS01
Country	Japan	Korea	China
Start Year	2010	2011	2012
Phase	3	3	3
Intervention	LDG vs ODG	LDG vs ODG	LDG vs ODG
Sample size	500	1050	1056
1^{o} endpoint	morbidity, RFS	RFS	RFS

KLASS-02-Korea
Morbidity of laparoscopic distal gastrectomy vs open for locally advanced gastric cancer

Primary endpoint is relapse free: 3 year survival

>500 patients in each arm

Total lymph node count similar in both groups

30 day complication rates: 16.4% vs 24.3% favoring laparoscopy

Post operative pain medicine use less in laparoscopic group

Time to flatus was 3.53 vs 3.71 days, p=0.03

Length of stay was significantly shorter with laparoscopy: 8.1 vs 9.3

Three-year relapse-free survival was 77.8% for LADG and 80.0% for ODG, for a hazard ratio of 1.035 (p value for noninferiority = 0.039)

Hyung WJ et al. 2020;38:3304–3314.

Randomized trial of laparoscopic vs open D2 distal gastrectomy for advanced gastric cancer
Morbidity and mortality
Chinese laparoscopic study group (CLASS01)

	Laparoscopic	Open	p value
Surgical time (min)	217.3	186	<.001
EBL, mL	105.5	117.3	.001
Time to ambulation	2.3	2.4	.037
Time to first flatus	3.5	3.6	.011
Postoperative stay	10.8	11.3	<.001

No significant differences in morbidities

No significant difference in 5-year DFS (HR 1.17, p=0.19)

Hu Y et al. J. Clin Oncol. 34: 1350-7, 2016
Huang C et al. JAMA Surgery 2021

Dutch randomized trial of open vs MIG in 227 patients (LOGICA)
Early and advanced gastric cancer

Laparoscopic group had less median blood loss (150 vs. 300 ml, p<0.001)

Post-operative complications (44% vs. 42%, p=0.91)

In-hospital mortality (4% vs. 7%, p=0.40)

Median lymph node yield (29 vs 29 nodes, p=0.49)

Median hospital stay (7 days in both groups, p=0.34)

1 year overall survival was also similar (76% vs 78%, p=0.74)

Van der Veen A. J Clin Oncol 2021, 978-989

European randomized trial of open (OTG) vs MITG
Total gastrectomy
N=96

One-year OS of 85.5% in the laparoscopic group and 90.4% in the open group (p=0.701).

There was no difference in mean hospital stay (8 days, p=0.338),

Mean number of lymph nodes resected (43.4 OTG vs 41.7 LTG, p=0.612)

Post-operative complications (42.9% OTG vs 34.0% LTG, p=0.408)

“The results of this trial provide evidence of non-inferiority regarding quality of the oncological resection in MITG compared to OTG in the treatment of advanced gastric cancer.”

N van der Wielen et al. Gastric cancer. 2021 Jan;24(1):258-271.

ESMO guidelines regarding gastrectomy-2022

- Laparotomy is an acceptable approach to achieve total or partial gastrectomy with D2 lymphadenectomy for gastric cancer.
- A laparoscopic approach may be selectively proposed in expert hands.
- Robot-assisted gastrectomy has shown similar oncological outcomes in terms of survival and lymph node yield compared with conventional laparoscopic gastrectomy.
- With technical advances, future gastric cancer surgery will most likely become increasingly minimally invasive and will probably take advantage of the rapidly developing robotic technologies.

Lordick F et al. Annals of Oncology 2022

Outcomes of minimally invasive gastric cancer surgery in the U.S.

Parameter	Open (34,516)	MIG (7,242)	AOR	p
Mortality	2.9%	1.4%	0.58 (0.34-1.00)	0.050
Cardiac	2.1%	1.2%	0.72 (0.42-1.24)	0.23
Respiratory	20.8%	18.3%	1.04 (0.88-1.23)	0.64
Gastrointestinal	3.8%	5.2%	0.89 (0.66-1.22)	0.48
Infectious	11.9%	10.0%	0.90 (0.73-1.11)	0.33
Acute kidney Injury	7.7%	6.0%	0.93 (0.70-1.22)	0.59
LOS	11.9	9.9	-0.7 (-1.3- -0.2)	0.011

More than 5X increase in MIG from 5.8% in 2008 to 32.9% in 2018

Park J et al. Ann Surg Oncol 29: 2022

Complications following minimally invasive gastrectomy East vs West

Author, Year	Country	Clavien-Dindo IV/V (East) (n)	Clavien-Dindo IV/V (West) (n)
Kim, 2012	Korea	0.82% (5839)	
Lee, 2019	Korea	1.48% (1050)	
Hu, 2016	China	0.67% (1039)	
Veen, 2021	**Netherlands**		**9.8% (227)**
Wielen, 2020	**Netherlands Sweden, UK, Italy**		**6.3% (96)**

Stillman et al. J Surg Oncol 126: 279-291

Robotic vs laparoscopic gastrectomy
Retrospective studies

- Multiple non randomized studies have been published comparing the feasibility and efficacy of robot-assisted gastrectomy (RG) versus laparoscopic gastrectomy (LG).
- RG is associated with longer operative time and sometimes greater costs compared to LG
- Studies have demonstrated comparable or superior lymph node yield, similar morbidity, and mortality when comparing RG to LG.
- A meta-analyses comparing RG to LG encompassing over 37,500 patients found no difference in total complication rate, anastomotic leakage, morbidity, or mortality between RG and LG.

Marano L et al. Update Surg. 2021;73:1673–1689

Robotic vs laparoscopic distal gastrectomy
Randomized trial from China
283 patients

Robotic arm showed:

1) Significantly longer operative time

2) Significantly shorter time to ambulation, first flatus, and liquid intake

3) Significantly less blood loss

4) Overall postoperative morbidity rate was significantly lower in the robotic group (9.2% vs 17.6%)

5) More likely to initiate adjuvant chemotherapy earlier: 28 (24–32) vs 32 days (26–42), P= 0.003

Multivariate logistic regression confirmed robotic use was independent protective factor for postoperative complication (odds ratio: 0.472, 95% confidence interval 0.225–0.993, P= 0.048)

Lu J et al. Ann Surg 2021: 273: 858-67

Robotic vs laparoscopic distal gastrectomy
Randomized trial from Japan
241 patients

Primary end point was the incidence of postoperative intra-abdominal infectious complications of Clavien-Dindo grade II or higher

- Short term outcomes available to date
- Incidence of intra-abdominal infectious complications was 10 of 117 [8.5%] in the LG group vs 7 of 113 [6.2%] in the RG group), p=ns
- Postop complications of grade II or higher was significantly higher in the LG group (23 [19.7%]) than in the RG group (10 [8.8%]) (*P* = .02)
- In grade IIIa or higher, the complication rate was still significantly higher in the LG group (19 [16.2%]) than in the RG group (6 [5.3%])(*P* = .01)

Primary endpoint not met but overall complication rate lower with robotic surgery. Not clear why this is the case.

Ojima et al JAMA Surg. 2021;156(10):954-963

Textbook Outcome (TO) for gastric cancer surgery

In 2017 the Dutch Upper Gastrointestinal Cancer Audit (DUCA) group designed the Textbook Outcome, a multidimensional scale that provides an ideal route after esophagogastric cancer surgery. It comprises ten perioperative quality-of-care parameters:

- Complete, potentially curative, resection as judged by the surgeon at the time of surgery
- No intraoperative complication
- Negative resection margin
- Greater than 15 lymph nodes sampled
- No severe postoperative complications (Clavien–Dindo grade II or higher)
- No re-intervention (surgical, endoscopic, or radiological) ≤30 days after surgery
- No unplanned ICU or medium-care unit (MCU) admission ≤30 days after surgery
- Duration of stay not exceeding 21 days
- No 30-day readmission
- No 30-day mortality following surgery

Busweiler LAD et al. Br J Surg 2017 742-50

Impact of textbook outcome in Dutch studies

- TO was associated with long-term overall survival (OS) after surgery for gastric cancer.
- Patients with a TO had 1-, 2-, and 3-year overall survival rates of 85%, 70%, and 64%, respectively,
- Patients with no TO had survival of 64%, 49%, and 42%
- TO in 23% of patients in hospitals performing 0 to 19 gastrectomies per year
- 29% in hospitals performing 20 to 39 gastrectomies per year
- 27% in hospitals performing more than 40 gastrectomies per year

Van der Kaaij R.T. Br. J. Surg. 2018;105:561–569

Van der Werf L.R Ann. Surg. 2019;270:868–876

European Society of Surgical Oncology
Teaching MIG

Event title	Event dates	Event venue	Website of the event	Main speciality	Name of the CME provider	Amount of ECMEC® credits
ESSO Hands on Course on Minimally Invasive Esophagectomy and Gastrectomy	14/11/2024 - 15/11/2024	Netherlands, Utrecht	Website	Oncology	European Society of Surgical Oncology	13.0 European CME credits (ECMEC®)

How do we make minimally invasive gastrectomy more common in the West?

1.Standardization of the procedure

2. Reliable, reproducible technique to teach

3.Mechanism to evaluate surgical quality

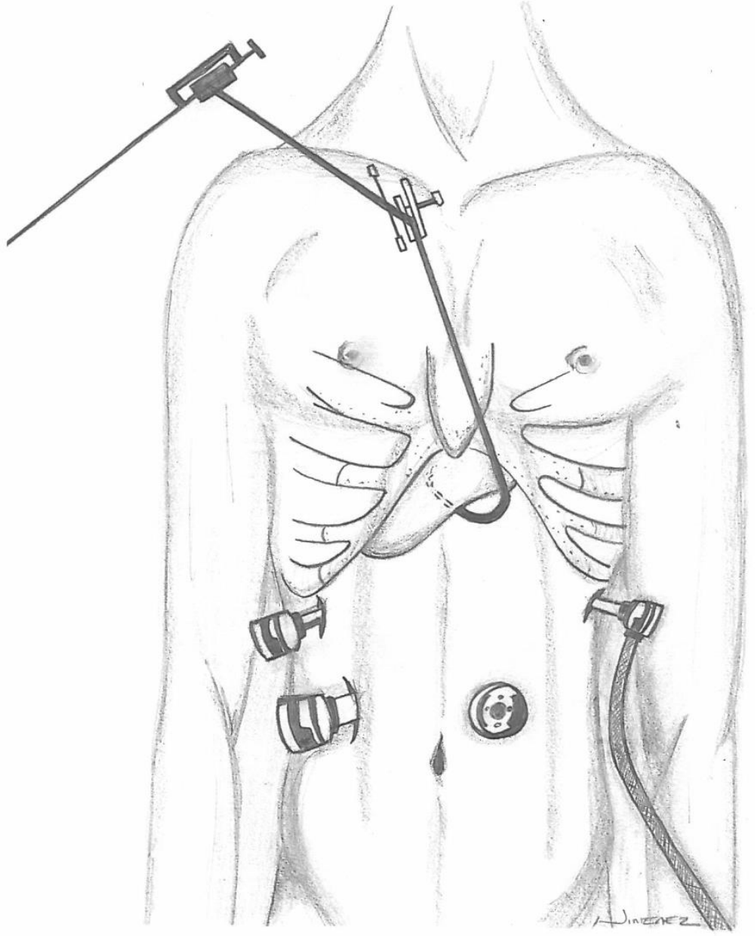
Standardization of these procedures
D1 vs D2 lymphadenectomy

Based on the current data, NCCN does recommend a D2 dissection without splenectomy

- June 1998 and December 2006, patients with gastric adenocarcinoma were assigned randomly to either D1 or D2 gastrectomy
- 267 eligible patients were allocated to either D1 (133 patients) or D2 (134) resection
- Overall morbidity rate after D2 and D1 dissections was 17.9 and 12.0 per cent respectively (P = 0.178)
- The postoperative 30-day mortality rate was 3.0 per cent after D1 and 2.2 per cent after D2 gastrectomy (P = 0.722).

Morbidity and mortality in the Italian Gastric Cancer Study Group randomized clinical trial of D1 versus D2 resection for gastric cancer.
Degiuli M, Sasako M, Ponti A. Br J Surg. 2010;97:643–649.

Minimally invasive gastrectomy



Ben-David K and Hochwald S
Laparoscopic distal subtotal gastrectomy for advanced gastric cancer
J Gastroint Surgery. 2015 Feb;19(2):369-74.

Positioning and equipment needed for laparoscopic distal gastrectomy for advanced gastric cancer

Patient **Positioning:**	1. Arms can be tucked or out at sides. 2. Patient is supine and footboard is placed. 3. Surgeon stands on right, assistant stands on the left side of the table. 4. No need for lithotomy position.

Equipment:	1. Nathanson retractor 2. Long (45 cm) instruments 3. Long bovie tip 4. Endoscopic stapler with intermediate and thick tissue loads 5. Staple reinforcement with peristrips 6. Small wound protector 7. 35 cm long clip applier 8. Endostitch with 2-0 silk and 2-0 vicryl sutures 9. 5 mm optical view port (1), 5 mm ports (2), and 12 mm port (1)

Ben-David K and Hochwald S Laparoscopic distal subtotal gastrectomy for advanced gastric cancer
J Gastroint Surgery. 2015 Feb;19(2):369-74.

Training in gastric surgery for malignancy

According to the United States (US) Graduate Medical Education General Surgery Report from 2022, current US general surgery residency graduates on average performed fewer than five gastrectomy procedures during their 5 years of residency training, suggesting limited exposure to gastric cancer surgery during their training.

Accreditation Council for Graduate Medical Education.
General Surgery Case Logs. Updated 2012. Available online:
http://www.acgme.org/acgmeweb/Portals/0/GSNatData1112.pdf

Training in laparoscopic gastric cancer surgery in the West

- An anonymous, cross-sectional, census survey was used to poll trainees' and staff members' opinions pertaining to laparoscopic gastrectomy.
- Academic and community tertiary teaching hospitals, affiliated with the University of Toronto.
- The results suggested that trainees do not routinely perform the major operative steps
- There was a statistically significant difference in opinions, related to the degree of the perceived active operating of the trainees.
- Adopting a stepwise approach, with task deconstruction, could optimize training
- Additional training modalities required to ensure proficiency

Training in Laparoscopic Gastric Cancer Surgery in the Western World: Current Educational Practices, Challenges, and Potential Opportunities at a Large University Centre
Fecso et al. J Surg Educ. 2016 Jul-Aug;73(4):749-55.

Sources of information and training

Several sources including videos that describe these procedures step by step

1. SAGES video library
2. ACS online video Library
3. Textbooks and on line resources for CGSO
4. Encourage hands on courses to be conducted by national societies and the appropriate device/product manufacturers
5. Cadaver and animal labs
6. Learn from our Asian colleagues—spend observation time in Asia

Minimally invasive gastrectomy for gastric cancer

Summary

Randomized trials have shown the benefit of MIG over open surgery for both EGC and AGC

MIG is routinely offered for most patients with gastric cancer in Asia

Results from MIG in the West based on a few limited randomized trials and retrospective reviews

Morbidity of MIG may be higher in the West compared to Asia

Textbook outcomes for gastrectomy need to be improved in the West

Two randomized trials suggest that robotic MIG may offer some benefits

Conclusions

Minimally invasive gastrectomy is operation of choice when performed by experienced surgeons

More effort needs to be made in the West for training of surgeons to perform MIG

Teaching institutions have the responsibility to train residents and fellows in a more effective manner

Robotic approach will likely become the procedure of choice over laparoscopy and open gastrectomy in the near future

Given the incidence of this disease and complexity of procedure, regionalization of care can help solve some of the issues

Thank You!

Questions?

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