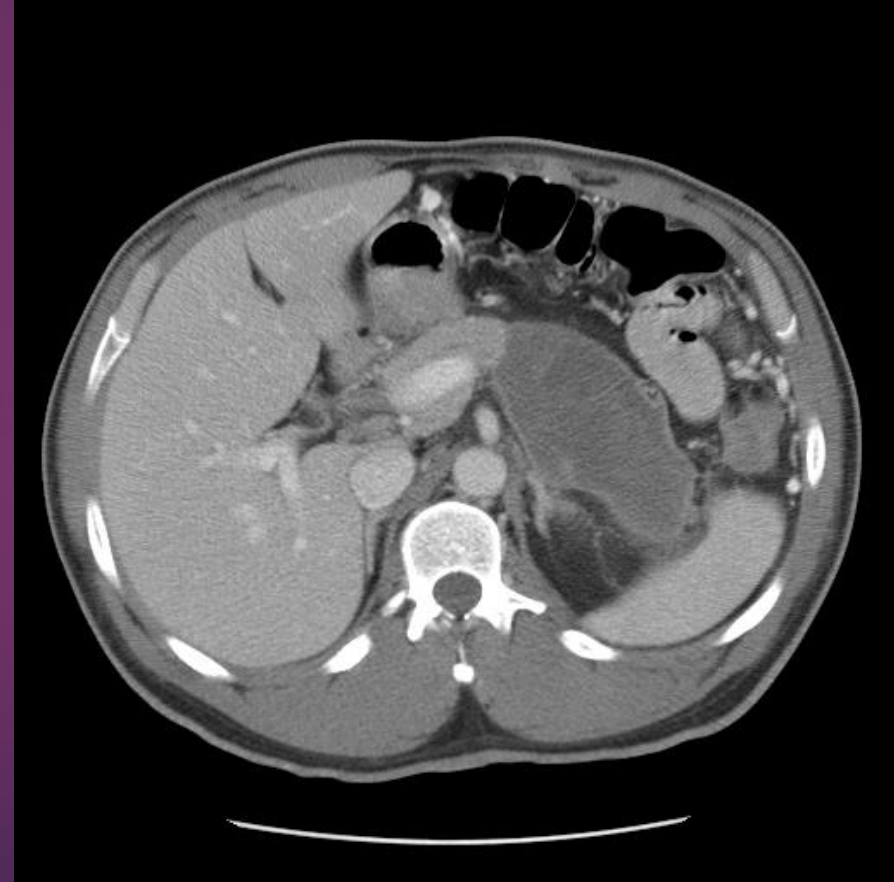
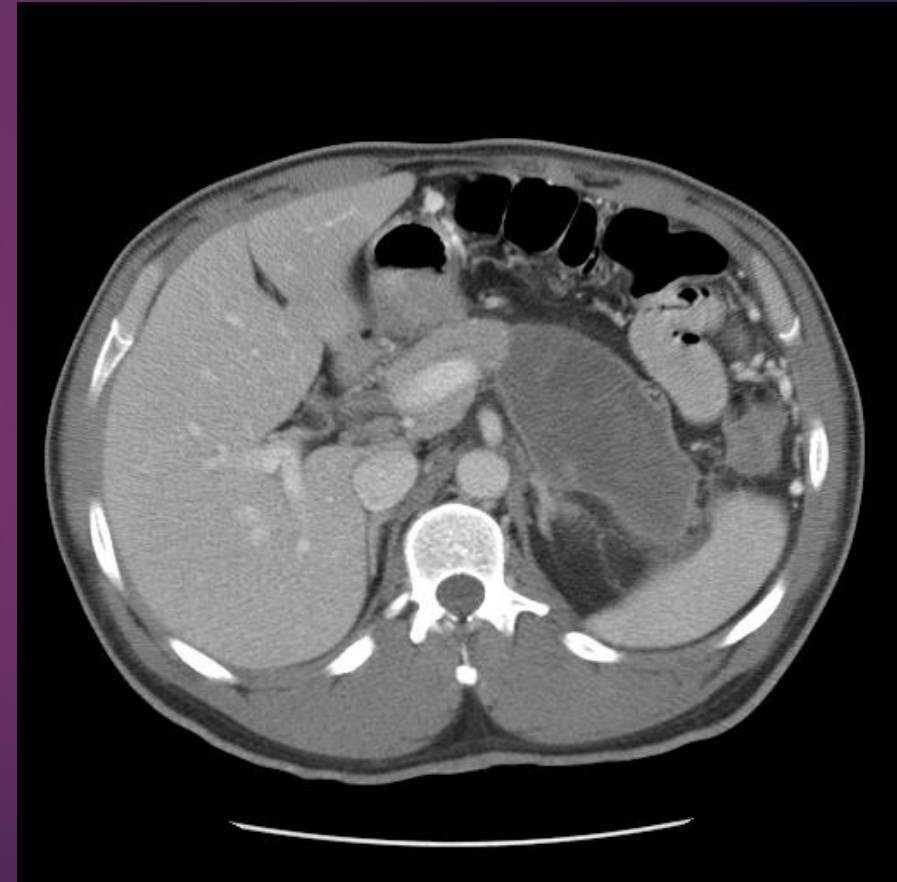


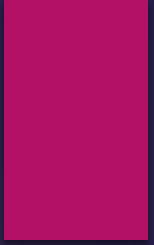
Management of Walled Off Necrosis – Minimally Invasive Surgical Options

Every WON Is Not the Same



Every WON Is Not the Same





Minimally invasive surgical and
endoscopic necrosectomy are
superior to open necrosectomy

Minimally invasive and endoscopic versus open necrosectomy for necrotising pancreatitis: a pooled analysis of individual data for 1980 patients

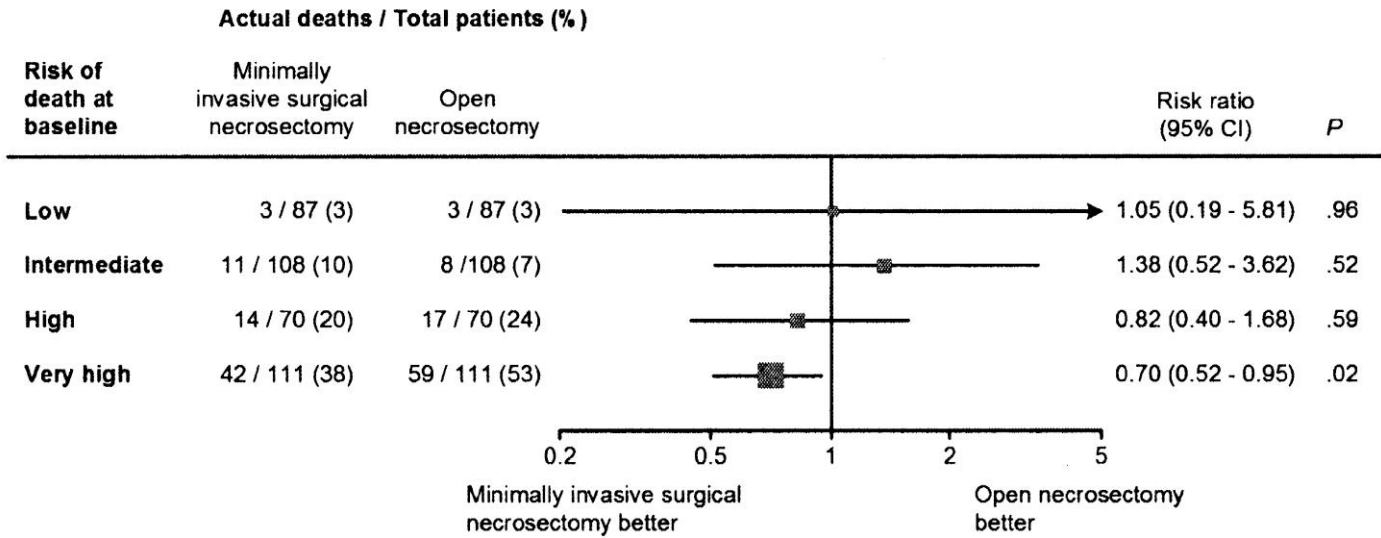
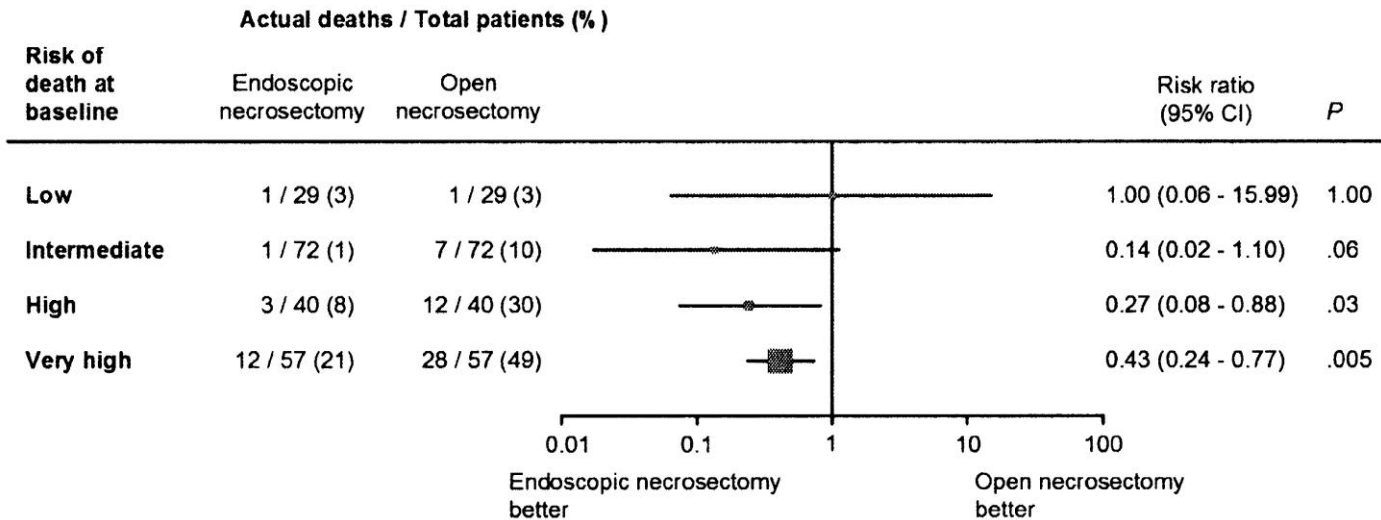
Sandra van Brunschot,¹ Robbert A Hollemans,^{2,3} Olaf J Bakker,⁴ Marc G Besselink,² Todd H Baron,⁵ Hans G Beger,⁶ Marja A Boermeester,² Thomas L Bollen,⁷ Marco J Bruno,⁸ Ross Carter,⁹ Jeremy J French,¹⁰ Djalma Coelho,¹¹ Björn Dahl,¹² Marcel G Dijkgraaf,¹³ Nilesh Doctor,¹⁴ Peter J Fagenholz,¹⁵ Gyula Farkas,¹⁶ Carlos Fernandez del Castillo,¹⁵ Paul Fockens,¹ Martin L Freeman,¹⁷ Timothy B Gardner,¹⁸ Harry van Goor,¹⁹ Hein G Gooszen,²⁰ Gerjon Hannink,²¹ Rajiv Lochan,¹⁰ Colin J McKay,⁹ John P Neoptolemos,²² Atilla Oláh,²³ Rowan W Parks,²⁴ Miroslav P Peev,¹⁵ Michael Raraty,²² Bettina Rau,²⁵ Thomas Rösch,²⁶ Maroeska Rovers,²⁰ Hans Seifert,¹² Ajith K Siriwardena,²⁷ Karen D Horvath,²⁸ Hjalmar C van Santvoort^{4,29}

What is already known on this subject?

- ▶ In patients with infected necrotising pancreatitis, endoscopic or percutaneous catheter drainage of the necrotic collection as a first step is now considered standard treatment.
- ▶ Patients in whom drainage alone does not lead to clinical recovery need to undergo a more invasive necrosectomy procedure.
- ▶ Minimally invasive surgical necrosectomy and endoscopic necrosectomy are gaining popularity over open necrosectomy. There is, however, no clear evidence from large comparative studies with clinical endpoints in favour of minimally invasive techniques. As a result, open necrosectomy is still an option in treatment guidelines, and observational studies on open necrosectomy continue to be published.
- ▶ A randomised trial comparing minimally invasive surgical or endoscopic necrosectomy with open necrosectomy with death as primary endpoint will most likely never be performed.

What are the new findings?

- ▶ This study included 1980 patients who underwent necrosectomy for acute necrotising pancreatitis in 51 hospitals across 8 countries worldwide.
- ▶ Detailed individual patient data were collected, and patients undergoing minimally invasive necrosectomy were compared with patients undergoing open necrosectomy for the primary endpoint of in-hospital death.
- ▶ To adjust for potential confounding and to study effect modification by clinical severity, thorough statistical analyses included multivariable regression modelling and propensity score matching with stratification according to pre-necrosectomy risk of death.
- ▶ Minimally invasive surgical and endoscopic necrosectomy were associated with lower death rates than open necrosectomy in patients who were severely ill at time of necrosectomy.

A**Matched cohorts****B****Matched cohorts**

Endoscopic or surgical step-up approach for infected necrotising pancreatitis: a multicentre randomised trial

*Sandra van Brunschot, Janneke van Grinsven, Hjalmar C van Santvoort, Olaf J Bakker, Marc G Besselink, Marja A Boermeester, Thomas L Bollen, Koop Bosscha, Stefan A Bouwense, Marco J Bruno, Vincent C Cappendijk, Esther C Consten, Cornelis H Dejong, Casper H van Eijck, Willemien G Erkelens, Harry van Goor, Wilhelmina M U van Grevenstein, Jan-Willem Haveman, Sijbrand H Hofker, Jeroen M Jansen, Johan S Laméris, Krijn P van Lienden, Maarten A Meijssen, Chris J Mulder, Vincent B Nieuwenhuijs, Jan-Werner Poley, Rutger Quispel, Rogier J de Ridder, Tessa E Römkens, Joris J Scheepers, Nicolien J Schepers, Matthijs P Schwartz, Tom Seerden, B W Marcel Spanier, Jan Willem A Straathof, Marin Strijker, Robin Timmer, Niels G Venneman, Frank P Vleggaar, Rogier P Voermans, Ben J Witteman, Hein G Gooszen, Marcel G Dijkgraaf, Paul Fockens, for the Dutch Pancreatitis Study Group**

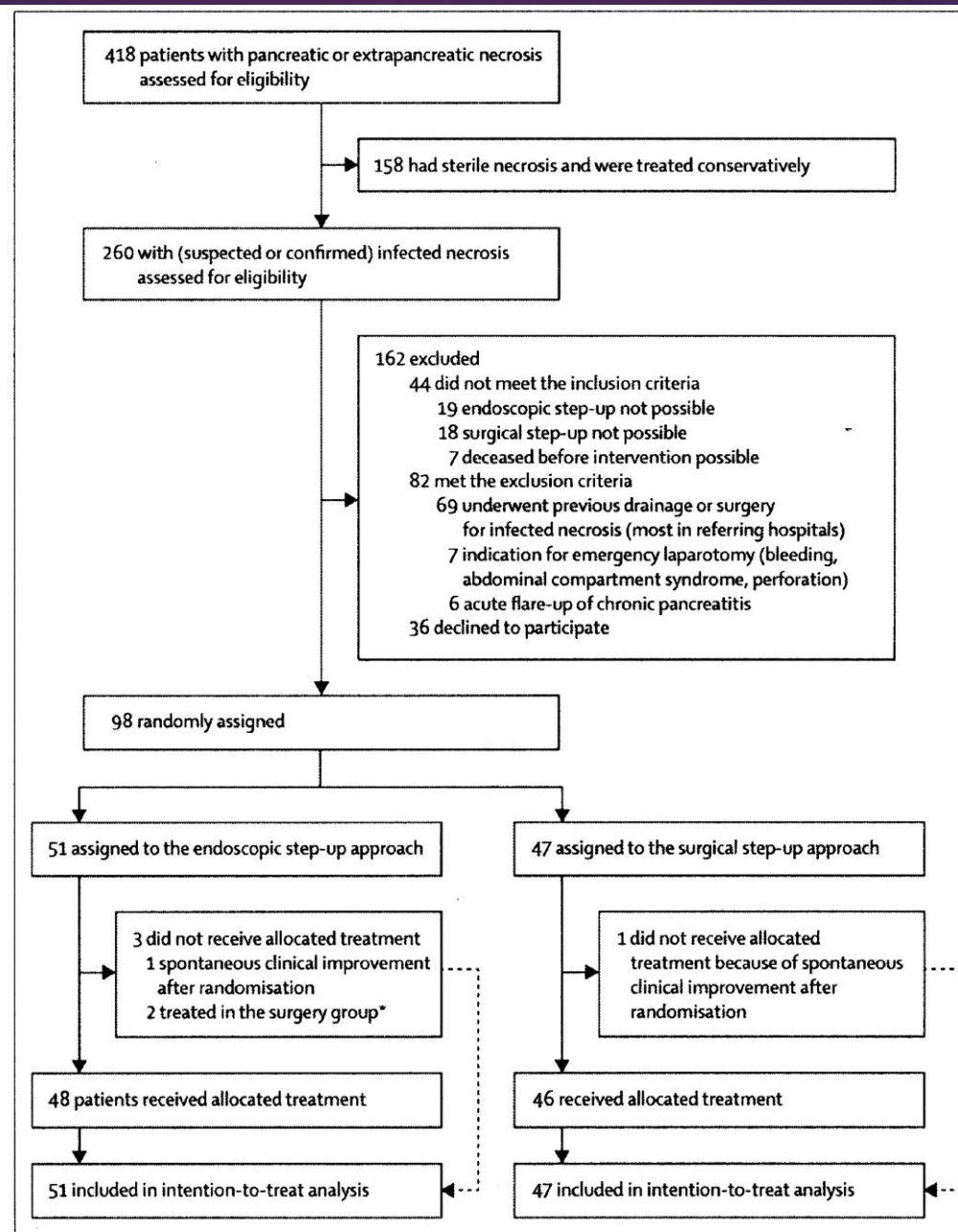


Figure: Trial profile

*Endoscopy unsuccessful.

	Endoscopic step-up approach (n=51)	Surgical step-up approach (n=47)	Relative risk (95% CI)	p value
(Continued from previous page)				
Health-care use				
Median number of interventions§	3 (2-6)	4 (2-6)	--	0.35
Drainage procedures¶	1 (1-3)	3 (1-5)	--	0.0041
Necrosectomies	2 (1-4)	1 (1-1)	--	0.0004
Number of necrosectomies	--	--	--	0.0062
0	22 (43%)	24 (51%)	0.84 (0.55-1.29)	--
1	9 (18%)	18 (38%)	0.46 (0.23-0.92)	--
2	8 (16%)	3 (6%)	2.46 (0.69-8.72)	--
≥3	12 (24%)	2 (4%)	5.53 (1.31-23.42)	--
Additional percutaneous drainage in the endoscopy group	14 (27%)	--	--	--
Additional VARD procedure in the endoscopy group	2 (4%)	--	--	--
Additional endoscopic drainage in the surgical group	--	2 (4%)	--	--
Additional endoscopic necrosectomy in the surgical group	--	0	--	--
Days between first drainage and first necrosectomy				
Median (range)	10 (5-16)	23 (9-62)	--	0.013
Mean (SD)	14 (14)	33 (30)	--	--
Days in ICU within 6 months of randomisation**				
Median (IQR)	0 (0-3)	2 (0-11)	--	--
Mean (SD)	13 (31)	13 (21)	--	0.31
Days in hospital within 6 months of randomisation				
Median (IQR)	35 (19-85)	65 (40-90)	--	--
Mean (SD)	53 (47)	69 (38)	--	0.014

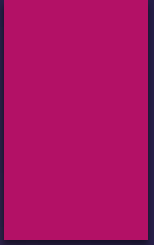
Data are n (%), mean (SD), or median (IQR) unless otherwise stated. Relative risk is reported for dichotomous variables for the endoscopic step-up approach as compared with the surgical step-up approach. ICU=intensive care unit. VARD=video-assisted retroperitoneal debridement. *Multiple events in the same patient were considered as one endpoint. †Organ failure occurring after randomisation and not present 24 h before randomisation. ‡Patients were assessed 6 months after randomisation; patient deaths were excluded. §This category included all drainage procedures (endoscopic or percutaneous) and necrosectomies (endoscopic or VARD) as part of the endoscopic or surgical step-up approach. ¶||This category included primary drainage procedures (endoscopic or percutaneous) as part of the endoscopic or surgical step-up approach and additional drainage procedures before and after necrosectomy in both treatment groups. ||This category included all necrosectomies (endoscopic or VARD procedure) as part of the endoscopic or surgical step-up approach. **For patients not present in ICU 24 h before randomisation.



Endoscopic step-up approach not superior to surgical-step up in reduction of major complications or death



Endoscopic step-up approach
resulted in fewer pancreatic
fistulas and shorter length of stay



For retrogastric WON, minimally
invasive surgical and endoscopic
necrosectomy achieve similar
results

Cyst Gastrostomy and Necrosectomy for the Management of Sterile Walled-Off Pancreatic Necrosis: a Comparison of Minimally Invasive Surgical and Endoscopic Outcomes at a High-Volume Pancreatic Center

**Mohammad Khreiss¹ • Mazen Zenati¹ • Amber Clifford¹ • Kenneth K. Lee¹ •
Melissa E. Hogg¹ • Adam Slivka² • Jennifer Chennat² • Andres Gelrud³ •
Herbert J. Zeh¹ • Georgios I. Papachristou² • Amer H. Zureikat^{1,4}**

Table 1 Pre procedural Demographics

Characteristics	Surgical <i>n</i> =20	Endo-therapy <i>n</i> =20	<i>P</i> value
Age, median (IQR)	55 (37–60.5)	55 (42.5–66)	0.534
Female (%)	4 (20)	11 (55)	0.048
Race, Caucasian (%)	18 (90)	19 (95)	1.00
BMI mean±SD	30.1±7.4	29.8±7.3	0.913
CCI	1.5 (1–2.5)	0.95 (0–1)	0.031
Etiology, <i>n</i> (%)			0.354
Gallstone	13 (65)	9 (45)	
Alcohol	3 (15)	3 (12)	
Idiopathic	3 (15)	2 (10)	
Other	1 (5)	6(30)	
WON size, mean±SD (cm)	15.2±4.2	11.2±4.9	0.008
WON size> 10 cm (%)	18 (90)	12 (60)	0.065
WON size> 15 cm (%)	10 (50)	3 (15)	0.041
Location, <i>n</i> (%)			
Head and neck	3(15)	5(25)	0.695
Body	15 (75)	11 (55)	0.695
Tail	10 (50)	5 (25)	0.191
Encompassing entire gland	2 (10)	4 (20)	0.661

Eight of the nine patients with biliary etiology underwent cholecystectomy prior to the endoscopic CG (mean time from cholecystectomy to endoscopic CG=26.9 weeks; range 1–72 weeks). Only one patient underwent cholecystectomy post endoscopic CG (8 weeks)

CCI Charlson Comorbidity Index

Characteristic	Surgical <i>n</i> =20	Endotherapy <i>n</i> =20	<i>p</i> value
Time from AP to treatment, weeks, median (IQR)	9 (6–12)	8 (6–44)	0.470
Number of patients requiring post procedure re-intervention for residual WON	3 (15) ^a	9 (45) ^o	0.082
Number of Post-procedure Intervention/patient median (range)	0 (0–1)	1 (0–10)	0.008

Number of patients requiring post procedure re-intervention for residual WON	3 (15) ^a	9 (45) ^b	0.082
Number of Post-procedure Intervention/patient median (range)	0 (0–1)	1 (0–10)	0.008
Index procedure LOS, days median (IQR)	7 (5–7)	2 (1–6)	0.003
Total LOS (index+re-interventions), median(IQR)	7 (6–10)	3 (1.5–11)	0.032
Failure	3 (15) ^c	2(10) ^d	0.661
Time to resolution, months, mean (± SD)	0.42±1.0	3.6±3.3	0.001

Cost of primary admission per day	5408±6851	6917±6293	0.017
Total cost of all related readmissions	17,977±20,191	32,087±43,272	0.855
Cost of readmission per day	2996±1229	3312±2178	0.855
Overall cost (primary+all readmissions)	23,206±15,676	24,993±31,494	0.168

^a All three re-interventions (failures) in the surgical group were endoscopically treated

^b The nine re-interventions were: 8=endoscopic and 1=percutaneous radiologically placed drain

^c For the surgery group, failure was defined a priori as *any* re-intervention after the index surgical procedure

^d For the endotherapy group, failure was defined a priori as salvage surgery after exhausting all endotherapeutic measures

Parameter	No re-intervention <i>n</i> =11	Re-intervention <i>n</i> =9	<i>P</i> value	Odds ratio (95 % CI)	<i>P</i> value
Age	57 (38–70)	53 (47–66)	0.879	0.99 (0.94–1.06)	0.912
Sex (F)	5 (45.5)	6 (66.7)	0.406	2.4 (0.39, 14.9)	0.347
BMI	24 (22–37)	31.7 (28.2–37)	0.043	1.13 (0.98–1.31)	0.099
Charlson Comorbidity index	1(0–1)	1 (0–1)	0.933	0.88 (0.33–2.3)	0.789
WON diameter >10 cm	5 (45.5)	7 (77.8)	0.197	4.2 (0.59–30.1)	0.153
WON diameter>15 cm	0 (0)	3 (33.3)	0.074	Predicts event perfectly	–

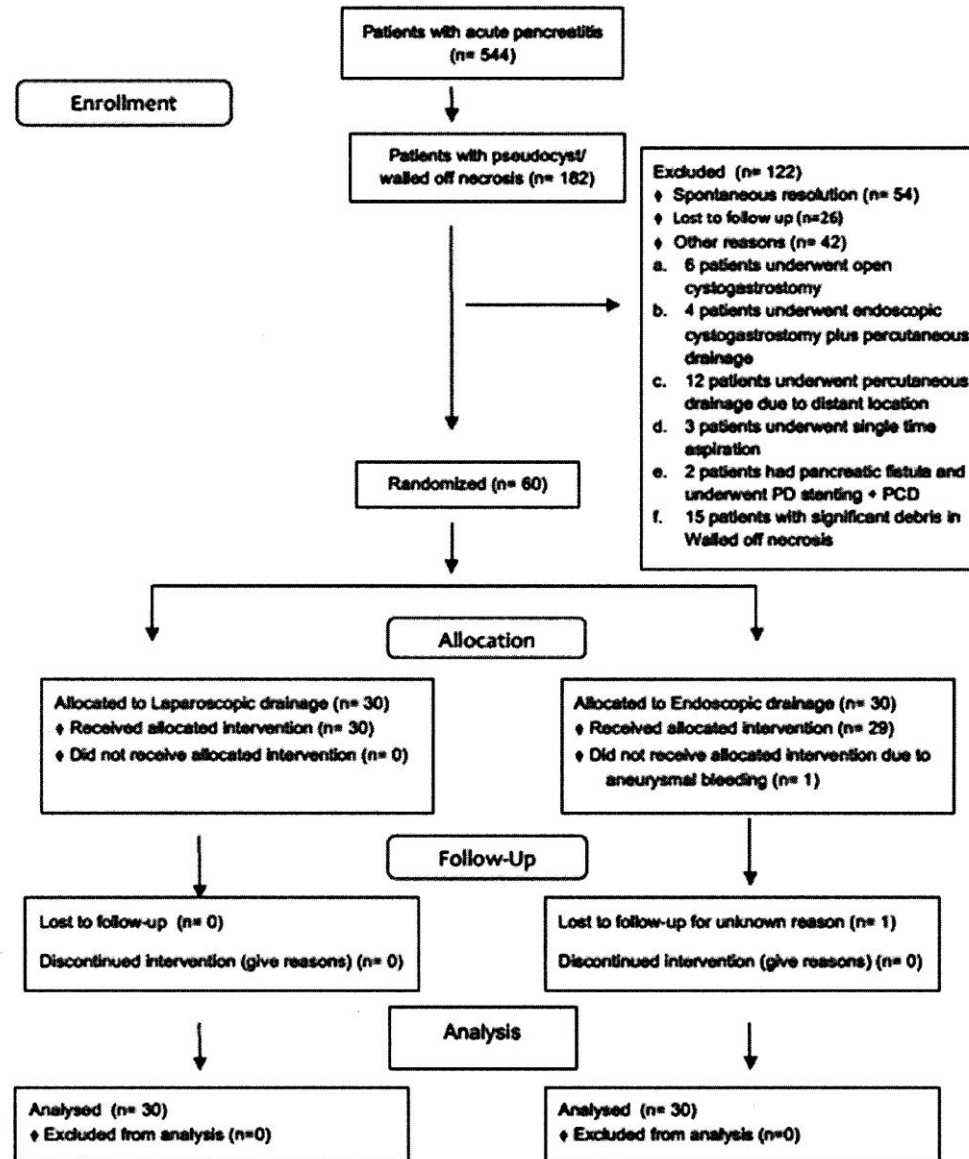
Endoscopic versus laparoscopic drainage of pseudocyst and walled-off necrosis following acute pancreatitis: a randomized trial

Pramod Kumar Garg¹ · Danishwar Meena² · Divya Babu² · Rajesh Kumar Padhan¹ · Rajan Dhingra¹ · Asuri Krishna² · Subodh Kumar² · Mahesh Chandra Misra² · Virinder Kumar Bansal²

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CONSORT Flow Diagram



Parameter	Laparoscopic group (<i>n</i> = 30)	Endoscopic group (<i>n</i> = 30)	<i>p</i> -value
Pseudocyst	6 (20%)	5 (16.6%)	1.0
Walled off necrosis	24 (80%)	25 (83.3%)	1.0
Location			
Predominantly head	2	1	0.8
Head and body	15	15	
Body and tail	13	14	
Mean size (volume in cc) (range)	1166.1 ± 1086.1 (245-3840)	1355 ± 827.9 (158-3160)	0.2
Wall thickness (mm)	0.57 ± 0.17	0.56 ± 0.15	0.9
Splenic vein thrombosis	2	0	0.5

Parameter	Laparoscopic group (<i>n</i> = 30)	Endoscopic group (<i>n</i> = 30)	<i>p</i> -value
Successful drainage after index procedure	25 (83.3%)	23 (76.6%)	0.7
Overall successful outcome	28 (93.3%)	27 (90%)	1.0
Conversion rate	3 (10%)	NA	–
External tube drainage	2 (6.6%)	NA	–
Necrosectomy	21 (70%)	12 (40%) ^a	0.03
Median (range) time to oral feeding (h)	60 (24–98)	8 (4–168)	0.001
Duration of antibiotics (mean, days)	11.1 ± 5.2	13.2 ± 8.4	0.1
Hospital stay (days)	7 (4–52)	8 (3–69)	0.1
Median, range			

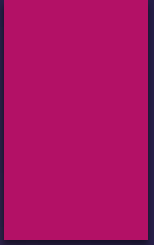
NA not applicable

^aNecrosectomy was done at a subsequent session

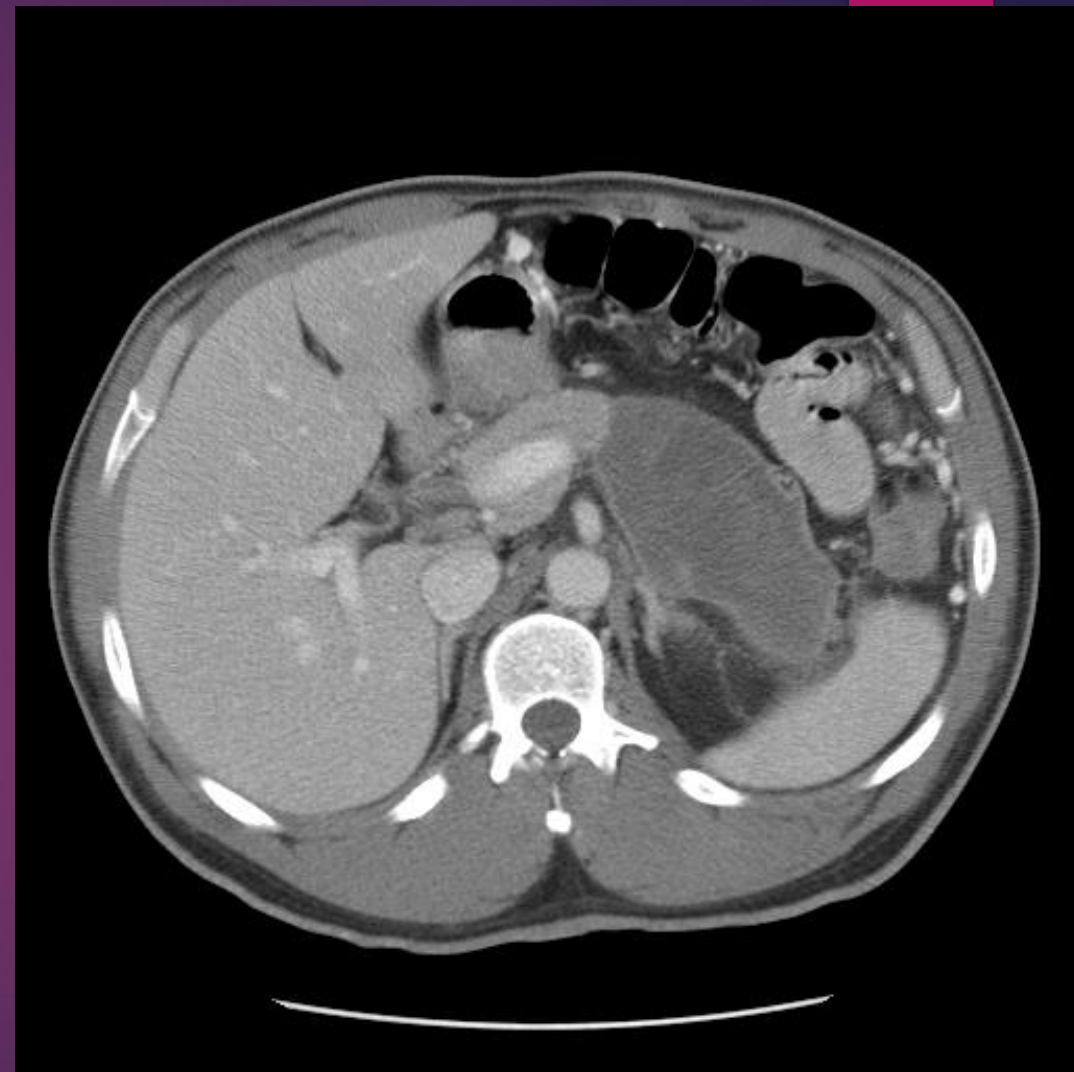
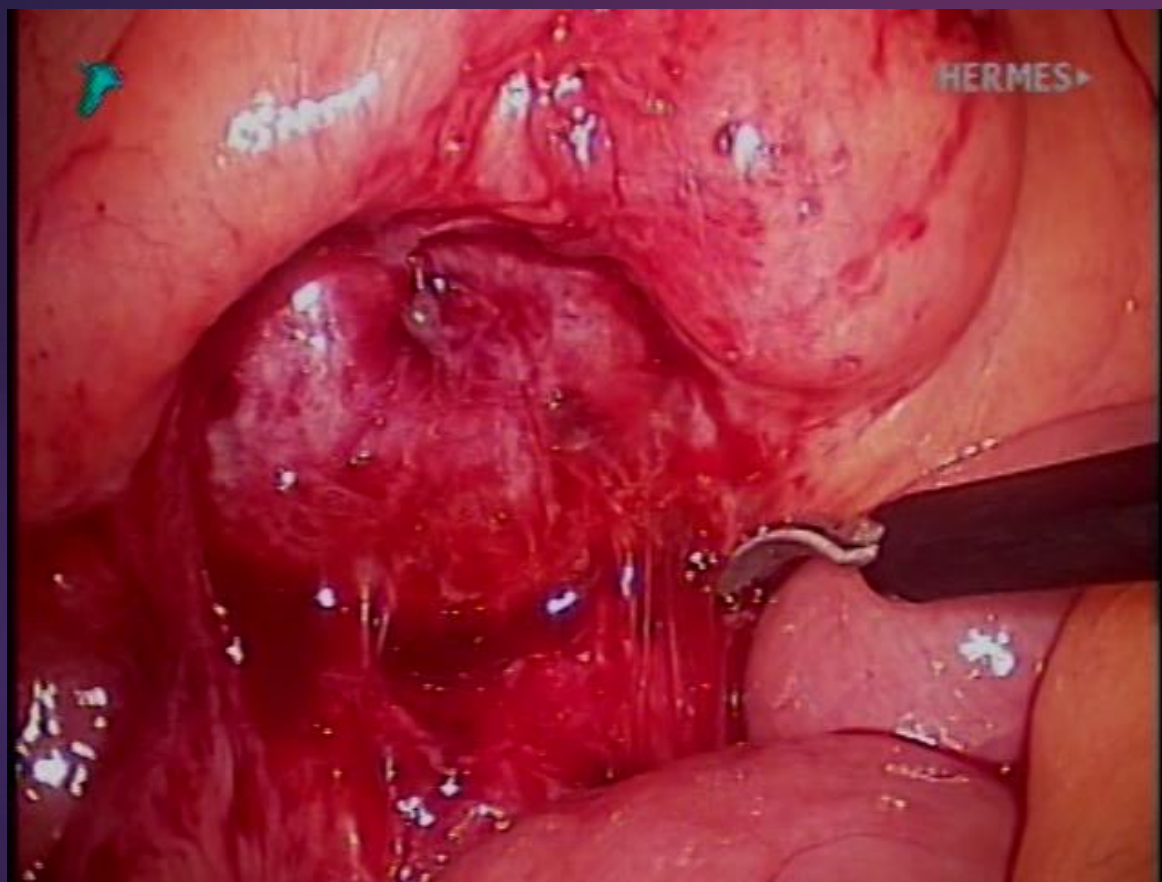
Parameter	Laparoscopic group (<i>n</i> = 30)	Endoscopic group (<i>n</i> = 30)	<i>p</i> -value
Clavien Dindo class I			
Delayed gastric emptying	3 (10%)	1 (3.3%)	0.6
Surgical site infection	5 (16.6%)	NA	–
Enterocutaneous fistula	1 (3.3%)	NA	–
Stent migration	NA	1 (3.3%)	–
Clavien Dindo class II			
Blood transfusion	8 (26.6%)	3 (10%)	0.19
Fever	9 (30.0%)	19 (63.3%)	0.01
Pneumonia	2 (6.6%)	0	0.5
Clavien Dindo class III			
Gastric perforation with peritonitis	0	1 (3.3%)	0.9
Need for additional procedures			
Endoscopic drainage/lavage	3	15	0.0001
Percutaneous drainage	1	2	
Laparoscopic drainage	NA	2	
Clavien Dindo class IVa			
Respiratory failure	1 (3.3%)	1 (3.3%)	1
Septic shock	1 (3.3%)	0	0.9
Peritonitis with shock	0	1 (3.3%)	0.9
Mortality	0	0	–

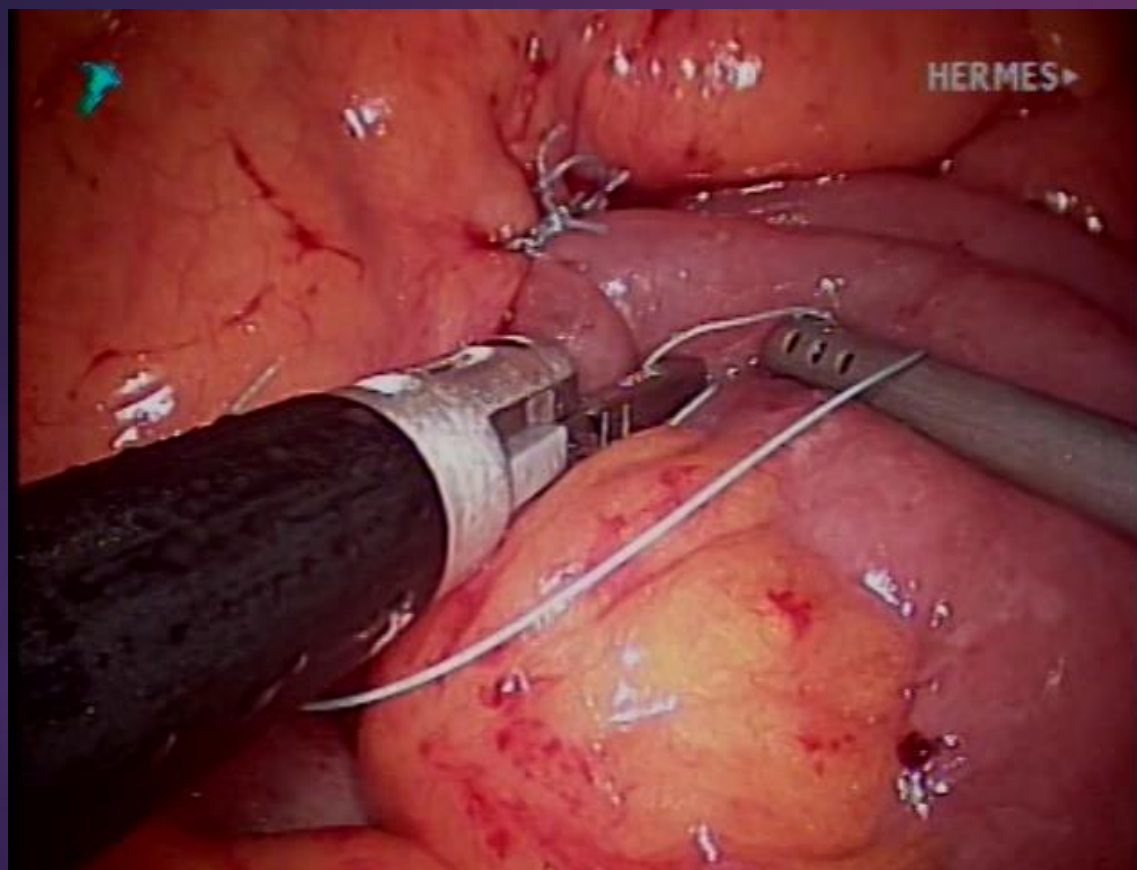
Laparoendoscopic Transgastric Pancreatic Debridement





WON inaccessible for endoscopic
necrosectomy may be amenable
to minimally invasive surgical
necrosectomy

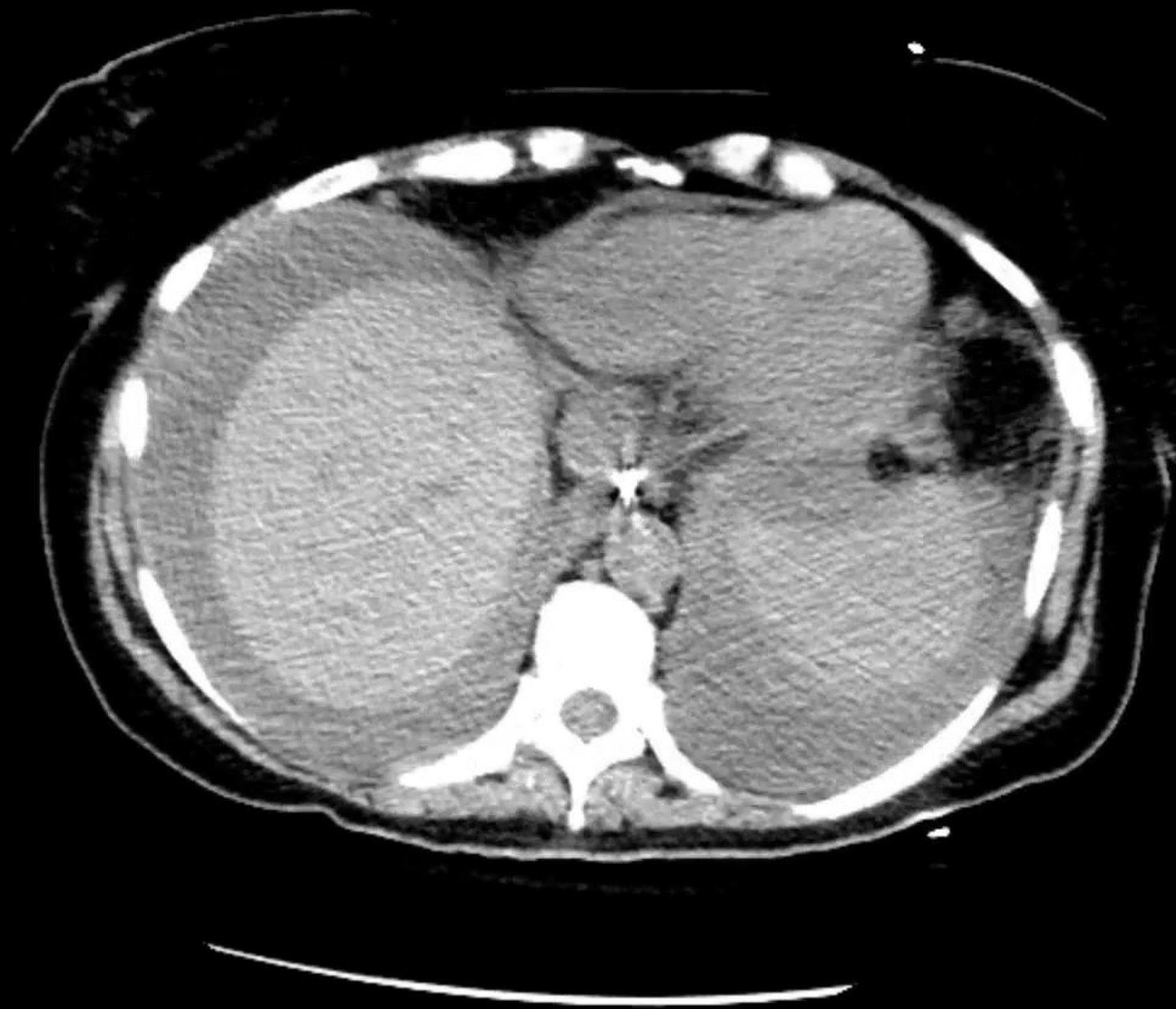




Transperitoneal Pancreatic Debridement



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2-14-16



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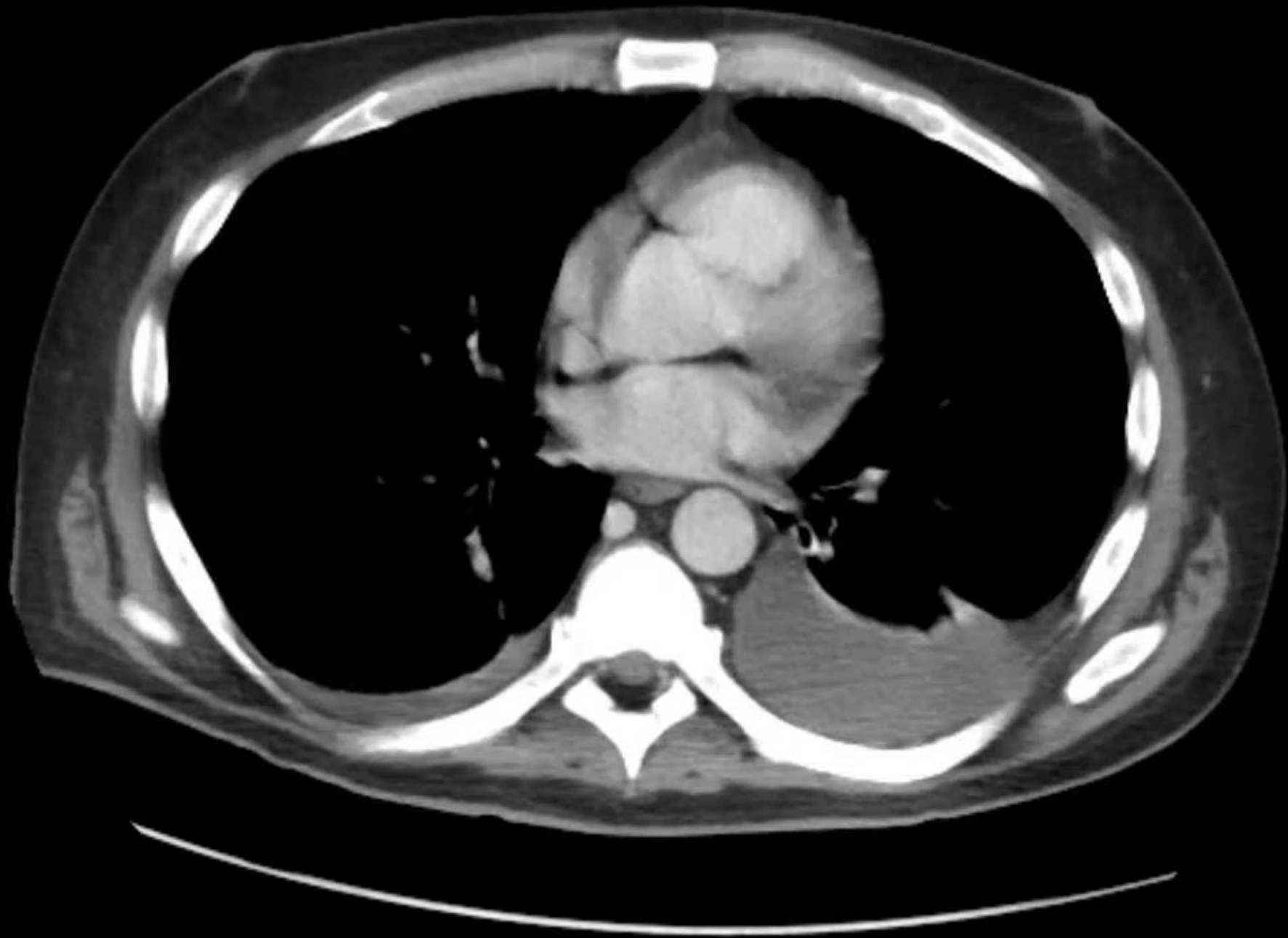
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6 - 14 - 19



7 - 22 - 19





A multidisciplinary approach that considers endoscopic and minimally invasive surgical techniques is preferred over open surgical procedures

Anatomic factors and local expertise will influence the approach chosen