Complicated Diverticulitis

Evidence Based Recommendations

Frederick A Moore MD

September 10, 2014

Complicated Diverticulitis

Evidence Based Recommendations

I have no financial disclosures

A Management Algorithm for Perforated Diverticulitis

Objectives

Provide a historical perspective on surgical management

Discuss current algorithm of surgical management

Debate definitive resection vs damage control vs laparoscopic lavage

WTA 2012 ALGORITHM

Western Trauma Association Critical Decisions in Trauma: Management of complicated diverticulitis

Frederick A. Moore, MD, Ernest E. Moore, MD, Clay Cothren Burlew, MD, Raul Coimbra, MD, Robert C. McIntyre, Jr., MD, James W. Davis, MD, Jason Sperry, MD, *and* Walter L. Biffl, MD, *Gainesville, Florida*

J Trauma Acute Care Surg 2012

WJES WORLD JOURNAL OF EMERGENCY SURGERY

Position paper: management of perforated sigmoid diverticulitis

Frederick A Moore[1*], Fausto Catena[2], Ernest E Moore[3], Ari Leppaniemi[4] and Andrew B Peitzmann[5]

World Journal of Emergency Surgery 2013

Complicated Diverticulitis

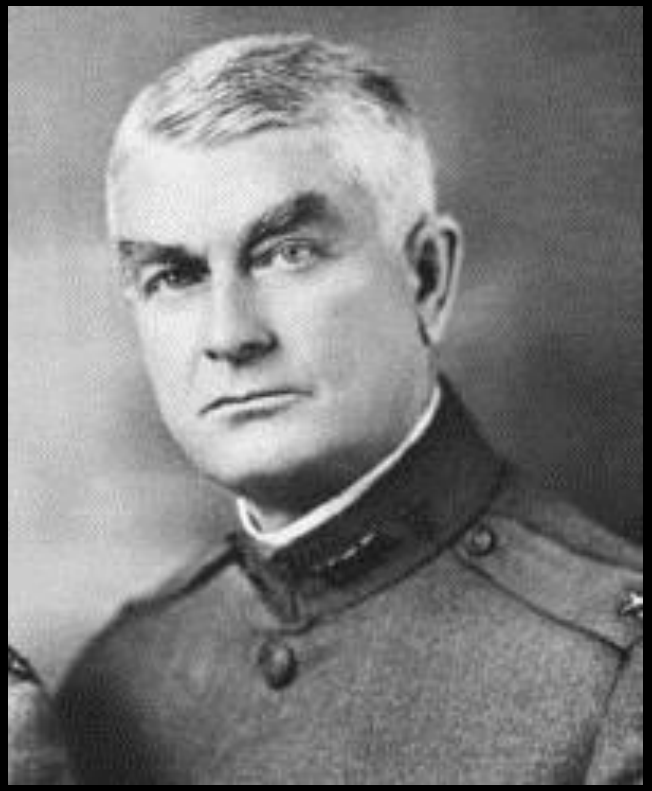
Disease of industrial revolution - roller milling wheat ↓ fiber by 2/3^{rds}

Relatively rare & high associated M & M - small single center studies

100 years of case series - virtually all retrospective & **expert opinion**

Evolving management strategies - **most remarkable over past 20 yrs**

Acquired Diverticulitis of the Large Intestine



Mayo describes 4 resections of the colon for diverticulitis

Surg Gynecol Obstet 1907

DIVERTICULITIS OF THE COLON

By E. Starr Judd,MD and Lee W.Pollock, MD

MAYO CLINIC

Ann Surg 1924

Perforated Diverticulitis with Peritonitis

Primary resection too difficult in the acute setting

Stirring up the infection results in very high mortality (pre- antibiotic era)

DIVERTICULITIS OF THE COLON

By E. Starr Judd,MD and Lee W.Pollock, MD

MAYO CLINIC

Ann Surg 1924

Perforated Diverticulitis with Peritonitis

Colostomy + Irrigation Distal Colon

± Delayed Resection

Primary resection too difficult in the acute setting

Stirring up the infection results in very high mortality

(pre- antibiotic era)

EXPERIENCE WITH THE SURGICAL MANAGEMENT OF DIVERTICULITIS OF THE SIGMOID

Reginald H.Smithwick MD

From The Massachusetts General Hospital

Ann Surg 1942

Compared numerous operations and concluded that best early mortality and long-term outcomes are achieved with

Preliminary proximal colostomy

Resection at 3 - 6 months after inflammation resolved

Perforated Diverticulitis with Peritonitis

Three - Staged Procedure

1st : Diverting Colostomy, Suture Closure & Drainage

2nd : Definitive Resection & Colostomy at 3 - 6 months

3rd : Colostomy Closure at 3 - 6 months

Acute Perforated Diverticulitis of the Sigmoid Colon With Generalized Peritonitis

HIRAM H. BELDING III,MD, Riverside Calif

Arch Surg 1957

With IV Terramycin q 12 hour X 3 days

Safely resected diseased colon in 5 cases

Two - Staged Procedure (Hartmann's Procedure)

1st : Resect & Colostomy

2nd : Delayed Colostomy Closure

Adv Surg. 1978;12:85-109.

Treatment of perforated diverticular disease of the colon.

Hinchey EJ, Schaal PG, Richards GK.

Hinchey Classification	
I	Pericolic abscess or phlegmon
II	Pelvic, intraabdominal, or retroperitoneal abscess
III	Generalized purulent peritonitis
IV	Generalized fecal peritonitis

WTA Complicated Diverticulitis Score

Modified Hinchey

Grade	Characteristic
I A	Phlegmon with no abscess
I B	Phlegmon with abscess < 4 cm
II	Phlegmon with abscess > 4 cm
III	Purulent peritonitis (no hole in colon)
IV	Feculent peritonitis (persistent hole in colon)

Other Complications: Stricture or fistula

Surgical Treatment of Perforated Diverticulitis of the Sigmoid Colon

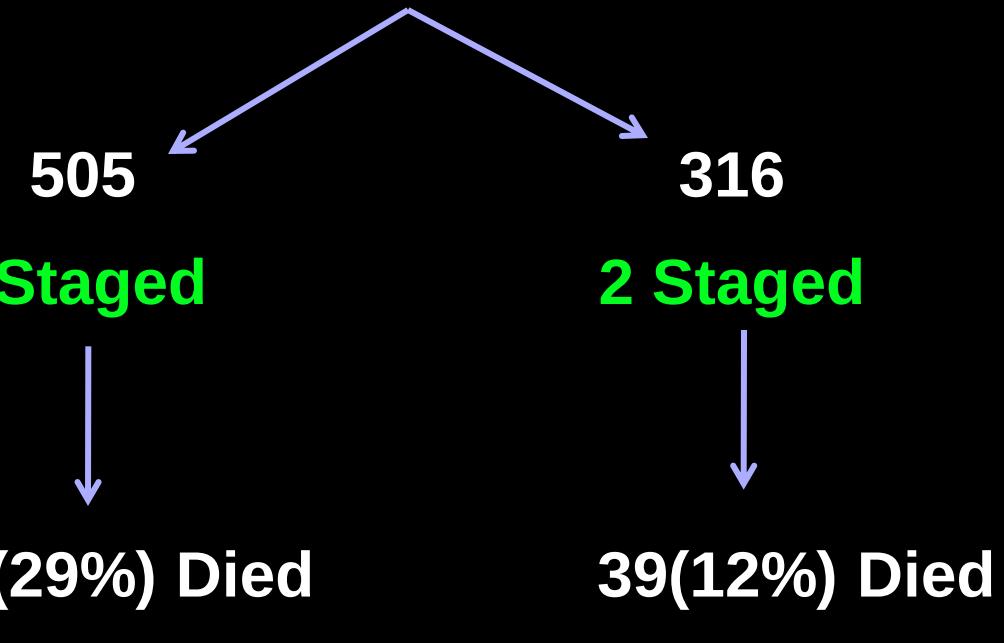
Jon M. Greif DO, Gregory Fried MD, Charles K.McSherry, MD.

Dis , Col & Rect 1980

Retrospective Review of 36 Case Series

821 case with Peritonitis

Selection Bias?



Surgical Treatment of Perforated Diverticulitis of the Sigmoid Colon

Jon M. Greif DO, Gregory Fried MD, Charles K.McSherry, MD.

Dis , Col & Rect 1980

Advocates of Acute Resection

↓ mortality with better antibiotics & supportive care

Will not miss colon cancer (~ 3 % of cases)

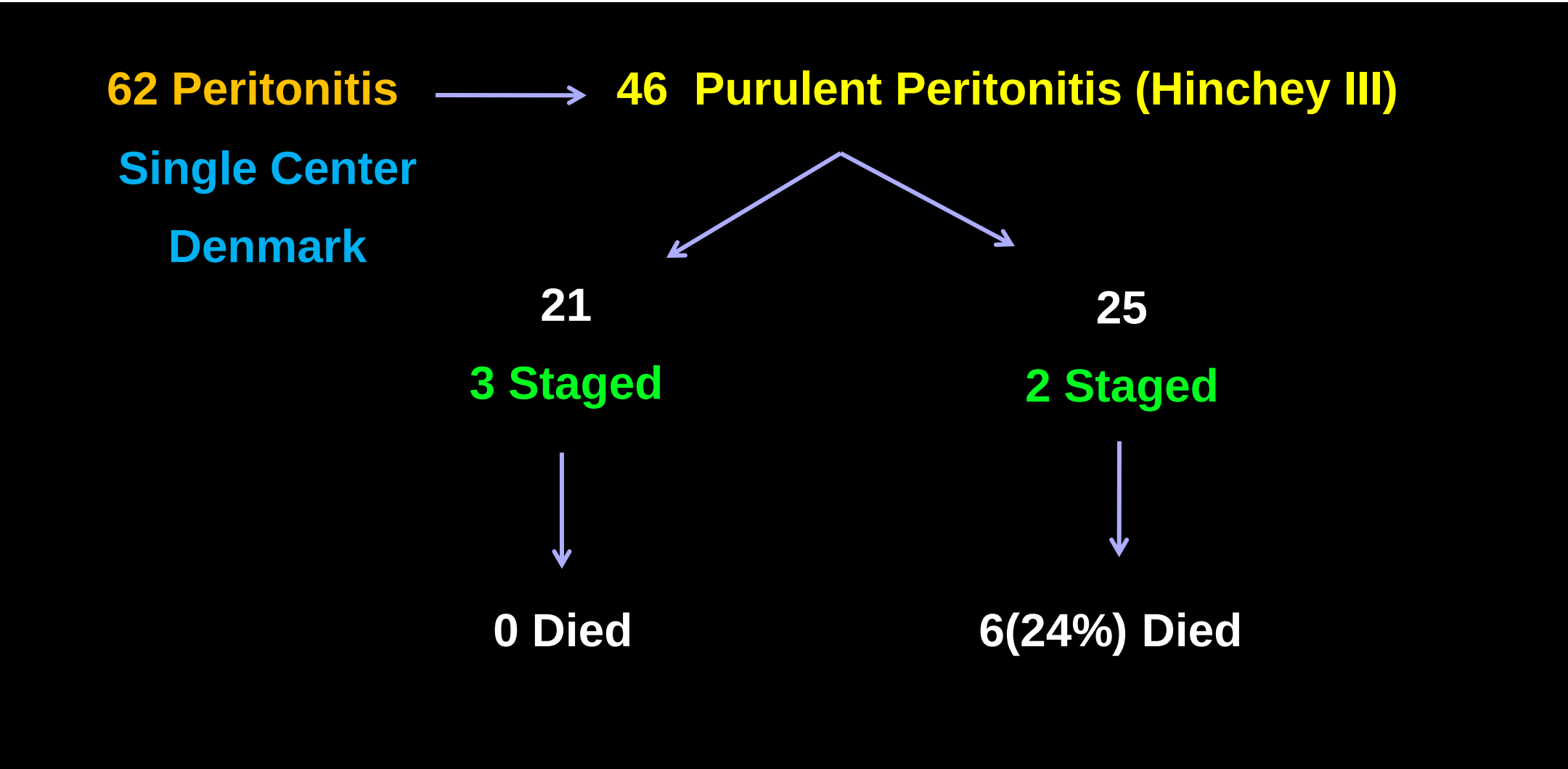
↓ morbidity (20% fistula in nonresected patients)

Treatment of perforated sigmoid diverticulitis:

A prospective randomized trial

O. Kronborg

Br J Surg 1993



Multicentre, randomized clinical trial of primary *versus* secondary sigmoid resection in generalized peritonitis complicating sigmoid diverticulitis

G. Zeitoun, A. Laurent, F. Rouffet*, J.-M. Hay, A. Fingerhut†, J.-C. Paquet‡, C. Peillon§ and th
French Associations for Surgical Research

Br J Surg 2000

103 Generalized Peritonitis (Hinchey III & IV)

Multicenter

	48	55
	3 Staged	2 Staged
Postop Peritonitis	10 (20%)	1 (2%) *
Mortality	9 (18%)	13 (23%)

* $P < 0.05$

Practice Parameters for the Treatment of Sigmoid Diverticulitis—Supporting Documentation

PREPARED BY
THE STANDARDS TASK FORCE
THE AMERICAN SOCIETY OF COLON AND RECTAL SURGEONS

REVISED

Drs. W. Douglas Wong and Steven D. Wexner, Project Directors;
Ann Lowry, Chairman; Anthony Vernava III, Vice Chairman, Marcus Burnstein, Frederick Denstman, Victor Fazio, Bruce Kerner, Richard Moore, Gregory Oliver, Walter Peters, Theodore Ross, Peter Senatore, Clifford Simmang

Dis Colon Rectum 2000

Perforated Diverticulitis with Peritonitis

Procedure of choice is segmental resection with colostomy

2 - Stage Hartmann's Procedure

Primary anastomosis with a defunctioning stoma versus Hartmann's procedure for perforated diverticulitis—a comparison of stoma reversal rates

P. H. Alizai • M. Schulze-Hagen • C. D. Klink • F. Ulmer •
A. A. Roeth • U. P. Neumann • M. Jansen • R. Rosch

Only ~50% of colostomies are reversed

Colostomy reversal is a high morbidity procedure

1 Stage PRA

Primary Resection With Anastomosis *vs.* Hartmann's Procedure in Nonelective Surgery for Acute Colonic Diverticulitis: A Systematic Review

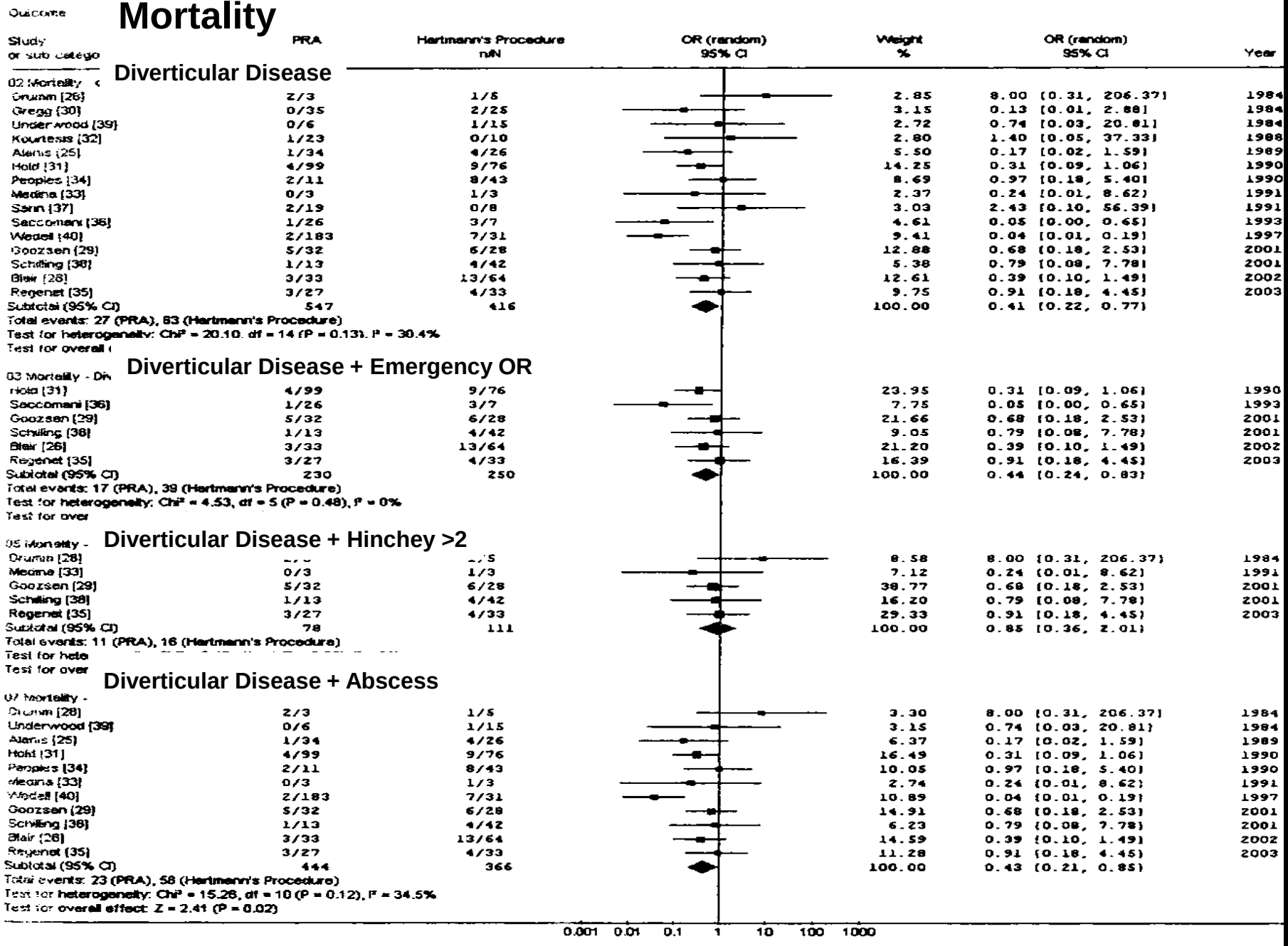
Vasilis A. Constantinides, B.Sc., M.B.B.S.,[1] Paris P. Tekkis, M.D., F.R.C.S.,[1]
Thanos Athanasiou, Ph.D., F.E.T.C.S.,[1] Omer Aziz, M.R.C.S.,[1]
Sanjay Purkayastha, M.B.B.S., M.R.C.S.,[1] Feza H. Remzi, M.D.,[2]
Victor W. Fazio, M.B., M.S.,[2] Nail Aydin, M.D.,[2] Ara Darzi, K.B.E., F.R.C.S.,[1]
Asha Senapati, Ph.D., F.R.C.S.[3]

Dis Colon Rectum 2006

15 comparative studies published from 1984 – 2004

(13 retrospective, 2 prospective nonrandomized)

Mortality



Diverticular Disease

Diverticular Disease + Emergency OR

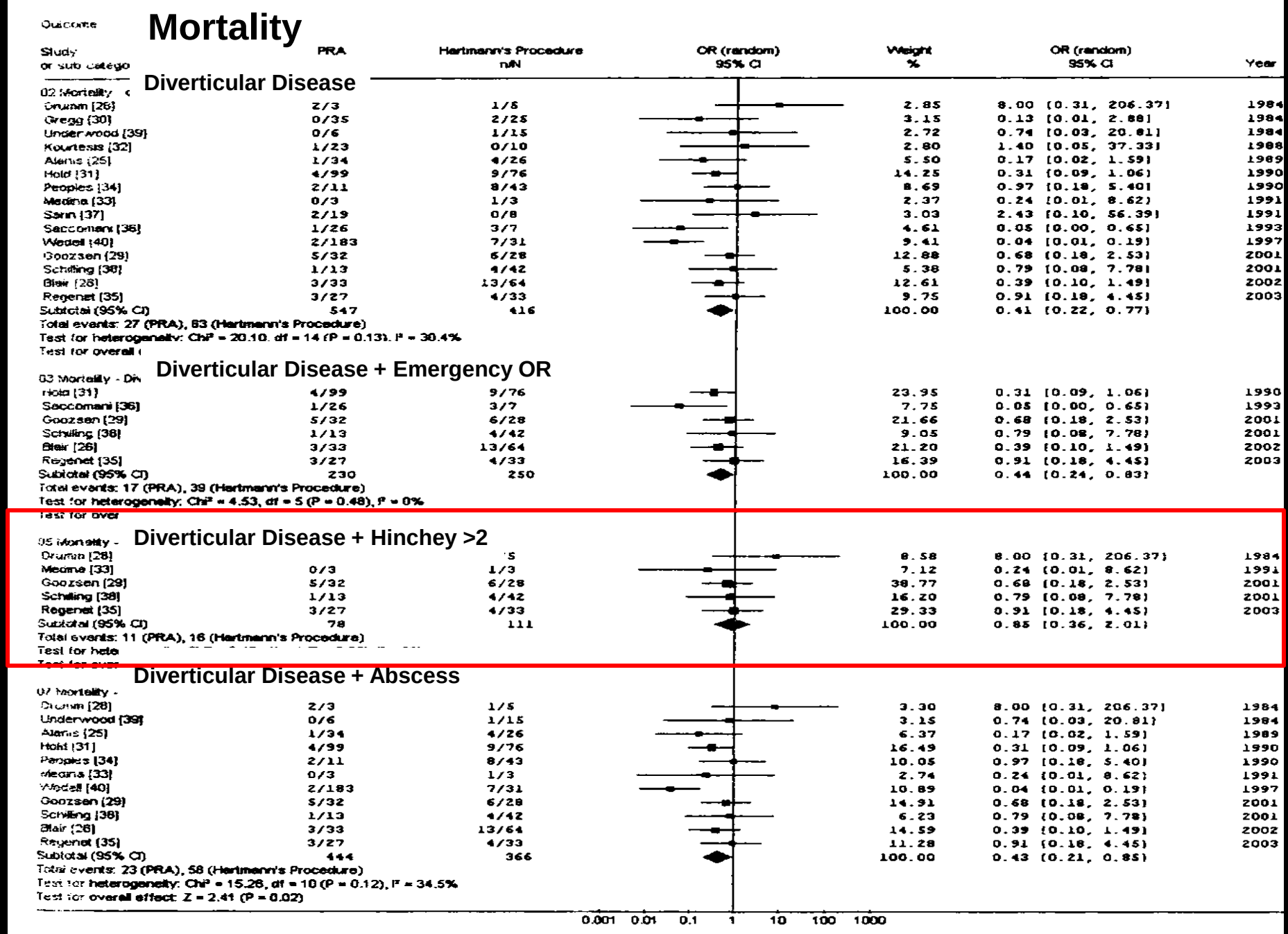
Diverticular Disease + Hinchey >2

Diverticular Disease + Abscess

Figure 1. P
Total numbe

= number of deaths/

Mortality



Diverticular Disease

Diverticular Disease + Emergency OR

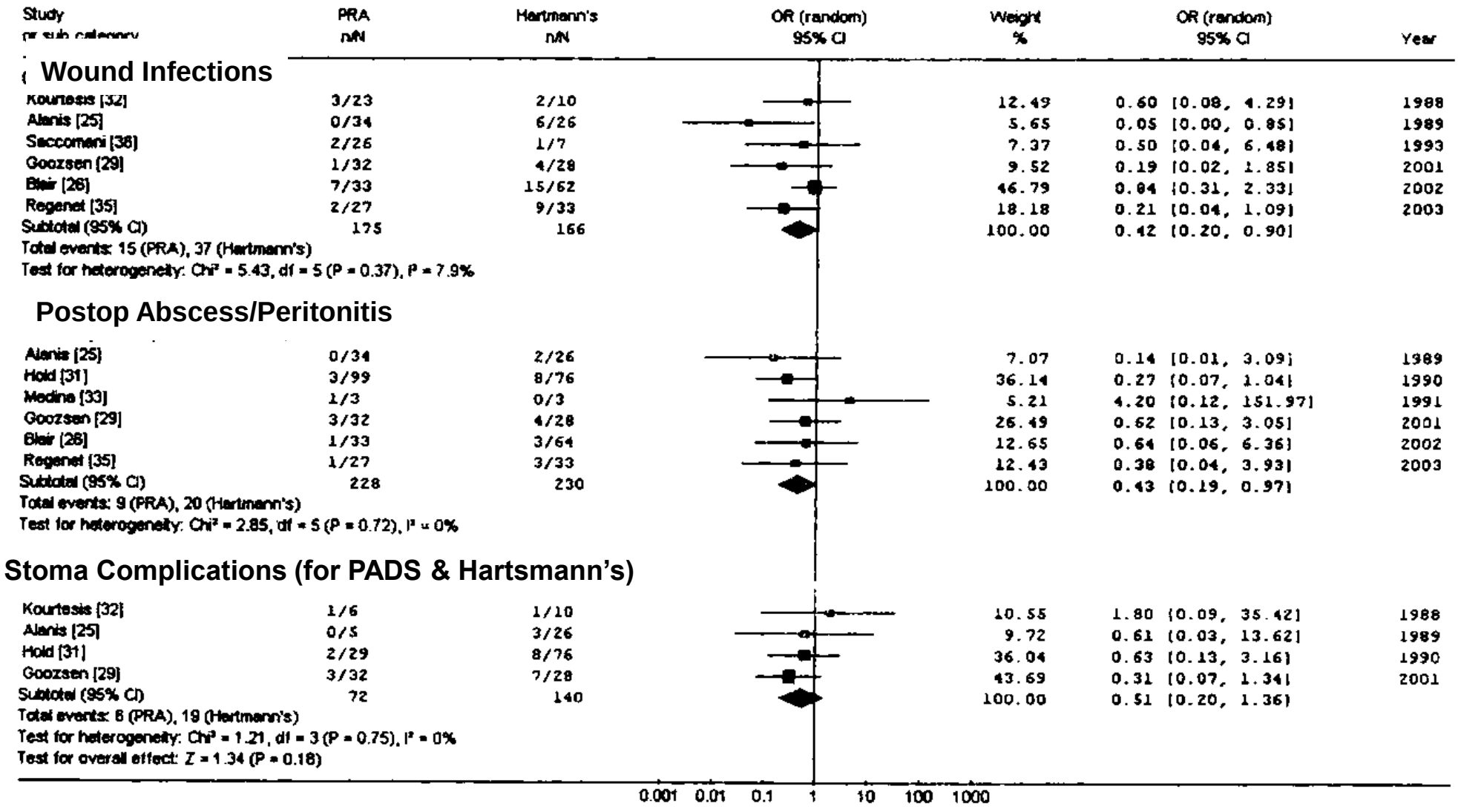
Diverticular Disease + Hinchey >2

Diverticular Disease + Abscess

Figure 1. P
Total numbe

= number of deaths/

Surgical Complications



Obvious Select Bias – Hard to Extrapolate But

Emergency PRA has low rate of anastomosis leak (6%)

PRA and Hartmann's had similar operative time

All Hinchey >2 subset : equal mortality (14.1% vs 14.4%)

Practice Parameters for Sigmoid Diverticulitis

Janice Rafferty, M.D., Paul Shellito, M.D., Neil H. Hyman, M.D., W. Donald Buie, M.D., and the Standards Committee of The American Society of Colon and Rectal Surgeons

Dis Colon Rectum 2006

Perforated Diverticulitis with Peritonitis

Alternatives are Hartmann's procedure or PRA with or without intraoperative lavage.

The role proximal diversion remains unsettled.

Laparoscopic Lavage for Perforated Diverticulitis: A Population Analysis

Ailín C. Rogers, M.B., B.Ch., B.A.O.[1,2] • Danielle Collins, M.D.[1]
Gerald C. O'Sullivan, F.R.C.S.I.[1,†] • Desmond C. Winter, M.D., F.R.C.S.I.[1,2]

DISEASES OF THE COLON & RECTUM VOLUME 55: 9 (2012)

		Study characteristics			Patient outcomes		
Authors		*No. of patients*	*Study design*	*Country*	*Length of stay, d*	*Complication n (%)*	*Mortality n (%)*
O'Sullivan et al[7]	**1996**	8	Case series	Ireland	10	2 (25)	0
Aouad et al[25]		1	Case report	France		0	0
Taylor et al[9]		12[a]	Case series	Australia	7	1 (12)	0
Mutter et al[26]		10	Case series	France	9	1 (10)	0
Galleano et al[27]		4	Case series	Italy	-	0	0
Myers et al[10]		92[a]	Cohort study	Ireland	8	5 (4)	3 (3)
Bretagnol et al[14]		24	Cohort study	France	12	2 (8)	0
Franklin et al[13]		40	Case series	USA	3	2 (5)	0
Mazza et al[28]		25	Case series	France	14	3 (12)	0
Lam et al[29]		6	Case series	Belgium	11	3 (50)	0
Favuzza et al[30]		7	Case series	USA	8	2 (28)	0
Jaffer et al[31]		1	Case report	UK	5	0	0
Karoui et al[32]		35	Case series	France	8	7 (17)	0
Lippi et al[33]		13[a]	Case series	Italy	-	2 (15)	3 (23)
White et al[15]		35	Case series	Australia	14	12 (34)	0
Huscher et al[34]		1	Case report	Italy	5	0	0
This study	**2012**	427	Population	Ireland	10	60 (14)	17 (4)
Total		**768 Patients from 17 studies**			10	13	3

Laparoscopic peritoneal lavage for generalized peritonitis due to perforated diverticulitis

E. Myers[1], M. Hurley[2], G. C. O'Sullivan[3], D. Kavanagh[1], I. Wilson[2] and D. C. Winter[1]

Br J Surg 2008

1257 Patient Admitted For Diverticulitis over 7 years

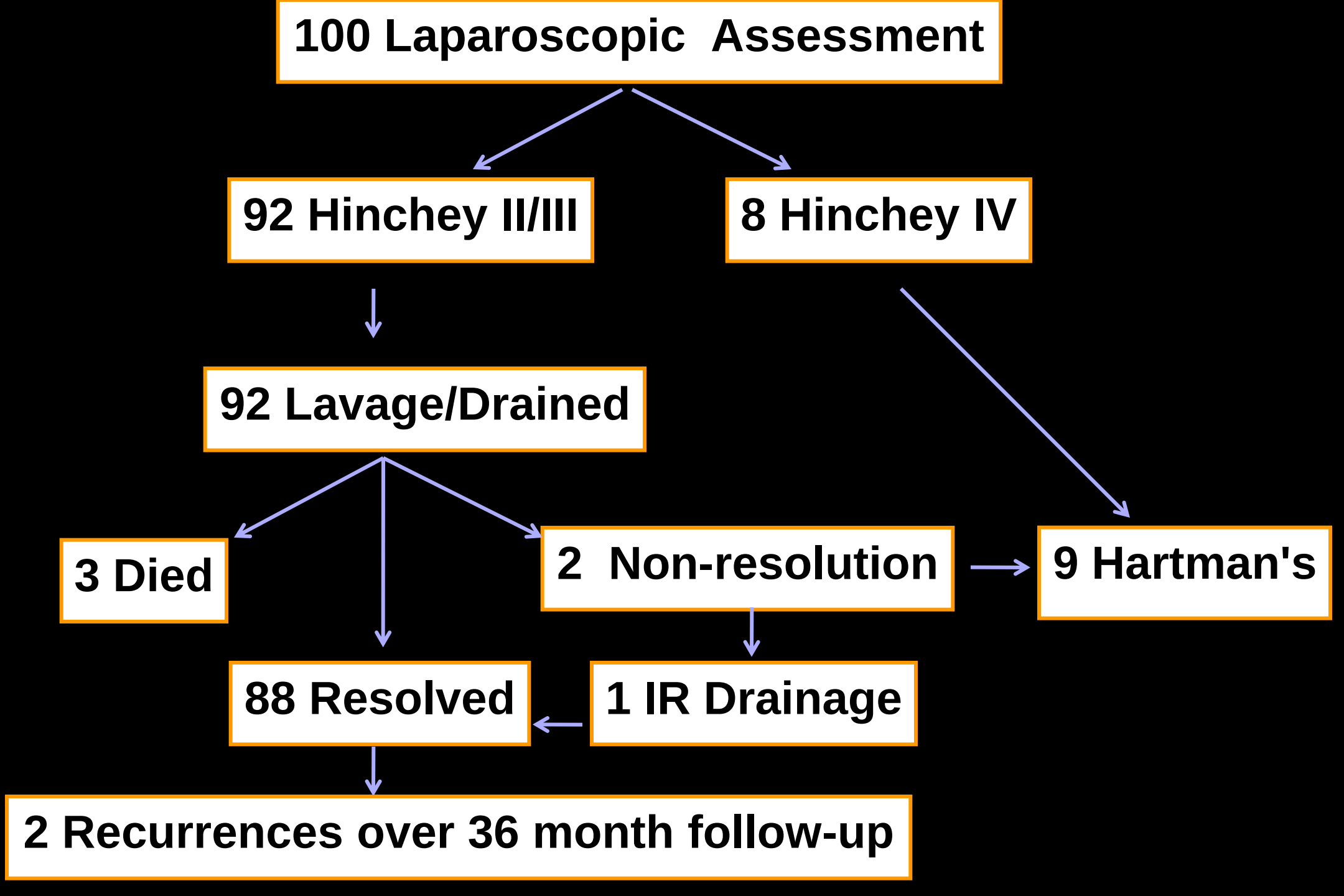
↓

100 (7%) had Peritonitis + Evidence Free Air on X-ray or CT

Resuscitated

3rd Generation Cephalosporin + Flagyl

Taken Emergently to OR for Laparoscopy


100 Laparoscopic Assessment
92 Hinchey II/III
8 Hinchey IV
92 Lavage/Drained
3 Died
2 Non-resolution
9 Hartman's
88 Resolved
1 IR Drainage
2 Recurrences over 36 month follow-up

Damage control strategy for the management of perforated diverticulitis with generalized peritonitis: laparoscopic lavage and drainage vs. laparoscopic Hartmann's procedure

Song Liang · Karla Russek · Morris E. Franklin Jr.

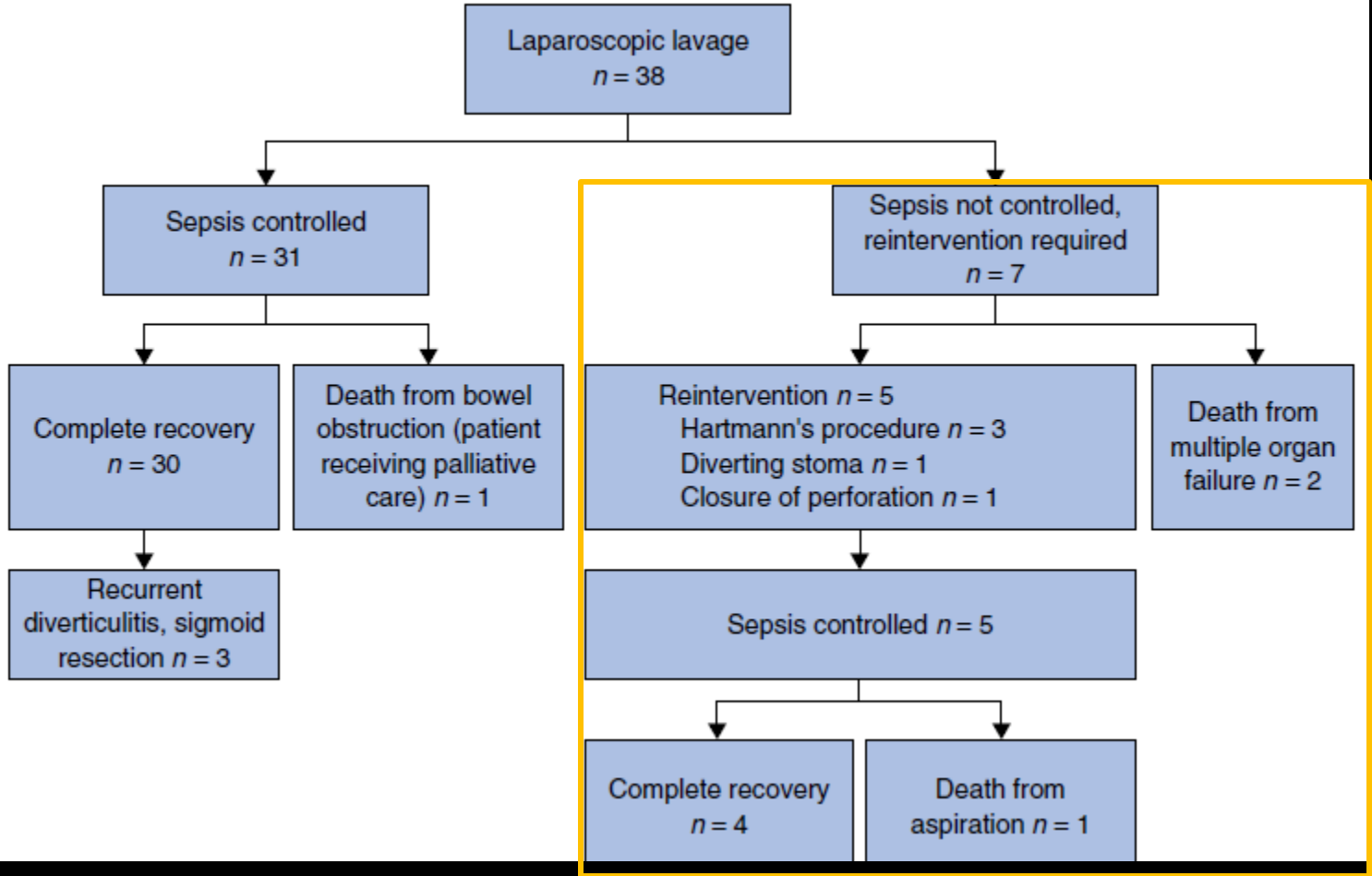
Surg Endosc 2012

	LLD	LHP	p value
# of Patients	47	41	
OR Time (minutes)	100 ± 40	182 ± 55	0.001
Blood Loss (ml)	34 ± 21	210 ± 17	0.01
Conversion	2 %	15 %	0.05
Complications	4 %	13 %	0.05
Mortality	0 %	2.4%	ns
Hospital Stay (days)	6.6 ± 2.4	16.6 ± 10	0.01
Colostomy Closure	na	72%	na
Elective Resection	45%	na	na

Early experience with laparoscopic lavage for perforated diverticulitis

H. A. Swank[1], I. M. Mulder[2], A. G. M. Hoofwijk[3], S. W. Nienhuijs[4], J. F. Lange[2] and W. A. Bemelman[1], on behalf of the Dutch Diverticular Disease Collaborative Study Group

Br J Surg 2013



Contraindicated in:

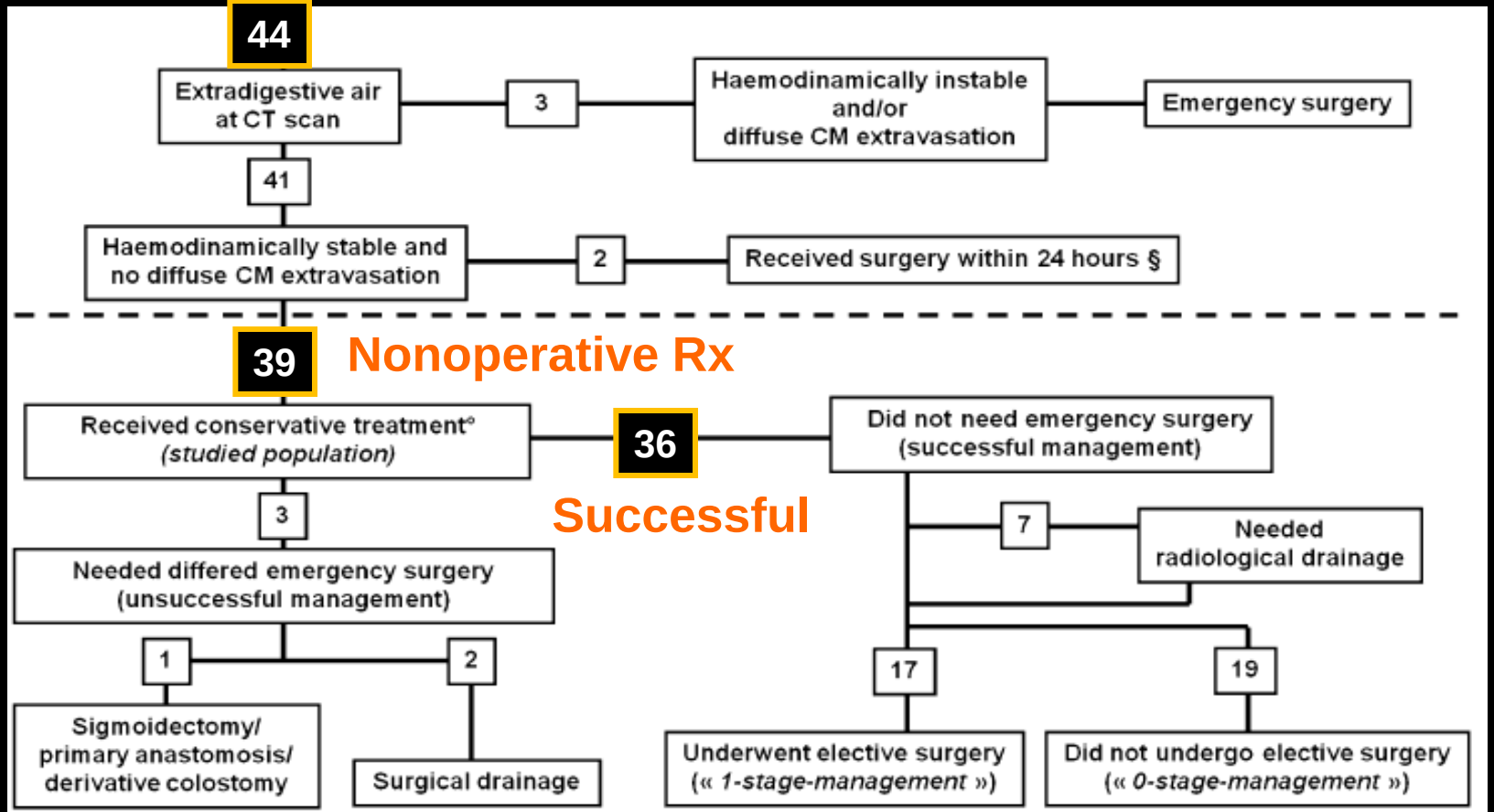
- **Stage IV**
- **Stage III**
- **Major Comorbidity**
- **Immunosuppression**
- **High CRP**

Challenging a classic myth: pneumoperitoneum associated with acute diverticulitis is not an indication for open or laparoscopic emergency surgery in hemodynamically stable patients. A 10-year experience with a nonoperative treatment

Renato Costi · François Cauchy · Alban Le Bian · Jean-François Honart · Nicolas Creuze · Claude Smadja

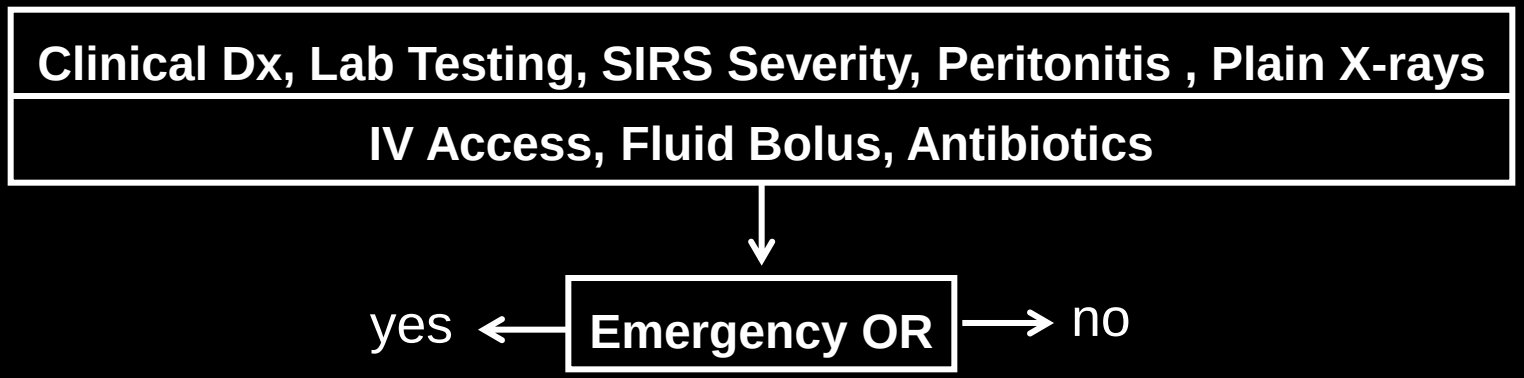
Surg Endosc (2012) 26:2061–2071

Used Rectal Contrast CT scanning to rule out stage IV disease



Management of Complicated Diverticulitis

ED



Peritonitis

Severe Sepsis

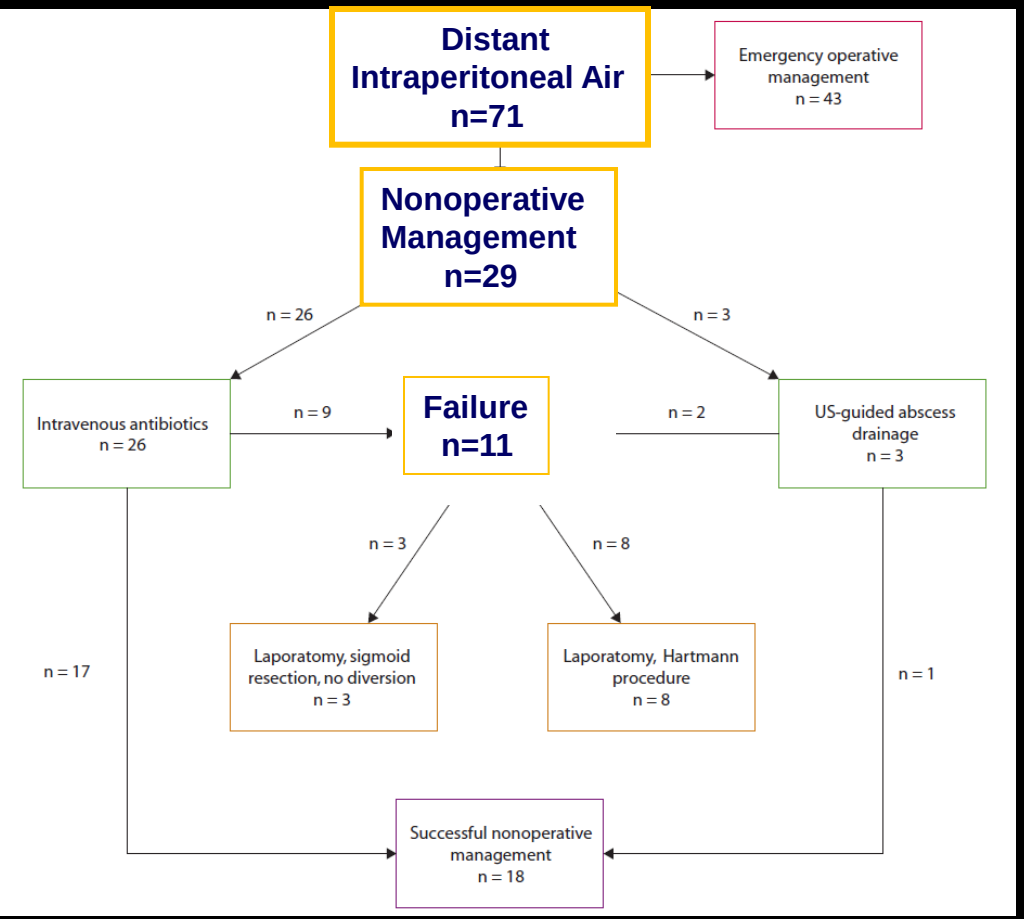
Free Air on Plain X-rays or CT scan ?

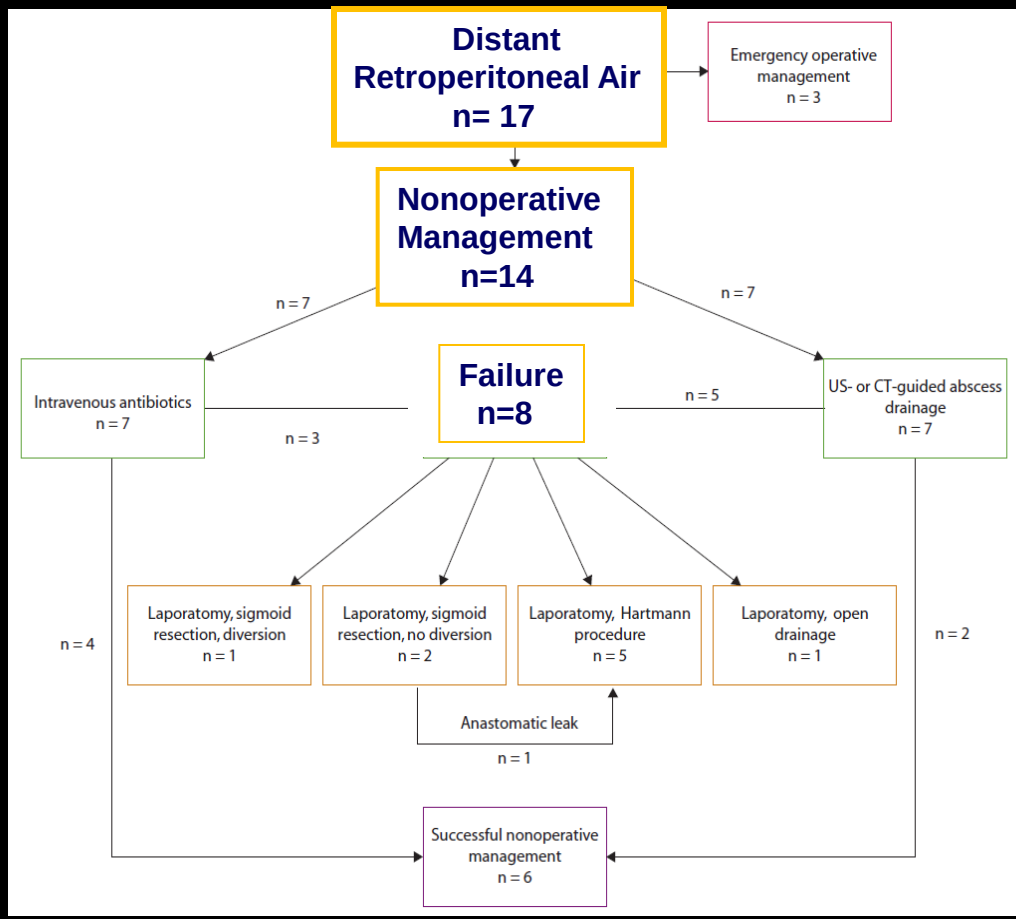
Nonoperative Management of Perforated Diverticulitis With Extraluminal Air Is Safe and Effective in Selected Patients

Helsinki, Finland

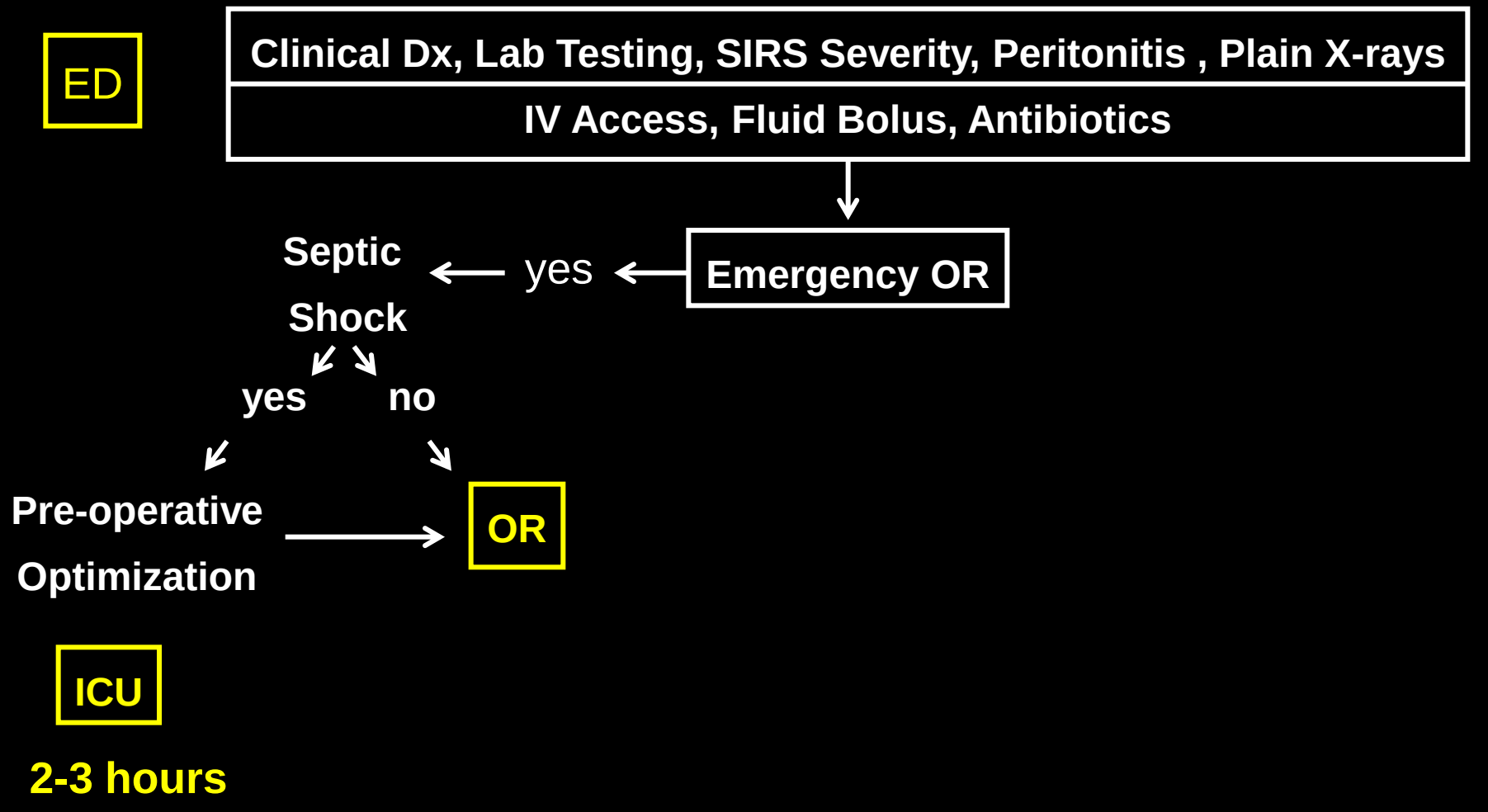
Ville J. Sallinen, M.D., Ph.D. • Panu J. Mentula, M.D., Ph.D.
Ari K. Leppäniemi, M.D., Ph.D.

Dis Colon Rectum 2014; 57: 875–881

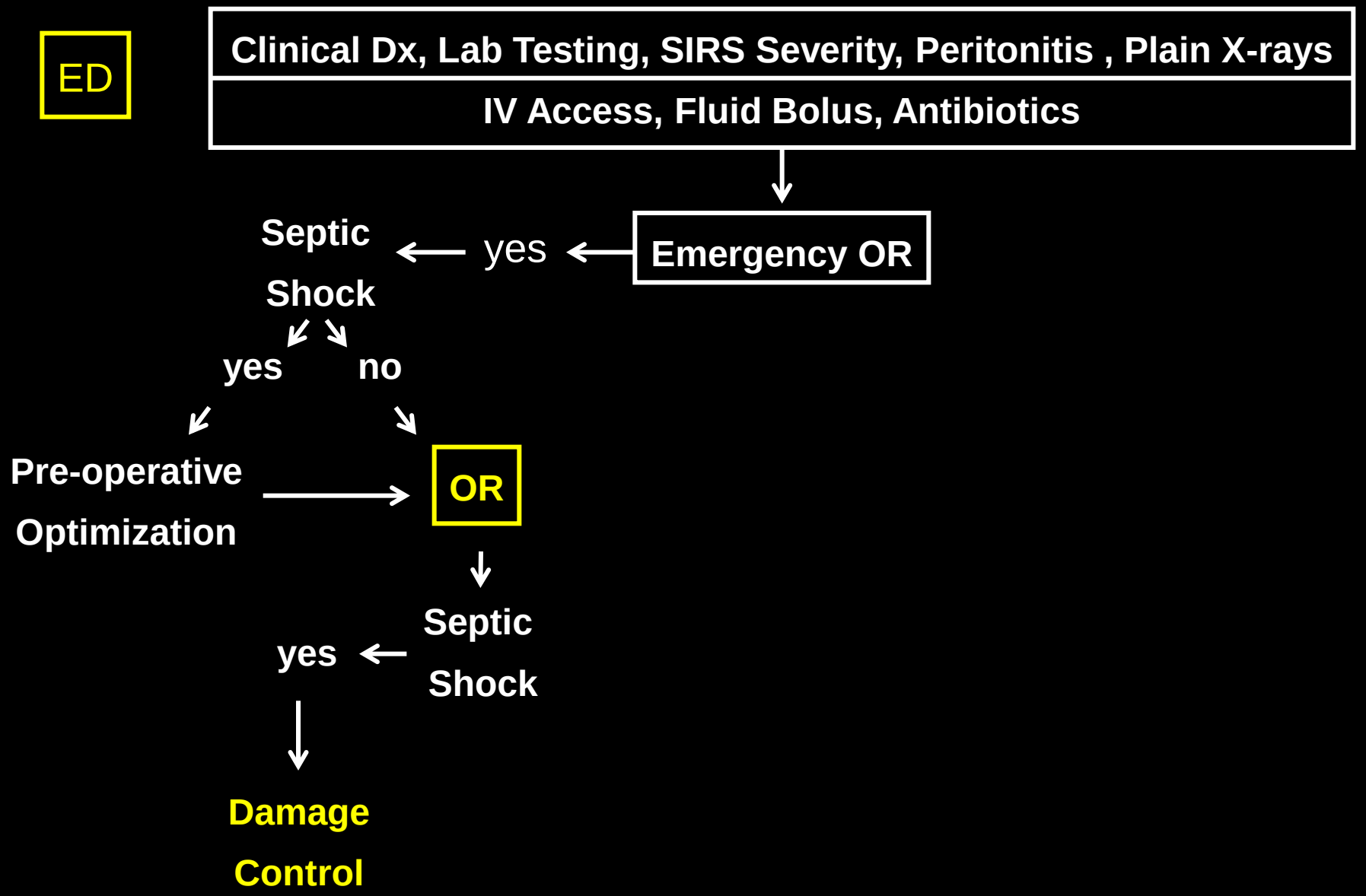




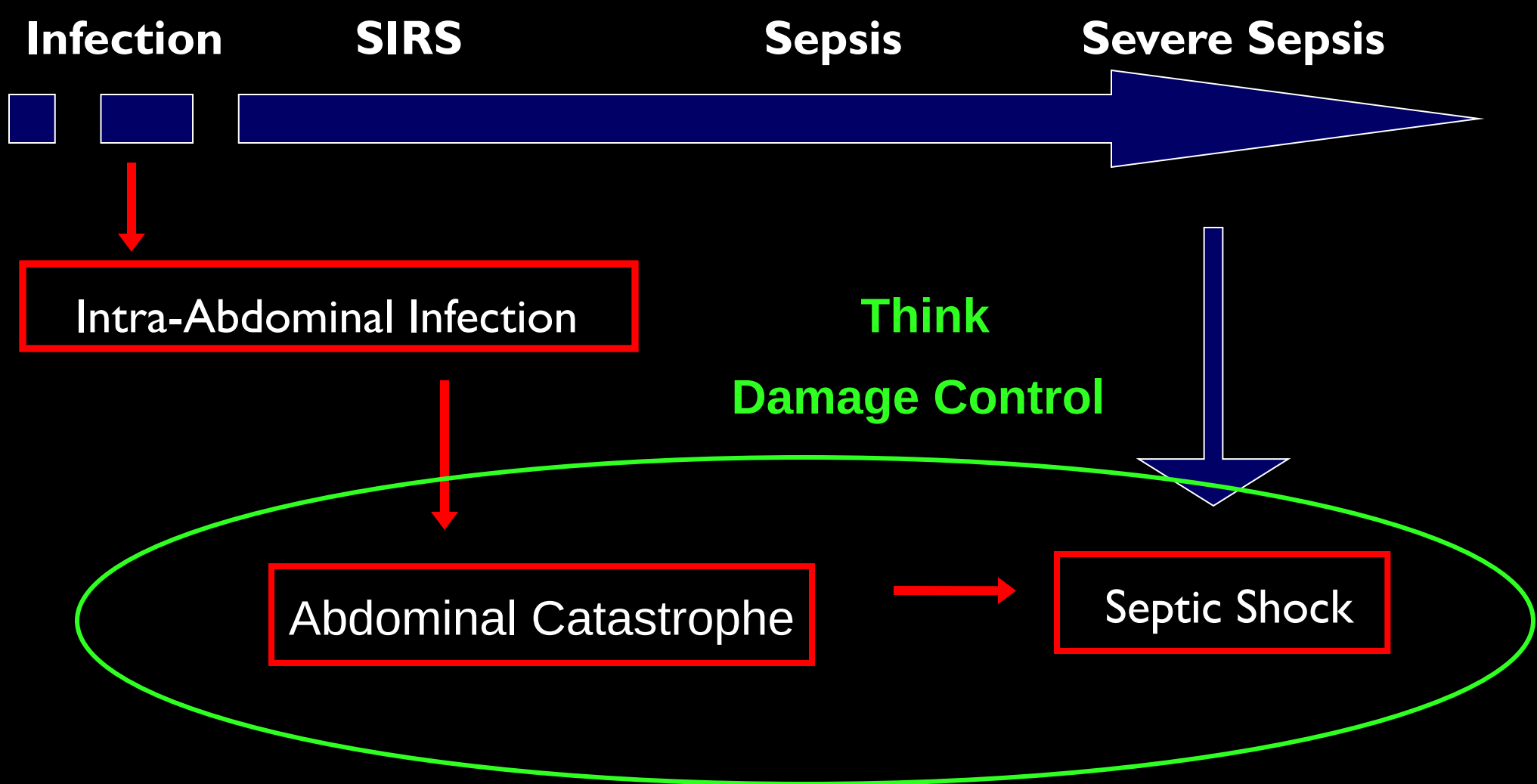
Management of Complicated Diverticulitis



Management of Complicated Diverticulitis



The Septic Abdomen and Sepsis



Joined New Surgery Department in August 2006

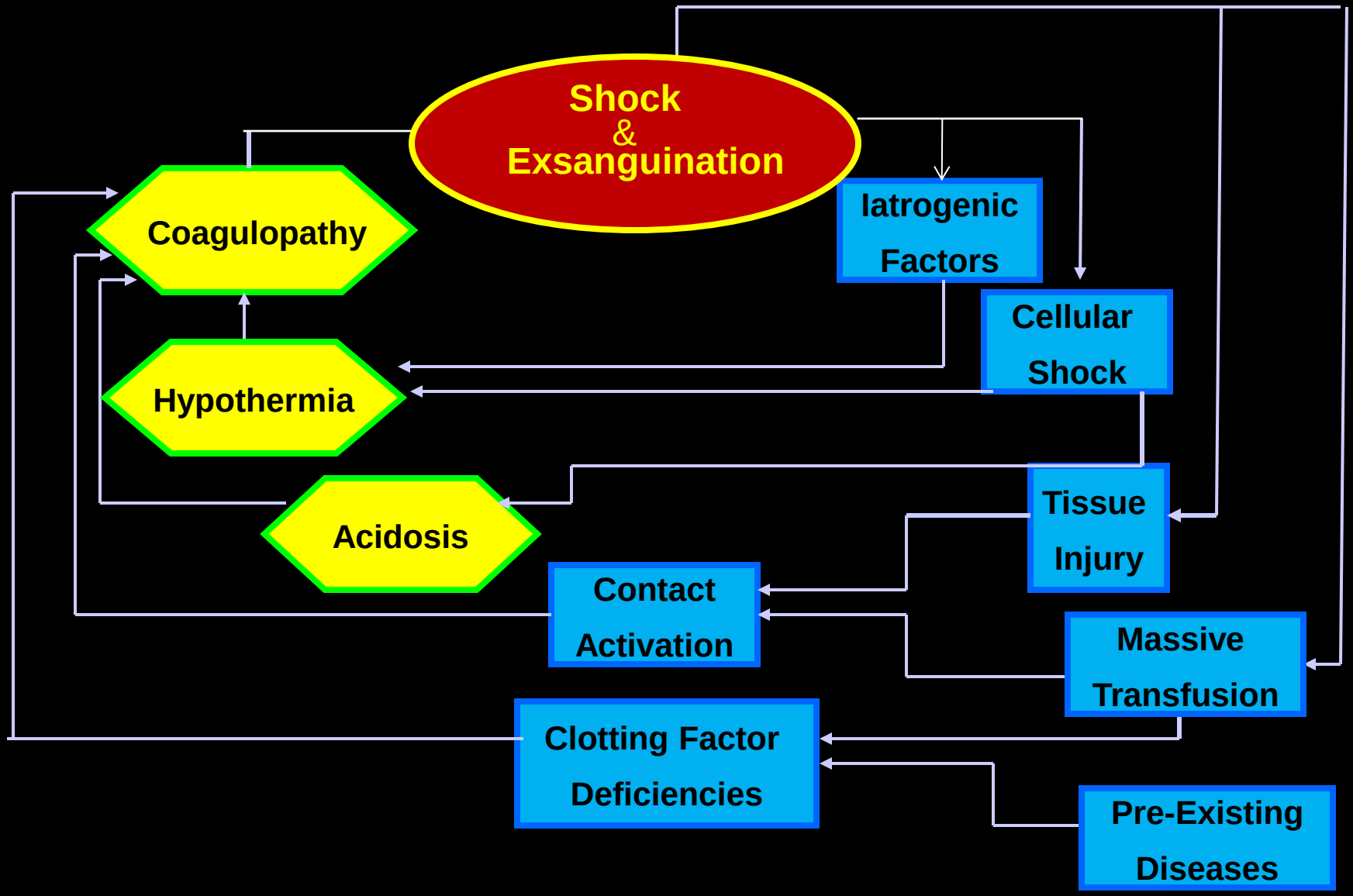
Chair - Barbara Bass

The Methodist Hospital (TMH), Houston TX

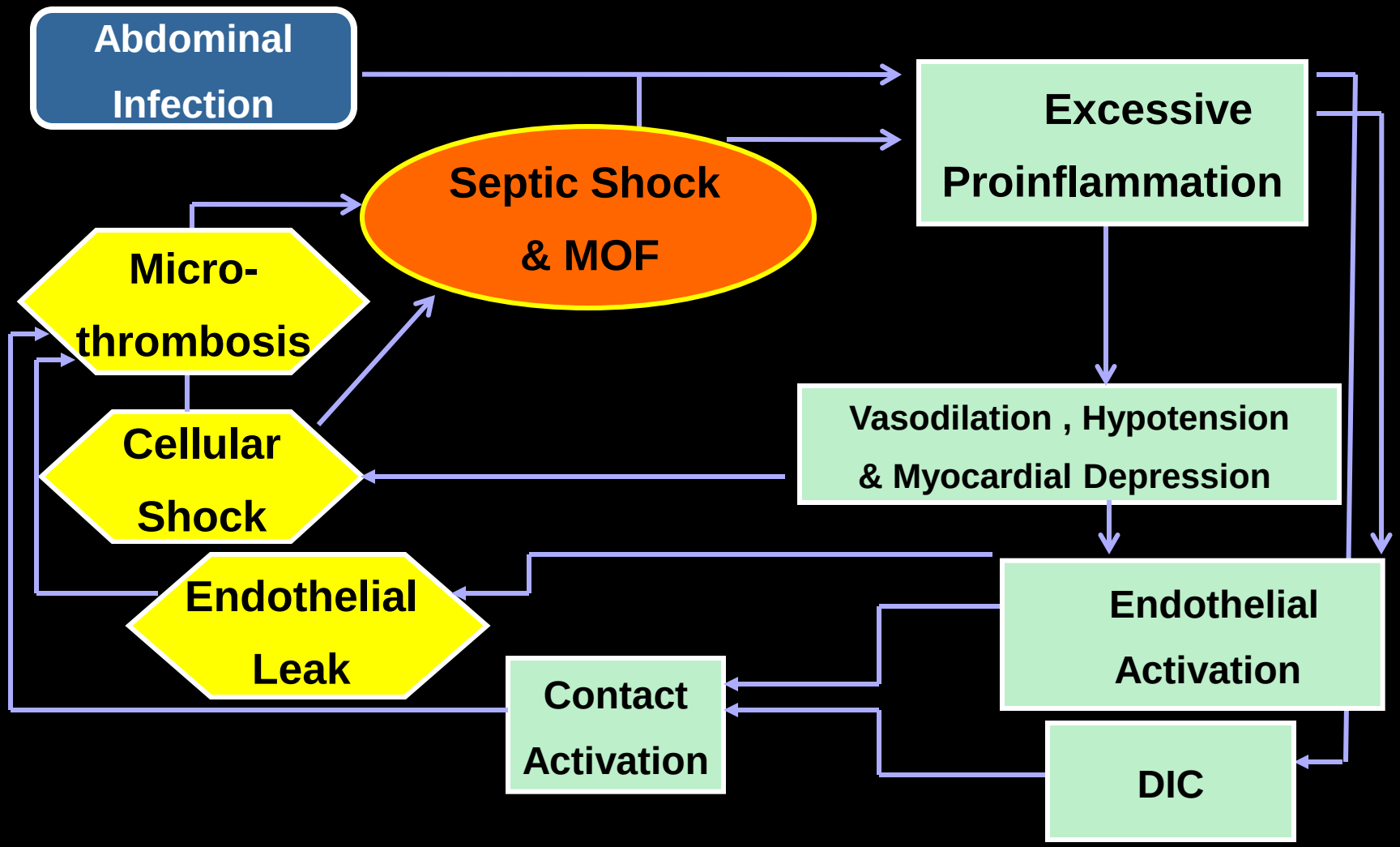
Sepsis in major killer in surgical ICU

Rationale for Damage Control in Trauma

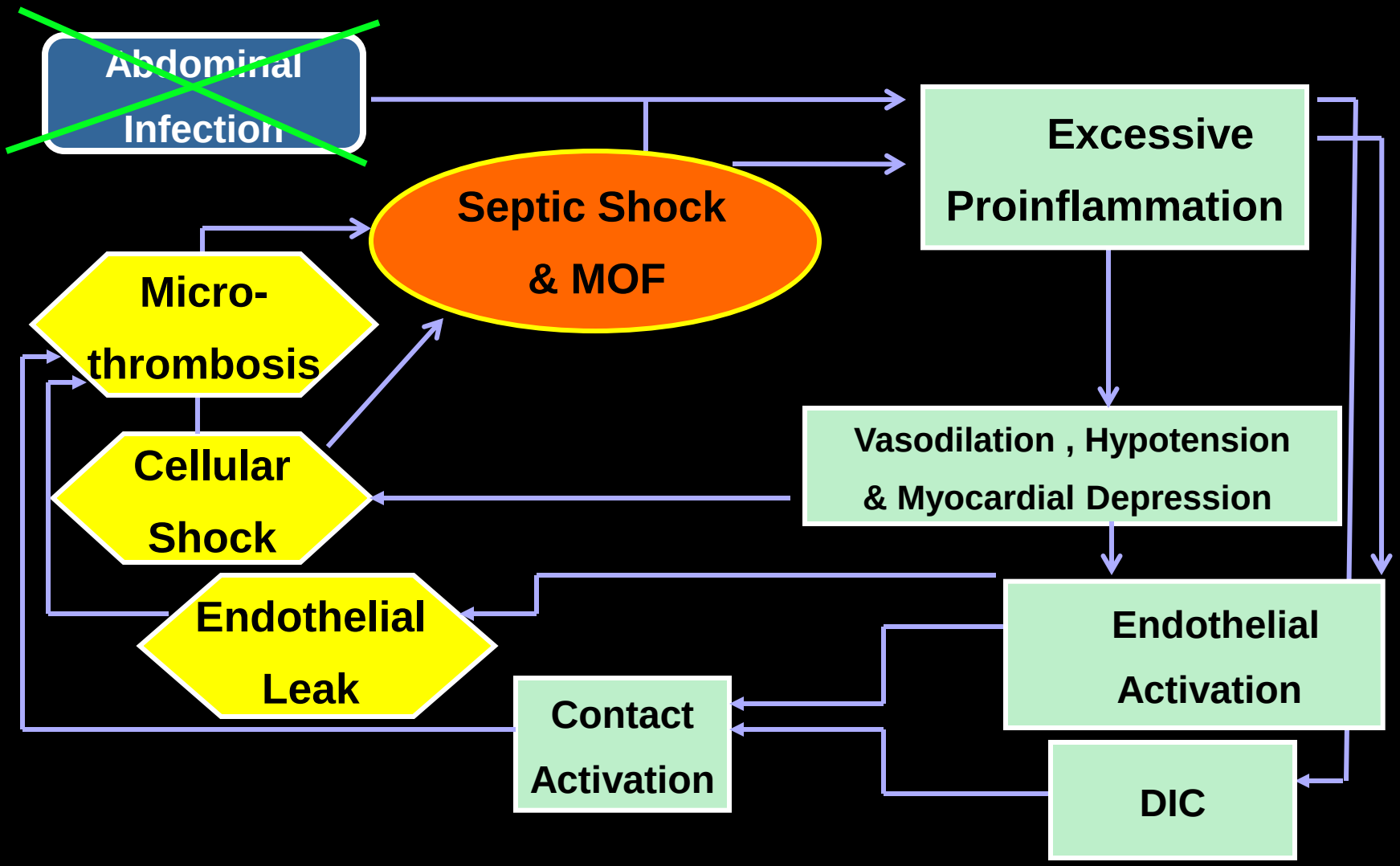
"The Bloody Vicious Cycle"



The Persistent Septic Shock Cycle



Break the Persistent Septic Shock Cycle



Prevent Acute Kidney Injury

Acute kidney injury is surprisingly common and a powerful predictor of mortality in surgical sepsis

Laura E. White, MD, Heitham T. Hassoun, MD, Azra Bihorac, MD, Laura J. Moore, MD, R. Matt Sailors, Bruce A. McKinley, PhD, Alicia Valdivia, *and* **Frederick A. Moore, MD,** *Houston, Texas*

J Trauma Acute Care Surg. 2013;75: 432–438. C

TABLE 4. Severity of AKI and Outcomes in Surgical Sepsis

	No AKI, 85 (35%)	Risk, 48 (30%)	Injury, 35 (22%)	Failure, 78 (48%)
Ventilator-free days	25 ± 1	21 ± 1*	21 ± 2*	15 ± 1***†
Dialysis-free days	28 ± 0	27 ± 1	25 ± 2*	19 ± 1***†
ICU-free days	21 ± 1	17 ± 1*	17 ± 2	12 ± 1***†
Secondary infections, n (%)	6 (7)	5 (10)	4 (11)	18 (23)*
Early MOF, n (%)	1 (1)	5 (10)*	5 (14)*	21 (27)***
Late MOF, n (%)	1 (1)	2 (4)	1 (3)	7 (9)*
ICU mortality (%)	1	4	11*	28***†
Hospital mortality, n (%)	2	4	26***	36***
Discharged home, n (%)	52 (63)	18 (39)*	14 (54)	19 (38)*

*$p < 0.05$ versus no AKI.
**$p < 0.05$ versus risk.
†$p < 0.05$ versus injury by t test.
‡$p = 5.0 \times 10^{-7}$ by χ^2 test.
All continuous variables expressed as mean ± SEM.

Damage Control
Pre-operative Optimization

- Secure airway / vascular access
- Volume resuscitation
- Broad spectrum anti-microbials
- Blood products as necessary
- Vasopressors as necessary
- Correct Electrolytes

Damage Control Laparotomy

Complete by 6 hours

- Source control
- Resect & Debride Dead Bowel
- Close Holes to Limit Contamination
- Hemorrhage Control/Pack
- Limited Irrigation/Drain
- Temporary abdominal closure

"Perforectomy"

Damage Control
Post-operative Optimization

- Resuscitation
- Ventilator support
- Coagulopathy correction
- Rewarming
- Monitoring for ACS
- Surviving Sepsis Campaign

Damage Control
Second Operation

- Re-opening of laparotomy
- Pack removal
- Further resection/debridement
- Ostomy vs Bowel Anastomosis
- Feeding tubes, drains
- Close Fascia vs Wound Vac

Management of Colon Wounds in the Setting of Damage Control Laparotomy: A Cautionary Tale

Jordan A. Weinberg, MD, Russell L. Griffin, MPH, Marianne J. Vandromme, MD, Sherry M. Melton, MD, Richard L. George, MD, Donald A. Reiff, MD, Jeffrey D. Kerby, MD, PhD, and Loring W. Rue, III, MD

Birmingham, Alabama

Delayed Anastomosis = 12% leak

J Trauma 2009

Primary repair of civilian colon injuries is safe in the damage control scenario

Jeffry L. Kashuk, MD, FACS, C. Clay Cothren, MD, Ernest E. Moore, MD, Jeffrey L. Johnson, MD, Walter L. Biffl, MD, *and* Carlton C. Barnett, MD, *Denver, CO*

Delayed Anastomosis = 13% leak

Surgery 2009

Damage Control Laparotomy and the Open Abdomen: Is There an Increased Risk of Colonic Anastomotic Leak

Mickey M Ott, MD, Patrick Norris, PhD, Bryan Collier, D0, Oliver L. Gunter MD, William Riordan, MD, Jose Diaz, MD, Vanderbilt University Medical Center

Delayed Anastomosis = 27% leak

J Trauma 2011

SAFETY OF PERFORMING DELAYED ANASTOMOSIS DURING DAMAGE CONTROL LAPARAROTOMY FOR DESTRUCTIVE COLON INJURIES

Carlos Ordenez, MD, Luis Pino, MD, Marisol Badiel, MD,John Loaiza, BSc, Jaun Carlos Puyana, MD, FundaciAfAn Valle del Lili Department of Surgery and Critical Care

Cila Columbia

Delayed Anastomosis = 8 % leak

J Trauma 2011

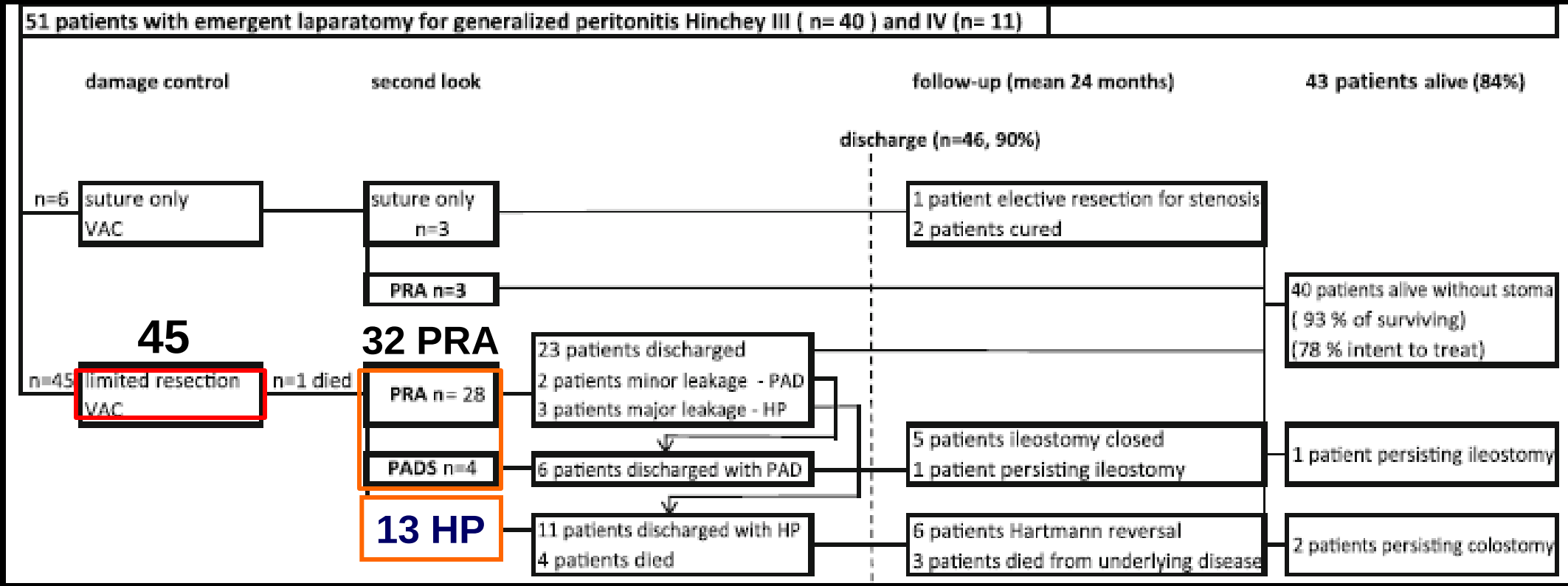
Damage Control Surgery with Abdominal Vacuum and Delayed Bowel Reconstruction in Patients with Perforated Diverticulitis Hinchey III/IV

Reinhold Kafka-Ritsch · Franz Birkfellner · Alexander Perathoner · Helmut Raab · Hermann Nehoda · Johann Pratschke · Matthias Zitt

Innsbruck, Austria

J Gastrointest Surg (2012)

51 Patients



Traditional Management of Patients with an Abdominal Infection and Septic Shock

Septic Abdomen

⬇

Operating Room

Definitive Operation

⬇

Vasopressors in OR

⬇

Early Death or

AKI ➡ MOF

Paradigm Shift in Management of Patients with an Abdominal Infection and Septic Shock

Septic Abdomen

⬇

Operating Room

Definitive Operation

⬇

Vasopressors in OR

⬇

Early Death or

AKI ➡ MOF

➡

Septic Abdomen

⬇

Resuscitation:

Volume/Antibiotics

⬇

Operating Room

Damage/Source Control

⬇

SICU Resuscitation

⬇

Prevent AKI & Live

The Availability of Acute Care Surgeons Improves Outcomes in Patients Requiring Emergent Colon Surgery

Laura Jane Moore, MD; Krista L Turner, MD; Stephen L Jones, MD; Bridget N Fahy, MD and Frederick A Moore, MD

Am J Surg 2011

Establish a Benchmark

We queried the 2005 - 2007 NSQIP dataset & our prospective sepsis database to identify patient with:

1) **Severe sepsis/septic shock (same definitions)**
2) **Emergency colon surgery**

Primary endpoint: 30 day mortality

Results

	ACS (n = 46)	NSQIP (n = 1101)
Average Age	62.3 ± 17.9	68.5 ± 13.5
Male	45 %	47.2 %
APACHE II	31 ± 8.2	Not Available
Predicted Mortality (APACHE II)*	73%	Not Available
Actual 30 Day Mortality**	28.3%	40.4%

* Actual vs. Predicted mortality p < 0.0001

** ACS vs. NSQIP mortality p = 0.06

Results

	ACS (n = 46)	NSQIP (n = 1101)
Average Age	62.3 ± 17.9	68.5 ± 13.5
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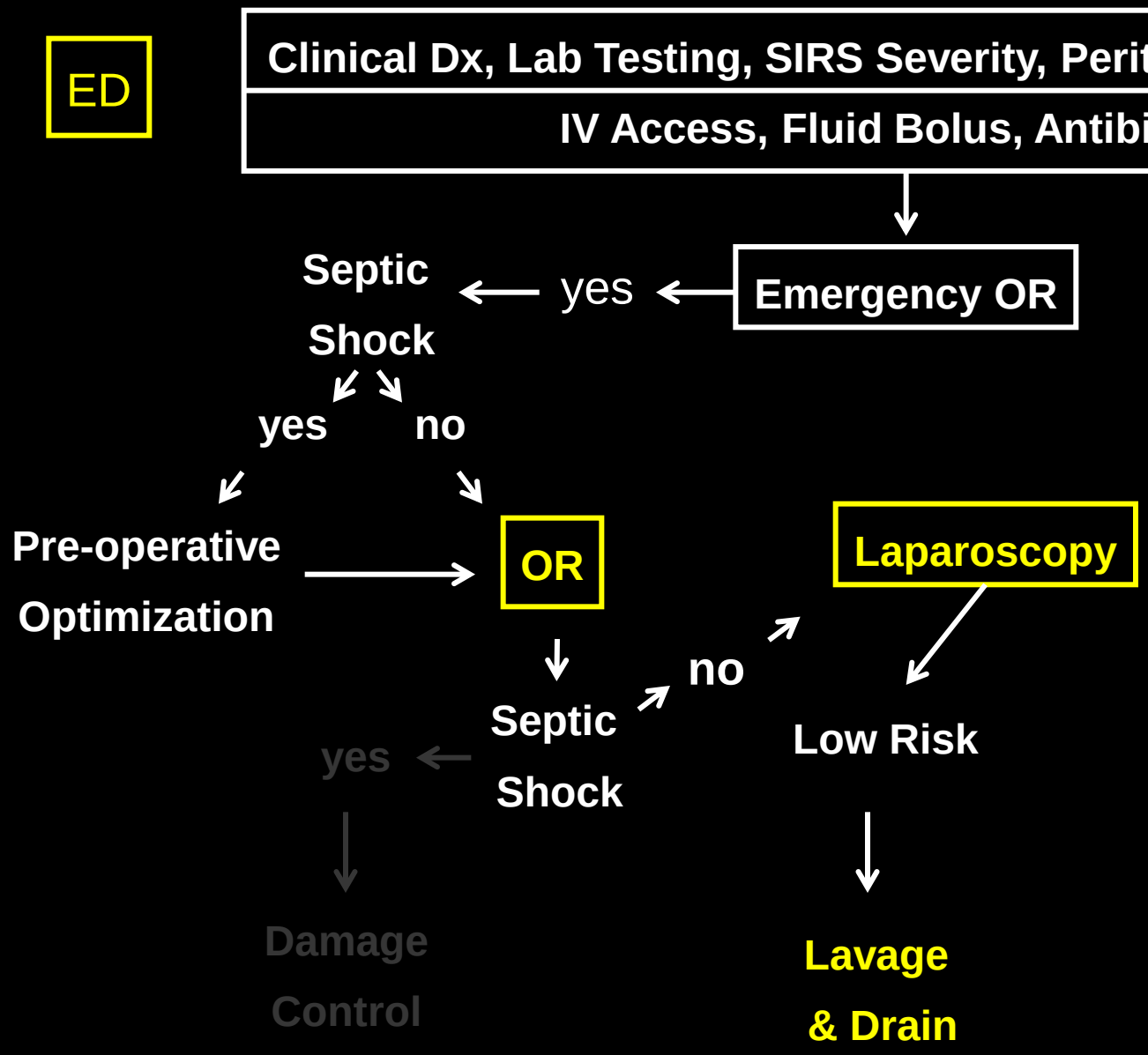
APACHE II	31 ± 8.2	Not Available
Predicted Mortality (APACHE II)*	73%	Not Available
Actual 30 Day Mortality**	28.3%	40.4%

* Actual vs. Predicted mortality p < 0.0001

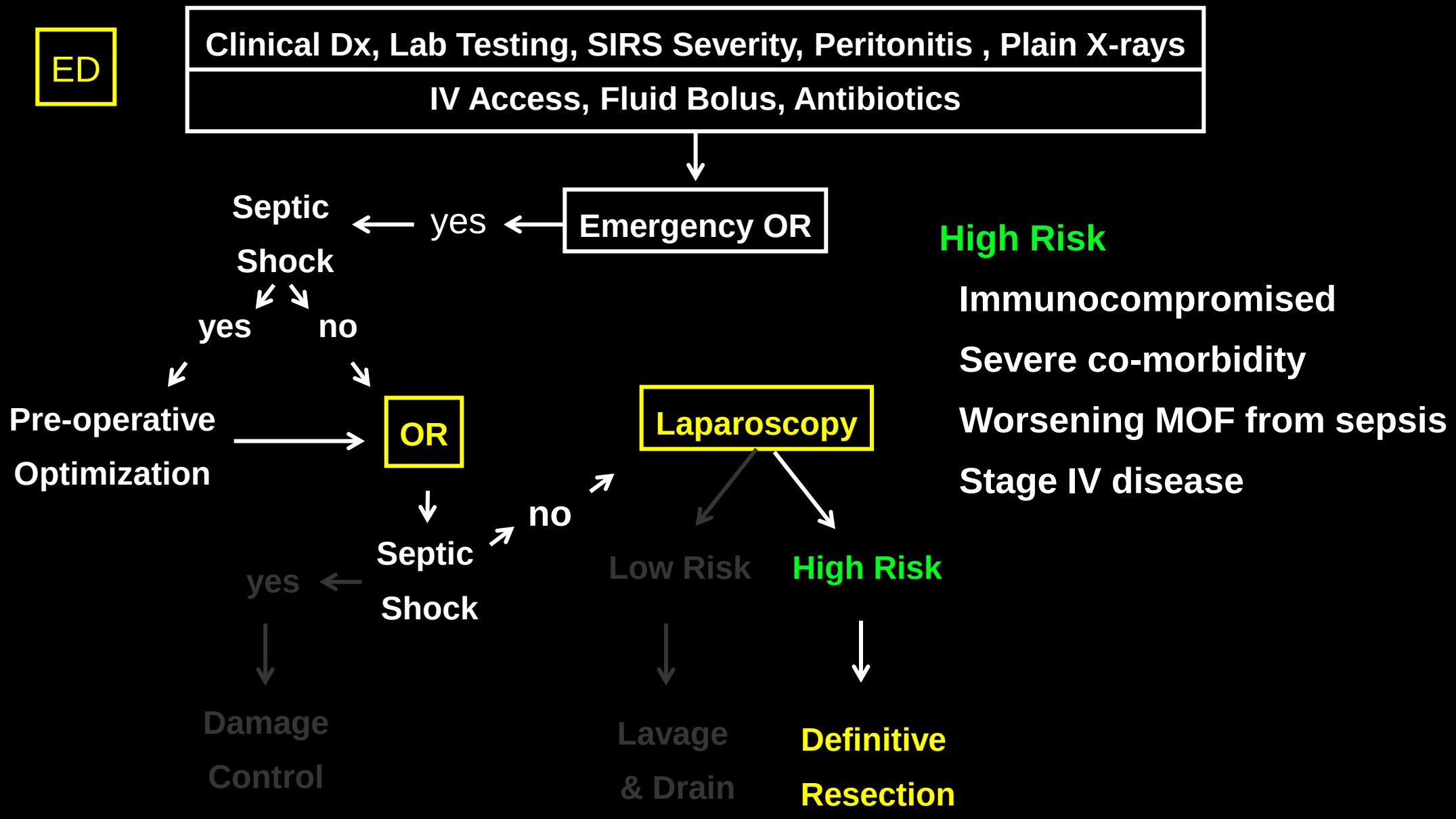
** ACS vs. NSQIP mortality p = 0.06

67% of our ACS patients underwent damage control

Management of Complicated Diverticulitis



Management of Complicated Diverticulitis



What is a Definitive Resection

proximal margin - back to normal colon

no diverticula in the anastomosis

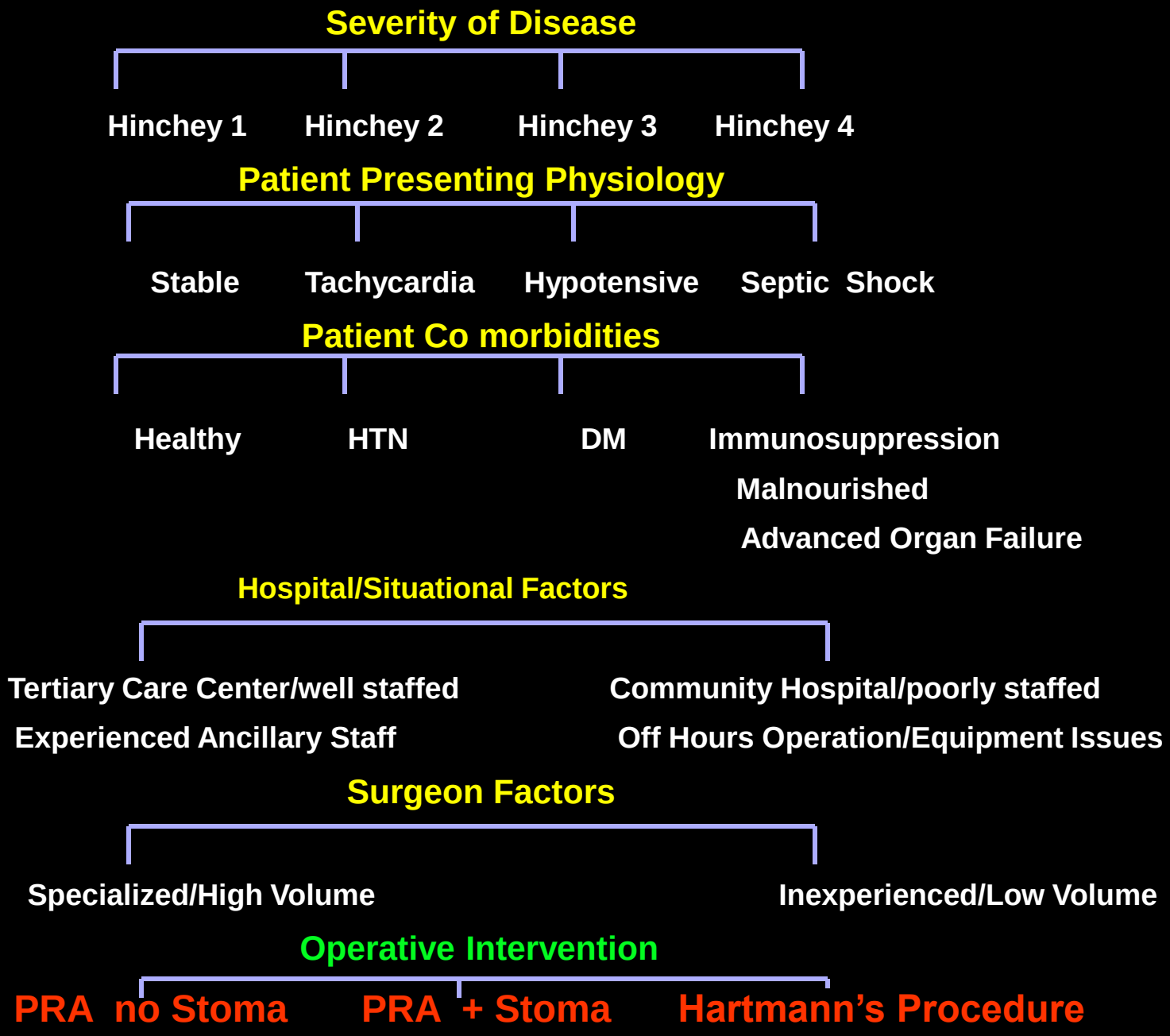
distal margin - rectum

ureteral stents - selective

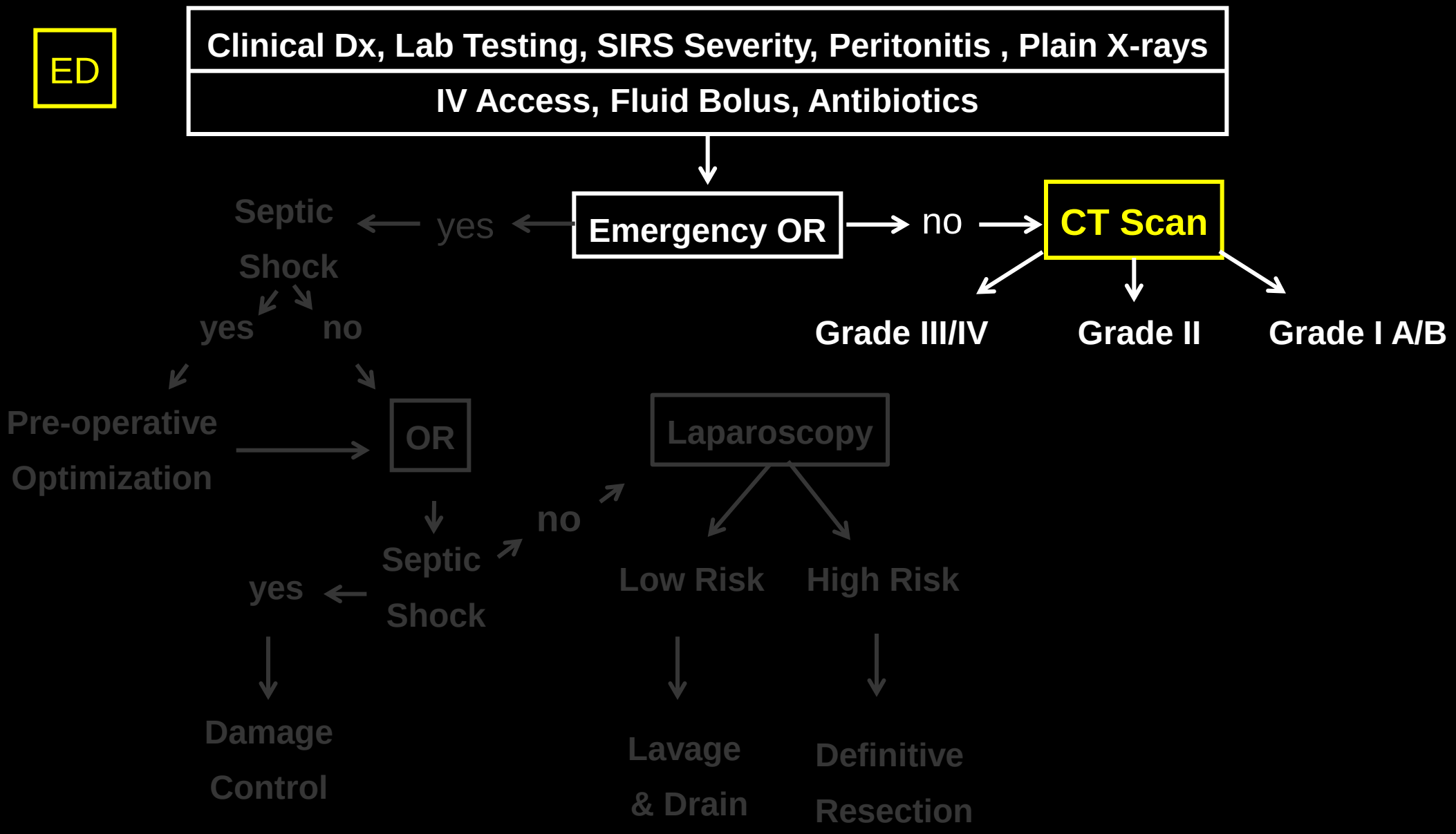
intraoperative colon lavage - does not work

omentoplasty of suture line - does not work

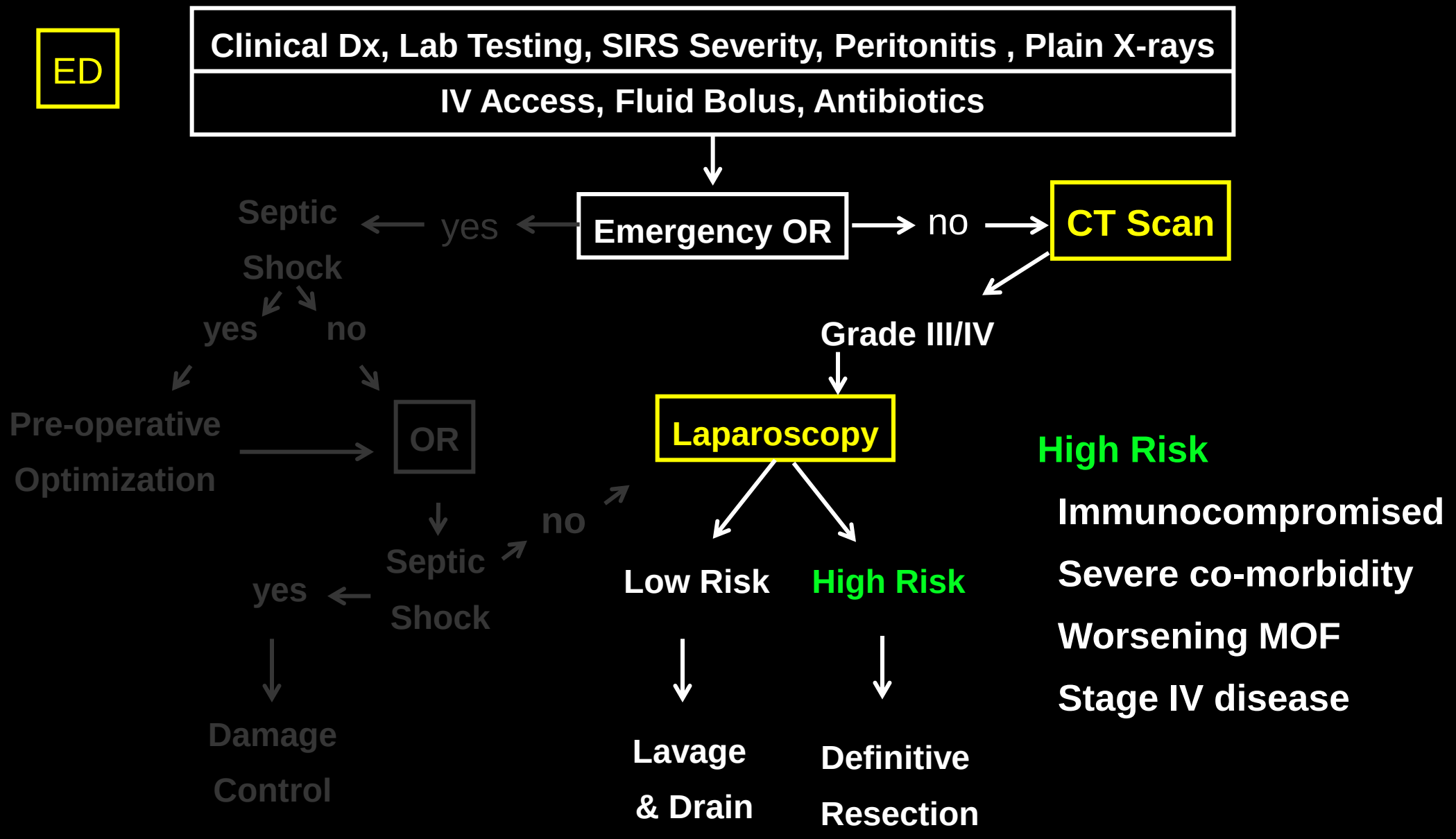
Factors to Consider after Definitive Resection



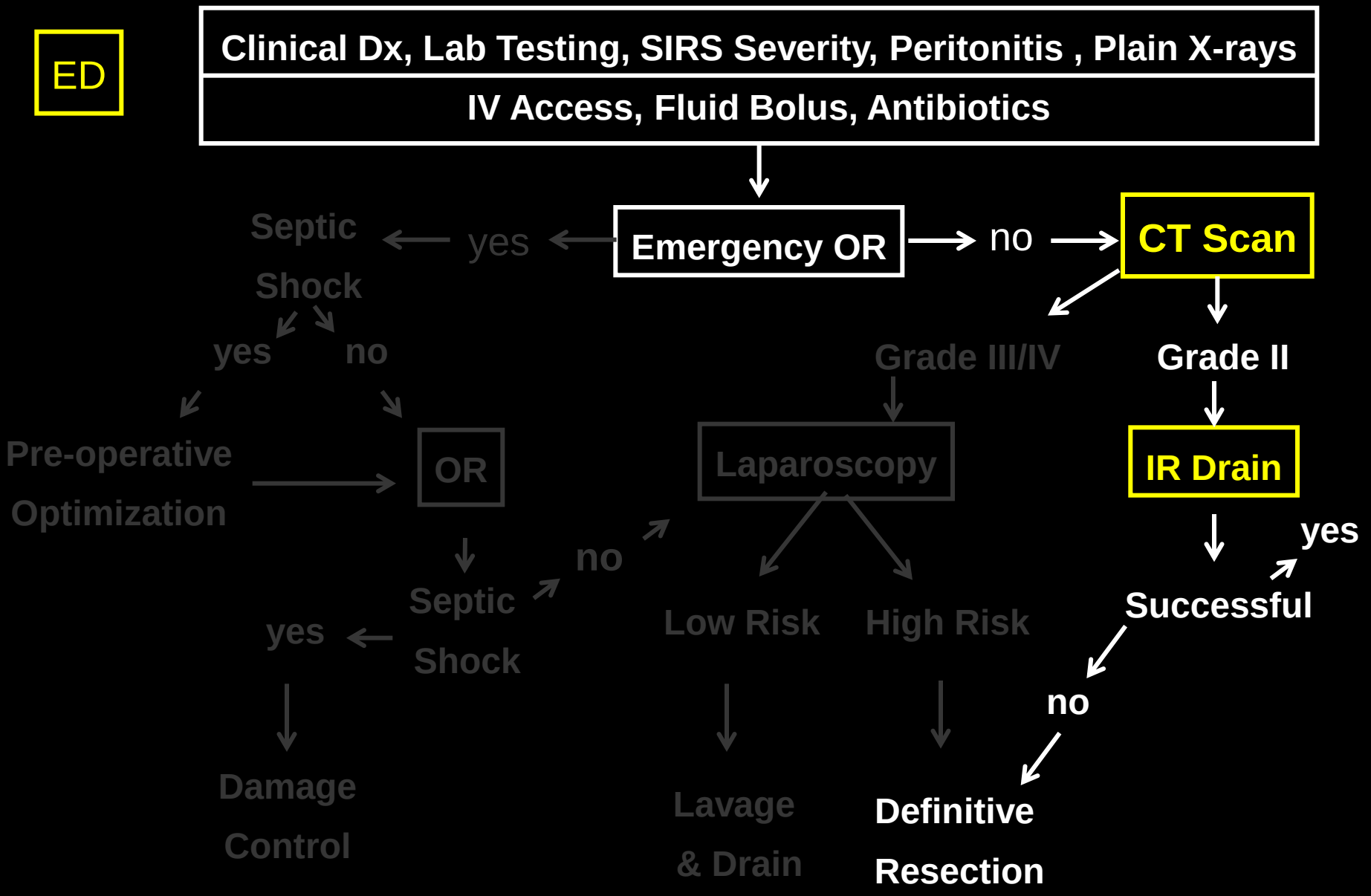
Management of Complicated Diverticulitis



Management of Complicated Diverticulitis



Management of Complicated Diverticulitis



Results from percutaneous drainage of Hinchey stage II diverticulitis guided by computed tomography scan

Y. Durmishi,[1] P. Gervaz,[1] D. Brandt,[1] P. Bucher,[1] A. Platon,[2] P. Morel,[1] P. A. Poletti[2]

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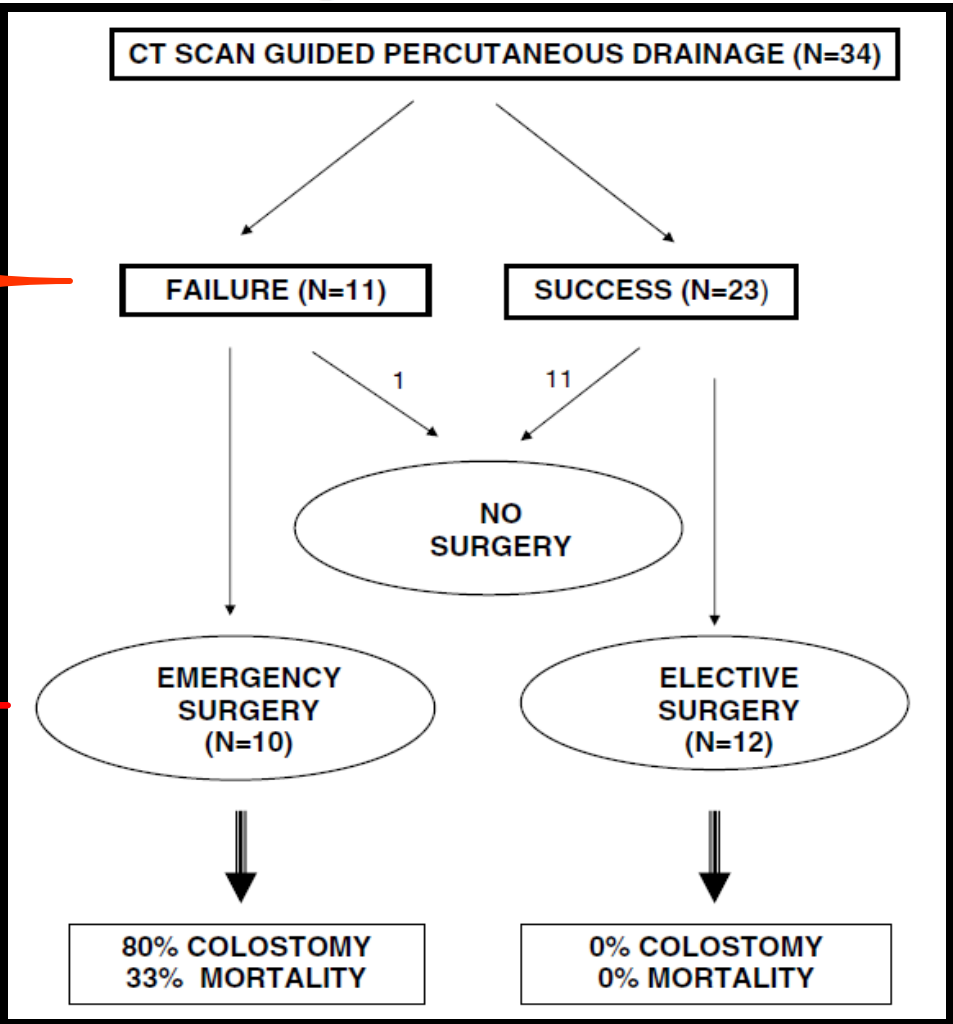
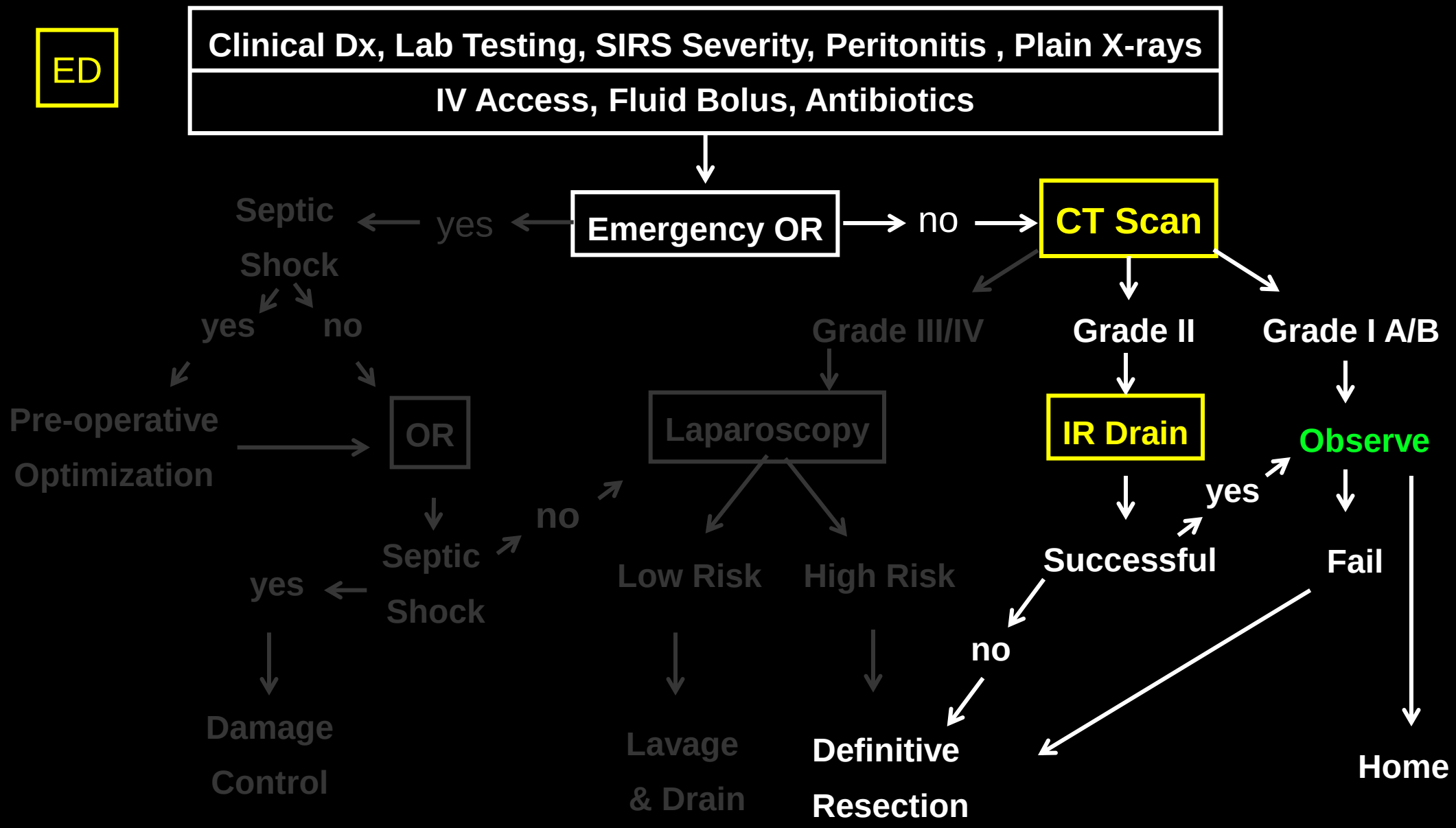
Surg Endosc 2006

Sepsis
Abscess
Recurrence
Fistula

Median
Delay 14d



Management of Complicated Diverticulitis



Observation

NPO

NG tube if symptomatic

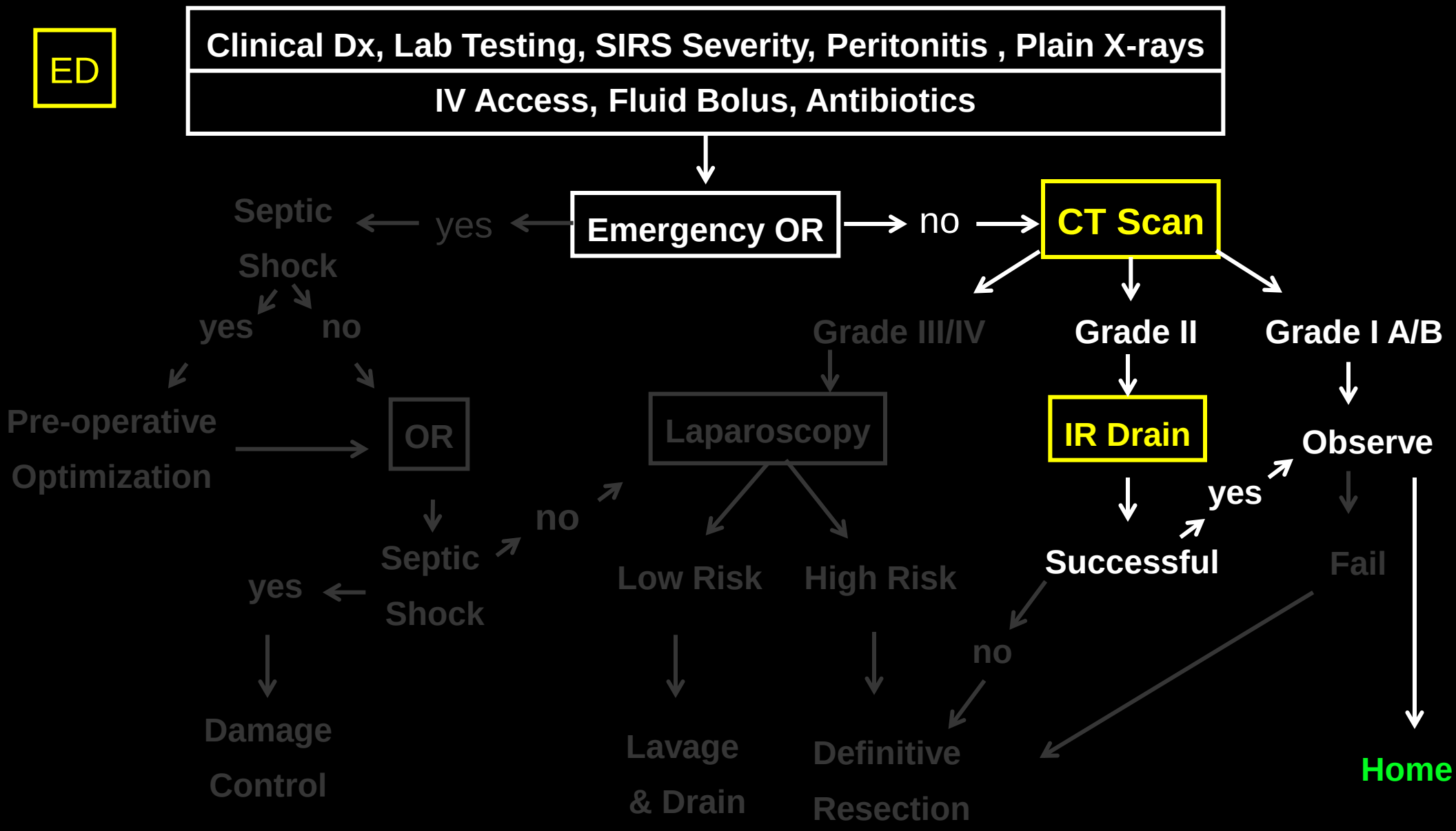
Broad spectrum IV antibiotics

Monitor PE, SIRS Severity and WBC

Start diet & PO antibiotics when return of bowel function, resolution of abdominal tenderness & leukocytosis

DC home when tolerating diet on a total 14 day course of antibiotics (? shorter duration).

Management of Complicated Diverticulitis



Follow-up

Return to clinic if symptoms recur

Return to clinic at 6 weeks for exam

If inflammation resolved ⟶ ? schedule colonoscopy

Risk of colon cancer after computed tomography-diagnosed acute diverticulitis: is routine colonoscopy necessary?

Ville Sallinen · Panu Mentula · Ari Leppäniemi

Helsinki, Finland

Surg Endosc 2014

633 CT Scan Dx Acute Diverticulitis

97 Emergency OR

536 No OR → 142 No Colonoscopy

7 Colon Cancer

394 Colonoscopy

17 (2.7%) Colon Cancers

16 Abscesses (11% of all abscesses)

1 Pericolic Air

Elective Prophylactic Resection After Complicated Diverticulitis

Persistent or recurrent symptoms

Immunocompromised host

Anatomic deformity including a stricture or fistula.


Pepper

Management of Complicated Diverticulitis

Emergency OR

yes → Septic Shock

yes → Pre-operative Optimization → OR

no → OR

OR → Septic Shock

Septic Shock → yes → Damage Control

Septic Shock → no → Laparoscopy

Laparoscopy → Low Risk → Lavage & Drain

Laparoscopy → High Risk → Definitive Resection

no → CT Scan

CT Scan → Grade III/IV → Laparoscopy

CT Scan → Grade II → IR Drain

IR Drain → Successful → no → Definitive Resection

IR Drain → Successful → yes → Observe

CT Scan → Grade I A/B → Observe

Observe → Fail → Definitive Resection

Observe → Home