

Internistische Thorakoskopie: Parapneumonischer Erguss und Empyem

Martin Brutsche



In memoriam **Jean-Marie Tschopp**
(1948–2020)



fera figure de modèle en Suisse. Sur le plan international, il deviendra un des membres les plus actifs du groupe de travail sur la thoracoscopie de l'European Respiratory Society. Parallèlement, avec son équipe, il fera du Centre Valaisan de Pneumologie un service moderne. Il introduit l'oxygénothérapie à domicile grâce à la Ligue pulmonaire valaisanne et crée le premier laboratoire du sommeil du Valais. Il participera à la mise en place des nouvelles structures hospitalières de son canton (chef du Département de médecine du Centre Hospitalier du Centre du Valais). Cette énumération n'est de loin pas exhaustive, mais témoigne de l'élan extraordinaire que Jean-Marie Tschopp a su créer autour de lui. Il n'hésitait pas à bousculer pour faire avancer, mais c'était avec l'objectif de promouvoir une médecine où prévaut la relation humaine et qui place le patient au

Lernziele

- Kennen der wichtigsten Risikofaktoren und Ursachen eines Empyems
- Kennen der Stadieneinteilung des parapneumonischen Ergusses im Hinblick auf eine individualisierte Therapie
- Kennen der Möglichkeiten & Grenzen der medizinischen Thorakoskopie und Fibrinolysetherapie

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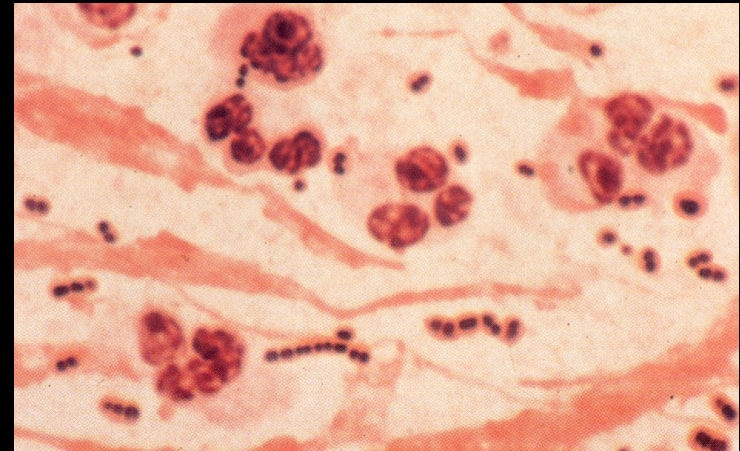
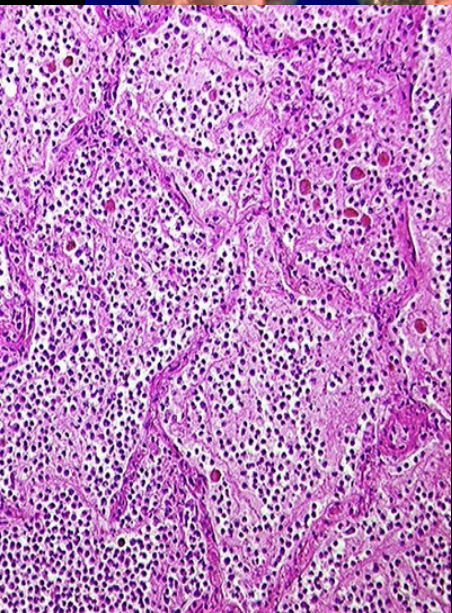
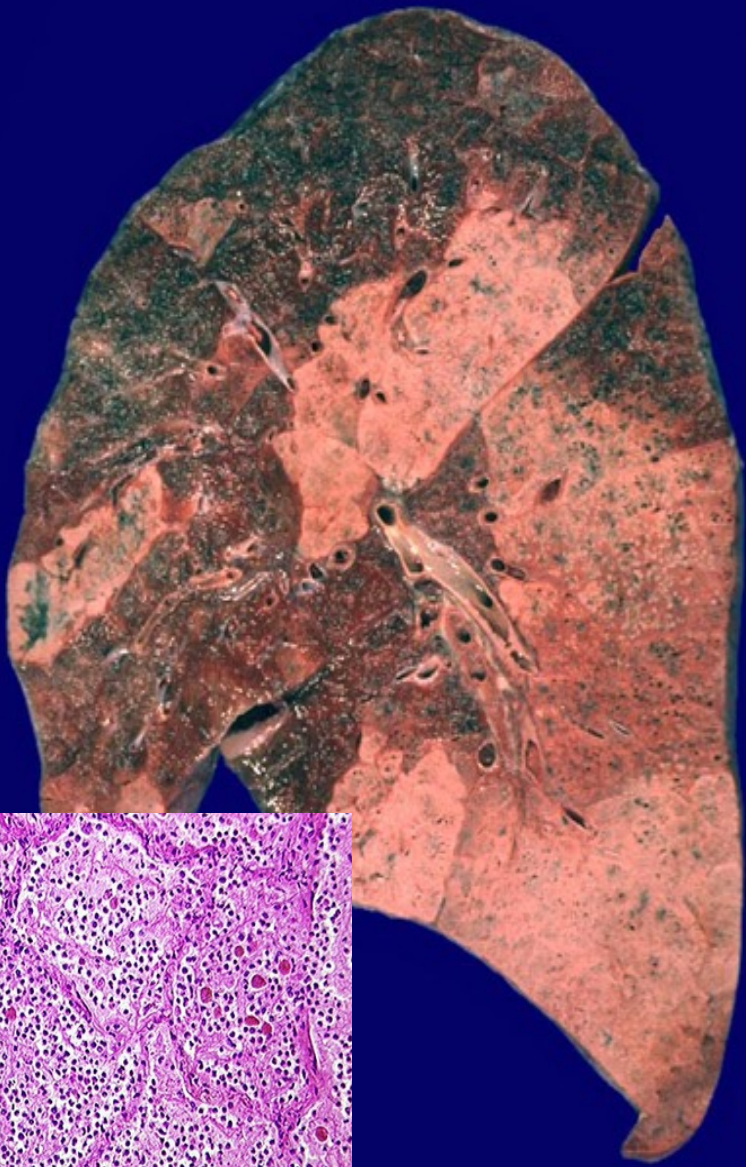
Risikofaktoren und Ursachen

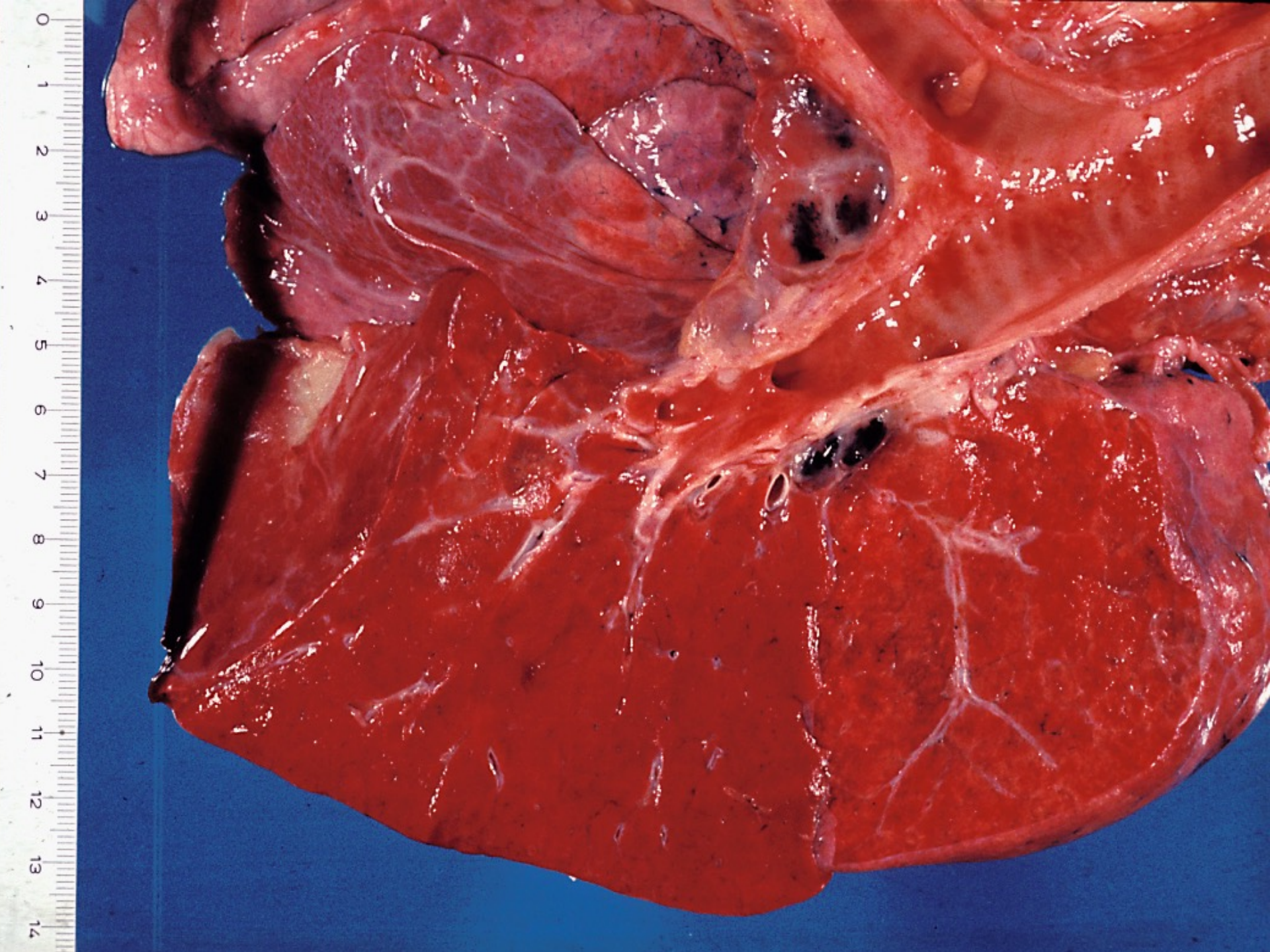
Underlying diseases/ predisposing conditions and risk factors [1, 2, 10–13, 76]	Prevalence (%)	Bacteriology
Pulmonary infection Community-acquired	55–70	Streptococcus milleri group (32 %) Anaerobes (16 %) <i>Streptococcus pneumoniae</i> (13 %) Staphylococci (11 %) MRSA (28 %) Staphylococci (18 %) Enterobacteriaceae (16 %) Enterococci (13 %) [3, 20] ^a
Hospital-acquired		
Post-thoracic surgery	12–21	Staphylococci (especially MRSA) Fungi [4, 7] Cocci (50 %) [66] - <i>Staphylococcus aureus</i> (24.2 %) - <i>Staphylococcus</i> species (6.3 %) - <i>Streptococcus faecalis</i> (6.3 %) Gram-negative rods (40.6 %) [66] - <i>Pseudomonas</i> (12.5 %) - <i>Proteus</i> (7 %)
Post-pneumonectomy		
Trauma	3–6	Staphylococci (34 %) (MRSA in 23 %) Anaerobes (11 %) Streptococcus species (11 %) [7, 77]
Chest tube	2–4	
Abdominal infection	1–2	
Others	9–15	
Esophageal perforation		
Bacteremia		
Pneumothorax		
Diabetes mellitus	20–22	<i>Klebsiella pneumoniae</i> [11]
Immunodeficiency	7–15	Staphylococci (especially <i>S. aureus</i> and MRSA) Fungi [4, 7, 13]
Aspiration		Anaerobes [7]
Poor dental hygiene		Anaerobes [7]

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Lobar Pneumonia






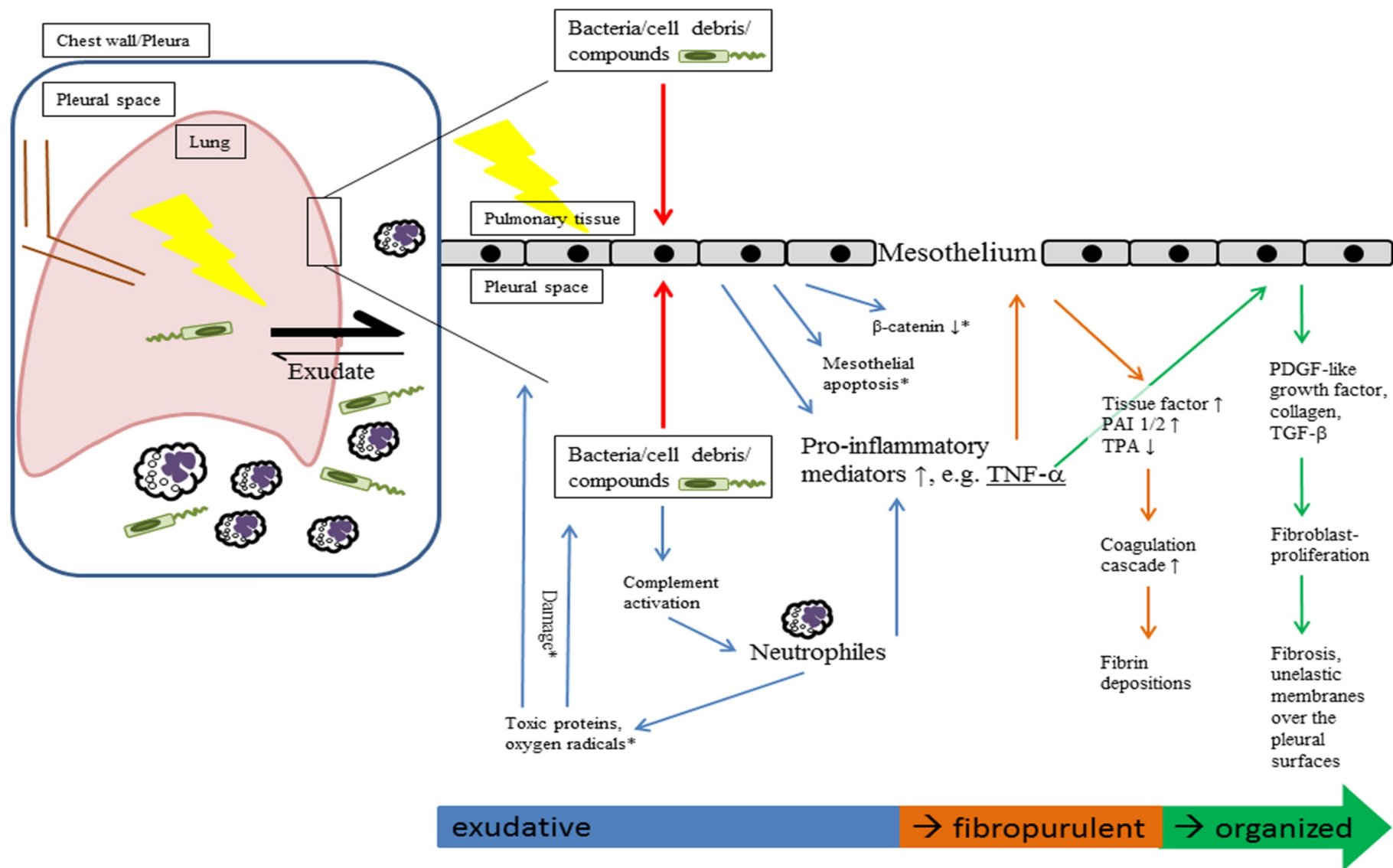
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Stage-directed therapy of pleural empyema

Martin Reichert¹ • Matthias Hecker² • Biruta Witte¹ • Johannes Bodner^{3,4} •

Winfried Padberg¹ • Markus A Weigand⁵ • Andreas Hecker¹  Langenbecks Arch Surg (2017) 402:15–26



	Exudative phase (stage I)		Fibropurulent phase (stage II)			Organized phase (stage III)	
ATS [17]	<ul style="list-style-type: none"> Inflammatory processes extend to the pleurae and result in immediate outpouring fluid Low cell content Re-expandable lung 		<ul style="list-style-type: none"> Frank pus accumulates especially laterally and dorsally High cell content (PMN) and fibrin depositions over the pleural surfaces and fibrinous strands within the fluid Tendency to loculations and formations of membranes Lung is less expandable 			<ul style="list-style-type: none"> Thick and sedimented exudate Fibroblast growth Fibrosis Inelastic membranes over the pleural surfaces Trapped lung 	
Light [18]	Class 1 Non-significant pp. effusion	Class 2 Typical pp. effusion	Class 3 Borderline complicated pp. effusion	Class 4 Simple complicated pp. effusion	Class 5 Complex complicated pp. effusion	Class 6 Simple empyema	Class 7 Complex empyema
	Small <10mm thick on lateral chest x-ray	>10 mm thick on lateral chest x-ray; Glc>40mg/dl; pH>7.2; gram-stain and culture negative	7.0<pH<7.2 and/or LDH>1000 U/L and Glc>40mg/dl; gram-stain and culture negative	pH<7.0 and/or Glc<40 mg/dl and/or gram-stain and culture positive; No loculations; No pus	pH<7.0 and/or Glc<40 mg/dl and/or gram-stain and culture positive; Multiloculated No pus	Pus; Single locule or free-flowing	Pus; Multiple locules
	Simple pp. effusion		Complicated pp. effusion			Empyema	
Muirs [33]	Pleura: Thin, leaky Fluid appearance: clear PMN+ Bacteria micros/culture: -/sterile pH>7.3 LDH<500U/L Glc>60mg/dl Fluid-Glc:Serum-Glc>0.5		Fibrin deposition, loculi opalescent PMN++ +/- pH<7.1 LDH>1000U/L Glc<40mg/dl Fluid-Glc:Serum-Glc<0.5			Thick granulation tissue Pus PMN++ +/- pH<7.1 LDH>1000U/L Glc<40mg/dl Fluid-Glc:Serum-Glc<0.5	
ACCP [6]	Category 1 Very low risk ^a	Category 2 Low risk ^a	Category 3 Moderate risk ^a			Category 4 High risk ^a	
	A ₀ =minimal, free-flowing effusion (<10mm on lateral chest X-ray) and B _x =unknown culture and Gram-stain and C _x =pH unknown	A ₁ =small to moderate free-flowing effusion (>10mm and <1/2 hemithorax) and B ₀ =negative culture and Gram-stain and C ₀ =pH≥7.2	A ₂ =large, free-flowing effusion (≥1/2 hemithorax), loculated effusion, thickened parietal pleura or B ₁ =positive culture or Gram-stain or C ₁ =pH<7.2			B ₂ =pus	
	Simple pp. pleural effusions		Complicated pp. pleural effusions			Empyema	
BTS [7]	Macroscopic appearance: clear fluid Pleural fluid characteristics: pH>7.2 LDH<1000U/l Glucose>2.2mmol/l No organisms on culture or Gram stain		Clear fluid or cloudy / turbid pH<7.2 LDH>1000U/l Glucose>2.2mmol/l May be positive culture / Gram stain			Frank pus No biochemical tests necessary May be positive culture / Gram stain	

US-Thorax!

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Behandlung von erwachsenen Patienten mit ambulant erworbener Pneumonie und Prävention – Update 2016

S3-Leitlinie der Deutschen Gesellschaft für Pneumologie und Beatmungsmedizin, der Paul-Ehrlich-Gesellschaft für Chemotherapie, der Deutschen Gesellschaft für Infektiologie, des Kompetenznetzwerks CAPNETZ, der Österreichischen Gesellschaft für Pneumologie, der Österreichischen Gesellschaft für Infektionskrankheiten und Tropenmedizin und der Schweizerischen Gesellschaft für Pneumologie

Management of Adult Community-acquired Pneumonia and Prevention – Update 2016

Guideline of the German Respiratory Society, the Paul-Ehrlich-Society for Chemotherapy, the German Society for Infectious Diseases, the Competence Network CAPNETZ, the Austrian Respiratory Society, the Austrian Society for Infectious and Tropical Diseases and the Swiss Respiratory Society

Autoren

S. Ewig^{1,1}, G. Höffken^{2,2}, W. V. Kern^{3,3}, G. Rohde^{4,4}, H. Flick^{5,5}, R. Krause^{6,6}, S. Ott^{7,7}, T. Bauer⁸, K. Dalhoff⁹, S. Gatermann¹⁰, M. Kolditz¹¹, S. Krüger¹², J. Lorenz¹³, M. Pletz¹⁴, A. de Roux¹⁵, B. Schaaf¹⁶, T. Schaberg¹⁷, H. Schütte¹⁸, T. Welte¹⁹

7 Lungenabszess und Pleuraempyem

E62 Bei allen Patienten mit einem parapneumonischen Pleuraerguss soll eine frühe Thorakozentese erfolgen. Starke Empfehlung, Evidenz A.

E63 Es soll eine makroskopische Beurteilung und eine bakteriologische Analyse angeschlossen werden sowie bei allen nicht eitrigem Ergüssen eine Bestimmung des pH-Wertes. Starke Empfehlung, Evidenz C.

E64 Die systemische antimikrobielle Therapie soll das Erregerspektrum pleuraler Infektionen umfassen; dieses schließt auch Anaerobier mit ein. Bei Vorliegen bakterieller Kulturergebnisse soll die Therapie gegebenenfalls angepasst werden. Starke Empfehlung, Evidenz B.

E65 Bei klarem Erguss mit einem pH < 7,2, Hinweisen auf eine Organisation, dem pleuralen Nachweis von Bakterien oder bei Vorliegen eines Pleuraempyems soll unverzüglich eine effektive Drainage durchgeführt werden. Starke Empfehlung, Evidenz B.

E66 Bei einem septierten Erguss und ineffizienter Drainage soll entweder eine intrapleurale Behandlung mit Fibrinolytika oder eine Sanierung durch VATS erfolgen. Starke Empfehlung, Evidenz B.

folgen. Die Datenlage im Hinblick auf die Durchführung der intrapleuralen Fibrinolysetherapie via Drainage mit Urokinase, Streptokinase oder Alteplase in kontrollierten Studien mit größeren Populationen ist widersprüchlich [392,395–399]. Die Studien zeigen eine unterschiedliche Methodik und differente Einschlusskriterien. Eine aktuelle Metaanalyse zu sieben randomisierten Studien ergab, dass die Notwendigkeit chirurgischer Interventionen durch lokale Einbringung von Fibrinolytika reduziert werden kann [399]. Dies gilt vor allem für Patienten mit hohem Operationsrisiko oder fehlender Einwilligung zum Eingriff. Die Fibrinolyse sollte früh im Verlauf eingesetzt werden.

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Therapy	Antibiotics				
	No invasive therapy	Serial thoracentesis	Tube thoracostomy	VATS for evacuation of pus and loculations and decortication or	
			Tube thoracostomy + intrapleural fibrinolytic agents	Open decortication, open window thoracostomy, thoracomyoplasty (depending on etiology)	

ACCP [6]	Very low risk ^a	Low risk ^a	Moderate risk ^a	High risk ^a
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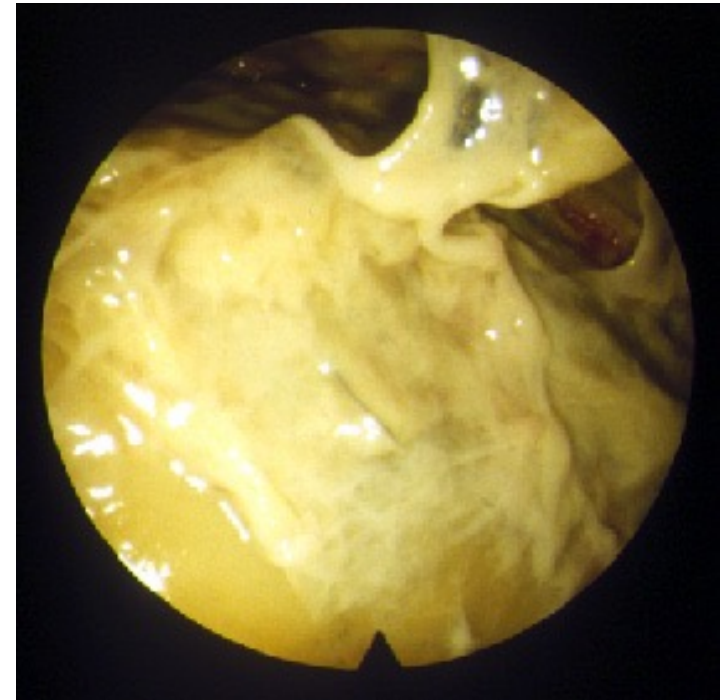
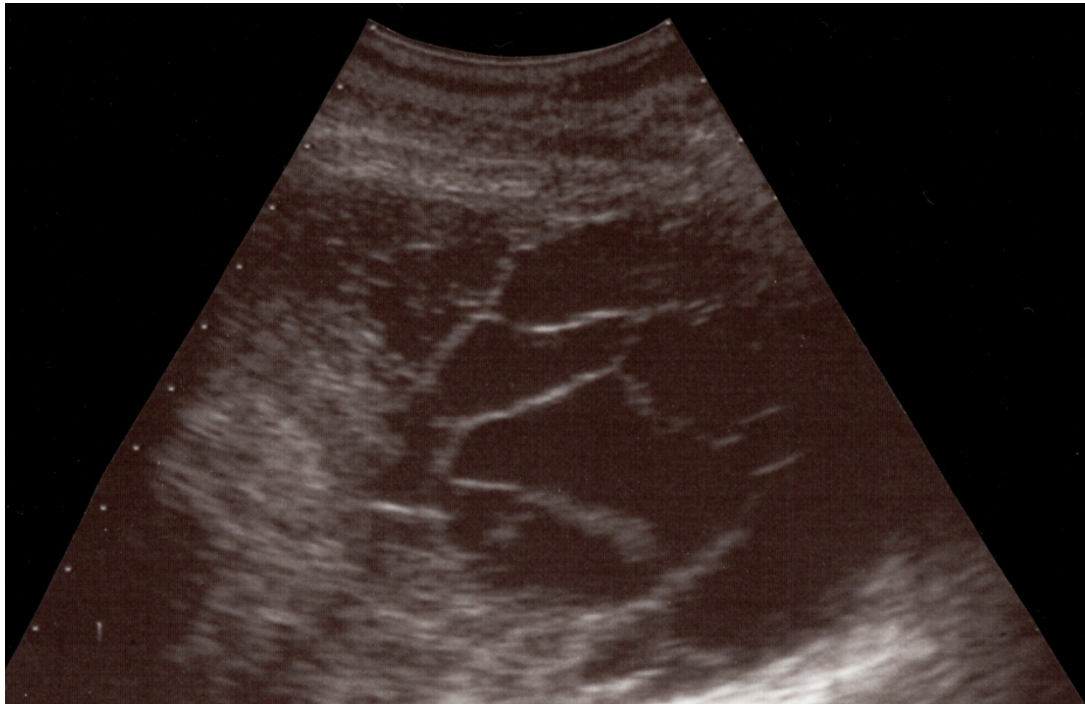
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Role for medical thoracoscopy in empyema? – Optional...



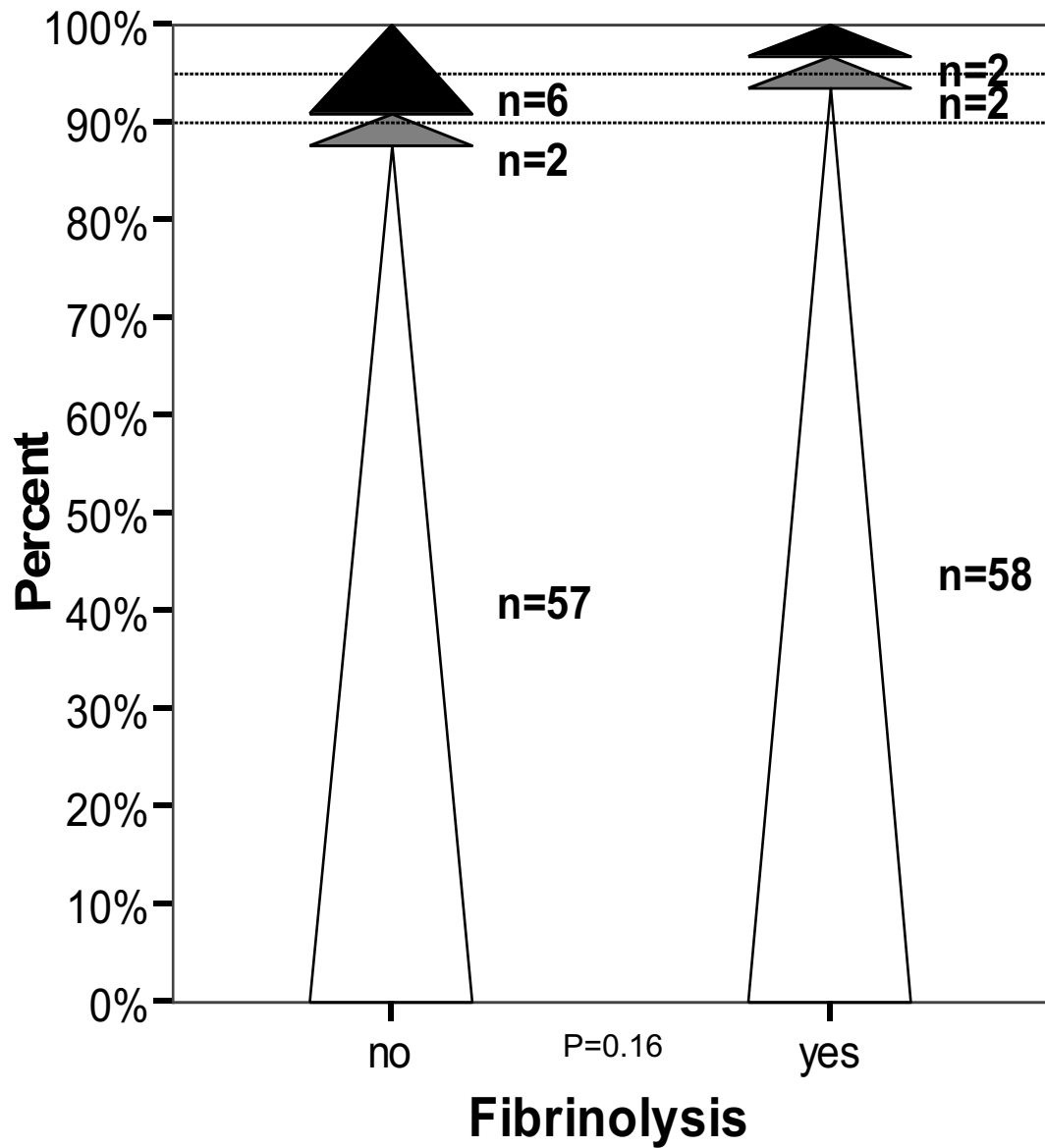
Treatment of Sonographically Stratified Multiloculated Thoracic Empyema by Medical Thoracoscopy*

Martin H. Brutsche, MD, PhD; Gian-Franco Tassi, MD; Sandor Györök, MD; Marlon Gökcimen, MD; Christophe Renard, MD; Gian Pietro Marchetti, MD; and Jean-Marie Tschopp, MD

Chest 2005

Outcome – medical thoracoscopy

- Retrospective analysis, n= 127 patients with multiloculated empyema
- Mean age 58 ± 18 years
- Complications in 9%
 - subcutaneous emphysema (n=3)
 - air leak >3 days (n=9)
- Primary success rate of medical thoracoscopy 91%
- 94% were cured by non-surgical means
- 6% required pleurectomy, mostly thoracotomy



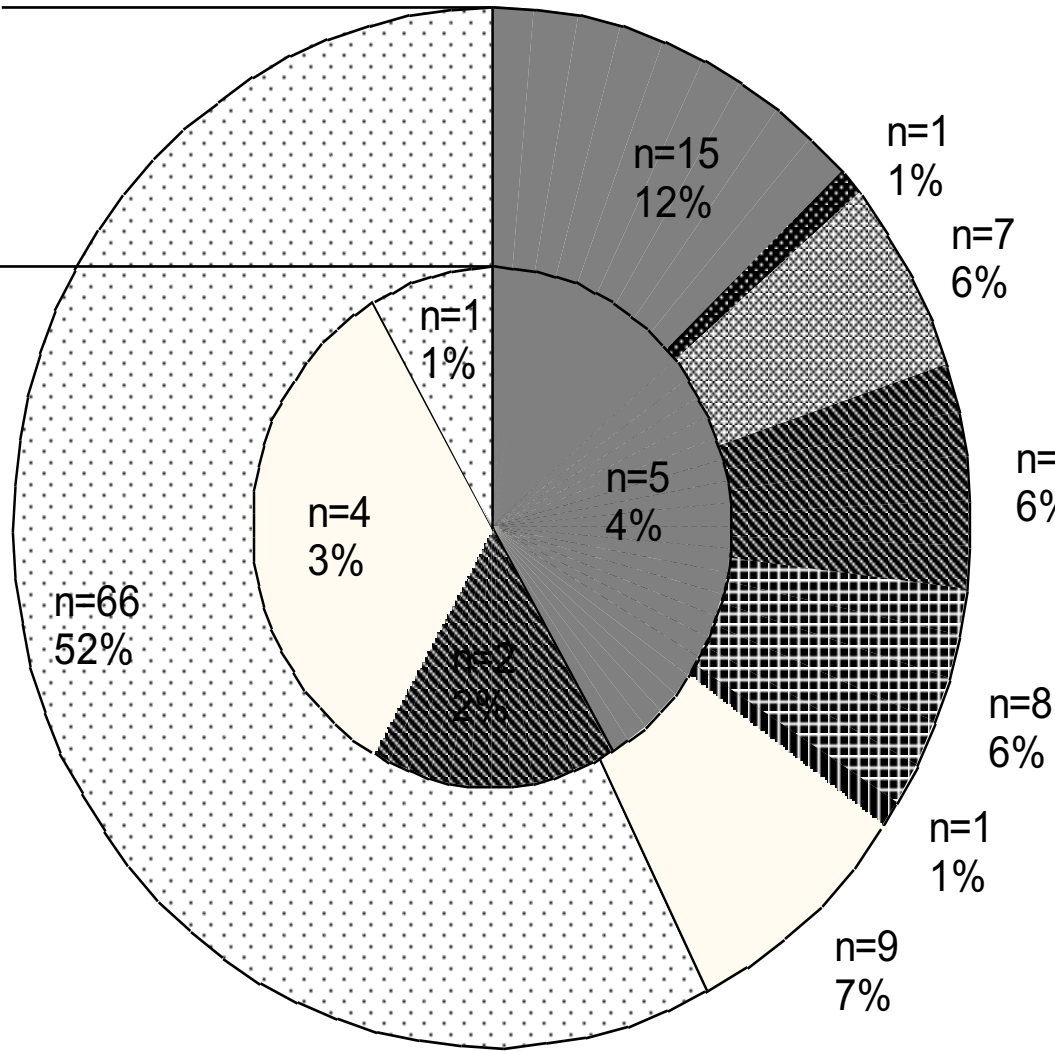
Bacteriological Diagnosis

Success

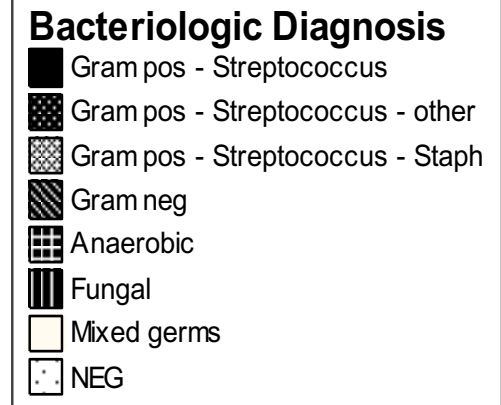
n=115
91%

Failure

n=12
9%



In 60/127
(47%) of
patients a
germ was
found in
pleural fluid



Treatment of Sonographically Stratified Multiloculated Thoracic Empyema by Medical Thoracoscopy*

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Chest 2005

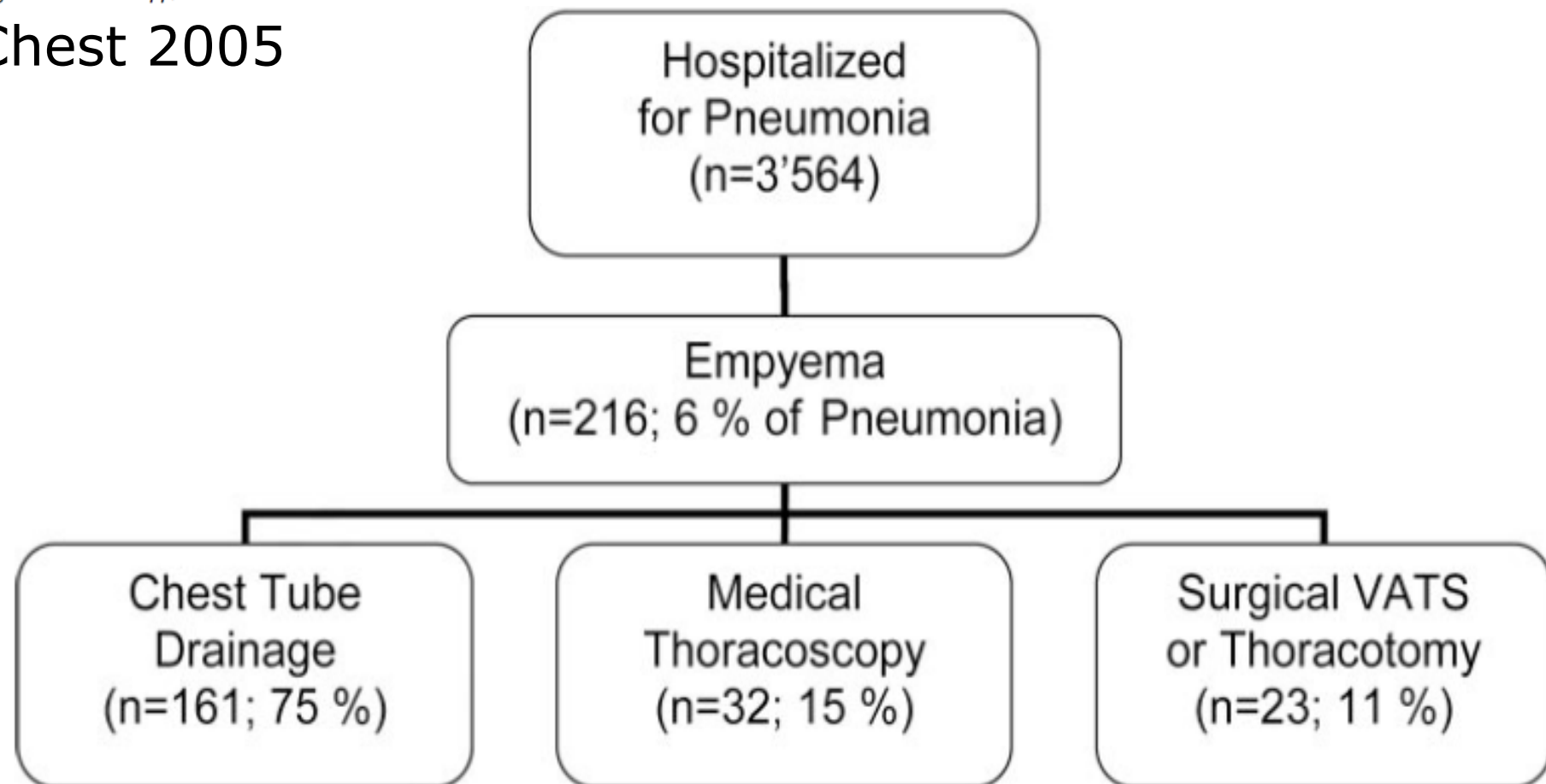
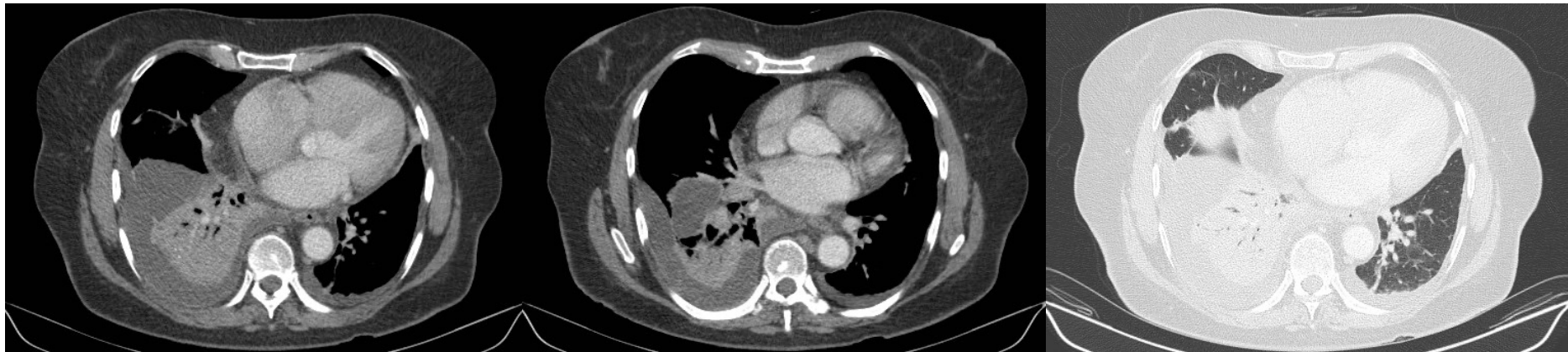


FIGURE 4. The prevalence of empyema was 6% of patients hospitalized for pneumonia. Most empyema cases were successfully treated by simple drainage. In case of multiloculated disease, either medical thoracoscopy or surgical VATS/thoracotomy with pleurectomy were performed.

70-y-Female, AHT, chronic renal insufficiency, mild OSAS

- Referral from another hospital with bacteriaemic, bilateral pneumonia due to streptococcus pneumoniae with progressive pleural effusion
 - ▶ 7-d Augmentin[®] according to resistance pattern
 - ▶ 2x pleural tap (exsudate), still recurrent
- Fair general condition, 38.5° C, RR 117/68 mmHg, HR 94/min, right-sided blunt percussion
- Lc 17, creatinine 113, CRP 282 mg/dL



Initial management

- Chest ultrasound: medium-size pleural effusion, visceral and parietal pleural thickening, moderately reduced diaphragmatic movement, presence of lung consolidation in the RLL



- Diagnostic pleural tap → pH 6.84...

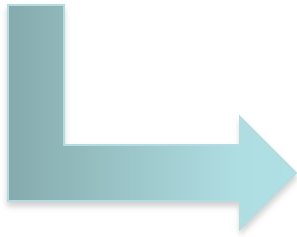
Initial management II

- Insertion of a 17 F-chest tube
- Seek advice of thoracic surgeons
 - ▶ Due to clinical stability and absence of dense pleural septation no VATS at this point – to be followed...
- Chest X-ray to document correct position of pleural tube
- Intrapleural instillation of Urokinase 250'000 IU on 3 consecutive days... → no significant change!



No response to fibrinolytics!

- Still clinically stable
- Persistence of CRP 235 mg/dL
- VATS?! (program issue... Is it ok, when we operate her on Monday?)
- Just waiting?



Intrapleural Use of Tissue Plasminogen Activator and DNase in Pleural Infection

Najib M. Rahman, D.Phil., Nicholas A. Maskell, D.M., Alex West, M.R.C.P., Richard Teoh, M.R.C.P., Anthony Arnold, M.R.C.P., Carolyn Mackinlay, M.R.C.P., Daniel Peckham, M.D., Chris W.H. Davies, M.D., Nabeel Ali, M.D., William Kinnear, M.D., Andrew Bentley, M.D., Brennan C. Kahan, M.Sc., John M. Wrightson, M.R.C.P., Helen E. Davies, M.R.C.P., Clare E. Hooper, M.R.C.P., Y.C. Gary Lee, Ph.D., Emma L. Hedley, Nicky Crosthwaite, R.G.N., Louise Choo, M.Sc., Emma J. Helm, F.R.C.R., Fergus V. Gleeson, M.D., Andrew J. Nunn, M.Sc., and Robert J.O. Davies, M.D.*

NEJM 2011

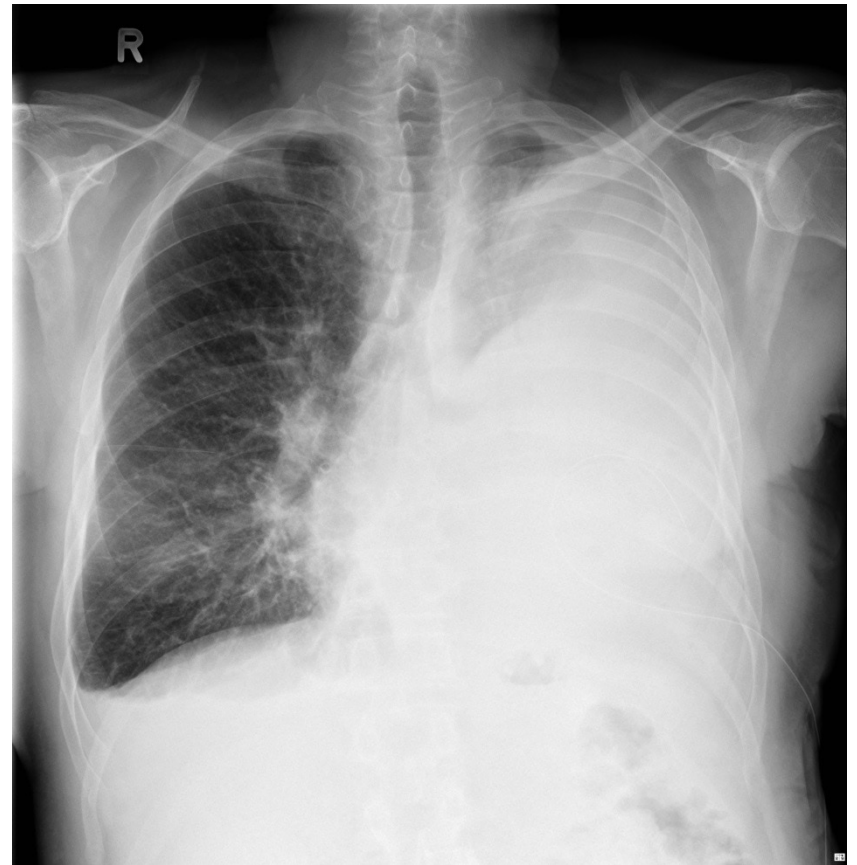
Intrapleural t-PA and DNase

- Twice daily sequential intrapleural treatment
 - ▶ T-PA (Actilyse©) clamped for 1 h & 1 h wash-out followed by
 - ▶ DNase (Pulmozyme©) clamped for 1 h
- Evacuation of 2.6 L and subtotal remission in 2 days



74-y-Male with hip replacement, type 2 DM, CAD,

- Post-Op: Heart failure, hyperactive confusion (delir)
- 1 week later: Development of left-sided empyema



Chest ultrasound before and 3 days after t-PA/DNase treatment

Before



3 days later...



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NEJM 2011

- Randomised, double-blind, placebo-controlled study with 4 treatment arms for 3 days (n= 210 patients)
 - ▶ Placebo (saline 0.9%) & placebo
 - ▶ t-PA (Actilyse[©], Böhringer Ingelheim, 10 mg) & placebo
 - ▶ DNase (Pulmozyme[©], Roche, 5 mg) & placebo
 - ▶ t-PA & DNase
- Primary outcome: change in pleural opacity D1 vs D7
- Secondary outcomes: referral for surgery, duration of hospital stay, and adverse events

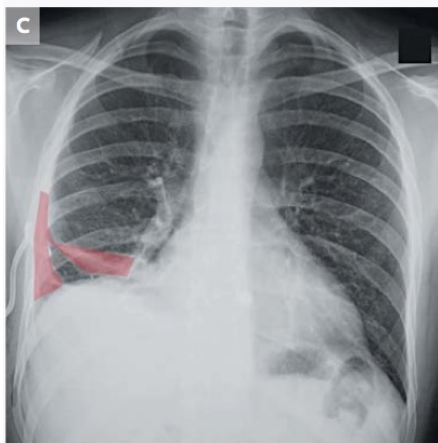
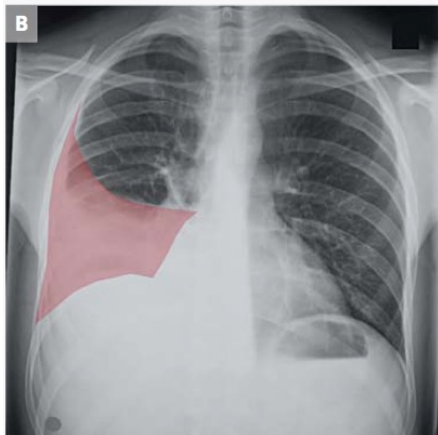
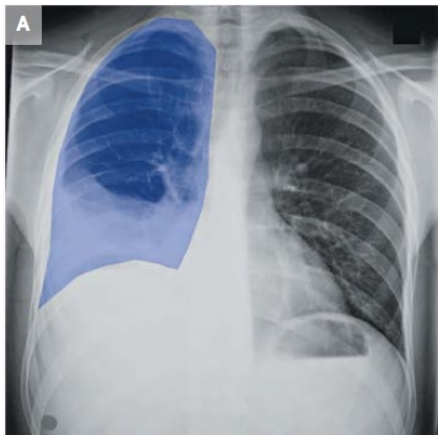


Table 1. Baseline Characteristics of the Patients, According to Study Group.*

Characteristic	t-PA (N=52)	DNase (N=51)	t-PA+DNase (N=52)	Placebo (N=55)
Age — yr	60±17	57±18	60±19	58±19
Male sex — no. (%)	39 (75)	42 (82)	31 (60)	39 (71)
Percent of hemithorax occupied with pleural fluid	39.8±22.6	41.9±22.9	44.2±24.9	36.3±23.3
Duration of symptoms before randomization — days				
Median	14	14	13	13
Interquartile range	7–30	7–30	7–22	7–21
Small-bore tube, <15 French — no. (%)†	41 (80)	44 (88)	48 (94)	49 (91)
Community-acquired infection — no. (%)	44 (85)	44 (86)	45 (87)	49 (89)
Radiographic evidence of loculation — no. (%)‡	49 (94)	47 (92)	49 (94)	47 (85)
Purulent pleural fluid — no. (%)	24 (46)	25 (49)	27 (52)	26 (47)
Positive Gram's stain or culture of pleural fluid — no. (%)	5 (10)	5 (10)	4 (8)	7 (13)
Pleural-fluid pH				
Median	6.9	7.0	6.9	6.9
Interquartile range	6.8–7.1	6.8–7.1	6.8–7.1	6.8–7.1
Lactate dehydrogenase in pleural fluid — IU/liter				
Median	2935	3077	3418	3337
Interquartile range	871–9908	365–7903	1321–7328	1034–8943

* All baseline characteristics were well matched among the four groups ($P>0.05$). Plus-minus values are means \pm SD.

† Data on tube size were missing for one patient in each study group.

‡ Radiographic loculation was assessed by means of combined blind scoring of chest radiographs and thoracic computed tomographic scans, where available (see the Supplementary Appendix).

Rahman et al. - Main results

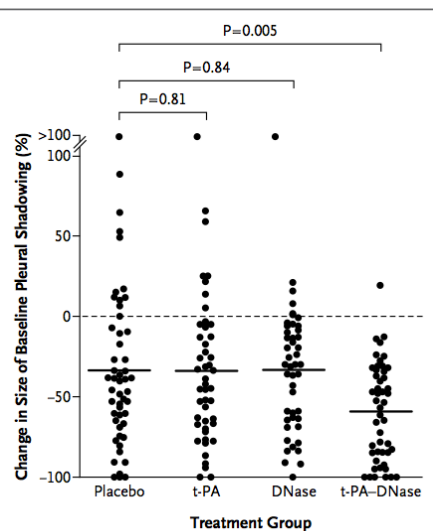


Figure 2. Change in Area of Pleural Fluid on Chest Radiography on Day 7 versus Day 1, According to Study Group.

Each circle represents an individual patient, and mean changes are indicated by the horizontal bars.

Table 2. Primary and Major Secondary Outcomes, According to Study Group.*

Outcome	t-PA	DNase	t-PA-DNase	Placebo
Change from baseline in hemithorax area occupied by effusion (primary outcome) — %	-17.2±24.3	-14.7±16.3	-29.5±23.3	-17.2±19.6
Percent difference vs. placebo (95% CI)	2.0 (-4.6 to 8.6)	4.5 (-1.5 to 10.5)	-7.9 (-13.4 to -2.4)	NA
P value	0.55	0.14	0.005	NA
Surgical referral — no. referred/total no. (%)	3/48 (6)	18/46 (39)	2/48 (4)	8/51 (16)
Odds ratio vs. placebo (95% CI)	0.29 (0.07 to 1.25)	3.56 (1.30 to 9.75)	0.17 (0.03 to 0.87)	NA
P value	0.10	0.01	0.03	NA
Hospital stay — no. of days	16.5±22.8	28.2±61.4	11.8±9.4	24.8±56.1
Percent difference vs. placebo (95% CI)	-8.6 (-40.8 to 3.3)	3.6 (-19.0 to 30.8)	-14.8 (-53.7 to -4.6)	NA
P value	0.21	0.73	<0.001	NA

* Plus-minus values are means ±SD. The mean values for the primary analysis are unadjusted, whereas the treatment effects have been adjusted for minimization criteria and opacification of the chest radiograph at baseline, according to the statistical analysis plan. Data on hospital stay are for all patients in the primary analysis (i.e., including two patients with outlying results). NA denotes not applicable.

Table 3. Serious and Nonserious Adverse Events at the Time of Hospital Discharge.*

Type of Adverse Event	t-PA (N=52)	DNase (N=51)	t-PA-DNase (N=52)	Placebo (N=55)	P Value
	<i>no. of patients (%)</i>				
Serious	0	2 (4)	3 (6)	1 (2)	0.22 by Fisher's exact test
Nonserious	7 (13)	8 (16)	9 (17)	6 (11)	0.80 by chi-square test (χ^2 [3 df]=1.0)

* The 6 serious adverse events included 2 intrapleural hemorrhages (both in the t-PA-DNase group), 1 episode of hemoptysis (in the t-PA-DNase group), 2 episodes of gastrointestinal bleeding (both in the DNase group), and 1 clinical deterioration (in the placebo group). The 30 nonserious adverse events included chest pain at the drainage site during study-drug administration (14 cases: 2 with placebo, 3 with t-PA, 3 with DNase, and 6 with t-PA-DNase; P=0.54 by Fisher's exact test), nausea (5 cases: 3 with placebo, 1 with DNase, and 1 with t-PA), transient confusion (4 cases: 2 with placebo, 1 with t-PA-DNase, and 1 with DNase), and erythema or rash (3 cases: 2 with t-PA-DNase and 1 with DNase).

Intrapleural tissue plasminogen activator and deoxyribonuclease for pleural infection. An effective and safe alternative to surgery. Ann Am Thorac Soc. 2014

- 8 multinational observation series to evaluate the pragmatic "real-life" application of tPA/DNase treatment for pleural infection in a large cohort of unselected patients
- Of 107 patients 92.3% were successfully managed without the need for surgical intervention
- No patients died as a result of pleural infection
- Most patients (84%) received tPA/DNase more than 24 hours after failing to respond to initial conservative management with antibiotics and thoracostomy
- Pain necessitating escalation of analgesia occurred in 19.6% patients, and nonfatal bleeding occurred in 1.8%.

Konklusion I - Empyemtherapie

- Die Behandlung des Empyems verlangt eine gute interdisziplinäre Kommunikation & Zusammenarbeit
 - ▶ Internisten
 - ▶ Lungenfachärzten
 - ▶ Thoraxchirurgen
- Die pleurale Infektion präsentiert sich in Stadien
 - ▶ LRTI/Pneumonie
 - ▶ Exsudatives Stadium (S I)
 - ▶ Fibropurulenten Stadium (S II)
 - ▶ Organisiertes Stadium (S III)
- Die kombinierte, intrapleurale Fibrinolyse mit t-PA/DNase reduziert die Notwendigkeit einer VATS



Punktion/Drainagen
Fibrinolyse

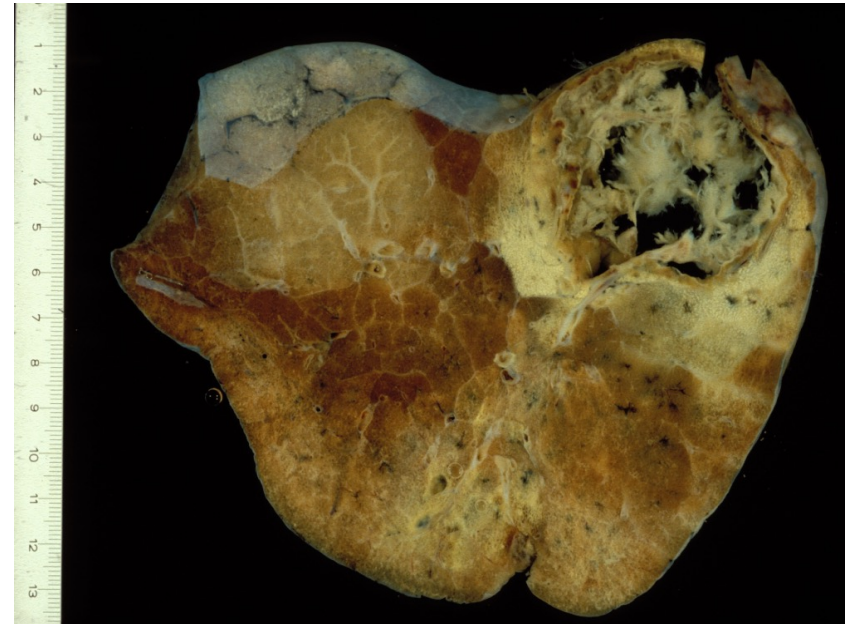
Med. Thorako
VATS

Konklusion II – Thorakoskopie

- Die Rolle der medizinischen Thorakoskopie ist in Guidelines nicht definiert
- Mögliche Indikation
 - ▶ Spätes fibropurulentos Stadium (S II)
- Kontraindikationen
 - ▶ Organisiertes Stadium (S III – dichte Septierung im US, keine diaphragmatische Bewegung mehr)
 - ▶ Subpleuraler Lungenabszess
 - ▶ Fistelbildung: Broncho-pleural, oesophago-pleural
 - ▶ Instabiler, septischer Patient
- Entscheid zwischen medizinischer Thorakoskopie und VATS ist auch von der Verfügbarkeit von Ressourcen abhängig...

Konklusion III – Thoraxchirurgie

- Der Thoraxchirurg ist unser Freund und sollte es auch bleiben...
 - ▶ Frühe Involvierung der Thoraxchirurgie
 - ▶ Rascher OP-Entscheid bei Verschlechterung, instabiler Situation, relevanter Lungenabszess/Seropneumothorax/Fisteln



Question: In which condition large-bore pleural tubes give better results than small-bore tubes

- A. Pleural Infection
- B. Pneumothorax
- C. Malignant pleural effusion
- D. All conditions A-C
- E. None condition A-C

Right Answer: E

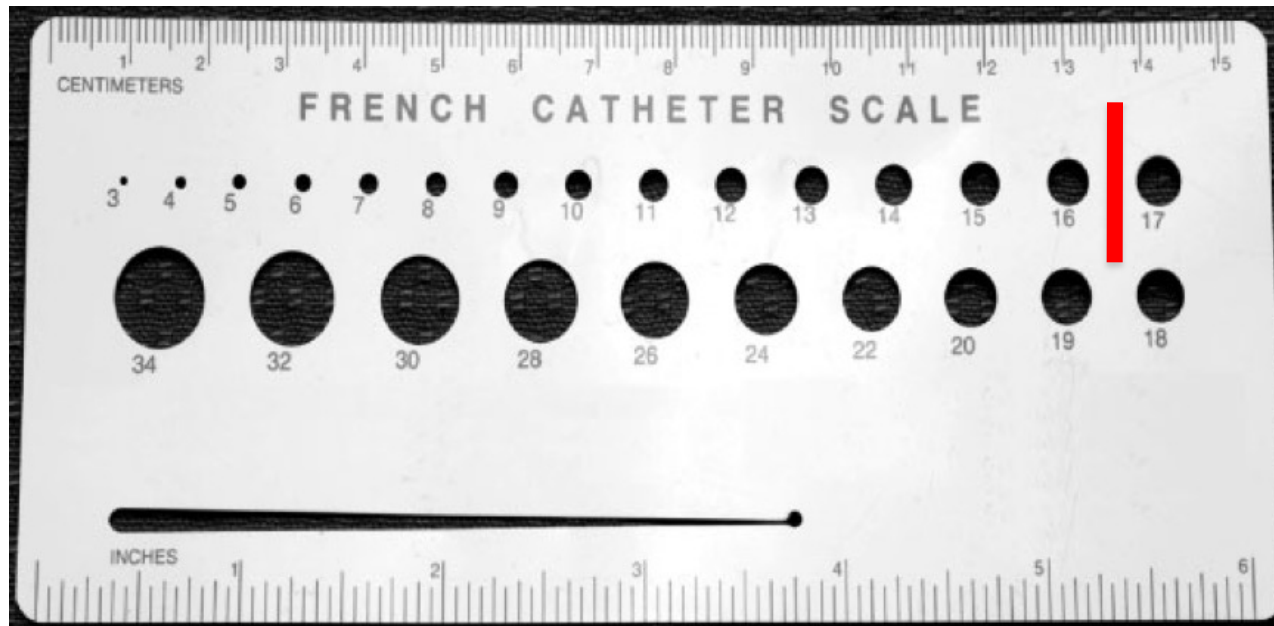
Optimal Chest Drain Size: The Rise of the Small-Bore Pleural Catheter

Semin Respir Crit Care Med 2010

Edward T. H. Fysh, M.B.B.S., B.Sc.,^{1,2}

Nicola A. Smith, B.H.B., M.B.Ch.B., F.R.A.C.P.,²

and Y. C. Gary Lee, M.B.Ch.B., Ph.D., F.R.A.C.P., F.C.C.P.^{1,2,3}



- Small-bore tube \leq 16 F (= 5.3 mm outer diameter)

Table 1 Summated Frequency in Published Series of Postinsertion Complications for Large- and Small-Bore Chest Tubes Inserted for Empyema/Parapneumonic Effusion^{8,11,21,22,50,51,54}

Complication	Large-Bore Chest Tubes		Small-Bore Chest Tubes	
	Incidence %	No. patients affected/ total insertions from cited references	Incidence %	No. patients affected/ total insertions from cited references
Pain	54	22/41	8	29/358
Intrapleural infection	0	0/130	0	0/292
Wound infection	0.7	1/130	0	0/292
Drain dislodgment	3.8	5/130	8	22/272
Drain blockage	5	7/130	4.7	13/272
Visceral injury	0	0/130	0	0/292
Malpositioning	0	0/130	0	0/292

Table 2 Summated Frequency in Published Series of Postinsertion Complications for Large- and Small-Bore Chest Tubes Inserted for Pneumothorax^{6,11,21,22,45,54-56}

Complication	Large-Bore Chest Tubes		Small-Bore Chest Tubes	
	Incidence %	No. patients affected/ total insertions from cited references	Incidence %	No. patients affected/ total insertions from cited references
Intrapleural infection	2	8/358	0	0/184
Wound infection	1.4	5/358	0	0/184
Drain dislodgement	0.8	3/358	5.4	10/184
Drain blockage	0.8	3/358	4.9	9/184
Visceral injury	0.2	1/358	0	0/184
Malpositioning	8.9	32/358	0.54	1/184

Table 3 Summated Frequency in Published Series of Postinsertion Complications for Large- and Small-Bore Chest Tubes Inserted for Pleural Effusions of Non-Infective Cause^{11,20–22,54}

Complication	Large-Bore Chest Tubes		Small-Bore Chest Tubes	
	Incidence %	No. patients affected/ total insertions from cited references	Incidence %	No. patients affected/ total insertions from cited references
Infection	13.6	6/44	2	6/275
Drain dislodgment	0	0/66	3.3	4/121
Drain blockage	0	0/66	0.8	1/121
Visceral injury	1.5	1/66	0	0/198
Malpositioning	0	0/66	1	2/198

- Es fehlen qualitativ hochstehende RCTs
- Keine Daten favorisieren den Gebrauch von grossvolumigen Drainage
- DGP-Guidelines – update 2016:...


Vorteile bestimmter technischer Details der Drainagetherapie sind nicht belegt (Durchmesser des Tubuslumens, kontinuierlicher Sog versus intermittierende versus kontinuierliche Spülung).

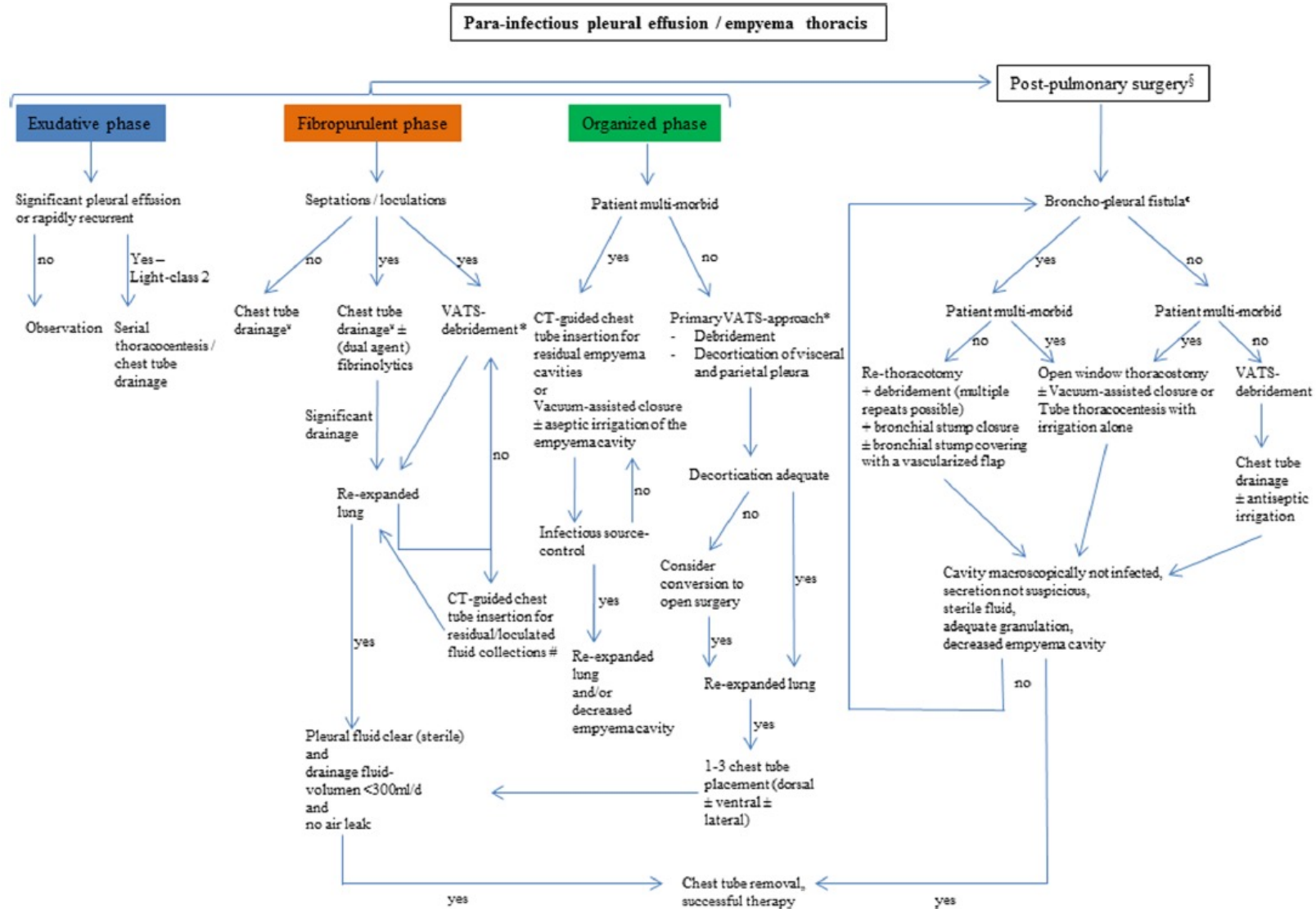
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Stage-directed therapy of pleural empyema


Martin Reichert¹ • Matthias Hecker² • Biruta Witte¹ • Johannes Bodner^{3,4} •

Winfried Padberg¹ • Markus A Weigand⁵ • Andreas Hecker¹  Langenbecks Arch Surg (2017) 402:15–26



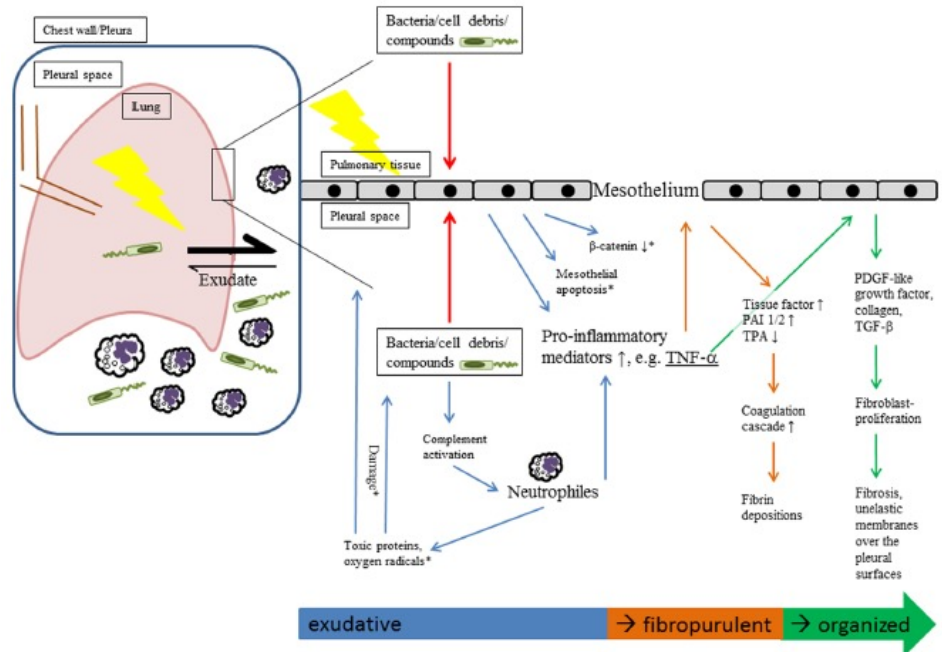
Stage-directed therapy of pleural empyema

Martin Reichert¹ • Matthias Hecker² • Biruta Witte¹ • Johannes Bodner^{3,4} •

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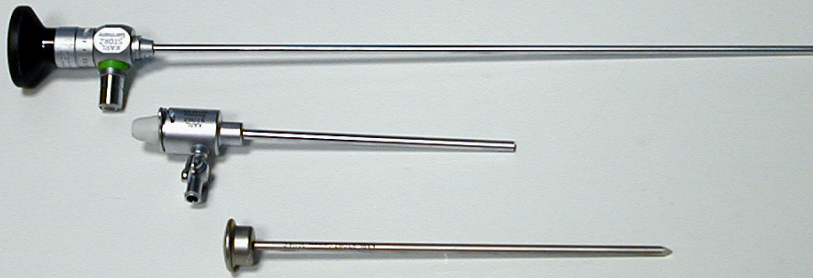
ATS [17]	Exudative phase (stage I)		Fibropurulent phase (stage II)			Organized phase (stage III)	
	<ul style="list-style-type: none"> Inflammatory processes extend to the pleurae and result in immediate outpouring fluid Low cell content Re-expandable lung 		<ul style="list-style-type: none"> Frank pus accumulates especially laterally and dorsally High cell content (PMN) and fibrin depositions over the pleural surfaces and fibrinous strands within the fluid Tendency to loculations and formations of membranes Lung is less expandable 			<ul style="list-style-type: none"> Thick and sedimented exudate Fibroblast growth Fibrosis Inelastic membranes over the pleural surfaces Trapped lung 	
Light [18]	Class 1 Non-significant pp. effusion	Class 2 Typical pp. effusion	Class 3 Borderline complicated pp. effusion	Class 4 Simple complicated pp. effusion	Class 5 Complex complicated pp. effusion	Class 6 Simple empyema	Class 7 Complex empyema
	Small <10mm thick on lateral chest x-ray	>10 mm thick on lateral chest x-ray; Glc>40mg/dl; pH>7.2; gram-stain and culture negative	7.0<pH<7.2 and/or LDH>1000 U/L and Glc>40mg/dl; gram-stain and culture negative	pH<7.0 and/or Glc<40 mg/dl and/or gram-stain and culture positive; No loculations; No pus	pH<7.0 and/or Glc<40 mg/dl and/or gram-stain and culture positive; Multiloculated	Pus; Single locule or free-flowing	Pus; Multiple locules
	Simple pp. effusion		Complicated pp. effusion			Empyema	
Muirs [33]	Pleura: Thin, leaky Fluid appearance: clear PMN+ Bacteria/micros/culture: -/sterile pH>7.3 LDH<500U/L Glc<60mg/dl Fluid-Glc:Serum-Glc>0.5		Fibrin deposition, loculi opalescent PMN++ +/+ pH<7.1 LDH>1000U/L Glc<40mg/dl Fluid-Glc:Serum-Glc<0.5			Thick granulation tissue Pus PMN++ +/+ pH<7.1 LDH>1000U/L Glc<40mg/dl Fluid-Glc:Serum-Glc<0.5	
	Category 1 Very low risk*	Category 2 Low risk*	Category 3 Moderate risk*			Category 4 High risk*	

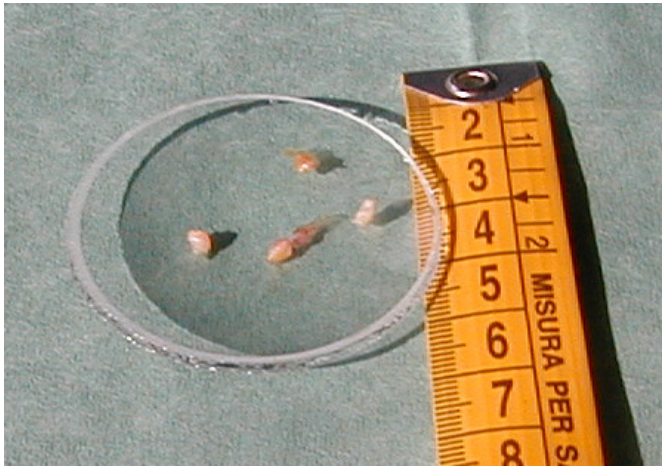


	Exudative phase (stage I)	Fibropurulent phase (stage II)	Organized phase (stage III)	
ACCP [6]	<ul style="list-style-type: none"> A₁=minimal, free-flowing effusion (<10mm on lateral chest X-ray) and B₁=unknown culture and Gram-stain and C₁=pH unknown 	<ul style="list-style-type: none"> A₂=small to moderate free-flowing effusion (<10mm and <1/2 hemithorax) and B₂=negative culture and Gram-stain and C₂=pH >7.2 	<ul style="list-style-type: none"> A₃=large, free-flowing effusion (≥1/2 hemithorax) and B₃=positive culture or Gram-stain or C₃=pH <7.2 	<ul style="list-style-type: none"> A₄=loculated effusion, thickened parietal pleura
BTS [7]	<ul style="list-style-type: none"> Macroscopic appearance: clear fluid Pleural fluid characteristics: pH>7.2 LDH<1000U/l Glucose>2.2mmol/l No organisms on culture or Gram stain 	<ul style="list-style-type: none"> Clear fluid or cloudy / turbid pH<7.2 LDH>1000U/l Glucose>2.2mmol/l 	<ul style="list-style-type: none"> May be positive culture / Gram stain 	
ATS [17]	<ul style="list-style-type: none"> Inflammatory processes extend to the pleurae and result in immediate outpouring fluid Low cell content Re-expandable lung 	<ul style="list-style-type: none"> Frank pus accumulates especially laterally and dorsally High cell content (PMN) and fibrin depositions over the pleural surfaces and fibrinous strands within the fluid Tendency to loculations and formations of membranes Lung is less expandable 	<ul style="list-style-type: none"> Thick and sedimented exudate Fibroblast growth Fibrosis Inelastic membranes over the pleural surfaces Trapped lung 	

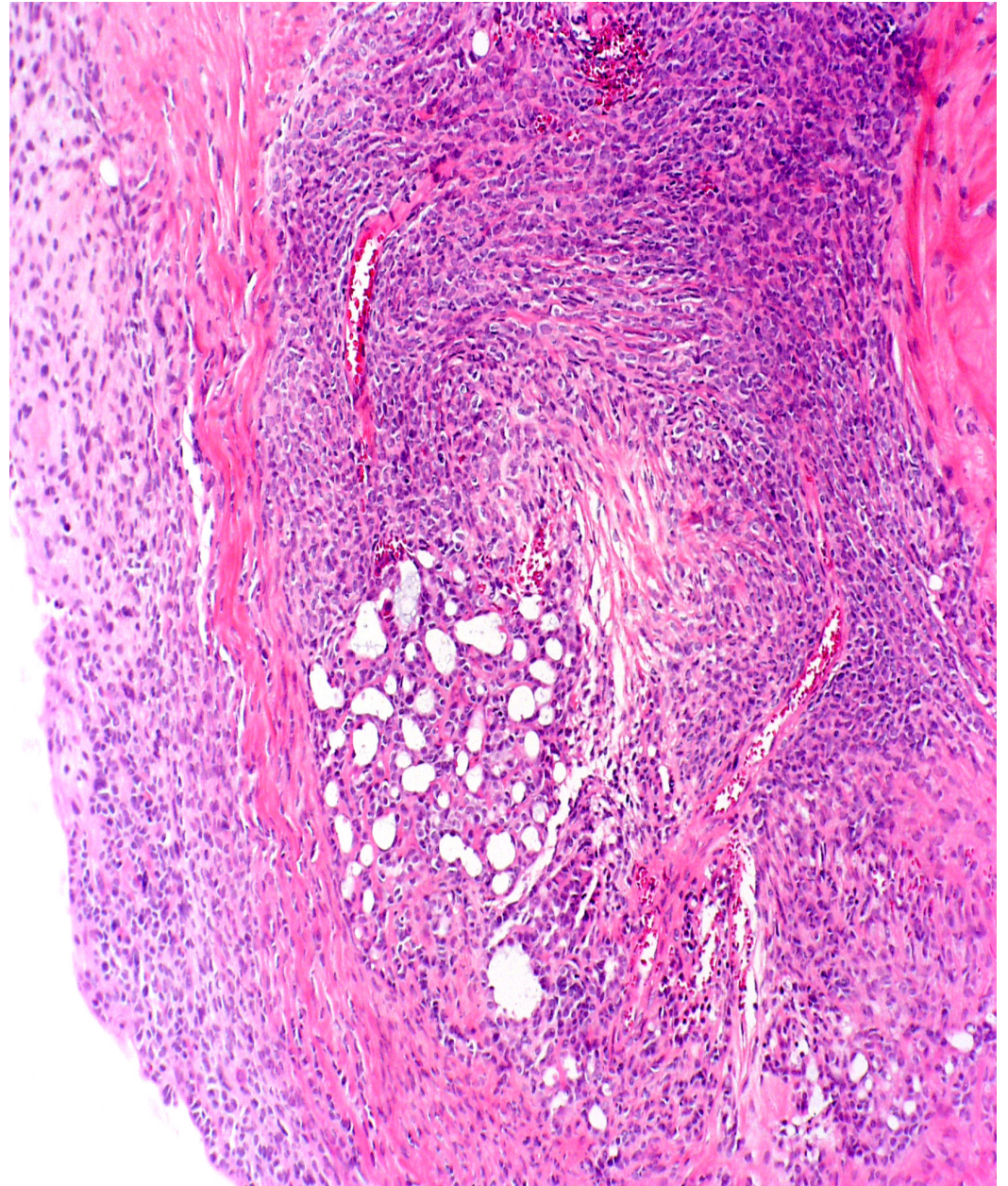
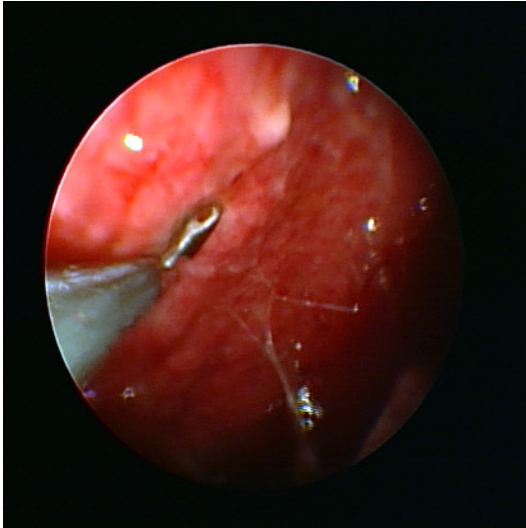
Therapy	Antibiotics	
	No invasive therapy	Serial thoracentesis
		VATS for evacuation of pus and loculations and decortication or
		Tube thoracostomy + intrapleural fibrinolytic agents
		Open decortication, open window thoracostomy, thoracomyoplasty (depending on etiology)

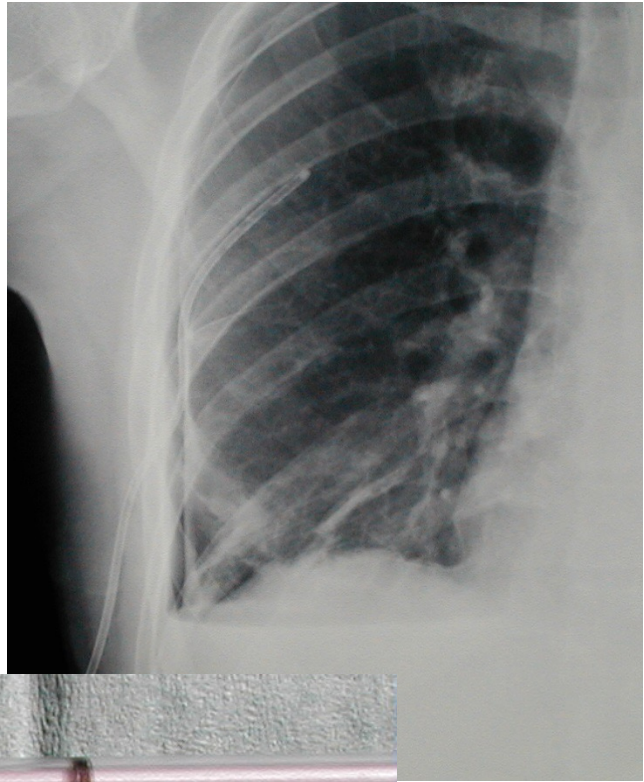
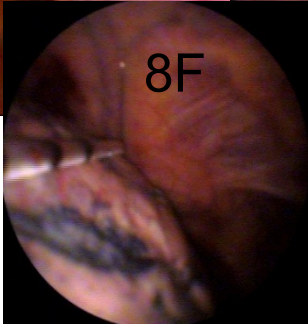
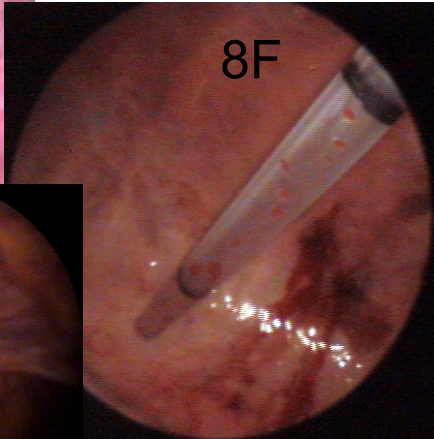
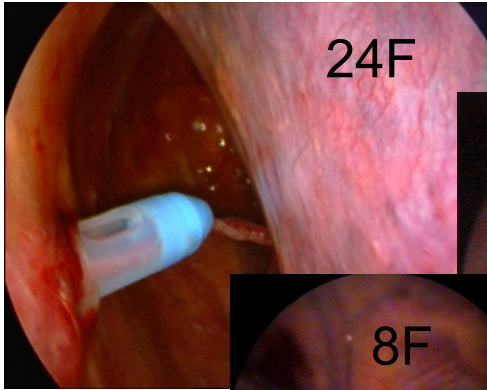
„Mini“ ist the new BIG! Mini-Thoracoscopy!



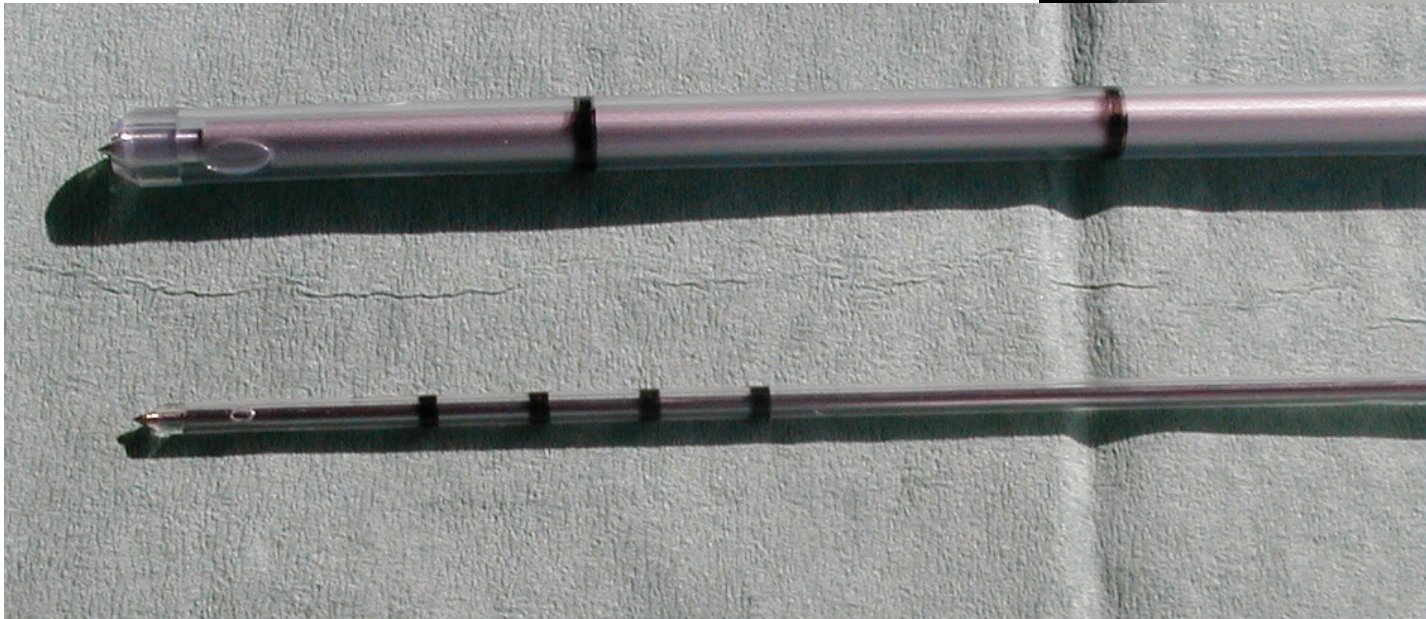


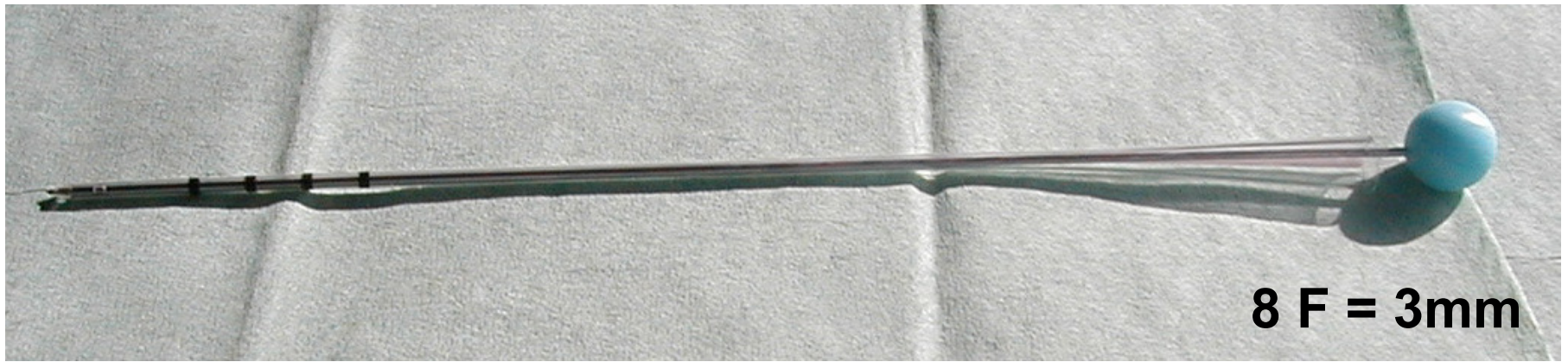
Biospies
3 x 5 mm





Chest Tubes





Cosmetics

