Management of Pneumothorax (PTX): the role of thoracoscopy

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Spontaneous pneumothorax (SP): classification

- 1. SP
  - primary SP (PSP):
    - no known underlying lung disease
  - secondary SP (SSP):
    - COPD, Tbc, catamenial, cystic fibrosis etc.
- 2. ~~Iatrogenic/traumatic~~

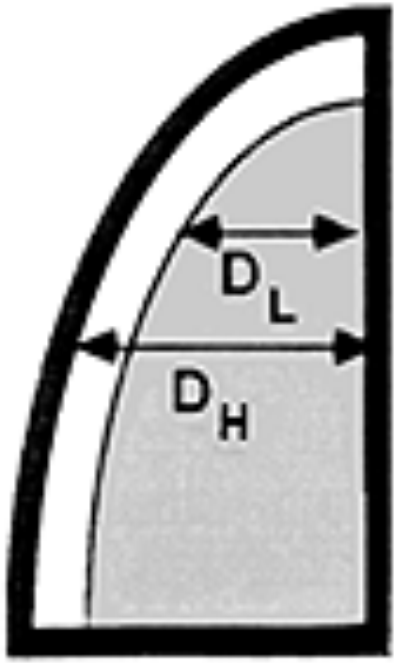
How can we better manage PSP!

- Difficult question
  - Controversies
    - Definitions
    - Recommendations
    - Beliefs

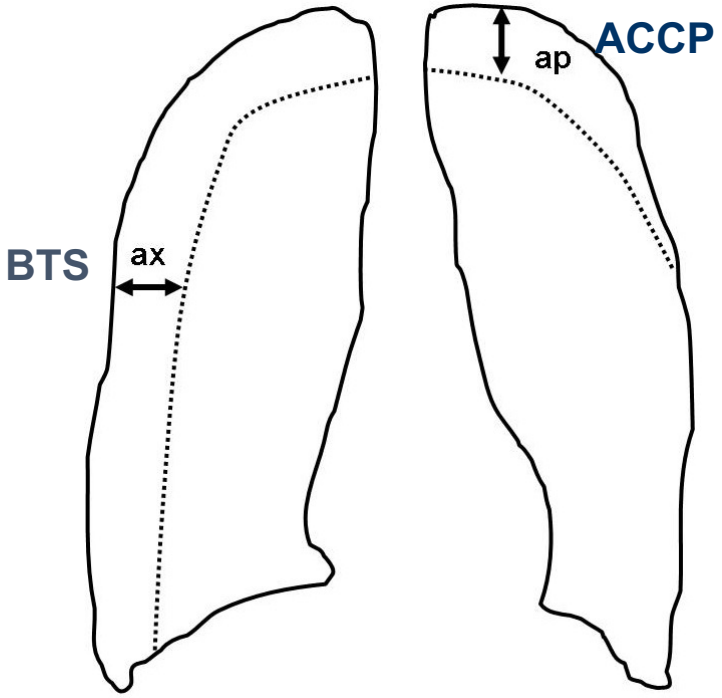
Controversies in PTX

Treat a large PTX: Definition of a large PTX

- **>15-20% (Light index)**



Size PTX(%)=$(1-D_L^3/D_H^3) \times 100$



Controversies in the guidelines!

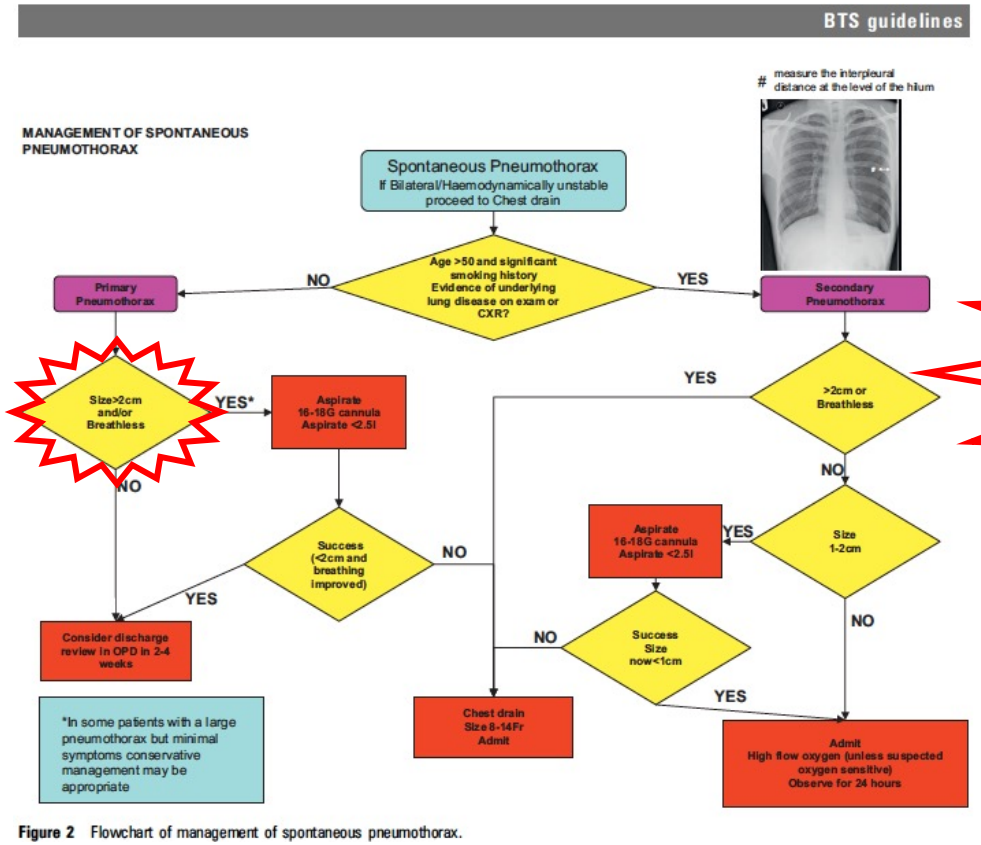


Figure 2 Flowchart of management of spontaneous pneumothorax.

- McDuff A et al. BTS guidelines. Thorax 2010;65(sup2):ii18=31

ERS statement 2015:

The decision to evacuate air is determined

- **Primarily by patient's symptoms**
- **Secondarily by his ability to carry out his normal life activities**
- **Lastly by the size of PTX**

Tschopp JM et al. ERS guidelines. ERJ 2015;46:321

Management of first episode of PSP

- **Therapeutic choices in PSP**
  - **Remove air from the pleural space**
  - **Which is the best option to remove air?**
  - **Observation (do nothing)?!**

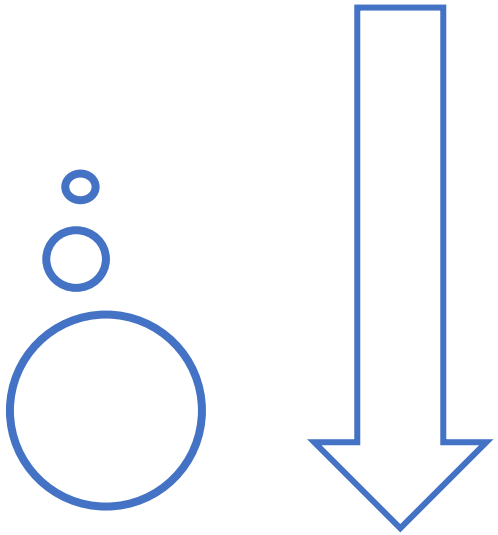
Stradling P, Pool G. Thorax 1966;21:145
Brown SGA et al. NEJM 2020;382:405

Noppen et al. AJRCCM 2002;165:1240-4
Thelle A et al, Eur Respir J 2017;49:1601

Marquette CH et al. Eur Respir J 2014; 43:582
Brims & Maskell. Thorax 2013; 68:664-9

Vanderschueren concept of PSP (1980)

- Stage I: normal
- Stage II: small blebs
- Stage III: bullae < 2 cm
- Stage IV: bullae > 2 cm



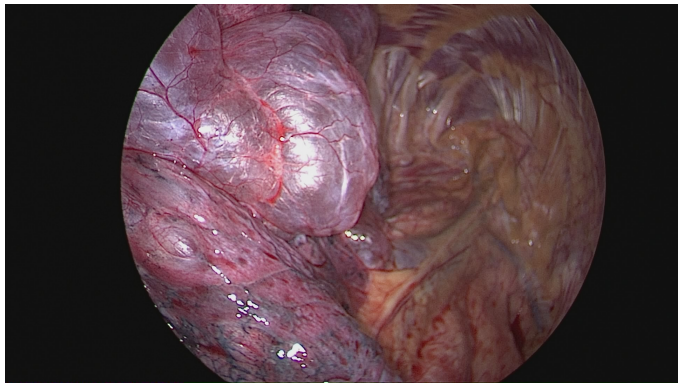
rupture
of bulla?

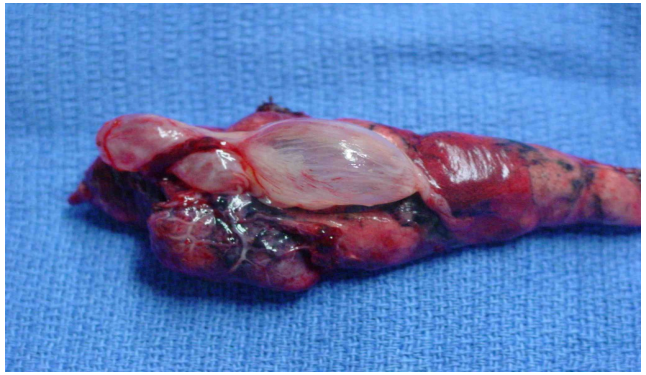
Vanderschueren. Lung 1990; 168 (suppl.): 1122 - 25

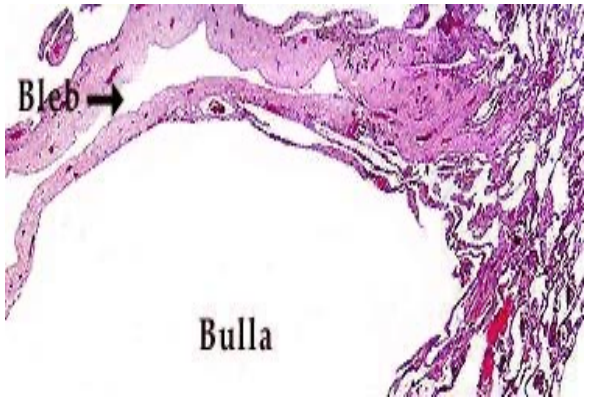
What is the cause of recurrences?

After bullectomie, recurrence rates are still significant, which means that the problem is not only the bullae/blebs

Courtesy of Pr Olivier Tiffet (St-Etienne)



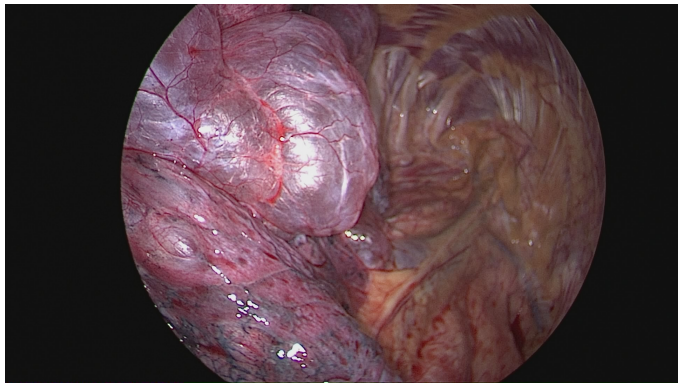




Courtesy of Prof. Marc Noppen

PSP: Facts of pathophysiology

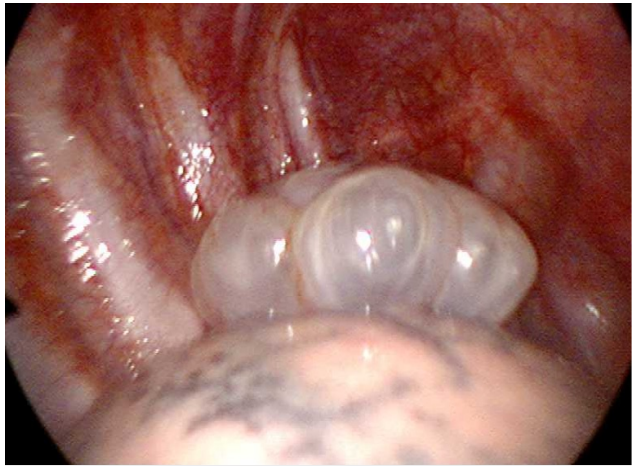
- CT Scans
  - 70 - 100% sub-pleural blebs (« empysema-like changes » - ELC ’s) in PSP
- ELC ’s bilateral in patients with sternotomy
  - (Gobbel 1963, Barnofsky 1957, Ikeda 1988, Donahue 1993, Miltlehner 1992, Lesur 1990)

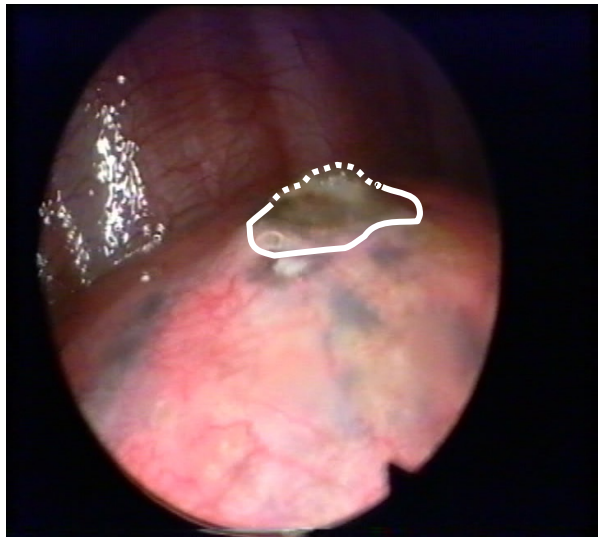


Courtesy of Pr Olivier Tiffet (St-Etienne)

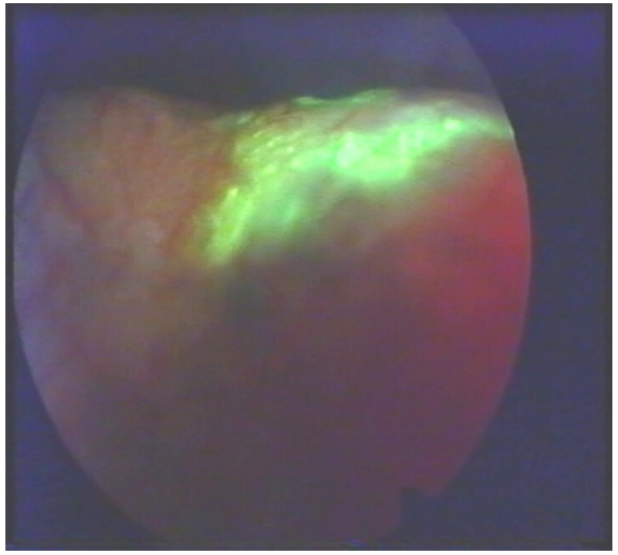
PSP: Facts of pathophysiology

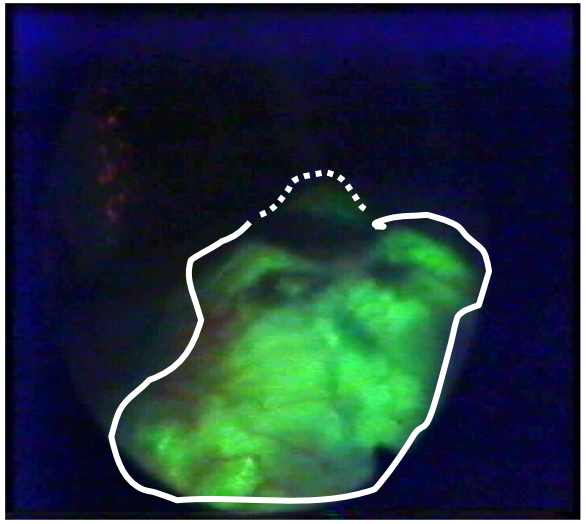
Noppen M. Am J Respiratory Care Med 2004;170:680-682





Courtesy of Pr Marc Noppen





Respiratory Bronchiolitis (RB) in PSP patients?

- Retrospective study in 79 pts
- Results:
  - RB: 70/79 (89%)
  - Interstitial abnormalities: 53/79 (67%)

Cottin V et al. Eur Respir J 1998;12:702

PSP: inflammation of the pleura?

- **De Smedt Eur Respir J 2004;23:896**

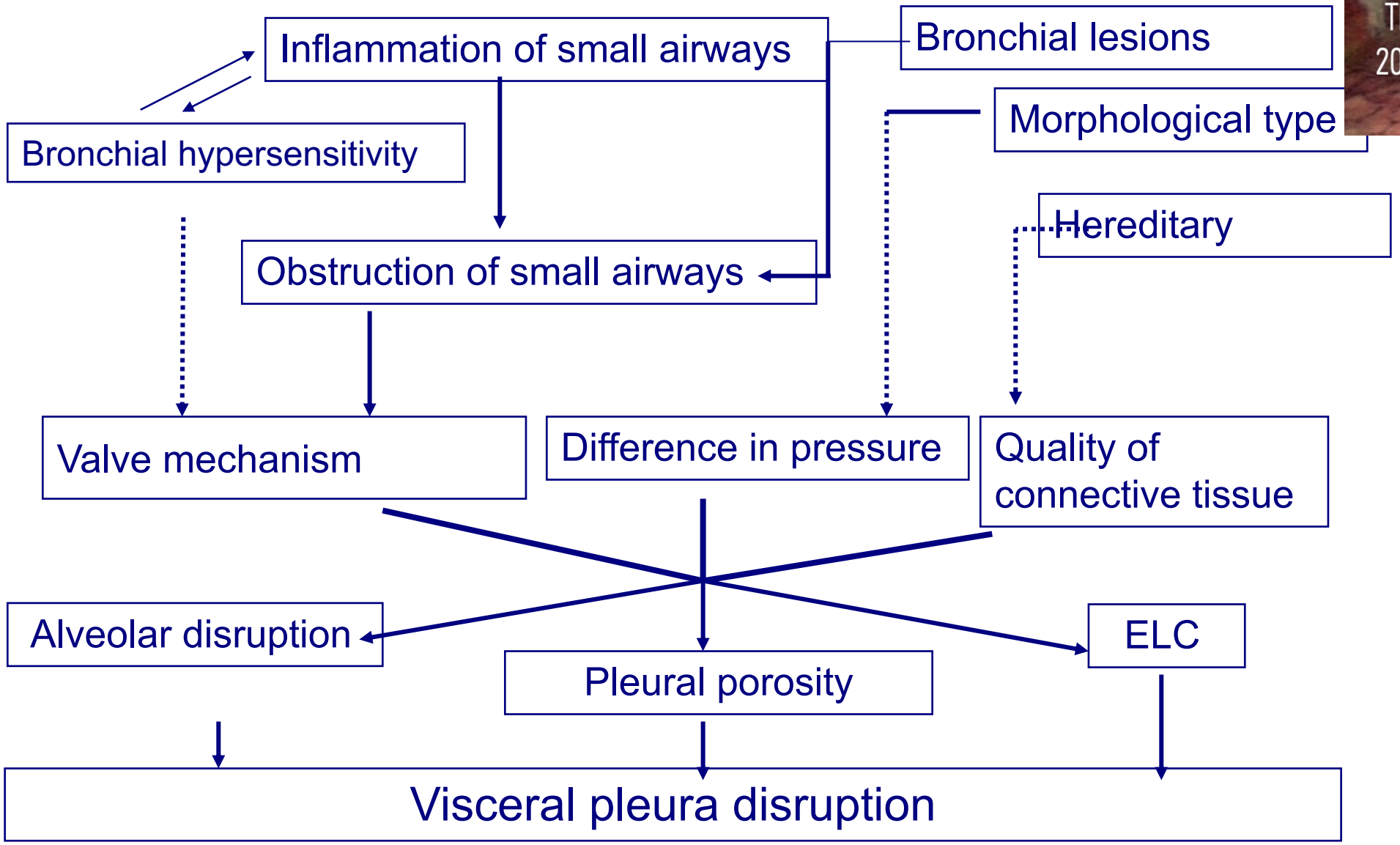
n = 29 PSP - 30 controls

Table 1. – Lavage cell counts

	PSP per mm^3	CONTR per mm^3	p-value
WBC	1973 (547–3040)	159 (74–214)	<0.001
NEU	384 (59–1052)	1 (0–2)	<0.001
EO	243 (120–635)	0 (0–0)	<0.001
BASO	22 (3–48)	0 (0–0)	<0.001
LYMPH	102 (46–201)	27 (14–60)	0.024
MACR	671 (268–919)	118 (47–146)	<0.004
MESO	10 (0–35)	0 (0–2)	0.034

Absolute cell counts per mm^3 in lavage fluid of primary spontaneous pneumothorax (PSP) patients and controls (CONTR) are expressed as median (interquartile range: 25–75). WBC: white blood cell counts; NEU: neutrophils; EO: eosinophils; BASO: basophils; LYMPH: lymphocytes; MACR: macrophages; MESO: mesothelial cells.

New insights in the pathophysiology of PSP



Tschopp JM et al. ERS guidelines. ERJ 2015;46:321

PSP: **Where is the leak** ?

- ✓ *The cause is probably a diffused and extended process of inflammation of the pleura and destruction of the adjacent pulmonary parenchyma*

PSP recurrences: facts

- Overall (drainage including)
  - 30% (16-57%) *Schramel et al. Eur Resp J 1997*
  - So, 70% no recurrence
- Recurrence depends on
  - Time: 2 yrs after 1st episode
  - Smoking
- Recurrence does not depend on
  - Patient's age
  - The importance of PSP

Recurrence rates after treatment of bullae: Bullectomy vs Pleurodesis

- VATS Bullectomy alone - *25 pts* : 20% recurrences

  Bullectomy + Pleurodesis - *24 pts* : 4% recurrences

  (cyclin) *Loubani, Respir Med 2000; 94: 888*

- VATS Bullectomy alone - *72 pts* : 6% recurrences

  Pleurodesis alone - *37 pts* : 0% recurrences

  (talc) *Hatz, Ann Thor Surg 2000; 70: 253*

- VATS Bullectomy alone - *50 pts* : 16% recurrences

  Bullectomy + Pleurodesis - *53 pts*: 1.9% recurrences

  (electrocauthery) *Horio, Surg Endosc 2002; 16: 630*

Treatment of bullae

Tschopp JM et al. ERS Statement. Eur Respir J 2015;46:321-35

Bleb/bullectomie should not be performed routinely

- Not more efficient
- Increase cost
- The leak is not necessarily due to a bleb
- No firm proof

ERS Statement 2015. Surgical procedures

TABLE 5 Surgical procedures for persistent or recurrent primary spontaneous pneumothorax

Strategy	Comment
Routine excision of the apex of the lung	Controversial
Selective excision of blebs or bullae	Controversial as not evidence-based for pulmonologists; general agreement among surgeons
Bullectomy	Controversial but better results than bullae ligation in non-randomised studies
Coverage of staple line with absorbable mesh	To be confirmed
Electro- or cold coagulation of blebs and bullae	Controversial
Endobronchial valves to close persistent air leak	Still anecdotal
Talc poudrage	95% success rate at follow-up; not advisable as sole treatment in cases of significant bullae

ERS STATEMENT | J-M. TSCHOPP ET AL. Eur Respir J 2015; 46: 321–335

ERS Statement 2015. Recurrence prevention and definitive management: Pleurodesis

TABLE 3 Indications for definitive management of primary spontaneous pneumothorax (PSP)

Second episode of PSP
Persisting air leak >3–5 days
Haemopneumothorax
Bilateral pneumothorax
Professions at risk (aircraft personnel, divers)

- Talc poudrage with graded talc is safe and the most cost-effective approach to obtain a diffuse chemical pleurodesis
- Surgical approach: VATS is preferred to open thoracotomy

ERS STATEMENT | J-M. TSCHOPP ET AL. Eur Respir J 2015; 46: 321–335

What to do in case of persistent air-leak / recurrence?

So, why don't we simply perform thoracoscopic pleurodesis to these patients?

Tschopp JM, Schnyder JM, Froudarakis M, Astoul P. Eur Respir J 2009;33:442-3

Treatment of complicated PSP by simple talcage under thoracoscopy

- Spontaneous Pneumothorax PSP n=65; SSP n=28
- Short term success rate: 90/93 (97%)
- Mean duration of follow up: 5.1+3.4 (1.5 - 9.2) yrs
- Long term success rate 80/84 (95%)
- No serious complication

Tschopp et al, Thorax 1997;52:329

Talc pleurodesis by medical thoracoscopy

Author	n	failure/relapse
Boutin 1985	100	5 %
Boutin 1991	505	7.3 %
Viskum 1989	99	2.5 %
El Kahwand 1995	200	6 %
Tschopp 2002	59	5%
Gyorik 2007	56	5%

Hallifax R et al, Thorax 2017;72:1121

Talc pleurodesis by medical thoracoscopy in PTX

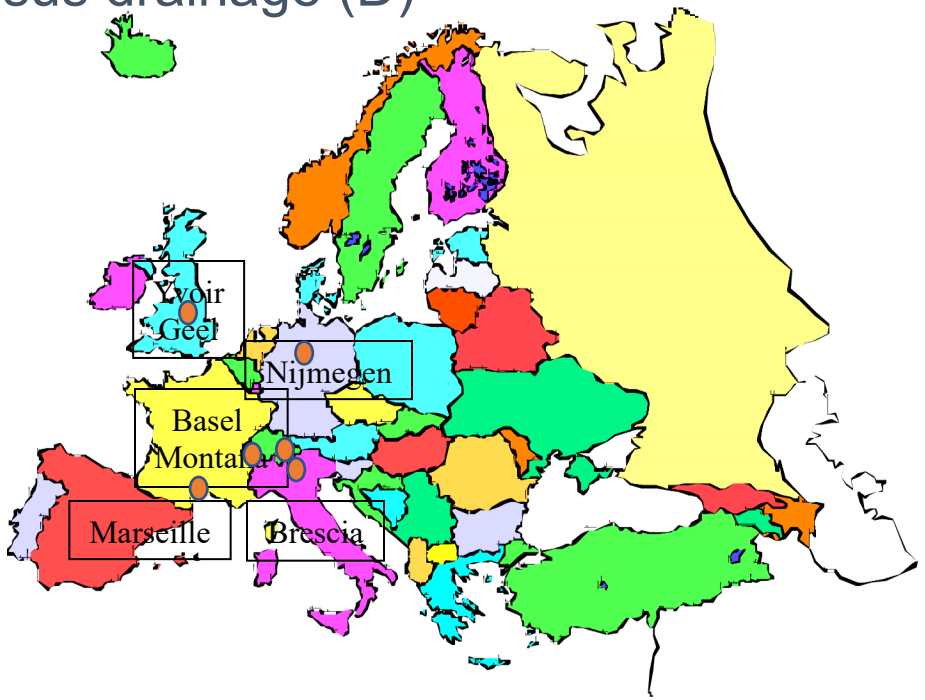
- Under deep sedation

Kostroglou A, Kapetanakis EI, Rougeris L, Froudarakis ME, Sidiropoulou T. Review of the Physiology and Anesthetic Considerations for Pleuroscopy/Medical Thoracoscopy. Respiration. 2021 Sep 9:1-15

Yes, but is this cost-effective?

European randomized controlled study:
Simple Talcage under thoracoscopy (TT) versus drainage (D)

- n = 108 -> 2 groups: TT versus D
- Failures after 5 years
  - TT= 5% vs D=27% (p < .01)
- No difference in complication rates
- No difference in immediate costs
- Total Cost TT < Cost D (considering recurrences)



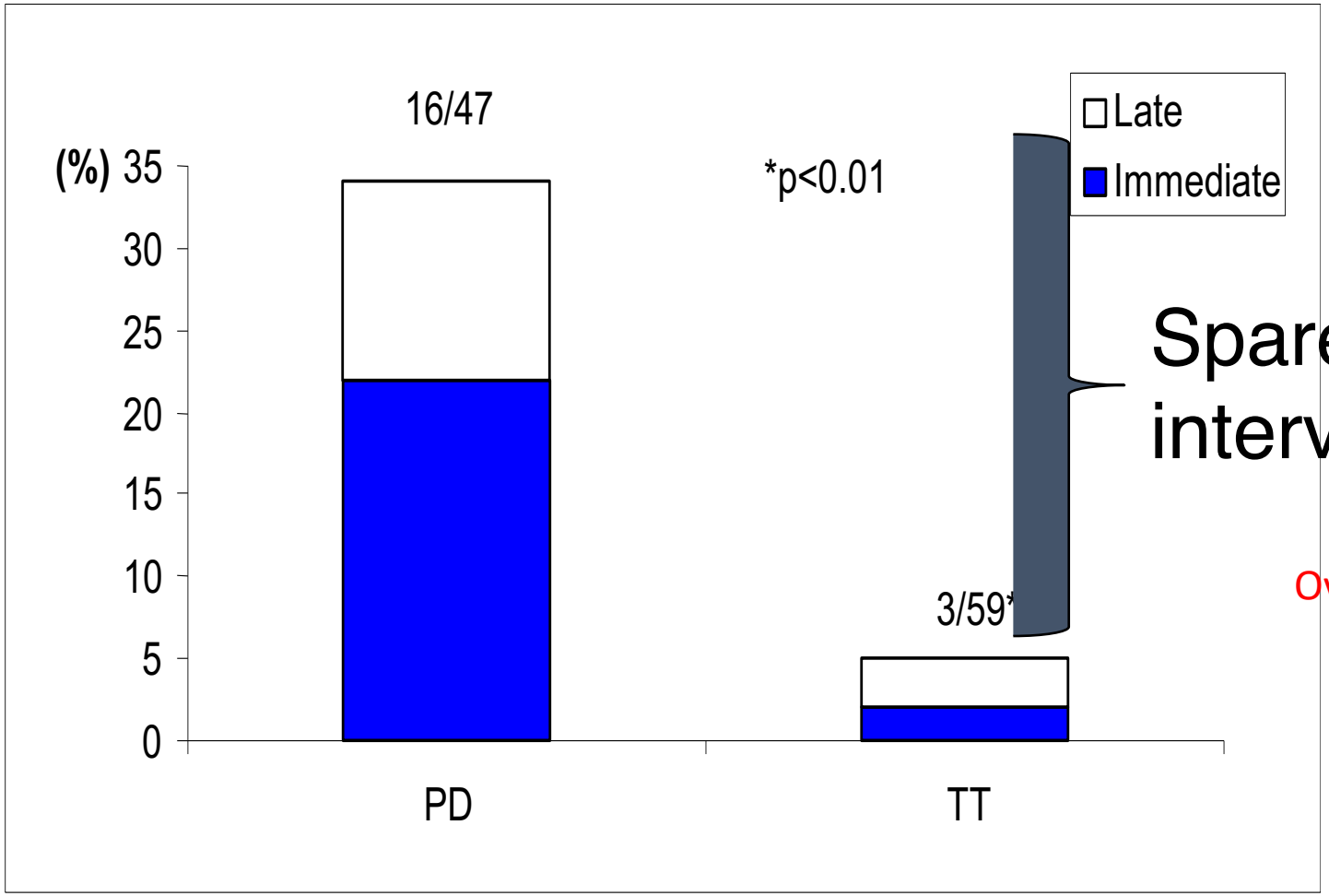
Tschopp JM et al, Eur Respir J 2002;20:1003

Costs[#] of hospitalisation and total costs[#] per patient for thoracoscopic and pleural drainage

	Thoracoscopic talcage	Pleural drainage
Professional (time · day^{-1} min)		
Physician (10)	60.20±35	53.05±28
Nursing care (120)[¶]	501.35±288	441.50±237
Materials		
Radiographs	254.15±168	232.25±106
Blood tests	83.15±34	75.60
Drugs	10.75±13	4.65±5
Dressings and chest tube	8.35±6	7.90±5
Clothing and cleaning	24.80±14	21.85±12
Food	126.25±77	115.15±62
Secondary talcage procedure[§]		78.40
Total hospitalisation costs	1069.00±635	1030.35±455
Total costs[f]	1461.10±635	1080.60±455[+]

Immediate costs

Tschopp JM et al, Eur Respir J 2002;20:1003



Spared interventions

Overall costs (including recurrences)

Simple talc poudrage under medical thoracoscopy is more cost-effective than a simple chest tube treatment

Tschopp JM et al, Eur Respir J 2002;20:1003

Secondary SP (SSP)

- Simple aspiration: less successful
- Prevention of recurrencies as much as possible: (RR of SSP 50%)
- Thoracoscopic talc poudrage success rate same as PSP: 95%

Noppen M. Eur Respir J 1997;10:412-417
Tschopp JM. Thorax 1997; 52: 329-332

Yes, but is this risky?

Thoracoscopy in COPD with PNO

Table 2—*Procedures, Hemodynamic Changes, Complications, Mortality, and Success

Variables	Values
Median time to thoracoscopy, d	4 (range, 3–5)
Median dose of midazolam, mg	2 (range, 1–2.8)
Hemodynamic changes	
Before thoracoscopy	
Heart rate, beats/min	81 ± 9
Systolic BP, mm Hg	120 ± 12
Sao_2, %	94 ± 2
During thoracoscopy	
Heart rate, beats/min	107 ± 16
Systolic BP, mm Hg	136 ± 10
Sao_2, %	91 ± 2
Vanderschueren stage	
1	21 (51)
2	2 (5)
3	5 (12)
4	13 (32)
Complications	
Fever	5 (12)
Pain	13 (32)
Cough	26 (63)
Subcutaneous emphysema	27 (66)
Immediate success, %	100
Long-term success, %	95
Mortality at 30 d	4 (10)

FEV_1, L	Cause of Death	Days Post-MT
0.50	AMI	1
0.70	Pneumonia	13
0.55	COPD	14
0.60	Pneumonia	17

- Deaths due to
  - Respiratory status
  - Comorbidities

Lee P, et al. Chest 2004; 125: 1315-20

Thoracoscopy in COPD with PNO

Table 1—*Demographics of Patients with COPD and SP

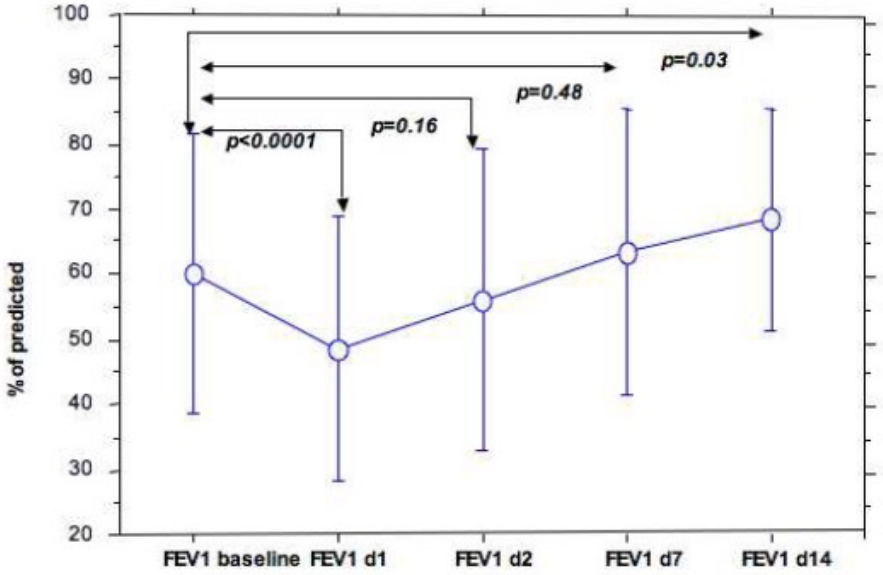
Variables	Values
Patients, No.	41
Mean age, yr	70.7 ± 7.2
Gender	
Men	38
Women	3
Pack-years	52.8 ± 22.3
FEV_1	
L	0.88 ± 0.28
% predicted	41 ± 14
FVC	
L	1.70 ± 0.42
% predicted	60 ± 14
FEV_1/FVC, %	52 ± 12
Body mass index, kg/m^2	17.2 ± 3.0
Functional status	
NYHA class 3	15 (37%)
NYHA class 4	26 (63%)
Fitness for thoracoscopy	
ASA grade 3	15 (37%)
ASA grade 4	26 (63%)
Median postoperative chest tube drainage, d	4 (range, 3–6.5)
Median length of stay, d	5 (range, 4–7.5)

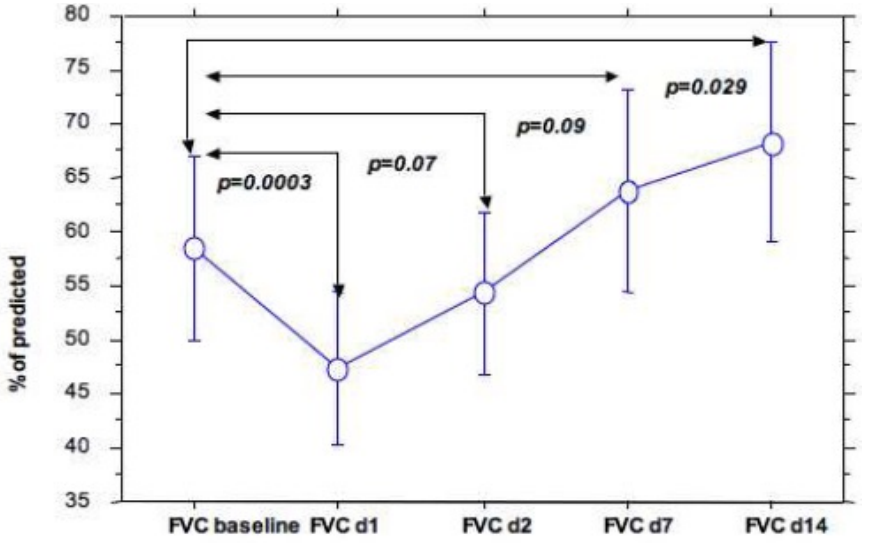
*Values given as mean ± SD, unless otherwise indicated.

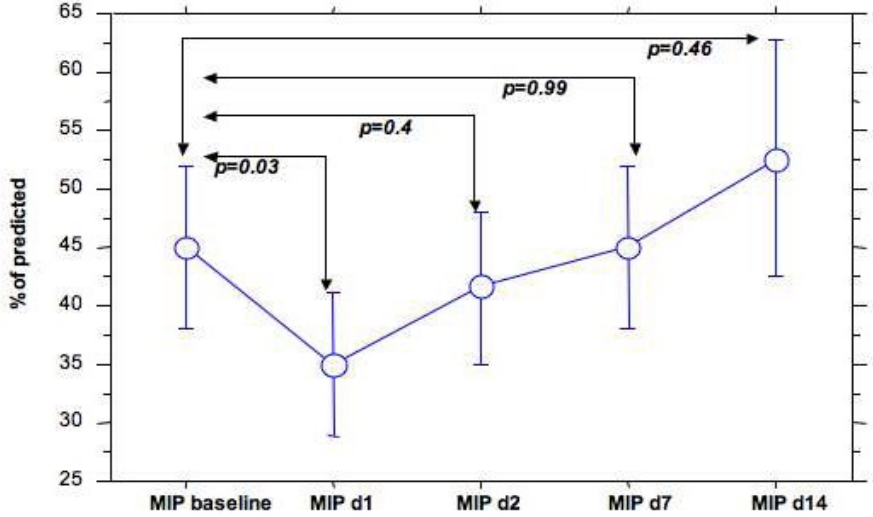
- 41 Patients with PSP due to COPD were recruited for pleuroscopy and talc poudrage under local anaesthesia
- Pain scores, safety and outcome

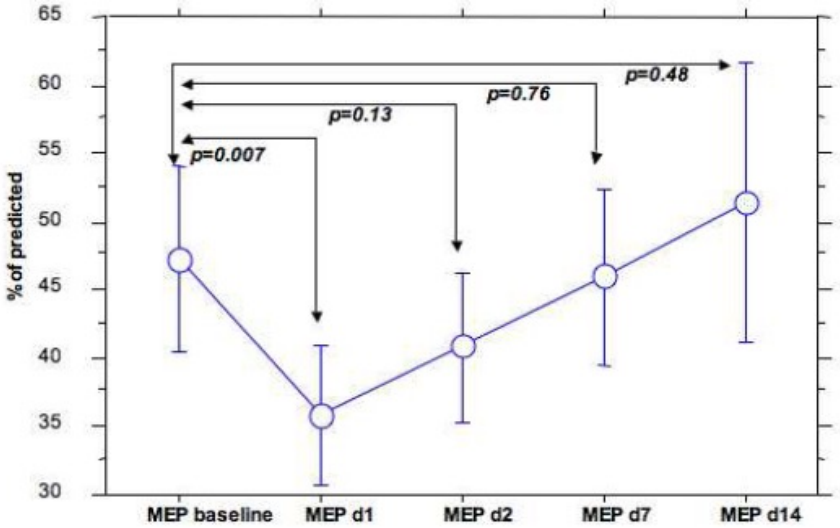
Lee P, et al. Chest 2004; 125: 1315-20

Why increased mortality in such patients









Froudarakis M et al, Respiration 2010;80:220

Conclusion: Thoracoscopic pleurodesis

- ✓<u>Simple</u> talc pleurodesis by thoracoscopy is a safe, mini-invasive and cost-effective technique to prevent recurrences of SP in selected patients
- ✓Need of deep sedation
- ✓Treatment of PSP or SSP: prevention of recurrences

Pr Jean-Marie Tschopp

Thank you Jean-Marie

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