

Management of Pneumothorax



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Pneumothorax

= the presence of air
 in the pleural space



Classification

1. Spontaneous PTX

- **primary: no (known) underlying lung disease**
- secondary: underlying lung disease (COPD, TBC, ...)
- catamenial: in conjunction with menstruation
- neonatal

2. Iatrogenic PTX

3. Traumatic PTX

4. (Bronchopleural fistula)

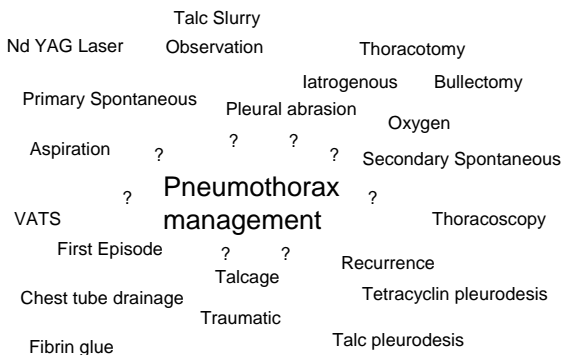
Primary Spontaneous PTX = PSPTX

= spontaneously occurring PTX in the absence
 of known underlying lung disease

- Incidence: 7.4 / 10⁵ / yr for Males
 1.2 / 10⁵ / yr for Female
- Demographics:
 - males > females
 - tall & thin
 - about 10 % family history
 - smoking // PTX
 - peak incidence 20-25 yrs

Therapeutic principles PSP

- I. To remove air from the pleural space
- II. To prevent recurrences



I. To remove air from the pleural space

- 1. Should *every* patient presenting with a PSP be treated ?
- 2. Should treatment choice depend upon the *first* episode or *recurrent* PSP ?
- 3. If removal of air is indicated, by *which technique* should this be achieved ?

I.1. Should every patient be treated?

- almost 100% chest pain or dyspnea/dyscomfort, but symptoms resolve spontaneously in most patients within 48 hrs (Sahn, NEJM 2000;342:868-74)
- "Collapse therapy" until 1950's
- until 1970's : conservative therapy succesful in 83% of patients (Stradling, Thorax 1966;21:145-9)
- spontaneous resolution : 1.25 % / 24 hrs (x 4 with O2 supplementation) (Northfield, BMJ 1971;4:86-8)
- waiting before re-expansion does NOT compromise re-inflation (Miller, EurRespirJ 1996;9:1173-4)

I.1. Should every patient be treated?

- consensus statement (Baumann, Chest 2001;119:590-602):

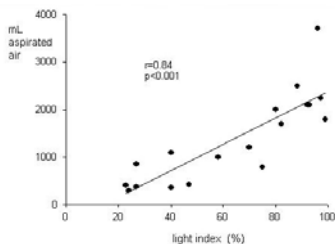
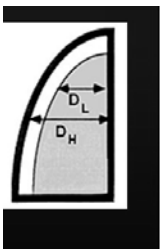
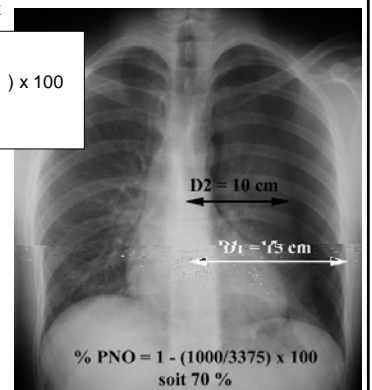
Treatment is indicated in large (>15-20%) and/or symptomatic patients

- size-estimation : Light index

$$\text{Size PTX (\%)} = \left(1 - \frac{D_L^3}{D_H^3} \right) \times 100$$

size-estimation : Light index

$$\text{Size PTX (\%)} = \left(1 - \frac{D_L^3}{D_H^3} \right) \times 100$$



I.2. Should treatment choice depend upon first or recurrent episode?

- recurrence rate (RR) after a 1st episode 16 -52 %, avg 30 % (Schramel, EurRespirJ 1997;10:1372-9)
- most recurrences occur < 2 yrs (Light, JAMA 1990;264:2224-30), but can occur later (Ruckley, Thorax 1966;21:139-44)
- after a 1st recurrence, the incidence of following recurrences seems to increase (62% 2nd, 83% 3rd) (Gobbel, JTCVS 1963;46:331-45), but this effect can be due to age factor (Noppen, EurRespirMonogr 2002, in press)

I.2. Should treatment choice depend upon first or recurrent episode?

- RR seems higher in women, taller and thinner men, and at younger age; the role of smoking is unclear (Abolnik, AmJMedSci 1993;305:297-303)
- two prospective studies comparing VATS with CTD only in first episodes of (predominantly P) SP showed cost savings using the more aggressive approach (Schramel, EurRespirJ 1996;9:1821-5; Torresine, EurJCardiothorSurg 2001;20:42-5)

I.2. Should treatment choice depend upon first or recurrent episode?

- → Consensus statement (Baumann, Chest 2001;112:590-602)
Because 2/3rd of all patients will never present recurrence, recurrence prevention treatment is indicated only after a 1st recurrence (despite probable better cost-efficiency for more aggressive recurrence prevention treatment)
- exceptions
 - if, after informed consent emphasizing 1. That most patients will NEVER have recurrences, 2. That recurrence can NOT be predicted in an individual patient, the patient still prefers immediate invasive (but most often unnecessary) securing pleurodesis treatment
 - flying personnel (AviatEnvironMed 1994;65:1128-9)

I.3. If removal of air is indicated, by which technique should this be achieved?

- chest tube drainage (CTD) attached to a water-seal device
- CTD attached to a Heimlich valve
- manual aspiration with immediate catheter removal

→ Consensus statement (Baumann, Chest 2001;119:590-602)

CTD (attached to water-seal or to Heimlich valve) is the treatment of choice

I.3. If removal of air is indicated, by which technique should this be achieved?

- However, three prospective, randomized trials comparing MA to CTD in mixed (P,S,1st,recurrent,iatr) (Andrivet, Chest 1995;108:335-40; BTS Thorax 1993;48:430-1) and "pure" 1st episodes of PSP (Noppen, AJRCCM 2002;165:1240-4) have shown that small catheter MA followed by immediate catheter removal is safe and successful in 60-70% of patients

→ new consensus? (Light, AJRCCM 2002;165:1202-3)

Because of ↓ morbidity, ↓ cost, and proven safety and efficacy, MA may represent the first-line treatment approach in uncomplicated 1st episodes of PSP. In case of immediate failure, or in clinically unstable patients, CTD is the preferred treatment.

II. To prevent recurrences

Recurrence prevention is indicated:

- in a 1st (or later) recurrence of PSP
- in a 1st occurrence with persistent air leak (> 4 ds) (Baumann, Chest 2001;119:590-602)
- in case of a 1st episode of PSP
 - after informed consent
 - flying personnel

What is the optimal recurrence prevention technique?

Treatment principles:

- treatment of the LUNG abnormalities (ELC, pleural porosity)
- treatment of the PLEURA (pleurodesis)
- combination of both

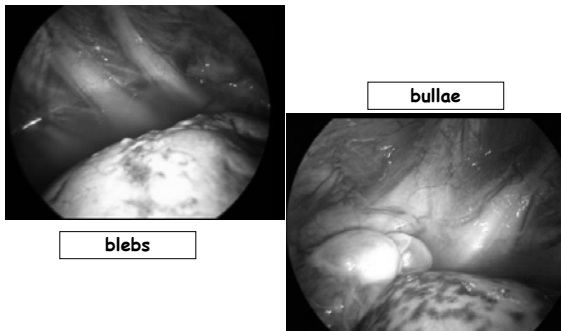
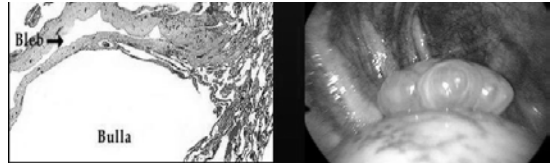
What is the optimal recurrence prevention technique ?

Discussion pertains to the uncertainties regarding the exact pathogenesis of PSP, *i.e.*

- 1. what is the LOCATION
 - 2. what is the CAUSE
- of the air leak(s).

1. What is the **location** of the air leak(s) in PSP ?

- Most authors and clinicians consider rupture of one (or more) ELC's , most often located at the apex of the lung, to be the location of air leakage in PSP



Pro: ruptured ELC is *the* site of the air leak

- Majority (75-100% ?) of PSP have ELC's (Lesur ,Chest 1990;98:341-7 ; Donahue, Chest 1993;104:1767-9)
- 80 %of non-smoking PSP have ELC (Bense ,Chest 1993;103:433-8)
- Stapling,oversewing or coagulation of ELC's is successful,with long-term recurrence of 5-10%(Hatz, AnnThoracSurg 2000;70:253-7)
- Recurrence after VATS is higher if no ELC's seen/treated (Naunheim, JThorCardiovascSurg 1995;109:1198-1204)
- Contralateral ELC's are present in 50-100% of PSP patients; the presence of contralateral ELC increases risk for contralateral PSP (Sihoe, Chest 2000;118:380-3)

But...

- If this is true , why do surgeons advocate to perform ELC treatment (bullectomy, blebectomy) **PLUS** some form of pleurodesis ?
- ELC treatment is expensive , and not free of complications (15- 50 % morbidity ,upto 2 % mortality) (Korner, EurJCardioThorSurg 1996;10:656-9 ; Ferguson, BrJSurg 1981;68:214-6)

“ Most PSP patients have ELC's... “

...but in how many cases are ELC's actually leaking?

- 3.6 % (6/166) (Weissberg, Chest 2000;117:1279-85)
- 25 % (7/28) (Radomsky, Pneumologie 1989;43:250-3)
- 73 % (72/95) (Hatz,AnnThorSurg 2000;70:253-7)

→ not every PSP has ELC's

→ not every PSP has an air leak at ELC's present

“ 80 % of non-smoking PSP patients have ELC’s “

- 20 % of age- and gender matched normal smoking subjects without PSP have ELC’s (Lesur, Chest 1990;98:341-7)
- there is no relation between the # and size of ELC’s and the occurrence of a 1 st or recurrent PTX (Smit, BrJRadiol 2000;73:356-9 ; Noppen , Chest 2001;119:1293) , and there is no difference in # and size of ELC’s between 1st or recurrent PSP’s (Janssen, Chest 1995;108:330-4)

“ELC treatment is successful ; not treating ELC’s decreases success”

5 studies on ELC treatment alone (= without pleurodesis)

- Ferguson, BrJSurg 1981;68:214-6 : 0% recurrence after “excision of involved area” in 45 pts (but : 15/45 were persistent air leaks, 30/45 were operated for ? Reason, and 249 pts were treated successfully conservatively! 2% mortality!
- Korner, EurJCardiothorSurg 1996;10:656-9 : 5% early and 5% late recurrences in 120 “ bullectomies without pleurodesis”. 1% mortality !

“ELC treatment is successful ; not treating ELC’s decreases success”

- Hatz, AnnThorSurg 2000;70:253-7 : 4.6 % RR in 72 pts with VATS bullectomy alone vs 0 % RR in 37 pts with pleurodesis alone
- Horio, SurgEndosc 2002;16:630-4 : 16 % RR in 50 pts with bullectomy alone vs 1.9 % RR in 53 pts with VATS bullectomy + pleurodesis
- Loubani, RespirMed 2000;94:888-90 :20 % RR in 25 pts with VATS bullectomy alone vs 4 % RR in 24 pts with bullectomy + pleurodesis

“If contralateral ELC’s are present , there is increased risk for contralateral PSP”

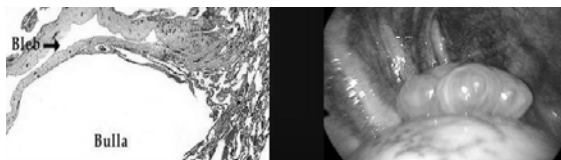
(Sihoe, Chest 2000;118:380-3)

- Sihoe’s statistics were wrong (see Noppen, Chest 2001;119:1293)
- the # or size of ELC’s does not correlate with **ipsilateral** PSP (Smit, BrJRadiol 2000;73:356-9), so why would it correlate with **contralateral** PSP...?

Therefore:

- SYSTEMATIC bleb/bullectomy in every patient should NOT be performed for recurrence prevention (even if ELC’s are present) because :
 - it adds nothing to pleurodesis
 - it is expensive
 - it has a higher morbidity /mortality than simple (talc) pleurodesis
 - ELC’s ,even when present, are not necessarily the location of the air leak(s) in every patient !

What is the **location** of the air leak(s) in PSP ?



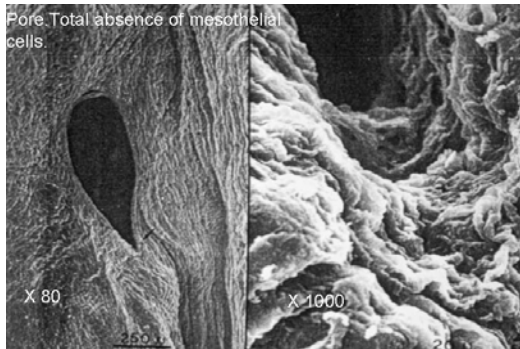
Upto 20 % RR after ELC treatment alone may reflect the fact that the actual location of an air leak may not necessarily be at the ELC’s , even when present...

What is the **location** of the air leak(s) in PSP ?

If not at the ELC's , then where...?

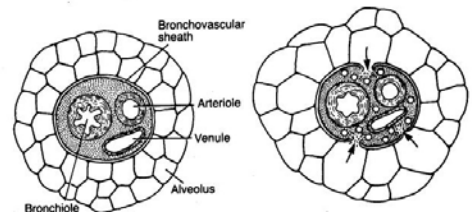
- LM and EM studies of PSP lung resection specimens have shown **true leak's at the ELC's** to be present in **25 %** of cases only...
- in the rest of cases, **other lesions** were present ("pleural porosis", "elastofibrosis"), **at or around ELC's**, and in lung zone's **where no ELC's were present...**

(Radomsky, Pneumologie 1989;43:250-3 ; Ohata M, Chest 1980;77:771-6 ; Masshof , DtschMedWschr 1973;98:801-5)

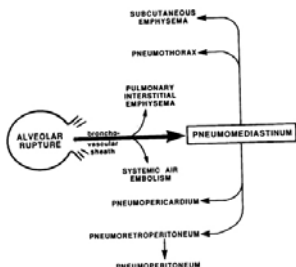


What is the **location** of the air leak(s) in PSP ? Alternatives...

Alveolar rupture into the peribronchovascular interstitium
(Sahn, NEJM 2000;342:868-74)

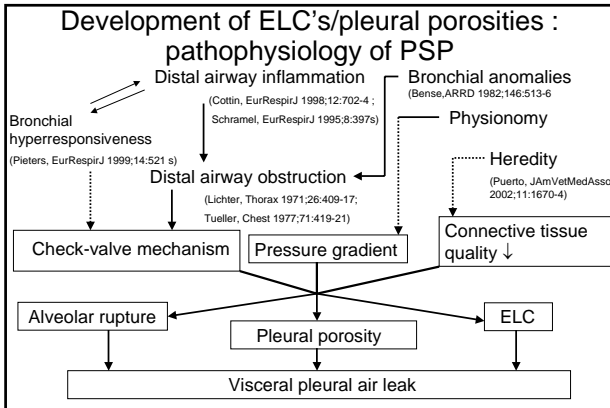
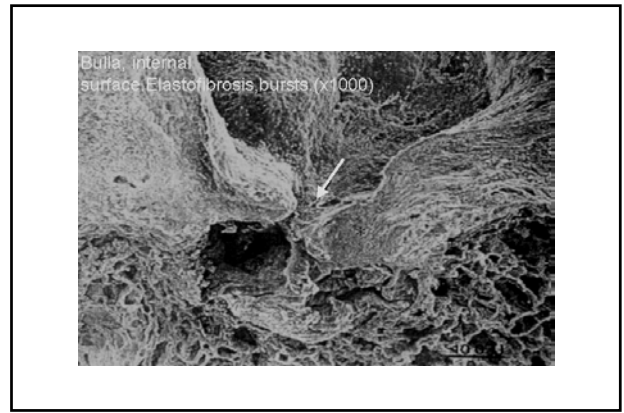
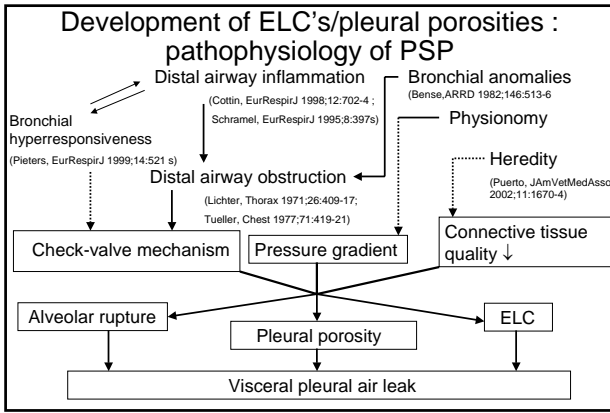


What is the **location** of the air leak(s) in PSP ? Alternatives...



What is the **location** of the air leak(s) in PSP ? Summary :

- True rupture of ELC's
- Pleural porosity / elastofibrosis
 - at ELC's when present
 - at other part of lung surface when ELC's are present
 - at lung surface , in the absence of ELC's
- Via interstitium
- Combination of the above



2. What is the **cause** of the air leak in PSP?

→ specific precipitating causes of PSP:

- (heavy) exercise? No ! (Bense, EurJRespirDis 1987;71:181-6)
- ΔP_{atm} or ΔP_{temp} ? (Scott, ARRD 1989;139:659-62 ; Smit, Chest 1999;116:676-81)
- air travel (multiple Δp) (Fuchs, AerospaceMed 1967;38:1283-5)
- synodic lunar cycle (Sok, MedHypoth 2001;57:638-41)
- type A personality (Martin, ArchBronchoneumol 2001;37:417-23)
- heavy music (sound energy) (Noppen, in press)
- ...?

What about treating the **pleura** alone (pleurodesis) ?

Pleurodesis via chest tube :

- acceptable in pts who wish to avoid surgery or who present high surgical risk (Baumann, Chest 2001;119:590-602)
- tetracyclin, minocyclin, doxycyclin, talc slurry, ... : results are intermediate between "nothing" (CTD, MA, rest) and thoracoscopic treatment (Almind, Thorax 1989;44:627-30 ; Colt, Chest 1997;111:442-8 ; Berger, Chest 1994;106:992-4 ; Light, JAMA 1990;264:2224-30 ; Alfageme, Chest 1994;106:347-50 ; Tschopp, Thorax 1997;52:329-32)

What about treating the **pleura** alone (pleurodesis) ?

Pleurodesis via thoracoscopy/VATS/surgery:

- no data on VATS/surgical pleurodesis alone, except Hatz, AnnThorac Surg 2000;70:253-7 : 0 % RR in pleurodesis alone vs 4.6 % in bullectomy alone.
- medical thoracoscopic talcage : 87 to 100 % recurrence prevention (Milanez de Campos, Chest 2001;119:801-6 ; Loddenkemper, EurRespirJ 1993;6:1544-5 ; Delaunois, MonArchChestDis 1998;53:148-50 ; Boutin, ClinChestMed 1995;16:497-503 ; Tschopp, Respiration 2000;67:108-11)

What about treating the *pleura* alone (pleurodesis) ?

VATS or Open Surgery ?
Controversial...

- VATS > OS (Hyland, CanRespirJ 2001;8:339-43) (indirect costs)
- VATS = OS (Miller, AnnSurg 2000;66:1014-5)
- VATS < OS (Kim, AnnThoracSurg 1996;61:1510-2) (recurrences)

Summary on “location , cause and recurrence prevention” of PSP:

- most PSP patients have ELC's
- the actual site of air leak may be at the ELC, or elsewhere (whether ELC's are present or not)
- the actual site of air leak in an individual patient cannot be determined non-invasively , nor predicted
- unless a clearly leaking ELC is present at thoracoscopy , systematic ELC treatment probably should not be performed
- pleurodesis techniques (alone, or combined with ELC treatment in case of visible air leak) are the cornerstone of recurrence prevention treatment
- medical thoracoscopy and VATS have never been directly compared

