Online Appendix A1 BTS Guideline for Pleural Disease

Section A Spontaneous pneumothorax

Question A1 Evidence Review and Protocol

A1 For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

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Question Evidence Review

A1 For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Background

Drainage of symptomatic pneumothorax, either with needle aspiration (NA) or intercostal chest drain (ICD) attached to an underwater seal is the current standard of care for primary spontaneous pneumothorax (PSP). There is ongoing debate over the respective benefits of NA over ICD, with multiple recent randomised trials comparing NA to ICD. Conservative management (i.e. no active intervention) is often undertaken in patients with small or incidental PSP, but could be an alternative to NA or chest drain in patients with larger pneumothoraces. Ambulatory treatment using a purpose made device containing a one-way valve, or Heimlich valve attached to chest drain has the potential to allow outpatient management of pneumothorax. A proportion of spontaneous pneumothoraces (SP) will recur and both chemical pleurodesis via chest tube and thoracic surgery have the potential to reduce this risk. Thoracic surgery is often the treatment of choice for on-going air leak, or for those with recurrent pneumothorax. However due to the risk of recurrence, trials have been performed to establish whether thoracic surgery could be offered as first presentation of pneumothorax. This review will investigate if conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery at first presentation are better than "standard care" (intercostal drainage) at improving clinical outcomes in adults with spontaneous pneumothorax.

Outcomes

Length of hospital stay, recurrence of pneumothorax, re-admission, need for further pleural procedures, complications, pain and breathlessness, quality of life, and mortality. Immediate success rates and radiological resolution were not included as an outcome of interest, as it was not felt to be a patient focused outcome

Evidence review

1. Conservative Management

Four studies were deemed relevant from the literature search. These included one randomised control trial (RCT)[1] and three retrospective cohort studies[2-4]. Two studies included participants under the age of 18 (minimum age 14) with PSP[1,3] and the remaining studies included all adult spontaneous pneumothorax cases (including SSP)[2,4].

Length of hospital stay

Three studies reported on the length of hospital stay following intercostal drainage or during conservative management for the treatment of spontaneous pneumothorax in adults. A summary of the results is shown in Table A1a.[1,3,4]

Table A1a: Comparison of length of hospital stay following intercostal drainage or during conservative management for the treatment of spontaneous pneumothorax in adults

	Median length of hospital stay [IQR] (days)	
Study	**Conservative management**	**Intercostal drainage**
Brown 2020[1]	0.2 [0.2 to 0.6]	3.0 [0.7 to 6.1]
Chew 2014[3]	0.6 [0.2 to 0.9]	6.5 [5.3 to 7.7]
Hart 1983[4]	-	5.5 (mean)

IQR – interquartile range

Recurrence of pneumothorax

All studies reported on the recurrence of pneumothorax and meta-analysis revealed slightly greater risk of recurrence following intercostal drainage (179 per 1000 patients) than compared with conservative management (111 per 1000 (80 to 155)) (Figure A1a).[1-4]

Re-admission

Only one study reported re-admission rate following intercostal drainage or conservative management for the treatment of spontaneous pneumothorax in adults, reporting that 17% of participants (28/162) required re admission following conservative management and 27% (41/154) following intercostal drainage.[1]

Need for further pleural procedures

The need for further pleural procedures was reported in all studies.[1-4] Meta-analysis was not performed as two studies did not report data for the conservative management arm[2,4] and one for the intercostal arm[1]. The remaining data are summarised in Table A1b.

Table A1b: Comparison of further pleural procedures following intercostal drainage or during conservative management for the treatment of spontaneous pneumothorax in adults

	% participants requiring further pleural procedures (no. patients)	
Study	**Conservative management**	**Intercostal drain**
Brown 2014[2]	NR	21% (46/220)
Brown 2020[1]	15% (25/162)	NR
Chew 2014[3]	6% (3/53)	0% (0/58)
Hart 1983[4]	NR	11% (13/115)

NR – not reported

Complications

Complications were reported in all studies and included haemothorax, local infection, pneumonia and empyema.[1-4] Data were not reported for the conservative management arm in two studies[2,4] and a summary of the data are shown in Table A1c.

Pain and breathlessness

Only one study reported pain and breathlessness with 2% of participants (4/162) experiencing pain and breathlessness following conservative management and 7% (11/154) following intercostal drainage.[1]

Quality of life

No studies directly assessed quality of life, but Brown et al (2020) reported that patients managed conservatively suffered significantly fewer days off work (3 days (1 to 8) compared with 6 days (2 to 14) in the intercostal drainage group, median (IQR)) although patient satisfaction scores were not significantly different (5.4 ± 1.0 and 5.3 ± 1.1 respectively, with 1 being very dissatisfied to 6 being very satisfied).[1]

Mortality

No studies reported on mortality following pneumothorax treatment with conservative management or intercostal drainage.

Table A1c: Comparison of complications following intercostal drainage or during conservative management for the treatment of spontaneous pneumothorax in adults

		% participants experiencing complications (no. patients)	
Study	**Complication**	**Conservative management**	**Intercostal drain**
Brown 2014[2]	All	NR	11% (25/220)
Brown 2020[1]	All	8% (13/162)	27% (41/154)
Brown 2020[1]	Haemothorax	2% (3/162)	3% (5/154)
Chew 2014[3]	Haemothorax	0% (0/53)	8% (5/53)
Brown 2020[1]	Skin infection	1% (1/162)	1% (1/154)
Chew 2014[3]	Skin infection	0% (0/53)	5% (3/53)
Brown 2020[1]	Empyema	1% (1/162)	2% (3/154)
Chew 2014[3]	Empyema	0% (0/53)	5% (3/53)
Hart 1983[4]	Respiratory infection	NR	2% (2/115)
Hart 1983[4]	Pleural effusion	NR	2% (2/115)
Hart 1983[4]	Lung collapse	NR	10% (12/115)

NR – not reported

2. Needle Aspiration

Nine relevant studies were identified from the literature search, which included seven randomised controlled trials[5-11] and two retrospective cohort studies[12,13]. Most studies examined patients with PSP, one study examined patients with PSP and SSP[11], reporting most outcomes separately, and a final study included PSP and SSP patients, reporting outcomes as a single group[12].

Length of hospital stay

PSP

Seven studies reported length of hospital stay (LOS) for NA and ICD for the treatment of pneumothorax and meta-analysis showed that the anticipated LOS was 2.55 days shorter (2.24 to 2.87) for patients treated with NA (Figure A1b).[5-10,13]

SSP

One study reported LOS for NA versus ICD in patients with SSP, which reported a shorter LOS with NA (2.5 days (1.2–7.8) compared with 5.5 days (3.6–9.2) with ICD, median (IQR), $p = 0.049$).[11]

Recurrence of pneumothorax

PSP

Seven studies reported recurrence of pneumothorax and meta-analysis showed no difference in the rate of recurrence following NA or ICD treatment for PSP (Figure A1c).[5-10,13]

SSP

No studies reported the rate of pneumothorax recurrence in SSP patients.

Re-admission

No studies reported on re-admission following NA or ICD for the treatment of pneumothorax.

Need for further pleural procedures

The need for further pleural procedures was reported in five studies[6,7,9,12,13] and meta-analysis revealed that the risk of a need for further pleural procedures was greater following NA (626 per 1000 patients (544 to 719) compared with 240 per 1000 following ICD) (Figure A1d).

Complications

Complications following NA or ICD were reported in four studies. Meta-analysis of two studies reporting the number of participants experiencing complications showed no overall difference in the risk of complications following NA or ICD (102 per 1000 patients (46 to 225) compared with 104 per 1000 respectively) (Figure A1e).[6,13]

When focusing on individual complications (subcutaneous emphysema, bleeding and wound infection), meta-analysis showed a slightly greater risk of subcutaneous emphysema following ICD (Figure A1f and summarised in Table A1d)[10,11], but it should be noted that one study included complications from PSP and SSP patients[11].

Table A1d: Anticipated risk of complications following needle aspiration or intercostal drainage for the treatment of pneumothorax

Complication	No. studies	Anticipated risk of complication (per 1000 patients) NA	ICD
Subcutaneous emphysema	2	9 (1 to 70)	92
Bleeding	2	14 (3 to 82)	51
Wound infection	2	9 (1 to 69)	51

ICD – intercostal drainage; NA – needle aspiration

Pain and breathlessness

Harvey et al reported on pain following NA or ICD treatment and using a pain score from 0 (no pain) to 9 (greatest pain), the mean pain score across hospital stay was 2.7 ± 3.3 in the NA group and 6.7 ± 3.6 in the ICD group (p <0.001).[7] No studies reported on breathlessness.

Quality of life and mortality

No studies reported on quality of life or mortality.

3. Ambulatory management

The initial literature search identified 135 papers of which four randomised controlled trials (RCT) were deemed relevant.[14-17] RCT design differed between studies, with two using specific ambulatory devices compared with standard care[16,17] and two using Heimlich devices attached to a chest drain, one comparing with standard care[14] and the other comparing with needle aspiration only (including repeat aspiration)[15]. For the purposes of meta-analysis, the comparator groups have been combined as 'standard care'.

Length of hospital stay

Two studies included length of hospital stay (LOS) data and meta-analysis showed a shorter length of stay following ambulatory management (3.47 days less (2.20 to 4.73)) than compared with those undergoing standard care (Figure A1g).[16,17]

Recurrence of pneumothorax

In three studies reporting long term recurrence rates, meta-analysis showed no difference in the risk of pneumothorax recurrence following ambulatory management (212 per 1000 patients (144 to 315)) or standard care (244 per 1000) (Figure A1h).[14-16]

Re-admission

Two studies reported re-admission rates following ambulatory management or standard care for the treatment of pneumothorax and meta-analysis showed no difference in the risk of re-admission between the two groups (141 per 1000 (83 to 243) following ambulatory management and 176 per 1000 following standard care) (Figure A1i).[15,16]

Need for further pleural procedures

The need for further procedures was reported in four studies and meta-analysis revealed no difference in the risk of further pleural procedures following ambulatory management or standard care (294 per 1000 patients (214 to 406) with ambulatory management and 286 per 1000 with standard care) (Figure A1j).[14-17]

Complications

Complications were reported in four studies following ambulatory management or standard care for the treatment of pneumothorax and meta-analysis showed no difference in the risk of complications following ambulatory management or standard care (354 per 1000 patients (270 to 459) following ambulatory management and 300 per 1000 with standard care) (Figure A1k).[14-17] However, it should be noted that there were variations in of the reporting of complications between studies, with one study including re-admission to hospital, prevalent in the ambulatory group, as a complication.

Pain and breathlessness

Only one study provided quantitative data on pain and breathlessness using the visual analogue scale (VAS) scoring system and a summary of the results is shown in Table A1e.[16]

Table A1e: Comparison of pain and breathless scores following ambulatory management and standard care for the treatment of pneumothorax

		Approximated VAS scores (mean)		
Pain / breathlessness	**Time**	**Ambulatory**	**Standard care**	***p***
Pain	Post-procedure (Day 0)	41	38	NS
Pain	Day 4	11	12	NS
Breathlessness	Post-procedure (Day 0)	34	36	NS
Breathlessness	Day 4	4	7	NS

NS – not significant; VAS – visual analogue scale (from 0 to 100)

Quality of life and mortality

Quality of life was not reported in any studies and no patient deaths were reported.

4. Chemical pleurodesis

The initial literature search identified 138 papers of which six were deemed relevant. These included three randomised controlled trials[18-20], one prospective cohort study[21] and two retrospective cohort studies[22,23], which included four different chemical agents, tetracycline[18,21-23], talc[18,20], minocycline[19], and gentamycin[22]. Four studies included PSP patients[18-20,23], one study SSP patients only[22] and the final study included PSP and SSP[21]. All studies administered the chemical agent via chest tube, compared to chest tube only, with the exception of two studies in which instillation was performed at thoracoscopy (one talc poudrage[20] and one tetracycline[23]).

Length of hospital stay

Three studies reported length of hospital stay following chemical pleurodesis or chest drainage alone for the treatment of pneumothorax.[18-20] One study included two chemical pleurodesis arms (talc and

tetracycline) and both were included in the meta-analysis[18], which showed no difference in the length of hospital stay between the two treatment techniques (0.19 days shorter following chemical pleurodesis (0.18 days lower to 0.55 days higher)) (Figure A1l).

Recurrence of pneumothorax

Six studies reported the rate of pneumothorax recurrence following chemical pleurodesis or chest drainage alone and meta-analysis showed a greater risk of pneumothorax recurrence following chest drainage alone for both PSP[18-21,23] and SSP[21,22] (Figure A1m). A summary of the results is shown in Table A1f.

Table A1f: Comparison of the anticipated risk of pneumothorax recurrence following chemical pleurodesis or chest drainage for the treatment of primary or secondary pneumothorax in adults

		Risk of pneumothorax recurrence (per 1000 patients)	
Pneumothorax type	**No. datasets**	**Chemical pleurodesis**	**Chest drainage alone**
All datasets	7	179 (138 to 227)	320
PSP[18-21,23]	5	189 (145 to 248)	314
SSP[21,22]	2	131 (72 to 238)	345

Re-admission and need further pleural procedures

No studies reported on the need for re-admission or the need for further pleural procedures.

Complications

Two studies reported complications following chemical pleurodesis or chest drainage alone, but different complications were reported in both.[18,20] A summary of the results is shown in Table A1g.

Table A1g: Comparison of the anticipated risk of complications following chemical pleurodesis or chest drainage for the treatment of primary or secondary pneumothorax in adults

		Rate of complication occurrence (no. patients)	
Study	**Complication**	**Chemical pleurodesis**	**Chest drainage alone**
Almind 1989* (tetracycline)[18]	Pneumonia	9% (3/33)	9% (3/34)
Almind 1989* (talc)[18]	Pneumonia	10% (3/29)	9% (3/34)
Tschopp 2002[20]	Fever	20% (12/61)	0% (0/47)

* Study included three experimental arms – talc, tetracycline and drainage alone

Pain and breathlessness

Pain was reported in three studies, but different methods of reporting were used across the studies.[18-20] Two studies reported the use of opioids and meta-analysis showed that chemical pleurodesis had a greater risk of requiring opioid treatment (691 per 1000 patients (540 to 890)) compared with drainage alone compared (297 per 1000) (Figure A1n). A summary of the remaining pain data is shown in Table A1h.

Breathlessness was not reported in any study.

Table A1h: Comparison of the anticipated risk of pain following chemical pleurodesis or chest drainage for the treatment of primary or secondary pneumothorax in adults

Study	Chemical pleurodesis	Chest drainage alone	*p*
	Incidence of pain (no. patients)		
Almind 1989* (tetracycline)[18]	52% (17/33)	53% (18/34)	NS
Almind 1989* (talc)[18]	48% (14/29)	53% (18/34)	NS
	VAS pain score (median [range])		
Chen 2013[19]	8.0 [1.0 to 10.0]	6.0 [0 to 9.5]	<0.0001
	Requirement for non-opiate painkillers (no. patients)		
Tschopp 2002 (paracetamol)[20]	61% (37/61)	47% (22/47)	NR
Tschopp 2002 (NSAID)[20]	38% (23/61)	45% (21/47)	NR

* Study included three experimental arms – talc, tetracycline and drainage alone

NR – not reported; NS – not significant; NSAID – non-steroidal anti-inflammatory drugs; VAS – visual analogue scale

Quality of life

No study reported on quality of life.

Mortality

Two studies reported mortality following chemical pleurodesis or chest drainage alone for the treatment of pneumothorax.[18,21] Both studies used tetracycline in the experimental arm, with Almind et al including talc as a third arm, but no deaths were reported at time of treatment, or post-procedure follow-up in the talc arm[18]. Meta-analysis was performed on the tetracycline chemical pleurodesis data versus chest drainage alone (Figure A1o) and a summary of the results is shown in Table A1i. While Almind et al focused on PSP patients alone[18], Alfageme et al included PSP and SSP patients, but a breakdown on mortality rate per pneumothorax type was not provided[21].

Table A1i: Comparison of the anticipated risk of mortality following chemical pleurodesis or chest drainage for the treatment of primary or secondary pneumothorax in adults

	Anticipated mortality rate (per 1000 patients)	
Subgroup	**Tetracycline**	**Chest drainage alone**
Study period	106 (46 to 246)	26
Time of treatment	33 (7 to 147)	20
Post-treatment follow-up	192 (67 to 549)	34

5. Thoracic surgery at initial presentation

From fifteen studies identified in the initial literature search, seven studies were deemed relevant. These included two randomised controls trials (RCTs)[24,25] and five retrospective cohort studies[26-30]. Four studies focused exclusively on PSP[24-26,30] while the remainder either included both PSP and SSP[27,29] or did not specify[28].

Surgical approaches varied both between studies, with four studies undertaking a video-assisted thoracoscopic surgical (VATS) approach[24-26,29] and three performing surgery through an open

thoracotomy[27,28,30]. Surgical intervention varied within studies per patient but included talc poudrage, resection of blebs/bullae, wedge resection, pleural abrasion and pleurectomy.

Length of hospital stay

Length of hospital stay was reported in four studies[24,25,27,29], with three reporting mean and SD data[24,27,29] and one reporting median and 95% confidence interval (CI) data[25]. The results of the meta-analysis of the mean and SD data are shown in Figure A1p and summarised in Table A1j.[24,27,29] Olsen et al reported no difference in length of initial hospital stay following VATS or intercostal drainage (4.1 days (3.4 to 4.8) and 3.8 (3.0 to 4.8) respectively, median (95% CIs), p = 0.42) for the treatment of PSP patients. When time spent in the hospital for readmission for elective surgery according to randomisation was taken into account, the surgical patients had a significantly higher median accumulated hospital stay (7.1 days (95% CI 6.4–7.9, p <0.001)).[25]

Table A1j: Comparison of length of hospital stay following thoracic surgery or intercostal drainage for the treatment of pneumothorax in adults

Surgery type	Pneumothorax type	No. studies	LOS for surgery compared with ICD
All datasets	PSP and SSP	3	1.99 days shorter (1.32 to 2.67)
VATS	PSP[24,27]	2	2.61 days shorter (1.88 to 3.35)
Thoracotomy*	PSP and SSP[29]	1	1.5 days longer (0.24 shorter to 3.24 longer)

* Open thoracotomy

LOS – length of hospital stay; PSP – primary spontaneous pneumothorax; SSP – secondary spontaneous pneumothorax; VATS – video-assisted thoracoscopic surgery

Recurrence of pneumothorax

Pneumothorax recurrence was reported in six studies and a summary of the meta-analysis (Figure A1q) is shown in Table A1k.[24-27,29,30]

Table A1k: Comparison of rate of pneumothorax recurrences following thoracic surgery or intercostal drainage for the treatment of pneumothorax in adults

		Risk of pneumothorax recurrence (per 1000 patients)	
Pneumothorax type	**No. datasets**	**Thoracic surgery**	**ICD**
All datasets	7	54 (36 to 80)	298
PSP[24-26,30]	4	60 (35 to 98)	317
SSP[30]	1	124 (43 to 378)	478
PSP and SSP[27,29]	2	28 (11 to 70)	212

PSP – primary spontaneous pneumothorax; SSP – secondary spontaneous pneumothorax

Re-admission and need for further pleural procedures

No studies reported on re-admission or the need for further pleural procedures.

Complications

Five studies assessed rate of complications, but there was variation in how complications were defined.[25,27-30] Three studies reported the number of participants who experienced complications[25,27,28] and meta-analysis showed a slight increase in the risk of complications following thoracic surgery (153 per 1000 patients (82 to 286) than ICD (39 per 1000) (Figure A1r). Complications related to the need for further procedures were excluded from the analyses.

All five studies also reported individual complications.[25,27-30] and two of these complications (respiratory failure and pneumonia) could be included in a meta-analysis (Figure A1s). A summary of the results is also shown in Table A1l.

Table A1l: Comparison of anticipated risk of respiratory failure and pneumonia complications following thoracic surgery or intercostal drainage for the treatment of pneumothorax in adults

Complication	No. datasets	**Risk of complication** (per 1000 patients) Thoracic surgery	ICD
All datasets	6	14 (5 to 34)	5
Respiratory failure[27,28,30]	3	7 (1 to 36)	6
Pneumonia[28-30]	3	19 (6 to 61)	5

The remaining complications are summarised in Table A1m.

Table A1m: Other complications following thoracic surgery or intercostal drainage for the treatment of pneumothorax in adults

Study	Pneumothorax type	**Complication rate** (no. patients) Thoracic surgery	ICD
		Persistent air leak	
*Tanaka 1993[30]	PSP	3% (3/100)	0% (0/81)
*Tanaka 1993[30]	SSP	29% (7/24)	0% (0/46)
*Hagen 1987[28]	PSP and SSP	17% (10/60)	0% (0/168)
		Haemothorax	
*Tanaka 1993[30]	PSP	1% [1/100]	0% [0/81]
*Tanaka 1993[30]	SSP	0% [0/24]	0% [0/46]
*Hagen 1987[28]	PSP and SSP	3% [2/60]	0% [0/168]
		Empyema	
*Hagen 1987[28]	PSP and SSP	2% [1/60]	0% [0/168]
†Schramel 1996[29]	PSP and SSP	1% [3/97]	0% [0/102]
		Other[#]	
†Olesen 2018[25]	PSP	3% [3/88]	0% [0/193]
*Tanaka 1993[30]	PSP	0% [0/100]	0% [0/81]
*Tanaka 1993[30]	SSP	4% [1/24]	0% [0/46]
*Granke 1986[27]	PSP and SSP	3% [2/78]	2% [1/49]
*Hagen 1987[28]	PSP and SSP	2% [1/60]	2% [3/168]
†Schramel 1996[29]	PSP and SSP	0% [0/97]	7% [7/102]

* Open thoracotomy

† Video-assisted thoracoscopic surgery

[#] Complications only reported in one study, including bronchopleural fistula, cardiac infection, pleural effusion and re-expansion oedema (list not exclusive)

ICD – intercostal drainage; PSP – primary spontaneous pneumothorax; SSP – secondary spontaneous pneumothorax

Pain and breathlessness

Pain and/or breathlessness were not reported in any study.

Quality of life

No study directly reported on quality of life. Cardillo et al compared lung function following VATS or ICD for the treatment of PSP, and there was no significant difference between groups.[26]

Mortality

Four studies reported mortality rates following thoracic surgery or ICD and a summary of the results is shown in Table A1n.[24,26-28]

Table A1n: Mortality rates following thoracic surgery or intercostal drainage for the treatment of pneumothorax in adults

			Mortality rate (no. patients)	
Study	**Surgery type**	**Pneumothorax type**	**Thoracic surgery**	**ICD**
Al-Mourgi 2015[24]	VATS	PSP	0% (0/19)	0% (0/22)
Cardillo 2007[26]	VATS	PSP	0% (0/50)	0% (0/50)
Granke 1986[27]	Open thoracotomy	PSP and SSP	0% (0/78)	0% (0/49)
Hagen 1987[28]	Open thoracotomy	PSP and SSP	0% (0/60)	2% (0/168)

Evidence statements

Conservative management

Length of hospital stay appears to be shorter following conservative management for the treatment of primary spontaneous pneumothorax in adults when compared with intercostal drainage (**Ungraded**)

Risk of pneumothorax recurrence appears to be greater following intercostal drainage when compared with conservative management for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

There may be more complications experienced following intercostal drainage when compared with conservative management for the treatment of primary spontaneous pneumothorax in adults (**Ungraded**)

Needle aspiration

Length of hospital stay appears to be shorter following needle aspiration for the treatment of primary spontaneous pneumothorax in adults when compared with intercostal drainage (**Low**)

There appears to be no difference in the rate of pneumothorax recurrence between needle aspiration or intercostal drainage for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

The need for further pleural procedures following needle aspiration may be increased when compared with intercostal drainage for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

The risk of overall complications following needle aspiration or intercostal drainage appear to be the same for the treatment of primary spontaneous pneumothorax in adults (**Very low**), but there may an increased risk of subcutaneous emphysema following intercostal drainage (**Low**)

Ambulatory management

There appears to be a reduction in the length of hospital stay following ambulatory management when compared with standard care for the treatment of primary spontaneous pneumothorax in adults (**Moderate**)

There appears to be no difference in the rate of pneumothorax recurrence, the rate of hospital re-admission, the need for pleural procedures or complications following ambulatory management or standard care for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

Chemical pleurodesis

There appears to be no difference in the length of hospital stay following chemical pleurodesis or intercostal drainage alone for the treatment of primary spontaneous pneumothorax in adults (**Low**)

The risk of pneumothorax recurrence appears to be lower following chemical pleurodesis when compared with intercostal drainage alone for the treatment of primary or secondary spontaneous pneumothorax in adults (**Very low**)

There appears to be a greater need for opioid pain relief following chemical pleurodesis when compared with intercostal drainage alone for the treatment of primary spontaneous pneumothorax in adults (**Moderate**)

Although there appears to be no difference in mortality rate at time of treatment (**Very low**), tetracycline chemical pleurodesis may cause greater post-treatment mortality when compared with intercostal drainage alone for the treatment of pneumothorax in adults (**Very low**)

Thoracic surgery

Length of hospital stay appears to be shorter following thoracic surgery, when compared with intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

The rate of pneumothorax recurrence appears to be reduced following thoracic surgery, when compared with intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

Pneumonia and persistent air leak complications appear to be greater following video-assisted thoracic surgery, when compared with intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

There appears to be no difference in the rate of mortality following thoracic surgery or intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults, with the mortality rate being very low for both treatments (**Very low**)

Recommendations

- Conservative management can be considered for the treatment of minimally symptomatic (i.e. no significant pain or breathlessness and no physiological compromise) or asymptomatic primary spontaneous pneumothorax in adults regardless of size (**Conditional** – by consensus)
- Ambulatory management should be considered for the initial treatment of primary spontaneous pneumothorax in adults with good support and in centres with available expertise and follow-up facilities (**Conditional**)
- In patients not deemed suitable for conservative or ambulatory management, needle aspiration or tube drainage should be considered for the initial treatment of primary spontaneous pneumothorax in adults (**Conditional**)
- Chemical pleurodesis can be considered for the prevention of recurrence of secondary spontaneous pneumothorax in adults (e.g. patients with severe COPD who significantly decompensated in the presence of a pneumothorax, even during / after the first episode) (**Conditional**)
- Thoracic surgery can be considered for the treatment of pneumothorax in adults at initial presentation if recurrence prevention is deemed important (e.g. patients presenting with tension pneumothorax, or those high risk occupations) (**Conditional**)

Good Practice Points

- ✓ When establishing local ambulatory treatment pathways, planning and coordination between with the emergency department, general medicine and respiratory medicine is vital.

- ✓ When performing chemical pleurodesis for the treatment of pneumothorax in adults, adequate analgesia should be provided before and after treatment
- ✓ All treatment options should be discussed with the patient to determine their main priority, with consideration for the least invasive option

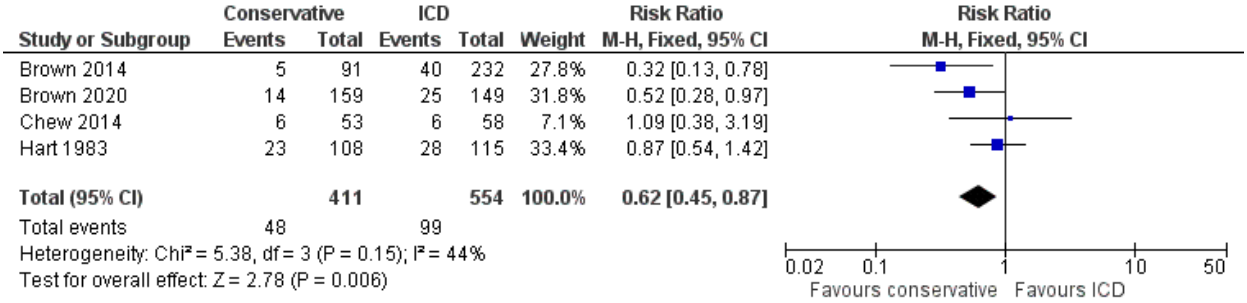
Research Recommendations

- Further research is needed comparing conservative to ambulatory management for the treatment of primary and (particularly) secondary spontaneous pneumothorax in adults
- Further research is needed into stratifying primary spontaneous pneumothorax adult patients by risk of recurrence to maximise the benefit of early thoracic surgery
- Further research is needed comparing needle aspiration to chest drain for secondary spontaneous pneumothorax in adults

Meta-analyses

1. Conservative Management

Figure A1a: Recurrence of pneumothorax (conservative management versus ICD)



2. Needle Aspiration

Figure A1b: Length of hospital stay (needle aspiration versus ICD for PSP)

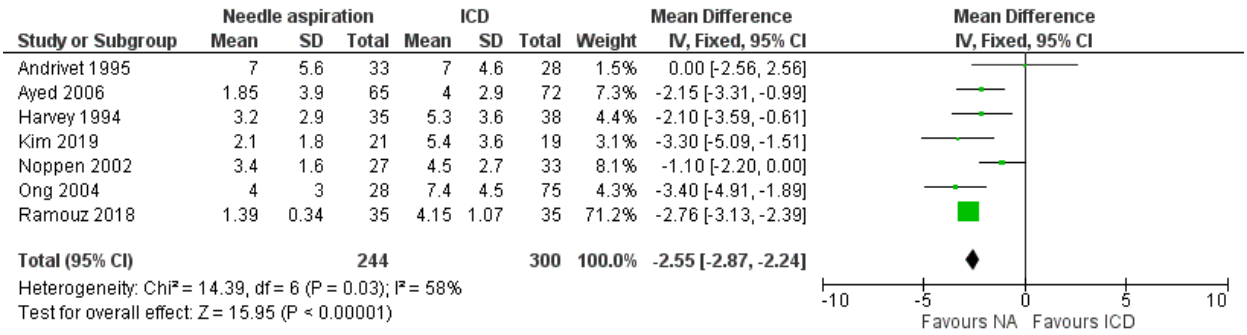


Figure A1c: Recurrence of pneumothorax (needle aspiration versus ICD for PSP)

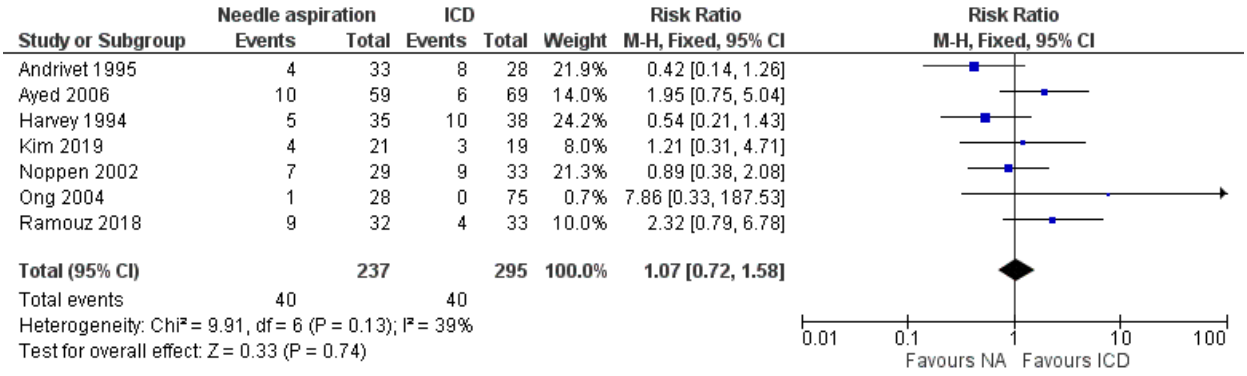


Figure A1d: Need for further pleural procedures (needle aspiration versus ICD in PSP)

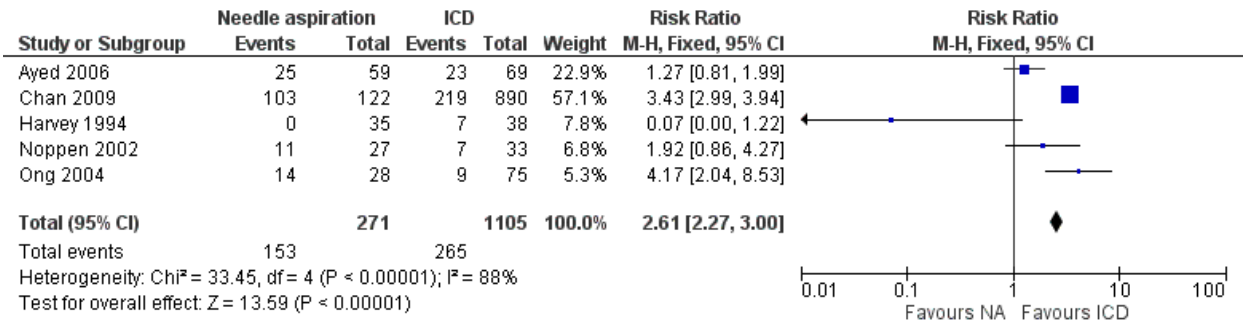


Figure A1e: Complications – all complications (needle aspiration versus ICD for PSP)

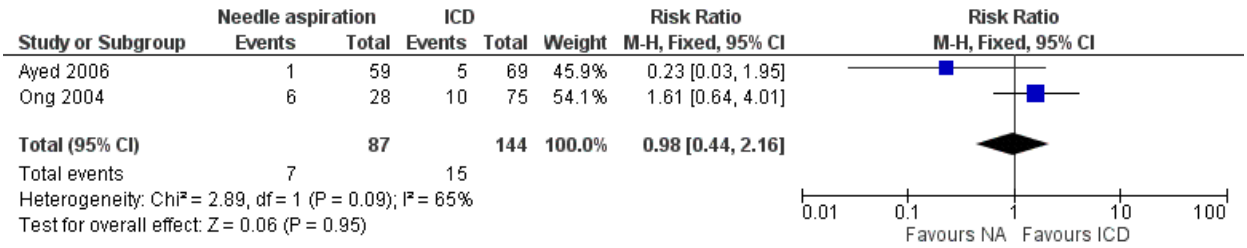
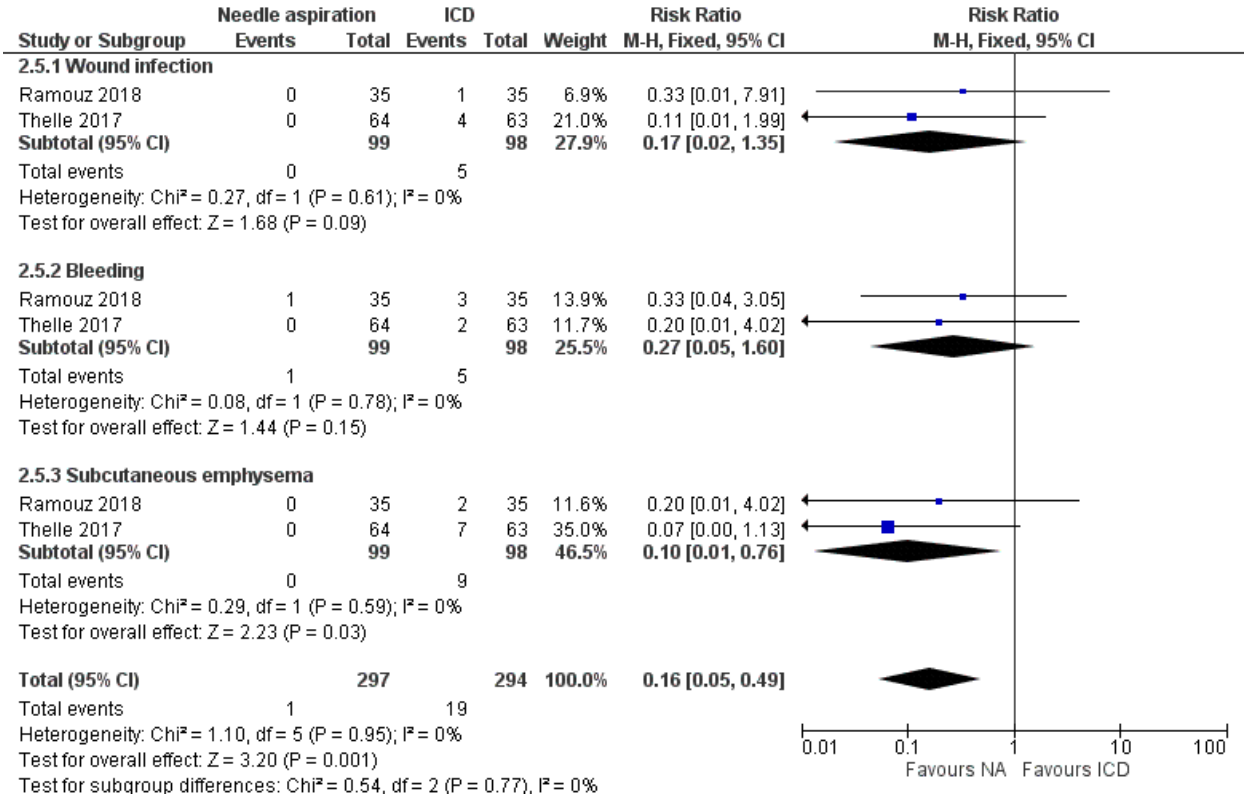


Figure A1f: Complications – individual complications (needle aspiration versus ICD)



3. Ambulatory management

Figure A1g: Length of hospital stay (ambulatory management versus standard care)

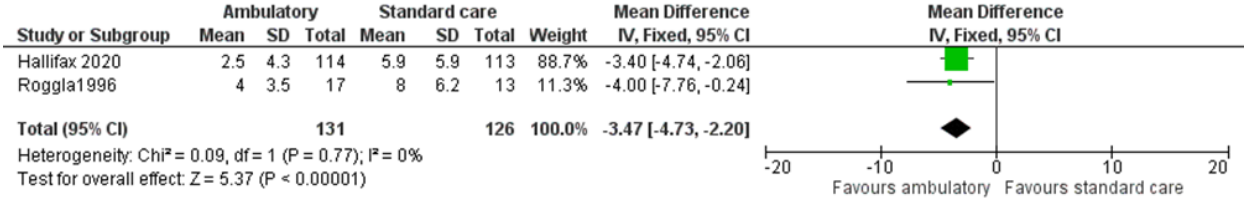


Figure A1h: Recurrence of pneumothorax (ambulatory management versus standard care)

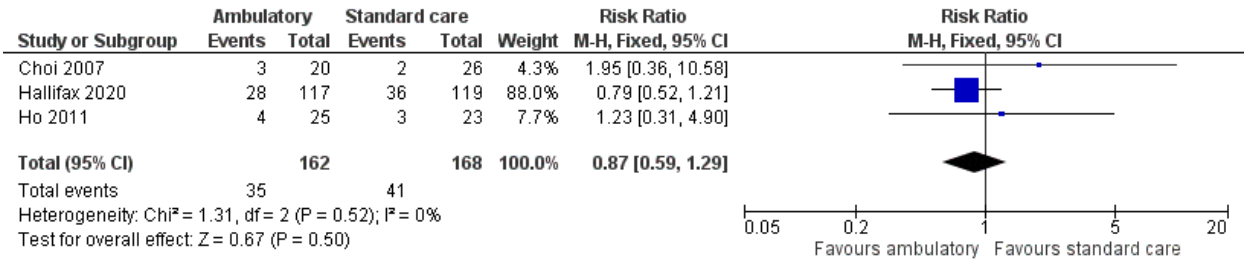


Figure A1i: Re-admission (ambulatory management versus standard care)

Figure A1j: Need for further pleural procedures (ambulatory management versus standard care)

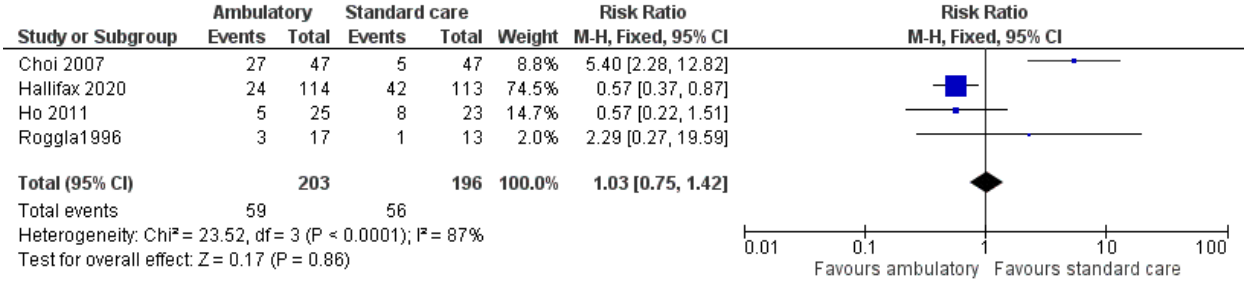
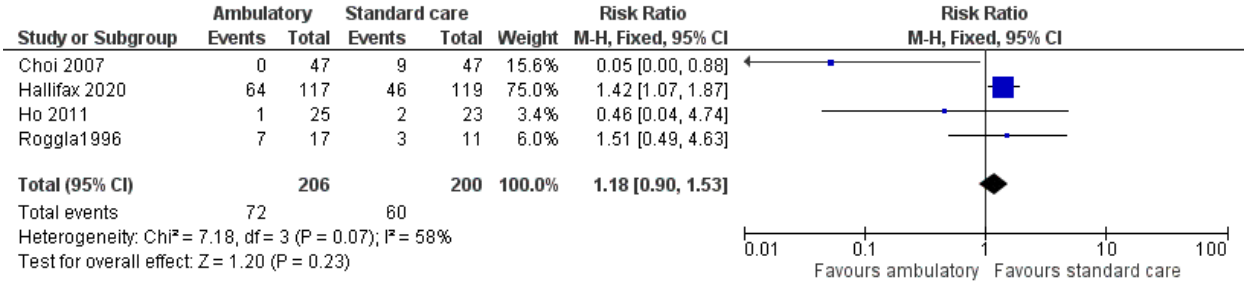


Figure A1k: Complications (ambulatory management versus standard care)



4. Chemical pleurodesis

Figure A1l: Length of hospital stay (chemical pleurodesis versus standard care)

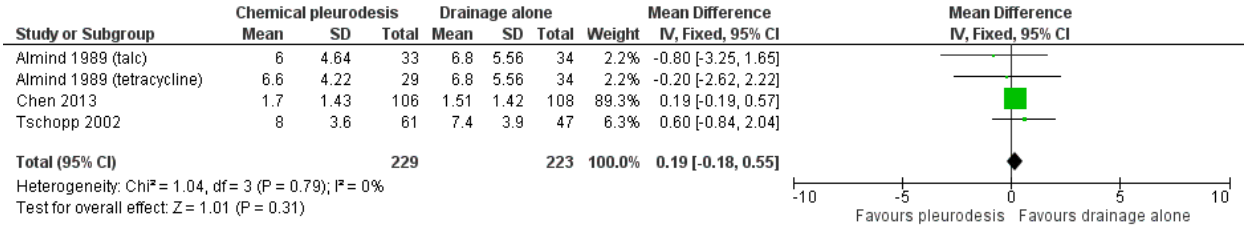


Figure A1m: Recurrence of pneumothorax (chemical pleurodesis versus standard care)

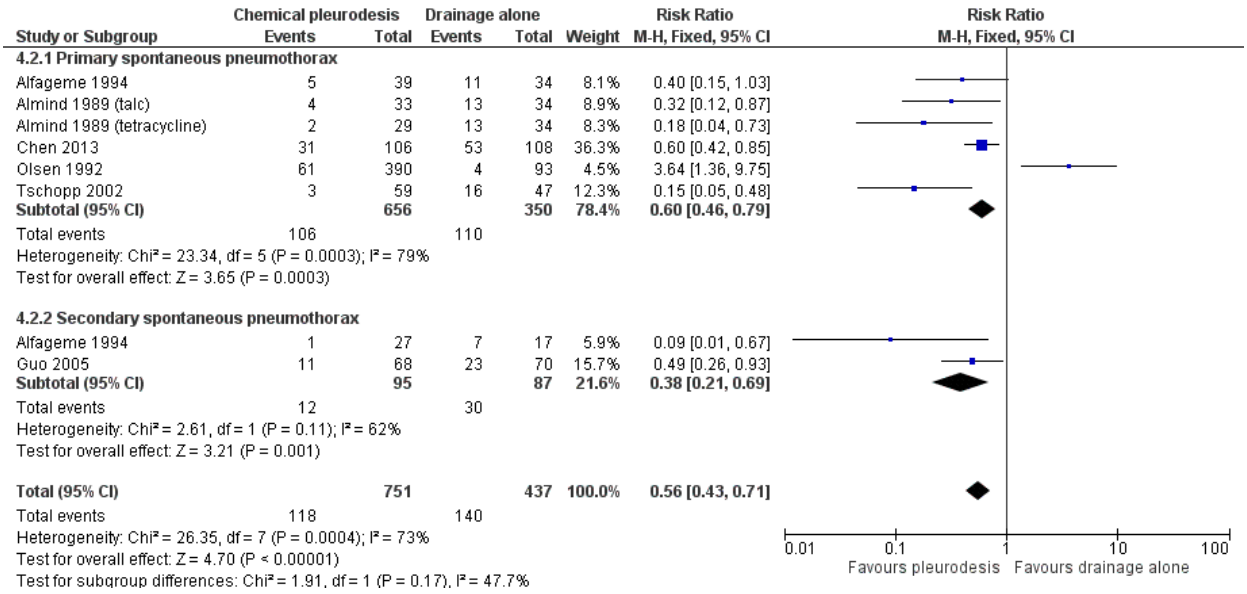


Figure A1n: Pain and breathlessness (chemical pleurodesis versus standard care)

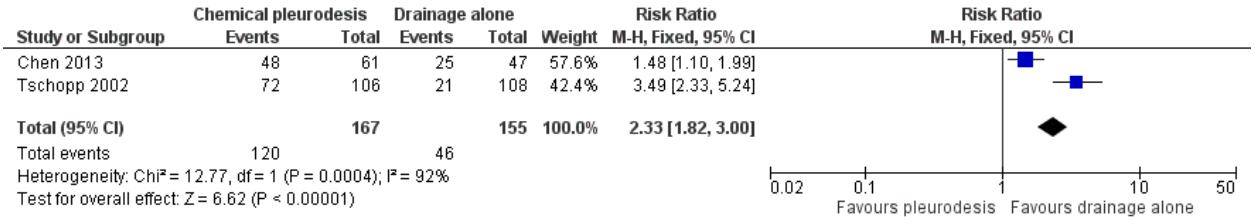
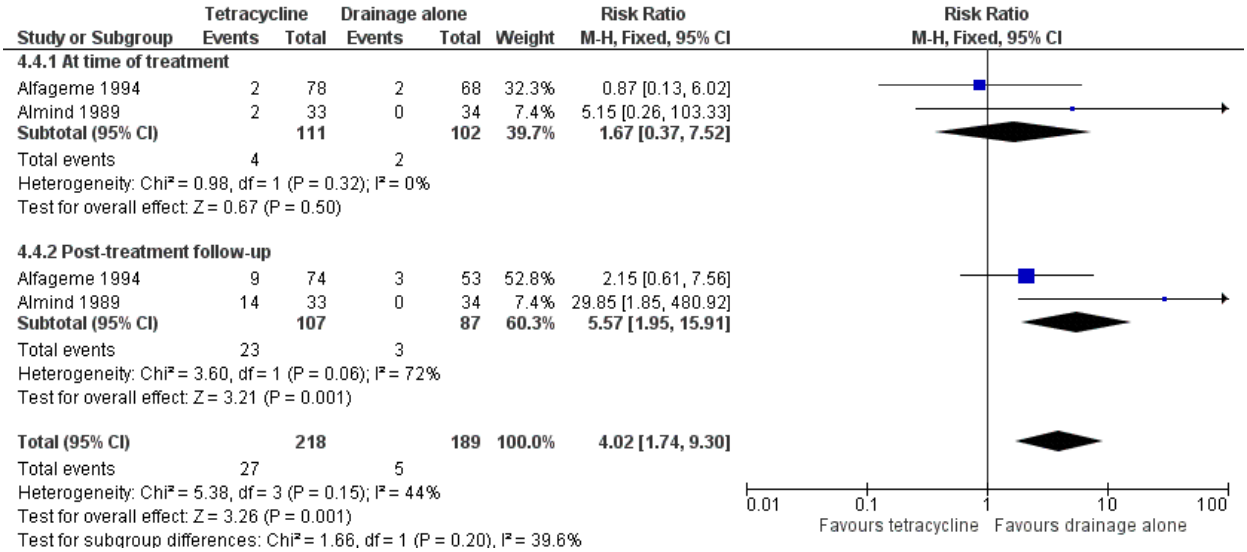


Figure A1o: Mortality (chemical pleurodesis versus standard care)



5. Thoracic surgery at initial presentation

Figure A1p: Length of hospital stay (thoracic surgery versus ICD)

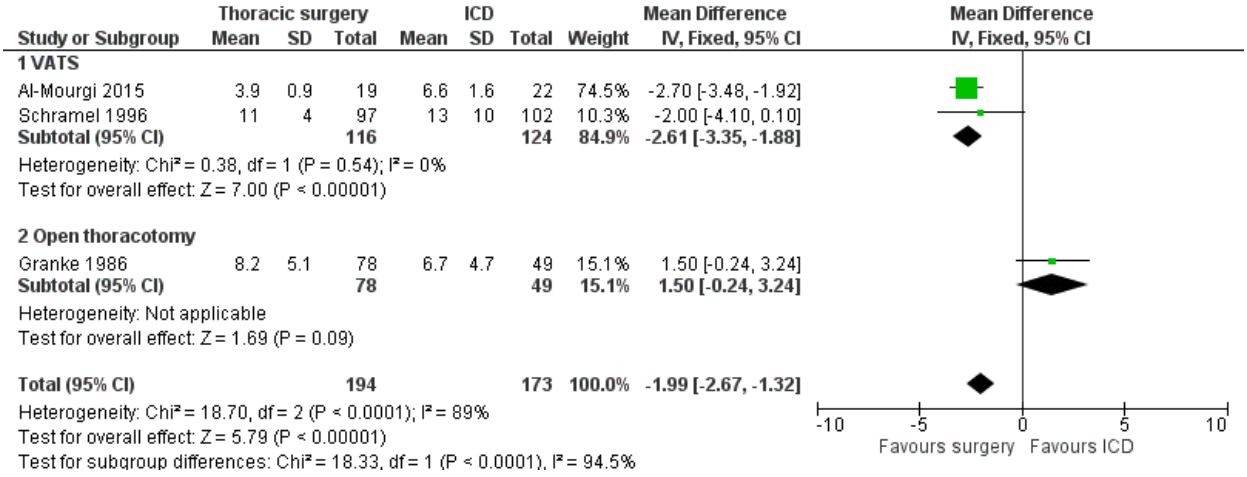


Figure A1q: Recurrence of pneumothorax (thoracic surgery versus ICD)

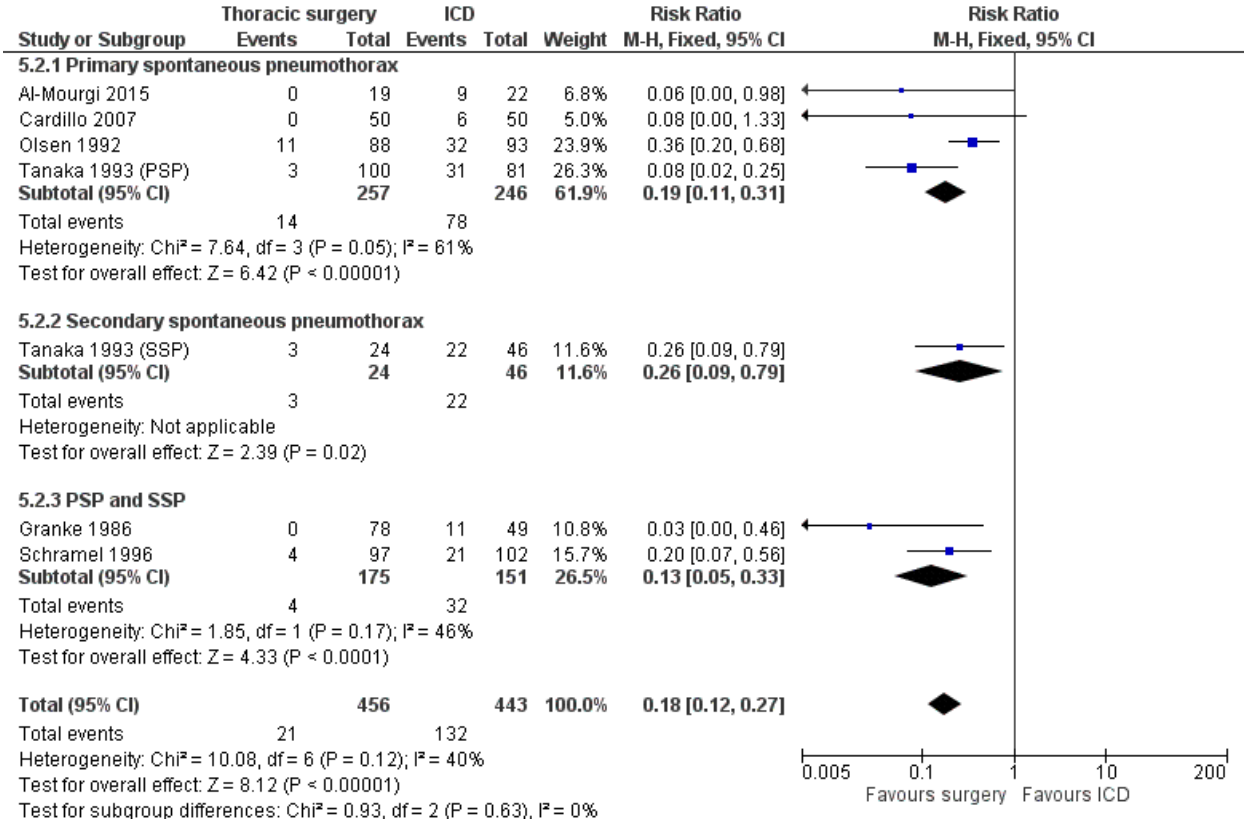


Figure A1r: Complications – all complications (thoracic surgery versus ICD)

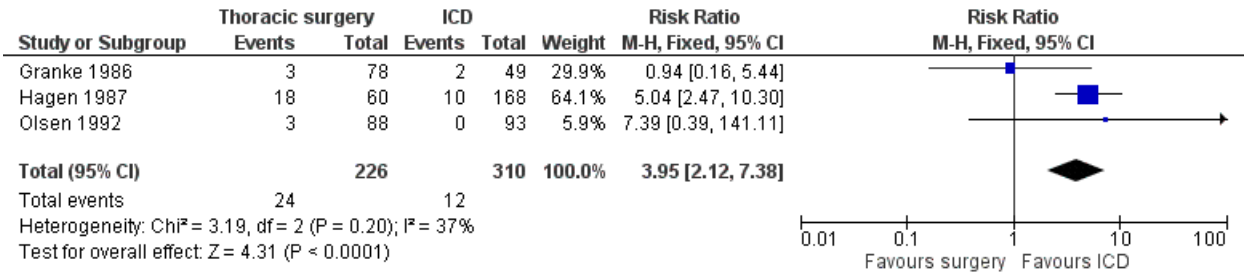
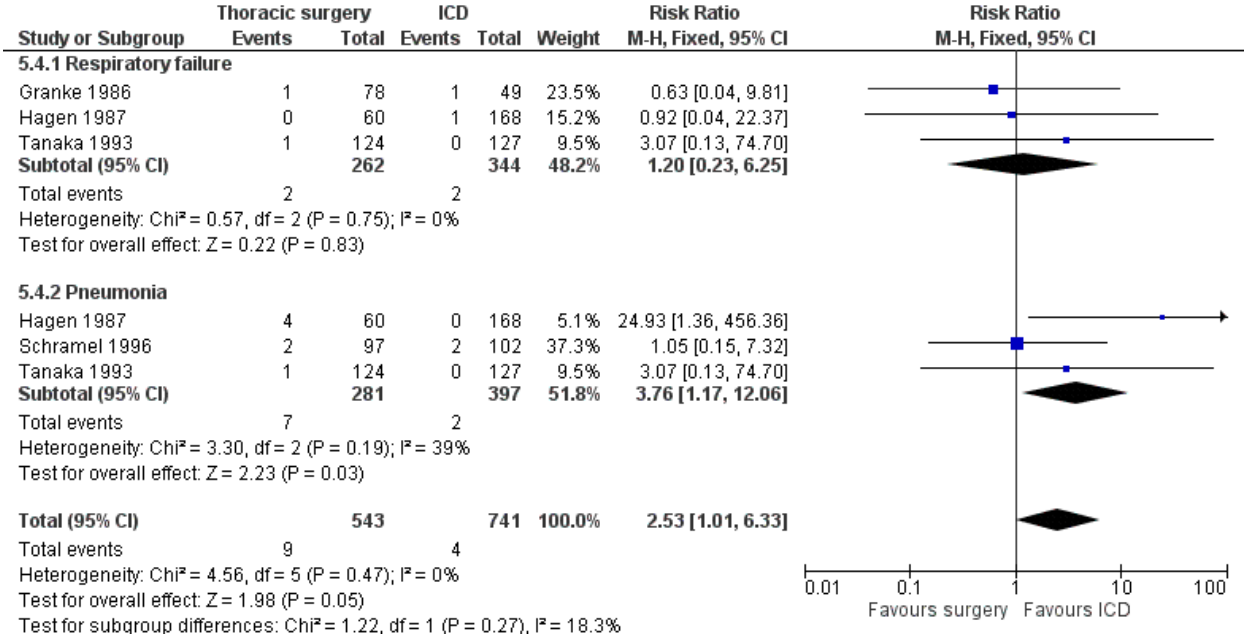
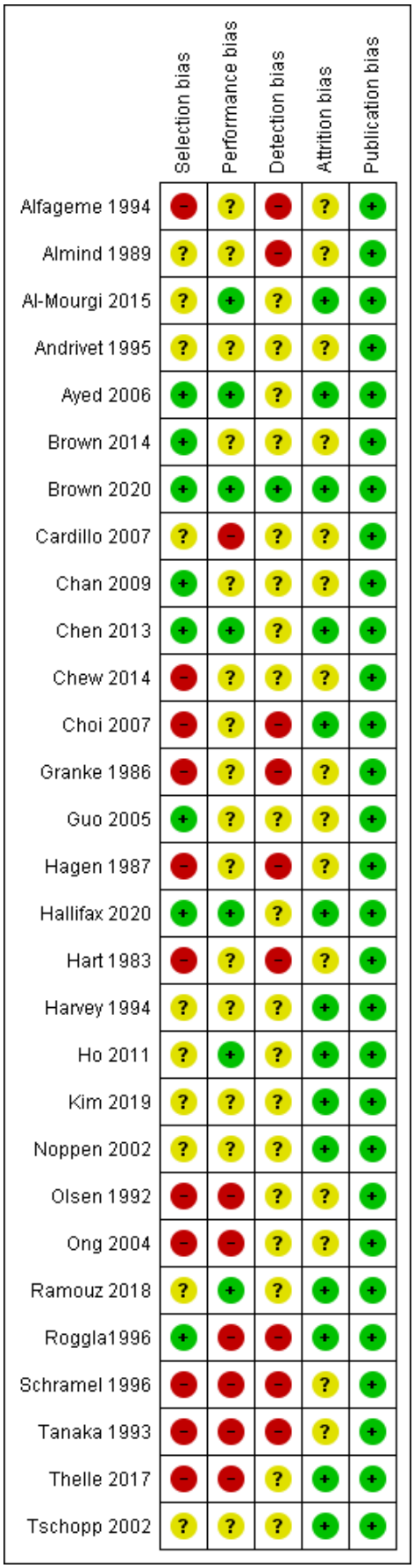


Figure A1s: Complications – individual complications (thoracic surgery versus ICD)



Risk of bias summary



GRADE analyses

1. Conservative management

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Conservative management

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Relative effect (95% CI)	Anticipated absolute effects		Quality of the Evidence (GRADE)
			ICD	Conservative mgmt.	
Pneumothorax recurrence	965 (4 studies)	RR 0.62 (0.45 to 0.87)	**179 per 1000**	**111 per 1000** (80 to 155)	⨁◯◯◯ **VERY LOW** [a,b]

CI: Confidence interval

Explanations

a. High risk of bias across the studies

b. Some imprecision, CIs cross one MID

2. Needle Aspiration

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Needle aspiration

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Estimate of effect	Quality of the Evidence (GRADE)
Length of hospital stay	544 (7 studies)	2.55 days lower (2.24 to 2.87 lower) in the intervention group	⨁⨁◯◯ **LOW** [a]

Explanations

a. High risk of bias across the studies

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Needle aspiration

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Relative effect (95% CI)	Anticipated absolute effects		Quality of the Evidence (GRADE)
			ICD	Needle aspiration	
Pneumothorax recurrence	532 (7 studies)	RR 1.07 (0.72 to 1.58)	**136 per 1000**	**145 per 1000** (98 to 214)	⨁◯◯◯ **VERY LOW** [a,b]
Need for further procedures	1376 (5 studies)	RR 2.61 (2.27 to 3.00)	**240 per 1000**	**626 per 1000** (544 to 719)	⨁◯◯◯ **VERY LOW** [b,c,d]
Complications	231 (2 studies)	RR 0.98 (0.44 to 2.16)	**104 per 1000**	**102 per 1000** (46 to 225)	⨁◯◯◯ **VERY LOW** [b,e,f]
Complications – combined	591 (2 studies)	RR 0.16 (0.05 to 0.49)	**65 per 1000**	**10 per 1000** (3 to 32)	⨁⨁◯◯ **LOW** [c]
Complications – Wound infection	197 (2 studies)	RR 0.17 (0.02 to 1.35)	**51 per 1000**	**9 per 1000** (1 to 69)	⨁◯◯◯ **VERY LOW** [c,g]
Complications – Bleeding	197 (2 studies)	RR 0.27 (0.05 to 1.6)	**51 per 1000**	**14 per 1000** (3 to 82)	⨁◯◯◯ **VERY LOW** [c,g]
Complications – Emphysema	197 (2 studies)	RR 0.10 (0.01 to 0.76)	**92 per 1000**	**9 per 1000** (1 to 70)	⨁⨁◯◯ **LOW** [c]

CI: Confidence interval

Explanations

a. Some inconsistency across the studies
b. Serious imprecision, CIs cross both MIDs
c. High risk of bias across the studies
d. Inconsistency in one study
e. Some risk of bias across the studies
f. Some inconsistency across the studies
g. Some imprecision, CIs cross one MID

3. Ambulatory management

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Ambulatory management

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Estimate of effect	Quality of the Evidence (GRADE)
Length of hospital stay	257 (2 studies)	3.47 days lower (2.2 to 4.73 lower) in the intervention group	⨁⨁⨁◯ **MODERATE** [a]

Explanations

a. Some risk of bias across the studies

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Ambulatory management

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Relative effect (95% CI)	Anticipated absolute effects		Quality of the Evidence (GRADE)
			ICD	Ambulatory	
Pneumothorax recurrence	330 (3 studies)	RR 0.87 (0.59 to 1.29)	**244 per 1000**	**212 per 1000** (144 to 315)	⨁◯◯◯ **VERY LOW** [a,b,c]
Re-admission	284 (2 studies)	RR 0.80 (0.47 to 1.38)	**176 per 1000**	**141 per 1000** (83 to 243)	⨁◯◯◯ **VERY LOW** [b,c,d]
Need for further procedures	399 (4 studies)	RR 1.03 (0.75 to 1.42)	**286 per 1000**	**294 per 1000** (214 to 406)	⨁◯◯◯ **VERY LOW** [b,c,d]
Complications	406 (4 studies)	RR 1.18 (0.90 to 1.53)	**300 per 1000**	**354 per 1000** (270 to 459)	⨁◯◯◯ **VERY LOW** [b,e,f]

CI: Confidence interval

Explanations

a. High risk of bias in two studies
b. Some inconsistency across the studies
c. Serious imprecision, CIs cross both MIDs
d. Some risk of bias across the studies
e. High risk of bias across the studies
f. Some imprecision, CIs cross one MID

4. Chemical pleurodesis

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Chemical pleurodesis

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Estimate of effect	Quality of the Evidence (GRADE)
Length of hospital stay	452 (4 studies)	0.19 days higher (0.18 lower to 0.55 higher in the intervention group	⨁⨁◯◯ **LOW** [a,b]

Explanations

a. High risk of bias across the studies
b. Some inconsistency across the studies

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Chemical pleurodesis

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Relative effect (95% CI)	Anticipated absolute effects		Quality of the Evidence (GRADE)
			ICD	Pleurodesis	
Pneumothorax recurrence	1188 (7 studies)	RR 0.56 (0.43 to 0.71)	**320 per 1000**	**179 per 1000** (138 to 227)	⨁◯◯◯ **VERY LOW** [a,b]
Pneumothorax recurrence – PSP	1006 (6 studies)	RR 0.60 (0.46 to 0.79)	**314 per 1000**	**189 per 1000** (145 to 248)	⨁◯◯◯ **VERY LOW** [a,b]
Pneumothorax recurrence – SSP	182 (2 studies)	RR 0.38 (0.21 to 0.69)	**345 per 1000**	**131 per 1000** (72 to 238)	⨁◯◯◯ **VERY LOW** [a,b]
Pain – opioid use	322 (2 studies)	RR 2.33 (1.82 to 3.00)	**297 per 1000**	**691 per 1000** (540 to 890)	⨁⨁⨁◯ **MODERATE** [c]
Mortality – at time of treatment	213 (2 studies)	RR 1.67 (0.37 to 7.52)	**20 per 1000**	**33 per 1000** (7 to 147)	⨁◯◯◯ **VERY LOW** [a,b,d]
Mortality – post-treatment follow-up	194 (2 studies)	RR 5.57 (1.95 to 15.91)	**34 per 1000**	**192 per 1000** (67 to 549)	⨁◯◯◯ **VERY LOW** [a,b]

CI: Confidence interval

Explanations

a. High risk of bias across the studies
b. Some inconsistency across the studies
c. Some risk of bias across the studies
d. Serious imprecision, CIs cross both MIDs

5. Thoracic surgery at initial presentation

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Thoracic surgery

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Estimate of effect	Quality of the Evidence (GRADE)
Length of hospital stay	367 (3 studies)	1.99 days lower (1.32 to 2.67 lower) in the intervention group	⨁◯◯◯ **VERY LOW** [a,b,c]
Length of hospital stay – VATS	240 (2 studies)	2.61 days lower (1.88 to 3.34 lower) in the intervention group	⨁◯◯◯ **VERY LOW** [a,c]

Explanations

a. High risk of bias across the studies
b. Some inconsistency across the studies
c. Some imprecision, CIs cross one MID

For adults with pneumothorax, is conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery better than intercostal drainage at improving clinical outcomes?

Population: Adults (18+) with pneumothorax

Intervention: Thoracic surgery

Comparator: Intercostal drainage

Outcome	Number of participants (studies)	Relative effect (95% CI)	Anticipated absolute effects		Quality of the Evidence (GRADE)
			ICD	Thoracic surgery	
Pneumothorax recurrence	899 (7 studies)	RR 0.18 (0.12 to 0.27)	**298 per 1000**	**54 per 1000** (36 to 80)	⨁◯◯◯ **VERY LOW** [a,b]
Pneumothorax recurrence – PSP	503 (4 studies)	RR 0.19 (0.11 to 0.31)	**317 per 1000**	**60 per 1000** (35 to 98)	⨁◯◯◯ **VERY LOW** [b,c,d]
Pneumothorax recurrence – PSP, SSP	326 (2 studies)	RR 0.13 (0.05 to 0.33)	**212 per 1000**	**28 per 1000** (11 to 70)	⨁◯◯◯ **VERY LOW** [b,e,f]
Complications - all	536 (3 studies)	RR 3.95 (2.12 to 7.38)	**39 per 1000**	**153 per 1000** (82 to 286)	⨁⨁◯◯ **LOW** [c]
Complications – individual	1284 (4 studies)	RR 2.53 (1.01 to 6.33)	**5 per 1000**	**14 per 1000** (5 to 34)	⨁◯◯◯ **VERY LOW** [c,g]
Complications – Respiratory failure	606 (3 studies)	RR 1.20 (0.23 to 6.25)	**6 per 1000**	**7 per 1000** (1 to 36)	⨁◯◯◯ **VERY LOW** [c,g]
Complications – Pneumonia	678 (3 studies)	RR 3.76 (1.17 to 12.06)	**5 per 1000**	**19 per 1000** (6 to 61)	⨁⨁◯◯ **LOW** [c]

CI: Confidence interval

Explanations

a. Some inconsistency across the studies
b. Serious imprecision, CIs cross both MIDs
c. High risk of bias across the studies
d. Inconsistency in one study
e. Some risk of bias across the studies
f. Some inconsistency across the studies
g. Some imprecision, CIs cross one MID

Recommendation Tables

Question Details

POPULATION:	Adults (18+) with pneumothorax
INTERVENTION:	Conservative management, needle aspiration, ambulatory management, chemical pleurodesis or thoracic surgery
COMPARISON:	Intercostal drainage (ICD)
OUTCOMES:	Length of hospital stay; recurrence of pneumothorax; re-admission; need for further pleural procedures; complications; pain and breathlessness; quality of life; mortality

2. Needle aspiration

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
PROBLEM	No	Probably no	Probably yes	**Yes**		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	**Moderate**	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	**Small**	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	**Very low**	Low	Moderate	High			No included studies
BALANCE OF EFFECTS	Favours the comparison	Probably favours the comparison	Does not favour the intervention or the comparison	**Probably favours the intervention**	Favours the intervention	Varies	Don't know

TYPE OF RECOMMENDATION

Strong recommendation against the intervention	Conditional recommendation against the intervention	Conditional recommendation for either the intervention or the comparison	**Conditional recommendation for the intervention**	Strong recommendation for the intervention
☐	☐	☐	☒	☐

CONCLUSIONS

Recommendation

In patients not deemed suitable for conservative or ambulatory management, needle aspiration should be considered for the initial treatment of primary spontaneous pneumothorax in adults

Justification

Length of hospital stay appears to be shorter following needle aspiration for the treatment of primary spontaneous pneumothorax in adults when compared with intercostal drainage (**Low**)

There appears to be no difference in the rate of pneumothorax recurrence between needle aspiration or intercostal drainage for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

The need for further pleural procedures following needle aspiration may be reduced when compared with intercostal drainage for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

The risk of overall complications following needle aspiration or intercostal drainage appear to be the same for the treatment of primary spontaneous pneumothorax in adults (**Very low**), but there may an increased risk of subcutaneous emphysema following intercostal drainage (**Low**)

Subgroup considerations

There was not enough evidence to make a recommendation on the use of needle aspiration for secondary spontaneous pneumothorax (SSP)

Research priorities

Further research is needed comparing needle aspiration to chest drain for secondary spontaneous pneumothorax in adults

3. Ambulatory management

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
PROBLEM	No	Probably no	Probably yes	**Yes**		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	**Moderate**	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	**Small**	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	**Very low**	Low	Moderate	High			No included studies
BALANCE OF EFFECTS	Favours the comparison	Probably favours the comparison	Does not favour the intervention or the comparison	**Probably favours the intervention**	Favours the intervention	Varies	Don't know

TYPE OF RECOMMENDATION

Strong recommendation against the intervention	Conditional recommendation against the intervention	**Conditional recommendation for either the intervention or the comparison**	**Conditional recommendation for the intervention**	Strong recommendation for the intervention
☐	☐	☐	☒	☐

CONCLUSIONS

Recommendation

Ambulatory management should be considered for the initial treatment of primary spontaneous pneumothorax in adults with good support and in centres with available expertise and follow-up facilities

Justification

There appears to be a reduction in the length of hospital stay following ambulatory management when compared with standard care for the treatment of primary spontaneous pneumothorax in adults (**Moderate**)

There appears to be no difference in the rate of pneumothorax recurrence, the rate of hospital re-admission, the need for pleural procedures or complications following ambulatory management or standard care for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

Subgroup considerations

Ambulatory management should not be considered for secondary spontaneous pneumothorax (SSP)

Research priorities

Further research is needed comparing conservative to ambulatory management for the treatment of primary and (particularly) secondary spontaneous pneumothorax in adults

4. Chemical pleurodesis

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
PROBLEM	No	Probably no	Probably yes	**Yes**		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	**Moderate**	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	**Small**	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	**Very low**	Low	Moderate	High			No included studies
BALANCE OF EFFECTS	Favours the comparison	Probably favours the comparison	Does not favour the intervention or the comparison	**Probably favours the intervention**	Favours the intervention	Varies	Don't know

TYPE OF RECOMMENDATION

Strong recommendation against the intervention	Conditional recommendation against the intervention	**Conditional recommendation for either the intervention or the comparison**	**Conditional recommendation for the intervention**	Strong recommendation for the intervention
☐	☐	☐	☒	☐

CONCLUSIONS

Recommendation

Chemical pleurodesis can be considered for the prevention of recurrence of secondary spontaneous pneumothorax in adults

Justification

There appears to be no difference in the length of hospital stay following chemical pleurodesis or intercostal drainage for the treatment of primary spontaneous pneumothorax in adults (**Low**)

The risk of pneumothorax recurrence appears to be lower following chemical pleurodesis when compared with intercostal drainage for the treatment of primary or secondary spontaneous pneumothorax in adults (**Very low**)

There appears to be a greater need for opioid pain relief following chemical pleurodesis when compared with intercostal drainage alone for the treatment of primary spontaneous pneumothorax in adults (**Moderate**)

Although there appears to be no difference in mortality rate at time of treatment (**Very low**), tetracycline chemical pleurodesis may cause greater post-treatment mortality when compared with intercostal drainage for the treatment of pneumothorax in adults (**Very low**)

Subgroup considerations

Chemical pleurodesis can be considered for secondary spontaneous pneumothorax (SSP)

Research priorities

None

5. Thoracic surgery at initial presentation

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
PROBLEM	No	Probably no	Probably yes	**Yes**		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	**Moderate**	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	**Small**	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	**Very low**	Low	Moderate	High			No included studies
BALANCE OF EFFECTS	Favours the comparison	Probably favours the comparison	Does not favour the intervention or the comparison	**Probably favours the intervention**	Favours the intervention	Varies	Don't know

TYPE OF RECOMMENDATION

Strong recommendation against the intervention	Conditional recommendation against the intervention	**Conditional recommendation for either the intervention or the comparison**	**Conditional recommendation for the intervention**	Strong recommendation for the intervention
☐	☐	☐	☒	☐

CONCLUSIONS

Recommendation

Thoracic surgery can be considered for the treatment of pneumothorax in adults at initial presentation if recurrence prevention is deemed important

Justification

Length of hospital stay appears to be shorter following thoracic surgery, when compared with intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

The rate of pneumothorax recurrence appears to be reduced following thoracic surgery, when compared with intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

Pneumonia and persistent air leak complications appear to be greater following video-assisted thoracic surgery, when compared with intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults (**Very low**)

There appears to be no difference in the rate of mortality following thoracic surgery or intercostal drainage, for the treatment of primary spontaneous pneumothorax in adults, with the mortality rate being very low for both treatments (**Very low**)

Subgroup considerations

There was not enough evidence to make a recommendation on the use of thoracic surgery for secondary spontaneous pneumothorax (SSP)

Research priorities

Further research is needed into stratifying primary spontaneous pneumothorax adult patients by risk of recurrence to maximise the benefit of early thoracic surgery

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Question Protocol

Field	Content
Review Question	Are conservative, aspiration, ambulatory, chemical pleurodesis or surgical interventions better than, or as good as, intercostal drainage at improving clinical outcomes in adult pneumothorax patients?
Type of review question	Intervention review
Objective of the review	A question comparing intercostal drainage alone with conservative, aspiration, ambulatory, chemical pleurodesis or surgical interventions. Which methods lead to best outcomes?
Eligibility criteria – population / disease / condition / issue / domain	Adults (18+) with spontaneous pneumothorax
Eligibility criteria – intervention(s)	Conservative Aspiration Ambulatory Chemical pleurodesis Thoracic surgery
Eligibility criteria – comparators(s)	Pleural intervention (aspiration ± intercostal drain) (chest tube, chest drain, pleural drain, pleural aspiration, thoracentesis)
Outcomes and prioritisation	Length of hospital stay Recurrence of pneumothorax Re-admission Need for further pleural procedures Complications Pain / breathlessness Quality of life Mortality
Eligibility criteria – study design	RCTs Prospective comparative studies Case series of >100 patients
Other inclusion /exclusion criteria	Non-English language excluded unless full English translation Conference abstracts, Cochrane reviews, systematic reviews, reviews Cochrane reviews and systematic reviews can be referenced in the text, but **DO NOT** use in a meta-analysis

Proposed sensitivity / subgroup analysis, or meta-regression	Primary pneumothorax Secondary pneumothorax
Selection process – duplicate screening / selection / analysis	Agreement should be reached between Guideline members who are working on the question. If no agreement can be reached, a decision should be made by the Guideline co-chairs. If there is still no decision, the matter should be brought to the Guideline group and a decision will be made by consensus
Data management (software)	RevMan5 — Pairwise meta-analyses Evidence review/considered judgement. Storing Guideline text, tables, figures, etc. Gradeprofiler — Quality of evidence assessment Gradepro — Recommendations
Information sources – databases and dates	MEDLINE, Embase, PubMED, Central Register of Controlled Trials and Cochrane Database of Systematic Reviews 1966 - present
Methods for assessing bias at outcome / study level	RevMan5 intervention review template and NICE risk of bias checklist (follow instructions in '*BTS Guideline Process Handbook – Intervention Review'*)
Methods for quantitative analysis – combining studies and exploring (in)consistency	If 3 or more relevant studies: RevMan5 for meta-analysis, heterogeneity testing and forest plots (follow instructions in '*BTS Guideline Process Handbook – Intervention Review'*)
Meta-bias assessment – publication bias, selective reporting bias	GRADEprofiler — Intervention review quality of evidence assessment for each outcome (follow instructions in '*BTS Guideline Process Handbook – Intervention Review'*)
Rationale / context – what is known	Chest tube drainage of symptomatic pneumothorax is often referred to as standard practice, but new evidence suggests that conservative management may be better. Patients often want to be treated in an ambulatory out-patient fashion and there is recent published literature on this that requires formal evaluation.