Pleural and pericardial effusions

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Conflict of interest

- I have no conflict of interest in relationship with this presentation to be disclosed

Limitations

- Literature frequently dealing with different solid tumours, considering only the pleural/pericardial extent
- Presentation focusing on NSCLC and SCLC; MPM is not considered

Epidemiology

1. Frequency
2. Pronostic and operational impact

Table 1 Major noninfectious acute complications of cancer patients per system

System	Complications
Neurologic	Cord compression syndrome
	Intracranial hypertension/hydrocephalus
Thoracic	Superior vena cava syndrome
	Pericardial effusion/cardiac tamponade
	Pleural effusion
	Pulmonary thromboembolism
	Massive hemoptysis
Abdominal	Intenstinal obstruction
	Inflammatory intestinal changes
	Biliary obstruction
	Urinary tract obstruction
	Bleeding complications

Guimaraes et al, Cancer Imaging 2014

The lung cancer patient at the emergency department: A three-year retrospective study

Respiratory symptoms	113	20.6
Dyspnea	71	62.8
Cough	20	17.7
Chest pain	13	11.5
Hemoptysis	9	8.0

Gorham et al, Lung Cancer 2013

Pleural effusions in cancer patients

Table 1 Primary tumour site in patients with malignant pleural effusion

Primary tumour site	Salyer[14] (n=95)	Chernow[1] (n=96)	Johnston[13] (n=472)	Sears[4] (n=592)	Hsu[12] (n=785)	Total (%)
Lung	42	32	168	112	410	764 (37.5)
Breast	11	20	70	141	101	343 (16.8)
Lymphoma	11	—	75	92	56	234 (11.5)
Gastrointestinal	—	13	28	32	68	141 (6.9)
Genitourinary	—	13	57	51	70	191 (9.4)

INCIDENCE OF MALIGNANT PLEURAL EFFUSIONS

	% of All Patients with MPE (All Stages)*	% of Patients with Disseminated Disease or at Autopsy with MPE†	Origin (%) of Primary Tumor from Cytology Reviews‡	Annual Cancer Deaths in the United States§	Estimated Cases of MPE in the United States per Year
Lung cancer	8–15	20–46	25–52	160,000	32,000–73,600‖
Breast cancer	2–12	36–65	3–27	44,000	15,840–28,600‖
Lymphoma	7	29–30	12–22	25,000	7,250–7,500‖
Other malignancies			29–46	330,000	23,600–47,000¶
Total					78,700–156,714

Roberts et al, Thorax 2010; Am J Respir Crit Care Med 2000: 1987

Frequency of pericardial neoplastic effusion in unselected populations

Etiology	N (%)[1]	N (%)[2]	N (%)[3]
Idiopathic	401 (34%)	76 (37%)	33 (46%)
Cancer	44 (4%)	30 (15%)	6 (8%)
Post-surgery	125 (11%)		
Uremic	85 (7%)	5 (2%)	8 (11%)
Infectious	55 (5%)	44 (22%)	
Post-radiation	7 (1%)		
Others	467 (39%)	49 (24%)	24 (34%)

[1]NEJM 350: 469; 2004; [2]Medicine 82: 385; 2003; [3]Am J Med 105: 106; 1998

Probability of malignant pericarditis according to the clinical presentation

	Moderate effusion Without tamponade	Severe effusion Without tamponade	Tamponade
	N = 124	N = 79	N = 119
Malignant	11 (14 %)	6 (5 %)	26 (31 %)
Benign	113 (86 %)	73 (95 %)	93(69 %)

Sagrista et al Am J Med 2000;109:95-101

Table 1 Review of aetiology, incidence and pathogenesis of pericarditis[1–3]

Aetiology	Incidence (%)	Pathogenesis
Infectious pericarditis		Multiplication and spread of the causative agent and release of toxic substances in pericardial tissue cause serous, serofibrinous or haemorrhagic (bacterial, viral, tuberculous, fungal) or purulent inflammation (bacterial)
Viral (Coxsackie A9, B1-4, Echo 8, Mumps, EBV, CMV, Varicella, Rubella, HIV, Parvo B19, etc.)	30–50[a]	
Bacterial (Pneumo-, Meningo-, Gonococcosis,	5–10[a]	
Neoplastic pericardial disease	35[a]	
Primary tumours	Rare	
Secondary metastatic tumours	Frequent	
Lung carcinoma	40[c]	
Breast carcinoma	22[c]	
Gastric and colon	3[c]	
Other carcinoma	6[c]	
Leukemia and lymphoma	15[c]	
Melanoma	3[c]	
Sarcoma	4[c]	
Other tumours	7[c]	
Breast carcinoma	22[c]	Accompanying disease during the infiltration of malignant cells
Gastric and colon	3[c]	
Other carcinoma	6[c]	
Leukemia and lymphoma	15[c]	
Melanoma	3[c]	
Sarcoma	4[c]	
Other tumours	7[c]	

ESC Guidelines, Eur Heart J 2004

Not all effusions are malignant in cancer patients!

Etiologies of pleural effusions in cancer patients

TABLE 2

CAUSES OF PARAMALIGNANT PLEURAL EFFUSIONS

Cause	Comment
Local effects of tumor	
Lymphatic obstruction	Predominant mechanism for pleural fluid accumulation
Bronchial obstruction with pneumonia	Paraneumonic effusion; does not exclude operability in lung cancer
Bronchial obstruction with atelectasis	Transudate; does not exclude operability in lung cancer
Trapped lung	Transudate; due to extensive tumor involvement of visceral pleura
Chylothorax	Disruption of thoracic duct; lymphoma most common cause
Superior vena cava syndrome	Transudate; due to increased systemic venous pressure
Systemic effects of tumor	
Pulmonary embolism	Hypercoagulable state
Hypoalbuminemia	Serum albumin < 1.5 g dl^{-1}; associated with anasarca
Complications of therapy	
Radiation therapy	
Early	Pleuritis 6 wk to 6 mo after radiation completed
Late	Fibrosis of mediastinum Constrictive perficarditis Vena caval obstruction
Chemotherapy	
Methotrexate	Pleuritis or effustion; ± blood eosinophilia
Procarbazine	Blood eosinophilia; fever and chills
Cyclophosphamide	Pleuropericarditis
Mitomycin/bleomycin	In association with interstitial disease

Am J Respir Crit Care Med 2000: 1987

Etiologies of pericarditis in cancer patients

Etiologies	Wilkes[1]	Posner[2]
Cancer	70 (55%)	18 (58%)
Idiopathic	42 (33%)	10 (32%)
Uremic	1 (1%)	-
Infectious	6 (5%)	-
Radiation	4 (3%)	3 (10%)
Others	4 (3%)	-

[1]Cancer 76: 1377; 1995; [2]Am J Med 71: 407; 1981

Diagnosis

Figure 1 Diagnostic Approach to a Suspected Malignant Effusion

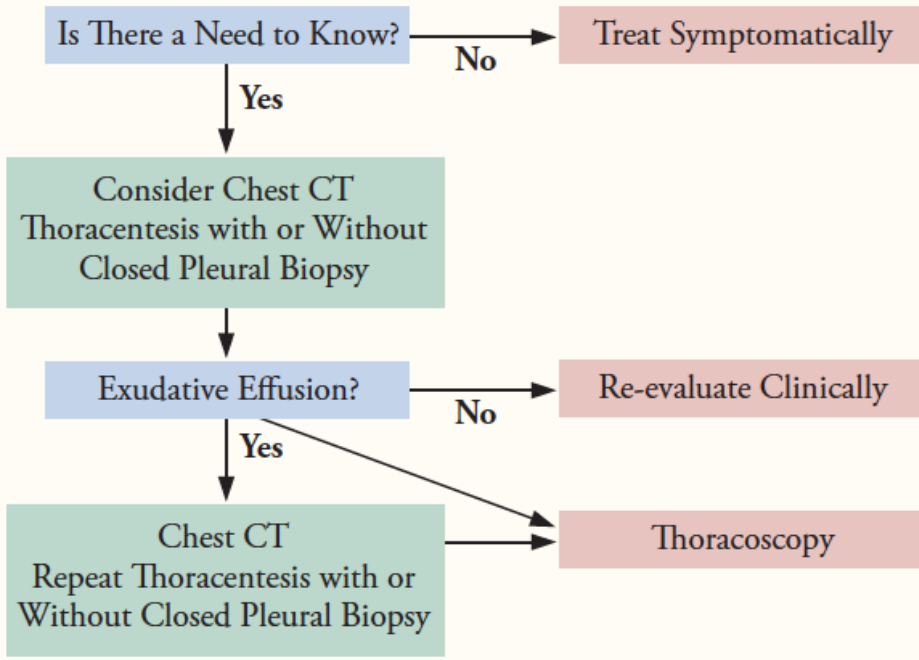


Table 1 Criteria for Differentiating Exudative from Transudative Pleural Effusion[38,40]

Criteria	Threshold Defining an Exudative Effusion
Light's Criteria	Pleural protein level > 50% of a simultaneous serum protein LDH > 60% of a simultaneous serum LDH or LDH > 2/3 of the ULNs
Heffner's 2-Test Combination Criteria	Pleural cholesterol > 45 mg/dL or Pleural fluid LDH > 2/3 of the ULN
Heffner's 3-Test Combination Criteria	Pleural fluid cholesterol > 45 mg/dL or Pleural fluid LDH > 2/3 of the ULN or Pleural fluid protein > 2.9 mg/dL
Heffner's Abbreviated Light's Criteria	Pleural protein level > 50% of a simultaneous serum protein or LDH > 60% of a simultaneous serum LDH

Yoneda et al, Clin Lung Cancer 2007

How doing the differential diagnosis?

- Neoplastic cells only seen in 50-60%

Group	Total No. Patients	qPCR	
		+[a]	–
Benign	46	3	4
Malignant	69	63[c]	

Cytology

Methods	qPCR	Cytology
Sensitivity	91.3 (±6.7)[a]	56.5 (±11.8)
Specificity	93.5 (±7.1)	100 (±0)
PPV	95.5 (±5.1)	100 (±0)
NPV	87.8 (±9.2)[a]	60.5 (±11.0)
Accuracy	92.2 (±4.9)[a]	73.9 (±8.0)

Cha et al, Clin Lung Cancer 2012

	CT-ANPB		Thoracoscopy	
Diagnosis	No. Performed	Sensitivity (%)	No. Performed	Sensitivity (%)
Malignant mesothelioma	15	12 (80)	18	17 (94)
Malignant pleural effusion caused by lung cancer	15	14 (93)	14	14 (100)
Pleural metastasis due to other organ carcinomas	8	7 (88)	10	9 (90)
Tuberculous pleurisy	10	9 (90)	9	8 (89)

Metintas et al, Chest 2010

Some interest for biological markers

Sensitivity 74% (95% CI: 0.59-0.85)

Specificity 85% (95% CI: 0.79-0.89)

LR+ 4.79 (95% CI: 3.48-6.61)

LR- 0.31 (95% CI: 0.19-0.50)

AUC SROC curve 0.86 (95% CI: 0.82-0.89)

Diag or malignant pleural effu meta-analysis

Tian et al, Int J Clin Exp path 2014

Diagnostic value of carcinoembryonic antigen in malignant pleural effusion: a meta-analysis

Shi HZ, Liang QL, Jiang J, Qin XJ, Yang HB

Sensitivity 60% (95% CI 55% to 65%; range 38% to 88%) for lung cancer if CEA > cut off value

AUC ROC curve 0.86 (standard error 0.12)

Respirology 2008

Accuracy of Fluorodeoxyglucose-PET Imaging for Differentiating Benign From Malignant Pleural Effusions

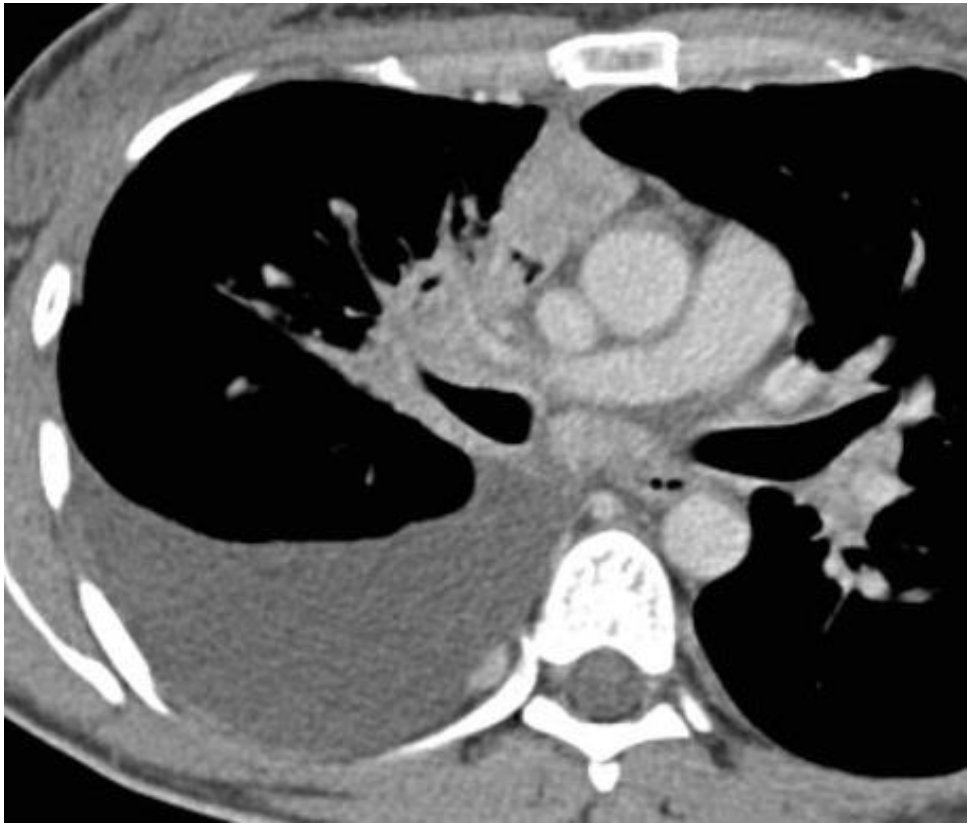
A Meta-analysis

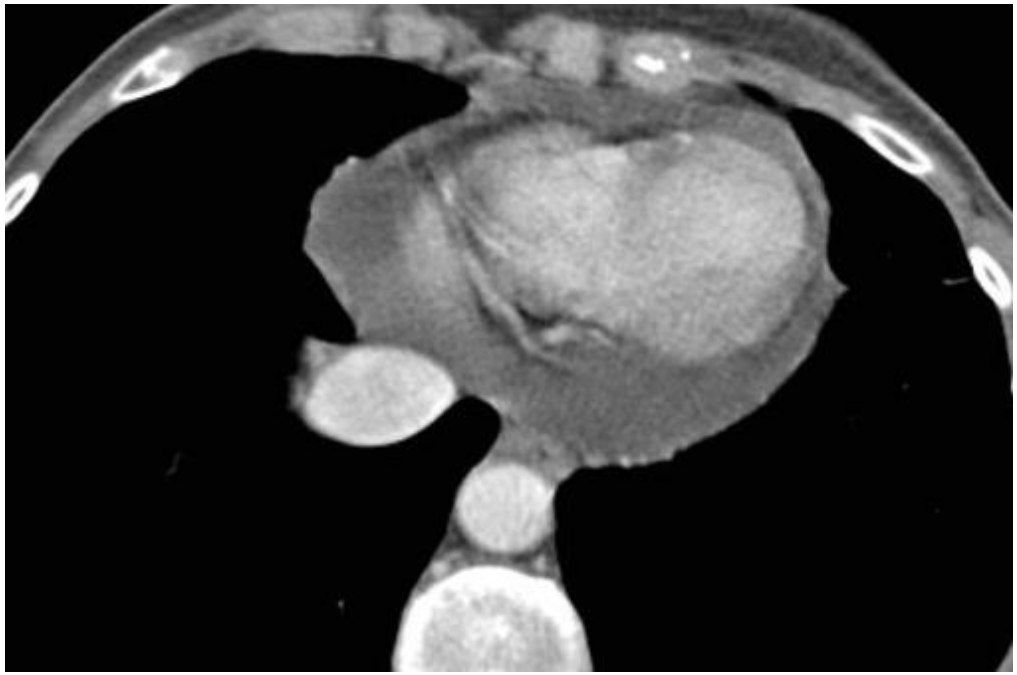
TABLE 3] Summary Measures of Diagnostic Accuracy for FDG-PET Imaging in the Identification of Malignant Pleural Effusions

Measure	Qualitative PET Imaging Readings	Semiquantitative PET Imaging Readings	Qualitative Readings Using PET Imaging Systems	Qualitative Readings Using Integrated PET-CT Imaging Systems	Semiquantitative Readings Using Integrated PET-CT Imaging Systems
Studies, No.	11	7	6	5	6
Sensitivity (95% CI), %	91 (86-94)	82 (69-90)	96 (90-98)	89 (81-94)	81 (66-91)
Specificity (95% CI), %	67 (56-77)	74 (62-84)	75 (59-87)	61 (44-75)	74 (58-85)
Positive LR (95% CI)	2.83 (2.04-3.98)	3.24 (2.24-4.70)	4.09 (2.34-7.1)	2.32 (1.61-3.45)	3.22 (2-5)
Negative LR (95% CI)	0.14 (0.08-0.22)	0.25 (0.14-0.39)	0.06 (0.03-0.13)	0.19 (0.11-0.31)	0.26 (0.14-0.43)
DOR (95% CI)	22 (10.2-41.7)	13.8 (7.3-23.9)	76.7 (22.1-195)	13 (6-24.8)	13.3 (6.32-24.8)
AUC	0.893	0.840	0.950	0.859	0.838

Porcel et al Chest 2015

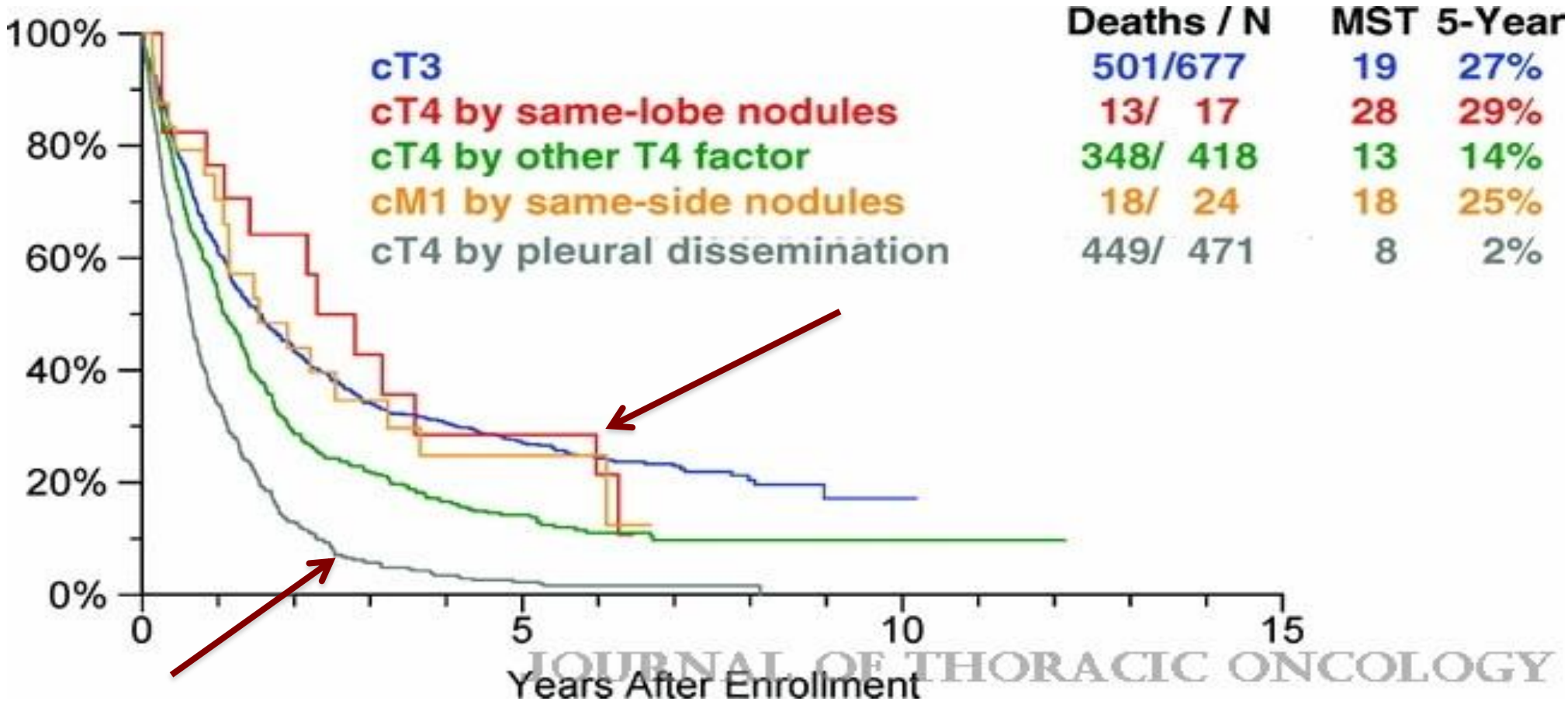
Prognostic and operational impact





T4 → M1a

Survival according to T4

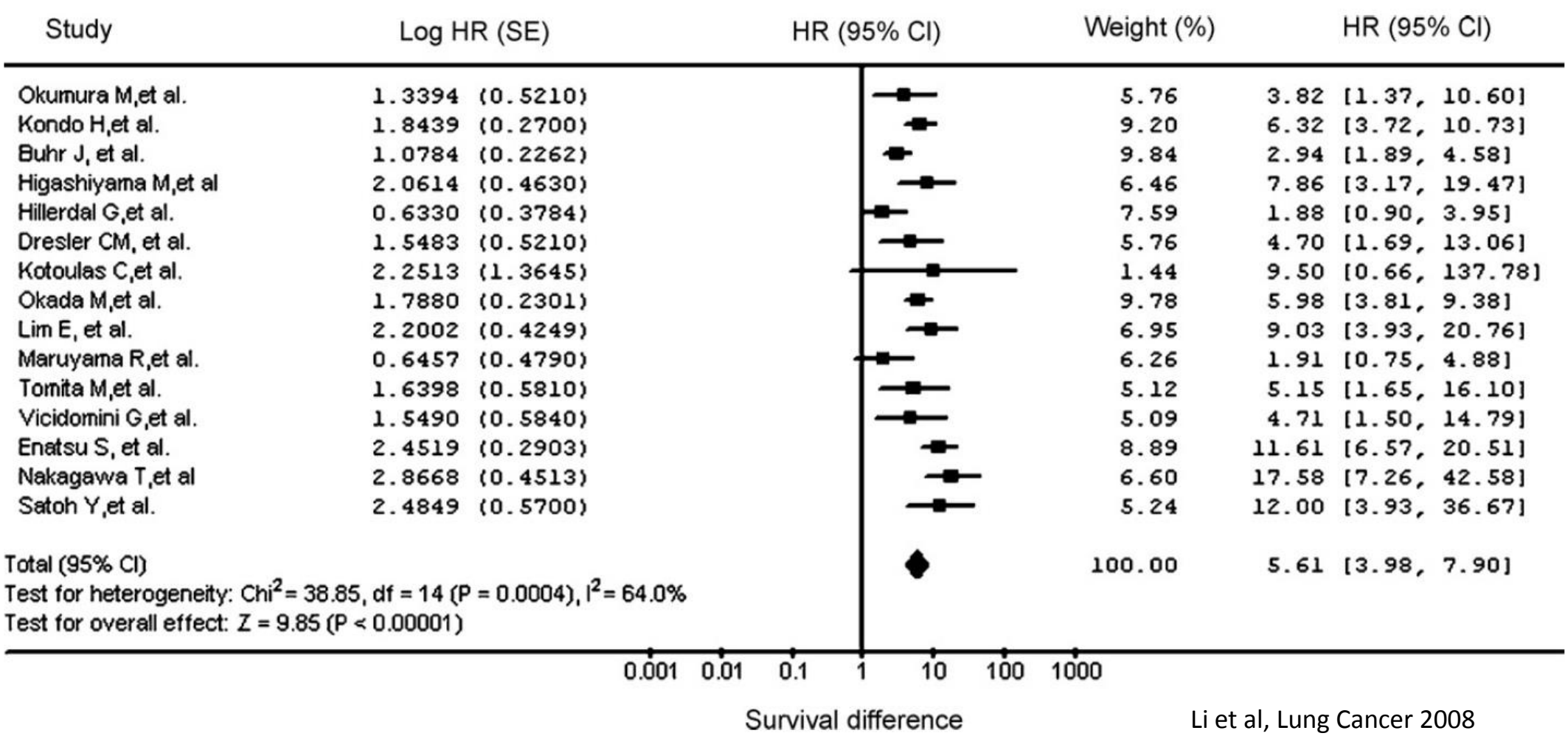


Goldstraw et al, J Thorac Oncol. 2007

Prognosis of cancer patients according to the nature of the pericardial effusion

Follow up (months)	Mortality Neoplastic effusion	Mortality Benign effusion
0	0/11 (0%)	0/14 (0%)
1	4/11 (36%)	1/14 (7%)
2	5/11 (45%)	3/14 (21%)
6	9/11 (81%)	6/14 (43%)
12	10/11 (91%)	8/14 (57%)

Chest 101: 938; 1992



Li et al, Lung Cancer 2008

In lung cancer patients where a malignant pleural effusion is found at operation could resection ever still be justified?

Alfonso Fiorelli and Mario Santini*

Interact Cardiovasc Thorac Surg 2013

Clinical presentation of pericardial effusion

Symptoms

	Wilkes[1]	Posner[2]	Maher[3]
Dyspnea	103 (81%)	17 (55%)	85 (91%)
Pain	26 (20%)	16 (52%)	19 (20%)
Orthopnea	21 (17%)	-	30 (32%)
Cough	19 (15%)	5 (16%)	39 (42%)
Malaise	19 (15%)	-	
Peripheral edema	13 (10%)	4 (13%)	16 (17%)
Facial swelling	-	4 (13%)	2 (2%)

[1]Cancer 1995. [2]Am J Med 1981. [3]J Thorac Cardiovasc Surg 1996

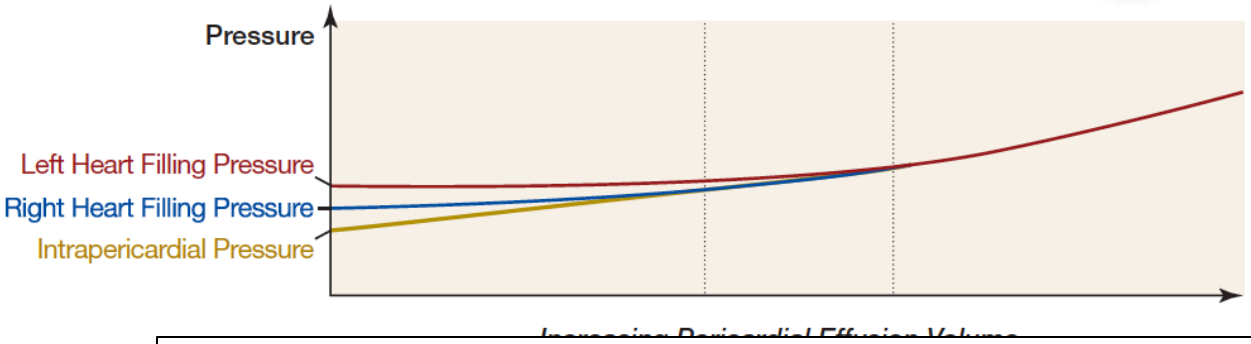
Clinical signs

	Wilkes[1]	Posner[2]	Maher[3]
Pulsus paradoxus	40 (32%)	12 (39%)	58 (62%)
Reducti			
Tachyca			%)
Periphe			%)
Jugular			%)
Pericard			)
None			
Reducti			
Hypotension/shock	-	14 (45%)	39 (42%)

	Malignant (%)	Idiopathic (%)
Tamponade	9 (50%)	2 (20%)
Pulsus paradoxus	8 (44%)	3 (30%)
Jugular turgor	6 (33%)	1 (10%)
Pericardial friction	2 (11%)	8 (80%)
Pleural effusion	10 (56%)	3 (30%)

[1]Cancer 1995. [2]Am J Med 1981. [3]J Thorac Cardiovasc Surg 1996

Does This Patient With a Pericardial Effusion Have Cardiac Tamponade?



Review with quantitative agregation of patients with tamponade

- Dyspnea: sensitivity range 87%-89%
- Tachycardia: sensitivity 77% (95% CI 69%-85%)
- Pulsus paradoxus: sensitivity 82% (95% CI 72%-92%)
- Elevated jugular venous pressure: sensitivity 76% (95% CI 62%-90%)
- Cardiomegaly on chest X-Ray: sensitivity 89% (95% CI 73%-100%)

Pulsus paradoxus > 10 mm Hg in a patient with a pericardial effusion:

- LR+ 3.3 (95% CI 1.8-6.3)
- LR - 0.03 (95% CI 0.01-0.24)

Roy et al, JAMA 2007

Therapeutic options for pleural effusions

Table 1 Different management options for malignant pleural effusions.

Options	Advantages	Disadvantages
Observation	• Non invasive	• Most will progress and require therapy
Repeated therapeutic thoracentesis	• Good option for patients with limited life expectancy • Prompt relief of dyspnea	• Rapid reaccumilation • Repeated procedures • Multiple hospital visits • Procedure related complications • Re-expansion pulmonary edema • Reduced quality of life
Chemical pleurodesis with chest tubes	• Highly effective (pleurodesis 81–93%)[25–27]	• Hospitalization 5–7 days • Expensive • Invasive • Associated morbidity
Medical thoracoscopy and VATS	• Highly effective (pleurodesis in greater than 90% of patients)[36–39] • Diagnosis and pleurodesis can be performed at the same time	• Inpatient • Invasive • Associated morbidity • Contraindicated if patient cannot tolerate single lung ventilation (VATS)
Pleuro-peritoneal shunts	• Could be an option in patients with failed chemical pleurodesis	• Shunt malfunction • Infection • Requires frequent pumping by the patient
Chronic indwelling pleural catheters	• Good option for motivated patients • Inpatient or out patient placement of catheter and mostly outpatient management of catheter and drainage • Minimally invasive • Cost effective • Control of dyspnea • Out patient pleurodesis (42–58%)[53,55,57] without chemicals • Can be used in patients with trapped lung for palliation of symptoms • Catheter can be used to administer intrapleural anticancer agents	• Family member or a visiting nurse required for home drainage • Catheter site Infection • Low pleurodesis rate compared to chemical pleurodesis with chest tube or VATS/medical pleuroscopy

Khaleeq et al,
Respiratory Med 2008

BTS guidelines for the management of pleural effusions

Sclerosant and complications

- Talc is the most effective sclerosant available for pleurodesis. (A)
- Graded talc should always be used in preference to ungraded talc as it reduces the risk of arterial hypoxaemia complicating talc pleurodesis. (B)
- Talc pleurodesis is equally effective when administered as a slurry or by insufflation. (B)
- Bleomycin is an alternative sclerosant with a modest efficacy rate. (B)
- Pleuritic chest pain and fever are the most common side effects of sclerosant administration. (B)

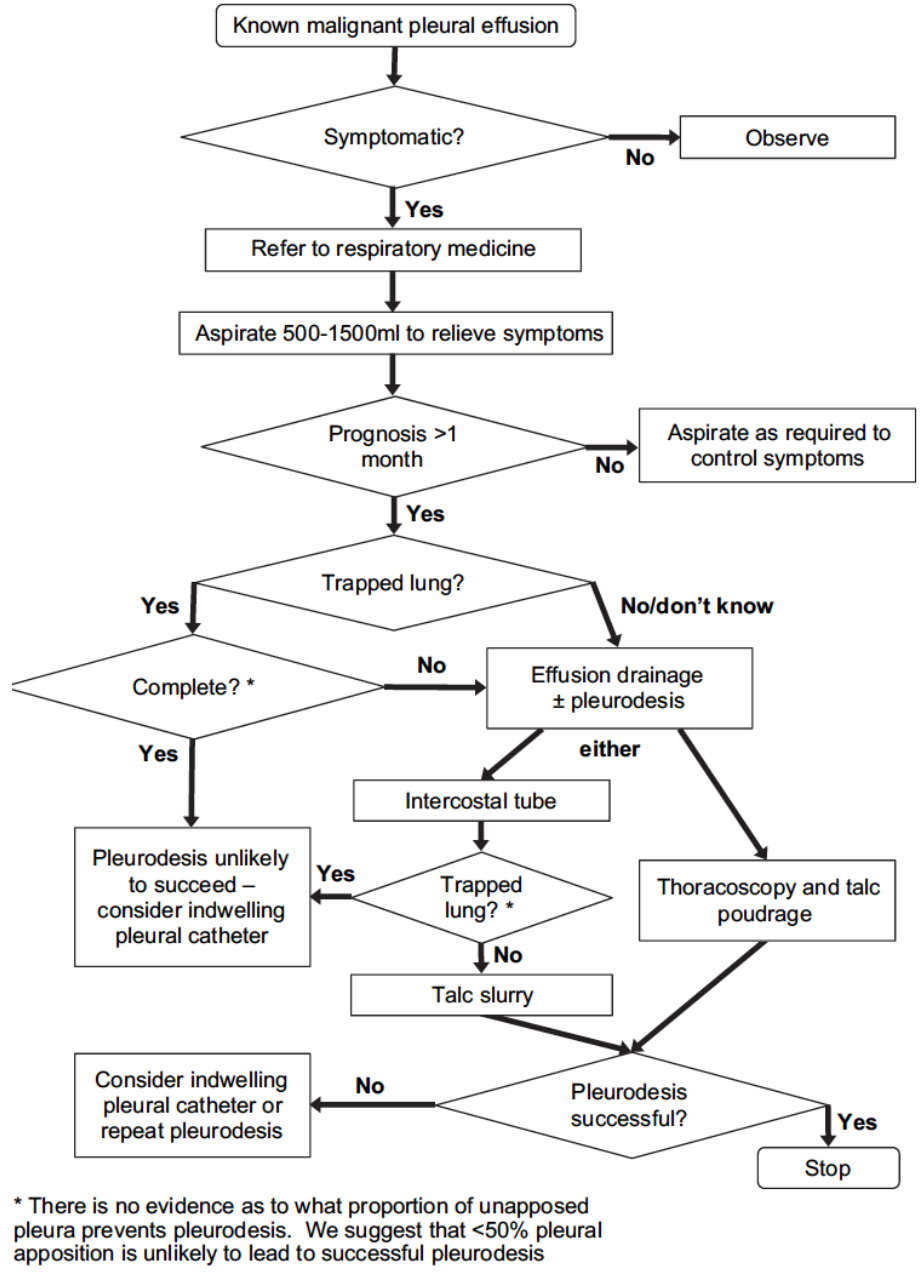


Figure 1 Management algorithm for malignant pleural effusion.

Roberts et al, Thorax 2010

Therapeutic effectiveness of sclerosing agents in pleural effusions

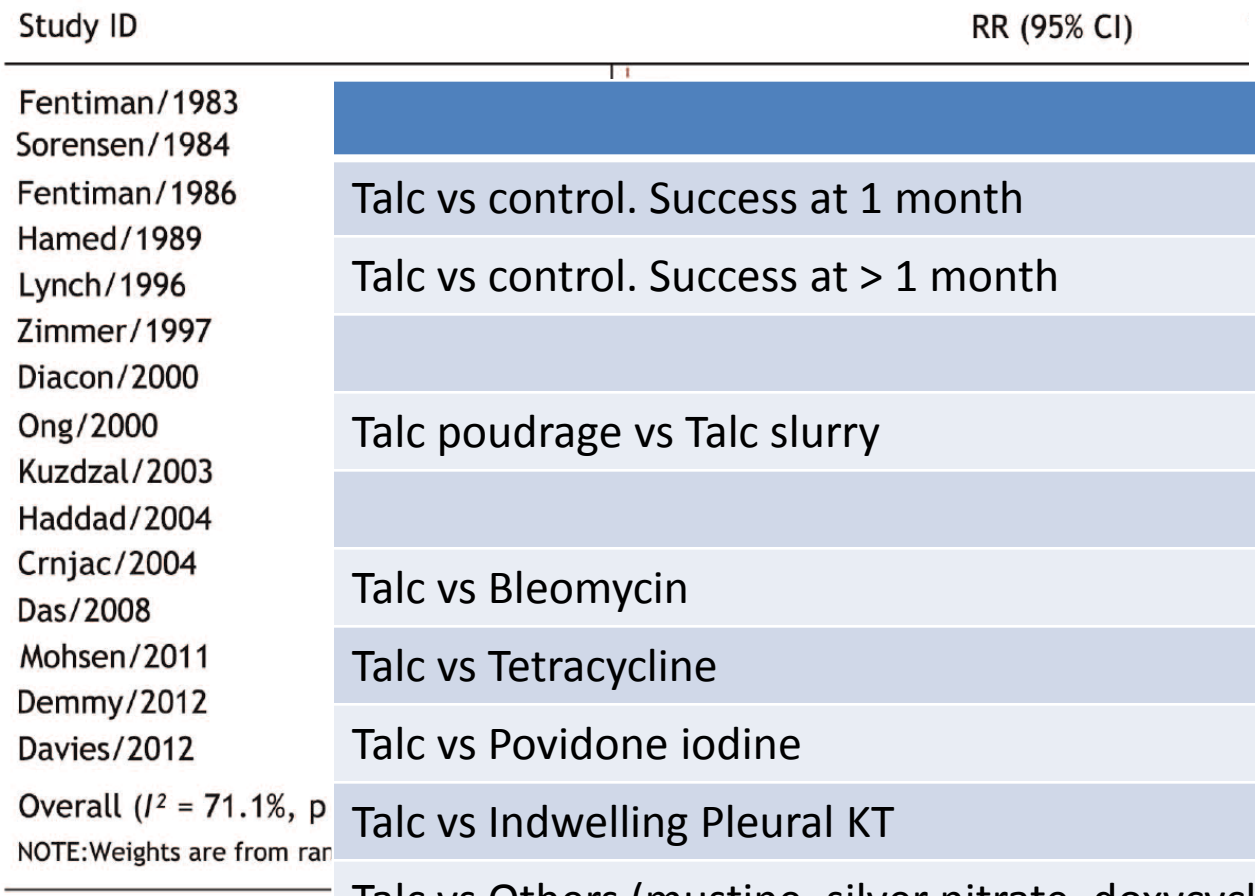
Pleurodesis agent	Complete Response Rate, %
Talc poudrage	91
Talc slurry	91
Doxycycline	80–85
	79
Bleomycin*	36–79 (compared with tetracycline†)
Batimastat (BB-94)	44–50
Iodopovidone	
Mitoxantrone	
Mepacrine	
Mitomycin C	
OK-432‡	
Intrapleural chemotherapy (cisplatin plus cytarabine)	
Doxorubicin	
Doxorubicin with LC9018	
Doxorubicin microspheres	
β-interferon	
Interleukin 2	

TABLE 1. Important Sclerosing Agents for Pleurodesis and Their Success Rate

Agent	Success Rate (%)
Talc	70–100[26–29]
Bleomycin	58–85[23,29–34]
Tetracycline	50–92[23,35–38]
Doxycycline	60–89[25,39–41]
Cisplatin	65–83[25,42–44]
Erythromycin	85–88[45–47]
Mitoxantrone	73–88[48–50]
Taxol	85–93[51,52]

Kvale et al, Chest 2003; Lombardi et al, Am J Clin Oncol 2010

Efficacy and Safety of Talc Pleurodesis for Malignant Pleural Effusion: A Meta-Analysis



	Relative risk
Talc vs control. Success at 1 month	0.94 (0.80–1.11)
Talc vs control. Success at > 1 month	1.35 (1.07-1.69)
Talc poudrage vs Talc slurry	1.12 (1.01–1.23)
Talc vs Bleomycin	1.25 (1.06–1.46)
Talc vs Tetracycline	1.36 (0.62–2.97)
Talc vs Povidone iodine	0.97 (0.81–1.15)
Talc vs Indwelling Pleural KT	1.00 (0.47–2.16)
Talc vs Others (mustine, silver nitrate, doxycycline, thoracoscopic mechanical pleurodesis, drainage alone)	1.61 (0.79–3.27)

Xia et al, Plos One 2014

Take into consideration toxicity…

ADVERSE EFFECTS OF COMMONLY USED PLEURODESIS AGENTS*

Chemical Agent	Total Patients (*n*)	Chest Pain (%)	Fever (%)
Talc	131	7	16
Corynebacterium parvum	169	43	59
Doxycycline	60	40	31
Tetracycline	359	14	10
Bleomycin	199	28	24

Walker-Renard, Ann Intern Med 1994

Therapeutic options for pericardial effusions

Table 3. Subxiphoid Pericardiostomy for Pericardial Effusions

Study [ref no.]	Date	No. of Patients	Mortality Rate (%)	Morbidity Rate (%)	Recurrence Rate (%)
Moores et al [18]	1995	155	0	0	2.5
Okamoto et al [17]	1993	51	0	0	3.9
Chan et al [16]	1991	22	5	0	9.1
Park et al [15]	1991	10	0	10	0
Sugimoto et al [14]	1990	28	0	0	7.1
Palatianos et al [13]	1989	41	0	0	2.4
Reitknecht et al [12]	1985	46	0	0	4.5
Ghosh et al [10]	1985	108	2	5.5	4.6
Levin and Aaron [9]	1982	28	0	7.0	7.0
Prager et al [8]	1982	25	1	0	0
Santos and Frater [6]	1977	46	0	0	0

Table 4. Percutaneous Catheter Drainage of Pericardial Effusions

Study [ref no.]	Date	Technique	No. of Patients	Mortality Rate (%)	Morbidity Rate (%)	Recurrence Rate (%)
Allen	Present series	Catheter	23	4.3	17.4	33.3
Celermajor et al [22]	1991	Catheter	36	3.0	5.6	19.4
Kopecky et al [23]	1986	Catheter	42	0	2.4	24.0
Shephard [27]	1987	Catheter/sclerosis	58	0	10.3	17.0
Davis [28]	1984	Catheter/sclerosis	33	0	0	0
Ziskind et al [24]	1993	Balloon/pericardiostomy	50	2.0	20.0	4.0
Lemmon and Ziskind [25]	1993	Balloon/pericardiostomy	81	0	14.0	11.0
Di Segni et al [26]	1995	Balloon/pericardiostomy	8	0	12.5	0

Allen et al, A,, Thorac Surg 1999

Systematic review of percutaneous interventions for malignant pericardial effusion

	Recurrence rate
Isolated pericardiocentesis	38.3%
Pericardiocentesis followed by extended catheter drainage	12.1%
Pericardial instillation of sclerosing agents	10.8%
Percutaneous balloon pericardiotomy	10.3%

Virk et al, Heart 2015

Table 2: Efficacy of single pericardiocentesis

References	Successfully controlled/no. of patients with malignancy treated (%)	Side effects and complications related to the procedure (%)
Overall	81/131[a] (61.8)	13/220[b] (5.9)
		Vagal hypotension ($n = 3$) Arrhythmia ($n = 6$), vasovagal reaction ($n = 2$), ventricular puncture ($n = 1$), breathing difficulties ($n = 1$)

Table 3: Efficacy of extended catheter drainage

References	Successfully controlled/no. of patients with malignancy treated (%)	Side effects and complications related to the procedure (%)
Overall	43/78[a] (55.1)	14/117[b] (12.0)
		Cardiac injury ($n = 2$), pneumothorax ($n = 1$) Transient ventricular arrhythmia ($n = 1$), hypotension ($n = 1$) Transient atrial fibrillation ($n = 2$), pericardial pain ($n = 1$), erratic drainage ($n = 1$) Catheter occlusion ($n = 3$), infection ($n = 1$), bradycardia and symptomatic hypotension ($n = 1$)

Jama et al, Interact Cardiovasc Thorac Surg 2014

Table 4: Efficacy of pericardial sclerotherapy

Agent	References	Successfully controlled/no. of patients with malignancy treated (%)	Adverse effects and complications related to the procedure (%)
Overall		**416/474 (87.8)**	**97/474 (20.5)**
Cisplatin		**159/176 (90.3)**	**24/176 (13.6)**
	Bischiniotis *et al.* [18]	23/25 (92.0)	Constriction ($n = 4$), transient atrial fibrillation ($n = 3$), non-sustained ventricular tachycardia ($n = 2$)
	Lafaras *et al.* [25]	55/56 (98.2)	Paroxysmal atrial fibrillation ($n = 5$)
	Maisch *et al.* [29]	36/42 (85.7)	Myocardial ischaemia ($n = 1$)
	Oida *et al.* [36]	7/7 (100)	Nausea ($n = 2$)
	Tomkowski *et al.* [38]	38/46 (82.6)	Transient atrial fibrillation ($n = 7$)
Tetracycline		**80/91 (87.9)**	**41/91 (45.1)**

Table 4: Efficacy of pericardial sclerotherapy

Agent	References	Successfully controlled/no. of patients with malignancy treated (%)	Adverse effects and complications related to the procedure (%)
Overall		**416/474 (87.8)**	**97/474 (20.5)**
	Van Belle *et al.* [39]	5/5 (100)	Transient fever ($n = 1$)
Mitomycin C		**19/28 (67.9)**	**1/28 (3.6)**
	Kaira *et al.* [23]	7/8 (87.5)	None reported
	Lee *et al.* [27]	12/20 (60.0)	Pericardial constriction ($n = 1$)
Mitoxantrone		**24/27 (88.9)**	None reported
	Lentzsch *et al.* [28]	6/6 (100)	None reported
	Musch *et al.* [34]	16/16 (100)	None reported
	Norum *et al.* [35]	2/5 (40.0)	None reported
Other			
Minocycline	Lashevsky *et al.* [26]	10/14 (71.4)	Severe chest pain ($n = 7$), pericardial injury ($n = 2$), vasovagal reaction ($n = 1$), transient fever ($n = 1$)
Carboplatin	Moriya *et al.* [32]	8/10 (80.0)	None reported
Aclarubicin	Kawashima *et al.* [24]	5/5 (100)	None reported
OK-432	Imamura *et al.* [22]	3/3 (100)	High fever, chills and chest pain ($n = 3$)

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Table 5: Efficacy of surgical approaches

Technique	References	Successfully controlled/no. of patients with malignancy treated (%)	Side effects and complications related to the procedure (%)
Overall		**514/550[a] (93.5)**	**63/1330[b] (4.7)**
Pericardial fenestration		**474/508[a] (93.3)**	**56/1258[b] (4.5)**
Subxiphoid		*357/383[a] (93.2)*	*42/1079[b] (3.9)*
	Becit *et al.* [40]	49/51 (96.1)	Myocardial injury ($n = 3$)
	Campbell *et al.* [41]	22/25 (88.0)	Hypotension ($n = 1$)
	Lajos *et al.* [46]	15/15 (100)	None reported
	Moores *et al.* [48]	80/82 (97.6)	None reported
	Olson *et al.* [50]	18/18 (100)	Lobar pneumonia ($n = 2$), atrial fibrillation ($n = 2$), fascial dehiscence ($n = 1$), constrictive pericarditis ($n = 1$), intraoperative entry into the left pleural

Table 5: Efficacy of surgical approaches

Technique	References	Successfully controlled/no. of patients with malignancy treated (%)	Side effects and complications related to the procedure (%)
Overall		**514/550[a] (93.5)**	**63/1330[b] (4.7)**

	Celik *et al.* [42]	25/26 (96.2)	Infection ($n = 1$), ventricular fibrillation ($n = 1$), pneumonia and sepsis ($n = 1$), pulmonary embolism ($n = 1$), heart failure ($n = 1$), prolonged ventilation ($n = 1$)
MCPF		*22/22 (100)*	*3/22 (13.6)*
	Toth *et al.* [54]	22/22 (100)	Dysrhythmia ($n = 3$)
Pericardiectomy		**38/38[a] (100)**	**7/68[b] (10.3)**
VATS		*38/38 (100)*	*7/68 (10.3)*
	Hazelrigg *et al.* [45]	18/18 (100)	Atelactasis ($n = 4$), pneumonia ($n = 2$), arrhythmia ($n = 1$)
	Mack *et al.* [47]	9/9 (100)	None reported
	Uramoto *et al.* [55]	11/11 (100)	None reported
Pericardio-peritoneal shunt		**4/4 (100)**	None reported
Denver shunt	Wang *et al.* [57]	4/4 (100)	None reported

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Table 6: Efficacy of percutaneous balloon pericardiotomy

References	Successfully controlled/ no. of patients with malignancy treated (%)	Side effects and complications related to the procedure (%)
Overall	**150/166[a] (90.4)**	**58/181[b] (32.0)**
		Intrapericardial balloon rupture ($n = 1$), right ventricular wall perforation, hypotension and bradycardia ($n = 1$)
		Pain ($n = 2$), profuse bleeding at entry site ($n = 1$), bradycardia ($n = 1$)
		None reported
		Pain ($n = 1$)
		Mild pleural effusion ($n = 4$)
		Pleural effusion ($n = 2$)
		Pleural effusion ($n = 8$)
		Cerebrovascular accident ($n = 1$), pneumopericardium ($n = 1$)
		Fever ($n = 14$), mild pneumothorax ($n = 3$), balloon breakage ($n = 1$)
		Fever ($n = 6$), profuse bleeding ($n = 1$), pleural effusion requiring thoracocentesis ($n = 8$), mild pneumothorax ($n = 2$)

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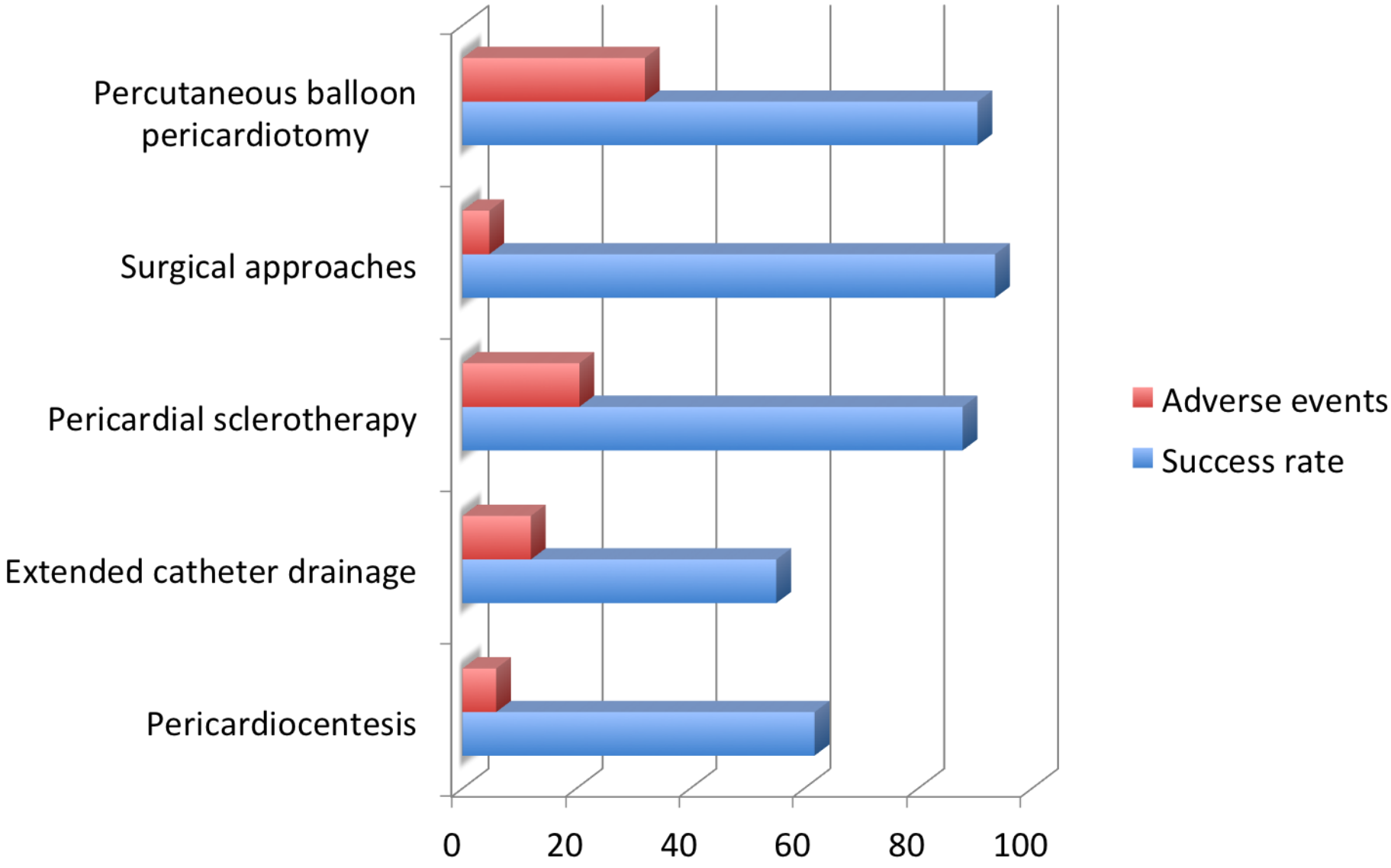

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Which option for tumours with oncogenic driver mutations?

Malignant Pleural Effusion from Lung Adenocarcinoma Treated by Gefitinib

#	Gender/ Age	Histology	Smoking (pack-years)	PS	# prior chemo.	Response to gefitinib*		TTF§ (mos)	Survival¶ (mos)	Mutation status	
						Tumor	MPE			EGFR	K-ras
1	M/67	Ad	ES (25)	3	2	NTL	PR	3.0	4.0	L858R+T790M	wildtype
2	F/58	Ad	CS (46)	1	1	NTL	PR	19.0	20.0	wild type	ND
3	F/52	Ad	NS	1	2	PR	NR	18.1	18.2	ND	ND
4	F/56	Ad	NS	1	1	SD	PR	9.6	13.9	wild type	ND
5	F/81	Ad	NS	4	0	SD	NR	5.5	6.5	L858R	ND
6	M/57	Ad	ES (72)	3	2	PD	NR	1.0	1.1	wild type	wildtype
7	M/61	Ad	ES (46)	3	1	PD	NR	0.2	0.5	wild type	wildtype

Kubo et al, Intern Med 2011

Acta Medica (Hradec Kralove). 2003;46(4):215-6.
Response to gefitinib in pericardial effusion due to lung cancer.
Kikuchi N1, Satoh H, Kodama T, Haraguchi N, Sekizawa K.

Conclusions

- Pleural and pericardial effusions are frequent complications in cancer patients
- Not all effusions are malignant!
- Malignant effusions have major prognostic and operational impact in lung cancer patients
- Treatment should be agressive:
  - Pleurodesis
  - Surgical drainage for symptomatic pericardial effusion