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18.19.3 Pleural tumours 4361 Suzuki H, et al. (2015). Long-term outcomes after surgical resection of pulmonary metastases from colorectal cancer. Ann Thorac Surg, 99, 435–40. Van Geel AN, et al. (1996). Surgical treatment of lung metastases: the European Organization for Research and Treatment of Cancer— Soft Tissue and Bone Sarcoma Group study of 255 patients. Cancer, 77, 675–82. Vogl TJ, et al. (2011). Microwave ablation therapy: clinical utility in treatment of pulmonary metastases. Radiol, 261, 643–51. 18.19.3 Pleural tumours Y.C. Gary Lee ESSENTIALS Benign tumours are rare in the pleural cavity, with solitary fibrous tumour of the pleura the most frequent of these rarities. Malignant pleural tumours are common and can arise from the pleura (most commonly mesothelioma) or as metastases from extrapleural malignancies (especially lung and breast cancer). They typically present with breathlessness, chest pain, and a pleural effusion. Diagnosis requires histocytological con- firmation of malignant cells from pleural fluid and/or pleural biopsies. Mesothelioma—most cases are due to asbestos exposure, char- acteristically after a latent period of more than 20 years, with risk related to the duration and intensity of asbestos exposure and the fibre type (worst with needle-like amphiboles). The condi- tion is incurable, with overall median survival of about 9 months.

Care involves control of pain and pleural effusion, chemotherapy with pemetrexed, cisplatin and bevacizumab, and radiotherapy

for symptom palliation. Recent randomized trials did not show benefits of radical resection. Metastatic pleural malignancy—most tumours that have spread to the pleura are incurable. For tumours that are highly responsive to chemotherapy (e.g. lymphoma or small cell car- cinoma) treatment may control pleural fluid re-accumulation. Definitive treatment for fluid control (e.g. talc pleurodesis) should be performed in patients with symptomatic recurrence of malignant pleural effusions. Randomized trials did not find significant differences in efficacy whether talc is delivered by thoracoscopic poudrage or as a slurry. Indwelling pleural catheters provide an effective alternative to pleurodesis or when the latter fails. Surgical pleurodesis may be considered in selected patients. Introduction Pleural malignancies can arise as primary tumours from the pleura (mostly mesotheliomas) or as metastases from extrapleural cancers (especially lung, breast, and ovarian carcinomas). Malignant pleural effusion affects about 660 patients per million population

annually, and account for up to 50% of exudative ef- fusions. Relatively little research has been performed on the best management for malignant effusions, and a recent worldwide survey of 859 respiratory specialists identified marked differ- ences in clinical practice. Benign pleural tumours Benign tumours are relatively rare in the pleural cavity, with solitary fibrous tumour of the pleura the most frequent of these rarities. Asbestos pleural thickening (e.g. plaques and round atel- ectasis) are discussed elsewhere (see Chapter 18.17). Extrapleural fat can occasionally mimic malignant pleural thickening, espe- cially in obese patients. Pleural lipoma is a rare entity of little clin- ical significance. Solitary fibrous tumour of the pleura Solitary fibrous tumour of the pleura (SFTP) accounts for less than 5% of all pleural tumours. It has also been called ‘localized fibrous mesothelioma’, ‘benign mesothelioma’ or ‘pleural fibroma’. The aeti- ology is unknown: there is no established relationship with asbestos or tobacco exposure. It affects both sexes equally and can affect pa- tients of all ages. The tumour arises from mesenchymal cells, usually from the visceral pleura. Symptoms and effusions are uncommon. Cough, chest pain, or dyspnoea is relatively mild, even if present. Hypertrophic pul- monary osteoarthropathy affects around 20% of patients, and inter- mittent hypoglycaemia due to tumour secreted insulin-like growth factor is reported. SFTPs are often huge when discovered (>10 cm in 50% of cases in one series—Fig. 18.19.3.1) and can be pedunculated (more common) or sessile. CT scanning usually reveals a well- encapsulated, lobulated mass showing heterogeneous attenuation, but there are no pathognomonic findings on imaging. The condition is usually amendable to surgery. Most SFTPs (c.80%) are benign with good long-term prognosis after resection. Malignant SFTPs do occur, the diagnosis usually being based on histological findings (hypercellular clusters, high mitotic activity, and infiltrations) but not on clinical or radiological findings. Recurrence after resection occurs at a rate of 2–8% in benign SFTPs, but up to 63% in malignant variants, and patients with malignant sessile SFTPs have a 30% mortality at 2 years. The role of neoadjuvant or postoperative chemotherapy has not been established. Mesothelioma Malignant pleural mesothelioma kills up to 3000 patients in the United Kingdom a year. An estimated 250 000 deaths from meso- thelioma are expected in western Europe alone over these three decades. Asbestos mining and its global uses are still increasing, especially in developing countries where regulation is poor. A sig- nificant rise of the global incidence of mesothelioma in the coming decades has been predicted.

 Aetiology Asbestos exposure Most mesotheliomas are due to asbestos exposure, characteristic- ally after a long latent period (>20 years in 96% of patients). Most (>90%) mesothelioma arises from the pleura, occasionally from the peritoneum, and rarely from the pericardium and tunica vaginalis of the testis. The risk of mesothelioma is related to the duration and intensity of asbestos exposure and the fibre type. Workers involved in the mining and processing of asbestos, and those using end-products of asbestos for insulation (e.g. plumbers and builders), are at obvious risk of developing mesothelioma, but family members of asbestos workers are also at increased risk from asbestos fibres brought home on work clothes. Home renovation that disrupts asbestos material used in old buildings are now increasingly recognized as a common source of exposure. The risk of developing mesothelioma depends on the physical characteristics of the inhaled asbestos fibres. Needle-like amphibole fibres—for example, crocidolite (blue asbestos), amosite (brown asbestos), anthophyllite, tremolite, and actinolite—are eliminated slowly from the lungs (half-life >7 years) and carry the highest risks. Serpentine fibres— for example, chrysotile (white asbestos)—are cleared more rapidly as they are curly, more soluble, prone to frag- ment, and are less oncogenic than amphiboles. The oncogenic mechanism(s) of asbestos is poorly understood, but involves DNA damage, alteration of cell-cycle check points, chromosomal

rearrangement/loss, altered expression of cytokine mediators, and dysregulation of apoptosis pathways. There are currently no means to identify which people exposed to asbestos are likely to develop mesothelioma. Recent research efforts have concentrated on identifying screening tests for early mesothelioma, but serum levels of soluble mesothelin, the most studied biomarker for this purpose, still have inadequate sensitivity to be used as clinically as a screening tool for the asbestos-exposed population. Other causes Erionite, a naturally occurring mineral found mainly in Turkey, induces pleuropulmonary diseases similar to asbestos and including mesothelioma. Mesothelioma is not linked with prior thoracic irradiation (e.g. for Hodgkin's lymphoma), or with smoking. Simian virus 40 (SV40) can induce pleural, peritoneal, and pericardial mesotheliomas in experimental animals, but epi- demiological studies do not support a causal link in humans. There is increasing preclinical evidence that carbon nanotubes can induce significant damage to the mesothelium and pre- dispose to mesothelioma, although this has yet to be proven in humans. No definite cause can be identified in up to 20% of patients with mesothelioma. Pathology Mesothelioma typically spreads in a diffuse sheet-like manner, beginning in the parietal pleura followed by visceral pleural in- volvement. The latter often results in encasement of the underlying lung (Figs. 18.19.3.2 and 18.19.3.3). As mesothelioma progresses it can infiltrate surrounding structures including the ipsilateral lung, chest wall, mediastinum, and later the contralateral pleural cavity and peritoneum. The gross appearance is often indistin- guishable from pleural metastatic carcinoma. Spread to regional lymph nodes is common, but clinically significant distant me- tastases are infrequent, although at autopsy 60% of patients have extrathoracic metastases. The common histological subtypes of malignant mesothelioma are epithelioid (60% of cases), sarcomatoid (10%), and biphasic with components of both (30%). Median survival is worse in patients with the sarcomatoid variant (<6 months) than in the epithelioid Fig. 18.19.3.1 Solitary fibrous tumour. The chest radiograph (a) of a 56-year-old man with a persistent cough shows a large lobulated opacity in the left hemithorax. Computed tomography (CT) and positron emission tomography (b) showed a 10.8 cm solid pleural-based mass (arrow) with heterogeneous low-grade fluorine-18 fluorodeoxyglucose (FDG) uptake, involving the left lower lobe and invading across the oblique fissure to involve the left upper lobe. CT-guided core biopsy of the mass (c) showed features consistent with a solitary fibrous tumour, which was subsequently resected.

 type (12 months). Desmoplastic mesothelioma is a rare (<1%) variant that histologically mimics benign fibrous tissue. Clinical features and diagnosis Pleural effusion and the associated dyspnoea and/or chest pain are the commonest presentations. Most (95%) patients have a pleural effusion at least sometime during their disease course. Constitutional symptoms, especially weight loss and lethargy, are common (c. 30%) at presentation and increasingly so as the cancer advances. Tumour fever can occur and is difficult to distinguish from infection. Involvement of other (mainly intrathoracic) struc- tures may result in pericardial effusion/arrhythmia, dysphagia, Horner's syndrome, spinal cord compression (Fig. 18.19.3.4) or su- perior vena cava obstruction. Distant metastases (e.g. cerebral in- volvement) are late events. The diagnosis of pleural mesothelioma usually arises from the in- vestigation of undiagnosed pleural effusion (see Chapter 18.17). Biomarkers for mesothelioma Much recent research has focused on discovering biomarkers for mesothelioma. Patients with mesothelioma have an ele- vated mesothelin level in their serum and pleural fluid when compared with patients with other pleural cancers or benign pleuritis. However, the sensitivity and specificity of mesothelin are insufficient to allow it as a standalone diagnostic test. In pa- tients with equivocal histocytologic results or who are unsuit- able for diagnostic interventions, an elevated mesothelin level may contribute to the

clinical-radiologic-histologic diagnosis in a multidisciplinary tumour board setting. Elevated serum mesothelin can occur in occasional carcinomas, and in patients with renal failure. Conversely, sarcomatoid mesotheliomas rarely overexpress mesothelin. Other biomarkers (fibulin-3, osteopontin, megakaryocyte potentiating factor, and so on) have shown promise but their roles as biomarkers have not been as thoroughly scrutinized as mesothelin. Prognosis The overall median survival for malignant pleural mesothelioma is about 9 months. Good performance status and epithelioid hist- ology are associated with better survival. Rarely isolated cases of long survivors (e.g. over 10 years) have been reported. There are several staging systems (e.g. International Mesothelioma Interest Group classification), and early-stage disease (e.g. limited to parietal pleura) carries better prognosis. Disease response in research settings are usually monitored by the modified RECIST criteria. Total glycolytic volume measurements on PET and mesothelin levels before and after chemotherapy also have pre- dictive values on survival. Management Mesothelioma is incurable despite the use of surgery, chemotherapy, radiotherapy, or their combinations. Specific antifolate/cisplatin chemotherapies are the only treatment to have shown survival bene- fits, albeit for about 12 weeks. Management should therefore aim to improve quality of life. The use of a multidisciplinary palliative care team experienced in mesothelioma is recommended, as the clinical course of mesothelioma differs from other solitary tumours. Patients often pursue legal claims for compensation, which can create additional stress. Pain control Most patients eventually experience pain and dyspnoea, and early use of opioids is required. Radiotherapy is effective for localized pain (e.g. from bone erosion) and needle tract metastases. Invasive pain control techniques with indwelling epidural catheters and spinal cordotomy are sometimes needed. Fig. 18.19.3.2 A patient with advanced right pleural mesothelioma: CT scan showed a thick rind of tumour encasing the lung (arrows), with resultant shrinking of the ipsilateral hemithorax. Fig. 18.19.3.3 Thoracoscopic view of pleural mesothelioma on the parietal pleural surface.

section 18 Respiratory disorders 4364 Pleural fluid control Recurrent effusions (and dyspnoea) are a key problem for most pa- tients with mesothelioma. In a series of 390 patients, 42% required further treatment to control fluid re-accumulation. Pleurodesis (either as surgical approach or talc slurry) was effective in two- third of patients and avoid further pleural intervention. However, pleurodesis is not useful when tumour has encased the visceral pleura, preventing lung expansion (‘trapped lung’, Fig. 18.19.3.5) and prohibiting apposition of the pleural surfaces. An indwelling pleural catheter is an increasingly used alternative and allows domiciliary pleural fluid drainage (Fig. 18.19.3.6)—see also under ‘Metastatic pleural malignancy’. Fig. 18.19.3.4 Spinal cord compression in mesothelioma. This 80-year-old patient with known malignant pleural mesothelioma presented with back pain, paraplegia, and urinary retention. (a) Magnetic resonance imaging of the spine shows tumour (short arrow) encasing the upper thoracic spinal cord resulting in severe canal stenosis and cord compression. (b) Malignant pleural disease is demonstrated by high signal intensity on the T2-weighted image. Fig. 18.19.3.5 Trapped lung. This 60-year-old man with mesothelioma underwent insertion of an indwelling pleural catheter for management of his large symptomatic malignant pleural effusion (left panel). Trapped lung was suspected prior to effusion drainage because of the absence of mediastinal shift away from the side of the large effusion. The lung failed to fully expand after fluid evacuation (right panel). The presence of visceral pleural thickening further supports the diagnosis of a trapped lung.

18.19.3 Pleural tumours 4365 Chemotherapy Mesothelioma is relatively resistant to common chemotherapeutic agents and drug penetration to the pleura and underlying tissues is variable. Palliative chemotherapy using cisplatin with either pemetrexed or raltitrexed (antifolate agents) can im- prove symptoms and prolong median survival by 2.8 months in mesothelioma. Radiotherapy Radiotherapy has been tried with curative intent, but the disease area to be covered is too large and the resulting radiation toxicity (to the underlying heart, liver, and so on) unacceptable. Intensity- modulated radiotherapy is under investigation. Radiotherapy however has an established role in symptom palli- ation, with about 60 to 80% of patients experiencing improvement in specific tumour-related complications, although it does not pro- long survival. Radiotherapy is often used in compression of the oesophagus, superior vena cava, and spinal cord, though clinical re- sponse is variable. Mesothelioma can invade sites of pleural procedures (Fig. 18.19.3.7), but the reported incidence varies among studies. Three (small) ran- domized studies on the use of prophylactic radiotherapy have shown conflicting results. Longitudinal series have revealed that the risks of needle track metastases are related to the size of the pleural pro- cedures (with needle aspiration the lowest and thoracotomy the highest). All efforts should be taken to minimize the number of pleural procedures in patients with possible mesothelioma to min- imize the frequency of unpleasant chest wall tumour invasion. A re- cent multicentred randomized trial did not find a role for routine prophylactic radiotherapy after large bore pleural interventions such as chest drain/thoracoscopy. Surgery and multimodality treatment Mesothelioma spreads along serosal surfaces and infiltrates under lying structures instead of growing as a discrete mass; hence com- plete surgical resection is not feasible. Fig. 18.19.3.6 An indwelling pleural catheter in a patient with recurrent pleural effusions. Fig. 18.19.3.7 Needle tract metastases in malignant pleural mesothelioma. This patient with mesothelioma developed a painful lump on the posterolateral chest wall (left panel, arrow) along the needle tract of a previous thoracentesis which was confirmed on CT imaging (right panel, arrow). The CT also revealed tumour involvement of the left hemidiaphragm and an indwelling pleural catheter in situ for management of his recurrent malignant pleural effusion.

 Radical surgery to provide tumour cytoreduction has been at- tempted in combination with adjuvant radiotherapy and chemo- therapy. Extrapleural pneumonectomy (EPP) and pleurectomy with decortication (P/D) are the two commonest approaches practised. EPP involves removal of the entire lung, parietal pleura, pericar- dium, diaphragm, and mediastinal lymph nodes. EPP carries sig- nificant mortality (5–10% from surgery alone) and morbidity (>25% life-threatening complications). A randomized clinical trial has now confirmed that patients who underwent EPP had a significantly shorter median survival than those who were randomized not to have EPP (14 vs. 19 months, respectively). Two studies have shown that EPP significantly impaired quality of life. P/D is an alternative debulking procedure which does not involve pneumonectomy. It failed to show any survival benefit in a recent multicentre, randomized trial but increased postoperative compli- cation when compared with talc pleurodesis. Metastatic pleural malignancy Most cancers can spread to the pleura resulting in a pleural effusion and associated dyspnoea. Up to 30% of patients with lung and breast carcinomas (Fig. 18.19.3.8) and 10% of those with lymphoma will suffer from a malignant effusion. Ovarian and colon carcinomas as well as adenocarcinomas from unknown primary site also occur. Metastatic malignant disease may follow direct spread or haema- togenous embolization of tumour to the peripheral lung paren- chyma, followed by visceral pleural invasion. The parietal pleura is assumed to be secondarily affected by shedding of malignant cells from the visceral pleura, or from tumour

migration via adhesions. Pleural involvement from direct cancer invasion (e.g. from breast cancer) or haematogenous spread can also occur. In lung cancer, the presence of malignant involvement of the pleura often denotes more advanced staging and prohibits curative surgery. The importance of pleural involvement in lung cancer has attracted strong interests. The latest TNM staging for non-small cell lung cancer included a classification of visceral pleural inva- sion (VPI). VPI denotes poorer prognosis in lung cancer patients who undergo resection. Also, in c.5% of lung cancer patients under- going surgery, tumour cells can be detected if a pleural lavage is performed during the operation. A positive lavage predicts a higher risk of cancer recurrence and poorer prognosis (median survival 12 months, vs. 49 months for those with a negative lavage). Malignant effusions develop primarily as a result of increased vas- cular permeability and resulting plasma leakage. Reduced pleural fluid outflow, secondary to tumour blockage of parietal pleural stomata and/or the downstream lymphatic drainage pathways, also contributes. Clinical features Dyspnoea results from altered respiratory mechanics when the pleural cavity expands to accommodate the extra (often litres) volume of fluid. The weight of large effusions often everts the diaphragm and may result in its paradoxical movements. Small malignant effusions can be asymptomatic. Underlying lung disease (e.g. lymphangitis, airway obstruction, comorbid chronic obstructive pulmonary dis- ease, or pulmonary embolus) and extrapulmonary causes (e.g. peri- cardial effusion or anaemia) often contributes to breathlessness and must not be overlooked. Pleuritic pain is common and implies malignant infiltration of the parietal pleura, as the visceral pleura is devoid of pain sensation. Diagnosis The diagnosis of malignant pleural metastases should be made by histological or cytological assessment of pleural fluid or pleural tissue samples (see Chapter 18.17). Clinical assessment, radiological appearances (e.g. on CT or PET) or tumour marker measurements cannot provide a definitive diagnosis. Imaging can, however, guide biopsy and improve yield. It is important to obtain a histocytological diagnosis of the type of malignancy (e.g. between mesothelioma and metastatic carcinoma): this alters treatment strategies and has prog- nostic implications. Management A tumour that has spread to the pleura is incurable in most cases. Surgery and radiotherapy are unable to eradicate pleural metastases. In patients whose primary tumour is highly responsive to chemo- therapy (e.g. lymphoma or small cell carcinoma), treatment may control the pleural effusion, but most cases of malignant effusion are not responsive to chemotherapy. Indications for pleurodesis If the patient is symptomatic from a malignant effusion, drainage is required and consideration should be given to attempts to pre- vent fluid re-accumulation. The conventional strategy is to create pleurodesis—the adherence of the parietal and visceral pleura— either surgically or by introducing a chemical agent. This can be achieved in about 70% of cases, although reported success rates vary markedly with the agents employed, clinical methods, and defin- itions of success. No clinical or biochemical markers reliably predict the outcome of pleurodesis in individual patients, but a low pleural Fig. 18.19.3.8 Thoracoscopy showing scattered tumour from metastatic breast carcinoma on the parietal pleural surface.

 fluid pH (<7.20) or glucose (<1 mmol/litre) is associated with a lower pleurodesis success rate and shorter survivals. Many breathless patients with a malignant effusion do not gain significant benefit after pleural fluid drainage: pleurodesis should be considered only in those who do. The presence of a trapped lung is a relative contraindication to pleurodesis as poor apposition of the pleural surfaces will render pleurodesis ineffective. Pleurodesis should be reserved for patients with good short-term prognosis (arbitrarily defined as expected survival >3 months) al- though predicting survival in individual patients is notoriously dif- ficult. The LENT score has been shown to help predict survival in malignant effusion patients: high pleural fluid LDH, poor ECOG performance status, high Neutrophil:Lymphocyte ratio in blood, and tumour types

predict prognosis. There are no controlled studies that define the best timing of pleurodesis, with most physicians recommending the procedure when the patient has had one or more episode of fluid recurrence. An alternative approach is to attempt pleurodesis of large effusions when they first present, as the recurrence rate is high (>70%) and early pleurodesis, before trapped lung ensues, may be more suc- cessful. This strategy avoids some episodes of unpleasant dyspnoea as fluid recurs. Pleurodesis produces adherence of the pleural surfaces by pro- voking acute pleural injury, which results in pleural inflamma- tion. If the inflammatory process is sufficiently intense, chronic inflammation and fibrosis ensues, resulting in pleural adhesions and eventual obliteration of the pleural cavity (successful pleurodesis). This process is often painful, as the parietal pleura is heavily infil- trated by sensory nerves. It is probable that the more intense the induced pleural inflammation, the higher the likelihood of suc- cess, but at the expense of producing more pain and distress to the patient. Methods of pleurodesis Pleurodesis can be performed by various surgical means (e.g. abra- sion of the pleura or pleurectomy). A thoracoscopic approach is preferred to thoracotomy. Alternatively, pleurodesis agents can be delivered intrapleurally via a chest tube when complete lung re-expansion is confirmed on radiographs following drainage of effusions. The most commonly used agent worldwide is talc, followed by tetracycline/doxycycline/minocycline, and bleomycin, though other agents (e.g. iodopovidone, silver nitrate, and picibanil (OK432)) have also been employed. A meta-analysis of 11 studies showed that talc is superior in efficacy to tetracycline and bleomycin. Talc can be delivered via a chest tube (as a slurry) or insuf- flated (as a poudrage) during thoracoscopy. Three published randomized trials have found no significant differences in their success rates. If a patient undergoes thoracoscopy for diagnostic purposes, talc poudrage can be performed at the same setting, otherwise pleurodesis can be performed by either talc slurry or poudrage, depending on availability, in patients with an estab- lished diagnosis. Pain is the most common side effect of pleurodesis, and narcotic analgesics and/or conscious sedation (e.g. midazolam) should be used where possible. Rotation of the patient does not improve the success rates of pleurodesis. In animal studies, systemic cortico- steroids and heparin can significantly reduce effective pleurodesis by inhibiting pleural inflammation and the coagulation cascade re- spectively; their relevance in humans is unknown. Talc pleurodesis toxicity Talc can induce fever and pain, which usually subsides within 72 h. Systemic absorption of talc particles and embolization to distant organs have also been reported if preparations containing small talc particles (<10 μm) is used. Marked systemic and pul- monary inflammation with resultant hypoxaemia can occur, presumably from systemic absorption of small talc particles. Talc- related adult respiratory distress syndrome (ARDS) occurred in 6% of patients and caused the death of 2.3% in a study of 484 pa- tients. Talc-related ARDS can occur with either talc poudrage or slurry, and with doses from 2 to 10 g, but no cases of the condition were observed in a study of over 550 patients in which a graded talc preparation (with median particle size >20 μm) was used— though even in this study patients had a higher oxygen require- ment after the pleurodesis. Recurrent pleural effusions For patients where pleurodesis fails, another attempt with a dif- ferent agent, implantation of an indwelling pleural catheter (IPC), pleuroperitoneal shunting, serial therapeutic thoracentesis, or a surgical pleurodesis are possible. Repeated thoracenteses combined with narcotics and oxygen are appropriate when a very short life expectancy (<2 weeks) is likely.
A pleuroperitoneal shunt is contra- indicated in the presence of ascites. Indwelling pleural catheters IPCs are increasingly used for ambulatory drainage of recurrent (es- pecially malignant) pleural and peritoneal effusions, allowing patients to perform fluid drainage when symptoms arise (Fig. 18.19.3.6). Spontaneous pleurodesis can occur in up to 50% of patients (who do not have a trapped lung) over time. IPC is accepted as the preferred treatment in patients who failed pleurodesis or have a trapped lung. Increasingly, it is used as an alter- native to talc pleurodesis as the first choice

of definitive therapy for recurrent effusions. A recent randomized trial suggested that IPC provides equally good improvement in quality of life and symptom- atic relief when compared with talc pleurodesis. IPC insertion can be performed on an outpatient basis and re- quires significantly shorter hospital stay than pleurodesis, as shown in two randomized studies. A pilot, nonrandomized study showed that patients treated with IPC spent significantly fewer days in hos- pital than those pleurodesed in their remaining lifespan. This obser- vation has recently been validated in a multicentred trial. It is important that patients fitted with an IPC be provided with sufficient aftercare. The adverse event rates associated with IPC use are low, as shown in large longitudinal series. Infection, often the major concern from clinicians, occurs in c.5% of patients and is gen- erally mild and easily controlled with antibiotics. Interestingly infec- tion (especially from Staphylococcus aureus) can induce pleurodesis in a significant proportion of patients, allowing removal of the IPC. Symptomatic loculation of the effusion can occur and may response at least in the short-term to intrapleural fibrinolytics. Catheter tract metastases develop most commonly in mesothelioma patients and can be treated with radiotherapy without removing the IPC beforehand.

Revision #1
Created 2026-01-22 16:40:19 UTC by Omar Ayman
Updated 2026-01-22 16:40:19 UTC by Omar Ayman