



Contemporary approach to the patient with malignant pleural effusion complicating lung cancer

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Abstract: Malignant pleural effusion (MPE) occurring in the patient with lung cancer can have profound prognostic and management implications. If clinically relevant, such an effusion first needs to be confirmed as malignant and then, in the majority of lung cancer patients, it will require a pleural intervention to relieve symptoms related to fluid accumulation. The field of pleural diseases in general, and pleural malignancy in particular, has undergone dynamic changes in recent years as the evidence base informing practice has grown by leaps and bounds. Both the diagnosis and management of MPE are dynamically changing disciplines in thoracic medicine. As commonly happens, emerging data have generated just as many questions as they have answered. The aim of the present review is to summarize the current knowledge about MPE resulting from lung cancer in a manner that is accessible to clinicians across medical specialties.

Keywords: Pleural effusion; lung cancer; pleurodesis; indwelling pleural catheter (IPC); thoracoscopy

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Introduction

According to American Cancer Society estimates, lung cancer remained the deadliest malignancy in the United States in 2018 (1). It is the second most prevalent cancer in men and women and the commonest cause of a malignant pleural effusion (MPE), accounting for approximately 30% of such effusions (2). The course of about 15% of patients with non-small cell lung cancer (NSCLC) is complicated by a documented MPE (3). The presence of an MPE in the setting of lung cancer indicates stage IV disease and is an independent determinant of shorter survival (4). The majority of lung cancer patients with an MPE will require a pleural intervention for the palliation of dyspnea, so the identification of pleural involvement can have both diagnostic and therapeutic implications. MPE associated with lung cancer has, therefore, been at the forefront

of recent advances in the diagnosis and management of pleural malignancy. The aim of the present review is to summarize the contemporary approach to the diagnosis and management of MPE in the patient with lung cancer.

Pathophysiology

Under normal conditions, the rate of pleural fluid elimination via lymphatic channels far exceeds the rate of its production at the level of pleural capillaries. A dramatic disturbance in one or both of these processes is required for clinically apparent pleural fluid accumulation to ensue. Metastatic pleural malignancy causes effusion formation by disrupting fluid circulation on both ends. Tumor deposits on the pleural surface can mechanically obstruct lymphatic drainage, leading to reduced fluid elimination (5). Concurrently, the constituent cancer cells are capable of

releasing potent mediators of vascular permeability, primary among them vascular endothelial growth factor (VEGF), thereby increasing pleural capillary leak and fluid formation. It is important to recognize that pleural fluid homeostasis in patients with lung cancer can be altered by cancer-related factors other than direct tumor implantation, resulting in a so-called “paramalignant effusion”. For example, a small to moderate exudative pleural effusion may be caused by an associated pulmonary embolism, whereas the finding of a unilateral transudative effusion would prompt consideration of unexpandable lung due to malignant endobronchial obstruction.

Diagnosis

Imaging

Initial concern about possible MPE is typically generated by thoracic imaging. Certain features on contrast-enhanced computed tomography (CT) of the chest such as pleural thickening (6) and focal pleural or lung parenchymal lesions (7) heighten suspicion for pleural malignancy. However, even expert radiologists’ chest CT interpretations carry an unacceptably low negative predictive value of 65% for pleural malignancy, indicating that CT suffers from a high false-negative rate (8). The sensitivity of CT for MPE can be increased by its integration with ¹⁸Fluorodeoxyglucose positron emission tomography (¹⁸FDG-PET), reaching 93% in comparison to 70% of CT alone (9). However, the utility of ¹⁸FDG-PET is limited by problems with specificity, which was roughly 75% in a pooled analysis (10). Ultimately, regardless of the presence or absence of suggestive findings, no radiological study can substitute for cytohistological confirmation if pleural malignancy is a consideration.

Pleural fluid characteristics

Thoracentesis is the initial diagnostic intervention in cases of suspected pleural malignancy. Malignant pleural fluid is frequently, though not always, hemorrhagic (11). The prototypical MPE fulfills Light’s criteria for an exudate and exhibits a predominance of lymphocytes on cellular differential count. Besides malignancy, other etiologies associated with this pattern include pleural tuberculosis, connective tissue diseases, and coronary artery bypass grafting surgery. When present, fluid pH <7.30 is a marker of increased pleural tumor burden and therefore portends a

worse prognosis and reduced pleurodesis success in MPE (12).

Pleural fluid cytology

The primary utility of thoracentesis in the diagnosis of MPE is the acquisition of pleural fluid for cytology. The yield of pleural fluid cytology in MPE overall is poor—about 50%—and recent studies have cast doubt on traditional dogma that repeat sampling should increase sensitivity (13,14). Adenocarcinoma is the likeliest lung cancer cell type to generate an MPE (3), and it is also associated with the highest cytological yield of the major lung cancers owing to its exfoliative nature. Pleural fluid cytology is positive in about 80% of MPE due to lung adenocarcinoma. Squamous cell carcinoma, on the other hand, has a particularly poor pleural fluid cytological yield of 25% or less (13,14). Small cell carcinoma has historically been a relatively rare cause of a clinically significant MPE (15), and it exhibits an intermediate yield of pleural fluid cytology: approximately 50%. Thus, in case of an initial negative pleural fluid cytology and ongoing concern for MPE from lung cancer, the decision between repeating cytology and proceeding to histological sampling (see below) could depend on the known or suspected cell type of the primary tumor (*Table 1*).

Pleural fluid tumor markers

Soluble tumor markers cannot substitute for cytohistological confirmation in MPE because they do not provide the pathological material required for the initial diagnosis of cancer and for oncological decision-making in cases of established malignancy. Measuring soluble tumor markers in pleural fluid suspected to be malignant would be of value, however, if—alone or in combination—they were more sensitive than pleural fluid cytology, thus justifying persistent concern for MPE in cytologically negative lymphocyte-predominant exudative effusions. It has been reasonably argued that the cutoff value of tumor markers must be set at the specificity level of 100% to prevent the unacceptable occurrence of false positivity (16). Applying this threshold principle, elevation of either carcinoembryonic antigen (CEA) or cancer antigen 15-3 (CA15-3) in pleural fluid has been shown to correctly classify over 40% of cytologically negative nonpurulent exudative effusions as MPE (17). The additive value of CEA and CA15-3 above pleural fluid cytology appears to vary with the histological subtype of lung cancer. In adenocarcinoma, the combined sensitivity of

Table 1 Reported range of pleural fluid cytology yield in malignant pleural effusion due to lung cancer according to different cell types

Lung cancer cell type	Yield of pleural fluid cytology
Adenocarcinoma	78–82%
Squamous cell carcinoma	14–25%
Small cell carcinoma	44–53%
Miscellaneous	0–47%

The miscellaneous category includes undifferentiated NSCLC and sarcoma among others. Data from (13,14). NSCLC, non-small cell lung cancer.

these tumor markers is comparable to that of pleural fluid cytology: approximately 70%. In squamous cell carcinoma, notorious for poor cytological yield, their sensitivity of 44% represents a substantial improvement over pleural fluid cytology. Although not a specific tumor marker, pleural fluid VEGF can detect malignancy in 60% of cytologically negative MPE at a threshold of 652 pg/mL (18). That cutoff is accompanied by false positivity, however, as evidenced by a specificity of 83%.

Needle pleural biopsy

If pleural fluid cytology fails to establish malignancy and proof of MPE is needed in the setting of known or suspected lung cancer, the next step is some form of pleural biopsy for histological diagnosis. Because of the patchy pleural involvement typical of metastatic implants, the yield of traditional percutaneous blunt needle biopsy of the pleura without the application of imaging (i.e., “blind” pleural biopsy) has been uniformly <50% across studies (19–21) and inferior to pleural fluid cytology in studies comparing the two (19,20). In a prospective randomized trial in which the predominant pleural malignancy was mesothelioma, dynamic CT-guided cutting needle biopsy aimed at the site of maximal pleural thickening was significantly more sensitive than the “blind” blunt needle technique: 87% *vs.* 47%, respectively (21). The use of static (i.e., not real-time) ultrasound (US) to assist needle biopsy of the pleura in 47 patients with eventually diagnosed MPE (close to two-thirds lung cancer) resulted in a yield of approximately 90% irrespective of the presence or absence of pleural thickening (22). Either a blunt or cutting needle was used in the presence of pleural thickening, and only a blunt needle in its absence. When CT assistance for blunt needle biopsy was compared to US assistance for cutting

needle biopsy for the diagnosis of MPE (about one-quarter lung cancer), the outcome favored CT: 77% *vs.* 66% (23). Taken together with data from other investigators (24), these results suggest that the yield of needle biopsy of the pleura in MPE improves with image guidance rather than assistance and with a higher percentage of lung cancer relative to mesothelioma.

Thoracoscopic pleural biopsy

With the advent of video-assisted thoracoscopic surgery (VATS), surgical pleural biopsy can be performed with less morbidity compared to traditional open thoracotomy, but the rate of post-operative complications is not negligible (25,26). Patients undergoing this procedure must be able to tolerate general anesthesia with single-lung ventilation and may experience lingering post-operative pain (27). These features of VATS pleural biopsy render it unappealing in the typical MPE patient with debility and limited life expectancy. As the current “gold standard”, the yield of VATS pleural biopsy in MPE exceeds 90% (25). If available, medical thoracoscopy (MT) is an alternative to VATS that can be performed under local anesthesia with or without sedation. This procedure entails the induction of an obligatory pneumothorax, which the patient must be able to tolerate while breathing spontaneously. Forceps biopsies of the parietal pleura can be performed during MT through a rigid or semi-rigid thoracoscope. Like that of VATS, the yield of this procedure in pleural malignancy exceeds 90% (28), and major complications are rare, though even death has been reported (29). A randomized trial comparing biopsy during MT with CT-assisted blunt needle biopsy of the pleura included 80 patients with eventual pleural malignancy, 29 (36%) of whom turned out to have metastatic lung cancer (30). Sensitivity of MT was numerically but not statistically superior to that of needle biopsy (95% *vs.* 87%) for all types of MPE. In cases with lung cancer as the primary tumor, yields were nearly identical: 14/15 (93%) for needle biopsy and 14/14 (100%) for MT. Complication rates were low and comparable for both procedures.

Management

General principles

The presence of an MPE in a patient with lung cancer is designated as intrathoracic metastatic disease (M1a) in the

most recent 8th edition of the International Association for the Study of Lung Cancer Tumor, Node, Metastasis (TNM) classification system (31). The M1a designation translates to stage IV disease, the fundamental treatment for which is palliative platinum-based doublet chemotherapy. Traditional chemotherapeutic agents are limited in their ability to reliably control the accumulation of pleural fluid with (32) or without (33) the addition of VEGF inhibitor bevacizumab and whether administered intravenously or intrapleurally (34). The ever-expanding role of targeted therapy aimed at driver mutations and the recent advent of checkpoint inhibition for stage IV lung cancer may eventually change the landscape of systemic MPE therapeutics, but at present the mainstay of management remains local procedural interventions in the pleural space (35). The primary treatment objective in these patients with incurable lung cancer is symptom relief and thereby quality of life improvement.

Thoracentesis

Therapeutic thoracentesis must be performed upon initial encounter with a suspected symptomatic MPE. Besides characterizing the pleural fluid and collecting a cytology specimen, this procedure allows determination of the impact of fluid removal on symptoms and assessment of the compressed lung's ability to re-expand. Information thus obtained is vital for planning subsequent steps. For patients with extremely short life expectancy, therapeutic thoracentesis can be viewed as definitive management if the need for multiple drainages before death is considered unlikely. Because the majority of patients with MPE will experience recurrence before death—often within two weeks of initial thoracentesis—the more durable strategies discussed below constitute superior options (36).

Pleurodesis

The principle behind pleurodesis is that the pleural space is not essential to life and thus can be sealed with the resultant benefit of cessation of fluid entry. The classical mechanism envisions an intense pleuritis triggered by a deliberate insult with consequent symphysis of the pleural membranes, which are thereby expected to fuse together completely and permanently by forming adhesions. Pleurodesis can be considered complete if fluid does not reaccumulate at all for the lifetime of the patient, partial if there is clinically insignificant reaccumulation, and failed if a repeat pleural

procedure becomes necessary (37). The effectiveness of pleurodesis can wane over time, so the success rate varies as a function of the time point at which it is assessed. The mechanism underlying pleurodesis is predicated on the ability of the visceral and parietal pleural surfaces to achieve apposition. It follows from this assumption that pleurodesis will be infeasible if the visceral pleura cannot reach the parietal pleura due to failure of lung re-expansion as happens in cases of malignant lung entrapment or endobronchial obstruction.

A mechanical means of accomplishing pleurodesis is pleural abrasion, which requires an operative approach. Many different chemical pleurodesis agents have been used in clinical practice, and their delivery is possible thoroscopically or via tube thoracostomy. In the English-speaking world, talc is the most commonly used pleural sclerosant (38). It is also the most effective agent and the most extensively studied (39). In the TIME1 randomized controlled trial (RCT) in which 294 patients with MPE underwent talc pleurodesis and in which pleurodesis failure was defined as the need for repeat pleural intervention, at 3 months close to 80% of patients remained successfully pleurodesed (40). An area of ongoing controversy is whether thoroscopic talc poudrage is superior to its bedside administration as slurry. The largest RCT completed so far to answer this question did not demonstrate a significant difference in pleurodesis success (defined radiographically) in the entire study population at 30 days, but notably a post-hoc subgroup analysis did detect an advantage to poudrage in patients with lung or breast cancer (41). Pooled analysis of the available data included in a recent clinical practice guideline yielded comparable efficacy and safety results between the two methods of talc delivery (42). Safety concerns regarding talc pleurodesis stem from occurrences of the acute respiratory distress syndrome (ARDS), believed to be the result of extrapleural inflammation induced by small talc particles that manage to escape into the systemic circulation (43). Lending support to this theory is the observation that ARDS cases were reported in a US study population that received ungraded talc (44) (i.e., containing small particles) but were not seen in a European cohort that received graded large-particle talc (45). For this reason, only the latter talc preparation is currently recommended and available for clinical use.

The second most popular pleural sclerosant is doxycycline, a tetracycline derivative that is somewhat less effective than talc (38,46). Its instillation into the pleural space causes intense inflammation and is therefore

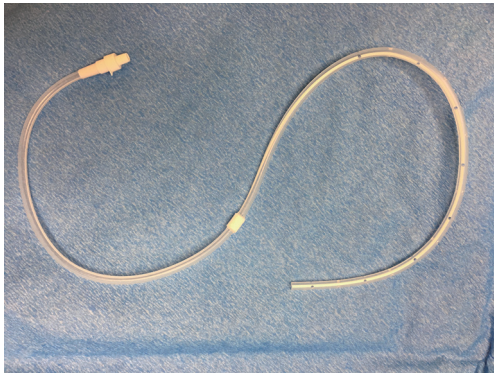


Figure 1 An example of an indwelling pleural catheter.

notoriously painful. Both topical and systemic analgesia is typically administered when doxycycline is used in an awake patient. Traditionally, opiate analgesics have been the preferred option for pain control while non-steroidal anti-inflammatory drugs (NSAIDs) have been avoided for fear of interference with pleurodesis. Notably, the TIME1 trial investigators compared the efficacy of talc pleurodesis in subjects with MPE receiving opiates for pain *vs.* those receiving NSAIDs and found pleurodesis outcome to be non-inferior with the latter. Doxycycline has not been associated with systemic toxicity such as ARDS.

Indwelling pleural catheter (IPC)

An alternative to pleurodesis for MPE that has gained popularity is the IPC designed to allow outpatient self-drainage (*Figure 1*). The catheter can be inserted on an ambulatory basis and is tunneled through subcutaneous tissue in order to reduce the likelihood of dislodgement and infection. The patient performs home-based pleural fluid drainage usually with the assistance of a family member or nurse either on a fixed schedule or as needed for symptom relief. A properly functioning IPC is virtually guaranteed to provide effective fluid control (47). Approximately 20% of patients experience IPC-related complications, however, the most common being infection and catheter malfunction (47-49). Many fewer patients—about 7%—require catheter removal due to complications, which tend to be minor (36,49). For example, unlike parapneumonic pleural space infection, IPC-related infection is rarely fatal, and international experience suggests that it can often be successfully treated while preserving the catheter (50). Failure of IPC drainage due to multiloculation of fluid typically leads to an attempt at fibrinolysis through the

catheter, though a recent RCT showed that intrapleural urokinase does not alleviate dyspnea in symptomatic MPE patients who develop this problem (51). It has been long recognized that some percentage of MPE cases managed with an IPC will undergo eventual catheter removal when fluid formation ceases due to so-called “spontaneous pleurodesis”, presumed to occur as a result of pleural irritation by the catheter itself (52). Estimates from observational data and RCTs not designed to study this outcome specifically place the rate of spontaneous pleurodesis at roughly 50% (36,47,49,53). Information from dedicated randomized trials reveals variability depending on time of assessment and drainage protocol. One RCT reported a spontaneous pleurodesis rate of 23% at 35 days and 27% at 70 days (54). An RCT studying drainage frequency as the primary variable showed a significantly higher spontaneous pleurodesis rate at 3 months in those who drained daily (47%) compared to those who drained on alternate days (24%) (55). From available data, it is possible to conclude that an approximately 50% spontaneous pleurodesis rate can be achieved with an IPC placed for MPE, but that number is reached after about 3 months of daily drainage. Importantly, the benefit of daily drainage appears to be limited to increasing the likelihood of spontaneous pleurodesis because a symptom-based regimen has been shown to be equally effective in controlling dyspnea (56).

Selection of management strategy

Certain circumstances can *a priori* favor the choice of either pleurodesis or IPC for the management of MPE in a given patient. For example, the presence of a pleural drain at time of decision-making could favor bedside pleurodesis. If metastatic pleural malignancy is established during thoracoscopy, talc could be insufflated for pleurodesis during the same procedure. Contact between visceral and parietal pleural surfaces is a necessary condition for successful pleurodesis. Therefore, after initial drainage of an MPE, the ability of the underlying lung to re-expand is assessed. Failure of lung re-expansion signifies either entrapment due to malignant pleural restriction or the presence of an endobronchial lesion preventing aeration. When such a situation is encountered, IPC becomes the default option if pleural fluid is contributing to symptoms (42). On the other hand, the absence of adequate family or professional support to assist with the drainage procedure in the patient’s residence is a practical argument against

the placement of an IPC. Notwithstanding these special considerations, most MPE patients are eligible for both interventions (57). Thoracoscopic pleurodesis, especially via VATS, can be prohibitively invasive for the frail, debilitated MPE patient, which is a common phenotype.

The first direct prospective comparison between IPC and pleurodesis for MPE was a trial of inpatients predominantly with lung cancer using doxycycline administration via tube thoracostomy (48). The most striking finding of this early study was the significant reduction in median hospital days in the IPC arm (1.0) *vs.* the pleurodesis arm (6.5). Of the patients with an initial successful doxycycline pleurodesis, 79% maintained durable fluid control throughout follow up, and in the IPC group 89% did not require subsequent medical attention for drainage problems. The MIST2 trial, a UK-based RCT, randomized hospitalized participants with MPE to IPC or talc slurry pleurodesis and assessed the patient-centered outcome of dyspnea at 7 weeks as its primary endpoint (49). Both interventions significantly improved dyspnea by that time point with no difference observed between them. At 6 months, however, the IPC group experienced less dyspnea than the pleurodesis group with a difference that was both statistically and clinically significant but one that did not translate into an accompanying difference in quality of life. Complications were overall more common in the IPC arm, but only minor complications were significantly increased. As with doxycycline, talc slurry pleurodesis resulted in a significantly shorter index hospitalization: median 0 *vs.* 4 days. A subsequent Australasian trial also confirmed this finding and further determined that IPCs reduce by 2 days an MPE patient's total inpatient stay in the remainder of life as compared to talc slurry pleurodesis (58). Meta-analysis data bear out another advantage of IPC over talc pleurodesis: reduced requirement for repeat pleural procedures (59). A cost-effectiveness comparison between talc pleurodesis and IPC most strongly favors the latter if professional drainage assistance is not required and the patient survival is shorter than 14 weeks, resulting in cost containment *vis-à-vis* nursing care and catheter supplies, respectively (60).

An intriguing answer to the pleurodesis *vs.* IPC dilemma is the option of combining these modalities. Its feasibility was first proposed in a pilot study wherein patients with established MPE underwent, in the same procedure, thoracoscopic talc poudrage followed by IPC placement for the possibility of pleurodesis failure, which then allowed rapid hospital discharge within a median of

1.8 days (61). Over 90% of the patients achieved successful pleurodesis and so underwent IPC removal after a median of 7 days. This strategy requires a more invasive procedure than bedside pleurodesis, and its cost-effectiveness has been questioned (62). Transferring the concept of IPC as insurance against pleurodesis failure to the bedside takes advantage of the ability of the IPC to serve as a conduit for instillation of sclerosing agents and assumes that MPE patients place high value on becoming catheter-free. The hope would be that chemical pleurodesis through the IPC could increase the intrinsic spontaneous pleurodesis rate of the IPC itself and shorten the time to its development. Initial fluid control with the IPC could also allow rapid transition to the outpatient setting while awaiting chemical pleurodesis. Concerns with the administration of talc slurry in this fashion would be occlusion of a long-term catheter and the combination of two factors (IPC and talc) known to promote fluid multiloculation. The results of such an approach were reported in a series of 24 MPE patients, majority with lung cancer, who received talc slurry via a recently inserted IPC—all but two underwent outpatient pleurodesis (63). Pleurodesis was successful in 22 of the 24 cases (92%) and all 22 had their IPC removed 14 days after receiving talc. No instances of catheter blockage or fluid multiloculation were encountered. Subsequently, this combined strategy was subjected to a multi-center trial in the UK that randomized 154 IPC recipients with MPE to outpatient talc pleurodesis or placebo if after 10 days they achieved adequate pleural apposition (54). The majority of participants had lung cancer. The primary outcome measure, successful pleurodesis by day 35, was achieved by a significantly greater percentage of patients who received talc compared to those who did not: 43% *vs.* 23%. The difference in favor of talc remained significant at 70 days (51% *vs.* 27%), which was a secondary endpoint. There was no significant difference in the rate of adverse events, including drainage problems due to catheter occlusion or fluid multiloculation.

In summary, the unresolved question of superiority between pleurodesis and IPC for MPE management may eventually be answered by combining the two modalities rather than by elevating one over the other. If no compelling indications or contraindications for either intervention pertain and the combined strategy is not an option, the choice becomes a product of patient preference and clinical pragmatism. Recent expert guidelines advocate the same approach, which is incorporated into a proposed MPE management algorithm (*Figure 2*) (42).

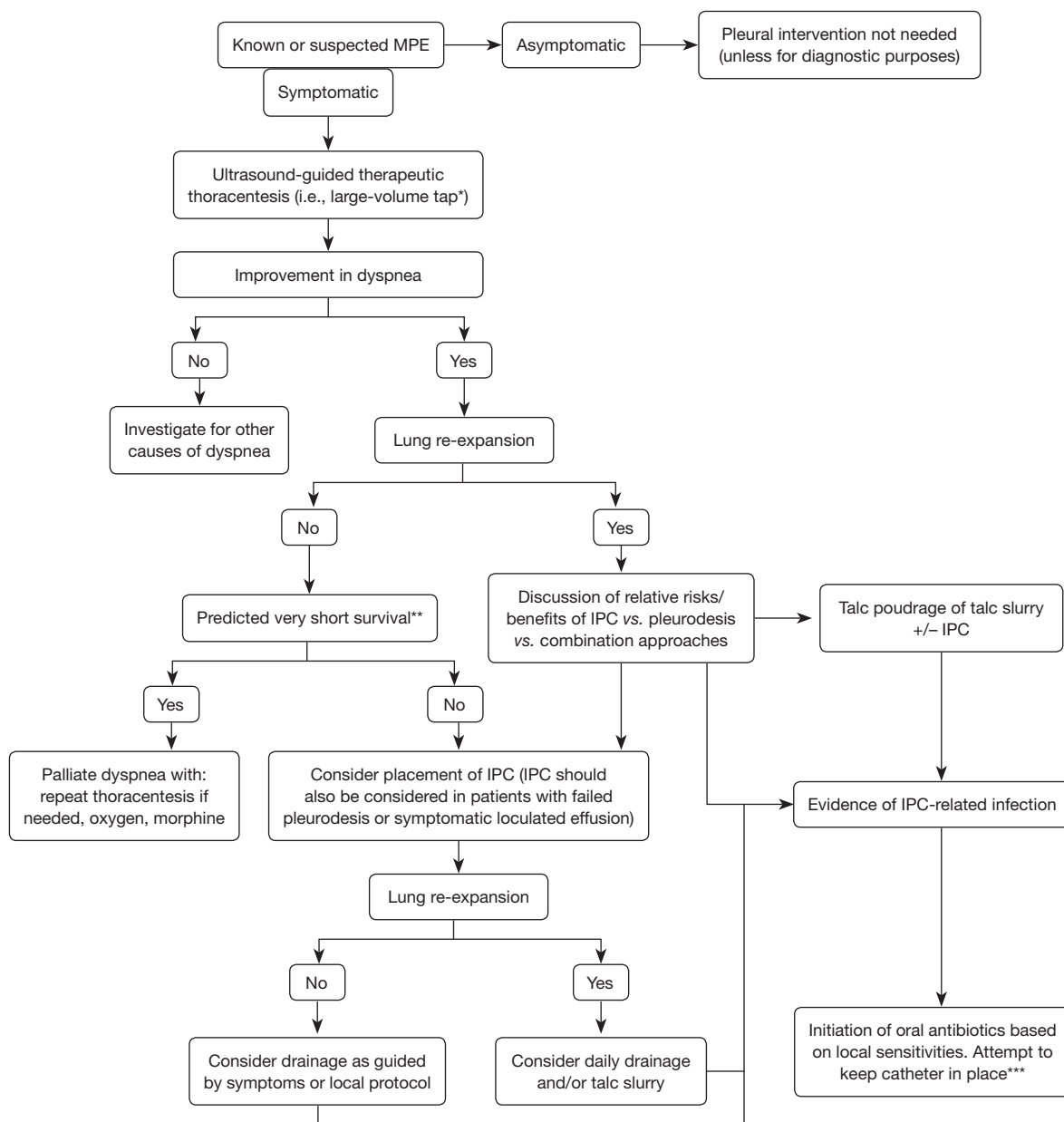


Figure 2 Management of patients with known or suspected MPE. *, with goals of assessing lung expansion and relief of dyspnea. This step may not be necessary if the patient's dyspnea is known to be attributable to the MPE; **, the recommendation of "Predicted very short survival" should be used as a rough guideline and individualized on a case-by-case basis; ***, there is a low likelihood of IPC—related infection. Escalation of care (intravenous antibiotics, hospital admission, removal of catheter) should be made on a case-by-case basis and is recommended if there are any signs/symptoms of worsening infection. Adapted from Ref. 42. Reprinted with permission of the American Thoracic Society. Copyright © 2018 American Thoracic Society. MPE, malignant pleural effusion; IPC, indwelling pleural catheter

Prognosis and outcomes

Regardless of its size, the presence of MPE in lung cancer is an independent adverse prognostic indicator (4).

According to the large multinational database used to derive the 8th edition of the TNM staging system for lung cancer, the median survival of lung cancer patients with pleural and/or pericardial effusion is approximately

11 months (31). Individual center experience suggests that specific institutions are observing far worse survival closer to 5 months (4). Combined data from MPE cohorts in the UK, Australia, and the Netherlands paints an even bleaker picture for lung cancer: median survival of less than 11 weeks (2). Complicating MPE management decisions based on anticipated survival is the great patient to patient heterogeneity, especially in the modern era of targeted oncological therapy. To help address this problem, the so-called “LENT” score has been derived and validated with higher scores corresponding to shorter survival (2). A particular MPE patient’s LENT score increases with higher pleural fluid lactate dehydrogenase level (L), worse Eastern Oncology Cooperative Group performance status (E), higher pleural fluid neutrophil to lymphocyte ratio (N), and higher risk primary tumors (T). It is worth noting that among the commonest cell types encountered in metastatic pleural malignancy (i.e., lung, breast, gynecological, and hematological), only lung cancer belongs to the highest risk primary tumor category for LENT calculation, automatically resulting in at least a moderately elevated score. Those with moderate scores survived a median of about 4 months, whereas those with high scores had a median survival of just 44 days.

Conclusions

Despite overall progress in the survival of stage IV lung cancer patients in recent times, the occurrence of an MPE as a complication of lung cancer still portends a very poor prognosis in most cases. Confirmation of the malignant nature of a pleural effusion in a lung cancer patient should be pursued if it will have an impact on prognosis or management. The initial thoracentesis is an ideal opportunity to both establish the diagnosis of MPE and assess the contribution of fluid to respiratory symptoms if any are present. The diagnostic potential of thoracentesis is limited by suboptimal sensitivity of pleural fluid cytology, especially in certain lung cancer sub-types, so occasionally more invasive sampling is required, and the next procedure of choice depends on patient factors and availability. The primary objective of the management of MPE due to lung cancer, as with any MPE, is alleviation of discomfort caused by the effusion. Typically, lasting palliation is intricately connected to durable fluid control. Currently available means of achieving fluid control are pleurodesis and IPC placement. The former, if successful, results in fewer downstream complications but prolongs the inpatient days.

About one-third to one-half of MPE patients who are managed with an IPC eventually develops a spontaneous pleurodesis, which allows catheter removal. Talc administration through a previously placed IPC has been shown to increase the likelihood of this desirable outcome, thereby lending credence to a bimodality approach. Other means of promoting this phenomenon, such as coating the IPC with a pleural sclerosant, are in the investigative phase. Anticipated patient survival time is often a factor in MPE management decisions. Prediction of this in individual lung cancer MPE patients is difficult but can be facilitated by calculating the LENT prognostic score.

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None

Footnote

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