ERS International Congress 2023: highlights from the Thoracic Oncology Assembly

Maria Joana Catarata[1,2], Andrew W. Creamer[3], Margarida Dias[4], Sile Toland[5], Malek Chaabouni[6], Koen Verbeke[7], Joana Vieira Naia[1], Maged Hassan[8], Sindhu Bhaarrati Naidu[9], Geraldine A. Lynch[10], Kevin G. Blyth[11,12], Najib M. Rahman[13] and Georgia Hardavella[14]

[1]Pulmonology Department, Hospital de Braga, Braga, Portugal. [2]Tumour and Microenvironment Interactions Group, I3S – Institute for Health Research and Innovation, University of Porto, Porto, Portugal. [3]Great Western Hospitals NHS Foundation Trust, Swindon, UK. [4]Pulmonology Department, Centro Hospitalar Vila Nova de Gaia/Espinho, Vila Nova de Gaia, Portugal. [5]Department of Medicine, Letterkenny University Hospital, Letterkenny, Ireland. [6]Asklepios Klinik Altona, Department of Internal Medicine II, Pulmonology and Thoracic Oncology Section, Hamburg, Germany. [7]Department of Respiratory Medicine, University Hospital Saint-Pierre, Université Libre de Bruxelles, Brussels, Belgium. [8]Chest Diseases Department, Alexandria University Faculty of Medicine, Alexandria, Egypt. [9]Department of Respiratory Medicine, University College London, London, UK. [10]Academic Respiratory Unit, University of Bristol Medical School, Bristol, UK. [11]Queen Elizabeth University Hospital, Glasgow, UK. [12]Institute of Infection, Immunity and Inflammation, University of Glasgow, Glasgow, UK. [13]Oxford University Hospitals NHS Foundation Trust, Oxford NIHR Biomedical Research Centre, John Radcliffe Hospital, Headington, UK. [14]9th Department of Respiratory Medicine, Sotiria Athens Chest Diseases Hospital, Athens, Greece.

Corresponding author: Maria Joana Catarata (mjcatarata@gmail.com)

Shareable abstract (@ERSpublications)
Lung cancer screening, management of early stages of lung cancer, application of artificial intelligence and new biomarkers were discussed during #ERSCongress 2023 https://bit.ly/3MFLxaP

Cite this article as: Catarata MJ, Creamer AW, Dias M, *et al*. ERS International Congress 2023: highlights from the Thoracic Oncology Assembly. *ERJ Open Res* 2024; 10: 00860-2023 [DOI: 10.1183/23120541.00860-2023].

Received: 5 Nov 2023
Accepted: 7 Nov 2023

Abstract

Lung cancer is the leading cause of cancer mortality in the world. It greatly affects the patients' quality of life, and is thus a challenge for the daily practice in respiratory medicine. Advances in the genetic knowledge of thoracic tumours' mutational landscape, and the development of targeted therapies and immune checkpoint inhibitors, have led to a paradigm shift in the treatment of lung cancer and pleural mesothelioma. During the 2023 European Respiratory Society Congress in Milan, Italy, experts from all over the world presented their high-quality research and reviewed best clinical practices. Lung cancer screening, management of early stages of lung cancer, application of artificial intelligence and biomarkers were discussed and they will be summarised here.

Introduction

In recent times, there has been a significant evolution in the approach to patients with thoracic tumours. New scientific advances improved the quality of life of these patients and overall survival. The implementation of lung cancer screening has revolutionised the diagnosis of this disease, with a significant reduction in mortality. New challenges have arisen, particularly with regards to incidental findings and their management. Artificial intelligence has started playing an increasing role in this field. Clinical trials have led to the approval of immunotherapy combined with chemotherapy in the neoadjuvant phase, as well as targeted therapy in the adjuvant phase for epidermal growth factor receptor (EGFR) mutation and anaplastic lymphoma kinase rearrangement, constituting a significant improvement in resectable non-small cell lung cancer (NSCLC). Furthermore, new biomarkers could be useful tools for predicting outcomes and treatment response in thoracic oncology. Regarding pleural malignancies, several promising clinical trials are underway that could change the prognosis of these patients. In this article, we will provide an overview of the thoracic oncology highlights presented at the European Respiratory Society (ERS) International Congress 2023.

New challenges and opportunities in lung cancer screening

Implementing lung cancer screening in the real world

Previous clinical trials have demonstrated that lung cancer screening using low-dose computed tomography (LDCT) scans reduces both lung cancer mortality and overall mortality [1, 2]. Despite these results, lung cancer screening has not yet been widely implemented in Europe. In fact, its applicability in clinical practice remains a challenge. In 2022, the European Commission proposed that lung cancer should be included in the European Union cancer screening recommendations [3]. There are some pilot studies on the implementation of lung cancer screening in Europe. At the 2023 ERS Congress, the final results of a French pilot study on lung cancer screening (DEP'K80) were presented [4]. The aim was to assess the feasibility and effectiveness of a lung cancer screening pilot programme with LDCT scans in a French department. Patients were prospectively recruited by general practitioners or pulmonologists from 2016 to 2020, using the same inclusion criteria as the National Lung Screening Trial (NLST), and three rounds of annual LDCT scans were planned. Out of 1369 participants, 75.1% underwent the first LDCT, 28.4% completed the second round and 28.4% completed the third round. The cumulative incidence of lung cancer was 2.5% and the false positive rate 2.74%. Most patients with lung cancer were in stage I–II (72.1%) and 81.4% were treated with surgery. This study demonstrated the feasibility of lung cancer screening in a real-life context and confirmed its efficacy but also raised awareness of the importance of participation in all rounds.

European lung cancer screening studies have set the ground for lung cancer screening implementation across Europe; however, significant challenges exist in real-life clinical settings. The ERS has addressed this as a key stakeholder in lung cancer screening and has recently launched SOLACE (Strengthening the screening of Lung Cancer in Europe) in collaboration with other stakeholders including patient organisations [5]. SOLACE is a pioneering new EU4Health project that was launched under the Europe's Beating Cancer Plan. A consortium of experts appointed by the European Society of Radiology and the ERS will work closely and will have continuous input from the European Lung Foundation and Lung Cancer Europe to ensure patient perspective is incorporated and considered throughout. The SOLACE project was presented during the 2023 ERS Congress and it aims to facilitate implementation of lung cancer screening programmes across Europe with particular focus in breaking down the barriers to screening. It will ensure that all people from various social and economic backgrounds have equal access to lung cancer screening. In particular, it will focus on difficult to reach groups that are at higher risk for lung cancer due to health inequalities and unequal access to healthcare services and/or insurance cover.

Incidental findings are unexpected anomalies detected in LDCT, often unrelated to lung cancer but carrying significant clinical implications. Currently, radiologists lack a consensus on how to define, report, and manage these incidental findings. The American College of Radiology (ACR) quick reference guide for lung cancer screening computed tomography (CT) incidental findings is available [6], but the need for international standardisation remains. This standardisation is crucial for determining clinical relevance and healthcare costs. Studies like the Dutch–Belgian Lung Cancer Screening (NELSON) trial found that only 7% of incidental findings were clinically relevant, with just 1% having clinical implications [7]. The HANSE study shows a higher percentage of clinically significant incidental findings [8], emphasising the need for further research on clinical implications.

Interestingly, the data revealed that non-malignant conditions like cardiovascular and non-malignant lung diseases played a significant role in all-cause mortality in the lung cancer screening population, as demonstrated in the NELSON study [7].

Artificial intelligence plays a potential role in lung cancer screening programmes. Automated detection and segmentation of NSCLC in CT images show promise in reducing the clinician's burden and improving accuracy. Trustworthiness and multidisciplinary collaboration will be essential in implementing artificial intelligence effectively.

The discussion underlines the importance of transparent and empathetic communication with patients about incidental findings. It is crucial to inform patients about potential findings and guide them through the next steps. Primary care physicians play a significant role in this process, as they have a deep understanding of their patients' medical history and can relay results and recommendations effectively.

Detecting emphysema and interstitial lung abnormalities during screening programmes is clinically relevant [9, 10]. Both conditions are valuable radiographic biomarkers for lung cancer risk. Screening programmes for patients with COPD allow for the diagnosis of other comorbidities [9–15]. Managing incidental findings effectively not only enhances the overall safety and effectiveness of these programmes but also

contributes to a more comprehensive approach to healthcare, extending beyond lung cancer to include the early diagnosis of other health conditions [9–15].

Another ongoing challenge in lung cancer screening is indeterminate pulmonary nodules, and differentiating those which represent early malignancy from benign causes. Such indeterminate nodules are found in up to a quarter of baseline LDCTs [16], and while evidence from the NELSON study has demonstrated radiological surveillance with volumetric assessment of growth to be an effective approach [7], false positive, false negative and delays to definitive diagnosis remain an issue. A study presented by John McCabe (London, UK) evaluated the accuracy of exponential function in modelling the observed growth of early-stage lung cancer presenting as solid (volume) and subsolid (mass) nodules, particularly solid (volume) and subsolid (mass) nodules, by analysing the nodules of patients in the SUMMIT lung cancer screening study [17]. This study concluded that volume growth of early-stage lung cancer presenting as solid nodules is well described by an exponential growth function. However, the mass growth of early-stage lung cancer presenting as subsolid nodules is less accurately modelled by an exponential growth function. These results support current guidelines that recommend longer-term surveillance for subsolid nodules due to their less predictable future growth. Furthermore, novel biomarkers and techniques could improve the diagnosis of indeterminate nodules.

Genomic analysis of bronchial and nasal epithelium and fluid-specific microRNA-based signatures

Ideally, subsequent investigations for indeterminate pulmonary nodules should provide a definitive answer while minimising invasive investigations. One such approach involves genomic analysis of bronchial epithelial cells, looking for cancer-associated gene expression profiles. In the AEGIS-1 and AEGIS-2 trials [18], participants with suspected lung cancer who were undergoing bronchoscopy underwent collection of epithelial cells from the (normal-appearing) mainstem bronchus for genomic analysis. In patients with an indeterminate pre-test probability of cancer but a nondiagnostic bronchoscopy, the genomic classifier achieved a 91% negative predictive value (NPV) (95% confidence interval (CI) 75–98) and a 40% positive predictive value (PPV) (95% CI 27–55). While these results offer insight into the potential additional utility of genomic analysis of (macroscopically normal) airway epithelium in suspected cancer, this approach still required bronchoscopy. Further analysis of samples collected in this trial found that gene expression alterations were shared between nasal and bronchial epithelium [19], opening the possibility for minimally invasive samples collected *via* nasal swabs to guide management decisions. This has led to the development of the Percepta Nasal swab (Veracyte, USA); a trial to demonstrate the clinical utility of this test in the management of patients with lung nodules is currently recruiting [20].

Another potential useful biomarker is the microRNA pattern of liquid biopsies. A study presented by Giovanna Maria Stanfoca Casagrande (Barretos, Brazil) showed that there are fluid-specific microRNA signatures in plasma and sputum that can potentially be employed in lung cancer screening programmes to guide the selection of high-risk subjects for early detection of lung cancer, which may reduce the healthcare system costs associated with lung cancer screening [21].

Exhaled breath condensate

An alternative minimally invasive approach for indeterminate pulmonary nodules is analysing patterns of volatile organic compounds (VOCs) in exhaled breath condensate. Exhaled breath contains a complex mixture of thousands of VOCs, and changes in the patterns of these may reflect pathological processes, allowing diagnoses to made *via* a non-invasive approach [22]. A multi-centre study using the aeoNose device (the eNose company) aimed to develop and validate a risk-prediction model to identify patients with NSCLC based on exhaled breath patterns [23]. A model combining clinical and exhaled breath parameters achieved a sensitivity of 95%, specificity of 49%, NPV 94% and area under the receiver operating curve (AUROC) of 0.86 in the validation cohort. A further study used the BreathCloud cohort (a muti-centre observational study using eNose analysis in patients with chronic respiratory disease [24] to explore whether this approach could detect early lung cancer in patients with COPD [25]. Lung cancer was developed within 2 years after inclusion in 37 of 682 patients with COPD in the study. Significant differences in VOC patterns at baseline test were identified between those patients with COPD who did and did not go on to subsequently develop lung cancer ($p<0.01$, AUROC 0.9). Another study, presented by Kathleen Zwijsen (Wilrijk, Belgium), showed that the analysis of VOCs from exhaled breath sampling using multi-capillary ion-mobility spectrometry (MCC-IMS) may be useful in distinguishing between benign and malignant pulmonary nodules. However, none of the selected VOCs showed a significant correlation with nodule size [26].

While these results are exciting, it remains to be seen how this technology may complement current screening programmes. As a cheap, feasible, point-of-care test, eNose may have a role in lung cancer

detection in less economically advanced settings with limited access to CT scans. Within Europe and the USA, exhaled breath analysis could have a role in risk-stratification prior to LDCT screening, used in combination with CT, or to predict malignancy risk in CT-detected indeterminate nodules.

Novel bronchoscopic techniques for small pulmonary nodules

Despite the increasing evidence for minimally or non-invasive approaches for identifying malignancy in pulmonary nodules, histopathological confirmation remains the only way cancer can be definitively diagnosed or excluded. Pre-resection diagnosis can reduce false positive surgical resection rates and can be obtained *via* conventional bronchoscopy for proximal endobronchial lesions or percutaneous image-guided biopsy for peripheral nodules. However, the associated risk of pneumothorax (15–40% [27]) with percutaneous biopsy, of particular concern in patients with emphysema, may preclude this approach. Electromagnetic navigation bronchoscopy (ENB) is a minimally invasive technology that uses electromagnetic guidance to accurately direct a bronchoscope to pulmonary lesions. Further imaging techniques including radial probe endobronchial ultrasound, fluoroscopy or cone-beam CT ensure the biopsies are accurately obtained.

Although many retrospective single-centre studies of experience with ENB have been published, multi-centre studies with long-term follow-up of diagnostic accuracy and safety were lacking. NAVIGATE is a prospective, multi-centre cohort study examining the diagnostic yield and safety of ENB in pulmonary nodules [28]. In NAVIGATE, ENB achieved sensitivity of 69%, specificity 100%, PPV 100% and NPV 56%. Pneumothoraxes requiring either admission or chest tube placement occurred in 2.9%. Diagnostic yield was higher in lesions of 20 mm or greater (77.6% *versus* 67.3%) and those in upper lobe location (76.5% *versus* 67.9%). Adequate tissue for molecular testing was obtained in 86.2% of the 87 lung lesions where testing was attempted. As experience and availability of ENB expands in Europe, this approach is likely to lead to further benefits for patients with indeterminate pulmonary nodules detected at lung cancer screening.

The ongoing challenge of ground-glass opacities in the lung

Ground-glass opacities (GGOs) or sub-solid nodules (SSNs) represent a frequent radiological finding, usually detected incidentally or during screening programmes or during chest CT scans offered to investigate other unrelated conditions. They may be neoplastic or not. There is currently no consensus between different guidelines regarding management and follow-up [29–31]. GGOs include ground-glass nodules or non-solid nodules, which are pure ground-glass lesions with a consolidation tumour ratio (CTR) of zero, and part-solid nodules (PSNs), in which we find a solid component (CTR>0) [32]. Histologically, the majority of lepidic pattern corresponds to lepidic predominant nonmucinous adenocarcinoma followed by minimal invasive adenocarcinoma (MIA) and adenocarcinoma *in situ*. The survival by MIA and adenocarcinoma *in situ* reaches 100%, which suggests that a conservative approach may be more suitable as long as no growing solid component is detected [33].

In screening programmes, the frequency of SSN varies between 10 and 20% mainly depending on the duration of the follow-up. In the NLST trial, the frequency of SSN was 9.4% [34], in the NELSON study it was 3.3% at baseline and 0.7% new SSN were detected at follow-up [35, 36], in the I-ELCAP study 4.2% NSN and 5.0% PSN at baseline with 0.7% NSN and 0.8% PSN at follow-up [37, 38], while the BioMILD trial [39] showed a frequency of 18.4%.

The follow-up of GGOs showed the majority of them remain stable or regress. At 3 months, 37.6% of pure GGOs and 48.7% of mixed GGOs disappear [40]. Only 5.4% of pure GGOs develop a solid component during a 4-year follow-up [41]. The Multicentric Italian Lung Detection (MILD) trial showed a 2% progression of SSNs (including those <5 mm) to lung cancer, 89% of them were stage I and no deaths were recorded [42]. The BioMILD trial showed that in 4.4% of SSNs were diagnosed as lung cancer, 98% of them were in stage I and one case of stage III [39]. Moreover, this trial also demonstrated that the incidence of SSNs was higher during the first 5 years but continued also up to 10 years [39]. Knowing that GGOs are the most frequent non-fibrotic CT abnormality observed in COVID-19 [43], the priority during the pandemic was not to differentiate if they were related to lung cancer. Actually, GGOs are described in 80% of the patients during the acute phase [44], and persist later among other radiological abnormalities [45, 46]. Control CTs after a COVID-19 infection show GGOs in 49% at 3 months [47], a decrease of the prevalence at 5 to 7 months [47–50], reaching 24% at 1 year [49, 51, 52] and 11% at 18 months [48, 51–54]. It is unclear how long the radiological clearance takes [55].

The available research studied patients with a severe disease or persistent symptoms and many of the studies in the meta-analyses were retracted. Therefore, more consistent research is needed to produce

consensual follow-up guidelines and the role of multidisciplinary teams (MDTs) is here crucial. It is suggested to perform a CT scan at 3 months after discharge for severe cases and at a longer interval to control radiological clearance or in patients with new or progressive respiratory manifestations [55–57]. Furthermore, the development of a predictive artificial intelligence module would be a helpful tool in the decision-making process [58].

Evolving concepts in lung cancer management: unravelling controversies, new biomarkers and treatment options

Current controversies in management of stage I NSCLC

Stage I NSCLC diagnosis is anticipated to increase over the next few years after a wider implementation of lung cancer screening [1, 2]. Although its management appears to be uncomplicated, current guidelines are controversial in some aspects of treatment [59–64] and this was discussed at the 2023 ERS Congress. According to the 8th Tumour, Node, Metastasis (TNM) classification of NSCLC [63], stage I NSCLC is defined as any lesion ranging from minimal invasion (Tmi) up to 4 cm (T2a) without any accompanying lymph node invasion (N0) or metastatic spread (M0). Despite the golden standard being anatomical resection (preferred over wedge resection) with a preference for video-assisted thoracic surgery (VATS), there are controversies in the management of T2aN0M0 disease. European Society of Medical Oncology (ESMO) guidelines suggest adjuvant chemotherapy for surgically resected stage I tumours in the upper limit of T2a (*i.e.* measuring 4 cm) with R0 resection (*i.e.* clear surgical margins) while National Institute for Health and Care Excellence (NICE) guidelines suggest no adjuvant chemotherapy for these and National Comprehensive Cancer Network (NCCN) suggests adjuvant for those R0 resected that are deemed high-risk (*i.e.* poor differentiation, visceral pleura, *etc*.) [59, 63, 64]. The above allude to the fact that patients receive different care depending on where they are diagnosed and treated. Discrepancies appear also in the management of surgically resected stage I tumours with R1 resection, where ESMO recommends postoperative radiotherapy and adjuvant chemotherapy, whereas NCCN recommends re-resection or radiotherapy for T1a-c and for T2a re-resection with or without chemotherapy or radiotherapy [59, 64].

New concepts in the management of resectable lung cancer and oligometastatic disease

In the perioperative stage of lung cancer treatment, research in the last couple of years has changed the treatment approach that had been relatively unchanged for a long period of time. In general, advancements made in stage IV lung cancer and in precision medicine for metastatic lung cancer have trickled down to the earlier stages, more precisely in the perioperative stage of lung cancer treatment. A number of studies have been conducted with regards to neo-adjuvant and adjuvant immunotherapy (supplementary to the more standard chemotherapy) and have found an improvement in progression-free survival and a survival benefit (table 1). Similar to targeted therapies for EGFR-mutated lung cancer in the perioperative phase, the expectation is that new guidelines will evolve in the future to incorporate a combination of chemotherapy and immunotherapy in the treatment of resectable lung cancer. Questions remain with regards to which patients will benefit the most, especially since PD-L1 status and pathological response seem to be related to outcome. Furthermore, compelling evidence have demonstrated the role of circulating tumour DNA as a potential biomarker to predict neoadjuvant immunotherapy efficacy and to predict recurrence-free survival in resectable disease [72–74]. Another ongoing challenge is the precise identification of NSCLC patients that could benefit from adjuvant chemotherapy. RNA-based expression of 12 genes from 139 surgically resected patients was retrospectively evaluated. Overall and event-free

TABLE 1 Studies of neo-adjuvant and adjuvant immunotherapy

Name of study	Year of publication	Lung cancer stage	Neoadjuvant or adjuvant	Treatment used[#]	Main outcome
Immunotherapy					
IMpower010 [66]	2021	IB-IIIA	Adjuvant	Atezolizumab	DFS improvement
PEARLS/KEYNOTE-091 [67]	2022	IB-IIIA	Adjuvant	Pembrolizumab	DFS improvement
CheckMate 816 [68]	2022	IB-IIIA	Neoadjuvant	Nivolumab	EFS improvement, higher PCR
KEYNOTE-671 [69]	2023	II-IIIB(N2)	Neoadjuvant plus adjuvant	Pembrolizumab	EFS improvement, higher PCR
Targeted treatment					
ADAURA [70]	2020	IB-IIIA	Adjuvant	Osimertinib	DFS improvement
ALINA [71]	NA (pending)	IB-IIIA	Adjuvant	Alectinib	NA (results pending)

DFS: disease-free survival; EFS: event-free survival; PCR: pathological complete response; NA: not available. [#]: added to standard treatment.

survival were assessed, and patients were stratified as low-risk (adjuvant chemotherapy non-benefit) and high-risk (adjuvant chemotherapy benefit). The 12-gene expression panel successfully stratified low- and high-risk patients regardless of adjuvant chemotherapy, with a 0.8% failure rate, and may be a promising tool for clinical management of early-stages NSCLC patients [75]. Moreover, a validation study was also performed to unravel the value of a 5-gene signature to predict prognosis in early-stage NSCLC patients. RNA-based expression of *DUSP6*, *ERBB3*, *LCK*, *MMD* and *STAT1* genes were assessed from surgically resected patients. Subgroup stratification as low-risk and high-risk of recurrence was performed. High expression of *DUSP6* and *ERBB3* genes were associated with better overall survival (HR=0.64; p=0.001 and HR=0.68; p=0.003), being a promising tool to predict prognosis in early stages of NSCLC [76].

Regarding the treatment of oligometastatic lung cancer, new ASTRO/ESTRO guidelines were recently published [77] and were presented and discussed at the 2023 ERS Congress. Oligometastatic lung cancer is defined as metastatic disease limited in number and location for whom a radical treatment is technically feasible with acceptable toxicity. This recent guideline suggests that multimodal treatment should be considered in oligometastatic lung cancer patients with <5 distant metastases and that the decision lies with the MDT. Radiotherapy is favoured if feasible to avoid pauses in systemic treatment and, with regards to timing, systemic treatment should be given first for a duration of three months. In case of oligo-progression after curative local treatment, the decision to re-treat lies again with the MDT but should be considered if toxicity of treatment is acceptable.

Pleural mesothelioma and malignant pleural effusion: are we still there?

Biomarkers for diagnosis and predicting treatment response in mesothelioma

12% of individuals diagnosed with non-specific pleuritis (NSP) develop pleural mesothelioma (PM) within 2 years, but predicting development of PM remains a significant challenge [78]. Meso-Origins is a study that will address this by following up patients with asbestos-associated pleural inflammation [79]. Pleural fluid mesothelin may help; high levels (>20 $nmol \cdot L^{-1}$) were associated with eventual PM diagnosis in 185 patients with NSP (OR 31.2 (95%CI 8.5–114.7)) [80]. Biomarkers with diagnostic utility in PM remain to be identified [81]. A novel proteomic technique identified PM-specific tissue leakage proteins and shows promise for improving diagnosis, but requires external validation [82].

Serum mesothelin (SM) may be beneficial for disease monitoring [83, 84]. In the largest such study to date of 209 patients, serial SM changes predicted survival (adjusted HR 2.28 (95% CI 1.31–3.93)), progression (adjusted OR 1.51 (1.01–1.95)) and disease response (adjusted OR 1.40 (1.03–1.92)) regardless of age, treatment, histology and initial SM value [85]. Similarly, a study of 15 patients identified six VOCs in exhaled breath which differentiated between stable and progressive disease [86]. Replication and validation in larger populations is needed.

Surgery for early resectable mesothelioma

In some centres, PM is deemed technically resectable at stage T1–3, N0-1, M0, although criteria for this vary. However, surgical treatment remains contentious at this stage, as achieving an R0 resection is widely acknowledged to be impossible [87, 88]. The Mesothelioma and Radical Surgery (MARS) trial reported extra-pleural pneumonectomy was associated with higher morbidity, showing it may not offer any benefit [88]. MARS2 recently reported that adding extended pleurectomy decortication to chemotherapy increased the risk of death and serious adverse events [89]. Other surgical options such as VATS pleurectomy confer no improvement in survival, prolong hospital stay and show reduced quality of life at 12 months compared to talc pleurodesis [90].

However, “early” PM may be defined as disease localised to the pleura (T1N0M0). Stage I is a reasonable surrogate of this but also includes T2 and T3 tumours. If staged accurately, the prevalence of stage I PM is reported as high as 54% [91]. There is little robust data on appropriate treatment in this group, including the use of surgery, as almost all studies have predominantly included participants with later stage disease.

Diagnosis of “early” PM requires careful differentiation from “mesothelioma *in situ*” (MIS), a pre-invasive lesion that may evolve into invasive PM in some patients [92]. Diagnosis of MIS requires a combination of pathological, radiological and clinical input. It is usually diagnosed in patients with non-resolving pleural effusion, with a single layer of non-invasive bland mesothelial cells growing along the pleural surface, without thoracoscopic or radiological evidence of tumour and with either BAP1 loss and/or CDKN2A/p16 homozygous deletion. A small case series suggests median progression to PM after 60 months (range 12–92) [93] but evidence is limited.

Malignant pleural effusion

Pleural effusion affects 15% of all cancer patients and 90% of PM [94]. Indwelling pleural catheters (IPCs) are beneficial for ambulatory management. Time to IPC insertion varies, with median duration 70 days in one study [95]. 70% of patients interviewed would consider IPC insertion over pleural aspiration as a first procedure, emphasising the importance of patient choice in managing malignant pleural effusions [95, 96]. Individuals with IPCs may develop drainage-related pain [97], which may be related to non-expandable lung. A novel system delivering lower fluid drainage pressure was trialled in 15 patients and demonstrated possible reduced pain, but conclusions were limited by study size [98].

If pleurodesis is prioritised, talc pleurodesis *via* intercostal chest drain is more effective than talc instillation *via* IPC [96, 99], although protocols vary. One study of 108 patients suggested waiting for drainage <150 mL/24 h was unnecessary, with early intercostal chest drain removal (12 h following talc) having similar pleurodesis rates [100]. While talc is recommended for pleurodesis [101], a pilot study of patients undergoing VATS found high pressure intra-pleural chemotherapy had similar pleurodesis rates to talc poudrage and may be explored for oncological benefit [102].

Moreover, MDT working is of the utmost importance [103]. Following implementation of the Scottish Mesothelioma Network in 2019, there was an improvement in survival for non-epithelioid PM, not fully explainable by immunotherapy introduction [104]. With rapidly changing definitions, treatments and new clinical trials [105, 106], MDT input for optimising mesothelioma care is more important than ever.

Concluding remarks

New challenges in lung cancer screening were highlighted in the 2023 ERS Congress. Revolutionary approaches to early-stage NSCLC were also discussed. The discovery of new biomarkers will provide better decisions and move closer to an even more personalised medicine. Pleural disease remains a constant challenge; however, new clinical trials give us hope for better survival and quality of life in these patients. ERS Congress will continue to contribute to the dissemination of high-quality research and to the best clinical practices.

Provenance: Commissioned article, peer reviewed.

Conflict of interest: The authors have nothing to disclose.

References

1 Kramer BS, Berg CD, Aberle DR, *et al.* Lung cancer screening with low-dose helical CT: results from the National Lung Screening Trial (NLST). *J Med Screen* 2011; 18: 109–111.
2 de Koning HJ, van der Aalst CM, de Jong PA, *et al.* Reduced lung-cancer mortality with volume CT screening in a randomized trial. *N Engl J Med* 2020; 382: 503–513.
3 European Commission. European Health Union: Commission welcomes adoption of new EU cancer screening recommendations. Date last updated: 9 December 2022. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7548
4 Leleu O, Storme N, Basille D, *et al.* Lung cancer screening by low-dose CT scan in France: final results of the DEP'K80 study after three rounds. *Eur Respir J* 2023; 62: Suppl. 67, OA3264.
5 Blum TG. The pioneering Strengthening the screening of Lung Cancer in Europe (SOLACE) project has now been launched. www.ersnet.org/news-and-features/news/solace-project-launch/
6 American College of Radiology. ACR® Lung Cancer Screening CT Incidental Findings Quick Reference Guide. 2022. www.acr.org/-/media/ACR/Files/Lung-Cancer-Screening-Resources/LCS-Incidental-Findings-Quick-Guide.pdf
7 Horeweg N, van Rosmalen J, Heuvelmans MA, *et al.* Lung cancer probability in patients with CT-detected pulmonary nodules: a prespecified analysis of data from the NELSON trial of low-dose CT screening. *Lancet Oncol* 2014; 15: 1332–1341.
8 Vogel-Claussen J, Lasch F, Bollmann BA, *et al.* Design and rationale of the HANSE Study: a holistic German lung cancer screening trial using low-dose computed tomography. *Rofo* 2022; 194: 1333–1345.
9 Mulshine JL, Aldige CR, Ambrose LF, *et al.* Emphysema detection in the course of lung cancer screening: optimizing a rare opportunity to impact population health. *Ann Am Thorac Soc* 2023; 20: 499–503.
10 Balata H, Punjabi A, Chaudhuri N, *et al.* The detection, assessment and clinical evolution of interstitial lung abnormalities identified through lung cancer screening. *ERJ Open Res* 2023; 9: 00632-2022.
11 Pinsky PF, Lynch DA, Gierada DS. Incidental findings on low-dose CT scan lung cancer screenings and deaths from respiratory diseases. *Chest* 2022; 161: 1092–1100.
12 de Torres JP, Bastarrika G, Wisnivesky JP, *et al.* Assessing the relationship between lung cancer risk and emphysema detected on low-dose CT of the chest. *Chest* 2007; 132: 1932–1938.

13 Wilson DO, Weissfeld JL, Balkan A, *et al.* Association of radiographic emphysema and airflow obstruction with lung cancer. *Am J Respir Crit Care Med* 2008; 178: 738–744.
14 Axelsson GT, Putman RK, Aspelund T, *et al.* The associations of interstitial lung abnormalities with cancer diagnoses and mortality. *Eur Respir J* 2020; 56: 1902154.
15 Ezponda A, Casanova C, Divo M, *et al.* Chest CT-assessed comorbidities and all-cause mortality risk in COPD patients in the BODE cohort. *Respirology* 2022; 27: 286–293.
16 van Klaveren RJ, Oudkerk M, Prokop M, *et al.* Management of lung nodules detected by volume CT scanning. *N Engl J Med* 2009; 361: 2221–2229.
17 Creamer A, Horst C, Dickson J, *et al.* Growth patterns of screen-detected malignant pulmonary nodules: accuracy of doubling-time models. *Eur Respir J* 2023; 62: Suppl. 67, OA3266.
18 Silvestri GA, Vachani A, Whitney D, *et al.* A bronchial genomic classifier for the diagnostic evaluation of lung cancer. *N Engl J Med* 2015; 373: 243–251.
19 AEGIS Study Team. Shared gene expression alterations in nasal and bronchial epithelium for lung cancer detection. *J Natl Cancer Inst* 2017; 109: djw327.
20 Madhani-Lovely FK, Bulman W, Morrie E, *et al.* Demonstrating clinical utility for a nasal genomic classifier for lung nodules: addressing the clinical trial learning curve with a familiarization phase. *Am J Respir Crit Care Med* 2023; 207: A6531.
21 Casagrande G, Chiarantano R, Polo A, *et al.* Fluid-specific miRNA-based signatures for lung cancer screening. *Eur Respir J* 2023; 62: Suppl. 67, OA3267.
22 Wilson AD. Advances in electronic-nose technologies for the detection of volatile biomarker metabolites in the human breath. *Metabolites* 2015; 5: 140–163.
23 Kort S, Brusse-Keizer M, Schouwink H, *et al.* Diagnosing non-small cell lung cancer by exhaled breath profiling using an electronic nose: a multicenter validation study. *Chest* 2023; 163: 697–706.
24 de Vries R, Dagelet YWF, Spoor P, *et al.* Clinical and inflammatory phenotyping by breathomics in chronic airway diseases irrespective of the diagnostic label. *Eur Respir J* 2018; 51: 1701817.
25 de Vries R, Farzan N, Fabius T, *et al.* Prospective detection of early lung cancer in patients with COPD in regular care by electronic nose analysis of exhaled breath. *Chest* 2023; 164: 1315–1324.
26 Zwijsen K, Wener R, Janssens E, *et al.* Exhaled breath analysis optimizes nodule management in a lung cancer screening program. *Eur Respir J* 2023; 62: Suppl. 67, OA3265.
27 DiBardino DM, Yarmus LB, Semaan RW. Transthoracic needle biopsy of the lung. *J Thorac Dis* 2015; 7: Suppl. 4, S304–S316.
28 Folch EE, Pritchett MA, Nead MA, *et al.* Electromagnetic navigation bronchoscopy for peripheral pulmonary lesions: one-year results of the prospective, multicenter NAVIGATE Study. *J Thorac Oncol* 2019; 14: 445–458.
29 Cardillo G, Petersen RH, Ricciardi S, *et al.* European guidelines for the surgical management of pure ground-glass opacities and part-solid nodules: Task Force of the European Association of Cardio-Thoracic Surgery and the European Society of Thoracic Surgeons. *Eur J Cardiothorac Surg* 2023; 64: ezad222.
30 Callister ME, Baldwin DR, Akram AR, *et al.* British Thoracic Society guidelines for the investigation and management of pulmonary nodules. *Thorax* 2015; 70: Suppl. 2, ii1–ii54.
31 MacMahon H, Naidich DP, Goo JM, *et al.* Guidelines for management of incidental pulmonary nodules detected on CT images: from the Fleischner Society 2017. *Radiology* 2017; 284: 228–243.
32 Hansell DM, Bankier AA, MacMahon H, *et al.* Fleischner Society: glossary of terms for thoracic imaging. *Radiology* 2008; 246: 697–722.
33 Kadota K, Villena-Vargas J, Yoshizawa A, *et al.* Prognostic significance of adenocarcinoma *in situ*, minimally invasive adenocarcinoma, and nonmucinous lepidic predominant invasive adenocarcinoma of the lung in patients with stage I disease. *Am J Surg Pathol* 2014; 38: 448–460.
34 Yip R, Yankelevitz DF, Hu M, *et al.* Lung cancer deaths in the national lung screening trial attributed to nonsolid nodules. *Radiology* 2016; 281: 589–596.
35 Walter JE, Heuvelmans MA, Yousaf-Khan U, *et al.* New subsolid pulmonary nodules in lung cancer screening: the NELSON trial. *J Thorac Oncol* 2018; 13: 1410–1414.
36 Scholten ET, de Jong PA, de Hoop B, *et al.* Towards a close computed tomography monitoring approach for screen detected subsolid pulmonary nodules? *Eur Respir J* 2015; 45: 765–773.
37 Henschke CI, Yip R, Smith JP, *et al.* CT screening for lung cancer: part-solid nodules in baseline and annual repeat rounds. *AJR Am J Roentgenol* 2016; 207: 1176–1184.
38 Yankelevitz DF, Yip R, Smith JP, *et al.* CT screening for lung cancer: nonsolid nodules in baseline and annual repeat rounds. *Radiology* 2015; 277: 555–564.
39 Pastorino U, Boeri M, Sestini S, *et al.* Baseline computed tomography screening and blood microRNA predict lung cancer risk and define adequate intervals in the BioMILD trial. *Ann Oncol* 2022; 33: 395–405.
40 Oh JY, Kwon SY, Yoon HI, *et al.* Clinical significance of a solitary ground-glass opacity (GGO) lesion of the lung detected by chest CT. *Lung Cancer* 2007; 55: 67–73.
41 Kakinuma R, Noguchi M, Ashizawa K, *et al.* Natural history of pulmonary subsolid nodules: a prospective multicenter study. *J Thorac Oncol* 2016; 11: 1012–1028.

42 Silva M, Prokop M, Jacobs C, *et al.* Long-term active surveillance of screening detected subsolid nodules is a safe strategy to reduce overtreatment. *J Thorac Oncol* 2018; 13: 1454–1463.
43 Parraga G, Svenningsen S. Chest CT findings 1 year after COVID-19: another piece of the post-pandemic puzzle. *Radiology* 2023; 308: e231502.
44 Adams HJA, Kwee TC, Yakar D, *et al.* Chest CT imaging signature of coronavirus disease 2019 infection: in pursuit of the scientific evidence. *Chest* 2020; 158: 1885–1895.
45 Han X, Cao Y, Jiang N, *et al.* Novel coronavirus disease 2019 (COVID-19) pneumonia progression course in 17 discharged patients: comparison of clinical and thin-section computed tomography features during recovery. *Clin Infect Dis* 2020; 71: 723–731.
46 Kwee TC, Kwee RM. Chest CT in COVID-19: what the radiologist needs to know. *Radiographics* 2020; 40: 1848–1865.
47 Noh S, Bertini C, Mira-Avendano I, *et al.* Interstitial lung abnormalities after hospitalization for COVID-19 in patients with cancer: a prospective cohort study. *Cancer Med* 2023; 12: 17753–17765.
48 Kurys-Denis E, Grzywa-Celinska A, Podgorska K, *et al.* What remains up to 7 months after severe and moderate pneumonia in non-vaccinated patients with long COVID? Results of a CT study. *J Clin Med* 2023; 12: 5388.
49 Pan F, Yang L, Liang B, *et al.* Chest CT patterns from diagnosis to 1 year of follow-up in patients with COVID-19. *Radiology* 2022; 302: 709–719.
50 Liu M, Lv F, Huang Y, *et al.* Follow-up study of the chest CT characteristics of COVID-19 survivors seven months after recovery. *Front Med (Lausanne)* 2021; 8: 636298.
51 Bocchino M, Rea G, Capitelli L, *et al.* Chest CT lung abnormalities 1 year after COVID-19: a systematic review and meta-analysis. *Radiology* 2023; 308: e230535.
52 Watanabe A, So M, Iwagami M, *et al.* One-year follow-up CT findings in COVID-19 patients: a systematic review and meta-analysis. *Respirology* 2022; 27: 605–616.
53 Konsberg Y, Szaro P, Aneman A, *et al.* Radiological appearance and lung function six months after invasive ventilation in ICU for COVID-19 pneumonia: an observational follow-up study. *PLoS One* 2023; 18: e0289603.
54 Barini M, Percivale I, Danna P, *et al.* 18 months computed tomography follow-up after Covid-19 interstitial pneumonia. *J Public Health Res* 2022; 11: 2782.
55 Martini K, Larici AR, Revel MP, *et al.* COVID-19 pneumonia imaging follow-up: when and how? A proposition from ESTI and ESR. *Eur Radiol* 2022; 32: 2639–2649.
56 George PM, Barratt SL, Condliffe R, *et al.* Respiratory follow-up of patients with COVID-19 pneumonia. *Thorax* 2020; 75: 1009–1016.
57 Antoniou KM, Vasarmidi E, Russell AM, *et al.* European Respiratory Society statement on long COVID follow-up. *Eur Respir J* 2022; 60: 2102174.
58 Dudum R, Asch SM. 'Incidentalomas' in the age of artificial intelligence. *J Gen Intern Med* 2023; 38: 2855–2856.
59 Postmus PE, Kerr KM, Oudkerk M, *et al.* Early and locally advanced non-small-cell lung cancer (NSCLC): ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 2017; 28: Suppl. 4, iv1–iv21.
60 Kris MG, Gaspar LE, Chaft JE, *et al.* Adjuvant systemic therapy and adjuvant radiation therapy for stage I to IIIA completely resected non-small-cell lung cancers: American Society of Clinical Oncology/Cancer Care Ontario Clinical Practice Guideline Update. *J Clin Oncol* 2017; 35: 2960–2974.
61 Detterbeck FC, Lewis SZ, Diekemper R, *et al.* Executive Summary: Diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. *Chest* 2013; 143: Suppl. 5, 7S–37S.
62 Guckenberger M, Andratschke N, Dieckmann K, *et al.* ESTRO ACROP consensus guideline on implementation and practice of stereotactic body radiotherapy for peripherally located early stage non-small cell lung cancer. *Radiother Oncol* 2017; 124: 11–17.
63 National Institute for Health and Care Excellence. Lung cancer: diagnosis and management. Date last updated: 26 July 2023. www.nice.org.uk/guidance/ng122
64 National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines) Non-Small Cell Lung Cancer. Date last updated: 18 October 2023. www.nccn.org/professionals/physician_gls/pdf/nscl.pdf
65 Amin MB, Greene FL, Edge SB, *et al.* The Eighth Edition AJCC Cancer Staging Manual: Continuing to build a bridge from a population-based to a more 'personalized' approach to cancer staging. *CA Cancer J Clin* 2017; 67: 93–99.
66 Felip E, Altorki N, Zhou C, *et al.* Adjuvant atezolizumab after adjuvant chemotherapy in resected stage IB-IIIA non-small-cell lung cancer (IMpower010): a randomised, multicentre, open-label, phase 3 trial. *Lancet* 2021; 398: 1344–1357.
67 O'Brien M, Paz-Ares L, Marreaud S, *et al.* Pembrolizumab versus placebo as adjuvant therapy for completely resected stage IB-IIIA non-small-cell lung cancer (PEARLS/KEYNOTE-091): an interim analysis of a randomised, triple-blind, phase 3 trial. *Lancet Oncol* 2022; 23: 1274–1286.

68 Forde PM, Spicer J, Lu S, *et al.* Neoadjuvant nivolumab plus chemotherapy in resectable lung cancer. *N Engl J Med* 2022; 386: 1973–1985.
69 Wakelee H, Liberman M, Kato T, *et al.* Perioperative pembrolizumab for early-stage non-small-cell lung cancer. *N Engl J Med* 2023; 389: 491–503.
70 Wu YL, Tsuboi M, He J, *et al.* Osimertinib in resected EGFR-mutated non-small-cell lung cancer. *N Engl J Med* 2020; 383: 1711–1723.
71 Solomon BJ, Ahn JS, Barlesi F, *et al.* ALINA: a phase III study of alectinib versus chemotherapy as adjuvant therapy in patients with stage IB–IIIA anaplastic lymphoma kinase-positive (ALK+) non-small cell lung cancer (NSCLC). *J Clin Oncol* 2019; 37: Suppl. 15, TPS8569.
72 Yue D, Liu W, Chen C, *et al.* Circulating tumor DNA predicts neoadjuvant immunotherapy efficacy and recurrence-free survival in surgical non-small cell lung cancer patients. *Transl Lung Cancer Res* 2022; 11: 263–276.
73 Gale D, Heider K, Ruiz-Valdepenas A, *et al.* Residual ctDNA after treatment predicts early relapse in patients with early-stage non-small cell lung cancer. *Ann Oncol* 2022; 33: 500–510.
74 Abbosh C, Frankell AM, Harrison T, *et al.* Tracking early lung cancer metastatic dissemination in TRACERx using ctDNA. *Nature* 2023; 616: 553–562.
75 Siqueira AP, Gonçalves MFS, Tegami IL, *et al.* Reproducibility of a 12-gene set for predicting outcome and benefit from ACT in early-stage NSCLC patients. *Eur Respir J* 2023; 62: Suppl. 67, OA1451.
76 Miranda KC, Siqueira AP, Gonçalves MFS, *et al.* Validation of a 5-gene signature for predicting outcomes in early-stage NSCLC patients. *Eur Respir J* 2023; 62: Suppl. 67, OA1449.
77 Iyengar P, All S, Berry MF, *et al.* Treatment of oligometastatic non-small cell lung cancer: an ASTRO/ESTRO clinical practice guideline. *Pract Radiat Oncol* 2023; 13: 393–412.
78 Secreto G, Toniolo P, Berrino F, *et al.* Serum and urinary androgens and risk of breast cancer in postmenopausal women. *Cancer Res* 1991; 51: 2572–2576.
79 Neilly M, Tsim S, Maclay J, *et al.* An update regarding the Meso-ORIGINS study: part of the PREDICT-Meso International Accelerator. *Eur Respir J* 2023; 62: Suppl. 67, PA3434.
80 Novelli F, Marugo F, Costa I, *et al.* Pleural fluid mesothelin as a further diagnostic tool in subjects with a histological diagnosis of non specific pleuritic (NSP). *Eur Respir J* 2023; 62: Suppl. 67, OA1558.
81 Dipper A, Maskell N, Bibby A. Ancillary diagnostic investigations in malignant pleural mesothelioma. *Cancers (Basel)* 2021; 13: 3291.
82 Schillebeeckx E, Fernandez E, Staes A, *et al.* Defining a new diagnostic biomarker panel for malignant pleural mesothelioma using a novel proteomic technique. *Eur Respir J* 2023; 62: Suppl. 67, OA1557.
83 Creaney J, Francis RJ, Dick IM, *et al.* Serum soluble mesothelin concentrations in malignant pleural mesothelioma: relationship to tumor volume, clinical stage and changes in tumor burden. *Clin Cancer Res* 2011; 17: 1181–1189.
84 de Fonseka D, Arnold DT, Stadon L, *et al.* A prospective study to investigate the role of serial serum mesothelin in monitoring mesothelioma. *BMC Cancer* 2018; 18: 199.
85 Lynch G, Morley A, Cooper W, *et al.* Serum mesothelin is a biomarker for disease progression and mortality in mesothelioma. *Eur Respir J* 2023; 62: Suppl. 67, OA1556.
86 Heirwegh E, Heirwegh E, Janssens E, *et al.* Exhaled breath analysis predicts treatment response in malignant pleural mesothelioma patients. *Eur Respir J* 2023; 62: Suppl. 67, OA1559.
87 Nadal E, Bosch-Barrera J, Cedres S, *et al.* SEOM clinical guidelines for the treatment of malignant pleural mesothelioma (2020). *Clin Transl Oncol* 2021; 23: 980–987.
88 Treasure T, Lang-Lazdunski L, Waller D, *et al.* Extra-pleural pneumonectomy versus no extra-pleural pneumonectomy for patients with malignant pleural mesothelioma: clinical outcomes of the Mesothelioma and Radical Surgery (MARS) randomised feasibility study. *Lancet Oncol* 2011; 12: 763–772.
89 Lim E, Waller D, Lau K, *et al.* MARS 2: a multicentre randomised trial comparing (extended) pleurectomy decortication versus no radical surgery for mesothelioma. World Conference on Lung Cancer, 2023; PL03.10.
90 Rintoul RC, Ritchie AJ, Edwards JG, *et al.* Efficacy and cost of video-assisted thoracoscopic partial pleurectomy versus talc pleurodesis in patients with malignant pleural mesothelioma (MesoVATS): an open-label, randomised, controlled trial. *Lancet* 2014; 384: 1118–1127.
91 Tate M, Roche J, Tsim S, *et al.* The Scottish Mesothelioma Network: impact of a national multidisciplinary team on overall survival in malignant pleural mesothelioma. *Lung Cancer* 2023; 178: Suppl. 1, S21.
92 Sauter JL, Dacic S, Galateau-Salle F, *et al.* The 2021 WHO Classification of Tumors of the Pleura: advances since the 2015 classification. *J Thorac Oncol* 2022; 17: 608–622.
93 Churg A, Galateau-Salle F, Roden AC, *et al.* Malignant mesothelioma *in situ*: morphologic features and clinical outcome. *Mod Pathol* 2020; 33: 297–302.
94 Dipper A, Bhatnagar R, Maskell N. Management of malignant pleural effusions. *Curr Opin Pulm Med* 2020; 26: 341–345.
95 Addala D, Iqbal B, Denniston P, *et al.* Qualitative study of patient priorities in the malignant pleural effusion pathway. *Eur Respir J* 2023; 62: Suppl. 67, OA1561.

96 Roberts ME, Rahman NM, Maskell NA, *et al.* British Thoracic Society Guideline for pleural disease. *Thorax* 2023; 78: Suppl. 3, s1–s42.

97 Putnam JB Jr, Light RW, Rodriguez RM, *et al.* A randomized comparison of indwelling pleural catheter and doxycycline pleurodesis in the management of malignant pleural effusions. *Cancer* 1999; 86: 1992–1999.

98 Welch H, Barton E, Beech E, *et al.* Does a novel indwelling pleural catheter drainage system improve patient experience? *Eur Respir J* 2023; 62: Suppl. 67, OA1563.

99 Bhatnagar R, Kahan BC, Morley AJ, *et al.* The efficacy of indwelling pleural catheter placement versus placement plus talc sclerosant in patients with malignant pleural effusions managed exclusively as outpatients (IPC-PLUS): study protocol for a randomised controlled trial. *Trials* 2015; 16: 48.

100 Gupta R, Koshy S, James P, *et al.* To study the efficacy of time dependant vs volume dependant chest drain removal protocol for talc slurry pleurodesis in patients with malignant pleural effusion. *Eur Respir J* 2023; 62: Suppl. 67, OA1562.

101 Bibby AC, Dorn P, Psallidas I, *et al.* ERS/EACTS statement on the management of malignant pleural effusions. *Eur Respir J* 2018; 52: 1800349.

102 Mastromarino MG, Calabrò F, Elia G, *et al.* Pressurized Intra-Thoracic Aerosol Chemotherapy (PITAC): preliminary results in malignant pleural effusion. *Eur Respir J* 2023; 62: Suppl. 67, OA1564.

103 Popat S, Baas P, Faivre-Finn C, *et al.* Malignant pleural mesothelioma: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol* 2022; 33: 129–142.

104 Tate M, Roche J, Tsim S, *et al.* The Scottish Mesothelioma Network: impact of a national MDT on overall survival in pleural mesothelioma. *Eur Respir J* 2023; 62: Suppl. 67, OA1560.

105 Kok PS, Forde PM, Hughes B, *et al.* Protocol of DREAM3R: DuRvalumab with chEmotherapy as first-line treAtment in advanced pleural Mesothelioma – a phase 3 randomised trial. *BMJ Open* 2022; 12: e057663.

106 Chu QS, Piccirillo MC, Greillier L, *et al.* IND227 phase III (P3) study of cisplatin/pemetrexed (CP) with or without pembrolizumab (pembro) in patients (pts) with malignant pleural mesothelioma (PM): a CCTG, NCIN, and IFCT trial. *J Clin Oncol* 2023; 41: Suppl. 17, LBA8505.