




BMJ Open Anaesthetic and perioperative considerations for extrapleural pneumonectomy and extended pleurectomy/decortication: a scoping review protocol

Sui Wah Sean Yip,¹ Laurence Weinberg ^{1,2} Julian Gooi,³ Siven Sivenayagam,⁴ Tim G Coulson,^{5,6} Stephen A Barnett,⁷ Simon R Knight,⁷ Jarryd Ludski ¹, Dong Kyu Lee ⁸

To cite: Yip SWS, Weinberg L, Gooi J, *et al.* Anaesthetic and perioperative considerations for extrapleural pneumonectomy and extended pleurectomy/decortication: a scoping review protocol. *BMJ Open* 2024;**14**:e078125. doi:10.1136/bmjopen-2023-078125

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<https://doi.org/10.1136/bmjopen-2023-078125>).

Received 25 July 2023

Accepted 05 May 2024



© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Professor Laurence Weinberg; laurence.weinberg@austin.org.au

ABSTRACT

Introduction Extrapleural pneumonectomy (EPP) and extended pleurectomy/decortication (ePD) are surgical cytoreductive techniques aimed at achieving macroscopic resection in malignant pleural tumours such as pleural mesothelioma, non-mesothelioma pleural malignancies such as thymoma and sarcoma, and rarely for pleural tuberculosis, in a more limited fashion. Despite extensive studies on both surgical techniques and consequences, a significant knowledge gap remains regarding how best to approach the perioperative anaesthesia challenges for EPP and ePD.

It is unknown if the risk stratification processes for such surgeries are standardised or what types of functional and dynamic cardiac and pulmonary tests are employed preoperatively to assist in the perioperative risk stratification. Further, it is unknown whether the types of anaesthesia and analgesia techniques employed, and the types of haemodynamic monitoring tools used, impact on outcomes. It is also unknown whether individualised haemodynamic protocols are used to guide the rational use of fluids, vasoactive drugs and inotropes. Finally, there is a dearth of evidence regarding how best to monitor these patients postoperatively or what the most effective enhanced recovery protocols are to best mitigate postoperative complications and accelerate hospital discharge. To increase our knowledge of the perioperative and anaesthetic treatment for patients undergoing EPP/ePD, this scoping review attempts to synthesise the literature and identify these knowledge gaps.

Methods and analysis This scoping review will be conducted in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Review Protocols methodology. Electronic databases, OVID Medline, EMBASE and the Cochrane Library, will be systematically searched for relevant literature corresponding to EPP or ePD and perioperative or anaesthetic management. Data will be analysed and summarised descriptively and organised according to the three perioperative stages: preoperative, intraoperative and postoperative factors in clinical care.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the first review to synthesise the perioperative anaesthesia considerations for extrapleural pneumonectomy and extended pleurectomy/decortication.
- ⇒ To ensure systematic searching, screening and reporting, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews tool is used.
- ⇒ The protocol includes a comprehensive data extraction template.
- ⇒ Only articles in English will be reviewed.
- ⇒ This review may miss studies published outside of journals (eg, book chapters and other grey literature).

Ethics and dissemination Ethics approval was not required. The findings will be disseminated through professional networks, conference presentations and publications in scientific journals.

BACKGROUND AND RATIONALE

Extrapleural pneumonectomy (EPP), also known as pleuro-pneumonectomy, is a standardised procedure of en-bloc resection of the parietal and visceral pleura with the ipsilateral lung, pericardium and hemidiaphragm.^{1–4} This technique was first documented in 1949 for the treatment of adult pulmonary tuberculosis⁵ and has a contemporary role as a surgical option for the management of pleural malignancies,⁶ primarily in resecting pleural mesothelioma (PM), in addition to other uncommon non-mesothelioma pleural malignancies such as thymoma and sarcoma, and rarely for pleural tuberculosis, in a more limited fashion.^{1 7 8} In contrast, a second surgical technique, extended pleurectomy/

decortication (ePD)^{9–11} is a lung-sparing procedure for debulking PM—however, confers a theoretical risk of leaving behind residual disease from the in situ ipsilateral lung.¹² In recent times, ePD has grown increased popularity owing to an improved perioperative safety profile.^{13–17} Several meta-analyses have revealed increased postoperative morbidity, mortality and complications in those receiving EPP compared with ePD with comparable disease recurrence rates and overall survival.^{15 18 19} However, EPP may still be considered in limited and rare contexts depending on the extent of disease and surgeon familiarity.²⁰ To improve tumour control and prevent recurrence, EPP or ePD are usually performed as part of a multimodality treatment programme, consisting of hyperthermic intrathoracic chemotherapy,^{21 22} and perioperative chemotherapy/radiotherapy.^{23–25}

The role of EPP/ePD in PM management remains controversial and EPP is no longer the procedure of choice recommended for PM. In particular, two large multicentre randomised control studies—Mesothelioma and Radical Surgery (MARS)⁷ in 2011 and Mesothelioma and Radical Surgery 2 (MARS2)²⁶ in 2023, demonstrated no survival or quality of life benefit for patients undergoing either surgery compared with a nonsurgical chemotherapy control group.²⁷ Despite controversy and academic scrutiny, these radical surgeries continue to be offered in limited contexts as a potential curative option to control pleural lesions.^{6 20 28} In some centres, the only indication for EPP in PM is if tumour invades the lung and the disease is otherwise not resectable, that is, advanced disease.

A recent small study by an Italian single-centre thoracic unit highlighted the role of ePD in improving short-term survival outcomes if performed prior to the administration of systematic chemotherapy compared with post-chemotherapeutic treatment.²⁹ To date, there is considerable bias in the literature pertaining to outcome measures post-EPP and post-ePD dependent on institutional experience and limited sample size reporting.²⁹ Thus, the decision to perform EPP or ePD, and the role of surgery in the multimodality treatment of PM, should be made on a case-by-case basis by a multidisciplinary team of specialists, including thoracic surgeons, medical oncologists, radiation oncologists, pulmonologists and anaesthetists in consultation with the patient and their family.^{29–31}

Surgery for EPP/ePD is a morbid and prolonged procedure involving the mediastinum, resulting in significant perturbations in cardiopulmonary haemostasis,⁴ and other complications such as supraventricular arrhythmia,^{15 32–37} cardiac failure,^{32 36} thromboembolism,^{32 35} respiratory failure,^{32 36} renal failure,³² pneumonia,^{33 34 36} empyema and bronchopleural fistula.^{32 36 37} Consequently, a 2018 systematic review found perioperative mortality from EPP to be as high as 11.8%, with complications occurring in 82.6% of patients²—a reflection of the many challenges that may arise throughout the perioperative period. In contrast to EPP, ePD has seen increasing popularity as

the surgical-technique-of-choice for PM debulking—with some studies reporting lower 30-day mortality rates of 2.35% and improved overall survival time.^{38 39} Given intraoperative and postoperative complications are not uncommon for either EPP or ePD, there are major impacts on quality of life and long-term survival, in addition to implications for health resource management.

While EPP/ePD has been comprehensively investigated from a surgical perspective,^{40–42} there is minimal research dedicated to mapping the perioperative anaesthetic care of such patients,^{43–46} despite the vital role anaesthetists have in preventing and treating the physiological and metabolic derangements that occur in the perioperative setting.^{47 48} This contrasts with the literature pertaining to the anaesthesia management of the pneumonectomy patient.^{49–51} However, there are several ‘EPP/ePD-specific’ anaesthetic challenges that need to be considered to ensure safe delivery of anaesthesia and operation success.^{45 46 52} These include greater risks of blood loss, arrhythmias, impediments to venous return, haemodynamic instability, pulmonary dysfunction and postoperative pain compared with standard pneumonectomy—owing to greater disruptions to mediastinal anatomy and procedural complexity.⁴⁴ Moreover, the assessment of postoperative complications is poorly described. Additionally, EPP for the treatment of PM is commonly performed with intraoperative administration of ‘intracavitary heated chemotherapeutics’ to reduce any residual tumour cells in the empty hemithorax, which also needs to be factored into the anaesthetic plan.^{43 44} There is little research into the anaesthesia-related considerations specific to these advanced therapies that occur in combination with EPP/ePD. Therefore, increasing this knowledge base is necessary to improve perioperative outcomes and reduce acute and longer-term complications.

To date, there have been no scoping or systematic reviews charting the available literature relating to anaesthetic and perioperative practices for patients undergoing EPP. Additionally, a review published in 2008 by Ng and Hartigan did not detail the anaesthetic management specific to each intraoperative surgical stage of the EPP procedure.⁴⁴ While piecemeal case reports and single-centre experiences have been published regarding the anaesthetic considerations of ePD,⁴⁶ to the best of our knowledge, no systematised reviews on this subject matter have been published.

As such, a significant knowledge gap remains regarding how to approach the perioperative anaesthesia challenges for EPP and PD surgery. It is unknown if the perioperative risk stratification processes for EPP/ePD are standardised across the specialty units, what types of functional and dynamic cardiac and pulmonary tests are necessary, and whether they impact on postoperative outcomes; further, it is also unknown whether different types of prehabilitation programmes impact on outcomes, and if so, what the prehabilitation programme specifically incorporates. Importantly, it is unknown whether the types of anaesthesia (volatile, intravenous, combination) and analgesia

techniques (epidural vs extrapleural/paravertebral catheter vs systemic opioid-based analgesia), and the types of perioperative haemodynamic monitoring tools used (eg, transesophageal echocardiography, pulmonary artery catheters), impact on outcomes. It is also unknown whether individualised haemodynamic protocols are used to guide the rational use of fluids, vasoactive drugs and inotropes. Finally, there is a dearth of evidence regarding how to best monitor this patient group postoperatively or what the most effective enhanced-recovery-after-EPP/ePD protocols are to best mitigate postoperative complications and accelerate hospital discharge.

To address this research gap, we propose to undertake a scoping review of the peer-reviewed literature relating to 'anaesthetic' and 'perioperative' considerations of EPP and extended pleural decortication. A scoping review is appropriate for this topic due to the limited quantity of published studies, allowing for more flexible and dynamic concept mapping. Additionally, the identification of key gaps in knowledge may be better assessed through a scoping review methodology.⁵³ Subsequently, this review aims to provide an updated understanding of perioperative care and anaesthetic treatments for patient cohorts undergoing EPP/ePD, including step-by-step considerations for each of the intraoperative stages unique to this procedure.

OBJECTIVES

The objective of this scoping review will be to appraise and map the current understandings of perioperative and anaesthetic management for patients undergoing EPP/ePD. This review will add to the current evidence base with the goal of improving medical practices and guiding future research. Specifically, this review will aim to:

1. Identify the current indications for EPP/ePD.
2. Evaluate and describe preoperative risk stratification tools to guide patient-focused discussions regarding the risk and benefits of anaesthesia and surgery.
3. Evaluate the types of perioperative prehabilitation programmes that are being employed to optimise fitness for surgery.
4. Evaluate what investigations are being conducted before surgery to aid in anaesthesia patient risk stratification for EPP versus ePD surgery.
5. Explore the types of anaesthesia and analgesia techniques being used to care for patients undergoing EPP/ePD.
6. Explore similarities and differences in anaesthesia and analgesia techniques being used to care for patients undergoing EPP versus ePD.
7. To evaluate similarities and differences in the types of haemodynamic monitoring devices (eg, transesophageal echocardiography, pulmonary artery catheter) that are being used intraoperatively to guide the rational use of fluid and vasoactive medications for patients undergoing EPP versus ePD.

8. Evaluate and describe the similarities and differences in intraoperative complications (eg, arrhythmias, bleeding, cardiac dysfunction) for EPP versus ePD, and what strategies are employed to prevent or treat these.
9. Evaluate postoperative analgesia techniques (eg, epidural, extrapleural catheter, patients controlled opioid analgesia) and whether these impact postoperative outcomes.
10. Evaluate and describe postoperative complication rates (eg, acute kidney injury, stroke, bleeding, cardiac failure, pneumonia and need for prolonged mechanical ventilation), and describe similarities and differences for EPP versus ePD cohorts.
11. Identify risk factors that may predict complications and mortality.
12. Summarise the duration of the intensive care and the hospital length of stay, and describe similarities and differences for EPP versus ePD cohorts.
13. Identify the inpatient readmissions to the intensive care unit (ICU), and describe similarities and differences for EPP versus ePD cohorts.
14. Identify in-patient 30-day, 1-year, 5-year and 10-year mortality rates, and describe similarities and differences for EPP versus ePD cohorts.
15. Identify gaps in the sociodemographic and health status of patients undergoing EPP/ePD and determine how these differ across various health domains, countries, ethnicities and sexes.
16. Identify and compare the impact of EPP/ePD on the patient's quality of life.

METHODS AND ANALYSIS

The scoping review will be conducted following the relevant aspects of the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Review Protocols (PRISMA-ScR) guidelines, allowing for a systematic review of the existing literature to ensure rigour and replicability. Additionally, the methodological framework described by Arskey and O'Malley (2005)⁵⁴ and furthered by Levac *et al*⁵⁵ will be used.

Protocol and registration

Following discussions with perioperative thoracic surgeons, intensivists, respiratory physicians, anaesthetists and physiotherapists working in thoracic surgery, this protocol was developed with the broad research question of describing the anaesthesia considerations in managing patients undergoing EPP/ePD. Outcomes of interest will focus on preoperative risk stratification techniques, prehabilitation strategies, intraoperative anaesthesia and analgesic techniques, and the prevention and management of perioperative complications, including mortality. Finally, the impact of EPP/ePD on quality of life will be explored. In order to guarantee the protocol's dissemination, public accessibility, transparency and opportunity for feedback from other significant stakeholders,

including patients and their carers or families, it has been submitted to an open-access peer-reviewed journal.

Search strategy

Literature search strategies were developed using medical subject headings (MeSH) and text words related to EPP/ePD quality indicators. MeSH terms and keywords relating to the “extrapleural pneumonectomy” or “extended pleural decortication” procedure, “anaesthesia” techniques, “intraoperative” techniques and strategies and “perioperative” care. Studies will be identified by searching Medline (OVID interface), CINAHL (EBSCO interface), EMBASE (OVID interface) and the Cochrane Central Register of Controlled Trials (Cochrane Library) (see online supplemental file 1). Finally, experts in the field of EPP/ePD will be contacted and consulted to ensure that all relevant data is obtained.

Types of studies

Primary empirical research studies will be eligible for inclusion, while editorials, protocols for planned studies, abstracts and dissertations will be excluded.

Eligibility criteria

Publications reporting on medical care related to perioperative or anaesthetic medicine on patients undergoing EPP/ePD will be included. For this review, ‘perioperative medicine’ will be defined according to the Australian and New Zealand College of Anaesthetist, comprising a broad, multidisciplinary science and practice prioritising patient optimisation throughout the operative period to mitigate risk and manage perioperative complications.⁵⁶ This encapsulates the three broad stages of the perioperative period: preoperative (risk assessment, decision for surgery, patient selection, optimisation), intraoperative (stages of anaesthesia) and postoperative (recovery and complication management, monitoring, rehabilitation) care.⁵⁶ The focus of this scoping review will be the role of the anaesthetist or anaesthesiologist in providing perioperative care for patients undergoing EPP/ePD.

As the primary aim of this review is to provide a broad overview of all the perioperative anaesthesia considerations for EPP/ePD, the search and inclusion of studies will not be restricted to any specific period of the perioperative timeline. Similarly, there will be no restrictions placed on the age of the human patients studied (ie, both adult and paediatric populations will be included). Additionally, there will be no restrictions to the types and modes of anaesthesia administered for EPP/ePD included in the review.

A proposed list of preoperative, intraoperative and postoperative considerations will be included (table 1). This may be subject to adjustments during the conduct of the review and will be guided by what parameters and considerations have been studied and documented in the available peer-reviewed literature.

Only publications or abstracts in English will be included to ensure their relevance to the studied healthcare

contexts and feasibility of implementation. However, limiting the search to English-specific studies may result in a degree of bias towards countries that primarily communicate in English. The types of evidence that will ultimately be included for analysis in the review will comprise primary empirical research studies (prospective or retrospective) and other full-text publications (eg, reviews). Conversely, editorial pieces (eg, position statements), protocol studies, abstracts, posters and articles that cannot be retrieved with a full-text version will be excluded. This review will include all studies published from 1 January 1949 to 6 March 2024.

Screening procedure

Publications will be reviewed and screened via the web-based systematic review application Covidence. A three-step screening process of the title, abstract and full-text review will be undertaken. First, two study reviewers will independently screen titles and abstracts obtained from the database search in accordance with the inclusion and exclusion criteria. Abstracts not available in English will be excluded. If the abstract is available in English and fulfils the eligibility criteria, but the main manuscript is not in English, then the full manuscript will be translated into English and included. Limiting the search to the English language may result in bias in the results of English-language speaking countries and reduce generalisability to non-English-speaking countries, but this was accepted by the authors given the scoping nature of the review.

To enhance the reliability of the screening by the two reviewers, a random sample of 50 publications will undergo a pilot test of the initial screening based on the eligibility criteria described above. The kappa statistic will then be computed to ascertain the inter-rater agreement for inclusion in the study.⁵⁷ The kappa result will be interpreted as follows: values <0 indicate no agreement, 0.01–0.20 indicate none to slight agreement, 0.21–0.40 indicate moderate agreement, 0.41–0.60 indicate considerable agreement and 0.81–1.00 indicate nearly perfect agreement. A kappa value between 0.80 and 0.90 (representing a high level of agreement) will serve as the acceptance criterion. Any disagreement will be discussed and resolved by a third reviewer of the study. The data-charting form will be revised, if necessary, in response to any discrepancies discovered by the third reviewer of the study.

Then, the full-text publications of all relevant and potentially relevant studies will be retrieved and independently screened by two reviewers, with any discrepancies resolved by a third reviewer, and all studies that do not satisfy the inclusion criteria will be excluded. In addition, summary tables and reference lists will be manually combed for additional publications that qualify. Prior to implementing the full scoping review, we will conduct pilot testing on the first 30 screened records to ensure feasibility and conformance with our data collection instruments and to identify potential problem areas

Table 1 Summary of proposed perioperative (preoperative, intraoperative and postoperative) considerations to be included in the scoping review

Perioperative period	Clinical practice considerations
Preoperative	<ul style="list-style-type: none"> ▶ Patient selection ▶ Risk assessment ▶ Investigations (eg, blood studies, echocardiography, respiratory function tests, cardiopulmonary exercise testing, radiological studies) ▶ Malignancy staging ▶ Pre-rehabilitation programmes
Intraoperative	<ul style="list-style-type: none"> ▶ Preoperative patient preparation (eg, monitoring, lines) ▶ Use of a double lumen tube (type and size) or bronchial blocker to achieve lung separation ▶ Choice of anaesthetic agents (induction, maintenance, emergence) ▶ Use of brain function monitoring and cerebral oximetry ▶ Analgesia techniques ▶ Lung isolation and one-lung anaesthesia techniques ▶ Use of lung recruitment manoeuvres or strategies ▶ Anaesthetic considerations during each major stage of the procedure (eg, during tumour dissection, dissection of great pulmonary vessels) ▶ Anaesthetic considerations of adjuvant therapy during the EPP/ePD procedure (eg, intraoperative intracavity hyperthermic chemotherapy) ▶ Use of vasoactive medications or inotropes ▶ Use of haemodynamic algorithms to guide fluid therapy and use of vasoactive agents ▶ Fluid therapy (type and amount) ▶ Frequency and management of arterial blood gas derangements ▶ Cardiac complication management, for example, arrhythmia management ▶ Other intraoperative complication considerations
Postoperative	<ul style="list-style-type: none"> ▶ ICU admission and length of stay in hospital ▶ Cardiac complications including assessment of cardiac function ▶ Incidence and management of right ventricular dysfunction ▶ Respiratory complications and management ▶ Renal complications and management ▶ Surgical site complications ▶ Pain management considerations ▶ Tumour-related complications ▶ Rehabilitation ▶ Morbidity and mortality

ePD, extended pleurectomy/decortication; EPP, extrapleural pneumonectomy; ICU, intensive care unit.

and deficiencies in the scoping review protocol. This will enable members of the research team conducting the screening to familiarise themselves with the protocol's procedures. The inclusion and exclusion criteria will be clarified so that the selection criteria can be applied consistently. The reasons for the exclusion of studies that underwent full-text review will be reported.

The outcome of the database search, title and abstract screening and full-text review will be detailed and documented in a PRISMA flowchart in the scoping review.

Data extraction

The included studies will be charted into a customised data extraction form to extract all relevant data from each study. Data extraction will be performed independently by two reviewers, with discrepancies reviewed and discussed with a third reviewer, as required. Summary tables will be produced to highlight the evidence base and address the

aims of this review. The following data will be extracted to address these primary and secondary objectives.

- ▶ First author.
- ▶ Year of publication.
- ▶ Type of study (eg, randomised control trial, cohort study, systematic review, case report, etc).
- ▶ Country of study.
- ▶ Type of health facility.
- ▶ Study demographics (eg, age group, indication for EPP/ePD).
- ▶ Choice of EPP or ePD and rationale for surgical approach.
- ▶ Preoperative assessment (risk assessment, patient selection and criteria used).
- ▶ Preoperative patient preparation.
- ▶ Operative procedure and anaesthetic management (eg, drug selection, fluid therapy, stages of anaesthesia).

- ▶ Postoperative management (eg, postoperative analgesia, ICU stay).
- ▶ Postoperative complications and prevalence.
- ▶ Postoperative morbidity and mortality (inpatient, 30-day and long-term).
- ▶ Quality of life outcomes.

Data synthesis

Using statistical software (StataCorp 2023 Stata Statistical Software, Release 18; StataCorp LLC), data will be analysed and descriptively summarised. The data will be presented as counts (proportions), medians (IQRs) and ranges (lowest to highest values). The characteristics of the study will be presented in tabular and graphic formats and summarised using a narrative approach in the text. Whenever possible, inferential statistics will be used to infer from the data the probabilities of observed differences between specific categories. Through a comparison of study and participant characteristics, research gaps will be identified. Where feasible, qualitative data that capture the authors' references to quality-of-life outcomes will be subjected to thematic analysis using Braun and Clarke's inductive-deductive method to identify themes and commonalities in how surgery affects patient quality of life or the impact of surgery on healthcare resources.

In reporting our findings, we will additionally emphasise similarities and differences in how patients undergoing EPP/ePD are selected for surgery and in any risk stratification procedure that occurs as part of their preoperative work. Where feasible, the differences in perioperative outcomes and management strategies between patients undertaking an EPP versus ePD will be highlighted. Specifically, this assessment will identify the individual-level, institutional-level and system-level quality of care indicators currently used for patients undergoing EPP/ePD.

Patient and public involvement

This work analyses existing research studies, and therefore, involves no patients or members of the public.

ETHICS AND DISSEMINATION

This scoping review will be reported in accordance with the PRISMA-ScR guidelines. Approval from the Human Research Ethics Committee was not required as the proposed review will only review previously published literature and will not involve human subjects or any unpublished data. The results of this study will be disseminated through peer-reviewed publications and professional presentations. Additionally, the scoping review will inform future practice guidelines for perioperative and anaesthetic management of patients undergoing EPP/ePD and help summarise the current evidence base.

IMPLICATIONS

This scoping review aims to provide a better understanding of the complexities faced by anaesthetists who care for patients undergoing EPP/ePD. In particular,

knowledge translation will occur throughout the review with the dissemination of the findings to local, national and international stakeholders.

Our findings could help to identify current evidence bases and knowledge gaps that, when filled, could aid anaesthetists and perioperative clinicians to reflect on the risks of EPP/ePD and provide patients and their families with valuable outcome data to help guide informative discussions about the benefits and risks of proceeding with complex thoracic surgery or seeking alternative management strategies. Finally, to improve the quality of care for a more efficient healthcare system for patients undergoing EPP/ePD, the extracted results will be summarised both quantitatively and qualitatively to assist anaesthetists and other clinicians in shaping their understanding of the anaesthesia challenges for EPP/ePD. By summarising the body of evidence of established and potential quality indicators for patients with EPP/ePD across the continuum of care, such performance measures can be used to determine the quality-of-care delivery for patients with EPP/ePD.

Author affiliations

- ¹Department of Anaesthesia, Austin Health, Heidelberg, Victoria, Australia
- ²Department of Critical Care, University of Melbourne, Parkville, Victoria, Australia
- ³Department of Cardiothoracic Surgery, The Alfred, Melbourne, Victoria, Australia
- ⁴Department of Cardiothoracic Surgery, Austin Health, Heidelberg, Victoria, Australia
- ⁵Anaesthesiology and Perioperative Medicine, The Alfred, Melbourne, Victoria, Australia
- ⁶Department of Anaesthesiology and Perioperative Medicine, Alfred Health and Monash University, Melbourne, Victoria, Australia
- ⁷Department of Thoracic Surgery, Austin Health, Heidelberg, Victoria, Australia
- ⁸Department of Anesthesiology and Pain Medicine, Dongguk University Ilsan Hospital, Goyang, Korea (the Republic of)

Contributors All authors contributed meaningfully to the preparation, drafting and editing of this scoping review protocol. LW (the guarantor) conceived the idea and guided the research team at all stages of protocol development. LW (corresponding author), SS, JG and DKL conceptualised the research questions and core research plan. SWSY and JL performed the data extraction before preparing the initial draft of this manuscript. JG, TGC, SAB, SRK and DKL helped write and approve the final submitted manuscript after several iterations and rounds of editing. LW and SWSY agree to be accountable for all aspects of this protocol.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is

properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Laurence Weinberg <http://orcid.org/0000-0001-7403-7680>

Jarryd Ludski <http://orcid.org/0000-0001-8076-6804>

Dong Kyu Lee <http://orcid.org/0000-0002-4068-2363>

REFERENCES

- Butchart EG, Ashcroft T, Barnsley WC, *et al.* Pleuropneumectomy in the management of diffuse malignant Mesothelioma of the pleura. experience with 29 patients. *Thorax* 1976;31:15–24.
- Duranti L, Padoles A, Bertolaccini L, *et al.* Extra-pleural Pneumectomy. *J Thorac Dis* 2019;11:1022–30.
- Rice D, Rusch V, Pass H, *et al.* Recommendations for uniform definitions of surgical techniques for malignant pleural Mesothelioma: a consensus report of the International Association for the study of lung cancer International staging committee and the International Mesothelioma interest group. *J Thorac Oncol* 2011;6:1304–12.
- Batirel HF. Extrapleural Pneumectomy (EPP) vs. Pleurectomy Decortication (P/D). *Ann Transl Med* 2017;5:232.
- SAROT IA. Extrapleural Pneumectomy and Pleurectomy in pulmonary tuberculosis. *Thorax* 1949;4:173:173–223.
- Wolf AS, Flores RM. Extrapleural Pneumectomy for pleural malignancies. *Thorac Surg Clin* 2014;24:471–5.
- Treasure T, Lang-Lazdunski L, Waller D, *et al.* Extra-pleural pneumectomy versus no extra-pleural pneumectomy for patients with malignant pleural mesothelioma: clinical outcomes of the mesothelioma and radical surgery (MARS) randomised feasibility study. *Lancet Oncol* 2011;12:763–72.
- Cao CQ, Yan TD, Bannon PG, *et al.* A systematic review of extrapleural pneumectomy for malignant pleural Mesothelioma. *J Thorac Oncol* 2010;5:1692–703.
- Rusch VW. Extrapleural pneumectomy and extended pleurectomy/decortication for malignant pleural Mesothelioma: the memorial sloan-kettering cancer center approach. *Ann Cardiothorac Surg* 2012;1:523–31.
- Sugarbaker DJ. Macroscopic complete resection: the goal of primary surgery in multimodality therapy for pleural Mesothelioma. *J Thorac Oncol* 2006;1:175–6.
- Bilancia R, Nardini M, Waller DA. Extended pleurectomy decortication: the current role. *Transl Lung Cancer Res* 2018;7:556–61.
- Domen A, Berzenji L, Hendriks JMH, *et al.* Extrapleural pneumectomy: still indicated *Transl Lung Cancer Res* 2018;7:550–5.
- Zhou N, Rice DC, Tsao AS, *et al.* Extrapleural pneumectomy versus pleurectomy/decortication for malignant pleural mesothelioma. *Ann Thorac Surg* 2022;113:200–8.
- Kostron A, Friess M, Inci I, *et al.* Propensity matched comparison of extrapleural pneumectomy and pleurectomy/decortication for mesothelioma patients. *Interact Cardiovasc Thorac Surg* 2017;24:740–6.
- van Gerwen M, Wolf A, Liu B, *et al.* Short-term outcomes of pleurectomy decortication and extrapleural pneumectomy in mesothelioma. *J Surg Oncol* 2018;118:1178–87.
- Flores RM, Pass HI, Seshan VE, *et al.* Extrapleural pneumectomy versus pleurectomy/decortication in the surgical management of malignant pleural mesothelioma: results in 663 patients. *J Thorac Cardiovasc Surg* 2008;135:620–6.
- Lang-Lazdunski L, Bille A, Lal R, *et al.* Pleurectomy/decortication is superior to extrapleural pneumectomy in the multimodality management of patients with malignant pleural mesothelioma. *J Thorac Oncol* 2012;7:737–43.
- Cao C, Tian D, Park J, *et al.* A systematic review and meta-analysis of surgical treatments for malignant pleural mesothelioma. *Lung Cancer* 2014;83:240–5.
- Taioli E, Wolf AS, Flores RM. Meta-analysis of survival after pleurectomy decortication versus extrapleural pneumectomy in Mesothelioma. *Ann Thorac Surg* 2015;99:472–80.
- Kindler HL, Ismaila N, Armato SG III, *et al.* Treatment of malignant pleural mesothelioma: American society of clinical oncology clinical practice guideline. *JCO* 2018;36:1343–73.
- Järvinen T, Paajanen J, Ilonen I, *et al.* n.d. Hyperthermic intrathoracic chemoperfusion for malignant pleural mesothelioma: systematic review and meta-analysis. *Cancers* 13:3637.
- Mangiameli G, Bottoni E, Cariboni U, *et al.* Single-center 20-year experience in surgical treatment of malignant pleural mesothelioma. *J Clin Med* 2022;11:4537.
- Rosenzweig KE, Giraud P. Radiation therapy for malignant pleural Mesothelioma. *Cancer Radiother* 2017;21:73–6.
- Sugarbaker DJ, Heher EC, Lee TH, *et al.* Extrapleural Pneumectomy, chemotherapy, and radiotherapy in the treatment of diffuse malignant pleural Mesothelioma. *J Thorac Cardiovasc Surg* 1991;102:10–4.
- Kuribayashi K, Doi H, Kijima T. Types of surgery post-Neoadjuvant chemotherapy for pleural mesothelioma. *Expert Rev Respir Med* 2019;13:1189–94.
- Lim E, Darlison L, Edwards J, *et al.* Mesothelioma and radical surgery 2 (MARS 2): protocol for a multicentre randomised trial comparing (extended) pleurectomy decortication versus no (extended) pleurectomy decortication for patients with malignant pleural mesothelioma. *BMJ Open* 2020;10:e038892.
- Griffin CM, van Berkel VH. Commentary: a return trip to MARS: less may be more when treating Mesothelioma. *J Thorac Cardiovasc Surg* 2022;163:1948–9.
- Rusch VW, Piantadosi S, Holmes EC. The role of extrapleural pneumectomy in malignant pleural mesothelioma. a lung cancer study group trial. *J Thorac Cardiovasc Surg* 1991;102:1–9.
- Falanga F, Rinaldi P, Primiceri C, *et al.* Feasibility and safety of extended pleurectomy/decortication for malignant pleural Mesothelioma. a single group experience. *Thorac Cancer* 2022;13:2792–8.
- Ettinger DS, Wood DE, Akerley W, *et al.* NCCN guidelines insights: malignant pleural mesothelioma, version 3.2016. *J Natl Compr Canc Netw* 2016;14:825–36.
- Opitz I, Weder W. Pleural Mesothelioma: is the surgeon still there. *Ann Oncol* 2018;29:1710–7.
- Zellos L, Jaklitsch MT, Al-Mourgi MA, *et al.* Complications of extrapleural pneumectomy. *Semin Thorac Cardiovasc Surg* 2007;19:355–9.
- Lang-Lazdunski L, Bille A, Papa S, *et al.* Pleurectomy/decortication, hyperthermic pleural lavage with povidone-iodine, prophylactic radiotherapy, and systemic chemotherapy in patients with malignant pleural mesothelioma: a 10-year experience. *J Thorac Cardiovasc Surg* 2015;149:558–65.
- Lauk O, Hoda MA, de Perrot M, *et al.* Extrapleural Pneumectomy after induction chemotherapy: perioperative outcome in 251 Mesothelioma patients from three high-volume institutions. *Ann Thorac Surg* 2014;98:1748–54.
- Sugarbaker DJ, Jaklitsch MT, Bueno R, *et al.* Prevention, early detection, and management of complications after 328 consecutive extrapleural pneumectomies. *J Thorac Cardiovasc Surg* 2004;128:138–46.
- Opitz I, Kestenholz P, Lardinois D, *et al.* Incidence and management of complications after neoadjuvant chemotherapy followed by extrapleural pneumectomy for malignant pleural mesothelioma. *Eur J Cardiothorac Surg* 2006;29:579–84.
- Di Martino M, Sotiropoulos G, Waller DA. Complications following radical surgery for malignant pleural Mesothelioma—prevention and management. *Shanghai Chest* 2018;2:56.
- Mangiameli G, Bottoni E, Voulaz E, *et al.* Extended pleurectomy/decortication for malignant pleural mesothelioma: humanitas's experience. *J Clin Med* 2021;10:4968.
- Friedberg JS, Simone CB II, Culligan MJ, *et al.* Extended pleurectomy-decortication-based treatment for advanced stage epithelial mesothelioma yielding a median survival of nearly three years. *The Annals of Thoracic Surgery* 2017;103:912–9.
- DaSilva MC, Sugarbaker DJ. Technique of extrapleural pneumectomy. *Operative Techniques in Thoracic and Cardiovascular Surgery* 2010;15:282–93.
- Chang MY, Sugarbaker DJ. Extrapleural pneumectomy for diffuse malignant pleural Mesothelioma: techniques and complications. *Thorac Surg Clin* 2004;14:523–30.
- Rusch VW. Extrapleural pneumectomy and extended pleurectomy/decortication for malignant pleural mesothelioma: the memorial sloan-kettering cancer center approach. *Ann Cardiothorac Surg* 2012;1:523–31.
- Ramegowda JK, Salam MA, Nayak V, *et al.* Anaesthetic management of extra-pleural pneumectomy and hyperthermic intrathoracic chemotherapy procedure. *Indian J Anaesth* 2015;59:807–10.
- Ng JM, Hartigan PM. Anesthetic management of patients undergoing extrapleural pneumectomy for mesothelioma. *Curr Opin Anaesthesiol* 2008;21:21–7.
- Hartigan PM, Ng J-M. Anesthetic strategies for patients undergoing extrapleural pneumectomy. *Thorac Surg Clin* 2004;14:575–83.
- Shah SB, Chowdhury I, Darlong LM, *et al.* Clinical pearls in anaesthesia for pleurectomy/decortication for malignant mesothelioma. *TOATJ* 2017;11:29–34.



- 47 Grocott MPW, Pearse RM. Perioperative medicine: the future of anaesthesia *British Journal of Anaesthesia* 2012;108:723–6.
- 48 Wacker J, Staender S. The role of the anesthesiologist in perioperative patient safety. *Curr Opin Anaesthesiol* 2014;27:649–56.
- 49 Hackett S, Jones R, Kapila R. Anaesthesia for pneumonectomy. *BJA Educ* 2019;19:297–304.
- 50 Lederman D, Easwar J, Feldman J, et al. Anesthetic considerations for lung resection: preoperative assessment, intraoperative challenges and postoperative analgesia. *Ann Transl Med* 2019;7:356.
- 51 Doan V, Hammond B, Haithcock B, et al. Anesthetic approach to postpneumonectomy syndrome. *Semin Cardiothorac Vasc Anesth* 2020;24:205–10.
- 52 Lauk O, Deschwanden CV, Inci I, et al. Perioperative anaesthesiological management of malignant pleural Mesothelioma patients undergoing Extrapleural Pneumonectomy (EPP) and extended Pleurectomy/Decortication ((E) PD). *Turk J Anaesthesiol Reanim* 2021;49:494–9.
- 53 Munn Z, Peters MDJ, Stern C, et al. Systematic review or scoping review? guidance for authors when choosing between a systematic or Scoping review approach. *BMC Med Res Methodol* 2018;18.
- 54 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 2005;8:19–32.
- 55 Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.
- 56 Fernando J, Alcock D, Yap SJ, et al. In: *A framework for perioperative care in Australia and New Zealand In AaNZCoA (ANZCA)*. Australian and New Zealand College of Anaesthetists, 2021.
- 57 Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977;33:159.

Supplementary File 1. Search Strategy – Extrapleural pneumonectomy and pleural decortication. Search dates: MEDLINE (1st January 1946), EMBASE (1st January 1974) to March 6th 2024

Database	Search Strategy	Number of Searches
MEDLINE	((("extrapleural pneumonectomy" or "extended pleurectomy decortication" or "extended pleurectomy decortication" or "pleurectomy decortication") and (anaesthe* or anesthe* or anaesthesia or anesthesia or periop* or perioperative or preop* or intraop* or postop* or haemodynamic or "risk assessment" or mortality or morbidity or "critical care"))).tw.	435
EMBASE	((("extrapleural pneumonectomy" or "extended pleurectomy decortication" or "extended pleurectomy decortication" or "pleurectomy decortication") and (anaesthe* or anesthe* or anaesthesia or anesthesia or periop* or perioperative or preop* or intraop* or postop* or haemodynamic or "risk assessment" or mortality or morbidity or "critical care"))).tw.	693
Cochrane	("extrapleural pneumonectomy":ti,ab OR "extended pleurectomy decortication":ti,ab OR "extended pleurectomy decortication":ti,ab OR "pleurectomy decortication":ti,ab) AND (anaesthe*:ti,ab OR anesthe*:ti,ab OR anaesthesia:ti,ab OR anesthesia:ti,ab OR periop*:ti,ab OR perioperative:ti,ab OR preop*:ti,ab OR intraop*:ti,ab OR postop*:ti,ab OR haemodynamic:ti,ab OR "risk assessment":ti,ab OR mortality:ti,ab OR morbidity:ti,ab OR "critical care":ti,ab)	39 (1 review, 38 trials)