Thoracic surgery in high-risk patients

We are pleased to present the readers of *Shanghai Chest* with this series of articles focusing on high-risk thoracic surgery patients. Invited experts have contributed reviews on a number of key areas across this important area of thoracic surgery practice.

Despite the existence of multiple studies and guidelines outlining the principal risk factors associated with adverse outcomes after thoracic surgery (1,2), defining a patient as high-risk remains a subjective process, with the relative importance of certain risk factors altering over time. This phenomenon is particularly apparent in the context of pulmonary function tests. Whilst forced expiratory volume in 1 second was traditionally recognised as an important risk factor for peri-operative mortality and morbidity (3), its role has diminished over time. Indeed, it has been superseded by diffusion capacity of the lung for carbon monoxide, which has emerged as strongly correlating with both mortality and cardiopulmonary morbidity after lung resection in the modern era (4,5).

A major increase in the rate of minimally invasive surgery combined with a decline in the incidence of pneumonectomy over time has also significantly altered the risk profile of patients undergoing lung resection in the United Kingdom (6). Patel *et al.* examine these themes further in their article discussing how high-risk patients are identified and defined.

In the era of promising non-surgical alternative treatments for early-stage lung cancer, such as stereotactic ablative body radiotherapy (7,8), the ability to adequately risk stratify patients with pre-existing high-risk characteristics is increasingly relevant. Whilst multiple clinical risk prediction models have been developed and validated (9,10), examination of their performance in high-risk patient subgroups has rarely been performed (11-13). Taylor *et al.* present a study examining the performance of three risk models when applied to several cohorts of patients undergoing lung resection for primary lung cancer who were deemed to be high-risk based on the presence of pre-existing risk factors.

Modern thoracic surgery is replete with technological, logistical and other patient-centred developments which have progressed the pre, peri and post-operative patient journey to a more sophisticated level. These include the incorporation of enhanced recovery after surgery (ERAS) principles (14,15) where appropriately optimising patients prior to surgery is paramount (16). Ahmed-Issap *et al.* provide a focussed summary of the principles of patient optimisation prior to their undergoing thoracic surgery.

High-risk thoracic surgery does not solely refer to patients undergoing lung resection for malignancy. A large number of patients undergo a range of procedures for benign thoracic disease every year (17), with varying degrees of inherent risk. Moreover, in the absence of malignant disease, the risk to benefit ratio is altered, meaning that thorough pre-operative discussions to allow for truly informed decision making should underpin the consent process in this area of practice. Examples include surgical lung biopsy, which is frequently labelled as a 'minor' procedure. However, such nomenclature belies the mortality and morbidity associated with this operation (18). As a purely diagnostic undertaking, it carries no therapeutic benefit and can sometimes lead to an exacerbation of a patient's underlying parenchymal pathology (19). Brunswicker *et al.* provide an overview of surgical lung biopsy and ask whether it still has a role in contemporary practice.

The management of pulmonary aspergillus is frequently challenging, and usually undertaken in regional or national specialist centres, due to the complexity and scarcity of the pathology. Reaching a decision to offer thoracic surgery for pulmonary aspergillus is not straightforward and is undertaken as part of a multidisciplinary process. Furthermore, surgery itself is also usually very technically demanding, with dense intrapleural adhesions frequently encountered, alongside the aim of avoiding spillage within the thoracic cavity (20). Garner *et al.*, drawing on their experience of working in a high-volume aspergillus centre, review the key principles of managing the patient with pulmonary aspergillus.

Surgical management of severe emphysema is another area of thoracic surgery practice associated with a higher risk of peri-operative morbidity and mortality. Options include the placement of endobronchial valves, lung volume reduction surgery and lung transplantation. The review article examining intervention for severe emphysema is provided by Hayes *et al.* The authors are cardiothoracic anaesthetists working in a cardiothoracic unit which provides extracorporeal membrane oxygenation (ECMO), mechanical circulatory support and the full range of cardiopulmonary transplant services. Consequently, they are well placed to provide a broad and comprehensive overview of all potential treatment options and the

factors to consider when managing these patients.

Finally, in extreme circumstances, a small number of patients require thoracic surgery with the utilisation of ECMO as an adjunct. Dependent upon the set-up, ECMO is capable of providing isolated respiratory support or combined cardiorespiratory support and both have been previously described in the literature. To conclude this series, Eadington *et al.* review the published literature regarding the utilisation of ECMO in thoracic surgery, in addition to outlining a number of peri-procedural factors to be considered, based on their experience working in centres which provide these circulatory support services.

Overall, we feel that these articles provide a comprehensive overview of the major topics and important considerations when managing high-risk patients being considered for thoracic surgery. We are grateful to all of the contributors to this series and look forward to feedback from readers of *Shanghai Chest* in response to the contents of this series.

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