Preoperative Evaluation of Patients Undergoing Lung Resection Surgery: Defining the Role of the Anesthesiologist on a Multidisciplinary Team

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IN THE FIELD of thoracic surgery, one of the key problems in lung resection is the management and function of the residual lung, which has the potential to interfere with both the pulmonary and cardiovascular systems, and, therefore, influence surgical outcome in terms of morbidity and mortality. Between 2007 and 2013, 5 papers addressing preoperative evaluation and risk stratification were published.[1-5] However, the members of the task forces responsible for these documents did not include all the professionals involved in the preoperative surgical evaluation, and the documents mainly addressed the stratification of respiratory risk. In 2014, new guidelines[6,7] addressing cardiac risk assessment in the perioperative period were published and proposed new and distinct approaches, rendering the literature on the assessment and risk stratification of thoracic surgery patients even more confusing. Guidelines are important because they have the potential to improve outcomes and quality of care, especially in high-risk surgical patients (HRSPs), and also improve the management of healthcare resources.

The most appropriate person to serve as the "perioperativist"—overseeing the involvement of all other stakeholders in the preoperative, intraoperative, and postoperative phases of the care of thoracic patients—is the anesthesiologist because of the nature of this professional's training and practice, which already require the assessment, evaluation, and preparation of patients with a multitude of complex comorbidities for surgery.[8]

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Around the world, the role of the anesthesiologist is being expanded thanks to the introduction of innovative delivery care models, such as enhanced recovery after surgery[9] and the perioperative surgical home,[10,11] which are aimed at improving patient outcome while increasing efficiency. Indeed, the 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery recognized the anesthesiologist as the ideal "perioperative physician" to coordinate the preoperative evaluation due to the anesthesiologists' unique and intensive training on the specific demands of the proposed surgical procedures.[8]

In this article, the authors discuss the key items relevant to preoperative evaluation, paying particular attention to the multidisciplinary approach, as depicted in Figure 1. The authors' goal was to establish a simple algorithm that is easy to apply in the clinical setting, an algorithm that takes into consideration the assessments made by the pulmonologist, medical and radiation oncologists, cardiologist, anesthesiologist, and, of course, the thoracic surgeon. The authors reviewed other recently published algorithms and considered the similarities and differences between them to identify the key steps that a preoperative functional evaluation should contain.

THE PULMUNOLOGIST'S PERSPECTIVE

In most cases, it is the pulmonologist who makes the diagnosis of lung cancer, and the patient then is referred to a surgeon. The evaluation of lung function status is one of the most important steps in estimating the risk of postoperative respiratory failure and outcome. Functional status is a reliable predictor of perioperative and long-term cardiac events, and patients with preoperative reduced functional status have a higher risk of developing complications,[12,13] whereas those with a good preoperative functional status are at lower risk. The majority of reports base the preoperative evaluation of respiratory function on spirometry parameters—in particular, forced expiratory volume in the first second (FEV_1) and carbon monoxide diffusing capacity (DLCO). These parameters are evaluated together and assessed as percentages of predicted values (pp), thereby taking into consideration differences related to patient age, height, weight, and sex. However, spirometry requires patient cooperation and its results must be interpreted cautiously before validation.[14-16] There is a general consensus that further tests are unnecessary when FEV_1 and DLCO are normal (ie, $>80\%$ of predicted values) and the patients are evaluated as low risk. For $ppFEV_1$ and

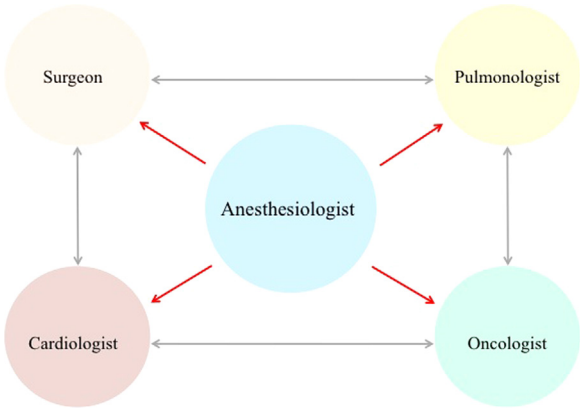

Fig 1. The "true" multidisciplinary approach requires a physician team leader, and anesthesiologists are uniquely positioned to serve as "perioperativists," actively involving all others healthcare participants.

ppDLCO >40% but <80%, the surgical risk is considered as intermediate, but this result should be subjected to interpretation, taking into account the patient's cardiovascular reserve (see the sections describing the anesthesiologist's and the cardiologist's perspective).

Some authors recently have extended this range to less than 40%, considering values as low as 30% as presenting an intermediate risk;[3,4,17-19] although the patient populations evaluated in such studies with very low levels of lung function were heterogeneous and the results were not compared with patient outcomes.[17,18] Nevertheless, this cut-off has been introduced into clinical practice on the basis of indirect evidence and expert consensus opinion.[4]

In a recent report on video-assisted thoracoscopic surgical (VATS) lobectomy, a preoperative FEV_1 or DLCO <30% of predicted values was shown to be a contraindication for surgery, and no other tests for the risk stratification of lung function were recommended at this point.[20] On the other hand, a number of other studies have suggested leaving the limit at 40%.[5,21,22] In summary, the scientific data published to date are inconsistent, making it difficult to formulate an official guideline. Because the lower proposed thresholds can be applied safely, with strong support from the literature, it seems reasonable to maintain a "safety margin" by considering the 40% cut-off and evaluating patients with values between 30% and 40% in more depth before pulmonary resection.

Arterial blood gas analysis should be performed in all patients scheduled for an elective pulmonary resection as part of the basic pulmonary function tests.[22] There is no consensus regarding a value of arterial oxygen tension that clearly indicates an increased risk for pulmonary resection. A $PaCO_2$ >45 mmHg has been associated with an increased risk of postoperative complications, but it is not considered to preclude pulmonary resection.[23] The presence of 1 of the 3 following conditions generally is associated with an increased risk of postoperative complication and/or respiratory failure: FEV_1 <30% of the predicted value, PaO_2 <60 mmHg, or $PaCO_2$ >50 mmHg.[24,25] The cardiopulmonary exercise test (CPET) commonly is used to provide information about the real cardiorespiratory reserve, and it can be performed by means of either a "high-technology" test (ie, measurement of peak oxygen consumption [VO_2 max]) or a "low-technology" test (eg, the shuttle test, stair climbing, or the 6-minute walk test with or without the measurement of oxygen saturation).[3-5] The various published guidelines recommend different tests; for example, one recommends the shuttle test over the stair climbing test,[5] and another suggests a VO_2 cut-off of 10 mL/kg/min,[4] rather than the standard value of 15 mL/kg/min.[26]

CPET generally is recommended in all patients with abnormal lung function (ie, in patients with FEV_1 and DLCO <80%). On the basis of indirect evidence and the consensus opinion of experts, but not objective clinical evidence, the DLCO cut-off value recently was changed from 80% to 60%.[4] Some guidelines suggest that exercise tests should be performed in all patients with FEV_1 and DLCO <80% as the first step in risk stratification, whereas other authors recommend that split-lung function tests are performed first and then only followed by CPET in patients with ppDLCO and/or $ppFEV_1$ <30%.[3,5]

Many different opinions have been published over recent years, generating an ambiguous situation that does not help clinicians resolve their doubts or advise them about the most suitable choices.[1-5] For concrete conclusions to be drawn, conclusive data are required, generated from large studies that compare parameters to outcome, type of surgery, and preoperative patient selection and that summarize all the different practitioner points of view.

A clear and simple guideline for clinicians is needed. The authors' response to this need is the following: high-technology testing in patients with ppDLCO and/or $ppFEV_1$ <40% followed by the stratification of patients with values ranging from 40% to 80% with "low-technology" tests (eg, stair climbing or the 6-minute walk test). If performance in these tests is less than <22 m or <400 m, respectively, these patients should be evaluated using a "high-technology" test (measurement peak oxygen consumption [VO_2 max]).

THE ANESTHESIOLOGIST'S PERSPECTIVE

Over the past decades, anesthesiologists have expanded their focus outside the operating room. This development is not unique to the United States; many countries in Europe have developed strategies to increase the role of the anesthesiologist in the perioperative setting.[8,9,27,28] None of the most recent studies on preoperative evaluation in thoracic surgery has taken into consideration the role of the anesthesiologist or the intensivist[1-5]; thus, these studies have not embraced the real advantages that a truly multidisciplinary team can offer. According to the 2014 ESC/ESA guidelines on noncardiac surgery, the anesthesiologist, who is expert on the specific domain of the proposed surgical procedure, usually should coordinate the preoperative evaluation.[7]

The aim of the anesthesiologist is to improve the surgical outcome by identifying potential anesthetic difficulties and any existing medical conditions and improving safety by assessing and quantifying risk, thereby allowing perioperative care to be planned. In this way, cardiac risk assessment plays an important role. Although the American Society of Anesthesiologists' classification of "physical status" for describing