Anaesthesia for patients with respiratory disease

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Unsurprisingly, pre-existing respiratory disease is a significant risk factor for postoperative pulmonary complications (PPCs). However, because there are also other important risk factors involved, it is necessary to take a broader clinical view of PPCs in order to understand how they can be assessed and minimised, not only in patients with pre-existing respiratory disease, but in all of our patients.

What are PPCs and their complications?

There are no standardised definitions of PPCs, which include a variety of conditions such as pneumonia, aspiration pneumonitis, respiratory failure, reintubation (within 48 hours), prolonged ventilation, bronchospasm, pleural effusion and pneumothorax.

PPCs occur in about 2.5% of cases following major non-cardiac surgery and have a similar mortality (~ 25%).[1] They not only prolong hospital admissions, but are much more expensive to manage than other common major complications (including cardiac, infective and thromboembolic).[2]

Preoperative assessment / investigations for PPCs

Assessing risk of PPCs

The major risk factors for PPCs are well defined, based on very large studies.
In a US Veterans study of over 300,000 patients,[3] the most important predictor of postoperative respiratory failure was the type of surgery, with an odds-ratio (OR) of 11 for abdominal aortic surgery, 3.5 for upper abdominal and peripheral vascular surgery, and 1.9 for any emergency procedures. The major patient–related risk factors were age > 70 (OR 2.6), ASA grade (III: OR 2.9; IV or V: OR 4.9), history of COPD (OR 1.8) and congestive cardiac failure (OR 2.9).

Surprisingly, while obesity increases the risk of other perioperative complications, it is not a significant risk factor for PPCs.[4]

Although several studies have shown that obstructive sleep apnoea (OSA- diagnosed by polysomnography or questionnaire) has been associated with a higher rate of postoperative complications in some studies, it has not been shown to increase the rate of adverse events or unplanned hospital admissions in patients undergoing day surgical procedures.[5] While recent practice guidelines recommend that the severity of OSA should be taken into account in the assessment of perioperative risk (along with the invasiveness of surgery and the requirement for postoperative opioids),[6] this recommendation is not supported by the available literature. In a prospective study of patients undergoing bariatric surgery who routinely received non-invasive ventilation postoperatively, severity of OSA was not associated with increased risk of PPCs.[7] The clinical value of routine screening for the presence and severity of OSA therefore remains unproven.

Recently, severe pulmonary hypertension has been recognised as a significant risk factor for postoperative respiratory failure (~25%), heart failure and death.[8]

Accurate methods to predict the risk of PPCs are useful to facilitate informed patient consent. However, these methods may be less useful in guiding perioperative clinical management, because of the low sensitivity of the tests available and because strategies that have been proven to reduce PPCs should be used in all patients, regardless of risk.

A number of scoring systems have been developed to predict the risk of PPCs. For example, in a recent study of 34,000 patients, the risk of reintubation was examined using an 11-point score that comprised ASA grade (III or IV= 3 points), emergency surgery (3 points), high-risk surgery (2 points), congestive cardiac failure (2 points) and COPD (1 point). The incidence of reintubation in patients with a score of 0 was 0.1%, vs. 5.9% if the score was 7-11.[9] However, because of the low rate of PPCs that may be predicted, this and other scoring systems are too insensitive to guide clinical decision-making in individual patients. Nevertheless, they are important research tools for investigating strategies to decrease PPCs.

Preoperative respiratory investigations

Poor predictive value is also a limitation of routine preoperative screening investigations. For example, spirometry is not recommended for routine screening for risk of PPCs.[4] This is because it has shown to be no better than clinical assessment

by history and examination in predicting the risk of PPCs. Unlike patients undergoing lung resections, there is also no lower limit of FEV_1 that reliably precludes non-thoracic surgery. Similarly, the use of routine preoperative chest X-rays in patients less than 70 years old is not indicated to predict PPCs in the absence of other risk factors. This is because routine preoperative CXRs mostly detect pre-existing chronic condition and have not been shown to significantly alter perioperative management or to improve outcome.[4,10] Cardiopulmonary exercise testing may provide a more quantitative means of assessing "fitness for surgery." In a trial currently underway in London, it is being assessed as a means of stratifying patient risk following colorectal surgery.

Preoperative strategies to decrease PPCs

Smoking cessation

Whether smoking cessation reduces PPCs remains unanswered.[8] This is because cough and sputum production may increase during the first month or two after smoking cessation.

Preoperative steroids

While well-controlled asthma and COPD are not major risk factors for PPCs, poorly controlled patients benefit from preoperative steroids and bronchodilators. In a study of patients with reversible, but poorly controlled reactive airways disease (FEV1<70% predicted and who were not already on chronic bronchodilator therapy), there was a high incidence of bronchospasm post-intubation in patients that received salbutamol alone, either preoperatively for 5 days (7/9 patients) or 10 minutes before induction (8/10 patients). This occurred despite improvements in their spirometry after salbutamol therapy. However, in patients who received methylprednisolone (40 mg) for 5 days preoperatively as well as salbutamol, the incidence of bronchospasm post-intubation was significantly decreased (1 / 10 patients, $p<0.001$).[11] Several studies have also shown that a short course of high-dose steroids preoperatively does not increase the risk of surgical complications.

Intraoperative strategies to decrease PPCs

"Protective" lung ventilation strategies (high PEEP / low tidal volume / low plateau pressure) have been shown to decrease mortality from acute respiratory distress syndrome in the landmark ARDSNet study.[12] There have subsequently been several recent studies on protective ventilation strategies during anaesthesia. Low levels of PEEP promote atelectasis during anaesthesia and in a large retrospective study, were associated with increased mortality and prolonged hospitalisation.[13] Two prospective trials have shown that protective ventilation strategies using moderate (but not high) levels of PEEP decrease PPCs in at-risk patients undergoing abdominal surgery. Ventilation with moderate PEEP (6-8 cmH_2O) and low tidal volumes (6-8 ml/kg + recruitment manoeuvres) reduced PPCs by about 50% when compared with "conventional" ventilation (no PEEP, VT 10—12 ml/kg, no recruitment manoeuvres).[14] However, ventilation with high PEEP (12 cmH_2O, VT =8ml/kg) did not decrease the incidence of PPCs when compared with low PEEP (0-2cmH_2O, VT 8ml/kg).[15] The high-PEEP group also required more vasopressors for hypotension intraoperatively.

In patients with reactive airways disease undergoing general anaesthesia, intraoperative bronchospasm may be detected by failure of expiratory flow to return to baseline. This sign can also guide the response to therapies; such as bronchodilators and prolongation of expiration (by decreasing respiratory rate and I:E ratio).

Although there is consensus opinion that substituting neuraxial or regional anaesthesia for general anaesthesia decrease PPCs, there is little supportive data. There is evidence to support the use of short vs. long -acting muscle relaxants and for laparoscopic vs. open surgery.[8]

For patients undergoing general anaesthesia, the use of an LMA instead of endotracheal intubation decreases the risk of laryngeal spasm post-extubation, although its effect on other PPCs is probably minor.[16] The use of volatile anaesthetics is theoretically attractive because of their bronchodilating properties. However, there is no data that their use decreases PPCs compared with TIVA.

The use of opiate-sparing techniques (such as multi-modal analgesia, local and regional anaesthesia) may limit PPCs due to respiratory depression. Several meta-analyses have shown that thoracic epidural analgesia reduces respiratory complications and duration of ventilation in high- risk patients undergoing major surgery,[17,18] although the magnitude of these benefits is reduced in more recent studies.[19]

Postoperative strategies to decrease PPCs

Following abdominal surgery, the selective use of nasogastric tubes in patients with abdominal distension or symptoms of nausea or vomiting decreases PPCs. However, nasogastric tubes also increase the risk of aspiration and have been shown to actually increase PPCs when used routinely.[20]

The most effective proven strategies to reduce PPCs are lung expansion techniques. These include incentive spirometry, breathing exercises and CPAP. These techniques probably all have similar efficacy, reducing PPCs by about one third. However, CPAP is particularly useful for patients who are unable to perform deep breathing exercises.[21]

Summary

Respiratory disease is one of several risk factors for PPCs. Other important risk factors include patient age and the type, site and acuity of surgery. Patients with respiratory disease should generally not be denied major surgery. However, elective patients with poorly controlled reactive airways disease should be treated with a course of high-dose steroids preoperatively.

There are only a few strategies that have been proven to reduce the incidence of PPCs. These include protective lung ventilation with moderate levels of PEEP, postoperative lung expansion techniques and the selective use of nasogatric tubes. Other strategies that may be effective include avoidance of general anaesthesia and the use of opiate-sparing analgesic techniques (such as regional anaesthesia). These strategies should be used in all patients at increased risk of PPCs, even in the absence of respiratory disease.

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