

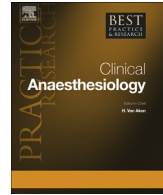


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10

Non-ventilatory approaches to prevent postoperative pulmonary complications



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This educational narrative review provides a summary of non-ventilatory strategies to prevent postoperative pulmonary complications (PPCs). It highlights patient- and procedure-related risk factors for PPCs that are non-modifiable, potentially modifiable, or well modifiable. Non-ventilatory strategies, mainly based on the modification of risk factors, play a key role in reducing PPCs. Non-modifiable risk factors, most importantly age, American Society of Anesthesiologists (ASA) class, and risk of the procedure, should be recognized and patients intensively screened for the potential to optimize other, potentially or well-modifiable, risk factors. Potentially modifiable risk factors, mainly comorbidities and the surgical approach, increase the risk of PPCs. Patient-related factors can be improved while procedure-related factors may be adapted in high-risk patients. Well-modifiable risk factors, mainly certain anesthesia techniques, for example, general anesthesia, intravenous opioids or liberal fluid management, and smoking or alcohol abuse, should be avoided as far as possible in order to prevent PPCs.

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Introduction

Postoperative pulmonary complications (PPCs) represent the most important cause of death after cardiac [1] and non-cardiothoracic [2] surgery, with an incidence of almost 8%, as recently demonstrated [3]. This incidence varies from 2.4% in orthopedic surgery to 31.4% and 39.6% in thoracic and cardiac surgery, respectively [4]. Therefore, measures to prevent the development of PPCs may improve patient outcome. Numerous patient- and procedure-related risk factors for PPC have been identified. Most, if not all, risk factors for PPCs are at least potentially modifiable.

Chronic obstructive pulmonary disease (COPD), asthma, obstructive sleep apnea (OSA), congestive heart failure (CHF), as well as other comorbidities have been shown to increase the risk of PPCs [4–6], and they may be improved to some extent. Cigarette smoking and alcohol abuse also represent relevant risk factors for PPCs, which can be reduced by timely smoking cessation [7] or may be modified by alcohol cessation interventions [8].

A reduction in the maximal inspiratory pressure after symptom-limited exercise is associated with an increase in PPCs [9], and its improvement may reduce their incidence, especially after high-risk surgery [10]. Other important factors that may influence the risk of PPCs – such as the choice of anesthetic strategy, the management of neuromuscular blockade as well as intravascular fluid therapy, the transfusion regimen, postoperative pain therapy, the use of nasogastric decompression, or the choice between open or laparoscopic surgical approach – are under the control of the anesthesiologist and the surgeon, respectively [11]. This review discusses the clinical evidence on non-ventilatory strategies that may be used to prevent PPCs, which are mainly based on the modification of risk factors. Table 1 provides an overview on non-modifiable, potentially modifiable, and well modifiable risk factors for PPCs. The main focus of this review is a general patient population undergoing noncardiac surgery.

Non-modifiable risk factors

Patient related factors

Advanced age and a high American Society of Anesthesiologists (ASA) class represent the most important patient-related non-modifiable risk factors for PPCs. Age independently predisposes patients to PPCs, even after adjustment for the presence of comorbidities [12]. Its importance has been evaluated and confirmed in several large observational studies, defining different thresholds that indicate a significant increase in the risk of PPCs (≥ 65 years [13] and ≥ 51 years) [4]. Similar to age, a high ASA class (≥ 3) is independently associated with an increased risk of experiencing a PPC [4]. In addition, it has proven to be more important than age as a risk factor for acute respiratory distress syndrome (ARDS) [14,15] or unanticipated postoperative reintubation [16,17].

Procedure-related factors

Procedure-related non-modifiable risk factors contribute substantially to an increased risk of PPCs; a higher-than-moderate risk level of the procedure and its classification as emergency represent the most relevant of these risk factors. Both multiply the risk of experiencing a PPC in general [4], as well as the risk of developing ARDS [14,15] or undergoing unanticipated postoperative reintubation [16,17] in particular.

The potential of non-modifiable risk factors for PPCs to worsen the clinical outcome has to be borne in mind. Therefore, patients presenting with non-modifiable risk factors should be intensively evaluated for their potential to optimize other, potentially or well-modifiable, risk factors in order to reduce the overall risk of PPCs. As critical care-based interventions are able to improve outcome, a planned admission to an intensive care unit after surgery should be considered in these patients [18].

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