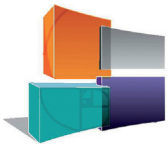
Annales Françaises d'Anesthésie et de Réanimation 33 (2014) 487–491



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Monothematic meeting of Sfar

Non-invasive ventilation after surgery☆,☆☆

Ventilation non-invasive postopératoire

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ARTICLE INFO

Available online 29 August 2014

Keywords:
Surgery
Anesthesia
Non-invasive ventilation
Intubation
Postoperatives complications

ABSTRACT

After surgery, hypoxemia and/or acute respiratory failure (ARF) mainly develop following abdominal and/or thoracic surgery. Anesthesia, postoperative pain and surgery will induce respiratory modifications: hypoxemia, pulmonary volumes decrease and atelectasis associated to a restrictif syndrome and a diaphragm dysfunction. Maintenance of adequate oxygenation in the postoperative period is of major importance, especially when pulmonary complications such as ARF occur. Although invasive endotracheal mechanical ventilation has remained the cornerstone of ventilatory strategy for many years for severe acute respiratory failure, several studies have shown that mortality associated with pulmonary disease is largely related to complications of postoperative reintubation and mechanical ventilation. Therefore, major objectives for anesthesiologists and surgeons are first to prevent the occurrence of postoperative complications and second if ARF occurs is to ensure oxygen administration and carbon dioxide CO_2 removal while avoiding intubation. Non-invasive ventilation (NIV) does not require endotracheal tube or tracheotomy and its use is well established to prevent ARF occurrence (prophylactic treatment) or to treat ARF to avoid reintubation (curative treatment). Studies shows that patient-related risk factors, such as chronic obstructive pulmonary disease (COPD), age older than 60 years, American Society of Anesthesiologists ASA class of II or higher, obesity, functional dependence, and congestive heart failure, increase the risk for postoperative pulmonary complications. Rationale for postoperative NIV use is the same as the post-extubation NIV use plus the specificities due to the respiratory modifications induced by the surgery and anesthesia. Postoperative NIV improves gas exchange, decreases work of breathing and reduces atelectasis. The aims of this article are (1) to review the main respiratory modifications induced by surgery and anesthesia which justify postoperative NIV use (2) to offer some recommendations to apply safely postoperative NIV and (3) to present the main results obtained with preventive and curative NIV in a surgical context.

Mots clés :
Chirurgie
Anesthésie
Ventilation non-invasive
Intubation et complications postopératoires

RÉSUMÉ

L'hypoxémie et/ou l'insuffisance respiratoire aiguë (IRA) postopératoire survient le plus souvent après une chirurgie abdominale et/ou thoracique. L'anesthésie, la douleur postopératoire et la chirurgie vont induire des modifications respiratoires : hypoxémie, diminution des volumes pulmonaires et atélectasie associée à un syndrome restrictif et un dysfonctionnement diaphragmatique. Assurer une oxygénation adéquate en cas de complications pulmonaires postopératoires telle qu'une IRA est primordial. Bien que le recours à l'intubation endotrachéale et la ventilation invasive a été considérée pendant de nombreuses années comme la pierre angulaire de la prise en charge ventilatoire en cas d'IRA sévère postopératoire, plusieurs études ont montré que la mortalité associée aux complications pulmonaires postopératoires étaient en grande partie liées aux complications liées à la réintubation et à la ventilation mécanique

☆ Article presented at Monothematic meeting of Sfar (Société française d'anesthésie et de reanimation): "Perioperative ventilation", Paris, May 21, 2014.
☆☆ This article is published under the responsibility of the Scientific Committee of the "Journée Monothématique 2014 de la Sfar". The editorial board of the Annales françaises d'anesthésie et de réanimation was not involved in the conception and validation of its content.

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http://dx.doi.org/10.1016/j.annfar.2014.07.742
0750-7658/

invasive. Par conséquent, les objectifs majeurs pour les anesthésistes et les chirurgiens sont : (1) d'éviter la survenue de complications postopératoires, (2) en cas de survenue d'IRA postopératoire, d'assurer un apport d'oxygène adéquate (oxygénation) et de veiller à l'élimination du CO_2 (ventilation), tout en évitant l'intubation. La ventilation non-invasive (VNI) ne nécessite pas de sonde endotrachéale ou de trachéotomie et son utilisation est bien établie pour prévenir l'apparition d'IRA (traitement prophylactique ou préventif) ou pour traiter une IRA afin d'éviter une réintubation (traitement curatif). Des études ont montré que les facteurs de risque liés au patient, telles que la broncho-pneumopathie obstructive chronique (BPCO), un âge supérieur à 60 ans, un ASA > II, l'obésité, la dépendance fonctionnelle, et l'insuffisance cardiaque congestive, augmentent le risque de complications pulmonaires postopératoires. La justification de l'utilisation de la VNI postopératoire est la même que l'utilisation de la VNI en post-extubation en plus des spécificités liées aux modifications respiratoires induites par la chirurgie et l'anesthésie. La VNI postopératoire améliore les échanges gazeux, diminue le travail respiratoire et réduit les atélectasies. Les objectifs de cet article sont : (1) de décrire les principales modifications respiratoires induites par la chirurgie et l'anesthésie qui justifient l'utilisation de la VNI postopératoire ; (2) de proposer des recommandations à l'utilisation en toute sécurité de la VNI postopératoire et (3) de présenter les principaux résultats obtenus par l'application de la VNI préventive et curative dans un contexte chirurgical.

1. Acute respiratory failure in the postoperative period

The respiratory function may be substantially modified during the postoperative period. Anaesthesia, postoperative pain and surgery, particularly when the site of the surgery approaches the diaphragm, often induce respiratory modifications such as hypoxaemia, pulmonary volume decrease (vital capacity, functional residual capacity, tidal volume) and atelectasis associated to a restrictive syndrome and a diaphragm dysfunction [1–3]. These modifications of the respiratory function occur early after surgery, and diaphragm dysfunction may last up to 7 days, with important deterioration in arterial oxygenation [4,5]. Moreover, swallowing disorders and vomiting may cause aspiration during the postoperative period. Maintenance of adequate oxygenation in the postoperative period is of major importance, especially when pulmonary complications such as acute respiratory failure occur [6]. It has been suggested that there are 2 potential goals of NIV [7] in the postoperative period (Fig. 1):

- to prevent ARF (preventive or prophylactic treatment);
- to treat ARF and avoid reintubation (curative treatment).

2. Physiologic effects of non-invasive ventilation and continuous positive airway pressure on postoperative respiratory function

Both NIV (which refer to two positive airway pressures) and continuous positive airway pressure (CPAP, which refer to one positive airway pressure) are frequently used in these clinical situations. Imaging studies have shown that the use of NIV may increase lung aeration and decrease the amount of atelectasis during the postoperative period of patients undergoing major abdominal surgery. Physiological studies have shown that CPAP is effective in improving arterial oxygenation after extubation without adverse hemodynamic effect, during postoperative period of cardiac or thoracic surgery [8,9]. Similarly, a physiological study in patients submitted to elective lung resection showed that, compared to standard medical therapy, the addition of NIV resulted in improved arterial oxygenation without changes in arterial carbon dioxide levels, dead space and pleural leaks [10]. By contrast, physiological studies in patients extubated after elective cardiac surgery have shown that NIV caused hemodynamic changes, with improvement in the cardiac index, without changes in systemic and pulmonary artery pressure or in arterial oxygenation [11]. In obese patients with restrictive ventilatory disorder undergoing gastroplasty, nasal NIV during the postoperative period improved the diaphragm dysfunction and accelerated recovery of patients [12].

3. Non-invasive ventilation and continuous positive airway pressure in the management and prevention of postoperative respiratory failure

A case-control study showed that patients with postoperative ARF after oesophagectomy treated with NIV had lower rates of reintubation, development of ARDS and anastomosis leakage, as well as shorter length of ICU stay, compared with historic controls treated conventionally [13]. A prospective observational study in patients who had ARF after abdominal surgery showed that the use of NIV resulted in avoidance of intubation in 67% cases [14]. Patients who required intubation had worse arterial oxygenation and more extended bilateral pulmonary infiltrates than those who escaped from intubation. In this study, arterial oxygenation and tachypnea improved only in the non-intubated patients, with a reduction in the hospital length of stay and mortality, compared with the intubated patients. Several randomised clinical trials have assessed the efficacy of NIV and CPAP in the management and prevention of postoperative ARF of different cause. In patients with solid organ transplantation and postoperative ARF, NIV improved arterial oxygenation and decreased the needs for tracheal intubation, compared with conventional treatment [15]. A study in patients who developed ARF during the postoperative period of lung cancer resection demonstrated that NIV was effective in decreasing the needs for tracheal intubation and improving hospital mortality [16]. A prospective survey confirmed the feasibility and efficacy of NIV in ARF following lung resection [17]. In a similar population of patients undergoing lung resection surgery, the use of prophylactic NIV during the preoperative and postoperative period resulted in less incidence of postoperative atelectasis, improvement of arterial blood gases and pulmonary volumes, as well as in shorter length of hospital stay [18]. The efficacy of NIV in these studies seems, however, related to the underlying disease of patients rather than the postoperative respiratory complications.

The prophylactic use of nasal CPAP in the postoperative period in patients undergoing elective thoracic-abdominal aortic surgery decreased the incidence of pulmonary complications, such as severe hypoxemia, atelectasis, pneumonia and reintubation and the length of hospital stay [9]. The same group [8] obtained similar benefits with the administration of prophylactic nasal CPAP following cardiac surgery, with improved arterial oxygenation,