Anesthesia New Century-Optiflow in Anesthesia-You may use NMJB without Endotracheal Tube or LMA and only with Nasal Cannula

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Abstract

Optiflow was wide used in internal medicine and pediatric. In anesthesia, there were many paper in publish about high-flow nasal oxygen optimizes preoxygenation and apnea time compared with low-flow techniques, and improves carbon dioxide (CO_2) clearance and enhanced apnea time, but no any paper to description using Optiflow in anesthesia. In this paper will be described how to use Optiflow in anesthesia and its principle and mechanism, benefits and limitation.

Keywords: Optiflow anesthesia; Low airway pressure; High flow; Nasal cannula

Introduction

What is Optiflow? Optiflow is word optimal flow, which was provided by Fisher & Paykel Healthcare in 20 years ago. Optiflow device could provide ability to independently titrate FiO_2 (up to 100%) and flow up to 60 L/min. In respiratory therapy, which was a revolutionary therapy and one of the most exciting developments since the introduction of noninvasive ventilation? In internal medicine, the physicists used this device to treat central sleep apnea and COPD, respiratory failure and heart failure patient instead of CPAP [1-4]. In recent years there were some publication about Optiflow could enhance the apnea time for intubation and also increased the outcome in postextubation [5]. But there were no any publication about Optiflow in anesthesia. Does it could be used in anesthesia? That is a good question.

Optiflow in internal medicine

Since Optiflow device was in marketing, the physician used it instead CPAP for COPD [1-4] and heart failure [6], sleep apnea syndrome [7,8] and in newborn infants [9].

The benefits of Optiflow

There were three kinds of benefits including caregivers, patients and hospitals.

For Caregivers

a. Reduced need to change between multiple oxygen devices

b. Accurate oxygen delivery

c. Improved respiratory efficiency

d. Effective postextubation support

e. Reduced escalation of care

For Patients

a. Reduced need to wear a face mask

b. Able to eat, drink and talk while receiving therapy

c. More comfortable

d. Full moveable

For Hospitals

a. Potential reduction in number of ventilator days

b. Potential reduction in length of stay in ICU

c. Cost down

d. Satisfaction enhancement

Optiflow in anesthesia, does it can?

Everybody knows that the oxygen could not transfer to the brain directly, because of the brain was protected by the skin and the skull bone. And the oxygenation must be done by the respiration system. The mechanism of respiration was by diffusion and bulk flow. Every time, at rest breathing, approximately one

third of tidal volume is breathe in from the anatomical dead space. The anatomy dead space in adult is about 150 ml (2.2mLs/kg) [10], and the alveolar dead space [10] is sum of the volumes of those alveoli which have little or no blood flowing through their adjacent pulmonary capillaries, i.e., alveoli that are ventilated but not perfused, and where, as a result, no gas exchange can occur. Alveolar dead space is negligible in healthy individuals, but can increase dramatically in some lung diseases due to ventilation-perfusion mismatch. This was about 24ml. The diffusion, we can not to control it, but the rebreathing gas in dead space we could control. Normally, we need inspiration and expiration to reduce the dead CO_2. But now we used high volume bulk flow, the dead space CO_2 will be changed to be oxygen, a nearly 100% oxygen in dead space. Which significantly reduce CO_2 rebreathing due to HFNC, approximately 1.8 cc/second increased in clearance for every 1.0 L/min increase in flow? Because of that, we may use neuromuscular junction blocker (NMJB) without endotracheal tube or LMA and only with nasal cannula (Figures 1-3).
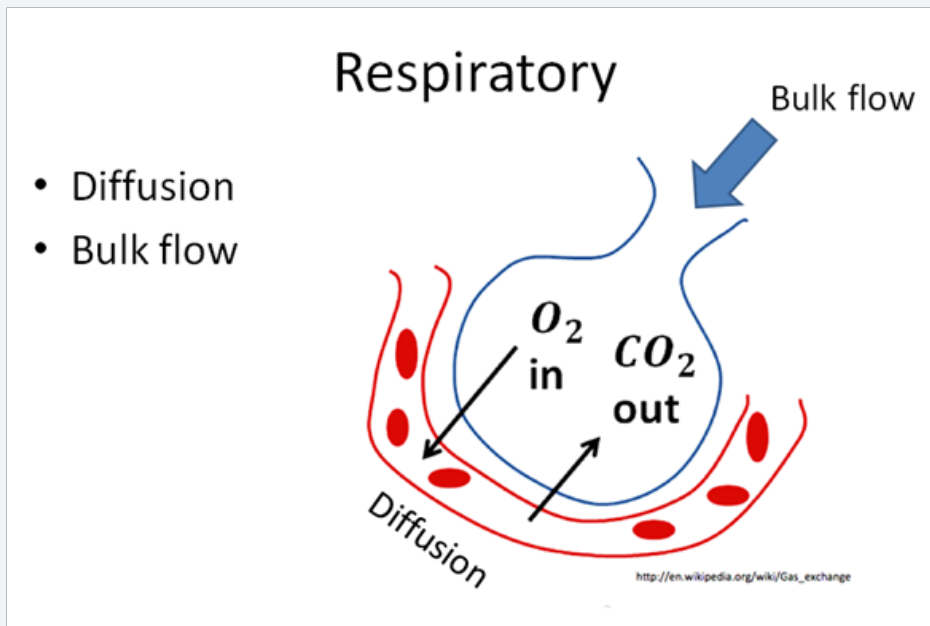

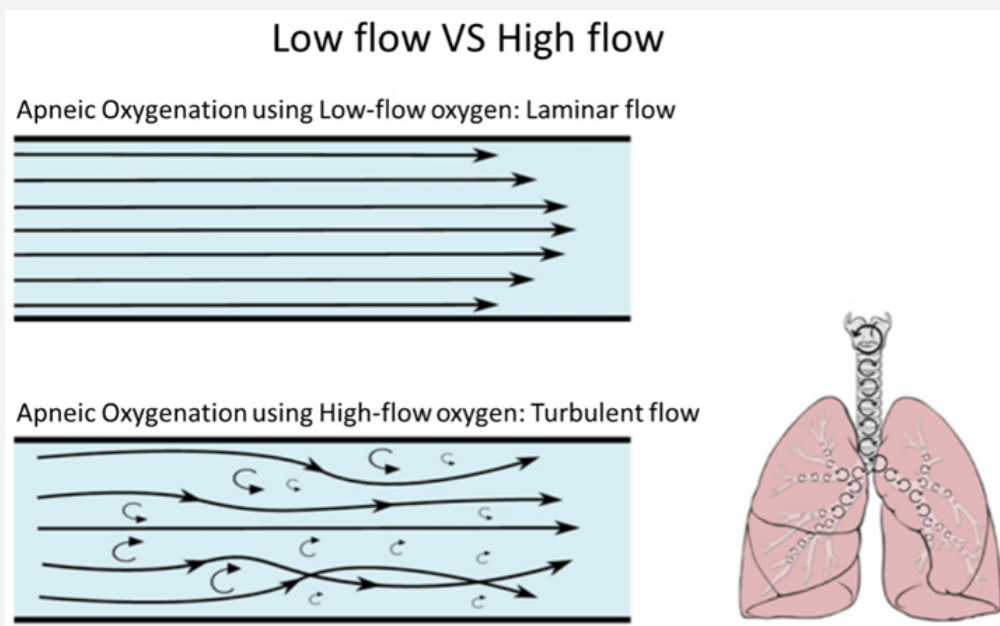**Figure 1:** The mechanism of respiration.
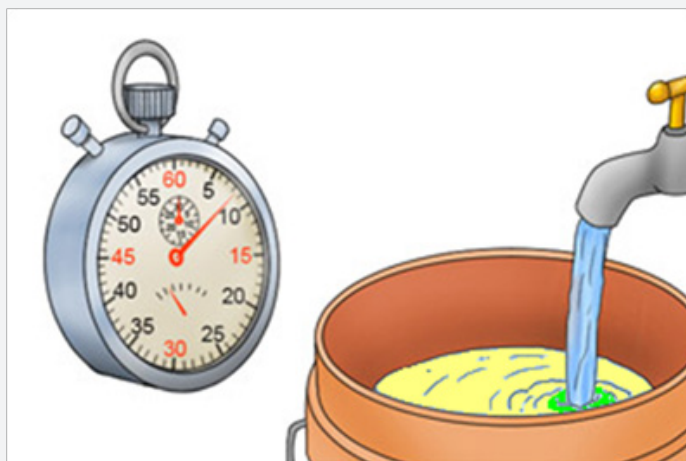

Figure 2: Low flow VS High flow.

Figure 3: The principle of dead space CO_2 wash out due to the volume and time. The bucket volume is a constant, when the flow increased, the time will decrease. As that, when the oxygen flow increased (using high flow), the dead space will be fully filled with oxygen earlier T_1F_1 = T_2F_2.

Optiflow is more effective than traditional oxygen delivery devices in

a. Improved patient comfort and tolerance

b. Greater therapy success than with face masks

c. Improved lung volumes

d. Improved respiratory rates

e. Improved oxygenation with fewer desaturations

f. Optimized mucociliary clearance

Is all Optiflow device could be used in anesthesia?

In Fisher & Paykel Healthcare, they provided two types of humidifier, one is home humidification and the other is hospital humidification. In hospital humidification, there were only MR810 Heated Humidifier and MR850 Heated Humidifier could be used in anesthesia. It was because of those model could provide 100% oxygen, invasive and noninvasive ventilation and the others were not.

The benefits of Optiflow in anesthesia

Heated and humidified oxygen with constant concentration

a. Inhaling dry and cold oxygen provokes upper airway dryness frequently leading to intolerance, and potentially impairing mucociliary function [11,12].

b. Conventional oxygen delivers exceeding 6 L/min can lead to insufficient nasal mucosa, even when a cold bubble humidifier is used [11,12].

Positive pharyngeal pressure [13]

a. Depends primarily upon the flow rate provided by HFNC but also upon the expiratory flow exhaled by the patient.

b. Maintain a steady level of positive pressure during the whole cycle of breath. Parke et al. reported that HFNC increased the mean pharyngeal pressure by about: 1 cm H2O per 10 L/min, within a range of 30-100 L/min.

c. At rest breathing, approximately one third of tidal volume is rebreathed from the anatomical dead space.

d. Significantly reduce CO_2 rebreathing due to HFNC, approximately 1.8 cc/s increase in clearance for every 1.0 L/min increase in flow.

How does the dead space gas washout?

Apneic oxygenation using low-flow oxygen is laminar flow, and the apneic oxygenation using high-flow oxygen is turbulent flow, so that the dead space CO_2 could be washout [14]. For easily understand, I give a simple study to explain. When you have a bucket of sea water, you used tap water to dilution it (Figure 3). Even you used low flow with long time or used high flow in short time, the sea water must be dilution to be nearly to tap water. So that, when you used high flow the dead space CO_2 could nearly totally wash out.

How does the respiration going on?

In the dead space CO_2 was exchanged by oxygen, every inspiration only with the minimal CO_2. So that, even the lung no ventilation, the diffusion was going on, and the patient without any hypoxia. This phenomenon you may use brain function monitor (Production by Masimo Company) to monitoring the SpO_2, which could monitoring SpO_2 from 100% to 400%.

How we can use Optiflow in anesthesia?

We must remember that, when you used Optiflow in anesthesia, you could not use inhalation agents, because the flow is too high, if you use that, the outcome is very horrible. And the concentration of inhalation agents you could not easily to control. So, you only could use TIVA/TCI for hypnosis and analgesia. Before induction, you may give the flow about 30L/min for 10 minutes; then you may run TCI. When the patient in sleep, you may adjust

the oxygen flow to be 70L/min. At that time you may use NMJB or not. If you do not used NMJB, the flow up to 50/min is enough.

Is it supported any surgical position?

Yes, it could, even in prone and lateral position.

Acidosis

During in spontaneous breathing, the patent with mild acidemia and doesn't need to treat. When in nonspontaneous breathing, the acidemia is worst then in spontaneous breathing patent. Sometimes you may treat with them.

In POR

When a patient in POR needs reintubation, we can use Optiflow to instead.

Indication

All kind of surgery even the patient is in critical state beside contraindication.

Contraindication

Severe respiratory acidosis. Non-patent nasal passages or facial trauma.

Facial surgery

Patients who cannot maintain a patent airway. Do not have spontaneous respiratory effort. Head and/or neck injury which has not yet been stabilized. Active hemorrhage with hemodynamic instability. Oral surgery needs electric cauterization.

a. Laparoscopic surgery.

b. Open heart surgery.

c. Transplantation surgery.

Conclusion

Used Optiflow in anesthesia was innovative and exciting, which could reduce perioperative mortality and morbidity. We could use Optiflow in most of surgery.

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