

Additional Factors Affecting Non-Invasive Ventilation in Patients with COVID-19

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Abstract

In this article, several factors concerning uncomplicated non-invasive respiratory support of COVID-19 patients are considered.

Keywords: COVID-19; Respiratory Failure; Respiratory Support; Non-Invasive Ventilation; Inspired Gases Humidification; Humidifier

Abbreviations

PEEP: Positive End-Expiratory Pressure; Ps: Pressure Support; Pramp: Time of Achieving Ps; ETS: Expiratory Trigger Sensitivity; RR: Respiratory Rate; Vt: Tidal Volume

Introduction

While research is ongoing as to best practices of respiratory support in COVID-19 patients after it was shown that tracheal intubation and mechanical ventilation were associated with high mortality, some logical, rational miscellaneous details concerning non-invasive ventilation should also be taken into account. These include possibility of worsening of respiratory failure with humidification, necessity of adequate sedation, positioning the inlet of the tight-fitting face mask in front of the nose of the patient in case they breathe via it, caution with which Ps parameter must be regulated and the need of increased supply of flowmeters which get out of order with the largest minute volumes.

Case Report

Firstly, two cases of obvious worsening of respiratory failure in COVID-19 patients already receiving non-invasive respiratory support via tight-fitting face mask right after switching on of the humidifier must be discussed.

This complication was not observed in all patients; rather, in several patients out of appr. 200 who were treated in my ICU from April 2020 till now. All these patients were fully cooperative and immediately reported shortness of breath after initiation of humidification. Their respiratory rate also increased by about 10%.

One of these patients breathing via the nose in the humidification-off period reported increased difficulty breathing with inlet of the tight-fitting face mask not in front of their nose. After repositioning of the mask the case resolved.

If non-invasive ventilation was initiated, PEEP was not high, 6 - 10 cmH₂O, F_IO₂ was up to 100% and Ps was around 10 cmH₂O. Pramp was low, 25 - 50 msec, to meet the demand of the patients, and ETS was 5 - 10% to give the patients the volumes they needed; in case of obstructive syndrome, ETS were increased up to 40% to allow longer expiration. Sedation with natrii oxybutirati or with morphine in case pulmonary edema developed was utilized.

Results and Discussion

As regards to humidification, despite improving ciliary clearance, reducing water and metabolic loss, decreasing density of inspired mixture thus reducing the work of breathing, at 30°C, which is an automatic option in our humidifiers for non-invasive ventilation (the other is 37°C for invasive ventilation) in nasal or oral cavity saturated water pressure is produced with condensation of water on the mucous membranes, which may increase resistance.

Inlet of the tight-fitting face mask situated not in front of the nose obviously increases resistance to flow.

With abovementioned parameters of non-invasive ventilation approximately one third of the patients did not progress to invasive ventilation and were either given high-flow oxygen therapy or conventional oxygen therapy thereafter despite initial RR up to 50 bpm, Vt = 800 - 1200 ml. Almost one third of the patients were sensitive to any changes to Ps despite quite low values.

Sedation was important in reducing RR and Vt, along with PEEP preventing self-inflicted lung injury [1]. Natrii oxybutirati was preferred owing to little influence on preload with COVID-19 shunts and its better sedation profile without long-term adverse effects on the consciousness.

One of the problems I encountered is the high incidence of breakdown of flowmeters with such a large minute ventilation.

Conclusion

Humidifiers must contain broader spectrum of temperatures, not just two automatic options.

Positioning tight-fitting face mask with inlet in front of the nose of the patient in case they breathe via it aids in decreasing resistance and could be a problem with anatomical variations of the face. As for Tobin [2], anaesthesiologists do not necessarily have to initiate mechanical ventilation in COVID-19 patients despite the largest RR and Vt ever. There should be a backlog of flowmeters in COVID-19 pandemic.

Acknowledgements

Herein, let me devote this article to my wife, who supports me in tough COVID-19 times while caring for our daughter, and to Valentina Vladimirovna Leonova, the nurse in the first cardiac ICU in the Soviet Union and subsequently Russia, who unexpectedly passed away and was always devoted to her job and who I utterly respect.

Conflict of Interest

None exists.

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