Evaluation of fractional delivered oxygen between nasal cannula and nasal oxygen catheter

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Introduction

Oxygen therapy is the main supportive treatment of hypoxia. Nasal cannula (NC) and nasal oxygen catheter (NOC) were used to administer oxygen therapy in hypoxia. Few studies have examined the difference in fractional delivered oxygen(FDO2) between these two systems. The aim of our study was to compare the difference of FDO2 between NC and NOC.

Material and Methods

On a bench study, a two-compartment model of adult lung (Dual Test Lung DTL, Michigan Instrument) was connected to a Servo i® Ventilator. The ventilator was set in volume-controlled mode. Three minute ventilation (MV: 6/9/12 L/min at Ti/Ttot=0.33) and two oxygen flow rate (OFR: 2 and 4 L/min) were analyzed. OFR was analyzed with a thermal mass flow meter Vogtlyn™ Red Y. The compliance of the artificial lung was set to 70 ml/cm H2O and the resistance set to 5 cm H2O/L.sec-1. The FDO2 and MV measurements were made using an iWorx® acquisition system (GA207 gas analyzer and analog / digital IX / 228s) and LabScribe II® software. To simulate the anatomic dead space of the nasopharynx (+/- 50 ml for an adult) we have used a 15 cm length corrugated tubing ISO 22 mm (CT22) at the level of inflow of DTL. NC was introduced at the entry of the CT22 while the NOC was introduced totally into the CT22. Statistical: ANOVA on ranks followed by Student Newman Keuls

Results

FDO2 between NC and NOC at OFR 2 and 4 L/min and VE: 6 – 9 – 12 L/min

VE(L/min)	NC 2 L/min	NOC 2L/min	NC 4 L/min	NOC 4L/min
6	31%(0.5)	37%(0.5)	38%(0.6)	43%(0.5)
9	29%(0.7)	34%(0.6)	34%(0.5)	39%(0.7)
12	26%(0.6)	30%(0.6)	30%(0.7)	34%(0.5)

Table 1: FDO2 comparison between NC and NOC at different OFR and MV

ANOVA on ranks : $p<0.05$, except between: NOC2 (VE 9L/min) and NOC4 (VE12L/min) / NC2 (VE 9L/min) and NOC2 (VE12L/min) / NOC2 (VE 12L/min) and NC4 (VE12 L/min) / NC4 (VE 9 L/min) and NOC4 (VE 9 L/min)/ NOC2 (VE 9L/min) and NC4 (VE 9 L/min)

Conclusion

In oxygen therapy, with NC or NOC, for a Ti/Ttot = 0.33, FDO2 is influenced by MV, OFR and oxygen system delivery. For the same level of OFR and system delivery, when MV increases, FDO2 decreases (see table 1). For the same MV and level of OFR, FDO2 was more efficient with NOC than NC. The differences of FDO2 between NOC and NC decrease with increasing MV. The FDO2 fluctuations according to the value of the MV are greater with the NOC to 4 L/min.

In clinical situation, NOC is less used than the NC. Compared to the NC, NOC is an alternative to increase the FDO2 with the same OFR. NOC is more efficient than NC because during expiratory time, anatomical dead space it fills with O2, which increases the FDO2. However, if the respiratory frequency increases then expiratory time decreases, filling with O2 decreases which reduces FDO2. Note that NOC may become uncomfortable at OFR greater than 5 L/min.

Bibliographic references

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