

## Variability of fractional delivered oxygen (FDO2) with nasal cannula

Frédéric Duprez(1); Thierry Bonus(1); Grégory Cuvelier(2); Sharam Machayekhi(1); Sandra Ollieuz(1); Gregory Reychler(3)

(1) Icu, C.H. Epicura Hornu, Hornu, Belgium; (2) Laboratoire de l'effort et du mouvement, Condorcet, Tournai, Belgium; (3) Irec, pôle de pneumologie, ucl, Cliniques Universitaires Saint Luc, Bruxelles, Belgium

### Introduction

Nasal Cannula (NC) is an option to deliver oxygen therapy. According to American Thoracic Society (ATS), standard NC delivers a fractional delivered oxygen (FDO2) of 24-40% at supply oxygen flows ranging from 1-5 L/min. An equation was proposed by ATS to predict oxygen delivery:  $FDO2 = 20\% + (4 * O2 \text{ L/min})$ . Moreover, for ATS, FDO2 is also influenced by respiratory frequency (Rf), tidal volume (Vt) and ratio Ti/Ttot. However, the equation of ATS does not take into account these parameters. Our hypothesis is that these parameters can significantly affect the FDO2. The aim of this study was to determine the effect of Rf, Vt and Ti/Ttot on FDO2.

### Material and Methods

The study was conducted on bench with NC connected to a two compartment adult lung model (Dual Test Lung ®) (DTL) controlled by a Maquet Servo I® ventilator. One oxygen flow rate (OFR) (5 L/min) and three minute ventilation (MV: 6/9/12 L/min) with two Ti/Ttot (0.33 and 0.25) were investigated. All settings of MV were generated by modifying Rf (10 to 40 CPM) and Vt (0.3 and 0.6 L). Inspiratory flows rate (IFR) obtained with settings range from 18 to 48 L/min. OFR was analyzed by a thermal mass flow meter Vogtlyn™ Red Y. FDO2 and MV measurements were made using a iWorx® acquisition system (GA207 gas analyzer) and LabScribe II ® software. Compliance of DTL was set to: 0.07 L/cm H2O and resistance to: 5 cm H2O/L.sec-1. Statistical: ANOVA repeated measures followed by Newman Keuls method.

### Results

#### FDO2 comparisons between:

#### Ti/Ttot 0.33 and 0.25 and three MV: 6 – 9 – 12 L/min at OFR: 5 L/min

MV (L/min)	Ti/Ttot = 0.33				Ti/Ttot = 0.25			
	RfxVt	FDO2	RfxVt	FDO2	RfxVt	FDO2	RfxVt	FDO2
6	10x0.6	41%(a)	20x0.3	42%(d)	10x0.6	36%(g)	20x0.3	37%(j)
9	15x0.6	36%(b)	30x0.3	35%(e)	15x0.6	32%(h)	30x0.3	32%(k)
12	20x0.6	31%(c)	40x0.3	30%(f)	20x0.6	30%(i)	40x0.3	29%(l)

Table 1: FDO2 comparisons between different TI/Ttot and MV at OFR 5 L/min

Rf: respiratory frequency (in CPM) - Vt: tidal volume (in Liter)

ANOVA RM results:  $p < 0.05$ . No statistical difference are found between: (a-d)/(b-e)/(c-f)/(g-j)/(h-k)/(i-l)/(b-j)/(b-g)/(f-k)/(c-k)/(f-h)/(f-l)/(f-i)/(c-i)/(c-l)/(e-g)

### Conclusion

IFR and OFR are the main determinants of FDO2. Equation of ATS is correct when IFR is equal to 18L/min.

When IFR is different of this value, Equation of ATS is not appropriate.

In our experiment, with an OFR of 5L/min, when IFR = 18 L/min (MV = 6 L/min and Ti/Ttot =0.33), the FDO2 is equal to 41 % (+/- 1%) (see table 1). To this value of IFR, the FDO2 is in accordance with the formula of ATS, but when IFR increase beyond 18 L/min, the FDO2 decrease and the formula is not in accordance with ATS. This can be explain because during inspiratory phase, air room (Fractional oxygen = 0.21) entry in airway mixes with OFR (FO2=1), which modifies the FDO2. In this case, when IFR increase then FDO2 decrease and vice versa. Medical and paramedical staff must be aware that with patients who receive OFR by nasal cannula, any change of OFR and/or inspiratory flow changes the FDO2. In this case, for maintain the same FDO2, it is necessary that modify the value of OFR.

### Bibliographic references

- Wagstaff T, Soni N. Performance of six types of oxygen delivery devices at varying respiratory rates. *Anaesthesia*, 2007, 62, 492-503

Number: **000055**

Speaker: **Frédéric Duprez**

Structure : **Structure 2**

Theme : **Emergency medicine and trauma**

Study type : **Experimental**

Conflicts of interest : **No**

Format instructions

Publication instructions

Ethic obligations

Presence obligation

Agreement to transfer rights

Updated on: **Saturday, September 17, 2016 1:01 PM**