Pediatric nasal nitric oxide measurement:
A new sampling method that assures the velum closure without subject cooperation

T. Carvelli[1], J.B Martinot[2], N.N Le Dong[3], H. Guenard[4], P.E Silkoff[5].

(1) CHR-Verviers/BE, (2) Clinique et Maternité Sainte Elisabeth - Namur/BE, (3) Cochin Hospital – Paris/FR,,
(4) Laboratoire de Physiologie CHU – Bordeaux /FR, (5) Department of Medicine Temple University-Philadelphia, PA/US

1 Background

Measurements of nasal NO concentration are helpful to screen for primary ciliary dyskinesia in children and infants with a suggestive clinical presentation. The best standardized method to sample nasal NO in isolation from the lower respiratory tract is performed with aspiration at a fixed flow through the nose while the subject exhales against resistance to close the velum. The time to NO plateau can be in excess of 30 seconds and the need to breathe against fixed resistance for this time makes this impractical in very young children.

We evaluated a new nasal NO sampling method (Fig.1) that does not require exhalation against resistanced

2 Material and Method

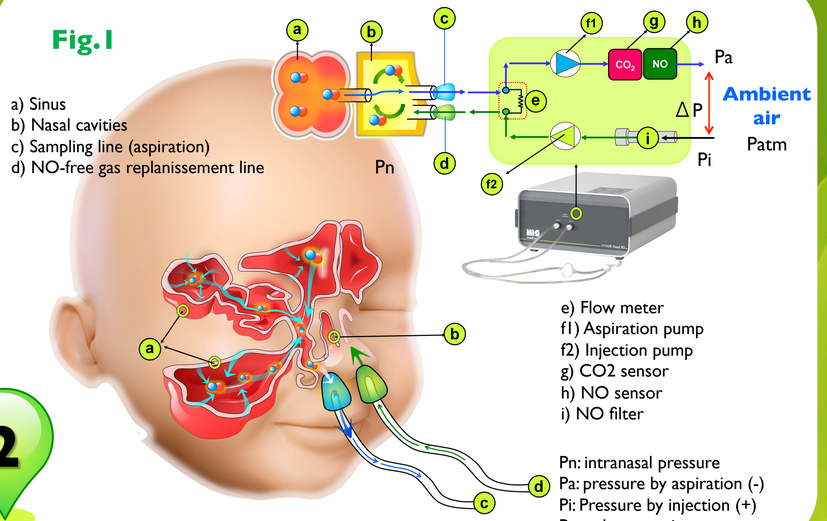
Nasal NO was measured in 15 healthy children (2-6 yrs old) using an electrochemical prototype (Medisoft, Sorinnes, Belgium). Each child performed 4 measurements per nostril.

The new method consists to create a parallel sampling circuit with air compensation. Nasal air is aspirated from one nostril and NO-free air is replenished to the other nostril thus creating a constant flow through both nasal cavities in series.

This maintains the intranasal pressure constant. The sampling flow rate is kept constant at 250 ml/min and CO2 is monitored in real time to ensure that there is no entrainment of gas from the pharynx that might contaminate the nasal sample with lower respiratory NO.

The main outcome parameters include: fractional concentration of nasal NO (nNO) , nasal NO output (VNO), length of the nasal NO plateau and reproducibility (coefficient of variation from 4 measurements) for each nostril

Fig.1



a) Sinus
b) Nasal cavities
c) Sampling line (aspiration)
d) NO-free gas replanissement line

e) Flow meter
f1) Aspiration pump
f2) Injection pump
g) CO2 sensor
h) NO sensor
i) NO filter

Pn: intranasal pressure
Pa: pressure by aspiration (-)
Pi: Pressure by injection (+)
Patm: barometric pressure

Subject number	Gender	Age (year)	(L) nostril nNO (mean, ppb)	(R) nostril nNO (mean, ppb)	Left nostril VNO (nl/min)	Right nostril VNO (nl/min)	Coefficient of variation (%)	Length of plateau (second)
1	Boy	4.00	643.60	612.50	160.90	153.13	3.39	20
2	Girl	4.04	472.50	425.00	118.13	106.25	7.63	30
3	Boy	2.67	447.50	437.50	111.88	109.38	4.93	8
4	Boy	4.92	1010.50	974.00	252.63	243.50	2.57	24
5	Girl	5.67	490.50	441.50	122.63	110.38	9.03	8
6	Boy	6.17	1043.00	992.00	260.75	248.00	3.09	12
7	Girl	6.08	855.50	855.00	213.88	213.75	2.70	8
8	Boy	4.50	793.75	709.00	198.44	177.25	7.92	12
9	Boy	4.58	343.00	406.00	85.75	101.50	9.86	4
10	Boy	2.92	400.00	400.00	100.00	100.00	0.00	16
11	Girl	5.00	226.00	163.00	56.50	40.75	19.10	17
12	Boy	4.00	802.50	719.50	200.63	179.88	6.36	18
13	Boy	5.58	848.50	798.50	212.13	199.63	5.35	20
14	Girl	5.90	284.50	265.00	71.13	66.25	6.13	29
15	Girl	4.00	324.50	279.50	81.13	69.88	9.32	10
Median		**4.58**	**490.50**	**441.50**	**122.63**	**110.38**	**6.13 %**	**16 sec**

3 Results

All subjects were able to perform the 4 tests for each side, with a low CoV (Median = 6.13%). VNO measured ranged from 48.6 to 254.8 nL/min. However, there was a significant difference between values obtained from the 2 nostrils (Wilcoxon test, p=0.01) for unclear reasons.

In most cases, the plateau lasted longer than 10 seconds. In general CO2 levels were very low indicating vellum closure: Median = 0.62% and 95%CI = 0.569 %- 0.672%). No relationship was found between age and nasal NO plateau length.

The individual results are shown in Table. Example from a 4 yrs old boy is presented in Fig. 2A.

Another example in Fig. 2B shows that the change in transnasal pressure might lead to alveolar air admixture and by consequence, fluctuation of the nasal NO signal.

Fig.2A

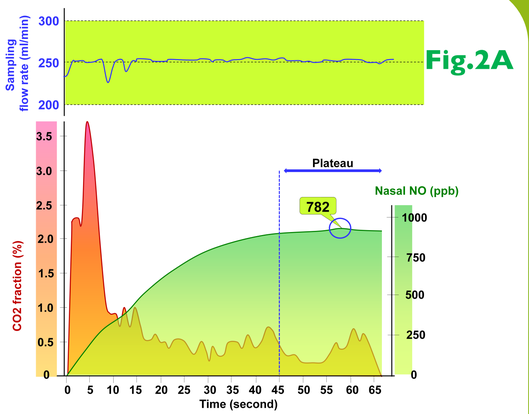
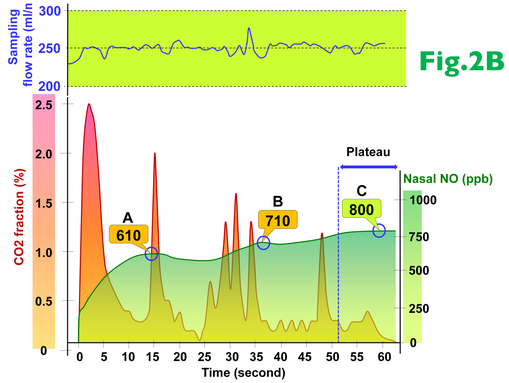


Fig.2B



4 Conclusion

The new method offers considerable advantages over the conventional technique. The control lower respiratory tract air contamination (CO2 monitoring) is assured, the measurement requires only tidal breathing with **no effort**, thus making the measurement easier to perform even with the small children under 5 years old.

The authors have no conflict of interest