

Comparison of response to aerosol drug delivery with mesh and jet nebulizers during non-invasive ventilation (NIV) in acute exacerbation of COPD.

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Introduction

Administering aerosolized medications to patients receiving noninvasive ventilation (NIV) is a common practice in critically ill patients with acute respiratory failure because it has demonstrated a clear clinical benefit [1,2]. Advances in aerosol technology have improved drug delivery efficiency during NIV [3]. In healthy subjects during NIV vibrating mesh nebulizers (VMN) delivered > 3-fold more radiolabeled drug into the respiratory tract compared with conventional jet nebulizers (JN) [4]. Clinical evaluation of the efficacy of aerosol therapy during NIV in the treatment of acute exacerbation of COPD (AE COPD) is very limited [5].

Aim

To compare efficacy of bronchodilators administered via a VMN and JN during NIV in patients with AE COPD



Methods

•30 patients treated with NIV for AE COPD.

Inclusion criteria

- AE COPD
- NIV (face mask)
- GOLD Stage 3-4 (Severe)
- Age > 40 years
- Able to perform PFT maneuver

Patients were consented and enrolled after AECOPD stabilization (3-5 days after admission).

Exclusion criteria

- Non-cooperative patients
- Unstable (hemodynamic, respiratory)
- Allergy or contraindication to salbutamol
- Pneumonia

Design

- Prospective randomized cross-over study;
- Subjects were randomly assigned into 2 treatments arms receiving salbutamol (2.5 mg): with VMN (Aerogen Solo®) and JN (Sidestream®);
- Alternate treatment arm was administered after ≥12 hour washout;
- Nebulizers were positioned between the leak port and the mask [6] during bi-level ventilation with a single-limb circuit and non-vented oronasal mask without humidification.

Measurements

- Clinical data (SpO₂, RR, HR, BP)
- Pulmonary function tests (FVC, FEV₁, IC, FEF_{50%})
- Cough peak flow
- Arterial blood gases
- Borg dyspnea score

Measurements were performed at baseline, 1, 2 and 4 hours after treatment.

Table 1. Basic characteristics of COPD patients.

Variables	Conventional jet nebulizer	Aerogen nebulizer	P value
Age, years	65,5±8,9	65,5±8,9	NS
Gender (M/F), no	23/7	23/7	NS
Height, cm	167±6,67	167±6,67	NS
Weight, kg	84,7±26,6	84,7±26,6	NS
Smoking history, packs/years	43,6±6,33	43,6±6,33	NS
RR, min ⁻¹	22,3±2,00	21,9±1,83	NS
HR, min ⁻¹	85,5±9,53	85,8±9,9	NS
SpO ₂ , %	82±7,78	85±5,62	NS
FEV ₁ , % predicted	32,2±12,8	31,5±11,7	NS
FVC, % predicted	48,9±16,6	50,3±17,2	NS
FEF ₅₀ , % predicted	15,5±10,3	15,2±10,7	NS
Cough peak flow, L/min	184,4±77,6	196,6±83,4	NS
Dyspnea Borg score	6,2±1,15	5,9±1,12	NS
PaO ₂ , mmHg	52,7±8,30	55,6±10,5	NS
PaCO ₂ , mmHg	61,2±10,5	56,0±7,2	0,0299
pH	7,367±0,03	7,383±0,03	NS
Lactate, mmol/L	2,38±0,46	2,20±0,51	NS

Data were presented as mean ± SD, except male/female as number.

Results

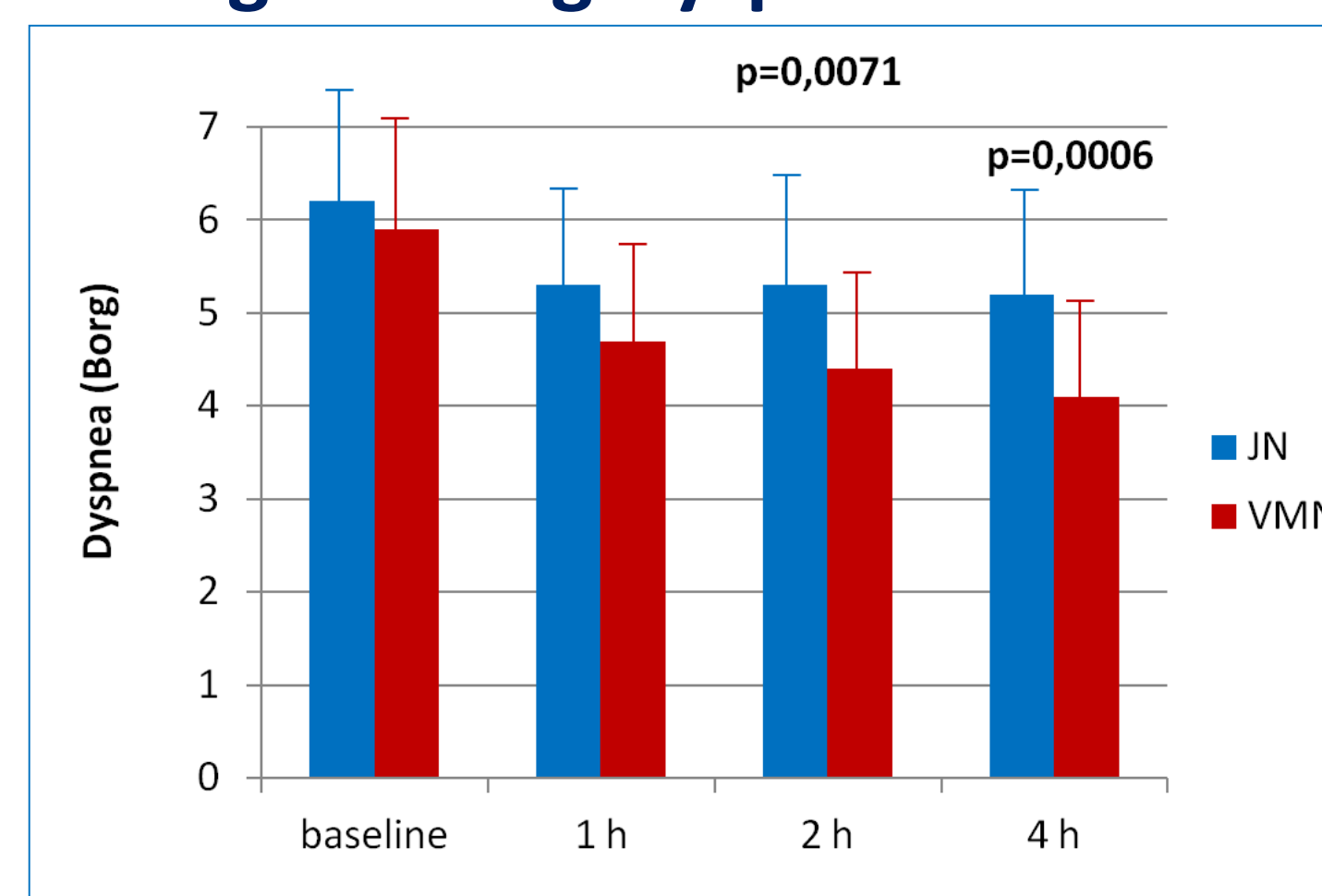
- The degree of change between groups in Borg dyspnea score was significantly reduced with VMN (5.9±1.1 to 4.1±1.17) than JN (6.2±1.2 to 5.2±1.2; p=0.0006) after 4 hours.
- A reduction in respiratory rate (baseline to 4h) from 21.9±1.9 to 19.3±1.4 b/min vs 22.3±2.0 to 20.8±1.64 b/min was observed; with VMN and JN, respectively; p=0.0003), and the degree of change was significantly reduced with VMN.
- All PFTs, SpO₂, PaO₂ and PaCO₂ parameters improved in both groups, but overall changes from baseline to 4 hours were greater with VMN than JN, especially for FVC (110 mL vs 400 mL).

Table 2. Changes in variables from baseline with conventional nebulizer or Aerogen nebulizer.

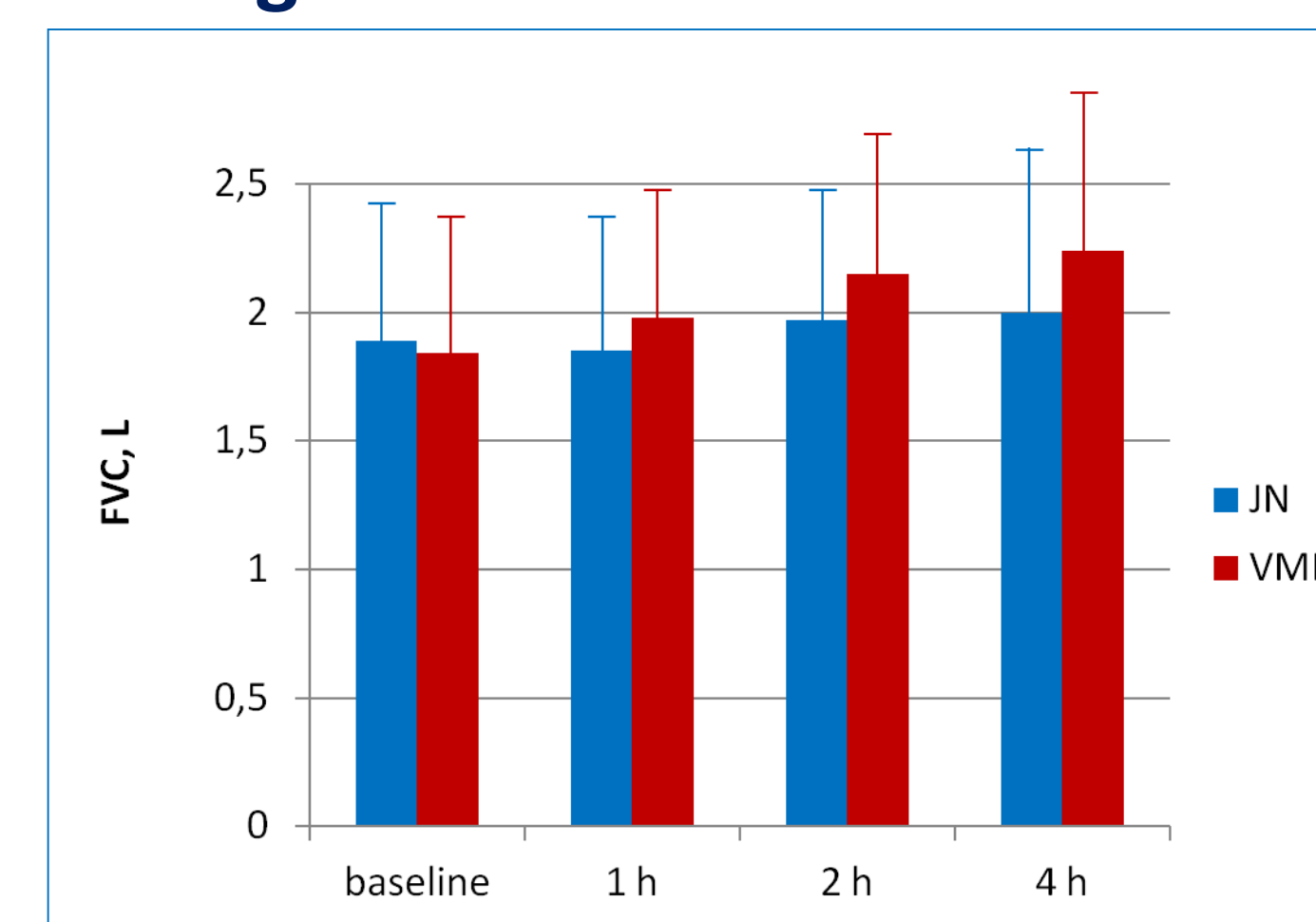
Variables	Conventional jet nebulizer	Aerogen nebulizer	P value**
SpO ₂ , %			
baseline	82±7,78	85±5,62	NS
1 h	87,7±4,2*	90,2±3,33*	0,0141
2 h	89,1±3,48*	92,1±2,68*	0,0004
4 h	89±4,39*	92,9±1,97*	0,0001
RR, min ⁻¹			
baseline	22,3±2,00	21,9±1,83	NS
1 h	21,3±1,84*	20,6±1,97*	NS
2 h	21,2±1,89*	19,7±1,48*	0,0007
4 h	20,8±1,64*	19,3±1,39*	0,0003
HR, min ⁻¹			
baseline	85,5±9,53	85,8±9,9	NS
1 h	88,6±12,6	86,2±9,6	NS
2 h	89,8±10*	84,6±8,39	0,0339
4 h	84,8±7,19	82,7±6,62*	NS
Cough peak flow, L/min			
baseline	184,4±77,6	196,6±83,4	NS
1 h	206,7±91,2*	226,8±102,91*	NS
2 h	201,1±81,0*	234,8±99,6*	NS
4 h	208,0±92,4*	234,0±95,6*	NS

* Indicated the significant result for within-group comparison (vs baseline data) under the significance level <0.05.
** p-Value was observed for comparing the difference in change from baseline between two groups.
NS – non significant.

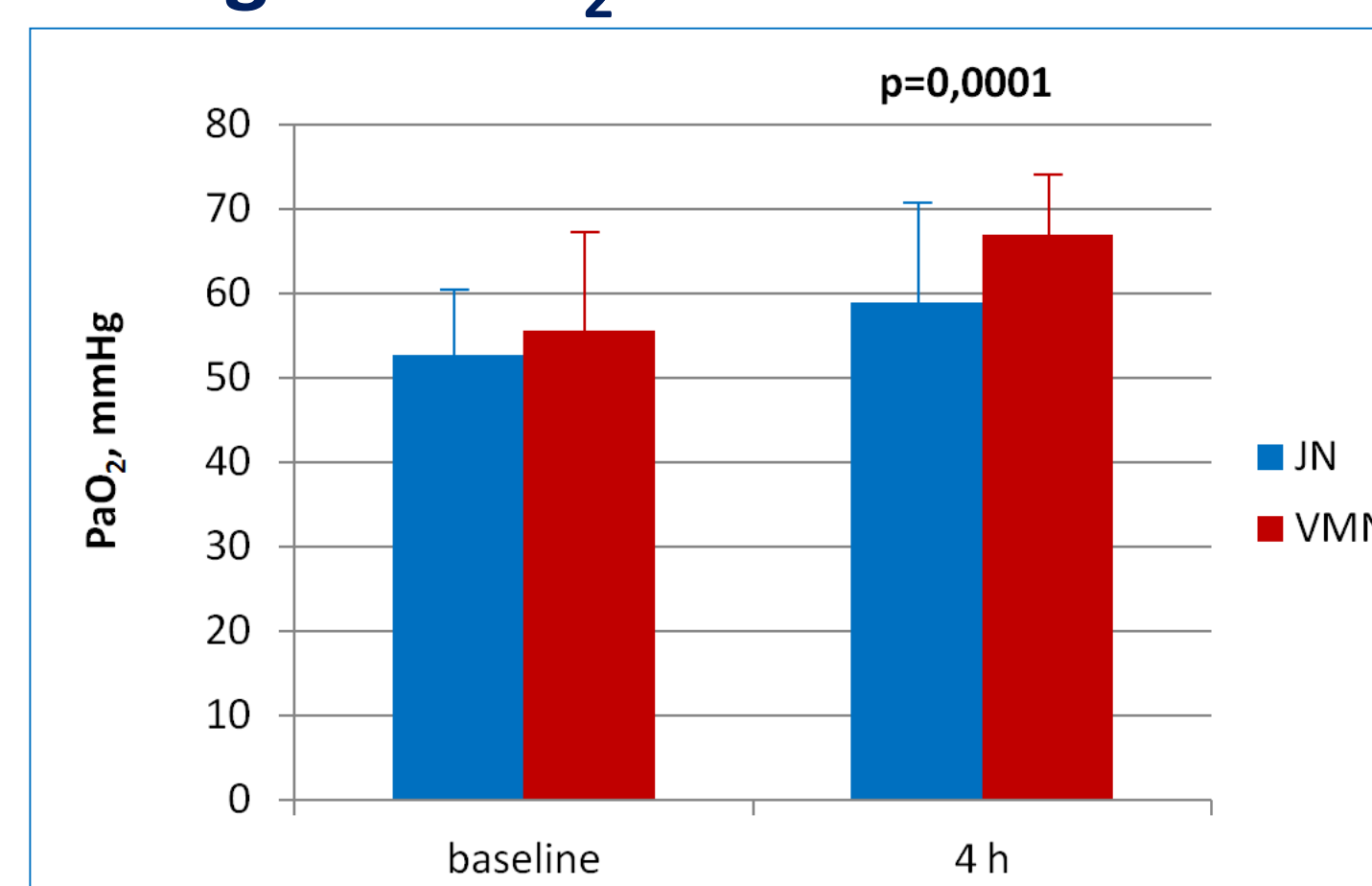
Change in Borg Dyspnea score



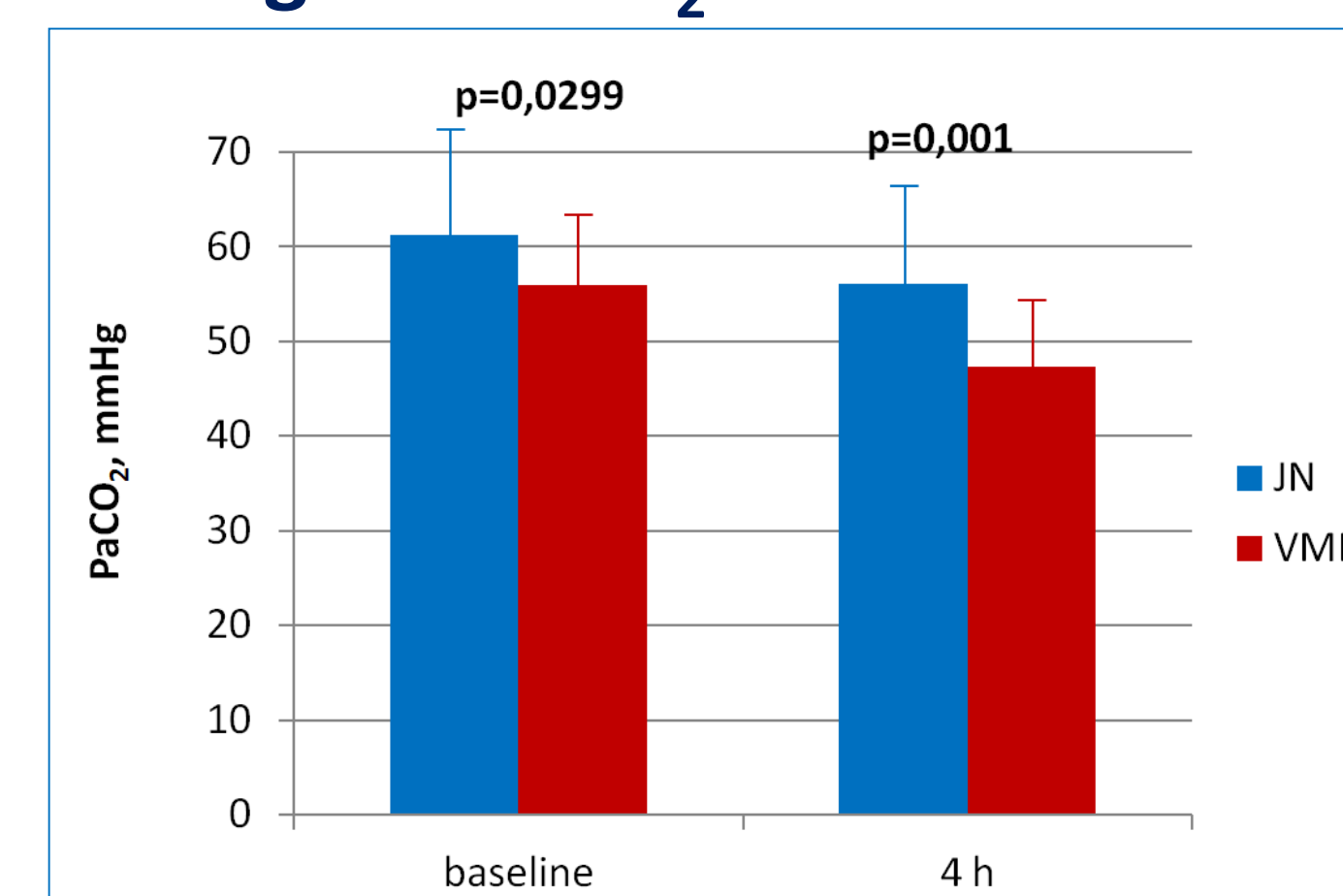
Change in FVC



Change in PaO₂



Change in PaCO₂



Conclusions

Bronchodilator administration during NIV with VMN in patients with AE COPD resulted in clinically significant improvements in PFTs and a significant improved Borg dyspnea score. Additional studies are required to determine impact on clinical outcomes.

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