WHITE PAPER

BiWaze® Clear System – effects of oxygen bleed-in on FiO_2 delivery in vitro

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INTRODUCTION

In the field of respiratory therapy, oxygen (O_2) therapy plays a critical role in the management of patients with compromised respiratory function. One essential parameter in O_2 therapy is the fraction of inspired oxygen (FiO_2), which refers to the concentration of O_2 in the inspired gas mixture. Accurate control and maintenance of FiO_2 levels are crucial in providing optimal oxygenation while minimizing the risk of O_2 toxicity or hypoxia. O_2 bleed-in is a technique that uses an auxillary gas flow to supplement the delivered FiO_2 during oscillating lung expansion (OLE) therapy.

This bench study aimed to investigate the effects of O_2 bleed-in on FiO_2 levels during OLE therapy with BiWaze Clear (ABM Respiratory Care, USA) under various therapeutic parameters.

STUDY METHOD

We utlized the ASL 5000 spontaneously breathing lung simulator (Ingmar Medical, USA) to simulate two patient models: an adult patient weighing 70 kg and a pediatric patient weighing 20 kg. The BiWaze Clear system was configured to deliver two therapy phases: positive expiratory pressure (PEP) and high-frequency oscillation (OSC). Each phase involved the evaluation of two pressure settings, representing a range commonly used during OLE therapy.

FiO_2 measurements were obtained for each O_2 bleed-in flow setting, starting from 1 liter/minute and incrementally increasing up to 15 liters/minute. O_2 bleed-in was achieved by introducing supplemental O_2 flow into the inspiratory path of the coaxial bacterial/viral filter. A paramagnetic O_2 sensor integrated into the ASL lung model was used to continuously analyze the FiO_2 level.

RESULTS

Adult with PEP of 5 cm H_2O	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	24.00
2	29.00
3	35.00
4	41.60
5	48.60
6	54.60
7	61.60
8	67.10
9	76.10
10	81.70
11	86.40
12	89.50
13	91.80
14	93.30
15	94.10

Adult with PEP of 15 cm H_2O	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	24.50
2	27.50
3	31.50
4	35.00
5	38.50
6	42.00
7	45.50
8	49.00
9	52.50
10	56.00
11	59.50
12	63.00
13	66.50
14	70.00
15	73.50

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Adult with OSC of 10 cm H_2O at 4 Hz	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	24.50
2	27.50
3	31.50
4	35.00
5	40.00
6	44.00
7	48.00
8	51.50
9	55.00
10	58.50
11	62.50
12	66.00
13	69.50
14	73.00
15	76.50

Adult with OSC of 30 cm H_2O at 4 Hz	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	23.30
2	25.50
3	28.30
4	31.40
5	34.60
6	37.80
7	40.70
8	43.80
9	46.20
10	49.10
11	51.50
12	54.70
13	57.20
14	59.30
15	62.20

Pediatric with PEP of 5 cm H_2O	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	26.70
2	34.30
3	43.00
4	49.60
5	55.40
6	63.00
7	69.80
8	74.80
9	80.00
10	84.30
11	88.00
12	91.60
13	93.30
14	94.50
15	94.90

Pediatric with PEP of 15 cm H_2O	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	26.00
2	32.50
3	38.00
4	44.00
5	50.00
6	56.00
7	60.00
8	66.00
9	71.00
10	76.00
11	80.00
12	84.00
13	87.50
14	90.00
15	92.50

Pediatric with OSC of 10 cm H_2O at 4 Hz	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	26.00
2	32.50
3	40.00
4	46.00
5	53.00
6	58.00
7	64.00
8	70.00
9	75.00
10	79.00
11	84.00
12	88.00
13	91.00
14	93.50
15	95.00

Pediatric with OSC of 30 cm H_2O at 4 Hz	
Bleed O_2 (L/min)	Delivered FiO_2 (%)
1	24.50
2	26.80
3	29.90
4	33.80
5	37.80
6	41.60
7	45.10
8	48.60
9	52.30
10	57.80
11	58.10
12	60.80
13	63.90
14	66.60
15	68.70

CONCLUSION

This bench study aimed to evaluate the effects of O_2 bleed-in on FiO_2 levels with a variety of therapeutic parameters during OLE therapy with BiWaze Clear. Through a comprehensive evaluation of different therapy parameters, our analysis showed a linear correlation between O_2 bleed-in flow and delivered Fio_2 for all therapy phases and pressures. We created guidance tables with the measured values of FiO_2 for the analyzed bleed-in flow rates for both patient models during the different therapy phases and settings. The findings of this study can aid clinicians in selecting the appropriate flow to bleed-in to optimize FiO_2 delivery with BiWaze Clear.

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