Section: Anaesthesia

Research

ASSESSMENT OF EFFECTIVENESS OF BAIN'S CIRCUIT ATTACHED TO A NIV MASK FOR ASSISTING SPONTANEOUS VENTILATION

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Abstract

Background: To assess effectiveness of Bain's circuit attached to a NIV mask for assisting spontaneous ventilation. **Materials and Methods:** Fifty- six adult COVID- 19 patients were divided into 2 groups of twenty- eight each. In group I, patients were ventilated using the modified Bain's circuit attached to an appropriately sized NIV mask and in group II patients were continued on ventilation using BiPAP. Hemodynamic variables such as partial pressure of CO2 (pCO2), partial pressure of O2 (pO2), SO2, heart rate and pH values were recorded at baseline, after 30 minutes and after 2 hours. **Result:** There was non- significant difference in mean heart rate, SpO2, pH, pO2, pCO2 and SO2 at baseline, after 30 minutes after 2 hours in group I and group II (P> 0.05). **Conclusion:** Modified Bain's circuit can be considered as an alternative to non-invasive ventilation in COVID- 19 patients.

INTRODUCTION

In December 2019, COVID- 19 (novel Corona virus) spread universally. It was the biggest pandemic of the 21st century leaving no country whether developed or developing. India recorded first case of COVID- 19 infection on January 30th 2020.[1] It was the first wave of pandemic which affected crores of people all over the world. In March 2021, the second wave resulted deadly as compared to first wave.[2] The geriatric group and especially those who were having co- morbidities was the vulnerable population in first wave whereas in second wave all age groups including young and children were also affected irrespective of any underlying pathology.[3]

The clinical symptoms comprised of high- grade fever, sneezing, dry cough, restlessness, sore throat, loss of taste, smell, diarrhea etc. Over the time, as diseases progress, the patients entered into acute respiratory distress syndrome (ARDS) and respiratory failure.[4] There is sudden fall in oxygen level in the body leading to hypoxemic state.[5] This condition alarms bell. As the oxygen saturation falls below 90%, ventilator requirement increases. Amid massive influx of Covid-19 patients requiring oxygen support and shortage of oxygen and ventilator beds use of Bain circuit can delay immediate requirement of life support system.[6] Considering this, we planned the retrospective comparative evaluation for the assessment of the effectiveness of Bain's versus BiPaP for assisting spontaneous ventilation.

MATERIALS AND METHODS

After considering the utility of the study and obtaining approval from ethical review committee of the institute, we selected fifty- six adult patients age ranged 30 - 60 years of either gender. All cases were confirmed cases of COVID- 19 diagnosed with reverse transcription polymerase chain reaction (RT-PCR), were hypoxic with SpO2 <90%.

Demographic data of each patient was entered in case history performa. Parameters such as heart rate (HR), non- invasive blood pressure (NIBP), arterial blood gas and saturation of peripheral oxygen (SpO2) were recorded. Patients were divided into 2 groups of twenty- eight each. In group I, patients were ventilated using the modified Bain's circuit attached to an appropriate size NIV mask (non-vented) and in group II patients were continued on ventilation using BiPAP. Hemodynamic variables were recorded after two hours. An arterial blood

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gases (ABG) test was done after two hours of ventilation, and partial pressure of CO2 (pCO_2), partial pressure of O2 (pO_2), and pH values were recorded. The results were compiled and subjected for statistical analysis using Mann Whitney U test. P value less than 0.05 was set significant.

RESULTS

There were 16 male and 12 female in group I and 17 male and 11 female in group II [Table 1].

The mean heart rate at baseline in group I was 115.4 beats/min and in group II was 120.5 beats/min. The mean heart rate after 30 minutes in group I was 101.2 beats/min and in group II was 113.2 beats/min. After 2 hours, it was 85.2 beats/min in group I and 92.3 beats/ min in group II. The mean heart rate was further recorded to next 8 hours and was observed to be insignificant (p>0.05). The difference was non- significant (P> 0.05) [Table 2].

The mean SpO_2 at baseline in group I was 68.5% and in group II was 68.9%. The mean SpO2 after 30 minutes in group I was 86.2% and in group II was 81.2%. The mean SpO_2 after 2 hours in group I was 95.2 and in group II was 94.8. After 2 hours the oxygen saturation was still observed to be insignificant between the groups (p>0.05). The difference was non- significant (P> 0.05) [Table 3].

The mean pH at baseline in group I was 7.31 and in group II was 7.30. The mean pH after 30 minutes in group I was 7.38 and in group II was 7.31. The mean pH after 2 hours in group I was 7.41 and in group II was 7.34. The difference was non-significant (P> 0.05) [Table 4].

The mean pO2 at baseline in group I was 41.5 mmHg and in group II was 45.3 mmHg. The mean pO2 after 30 minutes in group I was 67.8 mmHg and in group II was 60.4 mmHg. The mean pO2 after hours in group I was 77.5 mmHg and in group II was 67.2 mmHg. The difference was non-significant (P> 0.05) [Table 5].

The mean pCO2 at baseline in group I was 52.3 mmHg and in group II was 55.6 mmHg. The mean pCO2 after 30 minutes in group I was 47.2 mmHg and in group II was 45.9 mmHg. The mean pCO2 after 2 hours in group I was 38.4 mmHg and in group II was 40.1 mmHg. The difference was non-significant (P> 0.05) [Table 6].

Table 1: Patients distribution

Groups	Group I (28)	Group II (28)
Method	Modified Bain's circuit	BiPAP
M:F	16:12	17:11

Table 2: Comparison of heart rate

Heart rate (beats/min)	Group I	Group II	P value
Baseline	115.4	120.5	0.92
After 30 minutes	101.2	113.2	0.84
After 2 hours	85.2	92.3	0.09
After 4 hours	80.1	83.9	0.12
After 6 hours	78.9	81.1	0.92
After 8 hours	72.6	74.3	0.85

Table 3: Comparison of SpO2 (%)

SpO2 (%)	Group I	Group II	P value
Baseline	68.5	68.9	0.91
After 30 minutes	86.2	81.2	0.76
After 2 hours	95.2	94.8	0.61
After 4 hours	96.1	95.9	0.74
After 6 hours	97.2	97.3	0.38
After 8 hours	97.6	97.8	0.42

Table 4: Comparison of pH

pH	Group I	Group II	P value
Baseline	7.31	7.30	0.97
After 30 minutes	7.38	7.31	0.83
After 2 hours	7.41	7.34	0.72

Table 5: Comparison of pO2 (mmHg)

pO2 (mmHg)	Group I	Group II	P value
Baseline	41.5	45.3	0.12
After 30 minutes	67.8	60.4	0.25
After 2 hours	77.5	67.2	0.36

Table 6: Comparison of pCO2 (mmHg)

pCO2 (mmHg)	Group I	Group II	P value
Baseline	52.3	55.6	0.18
After 30 minutes	47.2	45.9	0.87
After 2 hours	38.4	40.1	0.76

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Table 7: Comparison of SO2 (%)

SO2 (%)	Group I	Group II	P value
Baseline	65.7	65.9	0.86
After 30 minutes	79.1	79.5	0.90
After 2 hours	93.2	96.7	0.84

DISCUSSION

COVID- 19 infection spread all over the world within short period of time. A large number of mortality has been recorded.[7] China was the first country who reported first case in Wuhan and it spread from here to other parts of world. Numerous diagnostic and treatment modalities have emerged for the proper and timely intervention.[8,9] Bain's modification of Mapleson's breathing circuit has been widely used and is regarded as the most effective system during controlled ventilation.[10] It can be safely used for spontaneous ventilation and for providing the fresh gas flow (FGF) kept at 1.5 to 2 times per minute ventilation.[11,12] In this study we assessed effectiveness of Bain's circuit attached to a NIV mask for assisting spontaneous ventilation.

Our study comprised of 56 confirmed cases of COVID- 19 infection. We divided patients into 2 groups of 28 each. There were 16 male and 12 female in group I and 17 male and 11 female in group II. Our results showed that the mean heart rate at baseline in group I was 115.4 beats/min and in group II was 120.5 beats/min. The mean heart rate after 30 minutes in group I was 101.2 beats/min and in group II was 113.2 beats/min. After 2 hours, it was 85.2 beats/min in group I and 92.3 beats/ min in group II. Singh et al,[13] enrolled twenty-four COVID patients which were randomized into group A (modified Bain's circuit) and group II (BiPAP). Hemodynamic and blood gas parameters were comparable between the two groups at baseline and on BiPAP. Group A showed better hemodynamic and blood gas profiles compared to group B, but the difference was not statistically significant.

We found that the mean SpO2 at baseline in group I was 68.5% and in group II was 68.9%. The mean SpO2 after 30 minutes in group I was 86.2% and in group II was 81.2%. The mean SpO2 after 2 hours in group I was 95.2 and in group II was 94.8. Sellers et al,[14] studied the effect of using a two-meter and three-meter Bain system during spontaneous preoxygenation and concluded that the smaller system was easier to breathe through and needed less negative pressure distally on inspiration.

Our results demonstrated that the mean pH at baseline in group I was 7.31 and in group II was 7.30. The mean pH after 30 minutes in group I was 7.38 and in group II was 7.31. The mean pH after 2 hours in group I was 7.41 and in group II was 7.34. The mean pO2 at baseline in group I was 41.5 mmHg and in group II was 45.3 mmHg.

Modified Bain's circuit had benefit of light-weight and low resistance. It is considered as ideal breathing system. A standard Bain's circuit is 1.6 meters long, with the diameter of the outer corrugated tubing being 22 mm and the inner tubing being seven mm.[15] In the second wave of COVID, markedly deficiency of equipments and insufficient oxygen supplies further warrants the use of Bain circuit. We found that the mean pO2 after 30 minutes in group I was 67.8 mmHg and in group II was 60.4 mmHg. The mean pO2 after hours in group I was 77.5 mmHg and in group II was 67.2 mmHg. The mean pCO2 at baseline in group I was 52.3 mmHg and in group II was 55.6 mmHg. The mean pCO2 after 30 minutes in group I was 47.2 mmHg and in group II was 45.9 mmHg. The mean pCO2 after 2 hours in group I was 38.4 mmHg and in group II was 40.1 mmHg. The mean SO2 at baseline in group I was 65.7% and in group II was 65.9%. The mean SO2after 30 minutes in group I was 79.1% and in group II was 79.5%. The mean SO2 after 2 hours in group I was 93.2% and in group II was 96.7%. Kumari et al,[16] recorded a case of COVID-19 associated mucormycosis in which authors used full-length Bain's circuit as a continuous positive airway pressure device They used a fresh gas flow of eight liters/minute with the APL valve slightly closed.

CONCLUSION

Modified Bain's circuit can be considered as an alternative to non-invasive ventilation in COVID-19 patients, particularly in the settings of insufficient oxygen supplies.

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