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BETTER OXYGEN SATURATION AND MINIMAL REBREATHING WITH BAIN'S CIRCUIT VERSUS NRBM DURING THE COVID-19 CRISIS FOR PATIENTS AWAITING NON-INVASIVE VENTILATORY SUPPORT

Anaesthesiology

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ABSTRACT

Background & Aims: COVID-19 brought new challenges to the healthcare system. One such challenge was the non-availability of ventilators for patients requiring non-invasive ventilation. Increased oxygen saturation up to 15-20% was seen alongside minimal rebreathing when Bain's circuit(1) was used in place of Non-rebreathing Mask (NRBM) in patients awaiting non-invasive ventilatory support.

Methods: During the COVID-19 pandemic, a common practice of anaesthesiologists for patients not maintaining recommended SaO2 of ≥90%(2) on facemask at flow rate of 10 litres/minute was to shift to NRBM, titrating oxygen flow up to 15 litres/minute, to maintain oxygen saturation above the target value. A common trend we saw in our hospital for patients maintaining sufficient respiratory effort but reduced SaO2 on NRBM at 15 litres/minute was that as soon as NRBM mask was replaced with Bain's circuit connected to the patient via a BiPAP mask, there was a sudden jump in SaO2 up to 15-20% at same oxygen flow rate.

Result: Keeping Oxygen flow above twice the patient's minute ventilation led to almost negligible rebreathing with the advantage of dramatic rise in patient's Sa02 level. Serial ABGs obtained to monitor any spike in PaCO2 confirmed if the oxygen flow rates were maintained at above twice the patient's minute ventilation, there was negligible to minor increase in patient's PaCO2 levels .

Conclusion: As we anticipate future wave of COVID-19, keeping Bain's circuit as a choice for oxygen therapy can be a lifesaving alternative for patients awaiting non-invasive ventilatory support.

KEYWORDS

Coaxial Mapleson D, COVID-19 pandemic, Anesthesia

INTRODUCTION :

COVID -19 brought new challenges to healthcare workers at all fronts.

One such challenge was lack of resources like unavailability of hospital beds due to overflow of patients, less availability of oxygen ports and unavailability of ventilators for invasive and non invasive ventilation.

This led to development of new ideas to provide oxygen (using double flow metres at common oxygen port) and ventilation to patients by any means possible and optimal utilization of all available hospital equipments and resources.

One such idea during the pandemic was using Bain's Circuit attached to a BiPaP mask in place of NRBM mask for the same flow rate.

MATERIALS AND METHODOLOGY :

A Prospective clinical study was carried out in Saraswathi Institute of Medical Sciences, Anwarpur, Hapur(U.P.), in moderate to severe COVID-19 patients.

Study Duration: Three months (May 2021 to July 2021)

Study Design: Randomized, prospective, clinical study.

Inclusion Criteria :

All moderate to severe COVID-19 patients admitted to ICU who had intact GCS of > 10, with sufficient respiratory efforts were included in this trial

Exclusion Criteria:

- Patients with GCS < 10
- Patients not having sufficient respiratory efforts
- Patients who become tachypenic on BAIN's Circuit trial of 30 minutes
- Clautrophobia of Bipap Mask
- Patients who couldn't maintain Spo2 > 88 even at 20 L/min flow rate after trial of BAIN's Circuit

During the covid - 19 pandemic, common practice of anaesthesiologists for patients not maintaining recommended Sp O2 of >= 90 % [1] on facemask at flowrate of 10 L/min was to shift to NRBM at flowrate 10 to 15 L/min, to maintain oxygen saturation above the target value in moderate to severely affected covid -19 patients.

Initially during the start of trial, some patients requiring and awaiting Non Invasive ventilatory support (due to shortage of supply) on NRBM were shifted on Bain's Circuit attached to a BiPaP mask.

The APL valve was left open to allow escape of exhaled gases and to minimize rebreathing

The trial was given under strict observation under a trained anaesthesiologist for 30 minutes with observing for vitals including SpO2, HR, BP, RR & GCS with standard monitors attached in ICU of our Hospital.

If the patient did not meet any exclusion criteria even after 30 minutes, the Oxygen therapy was continued.

RESULTS :

A common trend we saw in our hospital(at Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh) for patients maintaining sufficient respiratory effort but reduced SaO2 on NRBM @ 15 L/min was, as soon as NRBM mask was replaced with Bain's circuit (connected to patient via a bipap mask), a sudden jump in SaO2(&SpO2) upto 15 to 20 % was seen at same oxygen flow rate.[2]

Also, keeping Oxygen flow above twice the patient's minute ventilation led to almost negligible rebreathing with the advantage of dramatic rise in patient's SaO2 level.

Serial ABGs were obtained to monitor any spike in PaCO2 confirmed if the oxygen flow rates were maintained at above twice the patient's minute ventilation, there was negligible to minor increase in patient's PaCO2 levels.

Table 1. Arterial Blood Gas (ABG) Values For Patients On NRBM vs. Bain's Circuit

Serial No. With measured parameter	On NRBM @15 lts/min	On Bain's circuit for 1 hour	On Bain's circuit for 6 hours	On Bain's circuit for 12 hours
1.				
PH	7.36	7.35	7.32	7.32
PO2	50	81	84	83
PCO2	30.1	32.3	35.1	36.2
Bicarb.	20	20.6	22.1	22.3
SaO2%	82.5	95.1	96.2	95.4
2.				
PH	7.22	7.24	7.27	7.26
PO2	48	77	80	79
PCO2	26.4	30.3	31.7	32.5
Bicarb.	16.3	18.2	20.7	21.2
SaO2%	80.2	93.4	94.1	93.9

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3.				
PH	7.10	7.16	7.24	7.28
PO2	45	65	72	73
PCO2	21.6	25.1	30	32
Bicarb.	9.1	11.4	14.9	17.3
SaO2%	76.5	89.6	91.1	91.2
4.				
PH	7.47	7.46	7.41	7.31
PO2	65	81	96	155
PCO2	40.8	42.7	36.5	27.1
Bicarb.	29.4	31.6	29	13.3
SaO2 %	93.6	96.9	98.1	99.3

DISCUSSION :

The rationale of using BAIN's circuit was it belonged to a semi-closed type of circuit whereas NRBM is an open type of oxygen therapy, so more fio2 for less oxygen flow per minute will be obtained.

The use of BiPaP mask with BAIN's circuit further helps in maintaining appropriate seal and further helps to improve FiO2 delivered (close to 100%) to patient in comparision to NRBM (FiO2 variable between 80 to 100%)

However, lowered consciousness, abnormal breathing pattern, severe COVID infection requiring invasive measures limit the use of BAIN's Circuit and is only a bridge between NIV/HFNC and NRBM support.

Also, the benefit of PEEP applied during NIV support cannot be applied using a BAIN's circuit.

CONCLUSION:

As we anticipate 3rd wave of COVID-19 or future pandemic, keeping Bain's circuit as choice for oxygen therapy can be a lifesaving alternative for patients awaiting non-invasive ventilatory support.

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