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Early View

Research letter

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Continuous Positive Airway Pressure (CPAP) for Moderate to Severe Covid 19 Acute Respiratory Distress Syndrome (CARDS) in a Resource limited setting

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To the Editor:

Introduction

Management of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) associated Acute Respiratory Distress Syndrome (Covid 19 ARDS or CARDS) has challenged the health systems of developed countries, and even more so the health systems of resource poor settings(1). Within this context Continuous Positive Airway Pressure (CPAP) has been trialled in as an alternative less resource intensive respiratory support to early Invasive Mechanical Ventilation (IMV)(2) with promising results and now features in some major guidelines(3). However, there are limited studies from resource poor settings massively impacted by Covid 19. We retrospectively analysed the completed survival outcomes and characteristics for the exclusive use of CPAP for moderate to severe CARDS as defined by Kigali

criteria(4) in a cohort of patients admitted to Bach Christian Hospital (BCH) between April and August 2021.

Methods

BCH is a small 60 bedded secondary level hospital in rural Northern Pakistan (Khyber Pakhtunkhwa Province). A Covid 19 unit was opened at BCH in December 2020 to respond to the surge of severely unwell Covid 19 patients in Pakistan's second wave. This contained 9 High Dependency Unit beds with appropriate step-down patients transferred to another ward. Nursing staff with limited previous critical care experience were trained in the management of critically unwell patients, the use of CPAP and Arterial Blood Gas (ABG) sampling. The unit was staffed by a single nurse and nurse aid.

Patients were admitted in Covid19 unit at BCH based on Respiratory failure (SpO2 < 90% or Respiratory Rate > 30), in the presence of a clinical history and examination suggestive of Covid19 pneumonia with appropriate radiological and laboratory findings (14). SARS-CoV-2 PCR was performed on affording patients but limited due to cost and availability(6). However, all patients tested had positive results, and Covid 19 antigen testing was implemented from August.

Ethical approval was obtained from the hospital committee for this observational study.

Patients were initially resuscitated with 5L O_2 via Nasal Cannula (NC) or 15L O2 via Non-Rebreathe Mask (NRM) depending on severity with a target SpO2 of 95% (fig 1A). After 1h clinical assessment with an ABG was performed, and those with persistent tachypnoea or P_aO_2/FiO_2 < 150mmHg (corresponding to requiring more than 5L O2 via nasal cannula to maintain SpO2 > 90%) were commenced on CPAP at 10cmH_20 as recommended by UK guidelines(7) and the initial study from Genoa (2).

Philipps Respironics CPAP machines originally intended for home use for obstructive sleep apnea were used with their default Amara full face masks, with the addition of anti-bacterial/viral heat and moisture exchange (HME) filters. Philipps advise a separate inflow attachment for O2 entrainment(8), but in the absence of these pieces O_2 was entrained via a T tube to the machine end of the CPAP tubing. O_2 was supplied from a wall flow meter with a capacity of up to 15L/min.

Clinical status reassessed with an ABG after one hour on CPAP. Those who had improved on CPAP 10cm H_20 were placed on continuous CPAP for 72h as recommended by an Italian protocol(9) with breaks for eating and drinking. Those who failed to improve sufficiently on 10cmH_20 of CPAP were given a trial of 15 cmH_20 of CPAP which has been described in Italian and Scottish guidelines (10,11). If patients improved significantly on 15cmH_20, that pressure was continued. Otherwise 10cmH_20 was used for all patients given the risks of barotrauma at pressures >10cm H_20. All patients on oxygen including those on CPAP were encouraged to do prone positioning for at least 1 hour three times daily(12). Those unable to tolerate complete proning were encouraged to do semi prone positioning.

CPAP weaning was attempted after 72h of continuous CPAP. CPAP was stopped when P_aO_2/FiO_2 off CPAP was greater than 150mmHg or maintaining SpO2 > 90% on 5L O2 via NC. Patients who failed to wean off CPAP at all were given another 72h of continuous CPAP and a wean was reattempted afterwards.

Steroids (Dexamethasone) with appropriate thromboprophylaxis (Rivaroxaban, due to lack of LMWH availability) formed the mainstay of medical management. Remdesivir was not used due to lack of evidence of efficacy in severe disease, and Tocilizumab was used in select patients from July as per updated WHO guidelines(13).

Results

149 patients were admitted with suspected Covid 19 AHRF at BCH from April 9th to August 31st 2021. 99 patients met criteria for moderate to severe ARDS and were commenced on CPAP regardless of age or underlying comorbidities. 76 patients survived on CPAP (fig 1B).

The duration of successful patients on CPAP ranged from 5 to 21 days. Complications on CPAP included barotrauma, particularly with higher pressures. 4 patients on 15 cmH_2O developed these complications (2 pneumothorax and 2 pneumomediastinum), while only 1 patient on 10 cm H_2O had this complication (1 pneumomediastinum). The patients with pneumothorax had chest tube insertion, but even so all 5 of these patients unfortunately died. However this rate of barotrauma (5/99 patients or 5%) is similar to reported elsewhere for NIV in CARDS, which is lower than rates observed for IMV(14).

Patients with CARDS demonstrated improvement in oxygenation with CPAP (fig 1C). FiO_2 on simple oxygen including nasal cannula was approximated using the Shapiro formula(15), and a white paper from Phillips was used to estimated FiO_2 on CPAP(8).

No healthcare associated infections were reported among staff.

Discussion

Our survival rate on CPAP (76.8% total) is slightly lower than the 83% reported in the original study on CPAP in CARDS from Genoa(2). However, the original study excluded a significant number of patients who were not considered fit for resuscitation, while all patients received CPAP as per protocol in this study regardless of pre-morbid state. Our survival rate is significantly higher than the 29% reported on patients exclusively treated with CPAP in another Italian series(16), however it is likely that these patients had a greater frequency of underlying comorbidities as they were classed ineligible for intubation. The CARDS survival rate for CPAP at our centre is not too dissimilar to reported rates (around 80%) from Intensive Care Units employing NIV and IMV in resource rich settings(17), suggesting feasibility of CPAP as a ceiling of care treatment modality in pandemic circumstances. Even more significantly the survival rate is higher than the dire outcomes in Intensive Care Units (ICU) employing IMV in resource poor settings being inundated by late referrals(1). CPAP is less resource intensive in terms of equipment and staffing, and health workers can be easily trained in its operation. Early implementation of CPAP for CARDS in a non-ICU setting as opposed to late referral to an already overwhelmed ICU for IMV is likely to save many lives.

Significant limitations of this study include its observational nature, retrospective single centre design and small sample size.

Conclusion

CPAP is an efficacious and cost-effective modality of treatment for Covid 19 ARDS (CARDS), particularly in resource poor settings which now bear most of the pandemic burden.

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Conflicts of interest and funding

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