World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

THE ROLE OF ADDING VENTILATORY PRESSURE CYCLES IN OPTIMISING WORK OF BREATHING FOR COVID19 ICU PATIENTS ON NON-INVASIVE VENTILATION

Dr. Hussain Mohammedali Hussain
Anesthesia and intensive care specialist.
(M.B.ch.B , D.A , F.I.C.M.S) Email:Karbalaspring@gmail.com

Article history:

Received: August 1st 2022
Accepted: September 1st 2022
Published: October 7th 2022

Abstract:

Background Tachypnia and dyspnoea of ICU covid 19 patients with more than 60% lung involvement result in great patient discomfort ,hope loss, air hunger and respiratory fatigue followed by generalised fatigue with downgrading cases. Those patients initially put on tight NIV oxygenated mask fitness enhanced by more breathing pressure than simple O2 masks , doing so with merely ventilating them depending on their own respiratory pattern results in some sort of improvement in the above patient symptoms but if those patients fail to response to the overall treatment measures, besides, their families refuse endotracheal tube placement then we can't put them at the risks of more breathing pressures than usual because of possible fatal pneumothorax and /or emphysema. At this stage an important strategy was analysed and discussed in this article of adding ventilator generated mechanical breathing cycles to the overall patient's respiratory pattern in an attempt to

1) improve patients symptoms of discomfort, air hunger, hopelessness .
2) alleviate work of breathing (WOB) .
3)And to give more time for drugs therapy to show their effect for those patients, and hence more chance of survival.

Aim:

To assess the benefit of adding ventilator generated pressure cycles in optimising WOB in ICU covid 19 patients whose families refused endotracheal intubation.

Patients And Methods:

100 patients with (failed) pressurised and oxygenated NIV, as indicated by china-criticare predictor tool (CCPT) (15) and their families refused endotracheal intubation, were separated into 2 groups -a- (control group) and -b- (study group). **Phase 1/**both groups were checked in terms of demographic data, vital signs, WOB scale (11), and S/F ratio as baseline data then 8-10 machine generated breathing cycles were added to the patients breathing rate of the study group only.

Phase 2/ both groups' patients were checked in terms of SPO2/FIO2 ratio (S/F ratio) and WOB score 12 hours after adding (8-10) ventilatory generated pressure breathing cycles to the overall patient breathing pattern and rate of study group. **Phase3/**same data were taken 24 hours after applying ventilator produced breathing cycles.

Results & Conclusion:

There were no statistical differences regarding patients' demographic data, initial vital signs, initial WOB and S/F ratio data. Adding ventilator generated pressure breathing cycles to the patients whose CCPT indicates failed NIV and their families refused endotracheal intubation results in optimising WOB, improved S/F ratio after 12 hours and 24 hours.

Keywords: Ventilatory Cycles, Work Of Breathing, Covid19 ICU, NIV

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

INTRODUCTION:

The Work of breathing (WOB) is the energy expended to inhale and exhale a breathing gas. It is usually expressed as work per unit volume, for example, joules/litre, or as a work rate (power), such as joules/min or equivalent units.

WOB Estimation

1- Graphic estimation of the WOB.
2- Clinical assessment of the WOB (used in this article).

Non-invasive ventilation (NIV) is the use of breathing support administered through a face mask, nasal mask, or a helmet. Air, usually with added oxygen, is given through the mask under positive pressure; generally, the amount of pressure is alternated depending on whether someone is breathing in or out. It is termed "non-invasive" because it is delivered with a mask that is tightly fitted to the face or around the head, but without a need for tracheal intubation (2).

Figure(1) An NIV mask a tight fixed mask is essential for successful NIV (1).

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

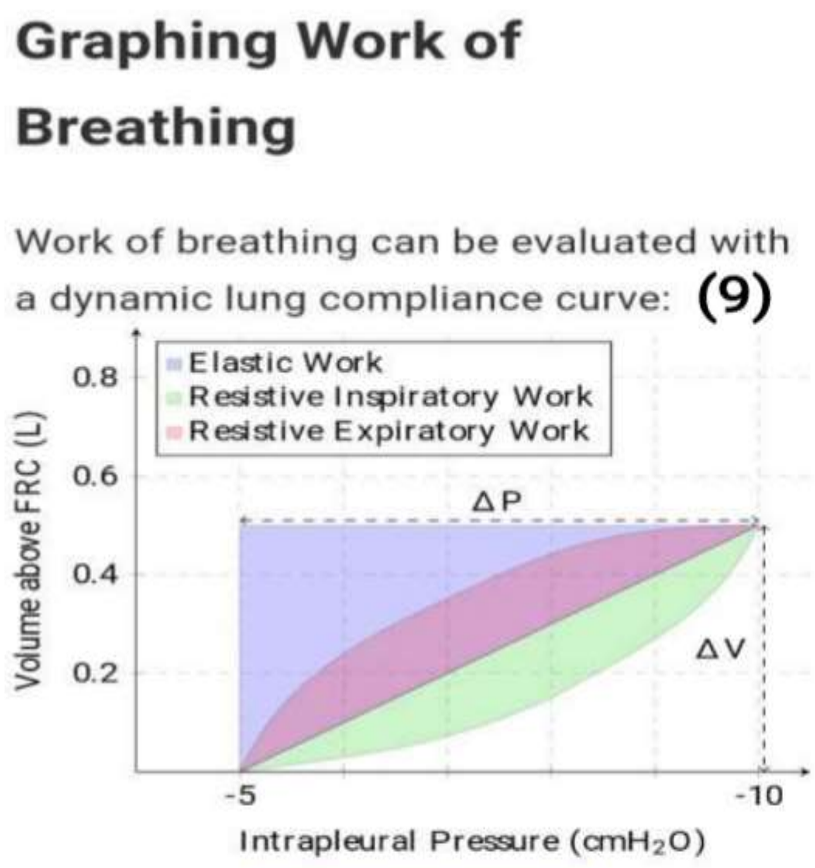


Figure (2) graphing WOB

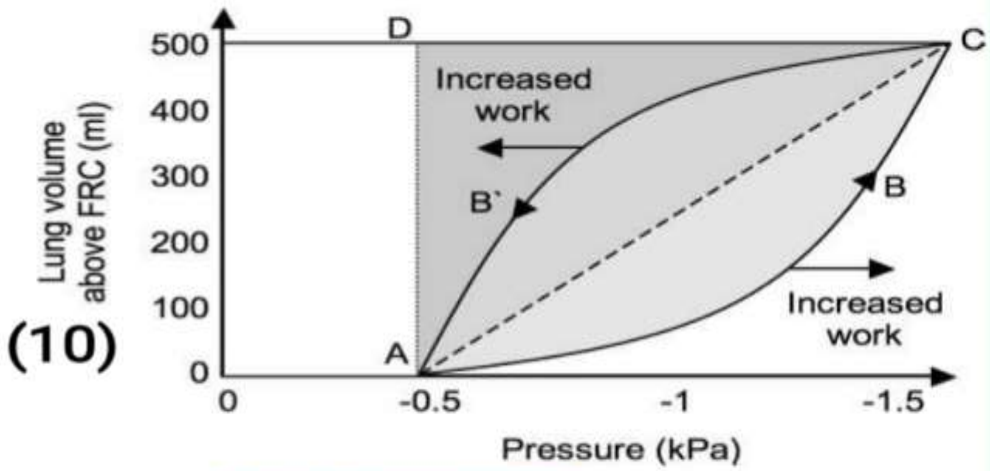
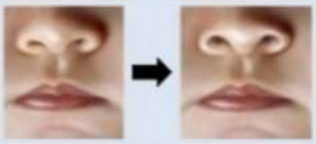


Figure (3) increasing WOB

WOB is the sum of resistive and elastic forces the more the area of the curve occupying the graph the more is the wob. if resistive force increased the resistive area increased with increased wob. if the elastic lung forces increased the elastic reisstance area increased with increased wob. all the breathing volume - pressure curves should assume nearly same figure to conclude wob status.

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

NEW WOB SCALE (11)

ELEMENT		METHOD	POINTS
	Respiratory Rate	By Counting (bpm)	≤ 20 = 1 21-25 = 2 26-30 = 3 > 30 = 4
	Nasal Flaring (inspiration)	By Observation	1
	Sternocleido-mastoid Use (inspiration)	By Palpation	1
	Abdominal Muscles Use (expiration)	By Palpation	1

Work of breathing scale assigning points to the respiratory frequency and activation of respiratory accessory muscles. Nasal flaring is determined visually by noticing widening of the nostrils during inspiration while standing at approximately one-meter from the patient. Activation of the sternocleidomastoid is determined by gentle palpation of its clavicular insertion using two fingers from the hand ipsilateral to the patient's side noticing increased tension during inspiration.

Activation of abdominal muscles is determined by gentle palpation of the abdomen using the hand ipsilateral to the patient's side noticing increased tension during expiration .

WHAT IS THE S/F RATIO

S/F ratio is a reliable noninvasive surrogate for PF ratio to identify patients with ARDS with the advantage of replacing invasive arterial blood sampling by non-invasive pulse oximetry. S/F ratio can be used to predicted P/F ratio in ARDS patients (12).

Predictors of NIV Failure:

1-The rox index (14) which predict NIV of HFNC (high flow nasal cannula) failure .

Data included in this tool includes SPO2 , FIO2, and respiratory rate. Patients on HFNC were not part of this study and hence this index not used.

2- The china-criticare predictor tool CCPT (15) which predict percentage failure of NIV of PSV or CPAP modes. It is applicable also for HFNC patients .

The data required in this tool includes; Age ,Glasgow coma score (GCS), Pulse oximetry (SPO_2), Fraction of inspired oxygen (FiO_2), Respiratory rate, breaths/min, Use of vasopressors, and Number of Comorbidities. All the patients in the 2 groups showed failed NIV

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

according to this predictor , and yet their families refused endotracheal intubation.

PATIENTS AND METHODS

This study is randomized controlled clinical trial (16). The study was conducted in the covid19 icu of imam hussain medical city in holly karbala , iraq from September 2020 till September 2021

ETHICAL CONSIDERATION

- Approval was obtained from the head of anesthesia and intensive care unit sector of the medical city and head of Anaesthesiology teaching center dr.Isam Shia'a (mbchb, ficms and anesthesia consultant).
- Acceptance obtained from patients and/or their families.

PARTICIPANTS:

100 patients, with failed NIV by china-criticare predictor tool(CCPT) and their families refused endotracheal intubation, were separated into 2 equal groups -a- (control group) and -b- (experimental group). both groups patients were checked in terms of SPO2/FIO2 ratio (S/F ratio) and WOB score as baseline data. Again both groups were checked in terms of WOB and S/F ratio 12 hours after adding (8-10) ventilator generated pressure breathing cycles to the patient's respiratory rate of the study group (b) only.

INCLUSION CRITERIA:

1-60% GGO or more lung involvement.
2-Apllied FiO2 more than or equal to 80%.
3-Tightly fixed NIV mask.
4-Failed NIV according to CCPT and family refusal of endotracheal intubation.
5-Concious patients.

EXCLUSION CRITERIA

1-Patients on HFNC.
2-Intubated patients.
3-Pediatric age group.
4-Intolerance to NIV mask.
5-Sucessful NIV according to CCPT.
6-Comatoes patients.
7-Shocked patients.
8-Patients with psychological problems.
9-Patients with pneumothorax, pleural effusion, restrictive lung disease, obstructive lung disease, single llung.
10-Feverish patients
11-Patient refusal.

STUDY PROCEDURE:

1_All patients in both groups (with failed NIV by china-criticare predictor tool(CCPT) and their families refused endotracheal intubation), were randomly separated into 2 equal groups -a- (control group) and -b- (experimental-study group).
2_ Points of interest were history, signs, and symptoms of a disease or condition that can exclude the patient from the study.
3_ age, patient identification number , approximate weight, height, and initial vital signs were recorded.
4_Phase1/ both groups patients were checked in terms of SPO2/FIO2 ratio (S/F ratio) and WOB score as baseline data.
5_Phase2/ both groups were then checked in terms of WOB and S/F ratio 12 hours after applying additional 8-10 machine generated breathing cycles to the patient's own respiratory rate of the experimental-study group (b) only.
6_ Monitoring was conducted via ECG, temperature, NIBP & SPO2 in addition to the ventilator screen values.
7_ WOB and S/F ratio were recorded at each phase.

RESULTS:

This study included 100 patients, 50 for each group, were enrolled, completed the study protocol and were included in the data analysis. Data taken from the patients includes height , approximate weight (17), gender, heart rate, mean arterial pressure MAP, temperature, GGO lung involvement percentage, china criticare predictor tool percentage value of NIV failure CCPT, WOB score and SPO2/FiO2 ratio (S/F R).

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

BASELINE PATIENT CHARACTERISTICS:

PARAMETERS	GROUP A (CONTROL) M±SD	GROUP B (STUDY) M±SD	P VALUE
height	181.33±10.	182.94±9.56	0.432
approximate weight	79.34±10.99	81.27±11.7	0.402
gender (m/f%)	25m/25f (50%)	25m/25f (50%)	1
heart rate	93.66±13.59	93.88±13.00	0.9343
MAP	91.53±9.47	92.6±7.5	0.53
temperature	37.170±0.41	37.3±0.440	0.129
GGO %	73.20±10.55	78.30±11.26	0.147
CCPT %	88.56±10.26	85.1±11.96	0.123
WOB scale	5.67±0.98	5.6±0.99	0.853
S/F R	0.87±0.02	0.87±0.02	0.941

Table (2) BASELINE PATIENT CHARACTERISTICS

BASELINE DATA : (PHASE1) INTERPRETATION

Initial data records includes height , approximate weight, gender, heart rate, MAP, temperature, GGO %, CCPT %, WOB score and S/F R. These 10 values did not difer between the two groups and the two-tailed P values were more than 0.05(18) and hence, by conventional criteria, this difference is considered to be not statistically significant (table2).

PHASE 2&3 DATA COLLECTION:

Shared characteristics between phase 1, phase 2 and phase3 includes height, weight, gender, GGO%, CCPT% .These data did not tested again after addition of breathing cycles to the study group and regarded as demographic data.

The values of interests in phase 2&3 are WOBscore and S/F Ratio of both groups 12 hours (phase2) and 24 hours (phase3) after adding the proposed machine generated breathing cycles to the study group only. These values then analysed and statistically tested for any significance (Tablets 3&4)

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

PHASE 2 CLINICAL DATA STATISTICS

	after 12 hours		
PARAMETERS	GROUP A (CONTROL) M±SD	GROUP B (STUDY) M±SD	P VALUE
heart rate	93.21±10.36	91.98±9.99	0.547
MAP	89.51±7.52	90.13±8.11	0.692
temperature	37.21±0.51	37.09±0.62	0.293
WOB scale	5.60±0.99	3.70±0.73	less than 0.0001
S/F R	0.87±0.01	0.91±0.01	less than 0.0001

Table(3) PHASE 2 CLINICAL DATA STATISTICS

PHASE 3 CLINICAL DATA STATISTICS

	after 24 hours		
PARAMETERS	GROUP A (CONTROL) M±SD	GROUP B (STUDY) M±SD	P VALUE
heart rate	93.11±9.87	93.09±10.2	0.992
MAP	85.6±11.6	87.7±10.1	0.346
temperature	37.13±0.34	36.97±0.58	0.463
WOB scale	5.7±0.85	3.6±0.75	less than 0.0001
S/F R	0.88±0.04	0.92±0.05	less than 0.0001

Table(4) PHASE 3 CLINICAL DATA STATISTICS

PHASE 2&3 DATA INTERPRETATION:

Heart rates , temperature readings, MAPs of both groups showed no significant differences after adding 8-10 pressure controled breathing cycles to the patients breathing rate of the study group . The 2 interesting parameters that attracted attention after adding breathing cycles were the WOB score and the S/F ratio and their P values, which were less than 0.0001 , are indicative of strong evidence of additional cycles impacts.

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

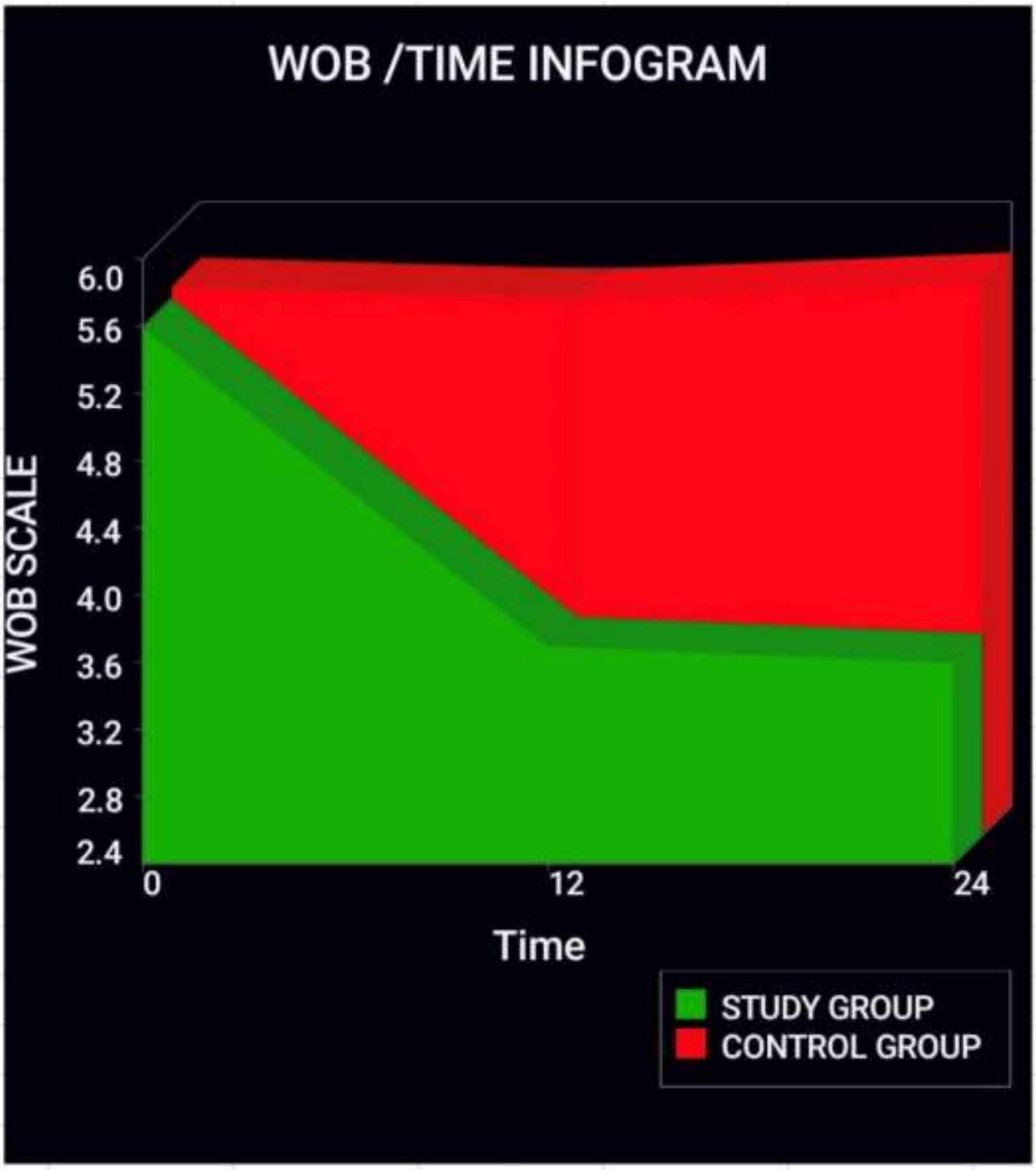


Figure (4) WOB/TIME infogram

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-15, October 2022
ISSN: 2749-3644

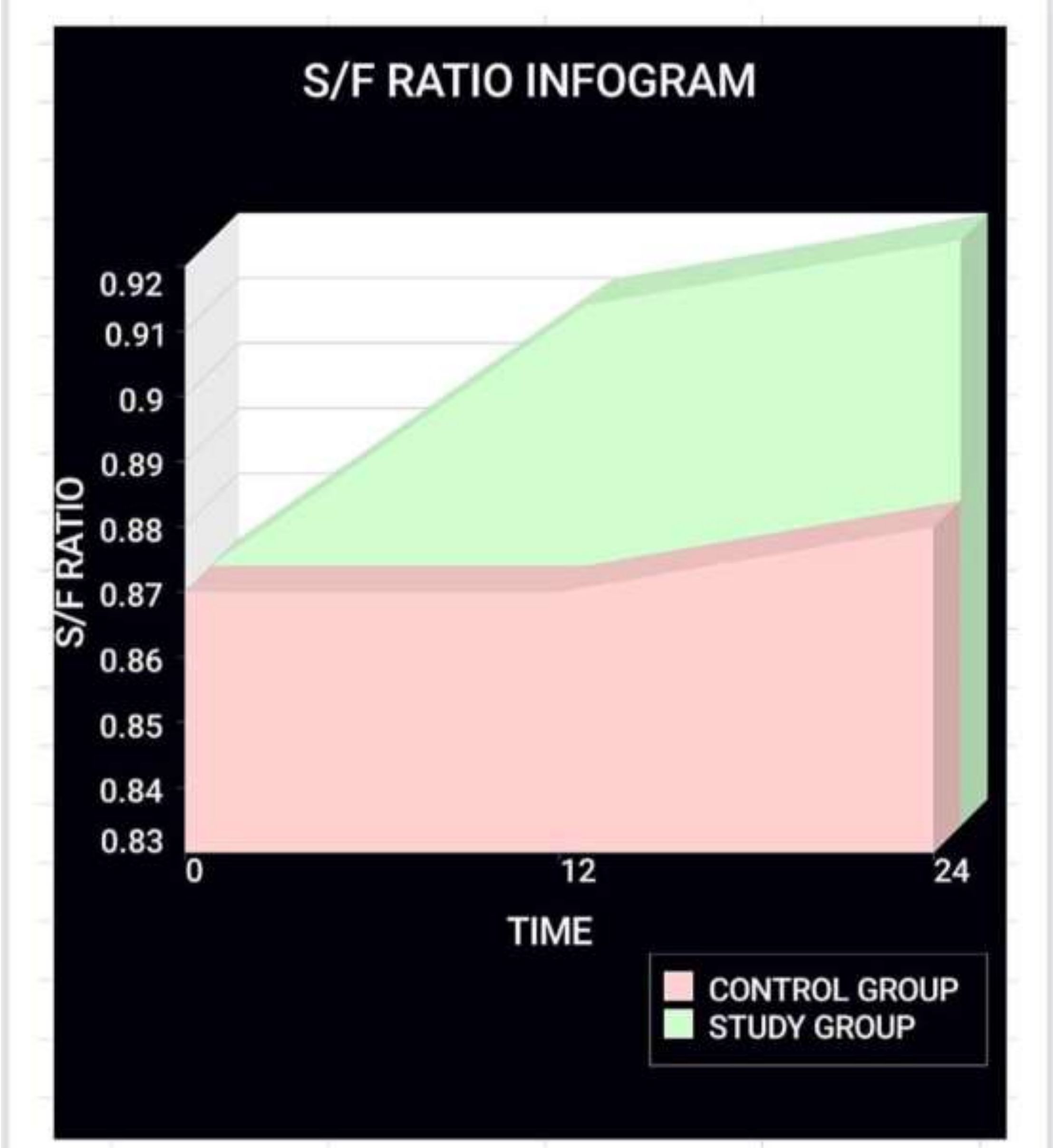


Figure (5) S/F ratio to time Infogram

DISCUSSION:

The primary goal of the research is to alleviate the feelings of discomfort ,hopelessness, air hunger, breathing fatigue and generalised fatigue for icu covid 19 patients with failed NIV and yet their families refused endotracheal intubation although they were told that the strategy under test which was the additin of ventilator generated breathing cycles to the patients breathing cycles is not alternative for endotracheal intubation whether early or late intubation.

Secondary goals is to give more time for the clinical result of drug therapy (antiviral, antibiotics , antifungal, antithrombotics) to take their action and buying more time before determining if the patient is downgrading or improving hence this may increase survival even with tiny chances.

Table (2) (baseline) of phase 1 data show no significant differences between the baseline patients characteristics of the control and study groups.

Table(3) of phase 2 clinical data analysis show no statistical differences between the control and study groups regarding patients heart rate , MAP and temperature readings, while the parameters under tests (WOB& S/F ratio) showed significant changes towards optimising WOB and slightly increasing S/F ratio 12 hours after combinig 8-10 device produced pressure controled respiratory cycles to the patients supported breathing (figure4&5)

table (4) show same improvement in S/F ratio and WOB after 24 hours and was infogramically represented in figures 4&5. The term (optimising WOB) here rather than decreasing WOB was intended to use in this thesis title because decreased respiratory rate not necessarily being a sign of improvement since respiratory muscles fatigue ,generalised fatigue or extreme hypercapnia can do so.

CONCLUSION:

Adding ventilator generated pressure controled breathing cycles to the respiratory rate of ICU covid19 patients with failed NIV can effectively optimises WOB and S/F ratio.

REFERENCES:

1. https://www.dc-med.com.tw/en/product/40-niv-mask/135-niv-mask.html
2. C. Hormann; M. Baum; C. Putensen; N. J. Mutz; H. Benzer (January 1994). "Biphasic positive airway pressure (BIPAP)--a new mode of ventilatory support". European Journal of Anaesthesiology. 11 (1): 37–42. PMID 8143712.
3. Davidson, A Craig; Banham, Stephen; Elliott, Mark; Kennedy, Daniel; Gelder, Colin; Glossop, Alastair; Church, Alistair Colin; Creagh-Brown, Ben; Dodd, James William; Felton, Tim; Foëx, Bernard; Mansfield, Leigh; McDonnell, Lynn; Parker, Robert; Patterson, Caroline Marie; Sovani, Milind; Thomas, Lynn (14 March 2016). "BTS/ICS guideline for the ventilatory management of acute hypercapnic respiratory failure in adults"
4. Forrest, Iain S.; Jaladanki, Suraj K.; Paranjpe, Ishan; Glicksberg, Benjamin S.; Nadkarni, Girish N.; Do, Ron (5 June 2021). "Non-invasive ventilation versus mechanical ventilation in hypoxemic patients with COVID-19". Infection. doi:10.1007/ s15010-021-01633-6. ISSN 1439-0973. PMC 8179090. PMID 34089483.
5. Al-Saadie KA, Abas HA, Almashhdani HA. Corrosion Protection of Iron Alloy Using Peganum harmala Extract as Inhibitor in Acidic Solution. Materials Sciences and Applications. 2015;6(11):1061.
6. Murthy, Srinivas; Gomersall, Charles D.; Fowler, Robert A. (11 March 2020). "Care for Critically Ill Patients With COVID-19". JAMA. 323 (15): 1499–1500. doi:10.1001/ jama.2020.3633. PMID 32159735.
7. Medical Dictionary for the Health Professions and Nursing. S.v. "work of breathing." Retrieved September 8, 2015, from http://medical-dictionary.thefreedictionary.com/ work+of+breathing.
8. Kadhim MM, Jassim GS, Obaid RF, Taban TZ, Almashhadani HA, Hachim SK, Sharma S. Potential application of some metal decorated AlP nano-sheet for detection of boron trichloride. Computational and Theoretical Chemistry. 2022 Aug 1;1214:113792.
9. Medical Dictionary. S.v. "work of breathing." Retrieved September 8, 2015, from http:// medical-dictionary.thefreedictionary.com/work+of+breathing.
10. Mosby's Medical Dictionary, 8th edition. S.v. "work of breathing." Retrieved September 8, 2015, from http://medical-dictionary.thefreedictionary.com/ work+of+breathing.
11. https://partone.litfl.com/work_of_breathing.html
12. https://www.cambridge.org/core/books/physics-pharmacology-and-physiology-for-anaesthetists/respiratory-physiology/E159DC3582D5FB1E7C5DC6865C89EF3C_31
13. Development of a work of breathing scale and monitoring need of intubation in COVID-
14. pneumonia -publication at: https://www.researchgate.net/publication/343351344
15. Article Info-Identification DOI: https://doi.org/10.1016/j.chest.2019.02.097 Copyright © 2019 American College of Chest Physicians. Published by Elsevier Inc. All rights reserved.
16. Almashhadani HA, Alshujery MK, Khalil M, Kadhem MM, Khadom AA. Corrosion inhibition behavior of expired diclofenac Sodium drug for Al 6061 alloy in aqueous media: Electrochemical, morphological, and theoretical investigations. Journal of Molecular Liquids. 2021 Dec 1;343:117656.
17. Evaluation of the SpO2/FiO2 ratio as a predictor of intensive care unit transfers in respiratory ward patients for whom the rapid response system has been activated. Citation: Kwack WG, Lee DS, Min H, Choi YY, Yun M, Kim Y, et al. (2018) PLoS ONE 13(7): e0201632. doi:10.1371/journal.pone.0201632 Editor: Yu Ru Kou, National Yang-Ming University, TAIWAN Received: April 19, 2018;

Accepted: July 18, 2018; Published: July 31, 2018.
18. Almashhadani HA. Synthesis of a CoO–ZnO nanocomposite and its study as a corrosion protection coating for stainless steel in saline solution. Int. J. Corros. Scale Inhib. 2021;10(3):1294-306.
19. Roca O et al. An Index Combining Respiratory Rate and Oxygenation to Predict Outcome of Nasal High-Flow Therapy. Am J Respir Crit Care Med. 2019 Jun 1;199(11):1368-1376. doi: 10.1164/ rccm.201803-0589OC.
20. Probability of non-invasive respiratory therapies failure in adults with COVID-19. Non-invasive respiratory therapies include high flow nasal cannula (HFNC) and non-invasive ventilation (NIV) content://com.sec.android.app.sbrowser/readinglist/0625004925.mhtml
21. RCT in clinical research typically compares a proposed new treatment against an existing standard of care; these are then termed the 'experimental' and 'control' treatments, respectively. Moher D, Hopewell S, Schulz KF, Montori V, Gøtzsche PC, Devereaux PJ, Elbourne D, Egger M, Altman DG (2010). "CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials". Br Med J. 340: c869. doi:10.1136/bmj.c869. PMC 2844943. PMID 20332511.
22. Adult Male and Female Height to Weight Ratio Chart. https://www.disabled-world.com/calculators-charts/height-weight.php REFERENCES 32 REFERENCES .
23. if the p-value is less than or equal to 0.05, then our hypothesis test will indeed have significance level. Neyman 1976, p. 161 in "The Emergence of Mathematical Statistics: A Historical Sketch with Particular Reference to the United States" , "On the History of Statistics and Probability" , ed. D.B. Owen, New York: Marcel Dekker, pp. 149-193.
24. https://journal.chestnet.org/article/S0012-3692(16)33702-3/fulltext
25. https://www.resmed.com/en-us/sleep-apnea/cpap-parts-support/cleaning-cpap -equipment/