ANNOTATION

of the dissertation work of Bekniyazova Assema Zhanaskhanovna on the theme: "The effect of various modes of vibroacoustic therapy on the course of coronavirus infection complicated by acute respiratory failure", submitted for the degree of Doctor of Philosophy (PhD) on specialty 8D10102- "Medicine"

Relevance of the study

Coronavirus infection is a dangerous infectious disease that can lead to serious lung damage. The disease can occur with varying degrees of damage to the respiratory system, and in severe cases can lead to acute respiratory failure (Cates J.et al., 2020). Treatment of patients with coronavirus pneumonia requires an adequate integrated approach, including physiotherapy (Melitta A. et al., 2022, Smondack P. et al., 2020).

Vibroacoustic pulmonary therapy is a method of physiotherapy that is based on a combination of acoustic and vibrational effects on the lung parenchyma, in the range of 20-300 Hz with a floating frequency and resonant effect (KP of the Ministry of Health of the Republic of Kazakhstan "Vibroacoustic pulmonary therapy", 2022). According to the manufacturer, based on the mechanism described above, the device helps to improve bronchial drainage, ventilation-perfusion relations and the opening of atelectasis and collapsed lung areas.

Despite the end of the pandemic, isolated cases of COVID-19, as well as cystic fibrosis with lung damage, are still found today (Hirawat R.et al, 2023). Post-covid syndrome is a term that is used to refer to a set of long-term symptoms observed in people after suffering from COVID-19. The use of a vibroacoustic device for the lungs can become a key link in the rehabilitation and comprehensive treatment of this category of patients.

Vibroacoustic therapy has demonstrated effectiveness in patients who have had a coronavirus infection. In the study of Shchikota A. et al, a decrease in shortness of breath and cough was noted by almost three times. A systematic review and meta-analysis of the role of physiotherapy in patients with post-cystic syndrome, including respiratory dysfunction, reflected the importance of respiratory system rehabilitation (Romanet et al., 2025). When searching for data in the evidence-based medicine database, the effectiveness of low-frequency chest vibrations in the treatment of lung diseases is limited.

The purpose of the study

To optimize the use of vibroacoustic pulmonary therapy (VALT) modes in the complex treatment of patients with coronavirus infection complicated by acute respiratory failure (ARF).

Object and subject of research

- The object of the study: patients with coronavirus infection complicated by acute respiratory failure.
- The subject of the study: the effect of various VALT regimens on the course of coronavirus infection complicated by ARF.

Research objectives

1. To compare the effectiveness and safety of the use of vibroacoustic pulmonary therapy regimens in the complex treatment of patients with coronavirus infection complicated by;

2. To evaluate the effectiveness of the «ARDS» regimen in patients with coronavirus infection complicated by acute respiratory failure in arterial blood (PaO2, PaCO2);
3. To evaluate the effectiveness of the "Pneumonia" regimen in patients with coronavirus infection complicated by acute respiratory failure in arterial blood (PaO2, PaCO2);
4. To develop a VALT protocol for patients with coronavirus infection complicated by ARF.

Method.

The study is a simple, blind, pilot randomized trial. The data were obtained in the intensive care unit from 2021 to 2022. The study was registered at ClinicalTrials.gov ., ID: NCT05143372.

Immediately before the procedure, arterial blood was taken once in the morning to determine PaO2, PaCO2 and P/F in the blood, as well as 10 minutes after the session of vibroacoustic therapy of the lungs.

All data was entered into the MC Excel database as patients were registered. After the specified period, the data was subjected to statistical processing using the Statistical Package for Social Sciences (SPSS) version 20.

The sample size was not calculated due to uneven registration of patients with coronavirus infection at different times from 2021 to 2022 due to the variability of the peak incidence.

The participants were randomly assigned to either the main or the comparison group in a 1:1 ratio using a random number generator on the website. www.randomizer.org . The researcher handed the medical staff a pre-prepared opaque envelope with randomly assigned numbers. Due to the need to select a mode on the device's display screen, all medical staff knew about the selected mode, while it was hidden from the patient.

The Kolmogorov–Smirnov criterion was used to determine the normality of the data. The Student's T-test was used only for normally distributed data. In cases with abnormal distribution, an intergroup analysis was performed using the Wilcoxon test in each group, before and after the VALT sessions.

The novelty of the study

For the first time, a pilot randomized controlled trial was conducted aimed at a comparative assessment of various modes of vibroacoustic therapy in patients with COVID-19 complicated by acute respiratory failure. New data has been obtained on the effect of the modes of the vibroacoustic apparatus on the dynamics of respiratory parameters, which makes it possible to justify the choice of the optimal therapeutic regimen.

Practical significance

Vibroacoustic lung therapy has been introduced into the practice of complex treatment of patients complicated by respiratory insufficiency, which makes it possible to accelerate the restoration of respiratory functions, shorten the duration of hospitalization and increase the effectiveness of rehabilitation, which ultimately leads to improved outcomes and a reduction in the burden on material resources of healthcare. The research materials can be used in the activities of pulmonologists,

physiotherapists, rehabilitologists, intensive care specialists, as well as in the development of clinical recommendations.

The main provisions submitted for defense

- The use of a certain regimen in complex therapy for acute respiratory failure can improve the parameters of gases in arterial blood;
- Choosing a specific regimen will help to purposefully treat a certain respiratory pathology.;
- VALT in complex therapy improves respiratory function and, as a result, reduces the duration of inpatient treatment.

Work approbation

The main results of the research and the provisions of the dissertation were reported and discussed at:

1. Forum of Anesthesiologists and Intensive Care Specialists of Russia 2021 (October 9, 2021);
2. Forum of Anesthesiologists and Intensive Care Specialists of Russia 2022 (October 16, 2022);
3. 5th International Forum of Anesthesiologists of Resuscitators of Kazakhstan (June 24-25, 2022);
4. Republican Scientific and practical conference with international participation "Innovations in Traumatology and Orthopedics" (July 27-28, 2023).

Also, as part of the study, the following was done:

1. Bark Technology Contract with NAO MUA 2022-2023;
2. Act of implementation “Use of vibroacoustic pulmonary apparatus in patients with trauma complicated by respiratory failure” at the N.D. Batpenov National Research Medical Center;
3. Copyright certificate No. 40520;
4. Development of the clinical protocol of the Ministry of Health of the Republic of Kazakhstan dated September 16, 2022. Protocol No.169 “Vibroacoustic pulmonary therapy".

Manuscripts:

1. Assema Bekniyazova, Aidos K Konkayev, Assiya Kadralinova, Maiya E Konkayeva, Aigerim A Yeltayeva. Case Report: Complex Treatment Using Vibroacoustic Therapy in a Patient With Co-Infection and COVID-19. Frontiers in medicine. 2022 Jun 7:9:893306. doi: 10.3389/fmed.2022.893306. Q1
2. Aidos K Konkayev, Assema Bekniyazova. Vibroacoustic therapy in the treatment of patients with COVID-19 complicated by respiratory failure: a pilot randomized controlled trial. Frontiers in medicine. 2023 Dec 14:10:1225384. doi: 10.3389/fmed.2023.1225384. Q2
3. Aidos Konkayev, Assema Bekniyazova, Zaituna Khamidullina, Maiya Konkayeva. Case series report: Use of vibroacoustic pulmonary therapy in patients with thoracic trauma complicated by acute respiratory failure. Front. Med., 04 September 2024. Sec. Intensive Care Medicine and Anesthesiology. Volume 11 - 2024 | https://doi.org/10.3389/fmed.2024.1399397. Q1

3 articles have been published on the topic of scientific work, which are included in the first quartile (2 articles) and the second quartile (one article) on the impact factor

according to the Journal Citation Reports of Clarivate Analytics. In one of the articles, the doctoral student is the first author and the corresponding author.

Results

According to the set goals and objectives of the dissertation, the effect of modes of the vibroacoustic pulmonary apparatus of domestic production on patients with coronavirus infection complicated by acute respiratory failure was investigated.

The following results were obtained:

- the baseline data of patients in both groups, including age and gender, were not statistically significant. There were also no major differences between the APACHE II, qSOFA, and PADUA scales;
- In the ARDS group, on the first day, the average value of PaO2 after the procedure increased by 12.5 mmHg, the median increased by 7.8 mmHg, 95% CI was within [69.8–85.2], and the standard deviation after the procedure was 20.6 mmHg;
- As for the group where the "Pneumonia" regimen was applied, the results on the change in PaCO2 levels on the third day showed the following: the average "Before" value was 43.6 mmHg, the median was 37.6 mmHg, 95% CI [37.2–50], the standard deviation was 17 mmHg. After the application of VALT: the average value was 48.7 mmHg, the median was 39.6 mmHg, 95% CI [40.8–56.6], the standard deviation was 21.1 mmHg.

In addition, vibroacoustic therapy was performed in a patient with sepsis due to a periprosthetic infection, whose condition was complicated by a severe form of COVID-19 with respiratory failure. The patient was treated in the hospital for 59 days, of which 57 days were in the intensive care unit. The treatment of multiple organ failure included complex treatment using antiviral and combined antibacterial therapy, taking into account the sensitivity of the pathogen to antibiotics, glucocorticoid therapy, anticoagulant therapy, noninvasive ventilation, as well as vibroacoustic pulmonary therapy. An integrated approach using a vibroacoustic device in the treatment of a patient with sepsis due to a periprosthetic infection with concomitant coronavirus infection has had a positive effect, despite the lack of etiological treatment for COVID-19.

A positive effect was also observed in patients with chest trauma who underwent osteosynthesis, whose condition was complicated by respiratory failure.

Conclusions

Coronavirus infection, despite the end of the pandemic, still occurs today in a milder form and not on the same scale as it was at the beginning of the spread of the virus, but it can also be complicated by respiratory failure and have long-term effects on the respiratory system. An integrated approach using vibroacoustic therapy can improve outcomes.

1. The «ARDS» regimens have demonstrated efficacy and safety when used in patients with coronavirus infection complicated by acute respiratory failure, while the «Pneumonia» regimen requires further research;
2. The «ARDS» mode increases the partial oxygen voltage in arterial blood;
3. The "Pneumonia" mode increases of the partial voltage of carbon dioxide in arterial blood;

4. The Clinical Protocol of the Ministry of Health of the Republic of Kazakhstan dated September 16, 2022 has been developed. Protocol No. 169 “Vibroacoustic pulmonary therapy".

The scientific direction of the dissertation corresponds to the priority development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan – Science of Life and Health.

Personal contribution of the dissertant

During the study, the dissertant participated in the formation of the methodological structure, formulation of the aim and objectives, collection of research materials, independently conducted statistical analysis and generalization of the obtained results, performed clinical and laboratory interpretation of patient data, analysis of literary data on the topic of the dissertation work.