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Original Article

Electroacupuncture-assisted Ribavirin Dosing for Long COVID: A Randomized Controlled Trial

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Abstract

Background and objectives: Various devices are used to study the unique electrical properties of acupuncture points (APs), with Voll's electropuncture diagnostics (EAV) occupying a prominent role. The technical design of EAV allows for the testing of drugs to determine their individual selection and dosages. However, the physiological basis of this phenomenon remains unclear. This study investigated the feasibility of evaluating the electrodermal activity of APs to determine the daily dose of ribavirin using electroacupuncture according to the Voll diagnostic system in patients with long COVID.

Methods: This blind, randomized, placebo-controlled trial included 101 patients (aged 16 to 50) who met the definition of long COVID and were examined using an EAV testing system that measures the electrodermal activity of APs. Ribavirin was tested at the APs with established decreased electrical impedance readings to determine the daily doses. Fifty-two participants were randomized to the experimental group, and forty-nine to the placebo group. These patients were considered for data analysis.

Results: The results of this study demonstrated the feasibility of using EAV to identify APs with decreased levels of electrodermal activity, followed by medicament testing (MT) of different ribavirin doses to restore the electrodermal activity at these points.

Conclusions: The results indicated that the tested doses of ribavirin in patients with long COVID correlate with electrodermal activity at certain APs along specific meridians. Higher doses of the drug were associated with lower electrodermal activity readings during MT using the EAV diagnostic system. However, further clinical and instrumental studies are needed to evaluate the clinical application of MT in the assessment of long COVID.

Introduction

Research on the electrical properties of acupuncture points (APs) has been conducted since the 1950s. Current findings suggest the following: The electrical potential at APs differs from that of the surrounding tissue. Changes in electrodermal activity at APs correlate with specific clinical conditions. Both clinical and laboratory data indicate that experimentally induced dysfunction and subsequent recovery correlate with increased or decreased electrical activity at the corresponding APs.[1–6] Voll developed a system of electropuncture diagnostics (EAV), which enabled him to create a medicine testing technique that studies the effect of drugs on the electrodermal impedance (EI) at APs.[7] Voll proposed using medicine testing to determine the optimal dose of a drug. For the first time, we proposed using medicament testing (MT) to test the daily doses of medicine. In the literature, there is some information about using MT to determine the daily doses of drugs.[8] In our view, the concept of a daily dose in traditional medicine reflects a standardized dose used to assess drug consumption rather than the dose at which the desired effect is achieved, demonstrating the idea of an optimal dose of medicine.[9] The purpose of MT is to restore electrodermal activity at an AP with a decreased level of electrodermal activity to normal readings, as measured by the Voll device, with the application of a drug. Our earlier study on diagnosing SARS-CoV-2-associated

Keywords: Long COVID; SARS-CoV-2; Medicament testing; Electrodermal activity; Acupuncture point; Measurement point; Ribavirin; Daily doses.

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pneumonia through ribavirin dose medicament testing revealed a significant difference in the tested doses of the drug in patients with varying disease severities. The study data showed that the ribavirin dose in patients with SARS-CoV-2-associated pneumonia directly depended on the severity of the pathological process: the more severe the patient's condition, the higher the tested daily ribavirin dose.[10]

We also showed a connection between the tested dose of sofosbuvir and the viral load in the blood of patients with chronic hepatitis C virus infection.[8]

According to the National Academies of Sciences, Engineering, and Medicine Committee, long COVID is an infection-associated chronic condition that occurs after SARS-CoV-2 infection and persists for at least three months as a continuous, relapsing, remitting, or progressive disease state affecting one or more organ systems.[11] It is estimated that in the United States, approximately 7% of adults and more than 1% of children - totaling 15 to 20 million Americans and more than 60 million people globally - have experienced long COVID. Manifestations of long COVID include systemic complaints (fatigue and poor concentration), signs of nervous system disorders (sleep disturbances, chronic headaches, "brain fog", memory defects, mood swings, and pain syndromes), cardiovascular disorders (rapid heartbeat, fainting, arrhythmia, and postural symptoms), and others.[12] It is hypothesized that SARS-CoV-2 may potentially persist in specific tissues, similar to what is observed with other non-retroviral RNA viruses.[13] This is the first study to determine the daily dose of ribavirin in patients with long COVID. The observation period was three years, and the study was based on measuring the EI at APs from different meridians using the EAV diagnostic system.

Materials and methods

Aim, design, and study settings

This blind, randomized, placebo-controlled trial aimed to investigate the potential of EAV diagnosis to identify APs with altered EI and to select the daily doses of ribavirin in patients with long COVID. The study's participants were selected from the outpatient department of the Research Institute of Virology. Further examination of the selected patients using the EAV method and subsequent MT was conducted at the "Avicenna" Medical Center from October 2020 to December 2023, during which patients were divided into two groups using a simple random sampling method. This approach was chosen due to the need for the participation of a second expert in the MT method. Patient examination, complaint registration, and medical history were collected before MT with the physician's participation in the general clinical setting of the medical center. The inclusion criteria for patients were as follows: both genders, ages 16 to 50 years, patients meeting the definition of long COVID,[11] willingness to sign a written informed consent form, including information on the need for the patient to comply with the conditions of the examination.[9] Patients with a positive test result for antibodies to chronic hepatitis C virus were excluded from the study. The study was conducted by the principles of the Declaration of Helsinki and was approved by the Institutional Review Board of the Research Institute of Virology (№ 6/8-1549 from 27/11/2020). All enrolled patients signed written informed consent forms for the study.

Characteristics of the participants

At the baseline visit, 204 patients were examined. Of these, 164 (80.4%) patients (median age 35.4 years; 53% female) met the diagnostic criteria for long COVID based on their complaints, medical history, and examination results. In this group, the experimental group consisted of 96 patients (58.5%), and the placebo group consisted of 68 patients (41.5%). Patients were followed for three years (2020–2023), with each subsequent examination to review the daily ribavirin doses occurring every 10–12 months. By the end of the observation period, 44 patients in the experimental group and 19 in the placebo group dropped out for various reasons, such as leaving the country, personal refusal to participate, lack of time, and other circumstances. This led to a reduction in the number of patients in both groups. The final numbers of patients were 52 (51.5%) in the experimental group and 49 (48.5%) in the placebo group. Among these patients, 42.5% were vaccinated against COVID-19: 51.9% in the experimental group and 37.2% in the placebo group.

Description of the intervention

In this blind, randomized, placebo-controlled trial, we assigned patients to the experimental and placebo groups at a 1.06:1 ratio, with further examination by EAV diagnosis followed by MT conducted by two experts with 33 and 22 years of experience in MT. MT was performed using the "Vistron" device (Kindling, GmbH Medizintechnik, 2015), developed to measure EI per Voll's method. Electrodermal readings of the tested APs were collected and analyzed before and after MT. The EAV diagnosis was performed according to the manufacturer's standards, taking into account conditions related to external factors, the patient, and the physician using the mentioned diagnostic equipment.[9]

MT

A key condition of MT, which allows the selection of drug doses, is the decreased electrodermal activity in the APs being studied, as registered during EAV diagnostics.[7–9] A positive reaction to the drug is considered when, upon placing the drug into the honeycomb of the EAV device during the diagnostic process, the electrical impedance at the AP being studied is restored to normal values (according to Voll). To determine the daily dose of the drug, the drug is placed in the honeycomb of the EAV device at the recommended daily dose according to the instructions. The EI at the AP is measured before and after placing the drug into the honeycomb. If there is a negative reaction to the tested dose of the drug, manifested by a further decrease in the EAV reading, an additional tablet is added to the honeycomb one by one, and the EI at the studied AP is measured each time. The final number of tablets placed in the honeycomb of the EAV device that restores normal electrodermal activity at the studied APs during the MT process is determined as the selected daily dose of the drug. Drug and dosage selection are closely related - only if the drug is correctly selected for the patient can the daily dose be tested.

The arbitrary measurement value (AMV) was used to analyze the MT results.[2]

Based on our previous experience examining patients with SARS-CoV-2-associated pneumonia and the preliminary data on diagnosing long COVID, we decided to use ribavirin (Copegus, Hoffmann-La Roche, 200 mg tablets) in the experimental group.[9,10] Glucose tablets were used as a placebo.

Statistical analysis

Statistical analysis of the data was conducted using the IBM SPSS Statistics 23 program. The Wilcoxon test was used for dependent variables, and the Mann–Whitney test was used for

Table 1. Results of medicament testing of daily doses of ribavirin (200 mg) in patients of reproductive age from 2020 to 2023

Meridians	2020–2021, Ribavirin 200 mg	2022, Ribavirin 200 mg	2023, Ribavirin 200 mg
Ne-3	232.8 ± 111.9	398.4 ± 179.4^^^	607.8 ± 282.9^^^##
Kr-8b	345.1 ± 165.8	543.9 ± 161.3^^^	602.4 ± 268.8^^^
3E-1b*	231.5 ± 100.1	272.2 ± 97.4	326.8 ± 135^^
He-8c*	165 ± 81.8	265 ± 66.9^	285 ± 120.3^
Le-1a*	211.1 ± 48.6	344.4 ± 52.7^^	538.9 ± 134.1^^##
Pa/Mi (S)-1a*	167.4 ± 70.1	234.8 ± 83.2^	350 ± 107.7^^^###
Pa/Mi (D)-1a*	305.9 ± 167.6	305.6 ± 174.8	382.4 ± 136.9^#
Ge-1b*	155 ± 43.8	250 ± 110.6^	195 ± 28.4#
Hau-1-3*	175 ± 52.4	158.3 ± 80.1	158.3 ± 58.5
Ni-1-3b*	245 ± 64.3	240 ± 65.8	160 ± 45.9^^##
Bl-66*	250 ± 40.8	192.9 ± 34.5^^	178.6 ± 39.3^^
Pa/Mi (D, S)-11	273.1 ± 90.4	219.2 ± 59.6^	380.8 ± 143.7^^##

*means a control measuring point adopted in the Voll system. ^$p < 0.05$, ^^$p < 0.01$, ^^^$p < 0.001$ – statistically significant differences compared to the corresponding indicators for 2020–2021 and 2022. #$p < 0.05$, ##$p < 0.01$, ###$p < 0.001$ indicate statistical significance for the corresponding indicators for 2022. Ribavirin doses are given in milligrams of the drug. 3E, endocrine system; Bl, bladder (Voll); Ge, joints; Hau, skin; He, heart; Kr, circulation; Le, liver; Ne, nervous degeneration; Ni, kidney; Pa/Mi, pancreas (D)/lien (S).

independent variables to determine statistically significant differences in quantitative data. Intergroup differences were considered significant at $p < 0.05$. Correlations were calculated using the nonparametric Spearman criterion, with significance considered at $r < 0.05$.

Results

The following APs (measurement points [MPs] of Voll's meridian system) were used to conduct MT: Ne-3, Kr-8b, 3E-1b*, He-8c*, Pa/Mi-1a* (S), Pa/Mi-1a* (D), Le-1a*, Ge-1b*, Hau-1-3*, Ni-1-3b*, Bl-66*, and Pa/Mi (D,S)-11.[14] The meridian names are given in the Voll system. At all specified MPs, the readings of the EAV device were recorded below the standard indications. These results were interpreted as hypoergic reactions, and the degree of expression of this reaction varied; these results were evaluated according to the accepted "interpretation of the results of the indicator drop".[8] Next, MT was conducted to determine the daily ribavirin dose using the aforementioned technique. This was based on previously obtained data on the diagnosis of long COVID.[9] Table 1 presents the data from the MT of tested daily doses of ribavirin (200 mg) over the observation period from 2020 to 2023.

Figure 1 shows a graphical representation of the data presented in Table 1.

The presented data showed that the tested daily doses of ribavirin varied at the studied APs of different meridians. Notably, the highest tested daily doses of ribavirin by the end of the observation period were recorded at the APs of the Ne, Kr, and Le meridians, constituting 607.8 mg, 602.4 mg, and 538.9 mg of ribavirin, respectively.

Table 2 shows the results of EAV measurements in the experimental group of patients over the observation period. The AMV was used to analyze the MT results.[2,6]

A comparison of the data in Tables 1 and 2 demonstrated the relationship between the EAV reading results and the tested daily doses of ribavirin. In 2023, the most pronounced decreases in electrodermal activity were observed in the studied MPs of the Ne, Kr, and Le meridians, with values of −5.22 (Ne-3), −5.8 (Kr-8b), and −6.03 (Le-1a*), respectively. The tested doses of ribavirin on these same meridians were 607.8 mg (Ne-3), 602.4 mg (Kr-8b), and 538.3 mg (Le-1a*), respectively.

Table 3 shows the results of EAV measurements in the experimental and placebo groups of patients during the observation period. The AMV was used to analyze the MT results.[2,6]

The presented data demonstrated a significant difference ($p < 0.001$) in the compared groups of patients according to the EAV pretest and posttest results, which was especially evident at the end of the observation period.

To identify and assess the closeness of the relationship between the two series of comparable quantitative indicators during the observation period - the results of the EAV pretest readings and ribavirin doses - we used the Spearman coefficient (Table 4). The Spearman coefficient was calculated for two meridians, Ne and Kr.

We found a significant correlation between the EAV prereading results and the tested daily ribavirin doses at the three-year follow-up for both meridians ($p < 0.001$).

Spearman's correlation coefficients were as follows: $\rho = -0.766$, $\rho = -0.918$, and $\rho = -0.846$ for the Ne meridian in the 2020–2021, 2022, and 2023 periods, respectively ($p < 0.001$). Spearman's correlation coefficients were as follows: $\rho = -0.821$, $\rho = -0.828$, and $\rho = -0.866$ for the Kr meridian in the 2020–2021, 2022, and 2023 periods, respectively ($p < 0.001$).

Figure 2 reflects the relationship between EAV pretest results and tested daily doses of ribavirin for Ne and Kr meridians over the observation period.

We also compared the changes in the EAV pretest results and the tested daily ribavirin doses during the observation period. The data presented in these tables convincingly demonstrate an inverse relationship between the tested daily doses of ribavirin and the EAV reading results: the higher the tested dose of ribavirin, the more pronounced the magnitude of the indicator drops of the EAV diagnostic apparatus. The data we obtained indicate a potential connection between the tested drug doses and the magnitude of the decrease in the readings of the EAV device associated with this process. However, this hypothesis requires further investigation.

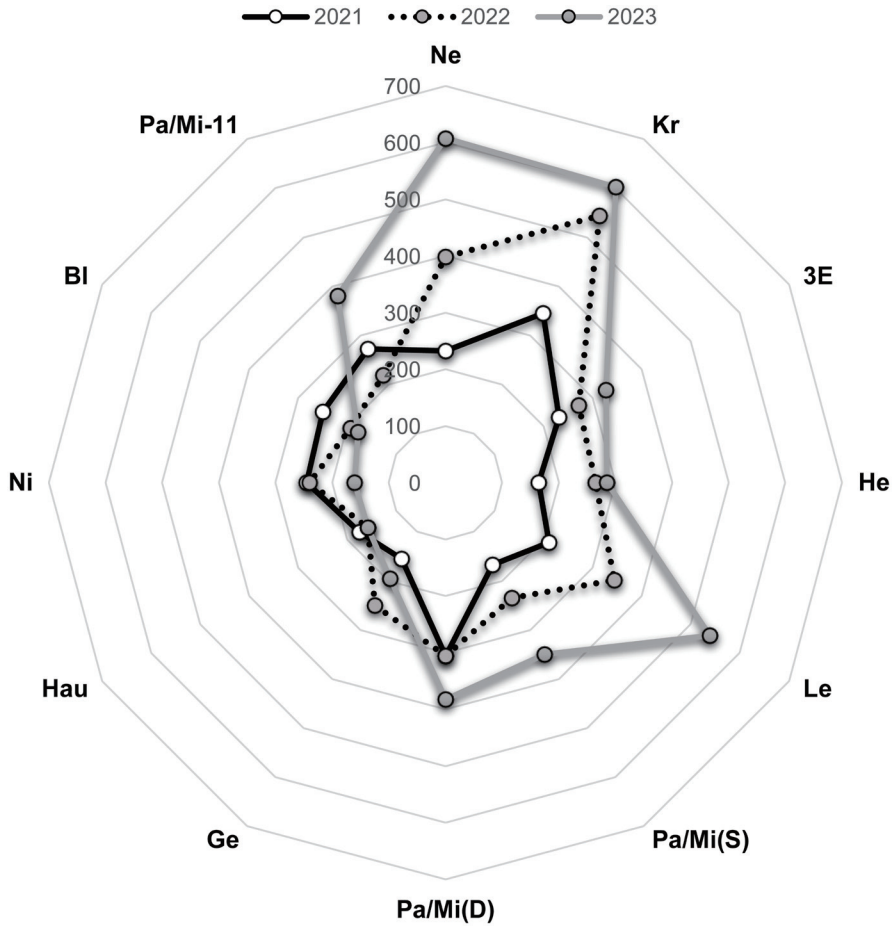

Fig. 1. Results of medicament testing of daily doses of ribavirin (200 mg) in patients of reproductive age from 2020 to 2023. 3E, endocrine system; Bl, bladder (Voll); Ge, joints; Hau, skin; He, heart; Kr, circulation; Le, liver; Ne, nervous degeneration; Ni, kidney; Pa/Mi, pancreas (D)/lien (S).

Discussion

The data we received may indicate that, in patients with long COVID, when observed over a three-year period, the tested daily doses of ribavirin at certain APs tend to increase. There appears to be a close relationship between the dose of the drug and the EAV device readings parameters. Given the currently accepted view that changes in electrodermal activity at APs correlate with specific clinical conditions, we suggest that the tested daily doses of the antiviral drug ribavirin may reflect varying degrees of damage to the organs and systems of the body due to the presence of SARS-CoV-2, as associated with the studied APs in the pathological syndrome known as long COVID. However, this conclusion requires further evidence.

In our opinion, the following mechanism may underlie the testing of daily drug doses in the MT process. We have previously suggested that MT is based on the interaction of the electromagnetic component of the drug, the activation of which occurs under the influence of the weak electric field of Voll's apparatus and the electric potential of the AP, which is studied during MT.[9] Suppose a decrease in electrodermal activity is observed at the studied AP. In that case, the inclusion of an external electromagnetic source (in the form of the electromagnetic component of a medicinal product) leads to the summation of the electrical components - the electrical potential of the AP and the medicinal product being studied - which is reflected on the display of Voll's diagnostic device. It is vital to select the correct medicinal product, as there is a connection between the chemical structure of the medicinal product and its electromagnetic component. Apparently, the same phenomenon occurs when determining drug doses. It must be assumed that different drug doses are related to organ (or tissue) processes associated with the studied AP. The more pronounced the pathological process in the organ (or tissue), the more pronounced the energy deficiency at the studied AP associated with this organ (or tissue) of the body. Accordingly, more external energy must be supplied from the outside to normalize the initially low level of readings at the studied AP, which leads to an increase in the drug dose being tested.

The first information on the need to dose medicines was mentioned in the works of the medieval scholars Abu Ali ibn Sina (Avicenna) and Paracelsus. A very peculiar comment on this subject was expressed by Cipolle: "Drugs do not have doses; people have doses".[15] For the first time, we proposed a noninvasive MT method for the individual selection of daily doses of ribavirin in patients with long COVID.

Ribavirin exhibits antiviral activity against a broad range of both DNA and RNA viruses *in vitro* and is widely used to treat viral infections, where the virus genome is represented by one- or double-stranded RNA. The mechanism of action includes direct inhibition of viral polymerase.[16] Recent studies on the activity of

Table 2. Data of the EAV reading results in the experimental group of patients over a three-year observation period

Meridians	EAV readings (U)	2020–2021, AMV	2022, AMV	2023, AMV
Ne-3	Pre-test	−2.93 ± 0.94	−4.01 ± 1.64^^^	−5.22 ± 3.77^^^#
	Post-test	6.02 ± 0.19	6.01 ± 0.23^^^	7.8 ± 9.89
Kr-8b	Pre-test	−3.63 ± 1.95	−5.46 ± 2.6^^^	−5.8 ± 3.55^^^
	Post-test	6.02 ± 0.24	6 ± 0.25^^^	6.03 ± 0.23^###
3E-1b*	Pre-test	−2.82 ± 1	−3.11 ± 1.21^^^	−3.73 ± 1.54^
	Post-test	5.93 ± 0.1	5.89 ± 0.13^^	5.71 ± 1.13^
He-8c*	Pre-test	−2.49 ± 0.61	−3.17 ± 0.86^^	−3.32 ± 1.02^
	Post-test	5.96 ± 0.07	5.92 ± 0.13^^	5.9 ± 0.13^^##
Le-1a*	Pre-test	−2.34 ± 0.74	−3.77 ± 0.9^^	−6.03 ± 1.48^^##
	Post-test	5.97 ± 0.28	5.9 ± 0.27^^	5.9 ± 0.3
Pa/Mi (S)-1a*	Pre-test	−2.46 ± 0.61	−2.52 ± 0.7^^^	−3.55 ± 2.23^^^###
	Post-test	5.99 ± 0.21	6 ± 0.21^^^	6.06 ± 0.24
Pa/Mi (D)-1a*	Pre-test	−3.66 ± 1.78	−3.62 ± 1.71^^^	−4.39 ± 1.67^#
	Post-test	5.99 ± 0.2	5.98 ± 0.22^^	5.98 ± 0.23^
Ge-1b*	Pre-test	−2.57 ± 0.51	−3.38 ± 1.05^^	−2.66 ± 0.36
	Post-test	5.86 ± 0.19	5.95 ± 0.21^	6.01 ± 0.12
Hau-1-3*	Pre-test	−1.68 ± 2.22	−2.65 ± 0.38^	−2.9 ± 0.45^
	Post-test	6.13 ± 0.3	6 ± 0.13^	6.03 ± 0.32^
Ni-1-3b*	Pre-test	−2.92 ± 0.69	−3.04 ± 1.37^^	−2.29 ± 0.4^
	Post-test	6.06 ± 0.25	5.82 ± 0.31^^	6.04 ± 0.36
Bl-66*	Pre-test	−3.49 ± 1.18	−2.87 ± 0.31^^	−2.99 ± 0.56
	Post-test	5.86 ± 0.14	5.86 ± 0.14^^	5.89 ± 0.19
Pa/Mi (D,S)-11	Pre-test	−2.25 ± 2.56	−2.99 ± 0.94^^^	−4.01 ± 1.4^^###
	Post-test	5.89 ± 0.13	5.91 ± 0.15^^^	5.95 ± 0.16

*means a control measuring point adopted in the Voll system. ^$p < 0.05$, ^^$p < 0.01$, ^^^$p < 0.001$ – statistically significant differences in relation to the corresponding indicators for 2020–2021 and 2022. #$p < 0.05$, ##$p < 0.01$, and ###$p < 0.001$ indicate statistical significance in relation to the corresponding indicators for 2022. EAV pretesting readings of MPs of different meridians are plotted with means and standard errors. 3E, endocrine system; AMV, arbitrary measurement value; Bl, bladder (Voll); EAV, electropuncture diagnostics; Ge, joints; Hau, skin; He, heart; Kr, circulation; Le, liver; MPs, measurement point; Ne, nervous degeneration; Ni, kidney; Pa/Mi, pancreas (D)/lien (S).

many antiviral drugs against Omicron have shown that ribavirin retains its activity against the SARS-CoV-2 virus, as do drugs such as IDD-1931, PF-07321332, remdesivir, favipravir, nafamostat, camostat, and aprotinin.[17] This report describes a noninvasive method for selecting daily doses of ribavirin for diagnostic purposes in patients with long COVID.

Limitations

There are several limitations of this study. The relatively small sample size is worth noting, as it limits our ability to draw valid conclusions from the research. Due to the current lack of diagnostic test systems for diagnosing long COVID, we could not refer to diagnostic results confirming the presence of SARS-CoV-2 in our patients' biological fluids or determine their viral load for this virus. The study uses the MT method, one of the systems specializing in detecting and analyzing the electrodermal activity of APs. The technical implementation of the technique is quite complex and requires skillful operation. Two MT specialists with 32 and 21 years of experience participated in this study. However, future studies should involve multiple specialists proficient in MT to compare the obtained data and assess the reproducibility of this method. Future studies with a larger sample size and a more robust design are warranted.

Conclusions

The results of this study demonstrate the feasibility of using the EAV to identify meridians with decreased EI at APs, followed by MT with ribavirin to restore the decreased electrodermal activity at the studied APs and to measure the daily dose of the drug. The study showed that the tested doses of ribavirin in patients with long COVID correlate with the indicators of electrodermal activity at certain APs of some meridians. The higher the tested dose of the drug, the lower the readings recorded during MT using the EAV diagnostic system. However, further clinical and instrumental studies are needed to assess the clinical application of MT in the evaluation of long COVID.

Table 3. Data from the EAV reading results in the experimental and placebo groups of patients over a three-year observation period

Meridians	EAV readings (U)	Placebo group	2020–2021, AMV	2022, AMV	2023, AMV
Ne-3	Pre-test	−3.87 ± 1.92	−2.93 ± 0.94*	−4.01 ± 1.64	−5.22 ± 3.77**
	Post-test	−3.65 ± 1.82	6.02 ± 0.19***	6.01 ± 0.23***	7.8 ± 9.89***
Kr-8b	Pre-test	−4.85 ± 2.42	−3.63 ± 1.95*	−5.46 ± 2.6*	−5.8 ± 3.55*
	Post-test	−4.42 ± 2.74	6.02 ± 0.24***	6 ± 0.25***	6.03 ± 0.23***
3E-1b*	Pre-test	−3.38 ± 1.52	−2.82 ± 1	−3.11 ± 1.21	−3.73 ± 1.54
	Post-test	−3.33 ± 1.37	5.93 ± 0.1***	5.89 ± 0.13***	5.71 ± 1.13***
He-8c*	Pre-test	−4.02 ± 0.86	−2.49 ± 0.61**	−3.17 ± 0.86*	−3.32 ± 1.02
	Post-test	−3.13 ± 1.64	5.96 ± 0.07***	5.92 ± 0.13***	5.9 ± 0.13***
Le-1a*	Pre-test	−3.91 ± 1.83	−2.34 ± 0.74*	−3.77 ± 0.9	−6.03 ± 1.48**
	post-test	−3.55 ± 1.99	5.97 ± 0.28***	5.9 ± 0.27***	5.9 ± 0.3***
Pa/Mi (S)-1a*	Pre-test	−2.77 ± 0.97	−2.46 ± 0.61	−2.52 ± 0.7	−3.55 ± 2.23***
	Post-test	−2.6 ± 2.91	5.99 ± 0.21***	6 ± 0.21***	6.06 ± 0.24***
Pa/Mi (D)-1a*	Pre-test	−2.62 ± 0.77	−3.66 ± 1.78	−3.62 ± 1.71*	−4.39 ± 1.67**
	Post-test	−3.4 ± 0.78	5.99 ± 0.2***	5.98 ± 0.22***	5.98 ± 0.23***
Ge-1b*	Pre-test	−2.97 ± 0.82	−2.57 ± 0.51	−3.38 ± 1.05	−2.66 ± 0.36
	post-test	−3.01 ± 0.72	5.86 ± 0.19***	5.95 ± 0.21***	6.01 ± 0.12***
Hau-1-3*	Pre-test	−4.2 ± 3.17	−1.68 ± 2.22	−2.65 ± 0.38	−2.9 ± 0.45
	Post-test	−4.26 ± 2.92	6.13 ± 0.3***	6 ± 0.13***	6.03 ± 0.32***
Ni-1-3b*	Pre-test	−2.99 ± 0.86	−2.92 ± 0.69	−3.04 ± 1.37	−2.29 ± 0.4*
	Post-test	−3.12 ± 0.59	6.06 ± 0.25***	5.82 ± 0.31***	6.04 ± 0.36***
Bl-66*	Pre-test	−2.83 ± 0.79	−3.49 ± 1.18	−2.87 ± 0.31	−2.99 ± 0.56
	Post-test	−3.19 ± 0.7	5.86 ± 0.14***	5.86 ± 0.14***	5.89 ± 0.19***
Pa/Mi (D,S)-11	Pre-test	−2.65 ± 0.65	−2.25 ± 2.56	−2.99 ± 0.94	−4.01 ± 1.4**
	Post-test	−2.84 ± 0.58	5.89 ± 0.13***	5.91 ± 0.15***	5.95 ± 0.16***

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$ indicate statistical significance in relation to the corresponding indicators in the control group. EAV pretesting readings of MPs of different meridians are plotted with means and standard errors. 3E, endocrine system; AMV, arbitrary measurement value; Bl, bladder (Voll); EAV, electropuncture diagnostics; Ge, joints; Hau, skin; He, heart; Kr, circulation; Le, liver; MPs, measurement point; Ne, nervous degeneration; Ni, kidney; Pa/Mi, pancreas (D)/lien (S).

Table 4. Estimates of the closeness of the relationship (Spearman coefficient) between the electropuncture diagnostics (EAV) pretest results and the tested doses of ribavirin from 2020 to 2023

Pair of variables	n	Spearman coefficient-ρ	t (N-2)	*p*-value
Ne_Ribavirin2021 & Ne_pre- test 2020—2021	32	−0.766522	−6.5374	0.000000
Ne_Ribavirin2021 & Ne_post- test 2020–2021	32	0.512815	3.2718	0.002690
Kr_Ribavirin2021 & Kr_pre-test 2020–2021	41	−0.821824	−9.0081	0.000000
Kr_Ribavirin2021 & Kr_post-test 2020–2021	41	0.153447	0.9698	0.338142
Ne_Ribavirin2022 & Ne_pre-test2022	32	−0.918862	−12.7549	0.000000
Ne_Ribavirin2022 & Ne_post-test2022	32	−0.012466	−0.0683	0.946013
Kr_Ribavirin2022 & Kr_pre-test2022	41	−0.828853	−9.2520	0.000000
Kr_Ribavirin2022 & Kr_post-test2022	41	0.061494	0.3848	0.702507
Ne_Ribavirin2023 & Ne_pre-test2023	32	−0.846807	−8.7200	0.000000
Ne_Ribavirin2023 & Ne_post-test2023	32	−0.167155	−0.9286	0.360504
Kr_Ribavirin2023 & Kr_pre-test2023	41	−0.826824	−9.1802	0.000000
Kr_Ribavirin2023 & Kr_post-test2023	41	−0.090787	−0.5693	0.572406

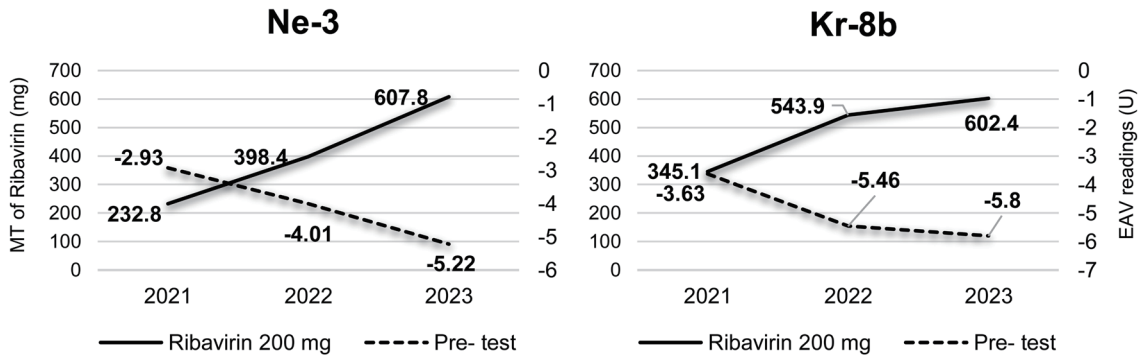

Fig. 2. Comparison of electropuncture diagnostics (EAV) pretest results and tested daily doses of ribavirin for nervous degeneration (Ne) and circulation (Kr) meridians for the follow-up period. MT, medicament testing.

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Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Author contributions

Study design and conceptualization (ND, GA, LD), methodology and investigation (ND, GA, LD), statistical analysis (DU), And original draft preparation (ND). All authors approved the final version for publication.

Ethical statement

The study was approved by the Institutional Review Board of the Research Institute of Virology of Uzbekistan (№ 6/8-1550, from 27/11/2020). All enrolled patients signed a written informed consent form for the study.

Data sharing statement

Study data are available upon reasonable request.

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