Effects of oral amino acid cystine (700 mg) and theanine (280 mg) administration on SARS-CoV-2 virus infection - A case series

Hiroaki Tanno¹, Michinaga Takahashi¹, and Takashi Tsuchiya²

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Abstract

An amino acid supplement containing 700 mg of cystine and 280 mg of the anine was administered to 4 patients during the treatment of SARS-CoV-2 virus infection. Negative reactions on polymerase chain reaction (PCR) testing were promptly obtained. Oral ingestion of cysteine and the anine (C/T) may promote SARS-CoV-2 virus elimination.

1 Introduction

COVID-19 is an infectious disease caused by the SARS-CoV-2 virus.[1] The treatment has not been established and vaccine development is delayed. Internationally, the number of SARS-CoV-2-infected patients exceeds 25,000,000. In Japan, [?]70,000 persons have been infected and the number of patients is increasing.[2]

According to a review of patients who died in Japan, persons aged [?]70 years accounted for 80%. The overall mortality rate is 1.6%, but it increases with age. It is [?]1% in those aged 10 to 49 years, whereas the rates in those aged 60 to 69 years, 70 to 79 years, and 80 to 89 years are 1.9, 5.7, and 11.5%, respectively; the mortality rate in elderly persons is reportedly [?]10-times higher than in young persons.[3] As immune deficiency is noted in the elderly, it is important to prevent immune deficiency and improve the immunity in the current situation in which treatment has not been established.

Cystine is synthesized through bimolecular binding of cysteine, as a sulfur-containing amino acid, to disulfide. It is contained in many foodstuffs, including meat. After cellular uptake, cystine is reduced to cysteine. Theanine is a tea component, and is decomposed to glutamic acid and ethylamide after being absorbed in vivo. Intracellular cysteine, glutamic acid, and glycine function as substrates for the synthesis of glutathione, which exhibits the most potent antioxidant actions in vivo. [4]

A previous study reported that the simultaneous administration of cystine and theanine (C/T) stimulated influenza antigen-specific immunoglobulin G (IgG) antibody production via glutathione synthesis in mice. An experiment using old mice also yielded similar results.[5-6] Furthermore, a study involving humans reported that C/T administration significantly increased antibody production after influenza vaccination in elderly patients with malnutrition.[7] These findings suggest that C/T administration influences the clinical course of SARS-CoV-2 virus infection. We report 4 SARS-CoV-2-infected patients who were admitted to our hospital, and treated using a supplement containing cystine (700 mg) and theanine (280 mg), leading to favorable results.

2 Subjects and Methods

The subjects were 4 patients admitted to our hospital under a diagnosis of SARS-CoV-2 virus infection. All patients had positive reactions on polymerase chain reaction (PCR) testing and symptoms such as fever and

¹Towada City Hospital

²Public Interest Incorporated Foundation Sendai City Medical Center

dysosmia. They were hospitalized as mild-status patients. A supplement containing cystine (700 mg) and theanine (280 mg) at a total volume of 1.5 g was orally administered once a day from X month 15th until discharge in all patients. While continuing standard treatment, the presence of the virus was examined using PCR testing. After confirming negative reactions on two consecutive sessions of PCR testing, which comprised a criterion for discharge, the patients were discharged. We investigated supplement compliance after the start of administration, PCR testing results, and the interval from the start of supplement administration until negative reactions on two consecutive sessions of PCR testing were obtained.

3 Case presentation

Concerning C/T adherence, C/T ingestion was possible every day in all patients.

Case 1

Patient: A woman in her nineties.

Complaint: Fever.

Medical history: Intestinal obstruction and dementia/hearing loss.

Infectious disease/allergy: Absent.

Present illness: In a nursing-care facility to which she had been admitted, it was clarified that a resident had novel coronavirus infection on X month 8th, 2020. Fever was noted on X month 10th and PCR testing was conducted on the same day. A positive reaction was detected and she was admitted to our hospital on X month 11th.

Physical examination on admission: The height, body weight, and body mass index (BMI) were 150 cm, 40 kg, and 17.78, respectively. The blood pressure, pulse rate, and body temperature were 121/59 mmHg, 71/min, and 36.8°C (after the oral administration of Acetaminophen), respectively.

Laboratory data on admission: Chest X-ray did not demonstrate pneumonia. The TB, AST, ALP, LDH, $\gamma\text{-}GTP$, ChE, TP, Alb, Cr, BUN, and CRP levels were 0.26 mg/dL, 20 IU/L, 10 IU/L, 230 IU/L, 218 IU/L, 16 IU/L, 256 IU/L, 6.9 g/dL, 3.6 g/dL, 0.79 mg/dL, 13.3 mg/dL, and 0.30 mg/dL, respectively. The HbA1c value, WBC, RBC, Hb level, Ht value, PLT count, PT-INR, D-dimer level, and ferritin level were 5.6%, 4,000/µL (Neut/Lymp=1.19), 438 x $10^4/\mu$ L, 12.9 g/dL, 39.4%, 26.5 x $10^4/\mu$ L, 0.92, 3.3 µg/mL, and 169.3 ng/mL, respectively.

Course after admission: Slight fever (37.0 to 37.9°C) persisted, but fever (>38°C) was sometimes observed. The CRP level ranged from 4 to 5 mg/dL. The general condition was maintained, and the patient was discharged on May 21st. No antiviral drug, such as Favipiravir, was used (admission period: 41 days).

C/T administration and PCR testing results

One pack/day of C/T was administered from X+1 month 15th, and this was continued until X+1 month 21st. In this patient, negative and positive reactions on PCR testing were repeatedly detected 4 times, but negative reactions on two consecutive sessions of PCR testing were obtained 5 and 6 days after the start of C/T administration (Figure a).

 ${\it Case}\ 2$

Patient: A woman in her nineties.

Complaint: Fever.

Medical history: Dementia.

Infectious disease/allergy: Absent.

Present illness: In a nursing-care facility to which she had been admitted, it was clarified that a resident had novel coronavirus infection on X month 8th, 2020. Fever was noted on X month 10th and PCR testing was

conducted on the same day. A positive reaction was detected and she was admitted to our hospital on X month 11th.

Physical examination on admission: The height, body weight, and BMI were 136 cm, 37.8 kg, and 20.44, respectively. The SpO_2 was 96% (room air). The blood pressure, pulse rate, and body temperature were 156/87 mmHg, 69/min, and 36.8° C, respectively.

Laboratory data on admission: Chest X-ray did not demonstrate pneumonia. The TB, AST, ALP, LDH, γ-GTP, ChE, TP, Alb, Cr, BUN, and CRP levels were 0.35 mg/dL, 36 IU/L, 22 IU/L, 260 IU/L, 181 IU/L, 24 IU/L, 227 IU/L, 6.0 g/dL, 3.6 g/dL, 0.47 mg/dL, 12.0 mg/dL, and 0.32 mg/dL, respectively. The HbA1c value, WBC, RBC, Hb level, Ht value, PLT count, PT-INR, D-dimer level, and ferritin level were 5.4%, 4,600/μL (Neut/Lymp=1.63), 410 x 10^4 /μL, 12.8 g/dL, 38.7%, 18.3 x 10^4 /μL, 0.92, 0.9 μg/mL, and 91.6 ng/mL, respectively.

Course after admission: As fever persisted, the administration of Ceftriaxon at 2 g was started on X month 13th. On X month 14th, the body temperature, respiratory rate, and SpO_2 were $38.1^{\circ}C$, 22 times/min, and 93% (room air), respectively. Chest X-ray did not demonstrate pneumonia. Subsequently, fever transiently reduced, but it recurred on X month 18th. Antibiotic therapy was continued and pyretolysis was achieved on X month 20th. The subsequent condition was stable and the patient was discharged on X+1 month 30th (admission period: 50 days).

No antiviral drug, such as Favipiravir, was used.

C/T administration and PCR testing results

One pack/day of C/T was administered from X+1 month 15th. Even after the start of C/T administration, positive reactions on PCR testing persisted, and the dose was increased to 2 packs from X+1 month 26th. After 3 days, a negative reaction was obtained for the first time. In addition, two consecutive sessions of PCR testing yielded negative reactions (Figure b).

Case 3

Patient: A woman in her forties.

Complaint: Dysgeusia.

Medical history: Not contributory. Infectious disease/allergy: Absent.

Present illness: Malaise developed on X month 21st, 2020. Headache, nasal obstruction, mild cough, and slight fever were noted from X month 24th. Dysgeusia was observed on X month 27th. PCR testing yielded a positive reaction and the patient was admitted on X month 28th.

Physical examination on admission: The height, body weight, and BMI were 156 cm, 46 kg, and 18.90, respectively. The SpO_2 was 98% (room air). Headache, cough, nasal obstruction, and mild dysgeusia were present. Slight malaise was noted. The blood pressure, pulse rate, and body temperature were 122/78 mmHg, $71/\mathrm{min}$, and $37.5^{\circ}\mathrm{C}$, respectively.

Laboratory data on admission: Chest X-ray did not demonstrate pneumonia. The TB, AST, ALT, ALP, LDH, $\gamma\text{-GTP}$, ChE, TP, Alb, Cr, BUN, and CRP levels were 0.33 mg/dL, 16 IU/L, 10 IU/L, 125 IU/L, 135 IU/L, 10 IU/L, 230 IU/L, 6.3 g/dL, 3.5 g/dL, 0.45 mg/dL, 7.8 mg/dL, and 0.10 mg/dL, respectively. The WBC, RBC, Hb level, Ht value, PLT count, PT-INR, D-dimer level, and ferritin level were 2,700/µL (Neut/Lymp=0.88), 403 x $10^4/\mu\text{L}$, 10.9 g/dL, 32.3%, 18.6 x $10^4/\mu\text{L}$, 0.91, 0.8 µg/mL, and 21.5 ng/mL, respectively.

Course after admission: Headache, slight fever, nasal obstruction, cough, and dysgeusia persisted, but the oral administration of Acetaminophen reduced headache. Pyretolysis was achieved on X+1 month 3rd.

Headache subsided on X+1 month 4th and taste was normalized. Subsequently, mild nasal obstruction and cough gradually reduced, and the patient was discharged on X+1 month 21st (admission period: 24 days).

No antiviral drug, such as Favipiravir, was used.

C/T administration and PCR testing results

One pack/day of C/T was administered from X+1 month 15th and this was continued until X+1 month 21st. The results of PCR testing were negative 5 and 6 days after the start of C/T administration (Figure c).

Case 4

Patient: A man in his forties.

Complaint: Dysgeusia.

Medical history: Fracture of the right lower thigh (20 years previously).

Infectious disease/allergy: Absent.

Smoking: Twenty cigarettes x 15 years. Smoking cessation was achieved in the latter half of his thirties.

Present illness: Fever (38°C) and cough developed on X+1 month 5th, 2020. Malaise was noted on X+1 month 6th. Dysgeusia was observed on X+1 month 7th. PCR testing was conducted. On the same day, a positive reaction was detected and the patient was admitted.

Physical examination on admission: The height, body weight, and BMI were 168 cm, 64 kg, and 22.68, respectively. The SpO₂ was 96% (room air). Nasal discharge and mild cough were present. Slight malaise was noted. Dysgeusia and dysosmia were noted. The blood pressure, pulse rate, and body temperature were 128/92 mmHg, 94/min, and 38.3°C, respectively.

Laboratory data on admission: Chest X-ray did not demonstrate pneumonia. The TB, AST, ALP, LDH, γ -GTP, ChE, TP, Alb, Cr, BUN, CRP, and Zn levels were 0.38 mg/dL, 25 IU/L, 24 IU/L, 128 IU/L, 201 IU/L, 38 IU/L, 395 IU/L, 6.4 g/dL, 3.7 g/dL, 0.83 mg/dL, 8.8 mg/dL, 1.18 mg/dL, and 51 μ g/dL, respectively. The WBC, RBC, Hb level, Ht value, PLT count, PT-INR, D-dimer level, and ferritin level were 3,500/ μ L (Neut/Lymp=3.31), 475 x 10⁴/ μ L, 14.2 g/dL, 41.9%, 14.6 x 10⁴/ μ L, 1.03, 1.0 μ g/mL, and 175.9 ng/mL, respectively.

Course after admission: The general condition was stable, but fever, nasal discharge, cough, and malaise persisted. Dysgeusia reduced from X+1 month 10th. Pyretolysis was achieved on X+1 month 13th. Blood testing revealed slight increases in the CRP, ferritin, and D-dimer levels (1.27 mg/dL, 278.7 ng/mL, and 3.0 μ g/mL, respectively), in addition to a decrease in the Zn level (62 μ g/dL) on X+1 month 14th. Chest X-ray revealed a slight peripheral shadow in the right lower lung field. Subsequently, mild cough was present, but the course was favorable. The patient was discharged on X+1 month 27th (admission period: 21 days).

No antiviral drug, such as Favipiravir, was used.

C/T administration and PCR testing results

One pack/day of C/T was administered from X+1 month 15th and this was continued until X+1 month 27th. PCR testing yielded a positive reaction 4 days after the start of C/T administration, but negative reactions were obtained 11 and 12 days after its initiation (Figure d).

4 Discussion

In Japan, COVID-19 was authorized as a designated infectious disease. After infection is confirmed, reporting and admission/isolation are required. In Aomori Prefecture (population: 1,250,000 persons), where our hospital is located, 35 patients with SARS-CoV-2 virus infection have been confirmed. At our hospital, as a medical institution designated for infectious diseases, 14 patients were hospitalized/treated. Criteria for

discharge at that time included the absence of fever (37.5°C or higher), confirmation of a negative reaction on PCR testing [?]24 hours after the confirmation of respiratory symptom relief, and additional confirmation of a negative reaction after [?]24 hours.[8] In this study, C/T was administered to 4 patients admitted to our hospital; symptoms reduced in all patients during the process of virus-disappearance confirmation using PCR testing according to the criteria for discharge. In Cases 1 to 3, negative reactions on two consecutive sessions were not obtained through 8, 3, and 4 sessions of PCR testing, respectively. In Cases 1 and 3, negative reactions were obtained on two consecutive sessions of PCR testing after the start of C/T administration. In Case 4, negative reactions were obtained on the 2nd and 3rd sessions of PCR testing after the start of C/T administration, leading to discharge. On the other hand, in Case 2, positive reactions were detected on two consecutive sessions of PCR testing after the start of C/T administration and the dose of C/T was increased 2-fold. Subsequently, negative reactions were obtained on two consecutive sessions of PCR testing, leading to discharge. The mean interval from the start of C/T administration until the criteria for discharge were met was 9.8 days, being shorter than the pre-administration course. Concerning SARS-CoV-2 virus infection, it was reported that some patients required a long period until negative reactions on PCR testing were obtained. At Fujita Health University Okazaki Medical Center, 90 pathogen carriers without symptoms were investigated, and the median interval until negative reactions on PCR testing were obtained was 9 days, whereas [?]15 days were required in 11 (12%) of the 90 subjects.[9] According to a report from China, when comparing the results between patients with and without symptoms (n=37 each), the antibody titer was significantly lower in the latter, and the median period during which the virus was detected in the former and latter was 14 and 19 (maximum: 45 days) days, respectively, being significantly different. [10] In the 4 patients treated at our hospital, the antibody test was not conducted, but all patients had a mild status and negative reactions on two consecutive sessions of PCR testing were not confirmed before C/T administration, especially in those aged [?]90 years; antibody production may have been low. C/T was reported to stimulate influenza antibody production in elderly persons with malnutrition. This suggests that C/T also improved the antibody production capacity in patients with SARS-CoV-2 virus infection, aiding in virus elimination. If C/T had not been administered, a longer period may have been required until obtaining negative reactions. This was deduced from the results in a small number of patients. In the future, a prospective study involving a larger number of patients must be conducted.

The course of Case 2 suggests that double-dose administration played a role in the negative reactions; therefore, an initial dose of 2 packs/day may be appropriate. A sufficient dose should be examined in the future, but a previous study suggested the safety of administration at 3 packs/day with no adverse reactions.[11]

Furthermore, C/T reduces invasiveness. Several studies reported that C/T reduced inflammation after high-intensity exercise loading in athletes, inhibiting a reduction in NK activity and improving the condition.[12-14] A study regarding perioperative C/T administration to patients who underwent surgery for gastric cancer noted early recovery from fever, inhibition of increased energy consumption, early normalization of IL-6/CRP, and early recovery from a reduction in the lymphocyte count ratio.[15] An experiment using a mouse small intestine manipulation model also yielded similar results, in addition to inhibition of a reduction in the small intestinal mucosa glutathione level and early behavioral recovery.[16] Furthermore, experiments using rats demonstrated that C/T administration reduced the mortality rates after reperfusion following ischemia, in an intraperitoneally-LPS-treated peritonitis model and after systemic irradiation.[17-19] Excessive secretion of inflammatory cytokines (cytokine storm), including IL-6, may be involved in severe COVID-19; C/T administration may also play a role in severe-status prevention and early reduction of inflammation.[20] Therefore, the use of C/T earlier than the timing of administration in our patients, i.e., immediately after infection, should be examined.

Recently N-Acethylcysteine(NAC), a precursor of glutathion, has been suggested to prevent COVID-19 associated cytokine storm and acute respiratory distress syndrome by inhibition of IL-6, IL-8, and TNF-α.[21] Ιν αδδιτιον, NA° βλοςας ανγιοτενσιν-ζονερτινγ ενζψμε $2(A^*E2)$, ωηιςη ις α ρεςεπτορ οφ $\Sigma AP\Sigma$ -δ΄-2 σπιαε προτειν.[22] Τηις μαψ αττενυατε πενετρατιον οφ $\Sigma AP\Sigma$ -δ΄-2 ιντο ζελλς. Τηε αυτηορς σπεςυλατεδ τηατ NA° μαψ πλαψ αν αδθυαντ ρολε ιν τηε τρεατμεντ οφ σεερε $^{\circ}O^{\circ}I\Delta$ -19 ςασες ανδ ιν τηε ζοντρολ οφ ιτς λετηαλ ζομπλιςατιον,

ας ωελλ ας πυλμοναρψ ανδ ςαρδιοασςυλαρ αδερσε εέντς. Τηυς, "/T μαψ βε αλτερνατίε οφ NA".

Ιν αδδιτιον, "/Τ ωας ρεπορτεδ το πρεεντ τηε ζομμον ζολδ· 173 ηεαλτηψ αδυλτς ωερε διιδεδ ιντο "/Τ- ανδ πλαςεβο-τρεατεδ γρουπς, ανδ 5-ωεεχ οβσερατιον ωας ζονδυςτεδ.[23] Ιν τηε πλαςεβο-τρεατεδ γρουπ, 23 (27.1%) οφ 85 συβθεςτς ηαδ τηε ζομμον ζολδ, ωηερεας 10 (11.4%) οφ 88 συβθεςτς ιν τηε "/Τ-τρεατεδ γρουπ ηαδ ιτ, δεμονστρατινγ α σιγνιφιζαντ διφφερενςε (π=0.011). Ανδ τηε ζυμυλατιε δυρατιον οφ δισεασε ωας 59 δαψς ιν τηε πλαςεβο-τρεατεδ γρουπ ανδ 18 δαψς ιν τηε "/Τ-τρεατεδ γρουπ, δεμονστρατινγ α σιγνιφιζαντ διφφερενςε (π=0.002). Τηεσε ρεσυλτς συγγεστ τηε πρεεντιε εφφεςτς οφ "/Τ αδμινιστρατιον ον "ΟΊΔ-19. Ιφ α αζζινε ις δεελοπεδ, "/Τ αδμινιστρατιον ατ τηε τιμε οφ αζζινατιον μαψ στιμυλατε αντιβοδψ προδυζτιον, φυρτηερινγ ιτς πρεεντιε εφφεςτς.

Το ζονφιρμ της εφφεςτς οφ $^{\circ}/T$ ον $^{\circ}O$ Τ Δ -19 πατιεντς, προσπεςτιε ζλινιζαλ στυδιες αρε νεεδεδ. Ωηεν ταχινγ $^{\circ}/T$ φορ πρεεντιον, ιτ ις α φοοδ, βεινγ μορε ααιλαβλε τηαν δρυγς. Ιτς τοταλ ολυμε ις 1.5 γ, βεινγ σμαλλ· τηερεφορε, αδηερενςε ις φαοραβλε, ωηιςη ωιλλ βε αδανταγεους.

5 δνςλυσιον

Αμινο αςιδ "/Τ προιδες τηε συβστρατες οφ γλυτατηιονε, ςψστεινε ανδ γλυταμις αςιδ. Ιτ εξηιβιτς αντιοξιδαντ ανδ αντι-ινφλαμματορψ αςτιονς. Βασεδ ον ουρ σεριες, τηε οραλ αδμινιστρατιον οφ "/Τ μαψ προμοτε $\Sigma AP\Sigma$ -δ"-2 ιρυς ελιμινατιον.

Αςχνοωλεδημεντς

We thank Afinomoto $\delta.,$ Inc. for proiding the amino acid supplement $\hfill ^{\circ}/T.$

δνφλιςτ οφ ιντερεστ

Τηε αυτηορς δεςλαρε τηατ τηερε ις νο ςονφλιςτ οφ ιντερεστ ρεγαρδινγ τηε πυβλιςατιον οφ τηις αρτιςλε.

Αυτηορς ςοντριβυτιον

ΗΤ ανδ ΜΤ ωερε ινολεδ οφ αςχυισιτιον οφ δατα, ωριτινγ οφ τηε αρτιςλε ανδ εδιτινγ τηε παπερ.

TT was indied in the sonseption and design of this sase report and writing of the article and editing the paper.

ονσεντ οφ πυβλιςατιον

Ωριττεν ινφορμεδ ζονσεντ ωας οβταινεδ φρομ της πατιεντ ορ πατιεντ'ς φαμιλψ φορ πυβλιςατιον.

Ρεφερενςες

- [1] ΩΗΟ. Ααιλαβλε ονλινε ατ: ηττπς://ωωω.ωηο.ιντ/εμεργενςιες/δισεασες/νοελ-ςοροναιρυσ-2019/τεςηνιςαλ-γυιδανςε/ναμινγ-τηε-ςοροναιρυσ-δισεασε-(ςοιδ-2019)-ανδ-τηε-ιρυσ-τηατ-ςαυσεσ-ιτ
- [2] WHO. Asilable online at: $\eta \tau \tau \pi \varsigma$: //www.who.int/doss/default-sourse/soronairuse/situation-reports/would-september-2020-approed. $\pi \delta \varphi$: $\pi \delta \varphi$:
- [3] Μινιστρψ οφ Ηεαλτη, Λαβουρ ανδ Ωελφαρε. Ααιλαβλε ονλινε ατ: $\eta \tau \tau \pi \varsigma$: $//\omega \omega \omega . \mu \eta \lambda \omega . \gamma o . \theta \pi / \varsigma o \nu \tau \epsilon \nu \tau / 10906000/000625626 . πδφ$
- [4] Κυριήαρα Σ , Σηιβαχυσα T, Ταναχα AK K. Ύστινε ανδ τηεανινε: αμινο αςιδς ας οραλ ιμμυνομοδυλατιε νυτριέντς. Σ πρινγέρ Π λυς .2013·2:635.δοι:10.1186/2193-1801-2-635
- [5] Κυριηαρα Σ , Σηιβαηαρα Σ , Αρισαχα H, ετ αλ. Ενηανζεμεντ οφ αντιγεν-σπεςιφις ιμμυνογλοβυλιν Γ προδυςτιον ιν μιςε βψ ςο-αδμινιστρατιον οφ $_{\Lambda}$ -ςψστινε ανδ $_{\Lambda}$ -τηεανινε. Θ ἔτ Mεδ Σ ςι $2007\cdot69(12)$: 1263-1270.
- [6] Ταχαγι Ψ , Κυριηαρα Σ , Ηιγασηι N, ετ αλ. δμβινεδ αδμινιστρατιον οφ $_{\Lambda -}$ ςψστινε ανδ $_{\Lambda -}$ τηεανινε ενηανςες ιμμυνε φυνςτιονς ανδ προτεςτς αγαινστ ινφλυενζα ιρυς ινφεςτιον ιν αγεδ μιςε. Θ $\tilde{\epsilon}\tau$ $M\epsilon\delta$ Σ ςι $2010\cdot72(2):157-165$.

- [7] Μιψαγαωα Κ, Ηαψασηι Ψ, Κυριηαρα Σ , ετ αλ.δ-αδμινιστρατιον οφ $_{\Lambda}$ -ζψστινε ανδ $_{\Lambda}$ -τηεανινε ενηανζες εφφιζαςψ οφ ινφλυενζα αςςινατιον ιν ελδερλψ περσονς: νυτριτιοναλ στατυσ-δεπενδεντ ιμμυνογενιςιτψ. Γεριατρ Γεροντολ Iντ $2008\cdot8:243-250$.
- [8] Μινιστρψ οφ Ηεαλτη, Λαβουρ ανδ Ωελφαρε. Ααιλαβλε ονλινε ατ: $\eta \tau \tau \pi \varsigma$://ωωω. $\mu \eta \lambda \omega$. $\gamma o. \theta \pi / \varsigma o \nu \tau \epsilon \nu \tau / 000618523. \pi \delta \phi$
- [9] Φυθιτα Ηεαλτη Υνιερσιτψ Οκαζακι Μεδιςαλ εντερ. Ααιλαβλε ονλινε ατ: $ηττπ://ωωω.κανσενσηο.ορ.θπ/υπλοαδς/φιλες/τοπιςς/2019νςο/ςοιδ19_ςασερεπορτ_200313.πδφ$
- [10] Long XE, Tang Eq. Shi XL, et al. "linical and immunological assessment of asymptomatic SARS-3"-2 injection. Nat $M\epsilon\delta2020$ https://doi.opy/10.1038/s41591-020-0965-6.
- [11] Κυριηαρα Σ , Ψοσηίδα Σ , Συχεγαώα E, ετ αλ. Εαλυατίον οφ σαφετψ οφ λονή-τερμ ανδ εξςεσσίε ίνταχε οφ Λ-ζψστίνε ανδ Λ-τηεανίνε ιν ηεαλτηψ αδύλτ συβθεζτς. Σείκατσυ Είσει 2008:52(4): 229-236.
- [12] Μυραχαμι Σ , Κυριηαρα Σ , Κοιχαωα N, ετ αλ. Εφφεςτς οφ οραλ συππλεμεντατιον ωιτη ςψστινε ανδ τηεανινε ον τηε ιμμυνε φυνςτιον οφ ατηλετες ιν ενδυρανςε εξερςισε: Ρανδομιζεδ, δουβλε-βλινδ, πλαςεβο-ςοντρολλεδ τριαλ. Βιοσςι Βιοτεςηνολ Βιοςηεμ 2009: 73(4): 817-821.
- [13] Καωαδα Σ, Κοβαψασηι Κ, Οητανι Μ , ετ αλ. "ψστινε ανδ τηεανινε συππλεμεντατιον ρεστορες ηιγη-ιντενσιτψ ρεσιστανςε εξερςισε-ινδυςεδ αττενυατιον οφ νατυραλ κιλλερ ςελλ αςτιιτψ ιν ωελλ -τραινεδ μεν. Θ Στρενγτη δνδ Pες $2010\cdot24(3)$: 846-851.
- [14] Μυραχαμι Σ, Κυριηαρα Σ, Τιτςηεναλ Α, ετ αλ. Συππρεσσιον οφ εξερςισε-ινδυςεδ νευτροπηιλια ανδ λψμπηοπενια ιν ατηλετες βψ ςψστινε/τηεανίνε ινταχε: α ρανδομίζεδ, δουβλε-βλίνδ, πλαςεβο-ςοντρολλεδ τριαλ. Θ Iντ Σος Σπορτ Nυτρ $2010\cdot23(7):ηττης://δοι.οργ/10.1186/1550-2783-7-23.$
- [15] Μιψαςηι T, Tσυςηιψα T, Οψαμα <math>A, ετ αλ. Περιοπερατιε οραλ αδμινιστρατιον οφ ςψστινε ανδ τηεανινε ενηανςες ρεςοερψ αφτερ δισταλ γαστρεςτομψ: α προσπεςτιε ρανδομίζεδ τριαλ. ΘΠΕΝ 2013·37: 384-391.
- [16] Σηιβαχυσα Τ, Μιχαμι Τ, Κυριηαρα Σ, ετ αλ. Ενηανζεμεντ οφ ποστοπερατιε ρεζοερψ βψ πρεοπερατιε οραλ ζο-αδμινιστρατιον οφ της αμινο αζιδς, ζψστινε ανδ τηςανινε, ιν α μουσε συργιζαλ μοδελ. %ιν Nυτρ $2012\cdot 31:555-561.$
- [17] Μιψαχυνι Τ, Φυκατσυ Κ, Ρι Μ, ετ αλ. Ύστινε ανδ τηεανινε ιμπροε συριαλ αφτερ γυτ ισςηεμια-ρεπερφυσιον. $Ανν Νυτρ Μεταβ2018^{\circ} 73:131-137.δοι:10.1159/000489825$
- [19] Ματσυυ-Ματσυψαμα Μ, Σηιςηιθο Κ, Τσυςηιψα Τ, ετ αλ. Προτεςτιε εφφεςτς οφ α ςψστινε ανδ τηεανινε μιξτυρε αγαινστ αςυτε ραδιατιον ινθυρψ ιν ρατς. Ενιρον Τοξιςολ Πηαρμαςολ 2020 ΠΜΙΔ: 32325407 δοι: 10.1016/θ.εταπ.2020.103395.
- [20] Ραγαβ Δ, Αλδιν ΗΣ, Ταειμαη Μ, ετ αλ. Της ΌΤΔ-19 ςψτοχινε στορμ \cdot Ωηατ ωε χνοω σο φαρ. Φροντ. Ιμμυνολ., 16 Θυνε 2020 | ηττπς://δοι.οργ/10.3389/φιμμυ.2020.01446
- [21] Ασσιμαχοπουλος $\Phi\Sigma$, Μαρανγος Μ. Ν-αςετψλ-ςψστεινε μαψ πρεεντ "Ο"Ι Δ -19-ασσοςιατεδ ςψτοχινε στορμ ανδ αςυτε ρεσπιρατορψ διστρεσς σψνδρομε. Μεδιςαλ Ηψποτηεσες 140 (2020) 109778
- [22] Φλορα $\Sigma\Delta$, Βαλανσκή P, Μαεστρα $\Sigma\Lambda$. Ρατιοναλε φορ τηε υσε οφ N-αςετήλςψστεινε ιν βοτη πρεεντιον ανδ αδθυαντ τηεραπή οφ ΌΤ Δ -19. ΦΑ Σ EB Θ 2020· 00:1-9 Δ OI: 10.1096/φθ.202001807
- [23] Κυριηαρα Σ, Ηιραοκα Τ, Ακυτσυ Μ, ετ αλ. Εφφεςτς οφ_{Λ-}ςψστινε ανδ _{Λ-}τηεανινε συππλεμεντατιον ον τηε ςομμον ςολδ: α ρανδομιζεδ, δουβλε-βλινδ, ανδ πλαςεβο-ςοντρολλεδ τριαλ. Θ Αμινο Αςιδς 2010· 307475. δοι:10.4061/2010/307475.

Φιγυρε Λεγενδς

Admission period, PP testing results, $^{\circ}/T$ dose, and administration period in 4 patients injected with SARS-5°-2

