Original Article

Remdesivir Effects on COVID-19 Infection in Adult Patients

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Abstract

Introduction: Coronavirus disease 2019 (COVID-19) is a serious pandemic affecting the global world since 2019 with heavy impacts on the social, economy, and normal daily life; one of the promising antiviral treatment used frequently all over the world is the remdesivir. **Aim:** The aim was to study the effect of 3–5 days remdesivir treatment course, regarding its starting time on clinical status and the fate of patients with COVID-19, with monitoring of the side effects. **Materials and Methods:** A prospective observational study involved 90 patients with COVID-19 who received remdesivir 5 days course; all were hospitalized, diagnosed by computerised tomography (CT) chest and polymerase chain reaction (PCR) at Merjan Teaching Hospital from August 2020 to October 2020. Those 90 patients' age ranged from 25 to 88 years. Sixty-two patients received convalescent plasma with remdesivir against 13 patients who not received it. Tocilizumab was added for 18 patients, whereas 57 were not treated with it. Clinical state (SpO_2, subjective dyspnea, respiratory rate (RR), fever, and the type of O_2 supplements) of the patients was assessed three times. Regarding the time of starting remdesivir treatment during the course of disease, patients were assessed in three groups: patients received remdesivir within <10 days, patients received it between 10 and 15 days, and patients received it >15 days. Mean of the duration of patients discharge was recorded. **Results:** It showed an extremely significant difference ($P < 0.001$) between the discharged and both referred to respiratory care unit (RCU) and death patients. There were significant differences ($P < 0.05$) in the clinical state (SpO_2, subjective dyspnea, RR, fever, and the type of O_2 supplements) of the patients in all three times of assessments with significant correlation ($P < 0.01$) between means of the clinical state (SpO_2 and subjective dyspnea score) and the fate (discharge, admission to RCU, and death) of patient who received it. There were no significant differences ($P > 0.05$) between means of time of starting therapy and the fate of patients. At the same time, no significant differences ($P > 0.05$) were seen in the mean of liver function test. There were no significant differences ($P > 0.05$) between the fate of patients who received convalescent plasma with remdesivir, but a significant disadvantage ($P < 0.001$) was seen in the fate of patient who received tocilizumab. **Conclusion:** We can conclude that remdesivir improves the clinical state of patients with COVID-19 regardless of the time of its starting during the course of disease.

Keywords: Adult patients, convalescent plasma, COVID-19, remdesivir, tocilizumab

Introduction

Coronaviruses are a large family of viruses; some can cause severe diseases such as Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS) coronaviruses.[1]

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is genetically related to above viruses; SARS-CoV-2 is a highly infectious virus and transmitted mainly by respiratory droplets and contact with respiratory secretion and saliva; another possible route of transmission is aerosol particles of the infected patients. However, this virus remains viable on surfaces for hours to days.[2,3]

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Coronavirus disease 2019 (COVID-19) is caused by SARS-CoV-2, which is noted in December 2019 in China and spread throughout the world. World Health Organization advertised it as global pandemic on March 11, 2020.[4]

Optimal management strategies continue to evolve because our understanding of the spectrum of COVID-19 continues to develop. In general, the management of COVID-19

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begins at first with supportive care including bed rest, sufficient calorie, and water intake, whereas oxygen therapy is used for patients with hypoxia. Antibiotics should be used when there is bacterial coinfection.[5] Immunomodulators, mechanical ventilation, plasma, immunoglobulin used differently according to the local guidelines of any country, antiviral agents (oseltamivir, lopinavir/ritonavir, favipiravir, and remdesivir), and other multiple management plans used across different countries according to patient condition.[6]

Remdesivir was developed at first to treat Ebola, hemorrhagic fever, that appears in West Africa in 2014.[7] It works by blocking an enzyme that helps viruses make copies of itself (replication) and in this way prevents it spread throughout the body.[7,8]

Studies showed that the drug blocked the activity of both SARS and MERS, which are members of similar family of the new virus (COVID-19).[9] Remdesivir is adenosine nucleotide prodrug that distributes into cells and then metabolized to active nucleoside triphosphate metabolite; remdesivir triphosphate acts as an analog of adenosine triphosphate (ATP) and competes with natural ATP substrate for the incorporation into nascent RNA chains by virus RNA-dependent RNA polymerase, which lead to delay chain termination.[7,9]

The most common adverse effects are: anemia (8%), acute kidney injury (7%), hepatitis: ALT/AST grade 3 (3%–6%) and ALT/AST grade 4 (2%–3%), pyrexia (5%), and hyperglycemia (4%).[10-12]

Remdesivir is given as a loading dose of 200 mg and maintenance dose of 100 mg in course from 5 to 10 days, prepared with 0.9% NaCl and given intravenously over 30–120 min.[11]

Aims of the study

The aims of the study were as follows:

- Assess efficacy on clinical states, patients' fates, and hospitalization durations
- Study the relation between the time of symptoms appearance and treatment starting on the efficacy/safety
- Assess the safety by monitoring the expected side effects
- Assess the risk/benefits of the concomitant use of convalescent plasma and tocilizumab.

Materials and Methods

A prospective observational study from August 2020 to November 2020 at Merjan Teaching Hospital included 90 patients who were admitted with the diagnosis of COVID-19; all patients received remdesivir course of 3 days or more with 200 mg loading dose and 100 mg maintenance dose.

Inclusion criteria

The following are the inclusion criteria:

- Diagnosis with COVID by computerised tomography (CT) or polymerase chain reaction (PCR) positive
- Age >12 years
- Normal liver function tests
- Glomerular filtration rate (GFR) <30
- Nonpregnant nonlactating
- Not allergic to remdesivir
- Patients received convalescent plasma and other patients received tocilizumab in concomitant with remdesivir also involved in this research to see if any drug interaction appears.

Patients were assessed daily during their hospitalization from day 1 (the date of admission) to his final fate (discharge, referral to respiratory care unit [RCU] or death). The assessment was done by clinical and laboratory parameters (SpO_2, respiratory rate [RR], PR, shortness of breath [SOB] fever, liver function test [LFT], renal function test [RFT], and complete blood picture [CBP]), plus other points to be considered:

1. CT involvement
2. Time to start the remdesivir treatment in relation to symptoms appearance (<10, 10–15, and >15 days)
3. Days of hospitalizations.

Data analysis

Statistical analysis was carried out using SPSS version 23. Categorical variables were presented as frequencies and percentages; continuous variables were presented as means ± standard deviation (SD). T-test was used to compare means between two groups. Chi-square test and Fisher-exact test were used to find the association between categorical variables. A P value of ≤ 0.05 was considered as significant.

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number 4 (including the number and the date in 14/4/2022) to get this approval.

Results

1. The sociodemographic distribution of patients:

The number of male was 58 and female was 32; 78 from all patients were nonsmoker, and 46 of them have 50% or more lung involvement by CT, as shown in Table 1.

The concomitant use of convalescent plasma was in 84.4%, whereas of tocilizumab was 32.2% of the total number of the participants. Table 2 shows the distribution of patients according to PCR results as shown in Figure 1.

Table 1: The sociodemographic distribution of all patients (N = 90)

Study variables		
Age	56.92 ± 14.0	25–88
BMI* (kg/m^2)		
Normal (18.5–24.9)	36	40.0%
Overweight (25–29.9)	40	44.4%
Obese (≥30)	14	15.6%
Total	90	100.0%
Gender		
Male	58	64.4%
Female	32	35.6%
Total	90	100.0%
Smoking habit		
Yes	12	13.3%
No	78	86.7%
Total	90	100.0%
Percentage of lung involvement by CT findings (%)*		
<50%	44	48.9%
≥50%	46	51.1%
Total	90	100.0%

*Mean BMI of patients was 26.07 ± 3.94, range = 20.0–49.0 kg/m^2; mean percentage of lung involvement by CT findings is 47.84% ± 22.13%

Table 2: The distribution of patients according to PCR results (N = 90)

Study variables	N	%
PCR		
Positive	46	51.1%
Negative	44	48.9%
Total	90	100.0%

2. The distribution of patients received remdesivir according to the fate:

Figure 2 shows the distribution of patients according to the fate of patients including the discharge of patient, admission to RCU, and overall death. Majority (n = 75, 83.3%) of patients were discharged from hospital in good health, 5.6% referred to RCU, and 11.1% were death. So there is an extremely significant difference ($P < 0.001$) between the discharged and both referred to RCU and death patients.

3. The distribution of patients according to the time of receiving remdesivir and hospitalization time:

Table 3 shows the distribution of patients according to time variables including the duration from the onset of disease to starting drug and the duration from day 1 of taking drug to the final fate.

4. The effect of remdesivir on the clinical state (SpO_2, subjective dyspnea, RR, fever, and the type of O_2 supplements) of the patients in three times of assessments:

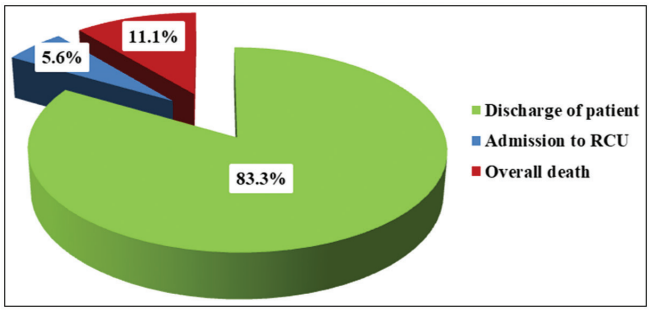

Figure 2: Distribution of patients according to the fate of patients

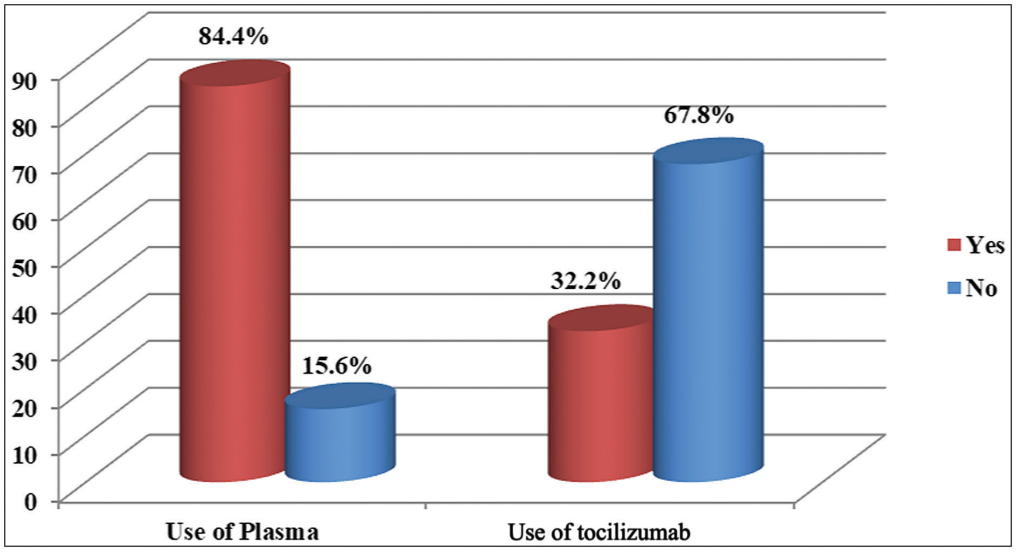

Figure 1: Distribution of patients according to the concomitant use of plasma and tocilizumab. A majority of patients (n = 76, 84.4%) used plasma and only 29 (32.2%) patients used tocilizumab

Table 3: The distribution of patients according to time variables (N = 90)

Study variables	N	%
Duration from the onset of disease to starting drug (days)		
<10 days	32	35.6%
10–15 days	40	44.4%
>15 days	18	20.0%
Total	90	100.0%
Duration from day 1 of taking drug to final fate (days)		
<10 days	57	63.3%
10–15 days	15	16.7%
>15 days	18	20.0%
Total	90	100.0%

The mean differences of SpO_2 (%) according to the time of assessments including the first assessment at the first day of therapy and the second assessment when patients complete treatment: there were significant differences between means of SpO_2 at two periods of assessments (at the first day of therapy: 87.56 ± 7.61, and when patients complete treatment: 89.30 ± 7.19 [paired t-test = −2.409, P = 0.018]), as shown in Figure 3.

The mean differences of subjective dyspnea score according to the time of assessments including the first assessment at the first day of therapy and the second assessment when patients complete treatment: there were significant differences between means of subjective dyspnea score at two periods of assessments (at the first day of therapy: 5.08 ± 2.47, and when patients complete treatment: 2.70 ± 2.05 [paired t-test = 9.997, $P \leq 0.001$*]), as shown in Figure 4.

The mean differences of SpO_2 (%) according to the time of assessments including the second assessment when patients complete treatment and the third assessment at discharge: there were significant differences between means of SpO_2 at two periods of assessments (when patients complete treatment: 89.30 ± 7.19 and at discharge: 90.03 ± 6.92 [paired t-test = −2.188, P = 0.031*]), as shown in Figure 5.

The mean differences of subjective dyspnea score according to the time of assessments including the second assessment when patients complete treatment and the third assessment at discharge: there were significant differences between means of subjective dyspnea score at two periods of assessments (when patients complete treatment: 2.70 ± 2.05 and at discharge: 1.056 ± 2.44 [paired t-test = 9.65, $P \leq 0.001$*]), as shown in Figure 6.

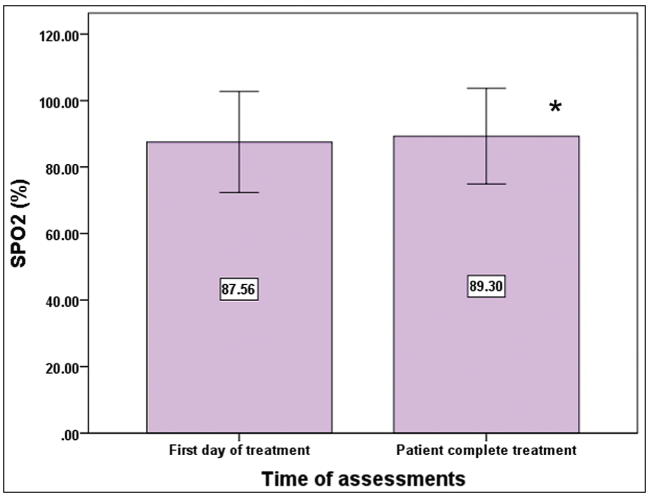

Figure 3: The mean differences of SpO_2 (%) according to the time of assessments. *P value < 0.05 (significant difference)

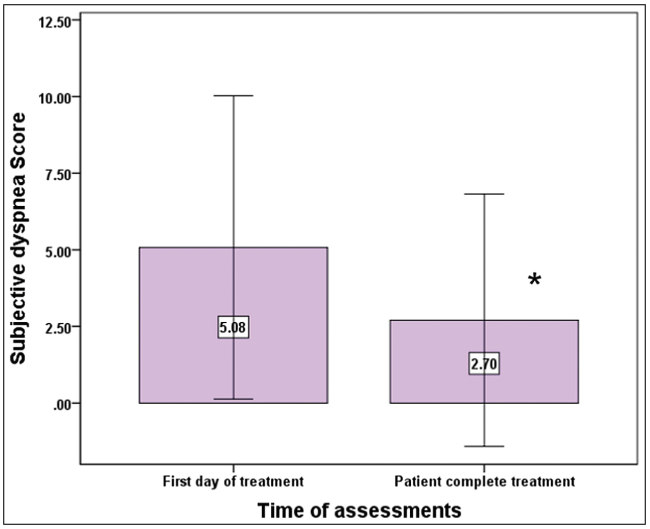

Figure 4: The mean differences of subjective dyspnea score according to the time of assessments. *P value < 0.05 (significant difference)

The distribution of patients according to respiratory rate

Figure 7 shows the distribution of patients according to respiratory rate including normal respiratory and tachypnea at three times of assessment including the first assessment at the first day of therapy, second assessment when patients complete treatment, and the third assessment at discharge.

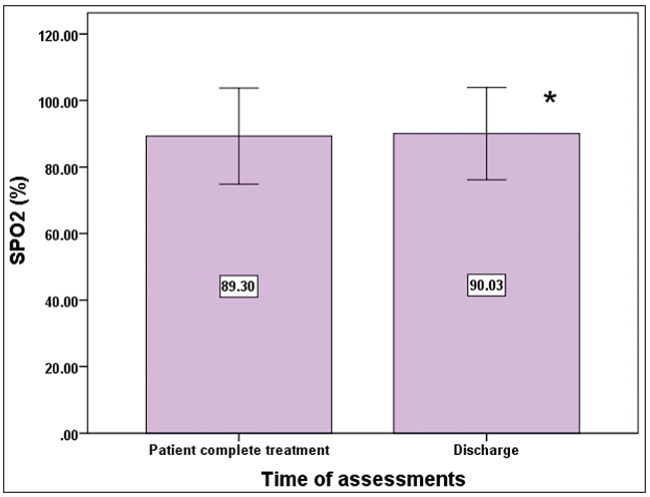

Figure 5: The mean differences of SpO_2 (%) according to the time of assessments. *P value < 0.05 (significant difference)

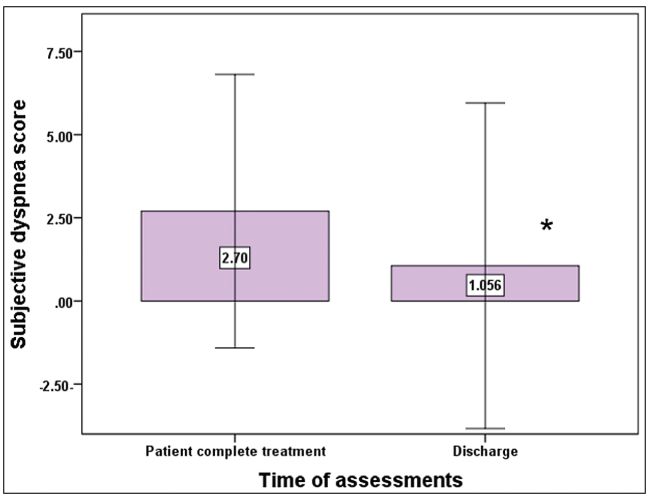

Figure 6: The mean differences of subjective dyspnea score according to the time of assessments. *P value < 0.05 (significant difference)

There were significant differences ($P < 0.01$) between the three assessments.

The distribution of patients according to fever

Figure 8 shows the distribution of patients according to fever at three times of assessment including the first assessment at the first day of therapy, the second assessment when patients complete treatment, and the third assessment at discharge. There were significant differences ($P < 0.01$) between the three assessments.

The distribution of patients according to the type of O_2 supplements

Figure 9 shows the distribution of patients according to the type of O_2 supplements at two times of assessment including the first assessment at the first day of therapy and the second assessment when patients complete treatment. There were significant differences ($P < 0.01$) between the times of assessments.

5. The safety profile study results:

No patients were dismissed from the study because of side effects (bradycardia, hepatitis, acute kidney injury, and hyperglycemia), which were monitored by clinical assessment, SGPT:SGOT, renal functions, CBP, and blood sugar.

The mean differences of study variables including SGPT, SGOT, SGPT:SGOT ratio, and lymphocyte level according to the time of assessments including the first assessment at the first day of therapy and the second assessment when patients complete treatment: there were no significant differences ($P > 0.05$) between means of study variables according to the time of assessments. , as shown in Table 4

6. The correlation between study variables (age, body mass index [BMI], CT findings, duration of starting

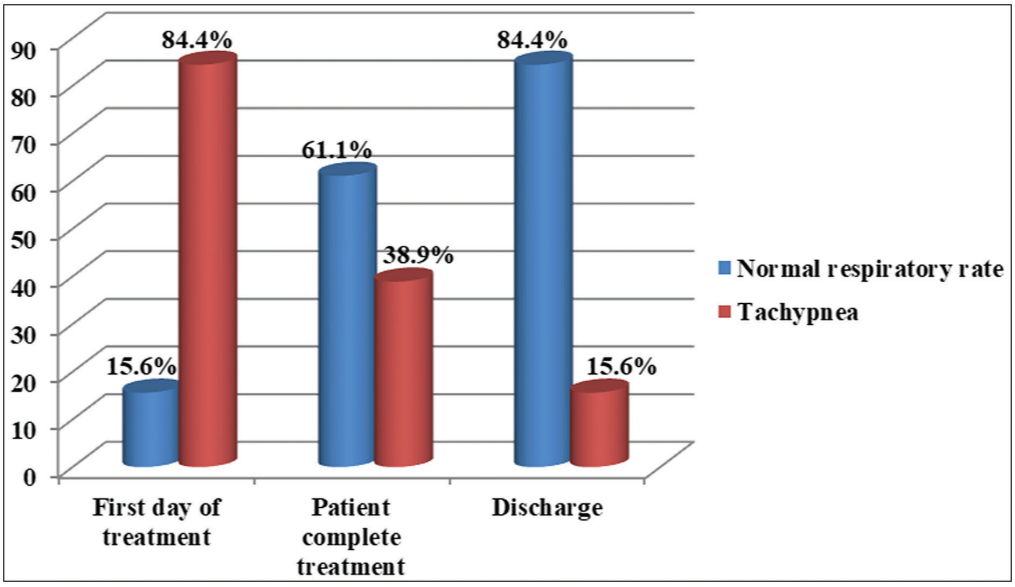

Figure 7: Distribution of patients according to the respiratory rate at three times of assessment

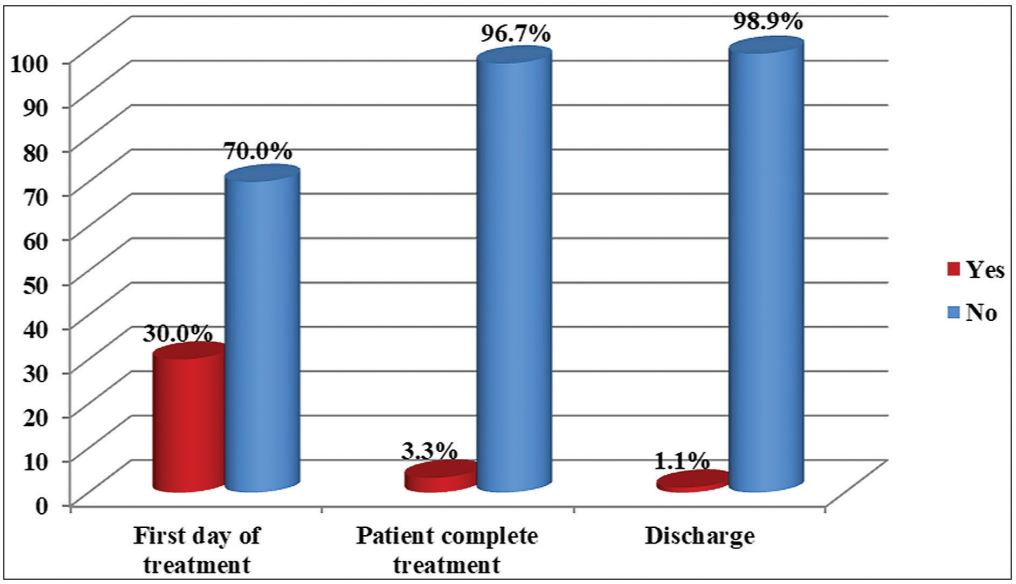

Figure 8: Distribution of patients according to fever at three times of assessment

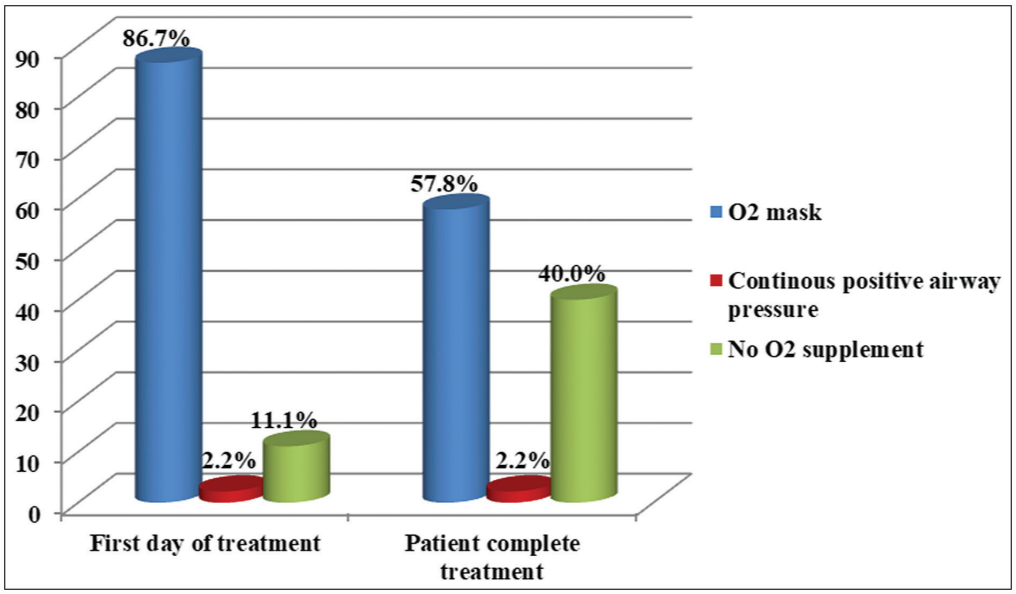

Figure 9: Distribution of patients according to the type of O_2 supplements at two times of assessment

Table 4: The mean differences of study variables (SGPT, SGOT, SGPT:SGOT ratio, and lymphocyte level) according to the time of assessments

Study variables	Time of assessment	N	Mean	SD	Paired t-test	*P* value
SGPT (IU/L)	First assessment at the first day of therapy	90	47.04	43.14	−0.226	0.822
	Second assessment when patient completes treatment	90	48.14	37.25		
SGOT (IU/L)	First assessment at the first day of therapy	90	37.46	27.62	1.072	0.287
	Second assessment when patient completes treatment	90	34.10	19.54		
SGPT:SGOT ratio	First assessment at the first day of therapy	90	1.35	0.88	−1.119	0.266
	Second assessment when patient completes treatment	90	1.47	0.97		
Lymphocyte level (%)	First assessment at the first day of therapy	90	1.87	2.52	−0.337	0.737
	Second assessment when patient completes treatment	90	1.96	1.81		

therapy, and hospitalization period after starting treatment) and the fate of patients received remdesivir:

The mean differences of study variables including age, BMI, CT findings, duration of starting therapy, and hospitalization period after starting treatment according to the fate of patient including discharge, admission to RCU, and death: there were significant differences ($P < 0.05$) between means of age according to the fate of patient. There was no significant correlation ($P > 0.05$) between both means of time of starting therapy and hospitalization time after starting it and patient fate (discharge, admission to RCU, and death), as shown in Table 5.

7. The correlation between the fate of patients and study variables (gender, smoking, PCR, the use of plasma, and the use of tocilizumab):

There was no significant correlation ($P > 0.05$) in gender, smoking, PCR, and the use of plasma with the final fate,

Table 5: The mean differences of study variables (age, BMI, CT findings, duration of starting therapy, and hospitalization period after treatment starting) with the fate of patients

Study variables	Fate of patients	N	Mean	SD	F-test	*P* value
Age (years)	Discharge	75	56.09	13.48	3.39	0.038*
	Admission to RCU	5	49.80	15.02		
	Death	10	66.70	14.21		
BMI (kg/m^2)	Discharge	75	26.12	4.10	0.449	0.64
	Admission to RCU	5	27.20	3.76		
	Death	10	25.20	2.74		
CT findings	Discharge	75	46.54	22.70	1.117	0.332
	Admission to RCU	5	61.00	18.16		
	Death	10	51.00	18.37		
Duration to start therapy (days)	Discharge	75	11.26	5.61	0.308	0.736
	Admission to RCU	5	12.00	4.69		
	Death	10	12.70	6.25		
Duration to complete therapy (days)	Discharge	75	9.58	5.87	2.223	0.114
	Admission to RCU	5	9.20	7.72		
	Death	10	13.70	4.69		

*P value < 0.05 (significant difference)

Table 6: The correlation between the fate of patient and study variables including gender, smoking, PCR, the use of plasma, and the use of tocilizumab

Study variables	Fate of patient			Total	*P* value
	Discharge	RCU	Death		
Gender					0.169
Male	48 (64.0)	5 (100.0)	5 (50.0)	58 (64.4)	
Female	27 (36.0)	0 (0.0)	5 (50.0)	32 (35.6)	
Total	75 (100.0)	5 (100.0)	10 (100.0)	90 (100.0)	
Smoking					0.145
Yes	8 (10.7)	1 (20.0)	3 (30.0)	12 (13.3)	
No	67 (89.3)	4 (80.0)	7 (70.0)	78 (86.7)	
Total	75 (100.0)	5 (100.0)	10 (100.0)	90 (100.0)	
PCR					0.833
Positive	38 (50.7)	2 (40.0)	6 (60.0)	46 (51.1)	
Negative	37 (49.3)	3 (60.0)	4 (40.0)	44 (48.9)	
Total	75 (100.0)	5 (100.0)	10 (100.0)	90 (100.0)	
Plasma					0.855
Yes	62 (82.7)	5 (100.0)	9 (90.0)	76 (84.4)	
No	13 (17.3)	0 (0.0)	1 (10.0)	14 (15.6)	
Total	75 (100.0)	5 (100.0)	10 (100.0)	90 (100.0)	
Tocilizumab					<0.001*
Yes	18 (24.0)	3 (60.0)	8 (80.0)	29 (32.2)	
No	57 (76.0)	2 (40.0)	2 (20.0)	61 (67.8)	
Total	75 (100.0)	5 (100.0)	10 (100.0)	90 (100.0)	

*P value ≤ 0.05 was significant; Fisher-exact test

but there was a significant adverse correlation ($P < 0.001$) between the fate of patient and the use of tocilizumab, as shown in Table 6.

8. The correlation between clinical variables (SpO_2, subjective dyspnea score, and SGPT:SGOT ratio) and patients' fate (discharge, admission to RCU, and death) at the end of remdesivir treatment: there were significant differences ($P < 0.001$) between means of SpO_2, subjective dyspnea score, and the fate of patient. At the same time, no significant differences ($P > 0.05$) were seen in the mean of liver function test, as shown in Table 7.

Discussion

Remdesivir is a promising antiviral treatment against MERS coronavirus that could be considered for implementation in clinical trials as it reduced the severity of disease, virus replication, and damage to the lungs when administered either before or after animals were infected with MERS-CoV.[13,14]

This study shows that remdesivir treatment in patients with COVID-19 had a statistically significant effect on patients' clinical status represented by an improvement in SpO_2, SOB, RR, fever, as we noticed significant changes between these parameters in different times of assessment (the first day of treatment, when patients complete the course of remdesivir [the second assessment], and the third assessment at discharge).

There were statistically significant differences between means of SpO_2 at the first assessment and second assessment and between the second assessment and the third assessment.

The mean of subjective dyspnea score according to the time of assessment was as follows: the first day = 5.08, second assessment = 2.70, and at discharge = 1.056, and there are statistically significant differences in the mean of subjective dyspnea score at different times of assessment.

The percentage of patients febrile at the first day of treatment was 30%; at the second assessment was 3.3%; and at discharge was 1.1%.

The percentage of patients tachypnic at the first day was 84.4%; at the second assessment was 38.9%, and at discharge was 15.6%.

Also there were differences between periods in the percentage of patients uses O_2: at the first day, the percentage of patients uses O_2 mask was 86.7%, and at the second assessment, it became 57.8%.

This result agreed with Grein *et al.*(2020), a cohort study for patients hospitalized for COVID-19 from the period of January 25, 2020, through March 7, 2020, in which clinical improvement with remdesivir use was observed in 36 of 53 patients (68%).[15] Another study done by Olender *et al.* from March 15 through April 18, 2020, in 105 hospitals in the United States, Europe, and Asia shows that patients randomized to a 5-day course of remdesivir had statistically significant differences in the clinical status compared with the standard care.[16]

So from the above, we found that remdesivir course of not more than 5 days has a statistical significant effect on general clinical state of patient with COVID-19 and finally on the patient fate by improving the SpO_2, SOB, RR, and fever, and the above two studies supported this result.

The distribution of patients according to the use of plasma and tocilizumab: the majority of patients 84.4% receive plasma as soon as possible after admission to hospital. Regarding tocillizumab, only 32.2% received it when it indicated only.

Regarding the association between the fate of patients and the use of plasma and tocilizumab, we found that there is no significant association between the fate of patient and the use of plasma ($P = 0.855$). As all patients in this study use remdesivir, we can say that there is no benefit from this combination (remdesivir and plasma) over the use of remdesivir alone on the final fate of patient.

Table 7: The mean differences of study variables according to the fate of patient at the end of remdesivir treatment

Study variables	Fate of patient	N	Mean	SD	F-test	*P* value
SpO_2 (%)	Discharge	75	92.45	1.81	89.15	<0.001*
	Admission to RCU	5	72.40	10.11		
	Death	10	80.70	9.10		
Subjective dyspnea score	Discharge	75	0.04	0.25	441.50	<0.001*
	Admission to RCU	5	7.80	1.09		
	Death	10	5.30	2.05		
SGPT:SGOT ratio	Discharge	75	1.32	0.82	0.164	0.849
	Admission to RCU	5	1.39	0.43		
	Death	10	1.49	1.38		

*P value < 0.05 (significant difference)

Regarding the use of tocilizumab, we noticed that there was an adverse effect on the fate of patients. Such results were due to the fact that tocilizumab used only when the patients develop cytokine storm with elevated inflammatory markers, which is by itself consider as bad prognostic signs on the patient's fate. Up to our knowledge, no such study was done in which giving plasma and remdesivir in combination versus remdesivir alone or combined both tocilizumab and remdesivir to assess their effects on the patients' fate.

We tried to find the relation between the duration of symptoms appearance and starting the treatment, so we divided the patients into three groups: patients starting the remdesivir treatment less than 10 days from starting of symptoms, patients received it from 10 to 15 days, and patients received it after more than 15 days. There were no significant differences between means of time of starting therapy and the fate of patient (discharge, admission to RCU, and death), which was 11.26, 12.00, and 12.7, respectively. So from the above result, we can say that statistically the duration from the onset of disease to starting remdesivir has no effect on the final fate of patient; this result may be from the small sample size involved in the study. Up to our knowledge, no study was done on the effect of early use of remdesivir during the course of disease on patients' fate. On the other hand, the clinical state of patient at the time of starting remdesivir has an effect on the final fate as we see significant differences between means of SpO_2 and subjective dyspnea score according to the fate of patients. The SpO_2 mean of discharged patients at the first day of assessment was 88.94, whereas patients with SpO_2 mean 84.4 at the first day of treatment there final fate was death and patients who refer to RCU their SpO_2 mean was 73.

Regarding the subjective dyspnea score means, at the first day of treatment, the mean in discharged patients was 4.78, the mean of subjective dyspnea score at the first day in patients who dead was 5.70, and the mean of dyspnea score in RCU referral patients was 8.2.

So from that we need to give remdesivir as soon as the patient is in a good clinical state regardless of the time of starting the therapy.

No significant differences were observed in the means of CT involvement according to the fate of patients (discharge, RCU, death) as we divided the patients into two groups: >50% and <50% CT involvement. Seventy-five of discharged patients have mean CT chest involvement of 46.54, RCU admitted patients had CT finding mean of 61.00, and dead patients' mean of CT finding was 51.00. From that, we conclude that the higher radiological finding at the time of presentation carries no effect on the final fate of patients receiving remdesivir course. This result may be explained that in this study we depended on radiological finding at the time of admission, and this radiological finding changes with time during hospitalization and can become worse.

Regarding the duration from starting remdesivir to the final fate (the duration of hospitalization), the mean of this duration for discharging patients was 9.58 days and that go with a known period of hospitalization of patients with COVID-19 (10–13 days).[17]

In this study, no patients dismissed from the study because of remdesivir side effect as we followed up patients by both clinical assessment and by liver function test in the form of SGPT:SGOT ratio both at the first day of treatment and after 3 days of starting treatment, which agreed with Montastruc *et al.* (2020) who stated that "although there was elevated liver enzyme but not to level that lead to discontinue the treatment,"[18] no significant differences were observed in the mean of liver function test according to the time of assessment (at the first day and after 3 days was 1.35 and 1.47, respectively), which conflict with a case series in Italy done by Pimentel *et al.* (2020) in which an elevation of aminotransferase after the initiation of remdesivir in three COVID-19 patients was seen.[19,20] According to Grein *et al.*(2020) who studied the remdesivir use for COVID-19, 23% of the patients reported increased hepatic enzymes, and two of them therefore discontinued remdesivir prematurely.[15] A recent randomized controlled trial in China also showed that total bilirubin, aspartate, and alanine aminotransferase increased, respectively, in 10%, 5%, and 1% of COVID-19 patients in the remdesivir group versus 9%, 12%, and none of COVID-19 patients in the placebo group. At the same time, more patients in the remdesivir group than the placebo group discontinued the drug because of aminotransferase or bilirubin increases.[21] All these results conflict with our study, which may be due to a small sample size.

Conclusions

We can conclude that remdesivir improves the clinical state of patients with COVID-19 regardless of the time of its starting during the course of disease. No benefit was seen from remdesivir and plasma combination, and there could be disadvantages seen on the final fate of patient when tocilizumab and remdesivir used together.

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Conflicts of interest

There are no conflicts of interest.

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