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Argument and Contention over the Use of Low-dose Irradiation toCOVID-19 Pneumonia: A Comprehensive Review

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Abstract-

Background: The concept of Low Dose Radiation Therapy (LDRT) as a viable treatment for COVID-19 pneumonia, caused by the highly contagious single-stranded RNA virus of the Coronaviridae family, is investigated through a review of current clinical trials. LDRT has anti-inflammatory effects on pneumonia inflammation. This study examines the efficacy, toxicity and finding output of delivering LDRT to severe pneumonia patients.

Methods: This review was compiled using Google Scholar, PubMed, Scopus, Embase, and CINAHL with the following search terms: LDRT for COVID-19 Pneumonia patients, Total lung irradiation for COVID patients, and SARS-CoV-2 from 2019 to 2022. Articles without data, duplicates, or irrelevant to the review were excluded. The focus of this paper is to review the past use of low-dose radiation in treating several types of pneumonia and the current arguments for the benefit of low-dose radiation in the treatment of COVID-19.

Results: After selecting relevant reports, this study selected 8 clinical trials and based on them conducted this paper and analyzed its feasibility. According to an analysis, the treatment increase clinical recovery and outcome shows 80% recovery of anti-inflammatory response from lung inflammation. It reduces oxygen supplementation requirements by more than 60% within 48 hours of LDRT treatment.

Conclusions: Low-dose radiation therapy (LDRT) has been effective against pneumonia of diverse etiology, and cost-effective treatment for elderly dying patients with COVID-19. In this study all the case, we find a highly effective approach using LDRT. In addition, greater clarity can be derived prior to using LDRT against Covid-19 Pneumonia patient if large scale preclinical studies and clinical trials are conducted.

***Keywords**: COVID-19, Low-Dose Radiotherapy, Pneumonia, Anti-inflammatory.*

Introduction:

The global pandemic known as COVID-19, which emerged in 2019, is attributed to the viral pathogen SARS-CoV-2. This infectious disease has resulted in a significant loss of life, with mortality rates exceed more than six million individuals on a global scale. COVID-19 virus is a single-strained RNA virus that causes maximum death by severe pneumonia in elderly aged patients during the pandemic period. Around 14 % of patients are suffering because of pneumonia, and it takes time to recover from this situation. The virus mostly affected the patient's lungs and damaged the alveoli air sac. For this reason, alveoli cannot transfer oxygenated blood to the blood vessels, which causes breathing difficulty and a shortage of oxygen in the patient body. Due to damage to the air sac, massive cytokines are released from the lung, producing inflammation in the lung and progressing to severe acute distress syndrome, known as pneumonia.[6]

In the case of treatment options, many studies are focusing on existing drugs and some with positive treatment trials. Standard therapies for people with COVID-19 pneumonia are Low-dose radiation (LDRT), Dexamethasone, Remdesivir and so on. Following some positive initial trial results as a treatment option for COVID-19 pneumonia, this paper focuses on Low-dose radiation (LDRT) as a novel approach for treating patient of COVID-19 pneumonia because LDRT possesses inherent characteristics for creating an anti-inflammatory response and recovery patients soon by increasing oxygen saturation that helped patient to recover against COVID-19 pneumonia patient severe symptoms, for instance, hypoxia, shortness of breath and so on.[1-5,9-10]

Many previous groups of investigations described the treatment of viral and bacterial pneumonia with a low-dose X-ray fraction ranging from 0.3 to 0.5 Gy.[26] Recent studies show that many human clinical trials using the concept of controlling pneumonia with low-level radiation dose from the previous have yielded encouraging results, suggesting that a similar strategy can be adopted to treat COVID-19 patients having with pneumonia. After low dose radiation this inflammation is reduced, as well as results are enhanced.[1,3]

Low-Dose Radiotherapy (LDRT) with a single dose, suggested by Kirkby and Mackenzie, delivered acutely to the lungs with 0.3 to 1 Gy of low-linear energy transfer (LET) radiations to treat COVID-19 pneumonia with normal tissue toxicity avoided and with shallow risk.[25]The publication of P.C. Lara et al. suggested that, for low- and middle-income countries, Low-dose radiotherapy (LDRT) would be a cost-effective and non-toxic treatment that can use for many patients who would suffer from COVID-19 Pneumonia.[24]

Thus, the objective of this study is to analyze and evaluate the benefits and drawbacks of the concept of history through the lens of recent clinical trials to has been ten further investigate into this area.[1-5, 19- 25]In addition, the concept of history and providing our own opinion by analyzing the arguments for and against it which may accelerate future research in this field. [5-8,19- 24]

Various empirical studies are conducted, which have the most significant favorable influence on recovering patients from COVID-19 pneumonia. Despite this, these studies get effective, safe approach as well as non-toxicity. In contrast, some publications have expressed reservations about the use of low-dose radiation for the treatment of elderly patients with COVID-19 pneumonia who are in the terminal stage, since there are potential adverse effects of radiation on human physiology.

Historical Evidence

It is important to remember that although pneumonia has long been a leading cause of death, it has historically been treated with a low dose of radiation and others some methods to eradicate it. In the article of EJ Calabrese et al. systematically analyzed several archival trials utilizing radiation therapy for non-responsive pneumonia from 1905 onward. X-rays were used to treat pneumonia throughout the first half of the 20th century. About 700

cases of bacterial, sulfonamide-unresponsive, interstitial, and atypical pneumonia were reported to have been effectively cured with low doses of X-rays, based on clinical symptoms, objective disease biomarkers, and

mortality events leading to disease resolution. During the same period, X-rays were as effective at lowering mortality as serum therapy or sulfonamide treatment.The results of the investigations were validated by studies using viral and bacterial pneumonia in four animal models (a dog, a cat, a guinea pig, and a mouse). A total of 863 patients were treated, and 717 were cured (17% were not healed) using X-ray therapy, as detailed by the 15

case reports. X-ray therapy rapidly reverses clinical symptoms, aiding in pneumonia clearance via an anti-inflammatory phenotype-inducing mechanism. [31]

Fig-1: LDRT is being provided to COVID-19 patient using Linear Accelerator (Papachristofilou A et al.)

Mechanism of action of LDRT

LDRT has an anti-inflammatory impact, which could aid in treating respiratory difficulties caused by COVID-19. This is supported by the fact that radiation has a long history of usage in the treatment of inflammatory and infectious disorders. The anti-inflammatory effects of LDRT have been shown in clinical investigations, and several experimental models are available, both in vitro and in vivo.[26] The radiobiological mechanisms that back up this theory are gaining traction. Low-dose radiation therapy (0.5-1.5 Gy) affects cells involved in the inflammatory response, leading to anti-inflammatory effects, as opposed to high-dose radiation therapy, which produces pro-inflammatory cytokines in immune and endothelial cells.[3,5,26]Some of these outcomes include a decrease in the creation of endothelial adhesion molecules, a decrease in the expression of pro-inflammatory cytokines, and an inhibition of contacts between leukocytes and endothelial cells. Low-dose irradiation induces macro-phage and polymorph nuclear apoptosis and decreases the release of inflammatory cytokines such NO, iNOS, L and E selectins, and ILbeta1. Apoptosis mediators like NF-B are also upregulated, as are anti-inflammatory cytokines like TGF-1. The LDRT's anti-inflammatory impact peaked at 48 hours post-irradiation and diminished by 72 hours. [13-18]These modifications allow LDRT to decrease inflammation and relieve potentially fatal symptoms by creating a local anti-inflammatory environment. This may account for the observed therapeutic impact of LDRT in reducing pneumonia symptoms caused by COVID-19.[23, 25]

Materials and Methods:

Search Strategy:

A comprehensive search was conducted on several databases, including Google Scholar, PubMed, Scopus, Embase, and CINAHL. The search spanned articles published from 2019 to 2022. The search terms were carefully chosen to cover all aspects of the research topic, including "SARS-CoV-2", "Low dose radiation for pneumonia treatment", "Low dose radiation for COVID-19 Pneumonia", and "the impact of low-dose radiotherapy for COVID patients". The titles, abstracts, and subject areas of the identified reports and papers were meticulously reviewed for relevance to ensure that the most pertinent and informative studies were selected.

Study Selection:

The initial search yielded approximately 400 reports related to the concept of COVID-19 pneumonia with low-dose radiation between 2019 to 2022. A rigorous screening process was implemented to ensure the quality and relevance of the selected studies. Reports that were duplicates, off-topic, or lacked sufficient data were excluded. After this initial screening, around 100 papers were selected for further review. A more detailed examination led to the selection of 50 papers closely related to our research topic. Ten of these documents specifically discussed low-dose radiotherapy for COVID-19 patients. After further investigation, seven reports were selected for clinical trials analysis.

Data Extraction:

Data from the selected studies were extracted and analyzed. The focus of these studies was the effectiveness of LDRT for patients with COVID-19 pneumonia. The selected publications suggest that incorporating LDRT into the COVID-19 treatment may aid in local control. This extraction process was done meticulously to ensure that the most relevant and informative data were gathered.

Quality Assessment:

The quality of the selected studies was assessed using appropriate tools. Factors considered included the study design, sample size, methodology, and the robustness of the findings. This assessment ensured that the studies included in the review were of high quality and provided reliable and valid results.

Data Synthesis:

Findings from the selected studies were synthesized to provide a comprehensive overview of the current knowledge on the use of LDRT in treating COVID-19 pneumonia. This synthesis informed the discussion and conclusion of the review. The synthesis process was done in a way that allowed for a clear and concise presentation of the current state of knowledge on the topic.

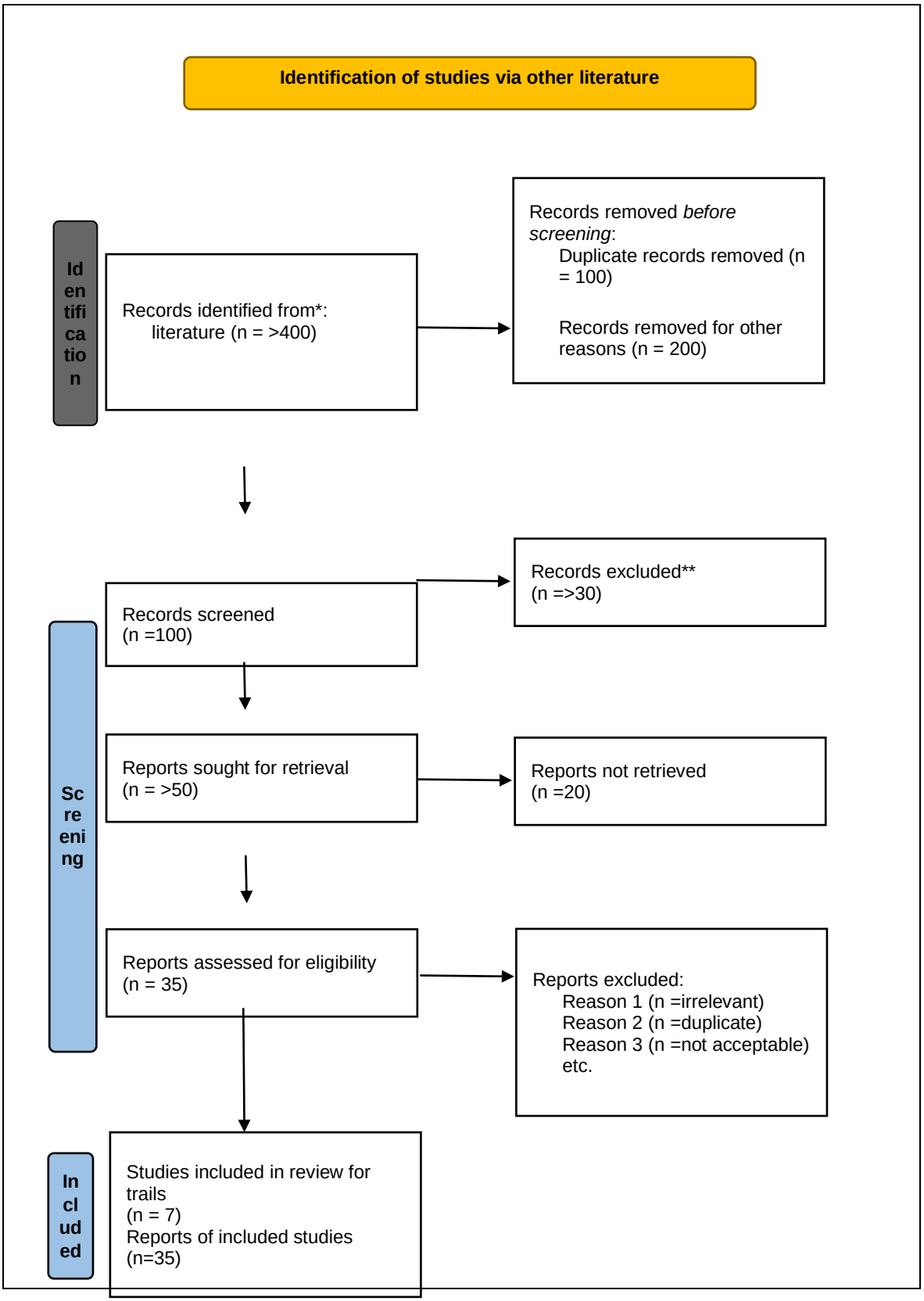

Fig-2: Flow diagram strategy to compile inclusion for this systematic review.

Result:

In the clinical trial conducted by Clayton B. Hess et al.[1], LDRT was provided to patients averagely five days in the hospital. During an observation period of 2 weeks after LDRT, 80% patient achieve clinical recovery. It takes around average 12 days for clinical recovery. Acute dermis, gastrointestinal, cardiovascular, or respiratory complications had not been observed. 80% of patients attained clinical recovery in a short time and were released from the intensive care unit within ten days of low dose RT.

Hess et al.[10] conducted another human clinical experiment in which 10 patients were randomly assigned to receive whole-lung LDRT on 24th April to 24th May in 2020, and 10 controls were aged and disease-matched. Affected individuals with radiographic consolidations, requiring supplemental oxygen, and who were not rapidly deteriorating at arrival or before pharmacological therapy or LDRT were found to be SARS-Cov-2 positive. Time to clinical recovery was measured by observing biomarker response, radiographic improvement, and overall health. While it took the control group an average of 12 days to recover, the LDRT group just needed 3 days.

Table 1: Contemporary studies reporting on COVID-19 patients with LDRT based on our observations.

No	Explorer	Time of Publication & Place	Nu. of Enrolled Patient	Average Age	% Comorbidities	Average day of admission	Radiation dose	Radiotherapy Fields	Level of response	toxic impacts
1	Clayton B. Hess et al.,[1]	April,2020; Georgia	5.0	90	83%	16	1.5	Anterior Posterior	80%	Absent
2	Govindaraj et al., [2]	May,2021; India	25	56	65%	7	0.5	Anterior Posterior-Posterior Anterior	88%	Absent
3	Ahmad Ameri et al., [3]	May-June, 2020; Iran	5	71.6	72%	7	0.5	Anterior Posterior-Posterior Anterior	80%	Absent
4	Ahmad Ameri et al., [5]	May-June ,2020 ; Iran	10	50	68%	7	1 & 0.5	Anterior Posterior-Posterior Anterior	40% & 80%	Lymphocytopenia (1 Gy)
5	Sharma et al., [9]	June - August,2020; India	10	51	30%	3	0.7	Anterior Posterior-Posterio	90%	Absent

								r Anterior		
6	*Hess et al.,* [10]	*April-May, 2020; USA*	*10*	*78*	*90%*	*5*	*0.5*	*Anterior Posterior- Posterior Anterior*	*90%*	*Absent*
7	*Sanmamed et al.,* [11]	*April-June,2020; Spain*	*41*	*66*	*55%*	*9*	*1*	*3D CRT*	*78%*	*Lymphocytopenia*

In the human experiment by Govindaraj et al.[2], 64% of patients reported a cough, and 80% of patients exhibited some typical fever symptoms. Patients experienced their first symptom within 10 days when they were admitted. In hospital patient stayed from 12 hours to 5 days, with a median of 2 days receiving fractional LDRT. Some metrics had improved outcomes as compared to the Pre-RT condition after receiving RT. 88% achieved recovery in clinical terms and release hospital after 10 days of therapeutic treatment.

In the human trial of Ahmed Ameri et al.[3]**,** 5 patients were enrolled in this study. LDRT was delivered to the patient 1 to 3 days after the hospitalization. During three radiation treatments, one patient (patient 3) made the decision to withdraw from the experiment. Due to deterioration in saturation of oxygen and body temperature, a single individual (patient 4) passed away on the third day following radiotherapy. 80% of patients achieved improved clinical outcomes & were released less than seven days after receiving low-dose RT.

In the human trial of Ahmed Ameri et al.[5]**,** 10 patients were enrolled in the study. Low dose RT on whole lung was delivered to patient as their national protocol. Single dose of 0.5 Gy was delivered on five patients, another one patient got two dose 0f 0.5 Gy and other four patient receive single dose of 1 Gy. After LDRT it appeared that response rate, clinical recovery was accelerated and showed positive outcome against SARS-CoV-2 infection.

Ten people with COVID-19 who were at moderate to high risk for the condition were enrolled in a clinical trial by Sharma et al.[9]between June 2020 and August 2020. Patients received LDRT to both lungs in a single fraction of 70 cGy, as recommended by the COVID-19 recommendations. Most people took all of their medication as directed. Nine patients had achieved full clinical recovery, typically within a week. After 24 days of LDRT, one hypertensive patient's condition deteriorated to the point of death. The nine patients showed no signs of acute radiation and were released from the hospital.

Forty-one COVID-19 patients over the age of 50 with bilateral lung involvement at imaging and requiring oxygen at room air (oxygen saturation >93%) participated in the human experiment conducted by Sanmamed et al.[11] Seventy-eight per cent of patients showed improvement after receiving 1 Gy of radiation to both lobes of the lungs in a single fraction.

Discussion:

This systematic review promising outcomes of low-dose radiation therapy (LDRT) as a potential treatment strategy for COVID-19 pneumonia. The study findings suggest that LDRT may hold promise as a therapeutic approach in mitigating viral pneumonia. The discussion will cover economic considerations, radiation dosage, methodological variability, and the need for further research in detail.

Economic Considerations:

One of the key aspects that underscore the potential utility of LDRT in the management of COVID-19 pneumonia is its economic feasibility. In regions with limited healthcare resources and lower-income populations, the cost-effectiveness of treatments becomes particularly crucial. P.C. Lara et al. have underscored the potential for LDRT to be a cost-effective and non-toxic treatment option for COVID-19 pneumonia patients in moderate to low-income nations. This is a significant consideration, as it suggests that LDRT could be a feasible treatment approach, even in settings with limited financial resources.[24]

The global availability of X-ray irradiation as a cancer treatment adds to the attractiveness of LDRT as a treatment modality for COVID-19 pneumonia. Given that X-ray facilities are widely accessible in healthcare systems across the world, the implementation of LDRT becomes more feasible. This aligns with the goal of providing effective treatments that can be readily deployed on a global scale. The ability to leverage existing infrastructure and expertise in radiation therapy makes LDRT a potential asset in the fight against COVID-19 pneumonia, especially in resource-constrained settings.

Radiation Dosage:

The choice of radiation dosage is a critical aspect of LDRT's effectiveness as a potential treatment for COVID-19 pneumonia. Recent research suggests that a single fraction of low-dose radiotherapy, typically within the range of 0.3 to 1 Gy, can prevent normal tissue toxicity during the treatment of viral pneumonia. This finding has significant implications for the optimization of LDRT protocols.[26]

However, it is important to note that the optimal radiation dosage for LDRT in the context of COVID-19 remains a subject of discussion. Different studies suggest varying thresholds, and the choice of an appropriate dose should be informed by a thorough understanding of its effects. Doses exceeding 1 Gy may have pro-inflammatory effects and contribute to the development of fibrous connective tissue in the lungs, which could potentially lead to complications. In contrast, lower doses, within the range of 0.3 to 0.8 Gy, are considered to have minimal deterministic effects. [26] In our study, a dosage of 1.5 Gy was used, which demonstrated promising results. This dosage choice may reflect the evolving understanding of LDRT in the context of COVID-19.

Ameri et al. conducted trials with both 0.5 and 1 Gy doses and found that 0.5 Gy was more effective than 1.0 Gy. This underscores the importance of carefully considering the radiation dosage, as it significantly influences treatment outcomes. The choice of radiation dosage should be made with the goal of achieving therapeutic benefits while minimizing potential side effects. It is essential for future research to further investigate and refine the optimal dosage for LDRT in the treatment of COVID-19 pneumonia. [3,5]

Methodological Variability:

The variability in research methodologies among studies addressing LDRT in the context of COVID-19 pneumonia highlights the need for standardization and consistency. Kefayat A. and Ghahremani F. have pointed out that several studies on low-dose radiation therapy are founded on outdated concepts and may lack sufficient evidence. [7] The discrepancies in study designs and data quality suggest that more extensive research is required to determine the effect of single-dose radiotherapy on viral pneumonia.

This methodological variability emphasizes the importance of rigor and reproducibility in future research endeavors. Standardized protocols and well-defined study parameters should be established to ensure that the findings are consistent and reliable. Addressing these methodological challenges will contribute to a more robust understanding of LDRT's potential in the management of COVID-19 pneumonia.

SiskoSalomaa et al.'s review has also highlighted the limitations and shortcomings associated with the historical use of low-dose radiation therapy in pneumonia treatment.[8] This historical context underscores the importance of contemporary research in shaping the understanding and application of LDRT for COVID-19 pneumonia. The current body of evidence is continually evolving, and it is essential to build upon this knowledge base through systematic, well-designed studies.

Future Research Directions:

This study underscores the necessity of conducting additional research before implementing human trials involving radiotherapy for COVID-19 patients. The potential benefits and risks of LDRT must be thoroughly assessed to ensure its safety and efficacy. The findings of our study provide an important foundation for future investigations into the role of LDRT in the treatment of COVID-19 pneumonia.

David G. Krisch et al. have stressed the importance of gathering robust evidence before commencing clinical radiation trials for COVID-19 management. This cautious approach is essential to ensure the safety and efficacy of LDRT. [30] As COVID-19 remains a global health challenge, the need for safe and effective treatment options is pressing. Future research should focus on filling the knowledge gaps, refining treatment protocols, and conducting well-designed clinical trials to assess the utility of LDRT in real-world healthcare settings.

Further Research Recommendation

In the paper of Bardi N. Pandey of the Bhabha Research Center recommends to combine LDRT with other treatments, such as convalescent plasma therapy. The synergistic therapeutic potential of combining convalescent plasma (CP) with LDRT should be explored to enhance overall treatment outcomes. LudwikDobrzynski suggested that combining LDRT with convalescent plasma therapy may enhance the anticipated therapeutic benefits of LDRT. This approach aligns with the concept of multimodal treatments, which may offer a more comprehensive solution to COVID-19 pneumonia[32-34]

Conclusion:

To the authors' knowledge, this systematic review underscores the potential of LDRT as a therapeutic approach for COVID-19 pneumonia.Preliminary findings suggest that LDRT can reduce the need for oxygen support within 48 hours of treatment, particularly in elderly patients who are at low risk of disease-related complications. It is crucial to note that while doses greater than 0.5 Gy are tolerable, doses exceeding 1 Gy may induce lung inflammation and fibrosis.

LDRT may offer cost-effective and accessible treatment options for patients, especially in resource-constrained settings. However, the safety and efficacy of LDRT require further investigation through large-scale clinical trials to provide more substantial evidence. The need for further research to refine dosing, address methodological variability, and clarify risks and benefits is evident.

The integration of LDRT with other treatments, such as convalescent plasma therapy, may open promising avenues for improving patient outcomes. These findings hold implications for the ongoing efforts to combat the COVID-19 pandemic and warrant continued exploration and evaluation in clinical practice. Therefore, it is recommended to conduct human trials on a larger scale to further explore this promising treatment option. Despite the challenges, LDRT presents a hopeful avenue in the quest to combat the severe respiratory complications associated with the pandemic. It is imperative for researchers and healthcare professionals to continue their efforts to better understand the potential of LDRT as a valuable addition to COVID-19 treatment strategies.

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Apendix

ID	Ordinal scale for clinical improvement by Hospital Day																		Discharge (Day after RT)	TTCR
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Patient1(90)	4	4	4	4	4	4	4	4	3	3	3	4	3	3	3	3	3	3	Pending 14	18 hours
Patient1(90)	4	4	4	4	3	3	4	4	3	4	4	4	4	4	3	1	-	-	Day16(12)	24 hours
Patient1(90)	5	5	5	4	4	4	4	4	4	4	3	3	4	4	4	4	3	4	Day21(14)	96 hours
Patient1(90)	4	4	4	4	4	3	3	4	4	4	3	3	3	3	1	-	-	-	Day15(10)	3 hours
Patient1(90)	4	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	-	-		18 hours

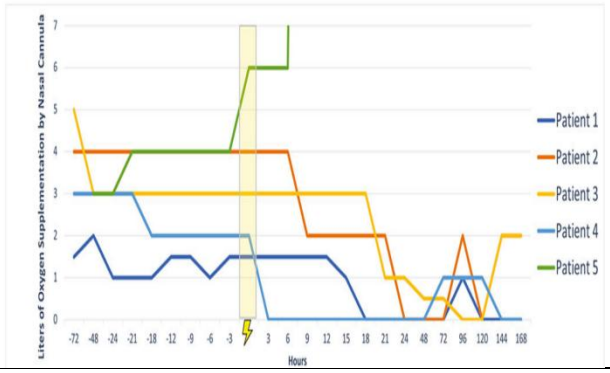

Fig-2: Oxygen saturations 72 hours before and after radiation therapy and the Time to Clinical Recovery (TTCR). (Zachary S. Buchwald, Clayton B. Hess, et al.)

Table 2: The clinical characteristics of the Pre-RT Covid-19 patients (Govindaraj et al.)

Characteristics		No of patients in this study (%)
Age (years)	56	25 (avg)
Sex	Male	16 (64%)
	Female	9 (36%)
Presence	Co-morbidity	65%(avg)
Baseline SpO2 in room air, %	70–79	3 (12%)

	80–89	20 (80%)
	≥90	2 (8%)
CT Severity Score (out of 25)	≤12	–
	13–19	22 (88%)
	≥20	3 (12%)
Baseline lymphophenia grade	No lymphopenia	8(32%)
	Lymphopenia of Grade 1	4(16%)
	Lymphopenia of Grade 2	8(32%)
	Lymphopenia of Grade 3	5(20%)

Table 3: Comparison of various parameters before and after radiotherapy in patients (Govindaraj et al.)

Time	Lymphocytes count cells per milliliter		SpO_2 /FiO_2 (SF) ratio in patients		Oxygen Demand in liters per minute	
	Median (IQR)	p value	Median (IQR)	p value	Median (IQR)	p value
Pre-RT	788 (583–1210)	Reference	200(151–276)	Reference	6(3–10)	Reference
Day 2	759 (540–1072)	1.000	314(198–425)	0.025	2(0.5–6.5)	0.017
Day 3	624 (542–808)	0.701	376(217–472)	0.000	1(0–5.5)	0.000
Day 7	558 (515–714)	0.001*	488(475–490)	0.000	0(0–0)	0.000

Table 4: The study conducted by Ahmed Ameri et al. examines the demographics and clinical features of patients.

Serial No	Characteristics	Individual 1	Individual 2	Individual 3	Individual 4	Individual 5
1	Gander	Male	Male	Female	Male	Male
2	Age	60	69	82	84	64

3	O2 saturation	87	86	75	89	74
4	Between onset of symptoms and RT	1 day	3 days	3 days	2 days	2 days
5	Diagnosis of COVID-19	Clinical findings & PCR	Clinical findings & PCR	Clinical findings & PCR	Clinical findings & PCR	Clinical findings & PCR
6	O2 supplementation	Facial mask	Nasal cannula	Face mask with reservoir bag	Face mask	Face mask & bag
7	Length of stay at hospital after RT	7 days	5 days	3 days	3 days	6 days
8	Outcomes	Discharged	Discharged	Opted out of trail	Expired	Discharged

Table 5: Patients demographics and clinical characteristics (Ahmed Ameri et al.)

Patients	**Sex/age (y)**	**Comorbidity**	**Presenting symptom**	**Dx of COVID-19**	**O_2 supply**	**Radiation dose**	**Hospital stayed after RT to discharge or death**	**Intubation after RT**
1	Male/60	CHF*	Dyspnea	Clinical findings RT-PCR	Facial mask	Single 0.5 Gy	7 d	None
2	Male/69	HTN-IHD	Fever-cough	Clinical findings RT-PCR	Nasal cannula	Single 0.5 Gy	5 d	None
3	Female/82	IHD	LOC	Clinical findings Imaging	Facial mask with reservoir bag	Single 0.5 Gy	3 d	None
4	Male/84	HTN	Cough	Clinical findings RT-PCR	Facial mask	Single 0.5 Gy	3 d	None
5	Male/64	HTN	Dyspnea, cough, fever	Clinical findings Imaging RT-PCR	Facial mask with reservoir bag	Single 0.5 Gy	6 d	None

6	Male/71	DM-HTN	Dyspnea	Clinical findings RT-PCR	BiPAP	Double 0.5 Gy (7-d interval)	10 d	Nome
7	Male/80	None	Dyspnea, fever	Clinical findings RT-PCR	Facial mask with reservoir bag	Single 1.0 Gy	2 d	None
8	Male/87	HTN	Dyspnea	Clinical findings RT-PCR	Facial mask with reservoir bag	Single 1.0 Gy	4 d	None
9	Male/68	None	Dyspnea	Clinical findings RT-PCR	Facial mask with reservoir bag	Single 1.0 Gy	14 d	None
10	Female/79	HTN	Dyspnea	Clinical findings RT-PCR	Facial mask with reservoir bag	Single 1.0 Gy	10 d	For 7 d

Table 6: Patients clinical characteristics (Sharma et al.)

Patient No	Age(year)	Gender	breathing rate	Saturation of Oxygen (%)	Oxygen Supplements	Systolic pressure (mm Hg)	Heartbeats per minute
1	52	Male	24	93	Yes	110	76
2	45	Male	21	93	Yes	138	88
3	43	Male	27	95	Yes	136	87
4	58	Male	28	91	Yes	159	77
5	38	Male	22	91	Yes	126	98
6	53	Male	22	95	Yes	105	83
7	56	Male	24	93	Yes	110	104
8	45	Male	22	93	Yes	103	88
9	50	Male	22	92	Yes	123	96
10	63	Male	22	95	Yes	120	98