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Research Paper

Invasive mechanical ventilation and clinical parameters in COVID19 patient: Can age be a factor?☆

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ABSTRACT

Background: Severity of corona virus disease 2019 (COVID19) is presented with respiratory distress and requires mechanical ventilation. Advanced age is one of the significant risk factors of the worst prognosis and mortality in this disease. The aim of this study is to investigate the clinical parameter among COVID19 patients under mechanical ventilation in regard to the age groups.

Method: In this retrospective study, COVID19 patients under invasive mechanical ventilation at Shahid Beheshti Hospital in Qom were included. The patients were divided in two age groups, those aged ≥50 years and <50 years. Clinical parameter of these patients like blood pressure, heart rate, respiratory rate, oxygen saturation and body temperature were recorded at the time of mechanical ventilation and 24, 48 and 72 h under the mechanical ventilation.

Result: A total of 317 patients were included in the study where 214 patients were over the age of 50 years and 98 were under 50 years. The mean age of patients was 59.71 ± 16.46 year. At the start of mechanical ventilation and 24, 48 and 72 h during the ventilation, blood pressure, pulse rate, rate of respiration, oxygen saturation, Glasgow coma scale and temperature were not significantly different at among the two age groups, $p > 0.05$, respectively.

Conclusions: The findings of the study indicated that prognosis of COVID19 patients under invasive mechanical ventilation in terms of changes in clinical parameters might not be associated with the age.

1. Introduction

Globally, more than 93 million people have been reported with coronavirus disease 2019 (COVID19), with 2 million deaths [1]. COVID19 is caused by novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus and is associated with system-wide presentations, primarily and commonly seen as dry cough, dyspnea, fever, sore throat and involvement of the lungs [2]. In case of severe acute respiratory syndrome, mechanical ventilation is required [3,4].

Invasive mechanical ventilation provides oxygen and ventilation via positive pressure into the airways. The procedure is commonly conducted by endotracheal tube [5]. It is gold standard to support breathing in patients with respiratory failure. These patients are also at a greater risk of developing secondary infections [6].

Studies have reported high mortality rate among COVID19 patients admitted to the intensive care unit (ICU), whereas, intubation may result death in approximately 80% of the patients [7–10]. This has resulted in ICU saturation and increased a significant burden on the over all health care system. 66.6% patients entering critical care units are likely to require mechanical ventilation within first 24 h of the admission [11]. Additionally, patients undergoing mechanical ventilation might not respond well to the therapeutic protocol, including antiviral drugs [12,13].

Jackson, Gold [14] reported that advanced age is one of the strongest predictors of the mortality-related to mechanical ventilation in COIVD19 patients. The conclusion of the study stated that this

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predictor can be superior to other risk factors such as abnormal vital and labs and comorbid condition. We hypothesized that advanced age can be associated with poor prognosis following mechanical ventilation. Therefore, the aim of this study is to evaluate the age-associated changes in the clinical parameters of the patients under mechanical ventilation at different time intervals.

2. Methods

This retrospective study was performed to evaluate the prognosis of invasive ventilation in patients with COVID-19 at Shahid Beheshti Hospital in Qom from January 2020–June 2020. Patients confirmed with COVID19 via positive PCR test from nasal or lower respiratory sample and were admitted to the hospital were included in the study. We excluded the patients with significant comorbidities like malignancies, cardiovascular disease, pulmonary disease and renal problems, patients receiving non-invasive ventilation, history of usage of glucocorticoids and corticosteroids, those who underwent cardiac arrest before intubation, received extracorporeal carbon dioxide removal and those who were smokers and drug users. In our study, invasive mechanical ventilation was performed using endotracheal tube or tracheostomy.

Data regarding the rate of invasive ventilation was collected from the files of the patients in regards with demographic characteristics and clinical and laboratory signs. Parameters such as heart rate, pulse rate, respiration rate, blood pressure and body temperature were evaluated at the start of mechanical ventilation and 24, 48 and 72 h of the ventilation. These variables were compared among the patients aged 50 years and above and those less than 50 years.

The mean and variance indices were used to describe the concentration and dispersion of quantitative data and relative frequency and frequency indices for qualitative variables. Chi-square and Fisher's exact tests were used to compare the rate of invasive ventilation in qualitative variables. Independent *t*-test was also used to compare quantitative variables according to the state of invasive ventilation. Comparison of clinical symptoms before and after invasive ventilation was performed using paired *t*-test.

Statistical calculations were performed with SPSS 24 software. Significance level was considered as $p < 0.05$.

This study was approved by the Research Ethics Board of Shahid Beheshti Hospital in Qom.

The study is reported in accordance with STROCSS criteria [15].

The registry and the unique identifying number (UIN) of your study. Researchregistry6230.

3. Results

Of the 317 patients in COVID19 patients included in the study, 167 were male and 139 were female. 214 patients were over the age of 50 years and 98 were under 50 years (Fig. 1). The mean age of patients is 59.71 ± 16.46 years. Seventy-five percent of patients were aged between 48 and 72 years.

Descriptive statistics on clinical symptoms before and after invasive ventilation by age for patients under invasive ventilation are reported in the table below: Independent *t*-test was used to compare clinical signs between people over and under 50 years of age was not significant (Table 1).

Descriptive statistics on clinical symptoms before and after invasive ventilation by gender for patients under invasive ventilation are reported in the table below: Independent *t*-test was used to compare clinical signs between people over and under 50 years of age was not significant (Table 2).

Descriptive statistics on clinical symptoms before and after invasive ventilation by smoking for patients under invasive ventilation are reported in the table below: Independent *t*-test was used to compare clinical signs between people over and under 50 years of smoker and non-smoker was not significant (Table 3).

Blood pressure at the time of ventilation and 24, 48 and 72 h after ventilation was not significant among the two age groups, $p = 0.49$, $p = 0.84$ $p = 0.80$ and $p = 0.764$, respectively. Similarly, GCS was also not significant at these intervals in the two group, $p = 0.53$, $p = 0.55$, $p = 0.60$ and $p = 0.367$, respectively. Other parameters like PO_2, pulse rate, respiration rate and temperature were also not significantly different at different time intervals, in these two age groups, $p > 0.05$, respectively, Table 3.

3.1. Descriptive statistics and statistical test of saturated oxygen before and after invasive ventilation for patients under invasive ventilation

Paired *t*-test showed that the amount of saturated oxygen after invasive ventilation was significantly different from the previous saturated oxygen ($p < 0.001$) (Fig. 2).

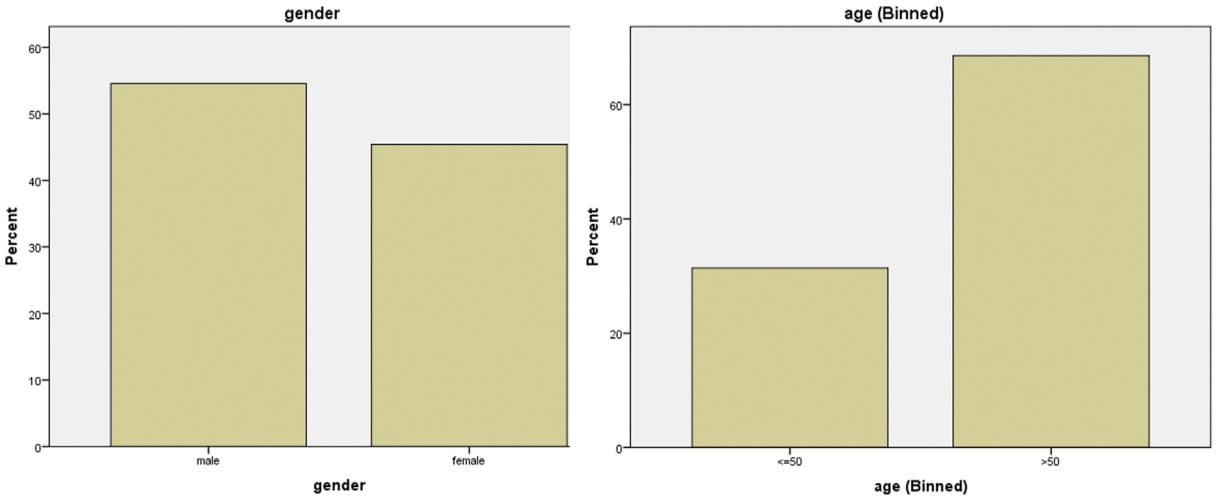

Fig. 1. Diagram of age and gender patient information.

Table 1
Descriptive statistics before and after invasive ventilation by age.

Group Statistics					
	Age (Binned)	N	Mean	Std. Deviation	Std. Error Mean
Sign bp0	≤50	11	12.464	.9394	.2833
	>50	51	12.169	1.3350	.1869
Sign bp24	≤50	11	12.209	1.0587	.3192
	>50	50	12.126	1.3206	.1868
Sign bp48	≤50	11	11.518	1.8798	.5668
	>50	46	11.407	1.1797	.1739
Sign bp72	≤50	10	11.680	2.4462	.7736
	>50	38	11.482	1.6670	.2704
Sign.gcs0	≤50	11	15.1500	.00000	.00000
	>50	50	15.0300	.62,727	.08871
Sign.gcs24	≤50	10	14.9500	.63,246	.20,000
	>50	35	15.0643	.50,709	.08571
Sign.gcs48	≤50	9	15.1500	.00000	.00000
	>50	33	15.0894	.34,816	.06061
Sign. gcs72	≤50	9	14.9278	.66,667	.22,222
	>50	30	15.0833	.36,515	.06667
Sign. o2sat0	≤50	11	75.55	14.376	4.335
	>50	51	79.20	12.035	1.685
Sign.o2sat24	≤50	11	80.82	11.496	3.466
	>50	50	80.30	12.176	1.722
Sign.o2sat48	≤50	11	78.55	12.144	3.662
	>50	46	76.74	14.570	2.148
Sign o2sat72	≤50	10	79.00	13.944	4.410
	>50	38	72.34	13.765	2.233
Sign.pr0	≤50	11	108.73	22.522	6.790
	>50	51	98.45	15.964	2.235
Sign.pr24	≤50	11	100.09	12.739	3.841
	>50	50	96.30	14.579	2.062
Sign.pr48	≤50	11	90.73	15.793	4.762
	>50	47	93.68	16.720	2.439
Sign.pr72	≤50	10	92.20	14.861	4.699
	>50	38	95.97	18.241	2.959
Sign.rr0	≤50	11	25.55	8.263	2.491
	>50	51	23.14	9.031	1.265
Sign.rr24	≤50	11	20.09	4.110	1.239
	>50	50	21.00	9.643	1.364
Sign.rr48	≤50	11	19.27	2.724	.821
	>50	46	22.41	12.487	1.841
Sign.rr72	≤50	10	19.40	2.171	.686
	>50	38	24.97	15.255	2.475
Sign.t0	≤50	11	37.536	.5259	.1586
	>50	51	37.261	.6809	.0953
Sign.t24	≤50	11	37.036	.5409	.1631
	>50	50	37.010	.4912	.0695
Sign t48	≤50	11	36.864	.5988	.1805
	>50	46	36.926	.5603	.0826
Sign.t72	≤50	10	36.940	.7306	.2310
	>50	36	36.981	.5450	.0908

Table 2
Descriptive statistics before and after invasive ventilation by gender.

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
Sign.bp0	male	36	12.156	1.2015	.2003
	female	26	12.150	1.1772	.2309
Sign..bp24	male	35	12.346	1.1480	.1940
	female	26	11.900	1.3994	.2745
Sign..bp48	male	33	11.230	1.2724	.2215
	female	24	11.700	1.3705	.2798
Sign..bp72	male	28	11.407	1.7425	.3293
	female	20	11.675	1.9695	.4404
Sign..gcs0	male	36	15.0944	.33,333	.05556
	female	25	15.1500	.00000	.00000
Sign..gcs24	male	29	15.0810	.37,139	.06897
	female	17	14.9735	.72,761	.17,647
Sign.gcs48	male	27	15.1500	.00000	.00000
	female	16	15.0250	.50,000	.12,500
Sign..gcs72	male	25	15.1500	.00000	.00000
	female	15	14.8833	.70,373	.18,170
Sign..o2sat0	male	36	80.69	11.858	1.976
	female	26	75.92	12.677	2.486
Sign..o2sat24	male	35	81.29	10.777	1.822
	female	26	79.31	13.564	2.660
Sign..o2sat48	male	33	76.70	11.693	2.035
	female	24	77.71	17.071	3.485
Sign..o2sat72	male	28	73.93	12.981	2.453
	female	20	73.60	15.622	3.493
Sign..pr0	male	36	98.67	16.818	2.803
	female	26	102.50	18.599	3.648
Sign..pr24	male	35	98.06	14.004	2.367
	female	26	94.58	14.536	2.851
Sign.pr48	male	34	93.88	17.252	2.959
	female	24	92.33	15.302	3.123
Sign..pr72	male	28	92.89	14.421	2.725
	female	20	98.60	20.874	4.668
Sign.rr0	male	36	23.97	10.454	1.742
	female	26	23.23	6.501	1.275
Sign..rr24	male	35	21.83	11.057	1.869
	female	26	20.15	5.619	1.102
Sign..rr48	male	33	21.52	10.800	1.880
	female	24	22.13	12.252	2.501
Sign..rr72	male	28	25.29	17.697	3.344
	female	20	21.65	4.030	.901
Sign..t0	male	36	37.231	.6878	.1146
	female	26	37.373	.6017	.1180
Sign..t24	male	35	37.057	.4871	.0823
	female	26	36.919	.4741	.0930
Sign..t48	male	33	36.912	.5464	.0951
	female	24	36.904	.5938	.1212
Sign..t72	male	27	36.967	.5392	.1038
	female	19	36.963	.6500	.1491

3.2. Comparison of hospitalization days by patients with invasive ventilation

Independent *t*-test showed that the average number of hospitalization days for patients who underwent invasive ventilation was higher than patients who did not have invasive ventilation ($p < 0.001$) (Table 4).

4. Discussion

In this retrospective study, we reported that the age of COVID19 patients undergoing mechanical ventilation is not associated with any significant changes in the clinical parameter. Age might not be the determinant of the prognosis of mechanical ventilation in these patients.

Studies have shown that advanced aged COVID19 patients are presented with greater pneumonia severity score, need of oxygen therapy, lymphopenia and need of mechanical ventilation, relative to young and middle-aged population. In a prospective study, Wang, Tang [16] reported 141 mechanical ventilation cases where advanced age and abnormal vitals were common in these patients compared to those who did not undergo mechanical ventilation. Nonetheless, the findings of the study reported that advanced age may not be a significant determinant of mechanical ventilation among these patients. The two age groups studies were patients aged 65 years or less and those aged above 65 years. A study has also reported that the age of COVID19 patients undergoing invasive and non-invasive mechanical ventilation may not differ. Nonetheless, gender and clinical parameters like neutrophils and leukocyte count, comorbidity and use of glucocorticoid can be predictors of invasive ventilation [17,18]. Gamberini, Tonetti [19] evaluated factors that can predict liberation from mechanical ventilation and reported that respiratory system compliance less than 40 mL/cm H_2O, advanced age, reduced arterial oxygen partial pressure to inspired fraction of oxygen ratio, increased sequential organ failure

Table 3
Descriptive statistics before and after invasive ventilation by smoking.

Group Statistics					
	Smoke	N	Mean	Std. Deviation	Std. Error Mean
Sign.bp0	no	56	12.238	1.3078	.1748
	yes	7	12.014	.8764	.3313
Sign.bp24	no	55	12.204	1.2323	.1662
	yes	7	11.714	1.4971	.5659
Sign.bp48	no	52	11.423	1.3390	.1857
	yes	6	11.700	1.2712	.5190
Sign bp72	no	43	11.412	1.8364	.2801
	yes	6	12.500	1.4311	.5842
Sign.gcs0	no	55	15.0409	.59,854	.08071
	yes	7	15.1500	.00000	.00000
Sign.gcs24	no	39	15.0218	.57,029	.09132
	yes	7	15.1500	.00000	.00000
Sign gcs48	no	37	15.0959	.32,880	.05405
	yes	6	15.1500	.00000	.00000
Sign gcs72	no	34	15.0324	.47,767	.08192
	yes	6	15.1500	.00000	.00000
Sign o2sat0	no	56	79.07	12.461	1.665
	yes	7	73.86	11.052	4.177
Sign o2sat24	no	55	81.33	11.795	1.590
	yes	7	73.71	11.086	4.190
Sign.o2sat48	no	52	77.44	14.420	2.000
	yes	6	75.67	10.309	4.208
Sign.o2sat72	no	43	74.44	14.060	2.144
	yes	6	71.00	13.755	5.615
Sign.pr0	no	56	99.32	16.796	2.244
	yes	7	110.71	21.716	8.208
Sign.pr24	no	55	96.64	13.974	1.884
	yes	7	98.00	17.088	6.459
Sign.pr48	no	52	94.23	14.975	2.077
	yes	7	83.43	23.720	8.965
Sign.pr72	no	43	94.72	17.652	2.692
	yes	6	96.00	17.561	7.169
Sign.rr0	no	56	23.64	9.213	1.231
	yes	7	24.29	6.184	2.337
Sign.rr24	no	55	21.24	9.408	1.269
	yes	7	20.00	5.774	2.182
Sign.rr48	no	52	21.79	11.824	1.640
	yes	6	21.33	3.502	1.430
Sign.rr72	no	43	23.65	14.304	2.181
	yes	6	24.00	8.222	3.357
Sign t0	no	56	37.350	.6715	.0897
	yes	7	36.943	.3867	.1462
Sign.t24	no	55	37.005	.5173	.0697
	yes	7	37.071	.2215	.0837
Sign.t48	no	52	36.913	.5740	.0796
	yes	6	36.917	.4355	.1778
Sign.t72	no	41	36.941	.6062	.0947
	yes	6	37.167	.2251	.0919

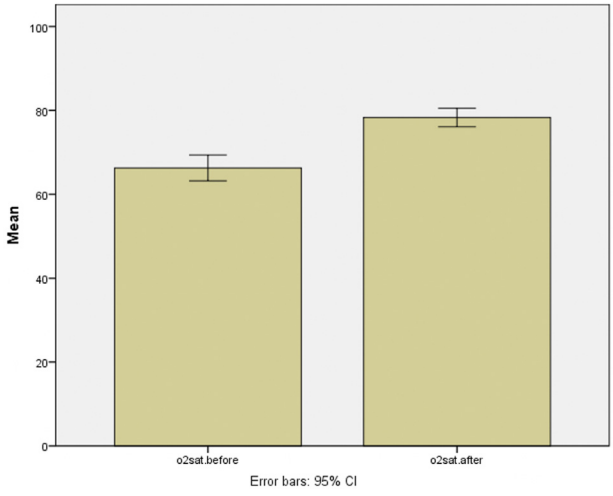

Fig. 2. Saturated oxygen before and after invasive ventilation.

Table 4
Hospitalization days by patients with invasive ventilation.

Group Statistics					
	Intubation	N	Mean	Std. Deviation	Std. Error Mean
day	Yes	53	7.36	5.955	.818
	No	6	3.00	.632	.258

assessment score at the time of admission and cardiovascular complication can prolong the duration of invasive mechanical ventilation. In a cohort study, Singer, Morley [20] showed that increased respiratory rate and hypoxemia are significant predictors of mechanical ventilation whereas blood pressure and temperature might not be the significant predictors. Mukhtar, Lotfy [21] also reported that drop in oxygen saturation is significantly greater in invasive ventilation patients compared to non-invasive ones.

Our study is a single-centered retrospective study, that has a small sample size. Furthermore, a number of biochemical parameters that are associated with bad prognosis of the disease are not investigated in this study.

5. Conclusion

The findings of our study showed that age might not contribute to the changes in clinical parameters among COVID19 patients under invasive mechanical ventilation. COVID19 patients under mechanical ventilation are likely to present similar prognostic outcomes, provided that other risk factors (comorbidities, drug history) are absent. We recommend further studies regarding the risk of undergoing mechanical ventilation among different age groups and associated biological factors.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Funding

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Author contribution

Dr. Nina Farzan: Planned the study, wrote the protocol, collected the data and drafted the manuscript and accepted the final draft.

Dr. Sepideh Vahabi and Dr. Shima Sadat Hashemi Madani: Planned and designed the study, collected the data.

Dr. Behrooz Farzan: analyzed the data and critically revised the draft and finally approved the manuscript.

Conflict of interest statement

The authors deny any conflict of interest in any terms or by any means during the study.

Guarantor

Dr. Nina Farzan.

Research registration number

Name of the registry: This study was approved by the Research Ethics Board of Qom University of Medical Sciences.

Unique Identifying number or registration ID: N/A.

Hyperlink to the registration (must be publicly accessible):N/A.

Consent for publication

Not applicable.

Availability of data and material

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijso.2021.100344.

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