Physiologic Outcome after using Home Non-Invasive Positive Pressure Ventilation in Chronic Respiratory Failure Patients

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Abstract
Background: Non-invasive positive pressure ventilation (NIPPV) is an e effective long-term treatment for chronic respiratory failure, Home NPPV has been shown to reduce patient's symptoms, improve physiologic measurements as health-related quality of life (HRQOL), PaCO2, PaO2, FEV1, FVC and 6 Minute walk test.
Aim of the current work was to monitor patients on Home NPPV as a long-term treatment for chronic respiratory failure stressing on their outcome, quality of life, ABG, Spiro metric PFT and 6MWT.
Methods: All Patients in this study 48 were either known or newly diagnosed chronic respiratory failure who were newly advised Home NPPV as a long term treatment according to the accepted guidelines for the initiation of NIV in different patient groups according to recommendations of the Swiss Society of Pulmonology 2020 for long-Term Mechanical Ventilation, the modality of NIV was CPAP or a bilevel positive pressure device in a spontaneous/timed mode delivered with fixed levels of positive end-expiratory pressure and pressure support and a backup respiratory rate). Inspiratory and expiratory positive airway pressures (IPAP and EPAP) were adjusted according to the patient's comfort, synchrony with the ventilator, marked reduction in the use of accessory muscles and accepted blood gases analysis.
Results: Patients included were 26 males (54.1%) and 22 females (45.9%) with a mean ± SD age 52.94 ± 13.39 years. Mean ± SD of BMI 31.37 ± 7.48 kg/m2 , significant improvement in health-related quality of life (HRQOL), PaCO2, PaO2, FEV1, FVC and 6 Minute walk test recorded.
Conclusion: The use of Home NPPV is effective long-term treatment for individuals with chronic respiratory failure by reducing patient's symptoms, improving health-related quality of life PaCO2, PaO2, FEV1, FVC and 6 Minute walk test.

Keywords: chronic respiratory failure, bilevel positive airway pressure, ABGs, 6MWT

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Introduction:

Chronic obstructive pulmonary disease (COPD), neuromuscular disorders (NMD), obesity hypoventilation syndrome (OHS), and restrictive thoracic lesions are some of the underlying conditions that lead to chronic hypercapnic respiratory failure (CHRF). Standard treatment techniques include long-term oxygen therapy, pulmonary rehabilitation, and medical care tailored to the underlying cause. Use of non-invasive positive pressure ventilation (NIV) to treat CHRF has grown. [1-2] complete recovery is not achievable in many situations,

necessitating a lifetime of home non-invasive mechanical ventilation (HNIV). Current study setted out to ascertain the effects of HNIV on the following variables: ABGs, HRQOL, FEV1, FVC and 6MWT due to various aetiologies with CHRF.

Patients and Methods

Patients who presented with CRF to Chest department were included, between June 2020 and May 2022, approval was obtained (**ZU-IRB #6193/2-6-2020).** Recommendations of the Swiss Society of Pulmonology 2020 for Long-Term Mechanical Ventilation served as the basis for the inclusion criteria [3]. A- Chronic COPD stable hypercapnic patients ($PaCO_2$ > 7 kPa [52.5 mm Hg]) with severe limitation(4) b- OHS If there is severe OSA, it is advised to try CPAP at first. c- RTD: restrictive thoracic disease patients as (kyphoscoliosis, TB sequences and deformed thoracic cage): $PCO_2 \geq 55$ mm Hg for longer than 10 minutes-NMD: neuromuscular disease patients as (Myasthenia gravis, post-polio syndrome and chronic inflammatory demyelinating polyradiculoneuropathy (CIDP)) Daytime hypercapnic ($PaCO_2 \geq 45$ mm Hg) e- Overlap syndrome who had OSA and COPD overlap and had chronic diurnal hypercapnic (a $PaCO_2$>45 mm Hg).

All subjects provided informed, written consent before participating.

Exclusion criteria

Patients under the age of 18, who are cognitively impaired, have bulbar weakness, uncooperative, unmanaged co-morbidities.

Study Design

This study is a Prospective cohort study

Study Protocol

Reviewing the recorded data of all the studied patients

a-Medical background highlighting the following: Demographic information (Age, sex, and measurement of BMI: Body mass index), Baseline assessment of health related quality of life (HRQOL) using PCS SF-12V2: physical clinical score short form (12 items) version 2, MCS SF-12V2: mental clinical score short form (12 items) version 2 (5) **b-** Chest X-ray (Postero-anterior or antero-posterior view) c- Arterial blood gases analysis. D- Spirometric pulmonary function tests e- previous Electrocardiography and echocardiography report.

Noninvasive ventilator support

According to the patient's comfort, synchrony with the ventilator, a significant decrease in the usage of accessory muscles, and acceptable blood gas measurement, the inhalation and exhalation positive airway pressures (IPAP and EPAP, respectively) were adjusted, after starting the ventilation process, the arterial blood gases were monitored. Oro-nasal masks are being used in all patients.

Assessment of the followings were done to all the studied patients

Follow up of Physiologic measurements at (baseline, 1, 3, 6, and 12) months including:

HRQOL using Short Form 12 (SF-12) 12 items have been shown to predict at least 90% of the variance in the physical and mental summary scales derived from the SF-36 (6, 7, 8**)**

Arterial blood gases analysis 6-**Spiro metric pulmonary function tests** d- **Six minute walking test (6MWT)**

By applying 6MWT and measurement of oxygen saturation (to be performed initially after diagnosis and reassessed after 1, 3.6,12 NIV therapy) (9).

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, and standard deviation, median and interquartile range (IQR). Significance of the obtained results was judged at the 5% level. The used tests were Student t-test, Mann Whitney test to compare between two studied groups, Paired t-test, Wilcoxon signed ranks test to compare between two periods.

Results

This study included 48 adult patients 26 males (54.1%) and 22 females (45.9%) age 52.94±13.39 years. BMI 31.37 ± 7.48 kg/m2, classified into five groups: 31.3 % Overlap syndrome (COPD and OSAS), 29.2% had OHS, 12.5% had COPD, 18.7% had RTD (kyphoscoliosis - post T.B - Thoracic cage) and 8.3% had NMDs (myasthenia gravis-post polio - CIDP). During the study 8 patients leave the study due to non-tolerance to NIV therapy and 3 patients were died arranged as follow: At 3rd month of study 2 patients leave the study due to non-tolerance to NIV therapy. At 6th month new 3 patients leave the study due to non-tolerance and 1 patient die so (total number leave the study 2+3+1 = 6 patients) At 12 month new 3 patients leave the study due to non-tolerance and 2 patients die so (total number leave the study 6+3+2 = 11 patients).The table (1), contains Baseline different patient characteristics and anthropometric data, base line PCS SF, MCS SF, paco2, pao2, FEV1, FVC and 6MWT

Table 1: Different patient's characteristics and anthropometric data

Variables	Min-Max				Mean ± SD		Median (IQR)			
Age (years)	22.0-75.0				52.94 ± 13.39		55.0(46.0-64.0)			
Male	Number				28		58.3%			
Female	Number				20		41.7%			
BMI (Kg/m^2)	16.0-46.0				31.37 ± 7.48		32.0(25.85-36.0)			
PCS SF-12 V2	35.0-64.0				49.65 ± 6.18		48.0(46.0-54.0)			
MCS SF-12V2	30.0-56.0				43.63 ± 5.84		42.0(40.0-47.0)			
FEV1	22.20-66.0				40.90 ± 10.68		42.60(31.65-48.15)			
FVC	25.0-117.80				58.93 ± 20.41		59.50(43.0-72.85)			
Paco2	50.0-78.0				62.91 ± 7.12		63.50(58.0-68.0)			
Pao2	38.0-60.0				53.41 ± 4.03		54.0(52.0-56.0)			
6MWT	145.0-320.0				219.8 ± 43.25		210.0(187.5-255.0)			
Chronic respiratory failure on Home NPPV	Overlap syndrome		OHS		COPD		RTD		NMD	
Number/percent	15	31.3%	14	29.2%	6	12.5%	9	18.7%	4	8.3%

The patients data about the values of PaCo2 and Pao2 were introduced in table (2) which showed improvement in Paco2 and pao2 at different periods , After 1 year of NIV therapy the lowest Paco2 and highest Pao2 achieved in NMD patients while highest Paco2 and lowest Pao2 (mean ± SD in RTD patients.

Table 2: Baseline and follow up PaCo2and Pao2 analysis among studied patients with different etiologies of chronic respiratory failure

		Baseline	1st month	3rd month	6th month	12th month
PaCO2	Overlap syndrome	(n = 15)	(n = 15)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	63.80 ± 8.54	60.53 ± 7.97	56.71 ± 7.64	53.25 ± 6.74	47.55 ± 2.42
	tp		<0.001*	<0.001*	<0.001*	<0.001*
	OHS	(n = 14)	(n = 14)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	60.57 ± 6.95	57.0 ± 6.18	54.0 ± 4.71	50.42 ± 3.37	46.91 ± 2.43
	tp		<0.001*	<0.001*	<0.001*	<0.001*
	COPD	(n = 6)	(n = 6)	(n = 5)	(n = 5)	(n = 5)
	Mean ± SD.	60.42 ± 6.53	58.42 ± 6.86	56.40 ± 7.50	52.90 ± 6.0	49.0 ± 4.47
	tp		0.001*	<0.001*	0.001*	0.001*
	RTD	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 8)
	Mean ± SD.	66.22 ± 5.17	63.22 ± 7.08	59.33 ± 6.58	56.22 ± 6.92	51.13 ± 6.31
	tp		0.020*	<0.001*	<0.001*	<0.001*
	NMDs	(n = 4)	(n = 4)	(n = 4)	(n = 4)	(n = 2)
	Mean ± SD.	64.0 ± 5.16	60.75 ± 5.62	58.0 ± 6.98	53.75 ± 7.68	45.0 ± 1.41
	tp		0.007*	0.027*	0.013*	0.042*
PaO2	Overlap syndrome	(n = 15)	(n = 15)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	49.47 ± 3.52	51.67 ± 3.29	54.14 ± 2.51	56.42 ± 2.43	58.9 ± 1.64
	tp		0.001*	0.001*	0.002*	0.003*
	OHS	(n = 14)	(n = 14)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	53.0 ± 2.91	54.21 ± 2.81	55.57 ± 2.41	56.92 ± 2.07	58.27 ± 2.53
	tp		0.004*	0.001*	0.002*	0.003*
	COPD	(n = 6)	(n = 6)	(n = 5)	(n = 5)	(n = 5)
	Mean ± SD.	49.0 ± 2.10	50.17 ± 2.04	51.60 ± 2.30	53.60 ± 2.51	56.60 ± 2.30
	tp		0.059	0.038*	0.042*	0.042*
	RTD	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 8)
	Mean ± SD.	47.56 ± 5.17	49.44 ± 5.17	51.11 ± 5.37	52.78 ± 5.21	55.13 ± 6.31
	tp		0.044*	0.017*	0.012*	0.017*
	NMDs	(n = 4)	(n = 4)	(n = 4)	(n = 4)	(n = 2)
	Mean ± SD.	47.0 ± 6.22	48.0 ± 6.73	50.75 ± 7.18	51.75 ± 7.93	59.0 ± 1.41
	tp		0.157	0.068	0.066	0.180

For assessing physical and mental score using short form of abbreviated version of the SF-36 were introduced in table (3) which showed significant increase in their values from base line through studied periods, After 1 year of NIV therapy the highest SF 12 v2 PCS achieved in OHS patients and lowest values were in RTD while the highest MCS achieved in overlap syndrome and lowest in COPD patients.

Table 3. Baseline and follow up SF 12 v2 PCS and MCS analysis among studied patients with different etiologies of chronic respiratory failure

		Baseline	1st month	3rd month	6th month	12th month
SF	Overlap syndrome	(n = 15)	(n = 15)	(n = 14)	(n = 12)	(n = 11)

	Mean ± SD.	49.60 ± 5.10	53.13 ± 5.60	56.36 ± 5.76	59.33 ± 6.15	64.64 ± 3.78
	t p		<0.001*	<0.001*	<0.001*	<0.001*
	OHS	(n = 14)	(n = 14)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	52.86 ± 5.97	56.43 ± 5.02	59.36 ± 3.91	62.42 ± 3.55	65.64 ± 5.10
	t p		<0.001*	<0.001*	<0.001*	<0.001*
	COPD	(n = 6)	(n = 6)	(n = 5)	(n = 5)	(n = 5)
	Mean ± SD.	52.67 ± 5.92	54.83 ± 7.08	57.60 ± 8.41	59.20 ± 9.01	61.40 ± 10.06
	t p		0.021*	0.027*	0.022*	0.025*
	RTD	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 8)
	Mean ± SD.	46.89 ± 3.59	49.89 ± 4.43	53.11 ± 5.21	56.33 ± 6.16	58.0 ± 7.69
	t p		0.001*	<0.001*	<0.001*	<0.001*
	NMDs	(n = 4)	(n = 4)	(n = 4)	(n = 4)	(n = 2)
	Mean ± SD.	40.25 ± 4.79	45.0 ± 4.76	51.0 ± 4.55	52.75 ± 8.77	62.50 ± 3.54
	t p		0.002*	0.001*	0.017*	0.017*
SF 12 V2 MCS	Overlap syndrome	(n = 15)	(n = 15)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	45.0 ± 5.83	47.33 ± 5.34	50.64 ± 5.69	53.92 ± 6.07	59.09 ± 4.28
	t p		<0.001*	<0.001*	<0.001*	<0.001*
	OHS	(n = 14)	(n = 14)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	46.36 ± 5.77	50.0 ± 5.38	52.71 ± 4.97	54.42 ± 4.87	57.36 ± 5.95
	t p		<0.001*	<0.001*	<0.001*	0.001*
	COPD	(n = 6)	(n = 6)	(n = 5)	(n = 5)	(n = 5)
	Mean ± SD.	40.33 ± 2.94	41.83 ± 3.37	44.20 ± 4.38	46.0 ± 5.10	49.0 ± 6.52
	t p		0.030*	0.009*	0.009*	0.010*
	RTD	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 8)
	Mean ± SD.	43.0 ± 3.32	45.11 ± 3.62	47.78 ± 3.90	50.56 ± 5.17	52.50 ± 6.19
	t p		0.002*	<0.001*	<0.001*	<0.001*
	NMDs	(n = 4)	(n = 4)	(n = 4)	(n = 4)	(n = 2)
	Mean ± SD.	35.25 ± 5.12	40.25 ± 4.79	45.0 ± 4.76	45.25 ± 5.74	54.0 ± 2.83
	t p		0.001*	0.001*	0.001*	0.042*

SD: Standard deviation, t: Paired t-test p: p value for comparing between Baseline and each other periods, *: Statistically significant at $p \leq 0.05$

Spirometric values presented in table (4) which showed improvement in FEV1 and FVC, After 1 year of NIV therapy the highest FEV1 and FVC achieved in overlap syndrome patients while the lowest FEV1 and FVC were in NMD patients.

Table 4. Baseline and follow up FEV1 and FVC analysis among studied patients with different etiologies of chronic respiratory failure

	Baseline	1st month	3rd month	6th month	12th month

FEV1	Overlap syndrome	(n = 15)	(n = 15)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	45.53 ± 11.67	49.67 ± 13.16	55.57 ± 11.58	60.08 ± 12.40	68.27 ± 6.40
	ᵗp		<0.001*	<0.001*	<0.001*	<0.001*
	OHS	(n = 14)	(n = 14)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	44.40 ± 8.66	46.36 ± 7.08	47.53 ± 7.32	49.03 ± 9.17	52.02 ± 8.82
	ᵗp		0.015*	0.001*	0.006*	0.008*
	COPD	(n = 6)	(n = 6)	(n = 5)	(n = 5)	(n = 5)
	Mean ± SD.	40.0 ± 8.94	42.83 ± 8.30	46.20 ± 11.32	51.40 ± 13.41	56.0 ± 15.57
	ᵗp		0.010*	0.025*	0.007*	0.005*
	RTD	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 8)
	Mean ± SD.	34.11 ± 7.36	37.60 ± 7.23	37.68 ± 4.99	42.76 ± 7.14	42.24 ± 10.71
	ᵗp		0.001*	0.034*	<0.001*	0.011*
	NMDs	(n = 4)	(n = 4)	(n = 4)	(n = 4)	(n = 2)
	Mean ± SD.	27.95 ± 4.41	27.85 ± 5.71	30.68 ± 4.62	29.75 ± 5.69	35.10 ± 0.14
	ᵗp		0.893	0.021*	0.117	0.276
FVC	Overlap syndrome	(n = 15)	(n = 15)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	76.11 ± 20.26	80.17 ± 20.13	87.51 ± 17.83	92.98 ± 17.90	96.78 ± 17.56
	ᵗp		0.016*	<0.001*	<0.001*	0.002*
	OHS	(n = 14)	(n = 14)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	57.37 ± 11.0	60.14 ± 8.96	62.64 ± 9.13	64.58 ± 11.96	69.27 ± 10.95
	ᵗp		0.007*	<0.001*	0.001*	<0.001*
	COPD	(n = 6)	(n = 6)	(n = 5)	(n = 5)	(n = 5)
	Mean ± SD.	66.53 ± 12.43	70.0 ± 11.61	74.84 ± 16.56	96.66 ± 17.91	89.38 ± 21.92
	ᵗp		0.030*	0.034*	0.088	0.005*
	RTD	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 8)
	Mean ± SD.	37.89 ± 8.02	43.0 ± 8.38	46.67 ± 7.19	52.22 ± 9.71	53.88 ± 14.42
	ᵗp		<0.001*	<0.001*	<0.001*	0.002*
	NMDs	(n = 4)	(n = 4)	(n = 4)	(n = 4)	(n = 2)
	Mean ± SD.	35.88 ± 4.33	36.50 ± 6.19	40.0 ± 4.40	40.0 ± 6.53	44.50 ± 0.71
	ᵗp		0.555	0.006*	0.062	0.058

FEV1: forced expiratory volume in 1st second, FVC: forced vital capacity

Regarding values of 6 MWT table (5) which showed significant increase in 6MWT at different periods, after 1 year of NIV therapy the best 6MWT values were achieved in OHS patients while the lowest was in NMD patients.

Table (5) Baseline and follow up 6MWT analysis among studied patients with different etiologies of chronic respiratory failure

		Baseline	1st month	3rd month	6th month	12th month
6 MWT	Overlap syndrome	(n = 15)	(n = 15)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	210.8 ± 20.68	224.8 ± 34.95	260.7 ± 44.19	296.7 ± 55.73	362.7 ± 35.11
	ᵗp		<0.001*	<0.001*	<0.001*	<0.001*
	OHS	(n = 14)	(n = 14)	(n = 14)	(n = 12)	(n = 11)
	Mean ± SD.	200.0 ± 44.72	239.3 ± 42.87	285.0 ± 52.44	308.3 ± 72.47	379.1 ± 85.96
	ᵗp		<0.001*	<0.001*	<0.001*	<0.001*
	COPD	(n = 6)	(n = 6)	(n = 5)	(n = 5)	(n = 5)
	Mean ± SD.	190.3 ± 32.04	234.2 ± 52.77	264.0 ± 40.99	308.0 ± 63.80	354.0 ± 103.6
	ᵗp		0.959	0.006*	0.050	0.044*
	RTD	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 8)

	Mean ± SD.	237.8 ± 37.76	286.1 ± 46.15	300.56 ± 47.0	313.3 ± 48.02	339.4 ± 65.05
	tp		0.002*	<0.001*	<0.001*	0.001*
	NMDs	(n = 4)	(n = 4)	(n = 4)	(n = 4)	(n = 2)
	Mean ± SD.	180.5 ± 41.13	247.5 ± 57.37	268.8 ± 59.49	282.5 ± 67.02	295.0 ± 35.36
	tp		0.092	0.021*	0.025*	–

6mwt: six-minute walk test, SD: Standard deviation: Paired t-test p: p value for comparing between Baseline and each other periods *: Statistically significant at p ≤ 0.05

Discussion

In the current study, the role of using home NIV (either CPAP or BIPAP) in CRF patients, and its effect on improving PaCO2, PaO2, HRQOL, FEV1, FVC and 6 Minute walk test were assessed. The 1 year analysis of PaCO2 and PaO2 showed no difference between patients at different studied periods as regard paCO2 while there was significant difference between them as regard PaO2 except at 12th month, follow up PaCo2 and pao2 among studied patients confirmed significant decrease of PaCO2 at different periods and significant increase of PaO2 also except at COPD (at 3th , 6th and 12 month) and NMD patients, lowest PaCO2 and highest paO2 values all over studied periods presented in OHS except at 12 month (lowest paCO2 and highest paO2 in NMD patients) may be explained by intact lung parenchyma and gas exchange unit so correction of peripheral hypoventilation by aid of NIV improve level of gas tension and gas exchange . Above ABG changes are matched with Tsolaki et al.,(10) who concluded that time courses of PaCO2 in four groups COPD, RTD, OHS and NMD confirming statistically significant difference by decreasing of PaCO2 after use of NIV with p value ($p < 0.001$) with lowest PaCO2 achieved in RTD at end of study while time courses of PaO2 in the four groups COPD, RTD, OHS and NMD confirming statistically significant difference by elevation of PAO2 after use of NIV with p value ($p < 0.001$) with highest PAO2 achieved in NMD, also Cantero et al., (11) had showed improvement in ABG after NIV use . SF 12 v2 PCS and MCS analysis showed significant difference between studied patients except at (6th and 12 month of PCS), the scores were significant increased in all studied patients during follow up periods, highest PCS and MCS achieved in OHS patients from base line and allover the study periods after NIV use except at 12 month (highest MCS in overlap patients) proving it role in improving in HRQOL either physical or mental score especially in SRBD. This is in agreement with Yüksel et al.(12) who studied restrictive thoracic diseases (RTD) and chronic obstructive pulmonary disease (COPD) patients with CHRF and showed significant improvements in HRQoL and sleep quality by the first month of HNIV establishment and remained stable over time in both groups. Tsolaki et al. (10)studied HRQOL in CRF patients, they showed that patients with RTD had significant improvement in PCS and MCS by the third month, In the OHS group the PCS scores improved by the sixth month ($p = 0.0031$) while the MCS scores improved earlier by the third month ($p = 0.010$), The PCS scores in COPD patients improved by the sixth month ($p < 0.0001$) and the MCS scores by the third month ($p = 0.003$) while Concerning the patients in the NMD group, their HRQoL did not change until the sixth month; in contrast, the PCS scores showed a significant deterioration from that time point and thereafter ($p = 0.014$). Concerning the patients of overlap syndrome Murphy et al., (13) demonstrated improvement in Health-related quality of life after NIV use. FEV1 and FVC values in the study had showed significant difference between different studied patients as regard of them, follow

up FEV1 and FVC analysis for 1 year illustrated significant improvement in FEV1 at different periods except in NMDs (at 1st, 6th and 12 month) and FVC in COPD at (6th month), highest FEV1 and FVC achieved in overlap syndrome from baseline and allover studied periods after NIV therapy except at 6 month(highest FVC in COPD). Increase in Spiro metric parameters can be explained by improved muscle status, cooperation with patients and correction of ABG values but they were limited in its maximum values. This was matched with Yüksel et al., (12) who studied restrictive thoracic diseases RTD and COPD patients with CHRF and follow expiratory flow rates in both groups in one-year follow-up period, they showed improvement in their values with $P < 0.05$, compared with baseline values, On contrary to above results Vassiliki (14) showed that Spirometric parameters did not change significantly throughout the study period after NIV use in CRF patients. Nauffal (15) showed also that Spirometric lung volumes and MIP (maximum inspiratory pressure) did not change significantly during the follow-up in any of the two groups (kyphoscoliotic group – neuromuscular group). Actually, neuromuscular patients showed a significant decrease of FVC and FEV1 at month 12. six MWT values had showed significant difference between studied patients in baseline and 1st month only , follow up 6MWT analysis confirmed significant increase in 6MWT at different periods except in COPD (at 6th month) and NMDs (at 1st month and 12th month) . highest 6 MWT presented in RTD patients from baseline and allover studied periods except at 12th month best 6MWT achieved in OHS patients mean ± SD 379.1 ± 85.96 m after NIV therapy This was in agreement with, Held et al., (16) who studied association of pulmonary hypertension due to hypoventilation and exercise capacity, and the haemodynamic and functional changes under non-invasive ventilation their patients were presented with 6-min walking distance 303± 133 m and after 3 month of non-invasive ventilation 384± 126m they found a significant improvement in 6 MWT ($p < 0.001$). Also Backer et al., (17) who studied long term effect of NIV in COPD patients , The 6-minute walking distance increased significantly in the NIV group (232 ± 151 m to 282 ± 146 m, $P < 0.01$), while there was no change in the control group (408 ± 34 m to 401 ± 78 m, $P = 0.085$) , On contrary, Lacedonia et al., (22) evaluated the differences between three groups of (overlap syndrome, COPD and Obstructive sleep apnoea syndrome), their results showed that there aren't any substantial differences as regards exercise performance, evaluated simply by 6MWT even though, as expected, patients with only obstructive sleep apnoea syndrome have a better performance . Regarding to mortality 6.3% died from all studied patients (3 patients), 2 of them were non-compliant to NIV therapy (1 overlap patient and 1 COPD patient) and last one died was compliant NMD patient concluding that increased mortality in non-compliant groups

Conclusions

Use of Home NPPV is effective long-term treatment for individuals with chronic respiratory failure improve PaCO2 , PaO2 , health-related quality of life , FEV1, FVC and 6MWT .

Abbreviations

Paco2: arterial tension of CO2 gas Pao2: arterial tension of oxygen FEV1: forced expiratory volume in 1st second FVC: forced vital capacity 6MWT: six minute walk test

Ethics approval and Consent to Participate

This study was approved by the administrative council of the chest department and institutional board review of Zagazig University **(ZU-IRB #6193/2-6-2020)**. Patients included in this study gave their informed and signed consent.

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Disclosure

There are no conflicts of interest reported by the authors in this work.

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