AIM OF THE STUDY

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To compare between different weaning parameters in combination of the general condition of the patients with COPD (neurological, electrolyte, respiratory, cardiovascular ,acid base status and body mass index) as predictors of weaning outcome and to study the effect of usage of non invasive PSV in patients who were difficult to wean.

PATIENTS

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This is a prospective cohort study was conducted on 100 patients with COPD admitted to Alexandria main university hospital who were mechanically ventilated for more than 24 hours and were considered candidates for weaning judged by the physician in charge.

Inclusion criteria:

Mechanically ventilated for at least 24 hours and the cause of mechanical ventilation has been resolved judged by the physician in charge.

Exclusion criteria:

Patients younger than 18 years, patients on vasopressors, patients with toxicological diseases.

Informed consent was taken from every patient included in the study whenever possible or from patient's next of kin. All selected patients fulfilling the inclusion criteria were subjected to full history (including age, sex and preexisting underlying disease), full clinical examination and Laboratory investigations were done on admission and daily.

METHODS

METHODS

The following values were measured in all patients with COPD candidate for weaning:

1. Vital signs:

a) Systolic blood pressure: Normal value is 90-140 mmHg.

b) Diastolic blood pressure: Normal value is 60-90mmHg.

c) Temperature: Normal value is 36.5-37.2 degrees.

d) Respiratory rate:

Was measured while the patient was on spontaneous mode of breathing (PSV). Normal value is less than 35 breaths/min.[191]

e) Heart rate: Normal value is 60-90 beats/min.

2. Tidal volume:

Was measured while the patient was on spontaneous mode of breathing (PSV). Normal value used for weaning from mechanical ventilator was 4-6 ml/kg.[192]

3. Rapid shallow breathing index:

Was measured while the patient was on spontaneous mode of breathing (PSV). Normal value used for weaning from mechanical ventilator was<105 breaths/min/litre.[193]

4. Maximum inspiratory pressure:

Was measured on volume control ventilation and during inspiratory pause. A value less than- 25cmH2Owas considered one of predictors of weaning success.[194]

5. P0.1(airway occlusion pressure in the first 0.1 second of inspiration):

Was measured on volume control ventilation while the patient was fully sedated and during first 0.1 second of patient inspiration. Normal value used for weaning from mechanical ventilator was < 6cmH2O.[195]

6. Compliance:

Was measured while patient on volume control ventilation, fully sedated and inspiratory pause for 0.5 to 1 sec, Cst = VT / (inspiratory plateau pressure – positive end expiratory pressure). Normal value used for weaning from mechanical ventilator was 40-60 ml/cmH2O. [196] Compliance was measured either by direct measurement by the ventilator if available or it was calculated by this equation: Cst = VT / (inspiratory plateau pressure – positive end expiratory pressure).

7. PaO2:

Was measured using arterial blood gas analysis. Normal value used from weaning from mechanical ventilator was >60 mmHg at FiO2 40%.[194]

8. PaCO2:

Was measured using arterial blood gas analysis. Normal value used for weaning from mechanical ventilator was <60 mmHg.[197]

9. PEEP:

Normal value used for weaning from mechanical ventilator was 5-8 cmH2O.[1]

10. Hypoxaemic index:

Was measured by dividing PaO2 by FiO2. Normal value used for weaning from mechanical ventilator was> 250.

11. Integrative weaning index(IWI):

Was calculated by this equation:IWI=CstxSaO2/RSBI.(Cst: static compliance,SaO2 :saturation of O2 in arterial blood ,RSBI :rapid shallow breathing index).A value of more than 25ml/cmH2O breaths/minute/liter was a good predictor of weaning outcome.[11]

12. P0.1/maximum inspiratory pressure ratio:

The $P_{0.1}/P_{Imax}$ ratio at a value of <0.3 has been found to be a good early predictor of weaning success.[16]

These above mentioned parameters were considered together with the:

1. Neurological and electrolyte status:

a) Presence of structural brain damage: evidenced by computerized tomography(CT) imaging of the brain.

b) GCS: Weaning value used was 8T-11T.

c) History of sedatives or hypnotics intake prior to the trial of weaning.

d) Presence of electrolyte disturbance (especially hypophosphataemia).

Phosphorus level was classified according to the following values:

a) normal phosphorus level: from 2.5-4.5 mg%.

b) low phosphorus level: from 2-2.5 mg%.

c) very low phosphorus level: less than 2mg%.[204]

2. Respiratory status:

a) **Presence of abnormal value of compliance.**

b) **Presence of abnormal value of resistance:** Normal value used for weaning from mechanical ventilator was 2-5 cmH2O/L/sec.[198]

c) **Alveolar arterial oxygen gradient(PAO2-PaO2):** Calculated used this equation (FiO2(barometric pressure-47)-PaCO2/0.8-PaO2). Normal value used for weaning from mechanical ventilator was <14 mmHg.[199]

3. Acid base status and body mass index:

a) **Body mass index:** Normal value used for weaning from mechanical ventilator was 18.5-25 kg/m2.[200]

b) **Presence of acid base disturbance:** the type of acid base disturbance was documented for every patient proved to suffer from this issue.

4. Cardiovascular status:

a) **Prescence of ischemic heart disease:** proved by ECG changes and elevated CK-MB or troponin levels in blood.

b) **Presence of arrhythmias:** (namely atrial fibrillation).

c) **Presence of heart failure :** proved by echocardiography.

d) **Haemoglobin level:** Should be more than 9gm/dl.[201]

Then patient was discontinued from MV by the physician in charge through a T-piece trial for 2 hours and if spontaneous breathing trial succeeded then success of weaning was determined by the ability to breath normally away from MV for 48 hours. The decision to return to MV was made by the physician in charge (who was completely blind to the study).

According to the success of the weaning trial patients were classified into 2 groups:

Group 1: Patients who failed in weaning trial .

Group 2: Patients who were successfully weaned.

Then all these weaning parameters in addition to parameters reflecting the neurological, electrolyte, respiratory, acid base , cardiovascular status of the patient together with body mass index and vital signs of the patient were compared according to their specificity, sensitivity ,positive and negative predictive values and accuracy to detect their ability as a predictor of weaning from mechanical ventilator.

The study also included the effect of usage of non invasive PSV with pressure support 15 cmH2O in patients who were difficult to wean.

Handling and analysis of data:

The raw data were coded and entered into SPSS system files (SPSS package version 18). Analysis and interpretation of data were conducted.

The following statistical measures were used:

- Descriptive statistics including frequency, distribution, mean, and standard deviation were used to describe different characteristics.
- Kolmogorov – Smirnov test was used to examine the normality of data distribution.
- Univariate analyses including: t-test and Mann Whitney test were used to test the significance of results of quantitative variables. Chi-Square test and Fisher's Exact test were used to test the significance of results of qualitative variables.
- Accuracy, Sensitivity, Specificity, Positive predictive value and Negative predictive value were calculated for testing efficiency of parameters used to predict prognosis of weaning from mechanical ventilation among the studied COPD patients.
- Receiver operating characteristic curve (ROC) were drawn for statistically significant quantitative data ,the area under the ROC curve denotes the diagnostic performance of the test. Area more than 50% gives acceptable performance and area about100% is the best performance of the test.
- The significance of the results was at the 5% level of significance.

RESULTS

RESULTS

This study was done on 100 patients with COPD on mechanical ventilator. 67 patients succeeded in the weaning trial (67%)(group2), while 33 patients failed(33%)(group1).

Demographic data:

The age of studied patients ranged from 40-75 years with a mean age of 61.2±9.9 in group 1, while in group2 it ranged from 41-70 years with a mean age of56.1±6.9.

Regarding to gender, the percentage of males was 66.7% and females 33.3% of the total number of patients in group1,while males represented 73.1% and females 26,9% of the total number of patients in group2.There was statistical significance between the 2 groups as regards age (p=0.012) as age was significantly lower in patients of group 2, while there was no statistical significance between the 2 groups as regards gender (p=0.503).**(Table 16, Figure 6,7).**

Table (16): Personal characteristics of the studied COPD patients according to successfulness of weaning from mechanical ventilation

Personal characteristics	Failed weaning (n=33)		Successful weaning (n=67)		Significance
	No.	%	No.	%	
Age (years)					
40-	2	6.1	10	14.9	
50-	15	45.5	31	46.3	
60-	8	24.2	23	34.3	t=2.61 P=0.012*
70-<80	8	24.2	3	4.5	
Min-Max	40-75		41-70		
Mean±SD	61.2±9.9		56.1±6.9		
Gender					
Female	11	33.3	18	26.9	X^2=0.449 P=0.503
Male	22	66.7	49	73.1	

t: t-test
X^2: Chi-Square test
*significant at P≤0.05

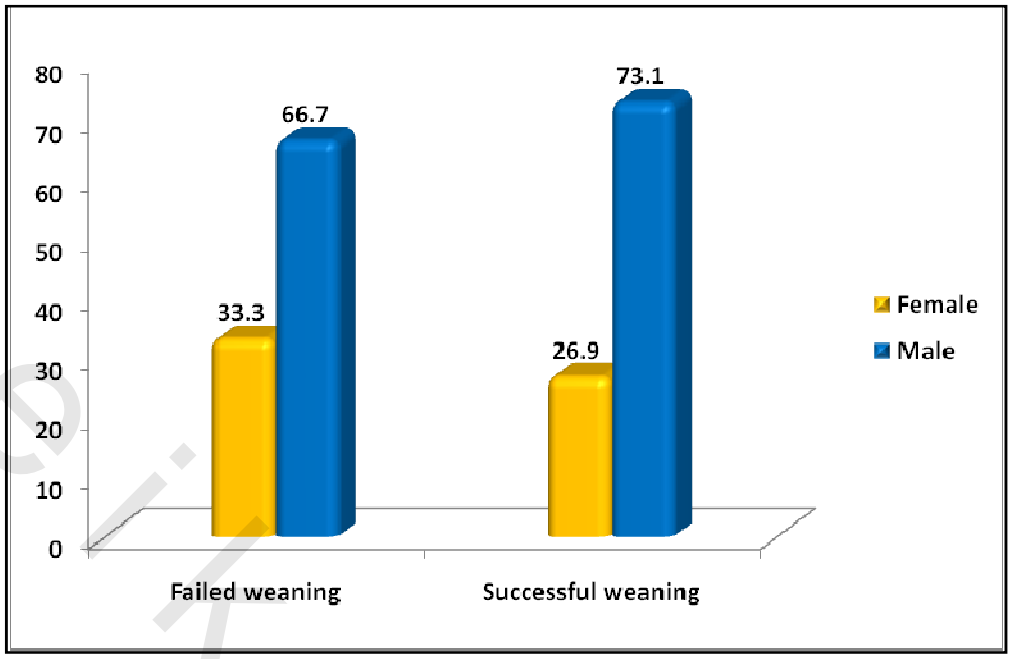

Figure (6): Gender of the studied COPD patients according to successfulness of weaning from mechanical ventilation (p=0.503)

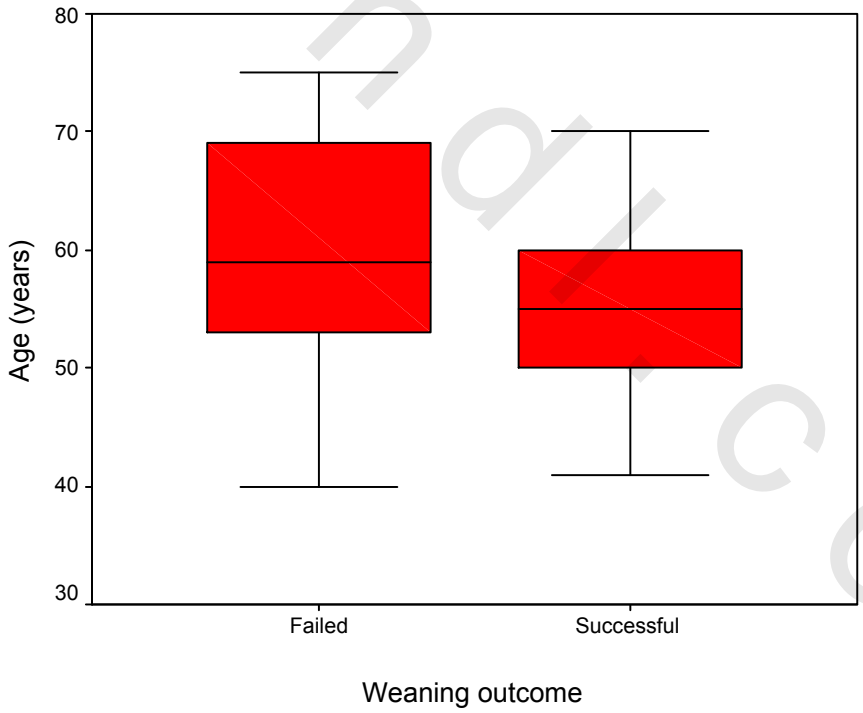

Figure (7): Age of the studied COPD patients according to successfulness of weaning from mechanical ventilator(p=0.012).

Neurological and electrolyte status in the two studied groups:

Glascow Coma Score of less than 11T was recorded in4 patients(12.1% of the total number of patients in group1)and Glascow Coma Score of 11T was recorded in29 patients(87.9% of the total number of patients in group1),while in group2 there was no patients with Glascow Coma Score of less than 11T and Glascow Coma Score of 11T was recorded in 67 patients(100% of the total number of patients in group2) with statistical significance between the 2 groups(p=0.01)as Glascow Coma Score of 11T was recorded in significantly higher number of patients in group2.

Structural brain damage(by CT imaging of the brain) proved was present in 2 patients(6.1% of the total number of patients in group1),while in group2 structural brain damage was present in4 patients(6% of the total number of patients in group2) with no statistical significance between the 2groups..(p=1). The 2 patients in group1 presented with altered mental status, while the 4 patients in group2 presented with one side lag or facial palsy.

Electrolyte disturbance was present in 4patients(12.1% of the total number of patients in group1),while in group2 electrolyte disturbance was present in12 patients(17.9% of the total number of patients in group 2) with no statistical significance between the 2 groups. 95 patients in our study presented with normal phosphorus level and 29 patients of them suffered failed weaning. While 4 patients presented with very low phosphorus and all of them suffered failed weaning. Only one patient presented with both low levels of phosphorus and potassium and was successfully weaned. (p=0.458).

Phosphorus level was classified according to the following values:

a) normal phosphorus level: from 2.5-4.5 mg%.

b) low phosphorus level: from 2-2.5 mg%.

c) very low phosphorus level: less than 2mg%.

Taking sedatives or hypnotics before the trial of weaning was absent in group1,while in group2 it was present in4 patients(6% of the total number of patients in group2) with no statistical significance between the 2 groups.(p=0.299).**(Table 17, Figure 8).**

Table (17): Neurological and electrolyte status among the studied COPD patients according to successfulness of weaning from mechanical ventilation

Neurological and electrolyte status	Failed weaning (n=33)		Successful weaning (n=67)		Significance
	No.	%	No.	%	
Glascow Coma Scale					
Less than 11T	4	12.1	0	0.0	**^{FE}P=0.01***
Score of 11T	29	87.9	67	100.0	
Structural brain damage					
No	31	93.9	63	94.0	^{FE}P=1.0
Yes	2	6.1	4	6.0	
Electrolyte disturbance					
No	29	87.9	55	82.1	X^2=0.551
Yes	4	12.1	12	17.9	P=0.458
Taking sedatives or hypnotics prior to weaning.					^{FE}P=0.299
No	33	100.0	63	94.0	
Yes	0	0.0	4	6.0	

^{FE}P: Fisher's Exact test
X^2: Chi-Square test
*significant at P≤0.05

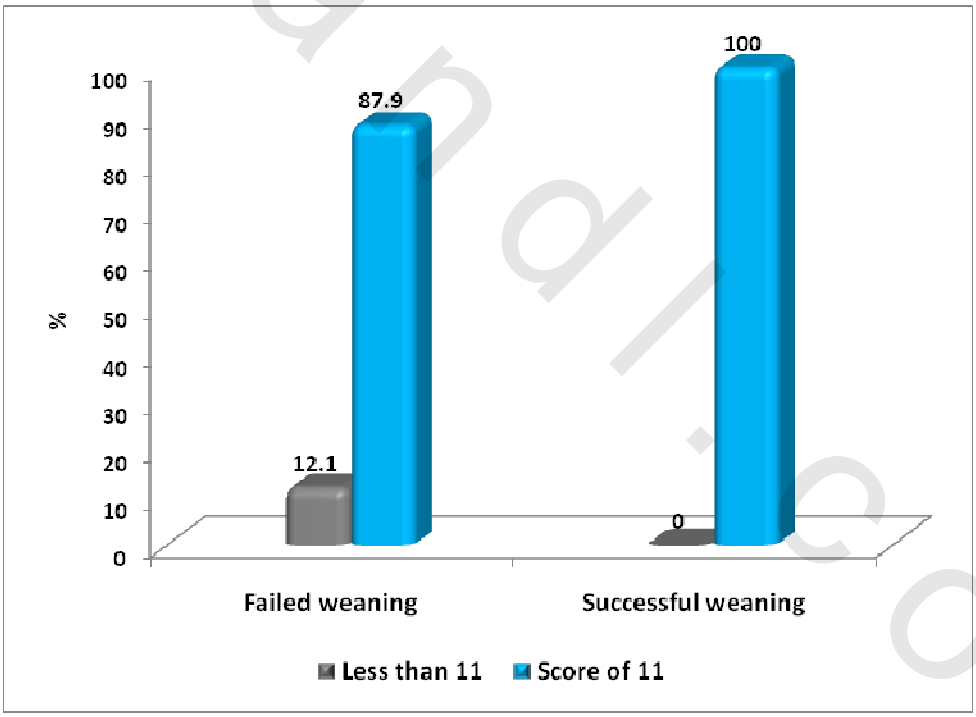

Figure (8): Glascow Coma Scale among the studied COPD patients according to successfulness of weaning from mechanical ventilation (p=0.01)

Respiratory status in the two studied groups:

Abnormal value of static compliance was present in 18 patients(54.5% of the total number of patients in group1),while in group2 abnormal value of static compliance was present in 46 patients(68.7% of the total number of patients in group2) with no statistical significance between the 2 groups.(p=0.167).

Abnormal value of resistance was present in 33 patients (100% of the total number of patients in group1),while in group 2 abnormal value of resistance was present in 32 patients(47.8% of the total number of patients in group2) with statistical significance between the 2groups as abnormal value of resistance was present in significantly lower percentage of patients in group2.(p<0.0001).

The diffirence between alveolar and arterial pressure of oxygen (PAO2-PaO2) ranged from14.6-422.5mmHg with a mean 158.0±98.1 in group1,while in group 2 it ranged from40.1– 310.9mmHg with a mean of169.4±78.5 with no statistical significance between the 2 groups.(p=0.331). (PaO2 measured on different FiO2 variables). **(Table 18, Figure 9).**

Table (18): Respiratory status among the studied COPD patients according to successfulness of weaning from mechanical ventilation

Respiratory status	Failed weaning (n=33)		Successful weaning (n=67)		Significance
	No.	%	No.	%	
Respiratory status					
Abnormal compliance					X^2=1.911 P=0.167
No	15	45.5	21	31.3	
Yes	18	54.5	46	68.7	
Abnormal resistance					**X^2=26.521 P<0.0001***
No	0	0.0	35	52.2	
Yes	33	100.0	32	47.8	
PAO2-PaO2(mmHg)					Z=0.971 P=0.331
Min-Max	14.6-422.5		40.1– 310.9		
Mean±SD	158.0±98.1		169.4±78.5		

^{FE}P: Fisher's Exact test X^2: Chi-Square test *significant at P≤0.05
Z: Mann Whitney test t: t-test *significant at P≤0.05

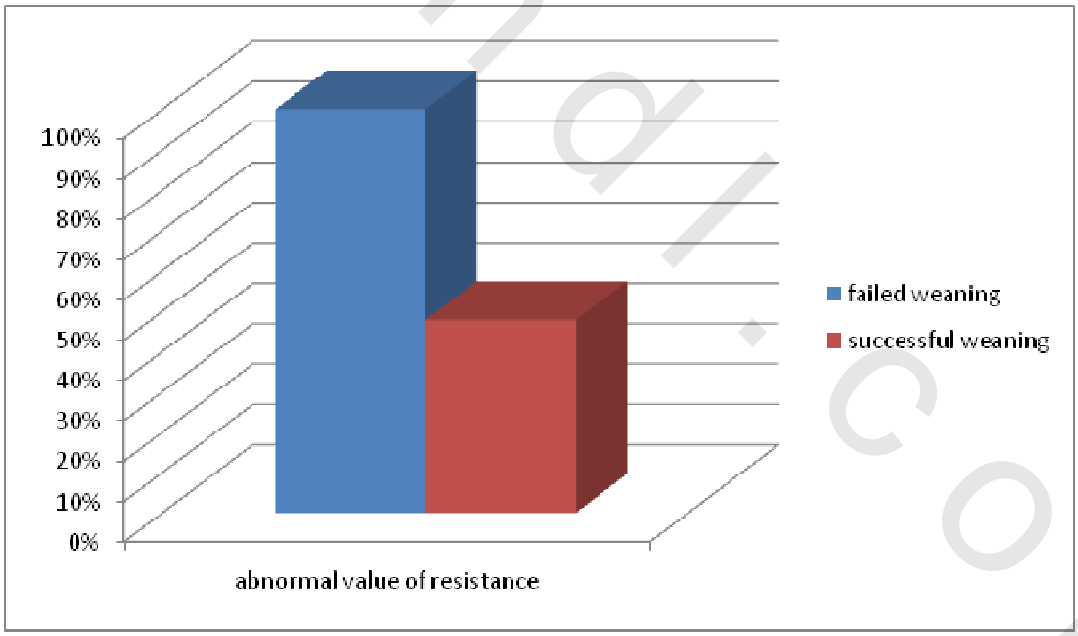

Figure (9): Abnormal value of resistannce of the 2 studied groups according to successfulness of weaning trial(p<0.0001).

Acid base status and body mass index in the two studied groups:

Acid base disturbance was assessed just before weaning and it was present in 4 patients (12.1% of the total number of patients in group1), while in group2 acid base disturbance was present in 10 patients(14.9% of the total number of patients in group2) with no statistical significance between the 2groups (p=1). A total of 14 patients was documented to have acid base disturbances, 11 patients suffered mild respiratory acidosis with PH ranged between 7.32-7.34 and 4 of them (36%)suffered failed weaning and needed NIV after extubation. PaCO2 ranged between 45-50mmHg. Serum HCO3 between 22-25meq/L with administration of IV NaHCO3(renal impairment was present). The remaining 3 patients suffered metabolic and respiratory alkalosis and none of them required NIV(successful weaning).

Body mass index(BMI) ranged from16.0-33.8kg/m2 with a mean of 22.7±3.4 in group1,while in group2 it ranged from18.8-36.8kg/m2 with a mean of 22.7±3.5with no statistical significance between the 2groups.(p=0.817).**(Table 19).**

Table (19): Acid base status and body mass index among the studied COPD patients according to successfulness of weaning from mechanical ventilation

Acid base status and body mass index	Failed weaning (n=33)		Successful weaning (n=67)		Significance
	No.	%	No.	%	
Acid base status and body mass index					
Body mass index(kg/m2)					
Under weight	1	3.0	0	0.0	X^2=0.231 P=0.817
Normal	29	87.9	63	94.0	
Overweight	1	3.0	0	0.0	
Obese	2	6.1	4	6.0	
Min-Max	16.0-33.8		18.8-36.8		
Mean±SD	22.7±3.4		22.7±3.5		
Acid base disturbance					
No	29	87.9	57	85.1	^{FE}P=1.0
Yes	4	12.1	10	14.9	

^{FE}P: Fisher's Exact test X^2: Chi-Square test *significant at P≤0.05

Cardiovascular status in the two studied groups:

Ischaemic heart disease(proved by ECG ischaemic changes and elevated CK-MB and cardiac troponin levels) was present in 10 patients(30.3% of the total number of patients in group1),while in group2 ischaemic heart disease present in 18 patients(26.9% of the total number of patients in group2) with no statistical significance between the 2 groups.(p=0.719).

Heart failure was present in 6 patients(18.2% of the total number of patients in group 1),while in group2 heart failure was present in 10 patients (14.9% of the total number of patients in group2) with no statistical significance between the 2groups.(p=0.676). Ejection fraction in patients presenting with heart failure ranged between 35-40%.

Haemoglobin level ranged from9.1-17.5g/dl with a mean of 11.4±1.9 in group 1, while in group2 haemoglobin level ranged from8.4-17.3g/dl with a mean of 11.2±1.9 with no statistical significance between the 2 groups.(p=0.212).

Cardiac arrhythmias(namely atrial fibrillation) was present in 2 patients(6.1% of the total number of patients in group 1),while in group2 cardiac arrhythmias was present in3 patients (4.5% of the total number of patients in group2) with no statistical significance between the 2groups as regard the presence of cardiac arrhythmias.(p=1).**(Table 20).**

Vital signs in the two studied groups:

Systolic blood pressure ranged from 100-140 mmHg with a mean of 124.5±12.8 in group1, while in group 2 it ranged from 100-150mmHg with a mean of 124.0±12.1 with no statistical significance between the 2 groups.(p=0.868).

Diastolic blood pressure ranged from 60-90 mmHg with a mean of 76.4±8.6 in group1,while in group2 it ranged from 60-100 mmHg with a mean of 77.3±9.8 with no statistical significance between the 2 groups.(p=0.655).

Temperature ranged from 36.5-40 degrees with a mean of 37.3±0.8 in group1,while in group2 it ranged from 36.5-38.8 degrees with a mean of 37.3±0.4.with no statistical significance between the 2 groups.(p=0.842).

Respiratory rate was measured on spontaneous mode (CPAP) and it ranged from 14-30 breaths/minute with a mean of 21.3±5.4 in group1, while in group2 it ranged from10-28 breaths/minute with a mean of 18.6±4.4. with no statistical significance between the 2 groups. (p=0.086).

Heart rate ranged from65-130 beats/minute with a mean of 91.5±16.0 in group1, while in group 2 it ranged from60-105 beats /minute with a mean of 84.3±9.4 with statistical significance between the 2 groups as heart rate was significantly lower in patients of group2.(p=0.017).**(Table 20, Figure 10).**

Table (20): Cardiovascular status and vital signs among the studied COPD patients according to successfulness of weaning from mechanical ventilation

Cardiovascular status and vital signs	Failed weaning (n=33)		Successful weaning (n=67)		Significance
	No.	%	No.	%	
Cardiovascular status					
Ischaemic heart disease					X^2=0.13 P=0.719
No	23	69.7	49	73.1	
Yes	10	30.3	18	26.9	
Heart failure					X^2=0.174 P=0.676
No	27	81.8	57	85.1	
Yes	6	18.2	10	14.9	
Hemoglobin level (gm/dl)					Z=1.249 P=0.212
Min-Max	9.1-17.5		8.4-17.3		
Mean±SD	11.4±1.9		11.2±1.9		
Cardiac arrhythmias(namely atrial fibrillation)					^{FE}P=1.0
No	31	93.9	64	95.5	
Yes	2	6.1	3	4.5	
Vital signs					
Systolic blood pressure (mmHg)					Z=0.167 P=0.868
Min-Max	100-140		100-150		
Mean±SD	124.5±12.8		124.0±12.1		
Diastolic blood pressure (mmHg)					Z=0.447 P=0.655
Min-Max	60-90		60-100		
Mean±SD	76.4±8.6		77.3±9.8		
Temperature (degree)					Z=0.199 P=0.842
Min-Max	36.5-40.0		36.5-38.8		
Mean±SD	37.3±0.8		37.3±0.4		
Respiratory rate (breath/min)					Z=1.717 P=0.086
Min-Max	14-30		10-28		
Mean±SD	21.3±5.4		18.6±4.4		
Heart rate (beat/min)					**Z=2.385 P=0.017***
Min-Max	65-130		60-105		
Mean±SD	91.5±16.0		84.3±9.4		

Z: Mann Whitney test ^{FE}P: Fisher's Exact test X^2: Chi-Square test *significant at P≤0.05

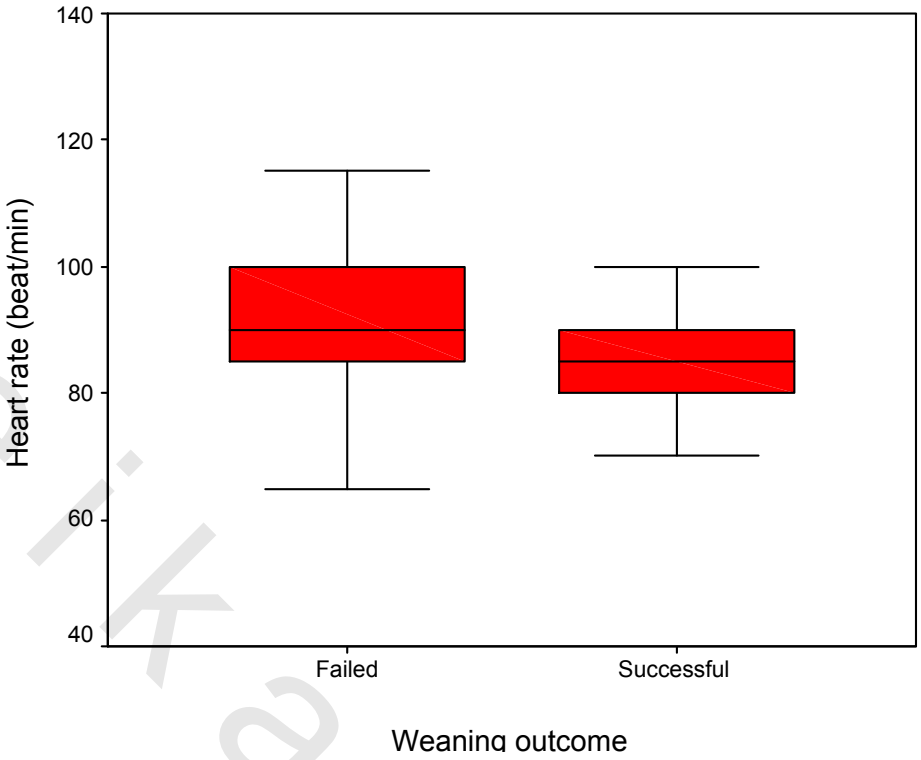

Figure (10): Heart rate in the 2studied groups according to successfulness of weaning trial (p=0.017).

Weaning parameters from mechanical ventilator in the two studied groups (Table 21, Figure 11,12):

Integrative weaning index(IWI) ranged from 56.9-421.2 ml/cmH2O/breaths/min/L with a mean of 148.2±94.7 in group1, while in group2 it ranged from58.1-818.1 ml/cmH2O/breaths/min/L with a mean of 206.6±155.7 with statistical significance between the 2 groups as IWI was significantly higher in patients of group2.(p=0.016)

Respiratory rate was measured on spontaneous mode (PSV) and it ranged from 14-30 breaths/minute with a mean of 21.3±5.4 in group1, while in group2 it ranged from10-28 breaths/minute with a mean of 18.6±4.4 with no statistical significance between the 2 groups.(p=0.086).

Tidal volume was measured on spontaneous mode (PSV) and it ranged from 330-800 ml with a mean of 483.0±149.4 in group1,while in group2 it ranged from280-850ml with a mean of 524.4±143.9 with no statistical significance between the 2 groups.(p=0.185).

Rapid shallow breathing index(RSBI) was measured on spontaneous mode (PSV) and it ranged from23.8-80breaths/min/L with a mean of 46.6±14.2 in group1,while in group2 it ranged from13.3-80 breaths/min/L with a mean of 39.1±15.9 with statistical significance between the 2 groups as RSBI was significantly lower in patients of group2.(p=0.025).

Maximum inspiratory pressure(MIP) was measured on volume control mode and it ranged from-35.5,-25cmH2O with a mean of -27.6±2.3 in group1,while in group2 it ranged from-33,-25.3cmH2O with a mean of -27.3±1.4 with no statistical significance between the2 groups.(p=0.608).

P0.1 was measured on volume control mode and it ranged from2-6 cmH2O with a mean of 3.8±0.9 in group1,while in group2 it ranged from1.5-5 cmH2O with a mean of 3.6±0.8 with no statistical significance between the 2 groups. (p=0.346).

Static compliance was measured on volume control mode and it ranged from 30.0-114.2 ml/cmH20 with a mean of 61.7±20.5 in group1, while in group2 it ranged from 40.0-121.4ml/cmH2O with a mean of 65.1±15. 3 with no statistical significance between the 2 groups.(p=0.351).

Arterial pressure of oxygen(PaO2) ranged from55-238mmHg with a mean of 106.8±46.1 in group1, while in group2 it ranged from57-201mmHg with a mean of 106.2±37.2 with no statistical significance between the 2 groups.(p=0.758). (PaO2 measured on different FiO2 variables).

Arterial pressure of carbon dioxide (PaCO2) ranged from25-72mmHg with a mean of 50.2±12.0 in group1, while in group2 it ranged from33-68mmHg with a mean of 50.3±8.5 with no statistical significance between the 2groups.(p=0.666).

Hypoxaemic index(HI) ranged from 122.2-460.0 with a mean of 241.0±90.8 in group1, while in group2 it ranged from95.0-450.0 with a mean of 232.7±89.7 with no statistical significance between the 2 groups.(p=0.956). (PaO2 measured on different FiO2 variables).

P0.1/maximum inspiratory pressure ratio ranged from 0.07-0.23 with a mean of 0.14±0.04 in group 1, while in group 2 it ranged from 0.05-0.18 with a mean of 0.13±0.03 with no statistical significance between the 2groups.(p=0.667).

Table (21): Ventilatory parameters among the studied COPD patients according to successfulness of weaning from mechanical ventilation

	Failed weaning (n=33)	Successful weaning (n=67)	Significance
Integrative weaning index(ml/cmH2O/breaths/min/L)			**Z=2.401 P=0.016***
Min-Max	56.9-421.2	58.1-818.1	
Mean±SD	148.2±94.7	206.6±155.7	
Frequency(breaths/min)			Z=1.717 P=0.086
Min-Max	14-30	10-28	
Mean±SD	21.3±5.4	18.6±4.4	
Tidal volume(ml)			t=1.334 P=0.185
Min-Max	330-800	280-850	
Mean±SD	483.0±149.4	524.4±143.9	
Rapid shallow breathing index(breaths/min/L)			**t=2.276 P=0.025***
Min-Max	23.8-80.0	13.3-80.0	
Mean±SD	46.6±14.2	39.1±15.9	
Maximum inspiratory pressure(cmH20)			Z=0.513 P=0.608
Min-Max	-35.5 – -25.0	-33.0 - -25.3	
Mean±SD	-27.6±2.3	-27.3±1.4	
P 0.1(cmH2O)			Z=0.942 P=0.346
Min-Max	2.0-6.0	1.5-5.0	
Mean±SD	3.8±0.9	3.6±0.8	
Static compliance(ml/cmH2O)			t=0.936 P=0.351
Min-Max	30.0-114.2	40.0-121.4	
Mean±SD	61.7±20.5	65.1±15.3	
PaO2(mmHg)			Z=0.308 P=0.758
Min-Max	55-238	57-201	
Mean±SD	106.8±46.1	106.2±37.2	
PaCO2(mmHg)			t=0.433 P=0.666
Min-Max	25-72	33-68	
Mean±SD	50.2±12.0	50.3±8.5	
PEEP(cmH2O)			t=0.0 P=1.0
Min-Max	5-5	5-5	
Mean±SD	5±0	5±0	
Hypoxaemic index			t=0.055 P=0.956
Min-Max	122.2-460.0	95.0-450.0	
Mean±SD	241.0±90.8	232.7±89.7	
Ratio P0.1/maximum inspiratory pressure			
Min-Max	0.07-0.23	0.05-0.18	Z=0.43
Mean±SD	0.14±0.04	0.13±0.03	P=0.667

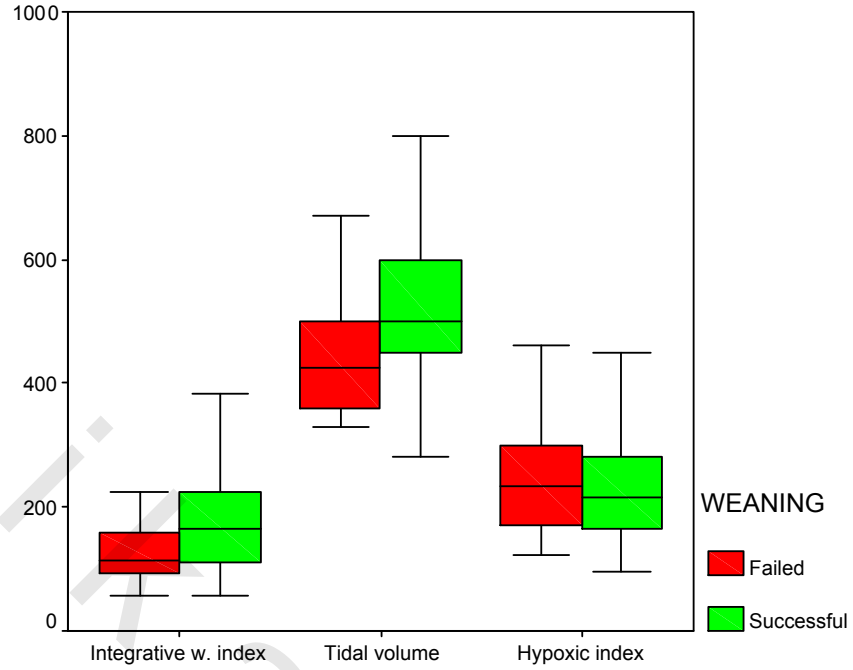

Figure (11): Integrative weaning index(p=0.016), tidal volume(p=0.185) and hypoxaemic index(p=0.956) in the 2 groups according to successfulness of weaning trial.

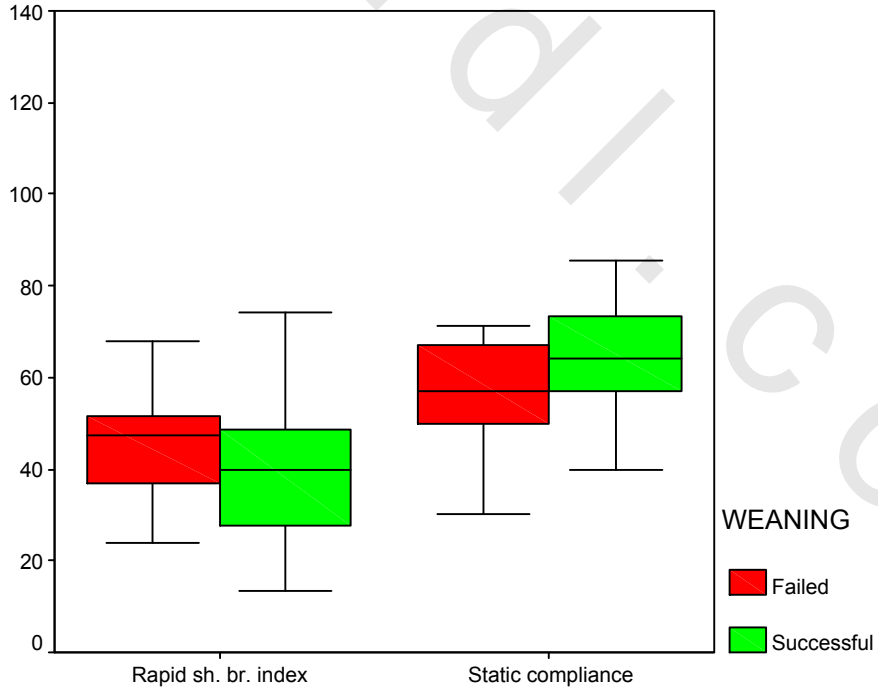

Figure (12): Rapid shallow breathing index(p=0.025) and static compliance(p=0.351) in the 2 groups according to successfulness of weaning trial.

Sensitivity, specificity, positive and negative predictive values and accuracy of statistically significant data in our study:

We compared different statistically significant data in our study according to their sensitivity, specificity, positive and negative predictive values(PPV and NPV) and accuracy. Then ROC curves were drawn to quantitative data according to their specificity and sensitivity. The area under the curve(AUC) was calculated to quantitative data.. Statistically significant data in our study was GCS, heart rate, integrative weaning index (IWI), rapid shallow breathing index(RSBI) and presence of abnormal resistance. Quantitative data in our study were heart rate, integrative weaning index and rapid shallow breathing index, while GCS and presence of abnormal resistance are expressed in the form of number and percentage so, ROC curves and AUC could not be done for them. **(Table 22, Figure 13-15).**

Table (22): Performance of predictors for failed weaning from mechanical ventilation among the studied COPD patient

Outcome	Predictors for weaning	Sensitivity	Specificity	PPV	NPV	Accuracy
Failure	Glascow Coma Scale (score of less than 11)	12.1%	100%	100%	69.8%	71%
	Presence of abnormal resistance	100%	52.2%	50.8%	100%	68%
	Heart rate (beat/min) (cutoff point=84 or more)	75.8%	43.3%	39.7%	78.4%	54%
	Rapid shallow breathing index (cutoff point=33.5 or more)	87.9%	43.3%	43.3%	87.9%	58%
Success	Integrative weaning index (cutoff point=96.0 or more)	83.6%	30.3%	70.9%	47.6%	66%

AUC=0.646, cutoff point=84, sensitivity=75.8%, specificity=43.3%

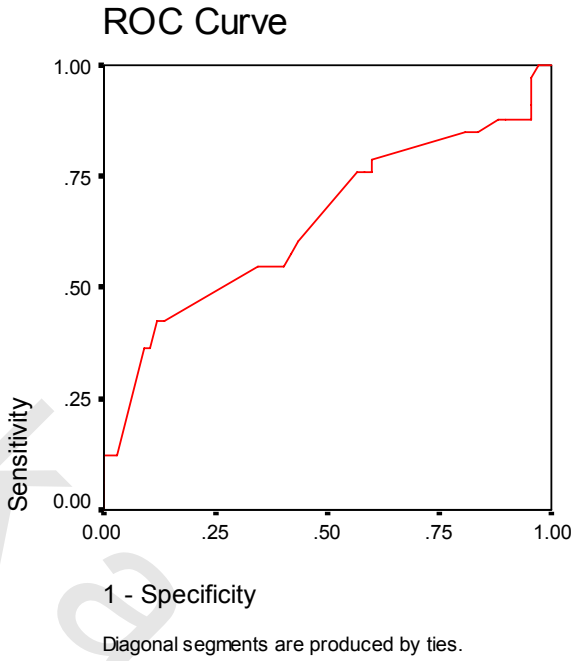

Figure (13): ROC curve for heart rate to predict *failed* weaning

AUC=0.648, cutoff point=96.0, sensitivity=83.6%, specificity=30.3%

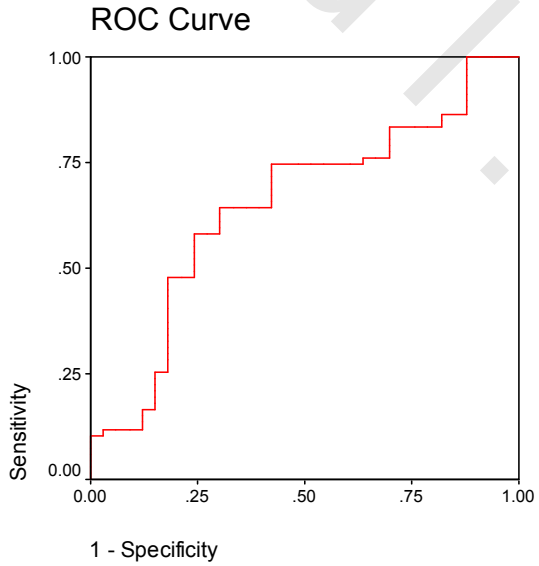

Figure (14): ROC curve for Integrative weaning index to predict *successful* weaning

AUC=0.658, cutoff point=33.5, sensitivity=87.9%, specificity=43.3%

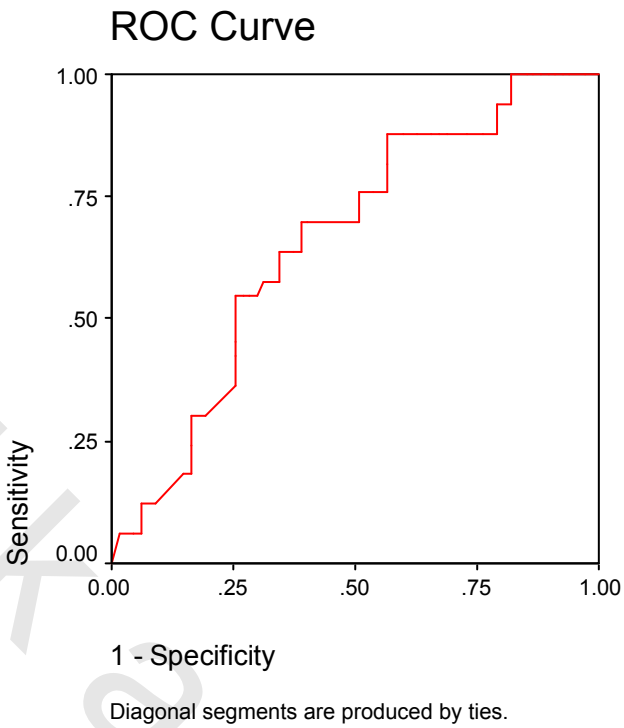

Figure (15): ROC curve for Rapid shallow breathing index to predict *failed* weaning

GCS showed the highest specificity 100%, positive predictive value(PPV)100% and accuracy 71%, while it showed the lowest sensitivity 12.1% and it showed a negative predictive value of 69.8% as a predictor of failure of weaning from MV.

Prescnce of abnormal value of resistance showed the highest sensitivity 100% and NPV 100% and it showed a specificity of 52.2%, PPV 50.8% and accuracy 68% as a predictor of failure of weaning from MV.

Heart rate showed the lowest PPV 39.7%, accuracy 54% and AUC 0.646 and it showed a sensitivity of 75.8%, specificity 43.3% and NPV 78.4% as a predictor of failure of weaning from MV. A cutoff value of 84 beats/min or more was identified to predict failure of weaning fromMV.

Rapid shallow breathing index(RSBI) showed a sensitivity of 87.9%, specificity 43.3%, PPV43.3%,

NPV 87.9% and accuracy 58% and it showed the highest AUC 0.658 as a predictor of failure of weaning from MV. A cutoff value of 33.5 breaths/min/Lor more was identified to predict failure of weaning fromMV.

Integrative weaning index(IWI) showed the lowest specificity 30.3% and NPV 47.6% and it showed a sensitivity of 83.6%, PPV70.9%, accuracy 66% and AUC 0.648 as a predictor of successful weaning from MV. A cutoff value of 96 ml/cmH2O/breaths/min/L or more was identified to predict successful weaning from MV.

Effect of use of non invasive PSV in difficult weaning patients:

Non invasive PSV was tried on the group of failed weaning trial (group1)whose number of patients was 33 to detect the effect of non invasive PSV as a weaning method and we found that non invasive PSV trial was successful in 17 patients(51.5%), while it failed in 16 patients(48.5%).**(Table 23, Figure 16).** PSV with pressure support 15 cmH2O was given to the patients. Patients were put on intermittent non invasive ventilation for 2 hours with rest for 1hour with overnight non invasive ventilation. As a comparison between the 2 groups, weaning duration was 4.5 +/-2.4 days in the group who succeeded in the non invasive trial versus 7.1+/-2.2 days in the group who failed in the non invasive trial(as this group has to be returned to invasive ventilation).

Table (23): Effect of use of non-invasive PSV in COPD patients with difficult weaning from mechanical ventilation

Effect of use of non-invasive PSV	Failed weaning (n=33)	
	No.	%
Failed	16	48.5
Successful	17	51.5

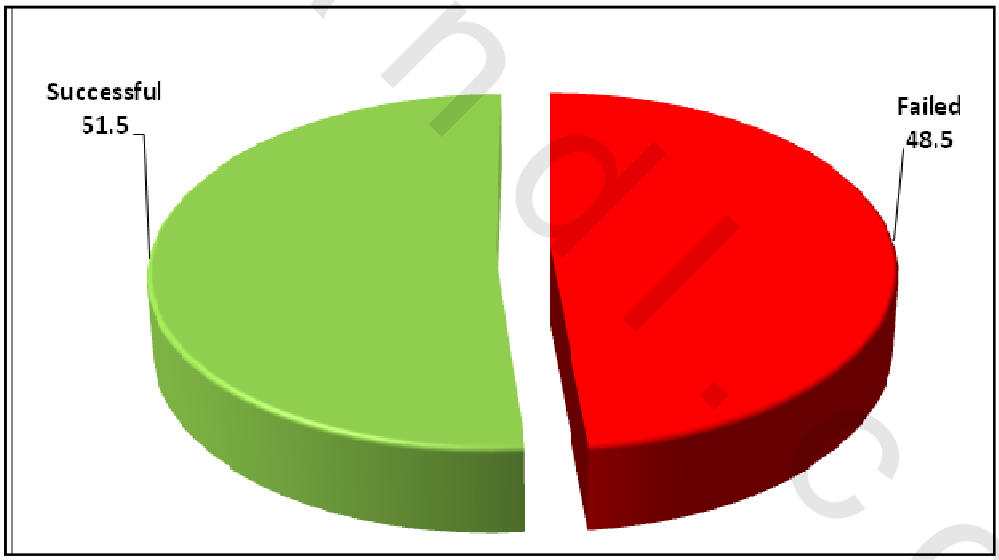

Figure (16): Effect of use of non-invasive PSV in COPD patients with difficult weaning from mechanical ventilation