Non Invasive Mechanical Ventilation in Acute Respiratory Failure.

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Abstract

Objectives : Acute respiratory failure is a common clinical condition encountered in emergency department and intensive care units (ICU). The use of NIV during acute respiratory failure (ARF) has increased since the late **1990**s for all diagnoses, including patients with and without chronic obstructive pulmonary disease (COPD). The use of NIV is associated with reduced tracheal intubation, duration of hospitalization, and mortality.

Aim of the work: To evaluates the effectiveness of Non invasive ventilation in the management of acute hypercapnic respiratory failure of different aetiologies as acute exacerbation of COPD, and acute hypoxemic respiratory failure.

Design of study: Prospective, Observational, Single-center study.

Patients and Methods: 103 patients with acute respiratory failure (ARF) were admitted to Respiratory Intensive Care Unit (RICU) of Chest Department at Assuit University Hospital and received non invasive ventilation, in all patients demographic , clinical and functional parameters were recorded including the cause of acute respiratory failure . NIV success was defined as clinical and gasometric improvement and discharge to regular ward, while need of endotrachial intubation was considered NIV failure.

Results: one hundred and three patients with mean age **59.1** years were included in the study,**62 (60%)** were males and **41(40%)** were females, Baseline pH, Pa**CO2** and Pa**O2** were **7.51±0.09, 72±21.63**and **59.41±20.34** mmHg respectively.

The success rate with NIPPV was **69%,** with **71**of **103** patients weaned successfully. Significant improvements were observed at **2** hour,**24-48hrs** following institution of NIPPV in pH **(7.34±0.08, P < 0.02),** PaCO2 **(62.87±17.94,** P < **0.002)** and PaO**2(74.30±14.45** P < **0.001).**These improvements maintained (within **24** hrs) postweaning from the ventilator, pH **7.39±0.04,** PaCO**2 56.76±10.18,** PaO**2 73.28±10.04 (P < 0.001).**

Duration of mechanical ventilation , length of ICU stay were significantly longer in NIV failure group **(p<0.0001).** , the complications and death were significantly higher in NIV failure group (p<**0.00001),**(p<**0.0001).**

Serum albumin level was significantly lower in the NIV failure group (p<**0.01).**

Conclusion: The use of NIV in patients presenting with ARF of diverse etiology has shown to be effective in the improvement of clinical and gasometric parameters, in preventing endotracheal intubation, and improving overall survival .

Keywords: Acute respiratory failure, noninvasive ventilation, COPD.

Introduction

Respiratory failure **(RF)** is a failure respiratory system in one or both of its gas exchange functions: oxygenation and/or elimination of carbon dioxide. It's defined by **PaO2<60** mmHg **(1).** Acute respiratory failure is a common clinical condition encountered in emergency department and intensive care units **(ICU) (2).** The utilization of noninvasive mechanical ventilation **(NIV**) has become one of the most important developments in the field of

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mechanical ventilation over the past two decades. The use of **NIV** during acute respiratory failure **(ARF)** has increased since the late **1990s** for all diagnoses, including patients with and without chronic obstructive pulmonary disease**(COPD)(3).** Non-invasive positive pressure ventilation **(NIPPV)** works by providing pressure support that gives ventilatory assistance during inspiration, allows respiratory muscles to work less, increases the volume inspired per minute and improves arterial blood gas **(ABG)** levels **(4).** The use of **NIV** is associated with reduced tracheal intubation, duration of hospitalization, and mortality**.(5)** Most experience with noninvasive ventilation has accrued with either bilevel positive airway pressure**(BiPAP)** or pressure support ventilation, less so with volume ventilation and continuous positive airway pressure **(CPAP),** which is infrequently used as a mode of ventilatory support**(6).**

Aim of the work:

The study evaluates

- Task of Non invasive ventilation in management of acute hypercapnic respiratory failure of different aetiologies as acute exacerbation of **COPD.**
- The effectiveness of **NIV** in acute hypoxemic respiratory failure.

Patients and Methods:

The present prospective, observational, single-center study was conducted on **103** patients with acute respiratory failure **(ARF) 62** males**(60%)** and **41** females **(40%)** their age ranged from **20** to **88** years with mean age **59.1** years.All patients were admitted to Respiratory Intensive Care Unit **(RICU)** of Chest Department at Assuit University Hospital during the period from January **2016** to December **2016** and were evaluated for the use of Non Invasive Ventilation **(NIV)** in acute Respiratory failure

Inclusion criteria:

Patient with acute respiratory failure with either:

-Acute Hypoxemic respiratory failure **(Type 1)** defined by :

a Pa**O2** of **<60** mmHg or Pa**O2** to Fi**O2** ratio**<200** with a normal or low PaC**O2**.

-Acute on top of chronic Hypercapnic respiratory failure(Type **2)** defined by:

a PH**<7.35** , PaCO**2 of >50** mmHg and a Pa**O2** of **<60** mmHg, HCO**3 >26** mmol/L

Exclusion criteria: The absolute contraindications for NIV

1. Respiratory or cardiac arrest.
2. Haemodynamic instability **(Systolic B.P<90mmHg and/or HR< 50 beat/min)** despite fluid challenge or use of vasopressors agents,unstable angina, acute MI, serious arrythmia.
3. Coma or seizure disorders**.**
4. Agitation need sedation.
5. copcious secretions that unable to be spontaneously cleared from the airway with high risk of aspiration.
6. facial trauma, burns, or facial surgery.

All admitted patients were subjected to:

1-Thorough History taking: from patients or their relatives.

Including: age, sex, occupation ,smoking status, underlying comorbidities , history of previous **ICU** admission.

2-Thorough Clinical Examination including:

-General examination :

Heart rate, respiratory rate ,Blood pressure(systolic and diastolic blood pressure) and temperature.

-chest examination , abdominal and cardiac examination

3-Investigations:

1. Chest radiograph: a- x-ray posteroanterior view , b-Computed tomography when needed.

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2. chest ultrasonography (US) when needed

3. Arterial Blood Gases analysis: including (PH,pa**O2** ,paC**O2** ,Sa**O2**)

4.other investigations: complete blood count (CBC), Blood chemistry including liver function tests ,renal function tests, serum electrolytes e.g. **Na+, K+, Cl, C a++.**

All patients were mechanically ventilated through an ICU ventilator using a dedicated NIV mode (Bennet 840 Ventilator system, Hamilton-GS, Puritan, Engström Carestation).The ventilator was connected with conventional ventilator tubing to a clear, oronasal face mask (PerformaTrak, Philips Respironics) the masks were used in all patients with suitable adult sizes. The head of the bed was raised to an angle of 45° and was kept elevated during NIV to reduce the risk of aspiration. Pressure Support Ventilation (PSV) associated with Positive end-expiratory pressure(PEEP) (CPAP and PS) is the used mode of support during NIV.

NIV setting: After the mask was attached to the patient, pressure support was adjusted and increased from **5** up to **20** cm H**2O** to obtain an tidal volume of **5-7** mL/kg of predicted body weight, a respiratory rate lower than **25** breaths per minute, attenuation of respiratory accessory muscle activity and achievement of patient's comfort. Positive endexpiratory pressure (PEEP) was initiated at **5** cm H**2O** and could be increased in steps of **2** to **3** cm H**2O** up to **15** cm H**2O.** The fraction of inspired oxygen Fi**O2** was titrated to maintain the arterial oxygen saturation Sp**O2 88-92%** in type II respiratory failure and **92-95%** in type I respiratory failure. NIV was continuously applied, with every **4–6** h of continuous NIV, patients had periods of ''rest'' **(20–30 min)** off the mask while receiving supplemental oxygen ,nebulizer, or dietary supplements with a minimal duration of 16 h per day until a significant clinical improvement of the patient occurred. If effective, gradual reduction of the duration of **NIV** could be then considered.

Monitoring

The following data were recorded for all patients:

-Clinical parameters (respiratory rate, heart rate, blood pressure,)

-Gasometric parameters (**PH,PCO2,PO2,SaO2%,HCO3)**

Before NIV initiation. ,Two hours (2hrs) and then **24- 48**hours after initiation of NIV. And **24** hrs after weaning.

Weaning from NIV

patients were weaned from NIV when the following criteria fulfilled including

•RR<**24**/min

•HR<**110**/min

•PH>**7.35**

•O2sat.≥90% on Fio2≤ 40%

The study primary outcome include either success of treatment with NIV or failure of treatment with NIV .

Successful treatment with NIV was defined according to objective and subjective criteria that reflect the patient's improvement following NIV initiation thereby avoiding intubation in these patients.

The objective criteria included

•A decrease of **≥20%** in respiratory rate compared with spontaneous breathing,

•An improvement in arterial blood gases with PH **>7.35**

•A decrease in PaC**O2** of **≥15%** compared with spontaneous breathing

•Maintaining a Sa**O2 ≥90%.**

The subjective criteria included improvement of the patient regarding both dyspnea and comfort.

Failure is defined as failure to achieve the previous criteria of successful treatment at any point of the study or the need for intubation.

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Failure was classified into:
a) Immediate failure (within1 hour)
b) Early (**1-48** hours)
c) Late failure (after **48** hours)
We also recorded Duration of mechanichal ventilation, ICU and hospital lengths of stay, the complications associated with noninvasive ventilation, ICU and hospital mortality .

Statistical analysis :

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS-version **20).** Results were presented as a mean± SD for quantitative data and as frequency and percentage for qualitative data. For comparison between two groups of quantitative data, independent sample T-test was used.For comparison between more than two groups of quantitative data, ANOVA test was used (as for comparison between clinical and gasometric parameters over the **48** hours of the duration of the study follow up). Chi-suqare test was applied for for qualitative data to compare between groups.Differences were considered significant when P value **<0.05.** To determine the optimum cut level that best predict outcome, the data were analyzed using the receiving operating characteristic curve (ROC) curve.

Results

Table (1): Demographic characteristics of studied population:

Variables	NO	(%)
Age		
Mean ± SD)	**59.1±13.5**	
Median (range)	**60 (20-88)**	
Gender		
Females	**41**	**(39.81%)**
Males	**62**	**(60.19%)**
Smoking status		
Current	**25**	**(24.27%)**
Ex-smoker	**31**	**(30.10%)**
Non smoker	**47**	**(45.63%)**
Smoking index		
Mild	**7**	**(6.80%)**
Moderate	**5**	**(4.85%)**
Heavy	**44**	**(42.72%)**

one hundered and three (**103)** patients with acute respiratory failure (ARF) admitted to Respiratory Intensive Care Unit of Assiut university hospital with a mean age of **59.1 ±13.5** years, ranges from **20** to **88** years old were enrolled in the study and the majority were males **(60.19%).**

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Table(2): Types of acute respiratory failure and Diagnosis of studied population

Variables	No	(%)
Type of acute respiratory failure		
Acute Hypoxemic	**10**	**(9.71%)**
Acute on top of chronic Hypercapnic	**93**	**(90.29%)**
Diagnosis and causes of ARF		
ARDS	**1**	**(0.97%)**
Bronchial asthma	**5**	**(4.85%)**
Bronchiectasis	**2**	**(1.94%)**
COPD	**48**	**(46.60%)**
COPD with CAP	**9**	**(8.74%)**
IPF	**5**	**(4.85%)**
IPF with CAP	**1**	**(0.97%)**
IPF with PE	**1**	**(0.97%)**
Kyphoscoliosis	**2**	**(1.94%)**
OHS	**7**	**(6.80%)**
OHS with CAP	**4**	**(3.88%)**
Overlap syndrome	**13**	**(12.62%)**
Overlap syndrome with CAP	**2**	**(1.94%)**
Pneumonia	**3**	**(2.91%)**

ARF: acute respiratory failure ,ARDS: acute respiratory distress syndrome, COPD:chronic obstructive pulmonary disease, CAP:community acquired pneumonia, IPF:idiopathic pulmonary fibrosis, PE:pulmonary embolism, OHS: obesity hypoventilation syndrome,Overlap syndrome: chronic obstructive pulmonary disease& obstructive sleep apnea

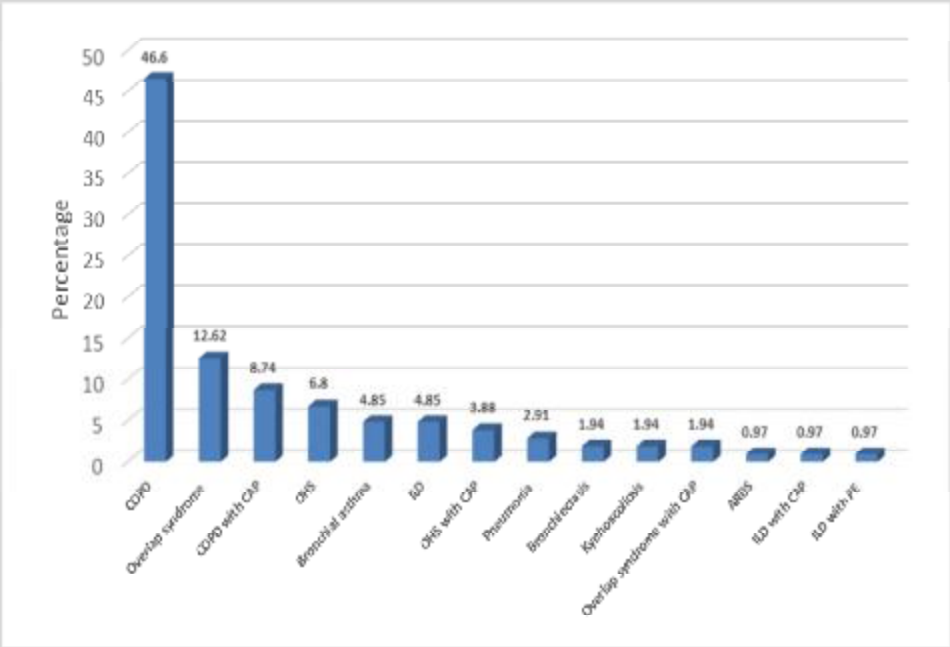

Fig.(1) : Diagnosis of studied population

As regard the type of acute respiratory failure **(ARF) (93)** out **of (103)** patients were presented with acute on top of chronic hypercapnic **RF** which represent the higher percentage **(90.29%)** and **(10)** patients were presented with acute hypoxemic **RF** and as regard diagnosis of the underlying causes of acute respiratory failure the acute

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exacerbation of **COPD** represent the higher percentage **(46.60%)** as illusterated in **Table (2), Fig (1) .**

Table(3): clinical parameters of studied population before and after NIV:

clinical parameters	Before NIV	After 2 hours	After 24-48 hours	P1	P2	P3
Respiratory rate Mean	**30.86±7.59**	**24.69±5.47**	**23.16±4.92**	***<0.0001**	***<0.0001**	**0.23**
Heart rate Mean	**107.12±17.38**	**99.99±14.79**	**99.24±14.41**	***0.003**	***0.001**	**1.00**
Systolic blood pressure Mean	**122.91±17.29**	**120.10±17.79**	**115.34±11.41**	**0.61**	***0.002**	**0.10**
Diastolic blood pressure Mean	**76.31± 10.19**	**74.98± 10.42**	**73.08±7.94**	**0.25**	**0.05**	**1.00**
Temperature Mean	**37.40± 0.47**	**37.32±0.24**	**37.31±0.36**	**0.36**	**0.20**	**1.00**

- **p1 compared before NIV & after 2hrs**
- **p2 compared before NIV & after 24-48hrs**
- **p3 compared After 2 hours & after 24-48h**

In Table (3) the clinical parameters of studied patients as respiratory rate ,heart rate , systolic **&** diastolic blood pressures and temperature were illustrated: before **NIV,** 2hrs , **24-48** hrs after **NIV**, the results show a significant reduction of **RR,HR,SBP** over time after use of **NIV .**

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Table (4): Gasometric parameters of studied population before and after NIV use:

Gasometric parameters	Before NIV	After 2 hours	After 24-48 hours	Post weaning	P1	P2	P3	P4	P5	P6
PH Mean Median	7.51±0.09 7.3 (7.12-7.53)	7.34±0.08 7.34 (7.17-7.57)	7.39±0.09 7.38 (7.17-7.83)	7.39±0.04 7.38 (7.34-7.51)	*0.02	*<0.0001	*<0.0001	*0.001	*0.001	1.00
PCO2(mmHg) Mean Median	72±21.63 72 (25-113)	67.36±18.07 68 (27-115)	62.87±17.94 66 (22-115)	56.76±10.18 59 (32-79)	0.39	*0.002	*<0.0001	0.45	*0.001	0.17
PO2(mm Hg) Mean Median	59.41±20.34 57 (21-142)	74.30±14.45 73 (46-120)	73.69±14.31 71 (37-168)	73.28±10.04 70 (54-95)	*<0.0001	*<0.0001	*<0.0001	1.00	1.00	1.00
SaO2(%) Mean Median	82.35±1.38 86 (40-99)	92.30±8.98 93 (85-99)	92.85±6.67 94 (56-100)	93.17±2.21 93 (87-97)	1.00	1.00	*<0.0001	1.00	*<0.0001	*<0.0001
HCO3(mEq/L) Mean Median	35.32±8.22 36 (18-60)	36.03±8.39 36 (17-57)	35.93±8.10 37 (18-53)	35.38±9.34 36 (20-93)	1.00	1.00	1.00	1.00	1.00	1.00

- **p1 compared before NIV & after 2hrs,**
- **p2 compared before NIV & after 24-48hrs**
- **p3 compared before NIV & post weaning**
- **p4 compared after 2hrs & after 24-48hrs**
- **p5 compared after 2hrs & post weaning**
- **p6 compared after 24-48hr& post weaning**

Table (4), demonstrate the gasometric parameters(**PH,PaCO2,PaO2,SaO2,HCO3)** of the study patients and show a highly significant improvement **2hrs & 24-48hrs** after **NIV use &** postweaning from **NIV**.

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Table (5):Outcome of studied populations as regard the success and failure of NIV.

OUTCOME	NO.	%
SUCCESS	71	68.93%
FAILURE	32	31.07%
Immediate Failure	4	3.88%
Early Failure	10	9.71%
Late Failure	18	17.48%

Table 5 show the outcome of the studied populations as regard the success and failure of **NIV; NIV** success occurred in **71** out of **103** patients and the success rate was **(68.93%),NIV** failure occurred **in 32** patients**(31.07%)** that needed intubation and invasive mechanical ventilation ,the patients with failed **NIV** were divided according to the timing of the **NIV** failure into immediate failure that occurred in less than **1hr in 4** patients**(3.88%),** early failure occurred during the first **24** hrs **in 10** patients**(9.71%)** and Late failure occurred after more than **48** hrs in **18** patients**(17.48%)** that represent the higher number of patients with **NIV** failure .

Table (6): Comparison between NIV success and NIV failure as regards Duration of mechanical ventilation ,Length of stay in ICU & Hospital , Complications and Death.

Variables	Success N=71	Failure N=32	P-value
Duration of mechanical ventilation Mean Median	 5.40±6.33 3 (1-45)	 13.40±10.11 11 (1-50)	 *<0.0001
Length of stay in ICU in days Mean Median	 7.85±7.32 5 (1-45)	 17.34±17.22 11.5 (1-90)	*<0.0001
Length of stay in Hospital in days Mean Median	 13.85±9.86 11 (3-60)	 20.00±17.48 15 (2-90)	 0.09
COMPLICATIONS No Yes	 46 (64.79%) 25 (35.21%)	 4 (15.5%) 28 (87.50%)	*<0.00001
Death No Yes	 68 (95.77%) 3 (4.23%)	 8 (25.00%) 24 (75.00%)	*<0.0001

The mean duration of mechanical ventilation , and the mean length of **ICU** stay were significantly lower in **NIV** success group in comparison to the **NIV** failure group, the mean length of hospitalization was longer in the **NIV** failed patients**(20.00±17.48 days)** but statistically not significant, the complications and the mortality rate was significantlly higher in the **NIV** failure patients compared to the **NIV** success patients(**p < 0.0001) (Table 6).**

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Table (7): Comparison between the NIVsuccess and NIVfailure as regards gasometric parameters:

ABG	Before NIV	After 2 hours	After 24-48 hours	Post weaning	P1	P2	P3	P4	P5	P6
PH Failure Success	7.33±0.09 7.31±0.08	7.32±0.10 7.35±0.07	7.37±0.13 7.40±0.07	7.39±0.04	1.00 *<0.0001	0.42 *<0.0001	*<0.0001	0.49 *0.002	*0.004	1.00
P value	0.29	0.13	0.14							
PCO2 Failure Success	65.09±20.84 75.11±21.40	68.09±19.18 67.03±17.36	67.31±22.94 61.06±15.27	56.76±10.18	1.00 *0.02	1.00 *<0.0001	*<0.0001	1.00 0.20	*0.002	0.74
P value	*0.03	0.78	0.11							
PO2 Failure Success	56.59±18.40 60.69±21.16	71.50±15.22 75.56±14.01	73.89±22.67 73.61±9.15	73.28±10.04	*0.006 *<0.0001	*0.002 *<0.0001	*<0.0001	1.00 1.00	1.00	1.00
P value	0.35	0.19	0.93							
SO2 Failure Success	80.75±15.92 83.07±12.90	91.78±3.69 93.69±3.21	90.00±11.29 94.01±2.71	93.17±2.21	*0.001 1.00	*0.007 1.00	*<0.0001	1.00 1.00	*<0.0001	*<0.0001
P value	0.44	0.09	*0.006							
HCO3 Failure Success	32.34±7.14 36.66±8.36	35.16±7.83 36.42±8.65	34,90±7.59 36.35±8.32	35.38±9.34	0.42 1.00	0.57 100	1.00	1.00 1.00	1.00	1.00
P value	*0.01	0.48	0.42							

- **P value compare success & failure**
- **p1 compared before NIV & after 2hrs**
- **p2 compared before NIV & after 24-48hrs**
- **p3 compared before NIV & post weaning**
- **p4 compared after 2hrs & & after 24-48hrs**
- **p5 compared after 2hrs & post weaning**
- **p6 compared after 24-48hrs & & post weaning**

In Table (7), There is no significant differences between the **NIV** success and **NIV** failure groups as regard the baseline gasometric parameters**(PH,PaO2andSaO2)** ,while there is a significant increase in the baseline **PaCO2 , HCO3** in the success group versus the failure group.

A highly significant improvement in the parameters **PH,PaO2,PaCO2** in the success group **2**hrs after **NIV** and during **24-48hrs of NIV**, and there is a highly significant improvement in the **SaO2** postweaning.

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In the **NIV** failure patients there is no significant change in the **PH , PaCO2 2hrs,24-48**hrs after **NIV,** there is initial significant improvement **in PaO2** and **SaO2**,and incomparing the gasometric parameters after **2hrs** to **24-48hrs of NIV** there is no significant change in all parameters including **PH,PaCO2,PaO2,SaO2,HCO3**.

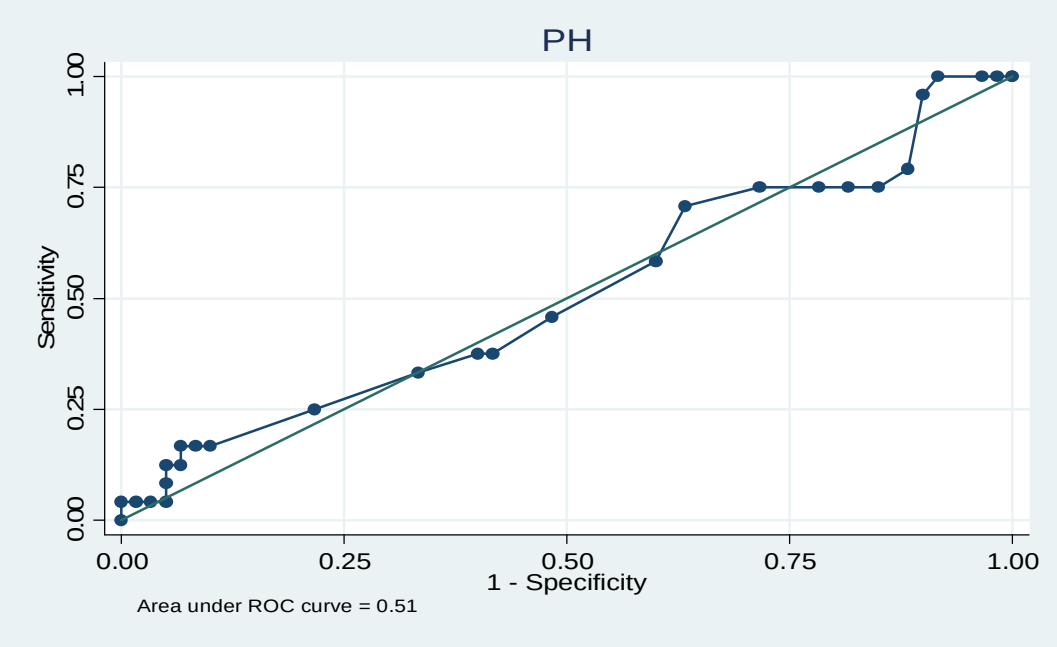

Fig (2): Area under receiving operating characteristic curve for PH to predict failure The optimum cut off level was ≤7.22 with 25.0% sensitivity and 85.0% specificity, with an AUC of 0.51 (CI [0.38-0.60]).

In the present study the optimum cut off level of **PH** was **(7.22)** that predict the **NIV** failure outcome with more opportunity for failure below this level, it was determined using the Receiving Operating Characteristic **(ROC)** curve **(Fig 2).**

Table (8): Comparison between NIV Success and NIV Failure as regards the blood count and the electrolytes and the serum albumin level.

Variables	Success N=71	Failure N=32	P-value
WBCs	11.09±5.22	12.20±7.32	0.68
HB	13.11±1.97	12.30±2.54	0.09
HT	44.14±7.52	40.50±7.46	*0.02
PLTs	248.86±102.16	260.38±113.83	0.84
NA	139.31±5.66	137.91±6.06	0.26
K	4.75±0.64	4.84±0.80	0.53
Mg	2.34±0.44	2.54±1.75	0.52
Ca	9.07±0.74	8.73±0.71	0.07
Albumin	3.09±0.52	2.77±0.67	*0.01

WBCs;white blood cells, HB;heamoglobin %, HT: hematocrite value,PLTS:platelets,NA:sodium,K:potassium,Mg:magnisium,Ca:calcium

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As regard the laboratory investigations, albumin level and **HT** were significantly lower in the **NIV** failure patients and the level of the calcium , sodium and **HB%** were also lower in the failure patients but statistically not significant**.(Table 8).**

Table (9): The clinical parameters changes before and after NIV in the study patients as regard the type of acute respiratory failure(Hypoxemic and Hypercapnic).

Clinical parameters	Before NIV	After 2 hours	After 24-48 hours	P1	P2	P3
Respiratory rate Hypoxemic Hypercapnic	 43.60±9.07 29.49±6.03	 30.7±7.60 24.04±4.82	 27.50±7.14 22.67±21.75	 *0.004 *<0.0001	 *<0.0001 *<0.0001	 1.00 0.22
Heart rate Hypoxemic Hypercapnic	 132.4±25.73 104.41±13.90	 112.2±13.38 98.68±14.39	 107.00±13.90 98.37±14.28	 0.07 *0.02	 *0.02 *0.01	 1.00 1.00
Systolic blood pressure Hypoxemic Hypercapnic	 122.0±20.44 123.01±17.05	 119.00±12.87 120.22±18.30	 108.00±6.32 116.17±12.09	 1.00 0.71	 0.12 *0.01	 0.30 0.27
Diastolic blood pressure Hypoxemic Hypercapnic	 77.00±12.52 76.24±9.99	 74.0.00±11.78 73.98±10.34	 68.00±4.21 73.65±8.07	 1.00 0.32	 0.18 0.21	 0.60 1.00
Temperature Hypoxemic Hypercapnic	 37.81±0.91 37..36±0.37	 37.44±0.28 37.31±0.24	 37.68±0.76 37.26±0.25	 0.75 0.05	 1.00 0.11	 1.00 0.93

- **p1 compared before NIV & after 2hrs.**
- **p2 compared before NIV & after 24-48hrs.**
- **p3 compared after 2hrs & after 24-48hrs.**

In Table (9), show a significant improvement in the clinical parameters**(the respiratory rate and the heart rate)** in the both types of acute respiratory failure **(the hypoxemic and the hypercapnic)** after **NIV (2hrs and 24-48hrs).**

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Table (10): The Gasometric parameters changes before and after NIV in the study patients as regard the type of acute respiratory failure.

gasometric parameters:	Before NIV	After 2 hours	After 24-48 hours	Post weaning	P1	P2	P3	P4	P5	P6
PH Hypoxemic Hypercapnic	7.44±0.5 7.3±0.76	7.44±0.06 7.34±0.08	7.43±0.06 7.38±0.09	7.40±0.04 7.39±0.05	1.00 *0.006	1.00 *<0.0001	1.00 *<0.0001	1.00 *<0.0001	1.00 *<0.0001	1.00 1.00
PCO2 Hypoxemic Hypercapnic	35.2±7.71 75.96±18.70	37.10±11.55 70.61±15.45	39.10±10.99 65.51±16.58	36.17±3.18 58.66±8.32	1.00 0.13	1.00 *<0.0001	1.00 *<0.0001	1.00 <0.17	1.00 *<0.0001	1.00 *0.046
PO2 Hypoxemic Hypercapnic	46.30±12.81 60.83±20.54	78.30±20.15 73.87±13.77	79.3±13.34 73.07±14.34	84.17±8.61 72.27±9.61	*<0.0001 *<0.0001	*<0.0001 *<0.0001	*<0.0001 *<0.0001	1.00 1.00	1.00 1.00	1.00 1.00
SO2 Hypoxemic Hypercapnic	79.60±15.08 82.65±13.80	94.00±3.97 93.00±3.41	95.80±2.39 92.5±6.92	95.33±0.52 92.96±2.20	0.93 1.00	0.66 1.00	*<0.0001 *<0.0001	1.00 1.00	*<0.0001 *<0.0001	*<0.0001 *<0.0001
HCO3 Hypoxemic Hypercapnic	23.50±4.52 36.59±7.49	24.3±5.93 37.29±7.62	26.30±6.18 37.000±7.59	25.00±3.34 36.34±9.14	1.00 1.00	1.00 1.00	1.00 1.00	1.00 1.00	1.00 1.00	1.00 1.00

p1 compared before NIV & after 2hrs,
p2 compared before NIV & after 24-48hrs,
p3 compared before NIV & post weaning,
p4 compared after 2hrs &after 24-48hrs,
p5 compared after 2hrs & & post weaning, ,
p6 compared after 24-48hrs & & post weaning

Table (10); demonstrate the changes in the gasometric parameters **(PH,PaCO2,PaO2,SaO2%)** before and after **NIV** in the acute Hypoxemic and hypercapnic patients. In patients with acute hypoxemic RF there is a highly significant improvement of the **PaO2** and the **SaO2% (p<0.0001).**In patients with acute hypercapnic RF there is a highly significant improvement of **PH,PaCO2,PaO2** and **SaO2% (p<0.0001).**

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Discussion

The use of noninvasive ventilation **(NIV)** in critically ill patients has dramatically increased**(7)** . The recent increase in the use of **NIV** in the critical care units has been motivated by the desire to minimize complications of invasive ventilation. The use of **NIV** in treating of acute respiratory failure with diverse etiology is now supported by randomized controlled trials and meta-analysis **(5,8,10,11,13)** In these studies, **NIPPV** was associated with a reduced need for invasive **MV,(5,8,10)** decreased mortality**(10-12)**and shorter length of hospital stay**.(8)**

This study included **103** patients with a mean age of **59.1 ±13.5** years, **62** males**(60%)** and **41** females **(40%)** admitted to respiratory intensive care unit of chest department of Assuit university hospital presented with acute respiratory failure that were managed by non invasive positive pressure ventilation, as regard the causes of **ARF** the study include different causes including acute exacerbations of **COPD** which represent **55.33%** of causes, and this is agree with randomized controlled trials and meta-analyses that support the use of **NIPPV** in the management of acute exacerbations of **COPD,** as well as ARF of other etiology**(8).** According to the type of respiratory failure the present study included **93 (90.29%)** patients presented with hypercapnic **RF** and **10 (9.71%)** patients presented with hypoxemic RF. The hypercapnic patients formed a significant proportion of patients in our study. Of these, **57** patients were diagnosed to have **COPD** .

This current study reports a success rate for **NIV** in **69%** of study patients **(71 out of 103 patients).** These results are consonant with previously published studies reporting success rates **50–80%** with **NIV** for acute respiratory failure **(5,8-11).**

High success has been described with **NIPPV** in previous studies of patients presenting with hypercapnic respiratory failure . Brochard et al. **(5),** observed a success rate of **74%** with **NIPPV** in hypercapnic patients . Martin and colleagues reported also a success rate of **78%** in the subgroup of hypercapnic patients **(n = 32) (13) .**

In this study, the clinical improvement of patients on **NIV** was confirmed by improvements in the physiological variables including **RR, HR ,BP** within first two hours of application. There was also a significant improvement in the average **PH, PaCO2,** and **PaO2** levels within hours of application of **NIV.** These improvements are similar to those published in a literature in a similar population of patients**(10-15).**

The current study showed that **31%** of the patients demonstrated **NIV** failure which agree with other rates reported in other studies**(9,16)** that showed **NIV** failure rates between **7%** and **62.5%.** The failure group had significantly longer duration of mechanical ventilation **,ICU** and hospital length of stay and had significantly higher complications and mortality rate. In this study the success group included only **25** patients had complications while 46 had no complications in which that results was highly significant in comparison to the failure group in which **28** out of **32** patients had complications **(p value = 0.00001)**and this in agreement with Girou et al **(22)** and Gay **(23)** in which **NIV** reduces by three to five times the risk of pneumonia associated with **IMV,** especially in immunosuppressed patients and those with comorbidities.

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Our study found a PH of **7.22** was a cut-off point in determining success or failure with more opportunity for failure below this level , this was similar to some centres describe that the most beneficial effect is obtained at level of **PH** less than **7.30(14),** while some centres report success at a worse PH value like **7.25** and less**(18)**, even **7.13(19).**

The present study results as regard laboratory investigations in comparison between success and failure groups show a significant lower level of serum albumin in the failed group**(p = 0.01).** Vitacca et al **(20)and Boosalis et al.,(21)** reported similar conclusions in a study of **39 COPD** patients. They found that malnourished patients, estimated by anthropometry, had higher risk of having poor outcome and increased need of **MV**

In the current study, the survivors percentage of studied population was **74%,** the mortality rate of studied population was **26%** included **23% ICU** mortality and **3%** hospital mortality .The mortality rate was highly significantly higher in the **NIV** failed group **(75.00%)** in comparison to the **NIV** success group **(4.23%)(p value < 0.0001).** this was similar to Singh et al.,(**2006)** reported that in patients with acute respiratory failure, associated with **NIV** failure show increased mortality**(24).**

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Conclusion

The use of noninvasive ventilation **(NIV)** in patients with acute respiratory failure has shown to be effective in the relief of dyspnea, the improvement of vital signs and gas exchange, in preventing endotracheal intubation, and improving overall survival.

Monitoring of patients closely is necessary to evaluate treatment responsiveness and to facilitate endotracheal intubation if **NIV** fails.

As a predicted parameter of **NIV** failure; PH of **7.22** was a cut-off point .

Conflict of interest

We have no conflict of interst to declare

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