EVALUATION OF NASAL OPTIFLOW DEVICE IN MANAGEMENT OF COPD PATIENTS IN ACUTE EXCERBATIONS

Thesis

Submitted for Partial Fulfillment of the Master Degree in Chest Diseases

Presented by

Nasra Ahmed Hussein Mohammed

M.B.B.ch.

Faculty of Medicine, Cairo University

Supervised by

Prof. Adel Mohammed Saeed

Professor of Chest Diseases

Faculty of Medicine

Ain Shams University

Dr. Khaled Mohammed Wagih

Assistant Professor of Chest Diseases

Faculty of Medicine

Ain Shams University

Faculty of Medicine - Ain Shams University

2014

Acknowledgment

First and foremost, I feel always deeply indebted to Allah, the Most Gracious and the Most Merciful.

I would like to express my deepest gratitude and cardinal appreciation to Prof. Adel Mohammed Saeed, Professor of Chest Diseases, who kindly supervised and motivated the performance of this work, for his kind guidance and constant encouragement throughout this work.

I am greatly honored to express my sincere appreciation to Dr. Khaled Mohammed Wagih, Assistant Professor of Chest Diseases, for his continuous support, help and generous advice throughout this work.

Finally, I want to dedicate this work to all the members of my family because of their patience and support.

Nasra Hussein

List of Contents

List of Tables

List of Tables (Cont...)

List of Figures

List of Figures (Cont...)

List of Abbreviations

Abb.	Meaning
%	Percentage.
°C	Celsius.
AARC	American Association for Respiratory Care
ABG	Arterial blood gases.
ATS	American Thoracic Society.
Aust	Australia.
BAT	Low battery indicator.
BE	Base excess.
BLVR	Bronchoscopic lung volume reduction.
BTS	British thoracic society.
CAL	Calibration symbol.
CAT	COPD Assessment Test.
CD 8	Cluster of differentiation antigen no.8
CHF	Congestive heart failure.
cm	Centimeter.
CO_2	Carbon dioxide.
COPD	Chronic obstructive pulmonary disease.
CPAP	Continuous Positive Airway Pressure.
Cr	Creatinine.
CSF	Cerebro-spinal fluid.
CT	Computed tomography.
DBP	Diastolic blood pressure.
DNI	Do-not-intubate.
ECG	Electrocardiography.
EGFR	Epidermal growth factor receptor.
ETS	Environmental Tobacco Smoke.
FDA	Food and Drug Administration.
FEV_1	Forced expiratory volume in first second.
FEV_1/FVC	Forced expiratory volume in first second/ forced vital capacity.
FG	French gauge or scale and it equals 1/3 mm.
FIO_2	Fraction of inspired oxygen.
FVC	Forced vital capacity.

List of Abbreviations **(Cont...)**

Abb.	Meaning
gm ..... :	Gram
GOLD..... :	Global Initiative for Chronic Obstructive Lung Disease
H_2O ..... :	Water.
HCO_3 ..... :	Bicarbonate.
HFNC..... :	High Flow Nasal Cannula.
HFT..... :	High Flow Therapy.
HGB..... :	Haemoglobin.
HIV ..... :	Human immunodeficiency virus.
HRCT..... :	High resolution Computed tomography.
HS ..... :	Highly Significant.
ICU ..... :	Intensive care unit.
ILD..... :	Interstitial Lung Disease.
Inc ..... :	Increase.
IPF ..... :	Interstitial pulmonary fibrosis.
ITOC ..... :	Intratracheal oxygen catheter.
IU ..... :	International unit.
K..... :	Potassium.
kPa..... :	Kilopascal.
L O_2/min ..... :	Liters of oxygen per minute
L..... :	Liter.
L/min ..... :	Liter per minute.
LCD..... :	Liquid crystal display.
LL..... :	Lower limb.
LVRS..... :	Lung volume reduction surgery.
ml..... :	Milliliter
ml/l ..... :	Millimeter per litre.
mmHg ..... :	Millimeter of mercury.
mmol/l..... :	Millimoles per liter.
mMRC ..... :	The Modified British Medical Research Council.
MV ..... :	Mechanical ventilation.
Na ..... :	Sodium.
NHF..... :	Nasal High Flow.

List of Abbreviations **(Cont...)**

Abb.	Meaning
NICU..... :	Neonatal intensive care unit.
NIV ..... :	Non Invasive Ventilation.
NC……..:	Nasal cannula.
NP ..... :	Nasal prong.
NPO ..... :	Nasopharyngeal oxygen therapy.
NS ..... :	Non Significant.
O_2..... :	Oxygen.
P ..... :	Level of signifiance.
$PaCO_2$ ..... :	The partial pressure of arterial carbon dioxide.
PaO_2 ..... :	Partial pressure of arterial oxygen.
PaO_2/FIO_2..... :	The partial pressure of arterial oxygen to the fraction of inspired oxygen ratio.
PCO_2 ..... :	Carbon dioxide tension.
PEEP ..... :	Positive End Expiratory Pressure.
PH ..... :	Negative logarithm hydrogen ions.
PO_2 ..... :	Oxygen tension.
r ..... :	Correlation coefficient.
RBS ..... :	Random blood sugar.
S ..... :	Significant.
SaO_2 ..... :	Arterial oxygen saturation
SBP ..... :	Systolic blood pressure.
SD ..... :	Standard deviation.
SpO_2 ..... :	Hemoglobin oxygen pulsed saturation.
Spp. ..... :	Species.
SPSS ..... :	Statistical program for social science.
TLC ..... :	Total leucocytic count.
USA..... :	United State of America.
VA ..... :	Alveolar ventilation.
VA/Q ..... :	Ventilation perfusion.
VE ..... :	Minute ventilation.
VM ..... :	Venturi mask.
WOB ..... :	Work of breathing.

INTRODUCTION

Respiratory failure may be acute or chronic, acute hypercapnic respiratory failure develops over minutes to hours, while chronic respiratory failure develops over several days or longer ***(Kaynar et al., 2010).***

The major treatment of respiratory failure is Oxygen therapy, which can be used for a variety of purposes in both chronic and acute patient care. Oxygen is essential for cell metabolism, as tissue oxygenation is essential for all normal physiological functions ***(Ritchie et al., 2006).***

There are many ways to deliver oxygen therapy as nasal cannula (NC). It is comfortably, provide oxygen at low flow rates, 2-6 liters per minute (LPM), delivering a concentration of 24-40% of FIO2 while the simple face mask, often used at between 6 and 12 LPM, with a concentration of oxygen to the patient of between 28% and 50% of FIO_2 , and also Venturi masks, which can accurately deliver a predetermined oxygen concentration to the trachea up to 60%of FIO_2 and in some cases where the patient requires high flow oxygen delivery as a flow up to 100% oxygen, a number of devices are available, with the most common being the non-rebreather mask,. There should be a minimum flow of 10 L/min. The delivered FIO_2 of this system is 60-80% ***(Garcia et al., 2005).***

High flows of warmed and humidified air/oxygen blends can also be delivered via a nasal cannula, allowing the patient to continue to talk, eat and drink while still receiving the therapy *(**Sim et al., 2008**)*.

Critical to nasal high flow (NHF) is the delivery of optimal humidity. Without it, the comfortable delivery of high flows directly into the nares would be impossible ***(Groves & Tobin, 2007).***

Nasal high flow is a new respiratory care therapy that aims to meet or exceed the patient normally inspiratory demand creating minimal air dilution ***(Ritchie et al., 2006).***

It can more accurately deliver prescribed oxygen concentrations at high flows providing both versatility and continuity of care as patients wean or their condition becomes more acute. This greater flexibility eliminates the need to switch between oxygen therapies delivery systems ***(Sim et al., 2008).***

Also it has many others benefits as flushing of anatomical dead space of the upper airway by the high incoming gas flows. This creates a reservoir of fresh gas available for each and every breath, minimizing re-breathing of carbon dioxide (CO_2) ***(Dysart et al., 2009)***.

Also it make a positive airway pressure throughout the respiratory cycle**,** as it was found that mean airway

pressure during the respiratory cycle has been shown to be elevated with the delivery of NHF ***(Parke et al., 2007).***

In addition to all of that the NHF can deliver optimal humidity which emulates the balance of temperature and humidity that occurs in healthy lungs, maintaining mucociliary clearance, this important for patients with secretion problems such as those with chronic obstructive pulmonary disease. By delivering optimal humidity, drying of the airway is reduced, which maintains the function of the mucociliary transport system, clearing secretions more effectively and reducing the risk of respiratory infection ***(Hasani et al., 2008).***

Finally nasal cannula promotes greater patient comfort and compliance than face masks, and assist patients requiring a greater level of support than low flow nasal cannula who would traditionally be placed on a face mask because of greater acuity ***(Park et al., 2008).***

Aim of the Work

The aim of this study is to evaluate the efficacy of nasal optiflow device in management of COPD patients in acute exacerbations in comparison with conventional Venturi mask.

Chronic Obstructive Pulmonary Disease

Chronic Obstructive Pulmonary Disease (COPD), the fourth leading cause of death in the world, ***(WHO. 2000)*** represents an important public health challenge that is both preventable and treatable. COPD is a major cause of chronic morbidity and mortality throughout the world; many people suffer from this disease for years, and die prematurely from it or its complications. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and aging of the population ***(Lopez et al., 2006).***

Definition:

Chronic Obstructive Pulmonary Disease (COPD), a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and comorbidities contribute to the overall severity in individual patients. ***(GOLD, 2014)***

Factors that influence disease development and progression:

- **Genes:**

The genetic risk factor that is best documented is a severe hereditary deficiency of alpha-1 antitrypsin, a major circulating