THE ROLE OF NON-INVASIVE VENTILATION IN INTENSIVE CARE UNITS

Essay

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List of Abbreviations

Abbrev.	Full term
[(A − a)PO٢	: Alveolar-arterial oxygen pressure difference
ACV	: Assist/control ventilation
AECOPD	: Acute exacerbations of chronic obstructive pulmonary disease
ALI	: Acute lung injury
ARD	: Acute respiratory distress syndrome
ARF	: Acute respiratory failure
BiPAP	: Bilevel positive airway pressure
BMI	: Body mass index
BTS	: British thoracic society
CMV	: Controlled mechanical ventilation
$CO_٢$	: Carbon dioxide
COPD	: Chronic obstructive pulmonary disease
CPAP	: Continuous positive airway pressure
CPO	: Cardiogenic pulmonary oedema
Crs	: Respiratory system compliance
D A-aO٢	: Alveolar/arterial gradient
DNI	: Do-not-intubate
ED	: Emergency department
EMG	: Electromyography
EPAP	: Expiratory positive airway pressure
ERV	: Expiratory reserve volume
ETI	: Endotracheal intubation
$FiO_٢$	: Fraction of inspired oxygen
FRC	: Functional residual capacity
FVC	: Forced vital capacity

List of Abbreviations (Cont'd)

Abbrev.	Full term
GCS	: Glasgow coma scale
HDU	: High dependency unit
IC	: Inspiratory capacity
ICC	: International consensus conference
ICU	: Intensive care unit
IPAP	: Inspiratory positive airway pressure
IRV	: Inspiratory reserve volume
MV	: Minute ventilation
NIV	: Non-invasive ventilation
NPPV	: Non invasive positive pressure ventilation
OHS	: Obesity hypoventilation syndrome
P	: Pressure
$PACO_2$	: Alveolar carbon dioxide pressure
$PaCO_2$	: Arterial partial pressure of CO_2
PAO_2	: Alveolar oxygen pressure
PaO_2	: Arterial partial pressure of oxygen
PAV	: Proportional assist ventilation
PRVC	: Pressure-regulated, volume control ventilation
PEEP	: Positive end expiratory pressure
PEEPi	: Intrinsic PEEP
PIO_2	: Inspired oxygen pressure
PSV	: Pressure support ventilation
R	: Airway resistance
RCP	: Royal college of physicians
RCTs	: Randomised controlled trial
RIICU	: Respiratory intermediate intensive care units

List of Abbreviations (Cont'd)

Abbrev.	Full term
RR	: Respiratory rate
RV	: Residual volume
S	: Spontaneous mode
S/T	: Spontaneous/Timed mode
SAPS	: Simplified acute physiology score
SIMV	: Synchronous intermittent mandatory ventilation
SVC	: Slow vital capacity
T	: Timed mode
T LC	: Total lung capacity
V	: Air flow
V/Q	: Ventilation-perfusion
V	: Alveolar ventilation
VAP	: Ventilation acquired pneumonia
VC	: Vital capacity
VD/VT	: Dead space–to–tidal volume ratios
VPAP or BiPAP	: Variable/bilevel positive airway pressure
Vt	: Tidal volume
VV+	: Volume ventilation plus
VPC	: Variable pressure control
VPS	: Variable pressure support

بسم الله الرحمن الرحيم

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INTRODUCTION

Noninvasive ventilation (NIV) refers to the delivery of mechanical ventilation to the lungs using techniques that do not require an endotracheal airway (endotracheal tube or tracheostomy tube) ***(Mehta and Hill, ٢٠٠١).***

Physiologic effect of NIV is the same as that of invasive ventilation and consists of unloading respiratory muscles and improving oxygenation ***(Nasilowski, ٢٠١١)***.

Noninvasive ventilation (NIV) has assumed an important role in the intensive care unit (ICU), with increasing use during the past ١٠ years. It is now considered the ventilatory mode of first choice for such forms of acute respiratory failure (ARF) as chronic obstructive pulmonary disease (COPD) exacerbations, acute cardiogenic pulmonary edema, and hypoxemic respiratory failure in immunocompromised patients and for facilitating extubation in patients with COPD who fail spontaneous breathing trials. Multiple randomized controlled trials have demonstrated that NIV improves outcomes in these forms of respiratory failure. Improved outcomes include avoidance of intubation and reduced morbidity and mortality compared to conventional therapy including intubation ***(Brennan et al., ٢٠١٠)***.

Weaker evidence supports the use of (NIV) for patients with (ARF) due to asthma exacerbations, with post-operative or post-extubation ARF, pneumonia, acute lung injury, acute respiratory distress syndrome, or during bronchoscopy ***(Amborsino and Vagheggini, ٢٠٠٨).***

The decreasing use of invasive mechanical ventilation, particularly at home, has been driven by many potential advantages of non-invasive over invasive ventilation. These include that it preserves normal physiologic functions such as coughing, swallowing, feeding, and speech and avoids the risks of tracheal and laryngeal injury and respiratory tract infections ***(Aboussouan, ٢٠١٠)***. Noninvasive ventilation can be used for both short-term and long-term indications depending on whether respiratory failure is acute or chronic. Not all patients are suitable candidates for noninvasive ventilation. Careful selection of patients is important for noninvasive ventilation to be successful. Equipment needs are different when noninvasive ventilation is provided in the hospital versus home. A properly fitting interface is crucial to the success of noninvasive ventilation. Family involvement is essential for success when long-term noninvasive mechanical ventilation is provided at home ***(Venkataraman, ٢٠١١).***

Some Factors that may limit the use of NIV are mask related problems such as air leaks, mask intolerance due to claustrophobia and anxiety, and poorly fitting mask.

Approximately ١٠–١٥٪ of patients fail to tolerate NIV due to problems associated with the mask interface despite adjustments in strap tension, repositioning, and trial of different types of masks. Other mask-related problems include facial skin breakdown, aerophagia, inability to handle copious secretions, and mask placement instability. The most commonly used interfaces in both acute and long-term settings are nasal and nasal-oral (NO) masks ***(Cardova and Jiminez, ٢٠١٠).***

AIM OF THE WORK

The objective of this study is to know the indications and contraindications of noninvasive ventilation, understand the physiologic effects, know how to apply different techniques, that is, negative pressure vs. positive pressure ventilation, understand the relative advantages and disadvantages of different types of patient–ventilator interfaces during noninvasive ventilation, review the evidence of the use of it in specific disease categories, review and learn to manage complications associated with non invasive ventilation.

ANATOMY OF THE RESPIRATORY SYSTEM

The organs of the respiratory system can be divided into two tracts. Those in the upper respiratory tract include the nose, nasal cavity, paranasal sinuses, phaynx and larynx. Those in the lower respiratory tract include the trachea, bronchial tree, and lungs ***(Shier et al., ٢٠١٢)***.

The Upper Airway

The upper airway consists of the nose, oral cavity, pharynx, and larynx. The primary functions of the upper airway are to act as a conductor of air, to humidify and warm the inspired air, to prevent foreign materials from entering the tracheobronchial tree, and to serve as an important area involved in speech and smell ***(Jardins, ٢٠٠٨)***.

The Lower Airway

The Tracheobronchial Tree

After passing through the larynx, inspired air enters the tracheobronchial tree, which consists of a series of branching airways commonly referred to as generations, or orders. These airways become progressively narrower, shorter, and more numerous as they branch throughout the lungs (Figure ١). In general, the airways exist in two major forms: cartilaginous airways consist of the trachea, main stem bronchi, lobar bronchi, segmental bronchi, and

subsegmental bronchi and non- cartilaginous airways are composed of the bronchioles and the terminal bronchioles. The cartilagenous airways serve only to conduct air between the external environment and the sites of gas exchange. The noncartilaginous airways serve both as conductors of air and as sites of gas exchange ***(Jardins , ٢٠٠٨).***

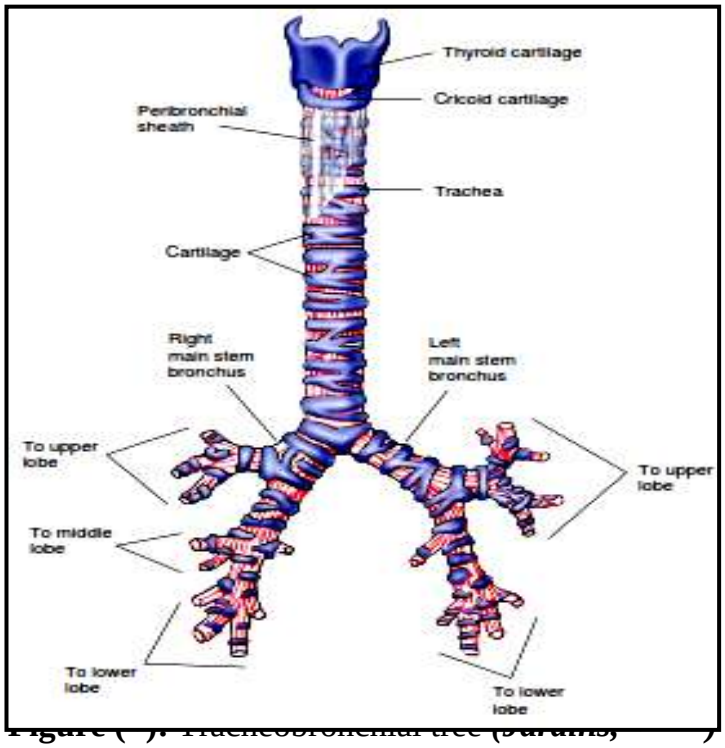

Figure (٣): Tracheobronchial tree (Jardins,)