# THE EFFECT OF POSITIVE PRESSURE VENTILATION ON RENAL FUNCTION IN CRITICALLY ILL PATIENTS; EFFECT ON RENNIN- ALDOSTERON SYSTEM

**Thesis**
*Submitted for Partial Fulfillment of MD Degree*
*In*
*Critical Care*


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2016

بسم الله الرحمن الرحيم

﴿ قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا
عَلَّمْتَنَا ۖ إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ ﴾

صدق الله العظيم

سورة البقرة آية (٣٢)

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**ABSTRACT**

Mechanical ventilation is associated with numerous organ-system complications. **The Aim of the study** was to investigate the effect of positive pressure ventilation on renin–aldosterone system and to investigate their prognostic value in relation to ICU course and outcome. **Results**: Mechanical ventilation caused elevation of renin and aldosterone levels especially with higher levels of PEEP.Renin and aldosterone levels in mechanically ventilated patients were significantly correlated with kidney function test (urea and Creatinine),length of mechanical ventilation, need for hemodynamic support, APACHE IV score and mortality.

**Keywords:** mechanical ventilation, lung –kidney crosstalk, renin-aldosterone system

# *List of Abbreviations:*

| | | |
|---|---|---|
| **ADH** | | **Antidiuretic hormone** |
| ***ALT*** | | **Alanine aminotransferase** |
| ***APACH IV*** | | **Acute Physiology and Chronic Health evaluation** |
| **ANP** | | **Atrial naturitic peptide** |
| **ARDS** | | **Adult Respiratory Distress Syndrome** |
| **ARF** | | **Acute renal failure** |
| ***AST*** | | **Aspartate aminotransferase** |
| **BPM** | | **Beat per minute** |
| **COPD** | | **Chronic obstructive pulmonary disease** |
| **CPAP** | | **Continuous positive airway pressure** |
| **CVP** | | **Central venous pressure** |
| **DBP** | | **Diastolic blood pressure** |
| **DM** | | **Diabetic** |
| **DVT** | **:** | **Deep venous thrombosis** |
| **ELIZA** | | **enzyme – linked immunosorbent assay** |
| **ET** | | **endothelin** |
| **FRC** | | **functional residual capacity** |
| **GFR** | **:** | **Glomerular filtration rate** |
| **GI** | | **Gastrointestinal** |
| **HDS** | | **Hemodynamic support** |
| **HR** | | **Heart rate** |
| **HTN** | | **Hypertension** |
| **ICU** | | **intensive care unit** |
| **IHD** | | **Ischemic heart disease** |

| | |
|---|---|
| **IL-6** | **Interleukin- 6** |
| ***IPPV*** | **intermittent positive pressure ventilation** |
| ***LOMV*** | **Length of mechanical ventilation** |
| ***LOS*** | **Length of ICU stay** |
| **LV** | **left ventricle** |
| **LVEDV** | **Left ventricular end-diastolic volume** |
| **MODS** | **Multiple organ dysfunction syndrome** |
| **MOF** | **Multiple organ faliure** |
| **MV** | **Mechanical ventilation** |
| **NO** | **Nitric oxide** |
| **PEEP** | **Positive end expiratory pressure** |
| **PGE** | **Prostaglandins** |
| **PPV** | **Positive pressure ventilation** |
| **PVR** | **pulmonary vascular resistance** |
| **RBF** | **Renal blood flow** |
| ***ROC*** | **Receiver operator characteristic** |
| **RR** | **Respiratory rate** |
| **RV** | **right ventricle** |
| **RVEDV** | **right ventricular end-diastolic volume** |
| **SBP** | **Systolic blood pressure** |
| **SD** | **Standard deviation** |
| **TNF-α** | **tumor necrosis factor-α** |
| ***UOP*** | **Urine output** |
| **VAP** | **Ventilator associated pneumonia** |
| **Vt** | **Tidal volume** |
| **ZEEP** | **Zero PEEP** |

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# ]INTRODUCTION

Mechanical ventilation is a standard component of intensive care unit management of critically ill patients and is widely used for respiratory support and improves oxygenation in critically ill patients. Mechanical ventilation is often a life-saving intervention, but carries many potential complications. There are numerous mechanisms underlying the development of complications in the ventilated patient. Complications may result from the endotracheal tube or tracheotomy tube (or with noninvasive ventilation, the mask), or from the effects of positive-pressure ventilation. (1)

The ventilatory strategy required to maintain adequate gas exchange may exacerbate, or even initiate, significant lung injury and inflammation. Mechanical ventilation can produce lung injury that is functionally and histologically indistinguishable from that seen in ARDS. Mechanical ventilation has also been shown to have significant effects on lung levels of inflammatory cells and soluble mediators. These inflammatory mediators may get released from the alveolar space into the general circulation and play a critical role in the pathophysiology of systemic inflammatory response, multiple system organ failure and shock. (2)

Mechanical ventilation may also affect distal organ function via effects on cardiac output, as well as the level of oxygenation and the distribution of blood to the various organ systems.

Positive intrathoracic pressure impairs venous return, decreases ventricular distensibility, and causes decreased ventricular filling. The decreased venous return leads to a decrease in right ventricular preload, which through sustained pressure changes in the cardiopulmonary vasculature leads to a sustained, decreased left ventricular afterload. Ultimately, decreased left ventricular preload decreases left ventricular afterload. These changes reduce cardiac output because although left ventricular afterload is reduced, the decreased left ventricular filling has a greater effect on cardiac output. Positive end-expiratory pressure (PEEP) may reduce cardiac output by causing a further increase in intrathoracic pressures. (3)

Because the kidneys receive 20% to 25% of cardiac output, any decrease in cardiac output caused by PEEP affects RBF. RBF is primarily affected by PEEP because of sympathetic activation related to increased plasma renin activity.[29] Although total RBF is relatively unchanged, blood flow is redistributed from the cortical to the juxta medullary nephrons. This redistribution would be associated with decreased urine output, decreased Creatinine clearance, and an increased fractional resorption of sodium. (4)

PEEP further affects the hormonal and sympathetic pathways. The effect is due to an increase in sympathetic tone, which is caused by increased plasma renin activity and decreases GFR because of decreased blood flow. PEEP has a transient effect on aortic blood pressure, and this effect reflexively activates the sympathetic nervous system through aortic and (sino) carotid baroreceptors. Changing renal function then slowly affects intravascular volume.