# CARDIAC ARRYTHMIA IN RESPIRATORY ICU

*An Essay*
Submitted for Partial Fulfillment in Master Degree
of Critical Medicine

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# List of Abbreviations

| *Abb.* | *Meaning* |
|---|---|
| **ACPO** | Acute cardiogenic pulmonary oedema |
| **ALI** | Acute lung injury |
| **ADP** | Adenosine triphosphate |
| **AF** | Atrial fibrillation |
| **AN** | Atrionodal region |
| **AP** | Action potential |
| **ARDS** | Acute respiratory distress syndrome |
| **ATP** | Adenosine triphosphate |
| **AV** | Atrioventricular node |
| **AV** | Arteriovenous |
| **AVNRT** | Atrioventricular nodal reentrant tachycardia |
| **BiPAP** | Bilevel positive airway pressure |
| **cAM P** | Cyclic adenosine 5'- monophosphate |
| **CAP** | Community acquired pneumonia |
| **CFTR** | Cystic fibrosis transmembrane conductanceregulatorchannel. |
| **CLCA1** | Calcium activated chloride channels. |
| **CT** | High-resolution computed tomography. |
| **CSF** | Cerebrospinal fluid. |
| **COPD** | Chronic obstructive pulmonary disease |
| **CPAP** | Continuous positive airway pressure |
| **CURB** | Confusion, urea concentration (<7 mmol/L-1), respiratory rate (>30/min-1), blood pressure (systolic pressure >90 mmHg) and age (65 yrs). |

| | |
|---|---|
| **Dl** | Diffusing capacity |
| **DPG** | 2, 3-diphosphoglycerate |
| **DVT** | Deep venous thrombosis. |
| **ECG** | An electrocardiogram |
| **$E_m$** | Resting membrane potential |
| **ERP** | Effective refractory period |
| **f** | Respiratory rate |
| **Fc** | Cardiac frequency |
| **GI** | Gastrointestinal |
| **GDP** | Guanosine diphosphate |
| **GTP** | Guanosine triphosphate |
| **HPS** | His-Purkinje system |
| **ICU** | Intensive care unit. |
| **IV** | Intravenous |
| **$K_{2P}$** | two-pore Potassium channel |
| **LAP** | left atrial pressure |
| **OSA** | Obstructive sleep apnea |
| **MAT** | Multifocal atrial tachycardias |
| **MDS** | Megadose |
| **MgSO4** | Magnesium sulfate |
| **N** | Nodal region |
| **NH** | Nodal His bundle region |
| **NIPPV** | Non-invasive postive pressure ventilation |
| **PAC** | Premature atrial contraction |
| **Paco2** | Pco2 in arterial blood |
| **PAOP** | pulmonary artery occlusion pressure |

| | |
|---|---|
| **PCP** | Pneumocystis jiroveci pneumonia |
| **PCV** | Pressure controlled ventilation |
| **PC-IRV** | Pressure-controlled, inverse-ratio ventilation |
| **PE** | Pulmonary embolism |
| **Peco2** | Expired gas |
| **PEEP** | positive end-expiratory pressure |
| **Pplat** | Inspiratory plateau pressure |
| **PIFR** | peak inspiratory flow rate |
| **PSP** | Primary spontaneous pneumothorax |
| **QTc** | *Corrected QT interval* |
| **RICU** | *Respiratory intensive care unit* |
| **RSA** | *Respiratory sinus arrythmia* |
| **TRP** | Transient refractory period |
| **TDP** | *Torsade de pointes* |
| **SAN** | The sinoatrial node |
| **SSP** | Secondary spontoneus pneumothorax |
| **SSS** | Sick sinus syndrome |
| **VCV** | Volume control ventilation |
| **VGSC** | Voltage-gated sodium channels |
| **VI** | Inspiratory flow rate |
| **V/Q** | The ventilation: perfusion ratio |
| ***V*T** | Tidal volume |
| **VTE** | Venous thromboembolism |

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# INTRODUCTION

The heart beat is normally initiated by an electrical discharge from the sinoatrial node. The atria and ventricles then depolarize sequentially as electricity passes through the specialized conducting tissue (***Boon et al., 2002***).

Most cardiac arrhythmias can be described as abnormalities of impulse formation, impulse conduction, or a combination of both. For example, the ventricular premature complex (VPC) which initiates monomorphic ventricular tachycardia in a patient with a prior anterior myocardial infarction represents an abnormality of impulse formation whereas the scar-mediated reentrant ventricular tachycardia is a manifestation of abnormal impulse conduction. Triggered activity and abnormal automaticity, two common mechanisms of arrhythmia, are categorized as disorders of impulse formation ***(Zimetbaum et al., 2009)***.

The principle function of the lungs is gas exchange. Although disease may substantially affect any of the functional elements of the respiratory system, the term acute respiratory failure (ARF) is used only when gas exchange is so severely impaired that arterial hypoxemia or hypercapnia occurs ***(Smith, 2005)***.

Respiratory failure may be classified as *hypercapnic respiratory failure* is defined as an arterial Pco2 (Paco2) greater than 45 mmHg. *Hypoxemic respiratory failure* is defined as an arterial Po2 ( (Pao2) less than 55 mmHg when the fraction of oxygen in inspired air (Fio2) is 0.60 or greater. In many cases, hypercapnic and hypoxemic respiratory failure coexist ***(Grippl, 2008)***.

It is well established that progressive hypoxia may be causally associated with a rise in heart rate, the effects of hypercapnia are more unpredictable, being associated with either a rise or a fall in the heart rate ***(Sanders et al., 1989***).

Patients with hypercapnic respiratory failure are subject to complications associated with both respiratory failure and its treatment. Several common complications have been identified: Cardiac arrhythmias of all types are common, relating to diverse factors including hypoxemia, wide swings in pH, electrolyte disturbances, and drugs that may be employed such as β-adrenergic agents, theophylline, and *digoxin* ***(Smith, 2005)***.

General principles of treatment are: 1.Treatment may be avoided if the patient is not suffering hemodynamic compomise or if this is not incipent 2. Reduce an unnecessarily high cvp to reduce risk of reccurent atrial fibrillation. 3. Correct hypokalemia. 4. Correct hypomagnesemia. 5. Avoid hypoxia or

hypercapnia. 6. Ensure central venous access is correctly postioned. 7. If ischemic consider revascaulerization. 8. Dc cardioversion or pacing is generally safer than phaamacotherapy. 9. Use familiar drugs where possible. 10. void polypharmacy ***(Montogmery et al., 2010***).

# AIM OF THE WORK

To study the effect of respiratory emergencies on heart rate and rhythm.

# ELECTROPHYSIOLOGY OF THE HEART AND NORMAL ECG

The heart is the life-beating, always thumping muscle in your chest. From inside the womb until death, the thump goes on.The heart for the average human will contract about 3 billion times; never resting, never stopping to take a break except for a fraction of a second between beats. If a person lives to be 80 years of age.His or her heart will continue to beat 100, 000 times a day. Many believe that the heart is the first organ to be functional.Within weeks of conception the heart starts its mission of supplying the body with nutrients ***(Provophys et al., 2007)***.

The heart wall, which encases the heart, is made up of three layers: epicardium, myocardium, and endocardium. The epicardium, the outermost layer, consists of squamous epithelial cells overlying connective tissue. The myocardium, the middle and thickest layer, makes up the largest portion of the heart's wall. This layer of muscle tissue contracts with each heartbeat. The endocardium, the heart wall's innermost layer, consists of a thin layer of endothelial tissue that lines the heart valves and chambers ***(Follin et al., 2006).***

The heart consists of four chambers: right and left atria, and right and left ventricles. The atria are smaller, thinner

walled, low-pressure chambers. Approximately 30% of blood flow to the ventricles is the result of atrial contraction, also known as *atrial kick.* The remaining 70% of blood that reaches the ventricles is the result of pressure differences between the atria and the ventricles. The ventricles are larger, higher-pressure chambers with thicker walls than the atria. The walls of the left ventricle are thicker than the right ventricle because the left ventricle must generate a large amount of force to eject blood into the aorta ***(Morton et al., 2005)***.

## ***Cardiac cells:***

There are five functionally and anatomically separate types:

1. Sinoatrial node.
2. Atrioventricular node.
3. His-purkinje system.
4. Atrial muscle.
5. Ventricular muscle ***(Banerjee (a), 2005).***

## ***Properties of cardiac muscle:***

Automaticity (chronotropy): the ability to initiate cardiac impulse.

Conductivity (dromotropy): the ability to conduct an electrical impulse.