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Handbook of Emergency Room Protocols

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Section 2

Critical Care

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2.1 Echocardiography in the Emergency Room

INTRODUCTION

Echocardiography (Echo) in the emergency room has emerged as an important noninvasive tool for improving the efficiency of the diagnosis of serious conditions in the medical emergency department.

Echo has an important role to play in patients presenting with:

- Chest pain
- Hypertension
- Unexplained dyspnea
- Palpitation
- Recurrent syncope
- Possible etiology of embolus in patients with cerebral or peripheral embolism
- Chest trauma

One must not hesitate in seeking the assistance of an echocardiogram whenever required.

Apart from diagnostic utilities, Echo is extremely useful in a situation requiring pericardial fluid aspiration, particularly in patients with cardiac tamponade. Insertion of a pacemaker lead is another important therapeutic use of Echo.

ACUTE CORONARY SYNDROME

Role of the Echo in acute coronary syndrome (ACS):

- Triage of patients in suspected ACS
- Infarct size estimation
- Assessment of ventricular function
- Assessment of reperfusion
- Evaluation of complications
- Identification of location/severity of diseases in patients with ongoing ischemia

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LEFT HEART FAILURE

Left heart failure may be due to a variety of following structural abnormalities:

- *Cardiac valves*: Valvular heart disease
- *Myocardium*: Cardiomyopathies and hypertension
- *Pericardium*: Constrictive pericarditis and tamponade
- *Coronary arteries*: Acute myocardial infarction
- *Aorta*: Proximal aortic dissection
- *Cardiac tumors*: Myxoma

ECHO IN STROKE PATIENTS

Cardiac source of emboli can present as stroke. Cardiogenic emboli can be due to:

- Left atrial (LA) thrombus
- Left ventricular (LV) thrombus
- LA myxoma
- Vegetations
- Paradoxical embolism through R-L shunt
- Prosthetic valve thrombosis
- *Miscellaneous*:
    - Mitral annular calcification
    - Sclerotic aortic valve
    - Mitral valve prolapse
    - Atrial septal aneurysm

ECHO IN SYNCOPE

The various anatomic cardiac causes of syncope are:

- *Severe aortic stenosis*: Valvular and supravalvular
- Large atrial myxoma
- Hypertrophic obstructive cardiomyopathy (HOCM)
- Severe mitral stenosis
- Severe pulmonary stenosis
- Cardiac tamponade
- Massive pulmonary embolism
- Severe pulmonary hypertension
- Acute myocardial infarction

ECHO IN PALPITATION

- Ischemic heart disease. By showing areas of scared tissue (akinetic and dyskinetic segments)
- Dilated cardiomyopathy
- Hypertrophic cardiomyopathy

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- Right ventricular dysplasia
- Ebstein's anomaly

ECHO IN HYPOTENSION AND SHOCK

In patients presenting with hypotension not due to a cardiac arrhythmia, two-dimensional echocardiography (2D Echo) can help in excluding cardiac causes of hypotension like:

- Acute cardiac tamponade
- Extensive myocardial infarction with severe systolic dysfunction
- Right ventricular infarction
- Mechanical complications of myocardial infarction:
  - Cardiac free wall rupture
  - Papillary muscle rupture
  - Rupture of ventricular septum
- Massive pulmonary embolism

Cardiac Tamponade

Cardiac tamponade can be diagnosed easily, quickly, and confidently with the aid of Echo. On 2D Echo, the following features suggest tamponade:

- Right ventricular (RV) free wall early diastolic collapse
- Right atrial free wall diastolic collapse
- Decrease RV diameter, especially right ventricular outflow tract (RVOT) 7 mm
- Dilated inferior vena cava (IVC) (>2.2 cm) with 50% decrease in diameter on inspiration

CONCLUSION

Echocardiogram-guided pericardial aspiration is a simple, safe, and rewarding therapeutic procedure. Echo is thus a very important tool in the emergency department, offering vital clues in early diagnosis and is also very useful in assisting therapeutic procedures. The fact that Echo is a portable, rapid, and noninvasive technology which can be repeated when required makes it highly useful in the emergency department. Hence, all physicians managing critically ill patients should learn the skill of echocardiographic examination in a focused manner at least. This skill adds to the clinical acumen toward a correct diagnosis and treatment.

2.2 Ventilatory Support in the Emergency Room

INTRODUCTION

Mechanical ventilation is needed to improve respiratory failure, incipient respiratory failure, and low output status. Intermittent positive-pressure

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ventilation using mechanical ventilation is the conventional method of assisted ventilation.

Respiratory failure occurs when gas exchange becomes significantly impaired resulting in abnormalities in arterial blood gases. Respiratory failure is diagnosed if $PaO_2 < 50$ mm Hg and $PaCO_2 > 49$ mm Hg. The causes for this abnormal gas exchange range from lung injury, chest wall injuries, neuromuscular diseases, obstructive airway disease, postoperative status, cardiac failure, and various systemic and metabolic abnormalities. The principal aim of therapeutic intervention is to improve oxygenation, remove CO_2 excess, and maintain acid–base balance. This aim is achieved through mechanical ventilation.

Mechanical ventilation can be stated for:

- Established respiratory failure, e.g., acute respiratory distress syndrome (ARDS), poisons, chronic obstructive pulmonary disease (COPD), polyneuropathy
- Incipient respiratory failure, e.g., postoperative, severe lung injury, and muscle fatigue
- Low output status, e.g., shock of any etiology
- Purposeful hyperventilation to reduce intracranial pressure

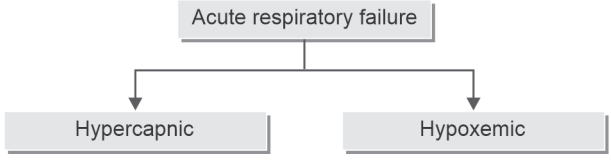
CLINICAL RECOGNITION

- Weak cough
- Respiratory rate (RR) 30 breaths/min
- Tachycardia
- Sweating/restlessness
- Exaggerated use of accessory muscles
- Cyanosis/convulsions

BIOCHEMICAL RECOGNITION

- Vital capacity < 10 mL/kg
- $PaO_2 < 60$ mm Hg
- $PaCO_2 > 50$ mm Hg
- RR > 35 breaths/min
- Inspiratory force < 25 cmH_2O
- MW < 2 × resting VE

CAUSES



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Acute Respiratory Failure

Hypercapnia

- Acute exacerbation of COPD
- Postextubation and weaning difficulties
- Postsurgical respiratory failure
- Thoracic wall deformities
- Decompensation in neuromuscular disease
- Status asthmaticus
- Acute respiratory failure in obesity hypoventilation syndrome.

Patients with End-stage Lung Disease

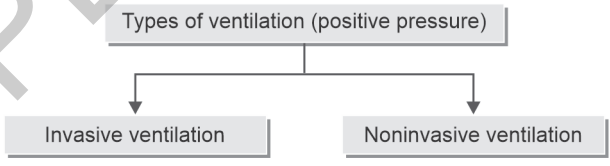
Hypoxemia

- Cardiogenic pulmonary edema
- Weaning difficulties
- Community-acquired pneumonia (CAP)
- ARDS
- Post-traumatic respiratory failure

Chronic Hypercapnic Respiratory Failure

- Obstructive sleep apnea
- Central sleep apnea
- COPD
- Myasthenia and other neuromuscular disorders
- Bronchiectasis
- Diffuse interstitial lung disease

Types of Ventilation (Positive Pressure)



PATIENT CONNECTION

- Face mask
- Endotracheal tube:
  - Oral – Mouth mask
  - Nasal – Nasal mask
- Tracheostomy tube
- Cricothyroid membrane

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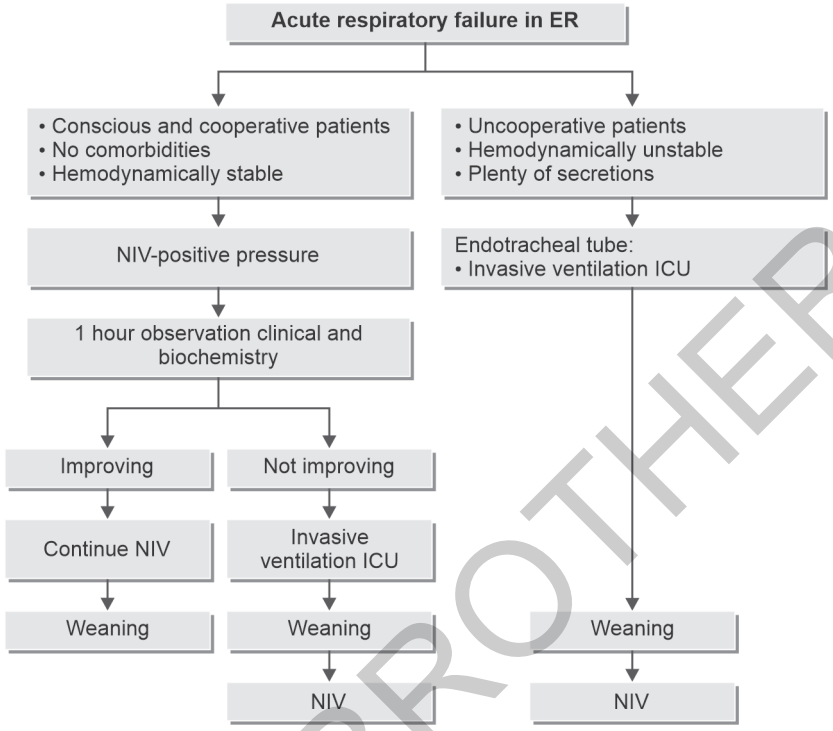

(ER: emergency room; ICU: intensive care unit; NIV: noninvasive ventilation)

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Handbook of
Emergency Room Protocols

Salient Features

- Comprehensive practical guide with up-to-date content
- Provides systematic approach to the diagnosis of common medical emergencies
- Based on stepwise management.

S Arulrhaj MD PhD FRCP (Glasgow and London) MBA is a distinguished Professor (Hony) at Dr MGR Medical University, Chennai, Tamil Nadu, India. He is a Dr BC Roy National Awardee, the highest professional award in India and the Founder Chairman, Chief Physician, and Intensivist of Sundaram Arulrhaj Hospitals, Tuticorin and Founder and Chairman for "ARULS Group". He has been the National President of Indian Medical Association and Association of Physicians of India (API). Prof Dr S Arulrhaj is the Founder Chairman of the Commonwealth Medical Association Trust and Commonwealth Medical eVarsity, UK. He is the Founder and Past Chairman of Commonwealth Health Professions Alliance, UK; Founder and Chairman of Indo Global Cardio Diabetes Academy, India, Past President of the Commonwealth Medical Association, Honorary National Professor of Medicine, IMA and IMACGP, India, and Chief Patron of IMACGP and IMA eVarsity, India. He has published Diabetes Update 2011, Clinical Medicine Update Book 2016, Cardiodiabetes Medicine 2017 and 2018. He is regularly contributing for Medicine Update, and API over 20 years. He is a postgraduate teacher in Internal Medicine over 20 years—DNB Medicine and has addressed acute medicine on various national and international platforms. Dr Arulrhaj's medical interests are nonintensive cardiology and intensive care. His public health interests are prevention and control of noncommunicable diseases, cardiodiabetic medicine, digital health, rural health, and prehospital trauma and emergency care. He has organized several conferences—national, international and state API, IMA, and conferences of GCDC and ISECON.

Printed in India

Available at all medical bookstores
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Medical Publishers (P) Ltd.
EMCA House, 23/23-B, Ansari Road,
Daryaganj, New Delhi - 110 002, INDIA
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