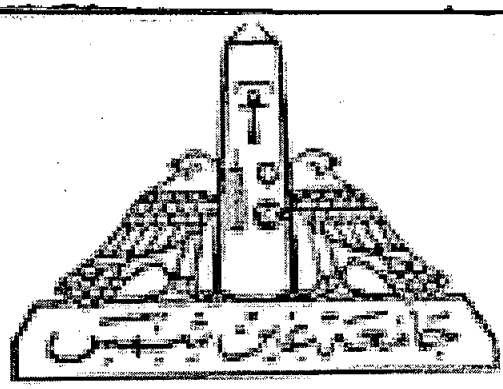


# الأدوية الداعمة للقلب في مرضى الحالات الحرجة

رسالة مقالية للحصول على درجة ماجستير الرعاية المركزة العامة

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فى الرعاية المركزة

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# Inotropic Support In Critically Ill Patients

**Essay**
**Submitted for Partial Fulfillment of Master Degree in Intensive Care**

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**2013**

بسم الله الرحمن الرحيم

وقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ
ورَسُولُهُ والْمُؤْمِنُونَ

**صدق الله العظيم**

**سورة التوبة آية (105)**


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**Mahmoud Eid Mahmoud**

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## List of Abbreviations

ABG: Arterial blood gases.

ACCF: American College of Cardiology Federation.

ACE: Angiotensinogen converting enzyme.

ACTH: Adreno cortico trophic hormone.

ADHERE: Acute Decompensated Heart Failure National Registry.

AHFS: Acute heart failure syndrome.

AMI: Acute myocardial infaraction.

AMP: Adenosine Monophosphate.

ASD: Atrial septal defect.

AV: Atrioventricular.

BP: Blood Pressure.

BUN: Blood urea nitrogen.

CABG: Coronary artery bypass graft.

Camp: Cyclic adenosine monophosphate.

CHF: Chronic Heart Failure.

CI: Cardiac index.

CO: Cardiac output.

COMT: catechol-O-methyl transferase.

CPB: cardio pulmonary bypass.

CPR: Cardiopulmonary resuscitation.

CT: computed tomography.

CUPID: Calcium Up-Regulation by Percutaneous Administration of Gene Therapy in Cardiac Disease trial.

CVP: Central venous pressure.

DA: Dopamine.

DO2: Oxygen demands.

ECG: Electrocardiogram.

EHF II: EuroHeart Failure Survey II.

EPI: Epinephrine.

ESC: European society of cardiology.

FENa: Fractional excretion of sodium.

HF: Heart failure.

IABP: Intra aortic ballon counterpulsation.

ICU: Intensive care unit.

IM: Intramuscular.

ISO**:** Isoprelanine.

IV: intravenous.

LV: Left ventricle.

LVEDP: left ventricular end-diastolic pressure.

LVEF: Left ventricular ejection fraction.

MAO: Monoamine oxidase.

MAP: mean arterial pressure.

MVO2: myocardial oxygen consumption.

NE: Norepinephrine.

NSTEMI: Non ST-elevation myocardial infarction.

NYHA: New York Heart Association.

OPTIMIZE-HF: Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure.

PAC: pulmonary artery catheter.

PAOP: Pulmonary artery occlusion pressure.

PAP: Pulmonary artery pressure.

PCWP: Pulmonary capillary wedge pressure.

PDE: phosphodiesterase inhibitors.

PDE3-Is: Phosphodiesterase inhibitors.

PEA: Pulseless electrical activity.

ROSC: Return of spontaneous circulation.

RV: Right ventricle.

SBP: Systolic blood pressure.

SERCA 2A activators: Sarcoplasmic reticulum calcium ATPase isoform-2.

SIRS: systematic inflammatory response syndrome.

STEMI: ST-elevation myocardial infarction.

STS: Society of thoracic surgery.

Svo2: mixed venous oxygen saturation.

SVR: Systemic vascular resistance.

TEE: Trans-Esophageal Echocardiography.

TnC: Troponin c.

UG: Ungraded.

VAD: Ventricular assisted device.

VASO: Vasopressin.

VF: Ventricular fibrillation.

VO2: Oxygen tissue delivery.

VSD: Ventricular septal defect.

VT: Ventricular tachycardia.

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# Introduction

Critically ill patients frequently develop low output syndromes due to cardiac dysfunction, myocardial injury, and inflammatory activation. Conventional inotropic agents seem to be useful in restoring hemodynamic parameters and improving peripheral organ perfusion but can increase short and long-term morbidity and mortality in these patients. Novel inotropes may be promising in the management of critically ill patients, having no serious side effects ***(Alla et al., 2007)***.

Shock is a state of inadequate perfusion where oxygen delivery to the tissues fails to meet oxygen demands. A shock state might emerge from a reduction in oxygen tissue delivery (VO2), or from an increase in oxygen demands (DO2). Cardiac patients are vulnerable in this clinical condition of impaired cardiac output and peripheral tissue hypoperfusion. Theoritically, inotropic agents can improve hemodynamic parameters increasing cardiac output and reducing left and right ventricular filling pressures. Therefore, inotropes are indicated for the treatment of all cardiac patients in clinical conditions characterized by peripheral hypoperfusion and fluid retention resulting from impaired cardiac contractility ***(Senz et al., 2009)***. Although these agents benefit cardiac patients by improving cardiac output, they have been also associated with arrhythmogensis, increased myocardial demands, myocardial ischemia and damage. Patients presented with acute heart failure syndrome AHFS stratified based on their systolic blood pressure

SBP on admission. Low SBP at presentation is one of the most crucial prognostic factors of adverse events (mortality and hospitalization) in acute heart failure patients ***(Dickstein et al., 2008).*** The indications for inotropic therapy in critically ill patients are:

Hemodynamic impairment with low cardiac output and increased left and/or right ventricular filling pressures, clinical worsening despite optimal oral medical treatment and critically ill patients characterized by abnormal hemodynamics, and including any of the following: Severe exercise limitation, diuretic resistant fluid overload and kidney or liver dysfunction.

Likewise, the European society of cardiology ESC guidelines indicate inotropic use in case of peripheral hypoperfusion with presence or not of congestion or pulmonary edema that is refractory to optimal doses of diuretics and vasodilators ***(Nieminen et al., 2005).***

Acute cardiovascular damage is anticipated in 20% or more patients of cardiac surgery.The myocardium has to endure subsequent periods of ischemia and reperfusion during open heart surgery. Therefore, contractile myocardial dysfunction is a common complication; hence inotropic agents or mechanical support is necessary ***(Mebazaa et al., 2007)***. The need for these management strategies is associated with higher morbidity and mortality.The possible mechanisms leading to myocardial damage are free radical formation, impairment of coronary vasculature and calcium

overload. The proposed pharmacological treatment of myocardial dysfunction after cardiac surgery included low-to-moderate doses of dobutamine and epinephrine, milrinone, or levosimendan. Initiation of levosimendan treatment before open heart surgery was associated with a higher initial postoperative stroke volume and a lower incidence of postoperative atrial fibrillation ***(Tritapepe et al., 2009)***. New agents, such as istaroxime and cardiac myosine activators may be safe and improve central hemodynamics in experimental models of heart failure and heart failure patients in phase II clinical trials. The non cardiac patients with low cardiac output symptoms in intensive care units e.g patients with septic shock, need inotropic agents to be treated with. In case of septic shock adrenaline, dobutamine, and dopamine are recommended as 1$^{st}$ line choice.Second line agents such as phenylephrine and vasopressin may be used when adrenaline and dopamine fail to restore an adequate organ perfusion ***(Dellinger et al., 2008)***.

In septic shock it will often be necessary to counteract the vasodilatory effects of the underlying disease process. Recent studies suggest that norepinephrine should be used as the first-line agent and vasopressin in low doses should be added when patients fail to respond to norepinephrine. Vasopressin should be used with caution in patients with poor cardiac function. Finally, the calcium sensitizers levosimendan, has been investigated in animal models of endotoxic shock where it appeared to improve organ perfusion, LV and RV function ***(Barraud et al., 2007).***

# Aim of The Work

To focus on recent updates for the use of inotropic agents in management of critically ill patients in intensive care unit (ICU) and their effectiveness in restoring hemodynamic parameters, improving organ perfusion and their effect on morbidity and mortality.