Prophylactic Use of Esmolol in Patients Undergoing Coronary Artery Bypass Grafting

Thesis submitted in partial fulfillment of the M.D degree in Anesthesiology

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الاستخدام الوقائي لعقار الازمولول في المرضي الذين يخضعون لعمليات استبدال الشرايين التاجية

رسالة مقدمة توطئة للحصول على درجة الدكتوراه في التخدير

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٢٠١٤

يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ (١٥)

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Abbreviations

ABG: Arterial blood gases

ACCF: American College of Cardiology Foundation

ACT: Activated clotting time

AHA: American Heart Association

ASA: American Society of Anesthesiologists

ASA: American stroke association

CABG: Coronary artery bypass graft

CARE score: cardiac anesthesia risk evaluation

CPB: Cardiopulmonary bypass

CVA: cerebrovascular accident

CVP: central venous pressure

DM: Diabetes mellitus

EACA: ε-aminocaproic acid

ECG: Electrocardiograghy

EF: Ejection Fraction

EuroSCORE: European System Cardiac Operative Risk Evaluation

Hb: hemoglobin

HbA1C: glycosylated hemoglobin A1c

IABP: Intra aortic balloon pump

ITA: Internal thoracic artery

L/min/m²: Litre/minute/m² of body surface area

LAD: Left anterior descending

LBBB: Left Bundle Branch Block

LV: left ventricle

LVEF: Left ventricular ejection fraction

MAP: mean arterial pressure

MI: myocardial infarction

MRSA: methicillin-resistant staph aureus

MVO_2: Myocardial Oxygen Consumption

ng/kg/min: nannogram/kilogram/minute

NIRS: near-infrared spectroscopy

NMBA: Neuromuscular Blocking Agents

NSTEMI: Non-ST segment elevation myocardial infarction

PCI: Percutaneous Coronary Intervention

POAF: Postoperative atrial fibrillation

POCD: postoperative cognitive dysfunction

PRBCs: packed red blood cells

RCA: Right coronary artery

STEMI: ST-elevated myocardial infarction

STS: society of thoracic surgeons

TA: Tranexamic acid

TEA: Thoracic Epidural Anesthesia

UA: unstable angina

VF: ventricular fibrillation

VT: ventricular tachycardia

α: Alpha

β: Beta

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Introduction

During the past two decades, ß-adrenergic blockade has been demonstrated to improve acute outcomes and long-term prognosis in ischemic heart disease ***(Ryan et al, 1999)***. **ß**-blocker therapy has also been demonstrated to reduce perioperative events among high-risk patients undergoing major non-cardiac and vascular surgery ***(Weisbauer et. al., 2007).***

Also, the administration of ß-adrenergic antagonists is known to attenuate myocardial ischemia-reperfusion injury during cardiac surgery. However, **ß-**adrenergic antagonists have been avoided during cardiopulmonary bypass (CPB) because of concern that the negative inotropic effects induced may make it difficult to terminate CPB ***(Scorsin et. al., 2003)***.

Esmolol is an ultra-short acting β-blocker which is rapidly metabolized in the blood by red blood cell esterase with elimination half-life of only 9 minutes ***(Quon & Stmpfli, 1985)***. All these properties make this β-blocker the first choice drug in critical patients in whom possible side effects such as cardiac failure, hypotension, or bradycardia make a rapid and immediate interruption of drug administration necessary and the concern of difficult weaning from CPB is not an issue anymore ***(Cork, et al., 1995).***

Aim of the Work

The aim of this work is to compare the clinical and biochemical effects of placebo and esmolol infused intraoperatively following induction in patients undergoing isolated coronary artery bypass graft (CABG) surgery and whether it is correlated with more improvement in postoperative morbidity and mortality.

Coronary Artery Bypass Grafting (CABG)

History of Coronary Artery Bypass Grafting

Indirect methods to restore blood supply to the ischemic myocardium were pioneered by **Claude Beck**, who reported in 1935 on the placement of a pedicled pectoralis muscle flap on the abraded pericardium ***(Beck, 1935)***. In 1951 **Vineberg** described direct implantation of the internal thoracic artery (ITA) into the myocardium ***(Vineberg & Niloff, 1950; Vineberg A, Miller, 1951)***, and **Sen** described "myocardial acupuncture" in 1968 ***(Sen et al., 1968)***.

Gibbon's development of the cardiopulmonary bypass machine and its successful clinical application by **Kirklin** at the Mayo Clinic and **Lillehei** at the University of Minnesota ***(Gibbon, 1954; Lillehei et al., 1955)***; made direct coronary revascularization technically feasible. Bailey in 1957 reported the first successful coronary endarterectomy, and in 1958 **Longmire** reported a mammary-to-coronary anastomosis performed after a surgical misadventure with a coronary endarterectomy ***(Bailey et al., 1957)***.

Goetz in 1960 performed the first successful planned coronary artery bypass operation, employing a metal cannula to connect the right ITA to the right coronary artery (RCA), with angiographic patency confirmed 2 weeks after operation ***(Goetz et al., 1961)***. The first reported use of a saphenous vein aorto-coronary bypass was reported by **Sabiston** in 1962; however, the postoperative death of the patient dissuaded

repetition of the procedure ***(Sabiston, 1963a; Sabiston, 1963b)***. The Russian surgeon **Kolessov** is credited with the first successful planned sutured internal mammary-to-coronary anastomosis in 1964 ***(Kolessov, 1966; Kolessov, 1967)***. **Garrett and DeBakey** reported a 7-year follow-up of a bypass with venous conduit performed also in 1964 ***(Garrett et al., 1973)***.

It was, however, the development of coronary angiography by **Mason Sones** at the Cleveland Clinic in 1957 that opened the door to the elective treatment of coronary atherosclerosis by means of direct revascularization ***(Sones & Shirey, 1968)***. Initial studies by **Rene Favaloro** and **Donald B. Effler** with venous and arterial conduits, and their systematic application of these techniques to treat clinical events associated with stenotic lesions of the coronary arteries, culminated in the first large series of aorto-coronary grafts with venous conduits reported in 1968 ***(Favaloro, 1970)***. Simultaneously **Dudley Johnson** of Milwaukee published a series of 301 patients undergoing coronary bypass with venous conduits in 1969 ***(Johnson et al., 1969)***. The success of these techniques was soon demonstrated in larger series, initiating the modern era of coronary artery surgery ***(Favaloro et al., 1970)***.

Indications for CABG

CABG is performed for both symptomatic and prognostic reasons. Indications for CABG have been classified by the American College of Cardiology (ACC) and the American Heart Association (AHA) according to the level of evidence supporting the usefulness and efficacy of the procedure as shown in table 1 ***(Eagle et al., 2004; Hillis et al., 2011)***: