NON CARDIAC SURGERY IN PATIENTS WITH CORONARY ARTERY STENTS: WHAT SHOULD THE ANESTHESIOLOGISTS KNOW?

Essay

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List of Abbreviations

ACC	American College of Cardiology
ACS	American College of Surgeons
ACS	Acute coronary syndrome
ADA	American Dental Association
ADP	Adenosine di phosphate
AHA	American Heart Association
AMP	Adenosine mono phosphate
ASRA	American Society of Regional Anesthesia
BENESTENT	Belgium Netherlands Stent
BMS	Bare metal stent
CABG	Coronary artery bypass graft
CAD	Coronary artery disease
CARP	Coronary Artery Revascularization Prophylaxis
COX	Cyclooxygenase
CURE	Clopidogrel in Unstable Angina to Prevent Recurrent Ischemic Events
DECREASE	Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography
DES	Drug eluting stent
GMP	Guanisine mono phosphate
LMWH	Low molecular weight heparin
MA	Maximum amplitude
MACE	Major adverse cardiac events
mTOR	Malignant target of rapamycin
NICE	National Institute for Health & Clinical Excellence
NSAID	Nonsteroidal anti-inflammatory drug
PCI	Percutanous coronary intervention
PFA	Platelet function analyser
PG	Prostaglandins

PREMIER	Prospective Registery Evaluating Myocardial Infarction: Events and Recovery
PTCA	Percutaneous transluminal coronary angioplasty
PWA	Platelet work analyzer
SCAI	Society for Cardiovascular Angiography and Intervention
SIGN	The Scottish Intercollegiate Guidelines Network
STEMI	ST segment elevation myocardial infarction
STRESS	Stent Restenosis Study
TX	Thromboxane
UFH	Unfractionated heparin
VEGF	Vascular endothelial growth factor

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Introduction

In the last 20 years, there have been important developments in the field of percutaneous coronary intervention (PCI), initially with balloon angioplasty alone and now in combination with coronary stent insertion ***(Smith et al., 2006)*** .

The technique was initially described in 1977 and involves advancement of a balloon-tipped catheter into an area of coronary narrowing, inflation of the balloon, and then subsequent removal of the catheter after balloon deflation ***(Grech, 2003)***.

Widespread use of balloon angioplasty was initially limited by two major complications: acute vessel closure during or immediately after the procedure secondary to thrombosis or vessel dissection and re-stenosis of the vessel due to a combination of elastic recoil, smooth muscle proliferation, and neointimal hyperplasia. Both of these complications were considerably reduced by the introduction of coronary stents which are deployed over a balloon at the site of an atheromatous lesion ***(Smith et al., 2006)***.

Puel and Sigwart, in 1986, deployed the first coronary stent to act as a scaffold, thus 1) preventing vessel closure during PTCA, and 2) reducing the incidence of angiographic restenosis, which had an occurrence rate of 30-40 % ***(Serruys et al., 2006)***. This increased safety and efficacy of PCI has led to an exponential rise in the number of procedures being performed, with currently more than 90% of all PCIs involving the placement of at least one coronary stent ***(Howard-Alpe et al., 2007)***.

By 1999, stenting composed 84.2% of all PCIs ***(Serruys et al., 2006)***. Nowadays, PCI with stenting is used as a routine treatment of coronary artery disease ***(Vicenzi et al., 2006)***. Consequently, an increasing sub-group of the population with coronary artery disease (CAD) has a coronary stent implanted and may subsequently require non-cardiac surgery ***(Howard-Alpe et al., 2007)***. Stent design and materials, implantation techniques and periprocedural antiplatelet drug regimens are persistently evolving. ***(Vicenzi et al., 2006)***

There was a lag of 13 yr after the initial publication of Sigwart and colleagues, until the first reports appeared

suggesting that PCI may have disadvantages in patients later undergoing non-cardiac surgery ***(Wilson et al., 2003)***.

Kaluza and colleagues drew attention to the problem by reporting an alarming 20% perioperative mortality rate in patients undergoing surgical procedures after PCI with stenting ***(Kaluza et al., 2000)***.

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INTRODUCTION

Cardiac Protection by Preoperative Cardiac Intervention

The evaluation of cardiac risk before non-cardiac surgical procedures and interventions aimed toward reducing that risk have become an integral part of the contemporary practice of medicine. In the nonoperative setting, it is generally accepted that the pathophysiology of acute myocardial infarction is usually due to the disruption of a vulnerable coronary-artery plaque followed by coronary artery thrombosis. Histopathological analysis of coronary arteries in patients who had a fatal myocardial infarction soon after non-cardiac surgery have confirmed this pathophysiology, with evidence of an unstable plaque present in more than half of patient ***(Dawood et al., 1996)***. The remainder is due to a prolonged imbalance between myocardial oxygen supply and demand in the setting of coronary artery disease. Myocardial oxygen supply may be diminished by anemia or hypotension, whereas oxygen demand may be increased by tachycardia and hypertension resulting from postoperative pain, withdrawal of anesthesia, or shifts in intravascular volume. Perioperative myocardial infarction usually occurs 1 to 4 days after surgery, when the effects of anesthesia have dissipated and perioperative pain and fluid shifts are occurring ***(Raby et al., 1992)***.

An association between fatal perioperative myocardial infarction and advanced left main coronary artery disease, severe three-vessel disease, or both is also common. Perioperative activation of neurohumoral pathways, an increase in catecholamine levels, a reduction in endogenous levels of tissue plasminogen activator, an increase in shear stress in association with platelet activation, and possibly coronary spasm have been postulated to be mechanisms leading to plaque disruption and subsequent coronary-artery occlusion. However, some patients appear to have a myocardial infarction without ST-segment elevation, perhaps caused primarily by periods of prolonged ischemia as a result of perioperative stresses that occur in the presence of severe fixed coronary-artery obstruction. Previous studies have shown that patients at increased risk for perioperative events can be identified on the basis of simple clinical markers (e.g., angina pectoris, previous myocardial infarction, diabetes mellitus, previous heart failure, renal insufficiency, poor functional capacity, or high-risk surgery) available at the time of the initial evaluation ***(Lee et al., 1999)***.

There is today overwhelming agreement that aggressive medical management to provide myocardial protection in the perioperative state is a central element in reducing the risk of adverse clinical events. In a landmark clinical trial, patients

undergoing non-cardiac surgery who had or were at risk for coronary artery disease were randomly assigned to receive atenolol intravenously before and immediately after surgery and orally thereafter for the duration of hospitalization or to receive placebo***(Mangano et al., 1996)***.

A significant reduction in the incidence of perioperative ischemia was observed among the patients who received atenolol. This reduction was associated with a lower mortality in the atenolol group six months after hospital discharge (0 percent, vs. 8 percent in the placebo group), after one year of follow-up (3 percent vs. 14 percent), and after two years of follow-up (10 percent vs. 21 percent). The lower mortality was predominantly due to a reduction in deaths from cardiac causes during the first six to eight months after noncardiac surgery (***Mangano et al., 1996)***.

Poldermans et al., in the Dutch Echocardiographic Cardiac Risk Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography (DECREASE) trial, investigated the use of the beta-blocker bisoprolol in high-risk patients referred for vascular surgery ***(Poldermans et al., 1999)***. In that study, the group treated with bisoprolol had a significant reduction in the incidence of death from cardiac causes as compared with patients

receiving standard care (3.4 percent vs. 17 percent) and a significant reduction in the incidence of nonfatal myocardial infarction (0 percent vs. 17 percent) ***(Poldermans et al., 1999)***.

The benefits of beta-blockers in these two studies are consistent with the proposed cascade of events that occur when sympathetic activation is triggered by perioperative stresses. Interrupting this cascade, even for a short period of time, might have long-term benefits ***(Poldermans et al., 1999)***.

More recently, a large body of data has been reported that support the pleiotropic and anti-inflammatory effects of statins, which promote the stabilization of potentially vulnerable coronary plaques and a reduction in adverse coronary events. In particular, the prehospital or preprocedure use of statins has been found to be associated with reductions in the incidence of in-hospital death in patients with acute coronary syndromes, of periprocedural myocardial infarction after percutaneous coronary intervention, and of perioperative mortality in patients undergoing major non-cardiac vascular surgery (***Poldermans et al., 2003)***.

Although no large, randomized clinical trials have been completed to confirm the efficacy of statins in these settings, the strong association shown in large observational studies supports

the inclusion of statins in the perioperative management of patients with known or strongly suspected coronary artery disease who are undergoing non-cardiac surgery ***(Poldermans et al., 2003)***.

Coronary intervention may be one effective strategy to optimize the cardiac risk patient scheduled for non-cardiac surgery (fig. 1). Available studies confirm a benefit of such an intervention if the indications for preoperative testing and intervention are independent from the surgical procedure (***Fleisher and Eagle, 2001)***. A net benefit of a preoperative intervention only exists if morbidity/mortality of non-cardiac surgery without any pre-operative intervention (= immediate clearance for surgery) is ≥ morbidity/mortality of non-cardiac surgery after extensive testing and intervention (fig. 2) (***Fleisher and Eagle, 2001)***.

Patients with low and intermediate risk procedures will not benefit. Outcome of patients after prophylactic revascularization before non-cardiac surgery seems not be different from patients with conservative management (***Fleisher and Eagle, 2001)***.