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Major Surgery after Recent Percutaneous Coronary Intervention

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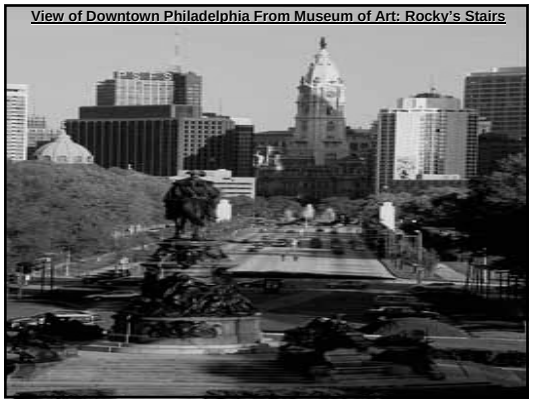
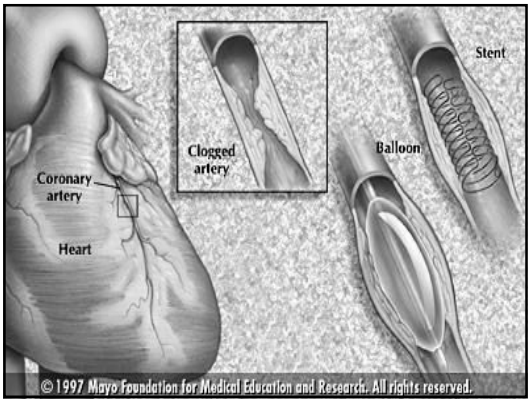
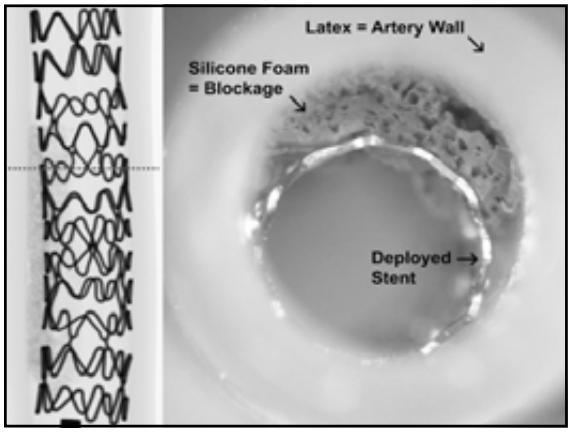


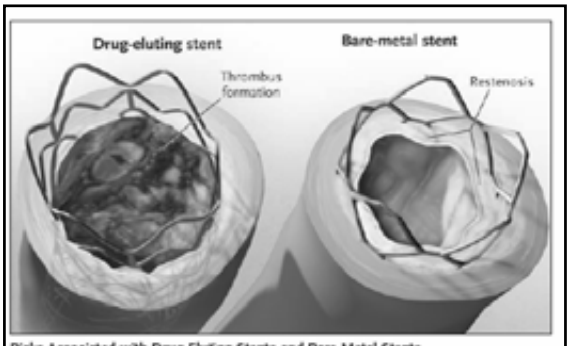
Overview

- Introduce the Coronary Stent
- Perioperative Relevance
  - Bare Metal Stent
  - Drug-Eluting Stent
- Current Guidelines
- Clinical Solutions

3/23/2008 4







Risks Associated with Drug-Eluting Stents and Bare-Metal Stents.
Ingrowth of tissue may cause bare-metal stents to become obstructed, resulting in the need for a second procedure. Drug-eluting stents inhibit this process, but uncovered struts may be prone to thrombosis after the discontinuation of antiplatelet therapy.

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

DRUG THERAPY

Coronary-Artery Stents

Patrick W. Serruys, M.D., Ph.D., Michael J.B. Kutryk, M.D., Ph.D., and Andrew T.L. Ong, M.B., B.S.

THE USE OF PERCUTANEOUSLY INTRODUCED PROSTHETIC DEVICES TO maintain the luminal congruity of diseased blood vessels was proposed by Dotter and Judkins in 1964,[1] well before the introduction of coronary angioplasty by Grüntzig et al. in 1977.[2] Palmaz et al. introduced the use of balloon-mounted stents (as used in coronary arteries today) in peripheral arteries in 1985.[3] Schatz et al. subsequently modified the Palmaz stent, which led to the development of the first commercially successful stent, the Palmaz–Schatz stent.[4] Puel and Sigwart were the first to implant a stent in humans in March 1986; they used a self-expanding mesh device. Sigwart and colleagues were also the first to describe the use of this stent in 1987 for *emergency vessel closure during balloon angioplasty*,[5] on the basis of the ability of the device to act as a scaffold to move luminal and medial flaps away from the lumen and maintain radial support to offset elastic recoil.[6] Early observational trials highlighted problems associated with the use of stents, in particular, a high incidence of subacute occlusion, despite aggressive anticoagulation regimens that prolonged hospital stays and were also associated with bleeding complications that were difficult to control and occasionally led to serious events.[7] Subsequent reports involving larger numbers of patients confirmed

from the Department of Interventional Cardiology, Thoraxcenter, Erasmus Medical Center, Rotterdam, the Netherlands (P.W.S., A.T.L.O.); and the University of Toronto, St. Michael's Hospital, Toronto (M.J.B.K.). Address reprint requests to Dr. Serruys at the Department of Interventional Cardiology, Thoraxcenter, Erasmus Medical Center, Dr. Molewaterplein 40, 3015 GD Rotterdam, the Netherlands.

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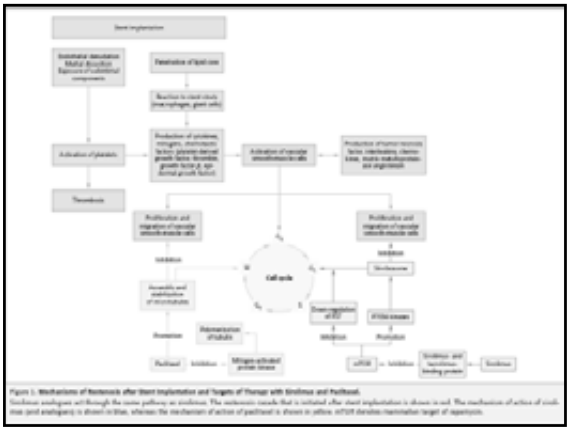
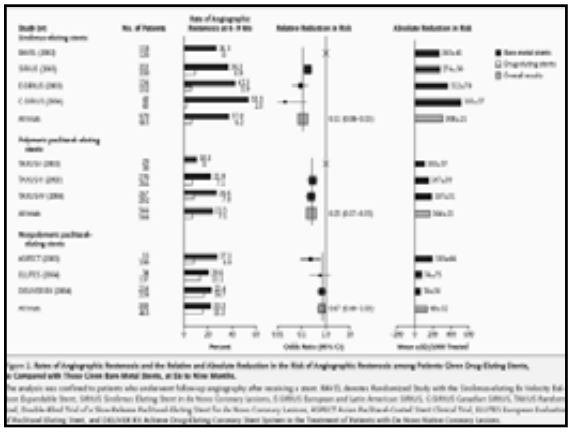
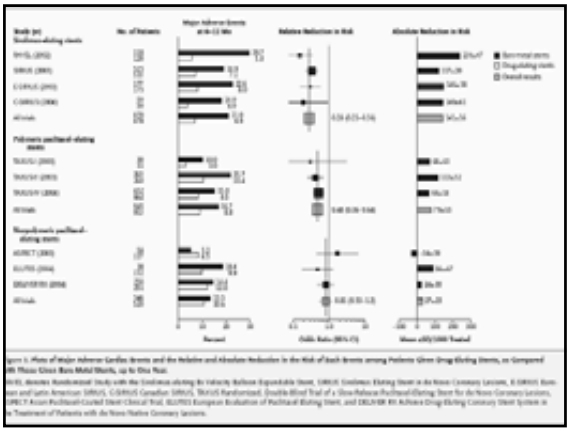
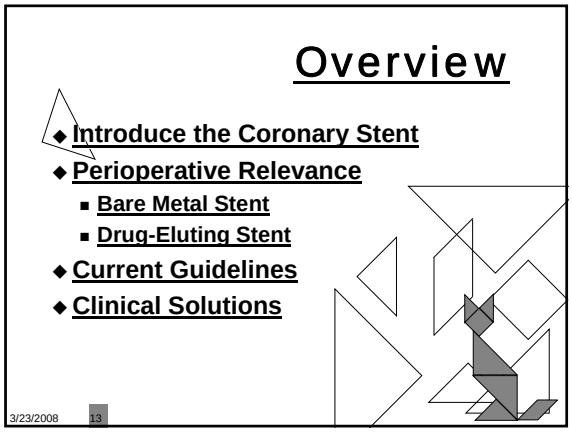
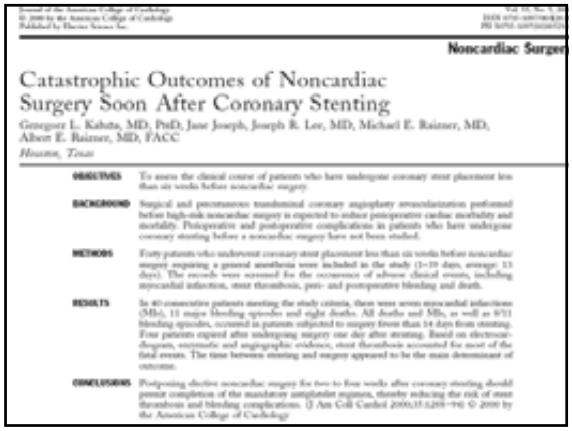







Overview
Introduce the Coronary Stent
Perioperative Relevance
Bare Metal Stent
Drug-Eluting Stent
Current Guidelines
Clinical Solutions
3/23/2008
13

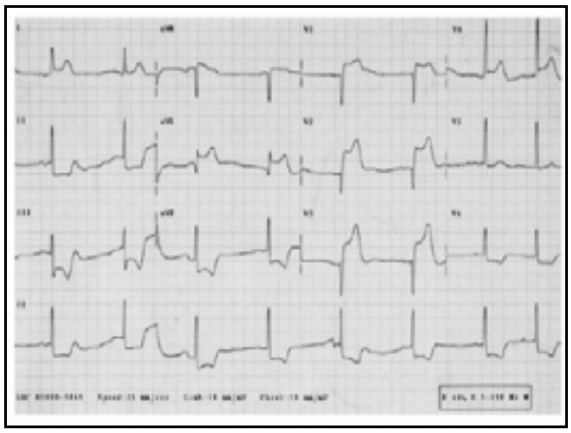

Incidence, Predictors, and Outcome of Thrombosis After Successful Implantation of Drug-Eluting Stents

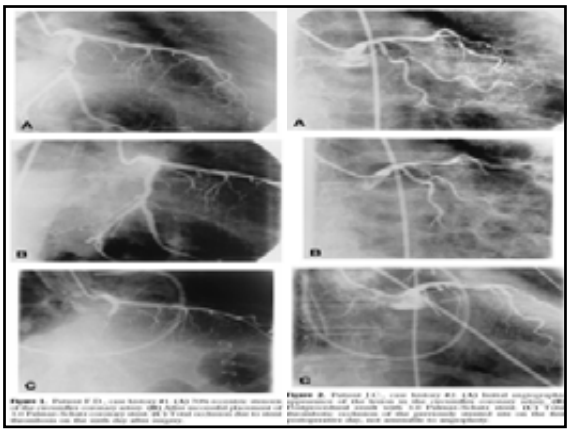

Noncardiac Surgery
Catastrophic Outcomes of Noncardiac Surgery Soon After Coronary Stenting

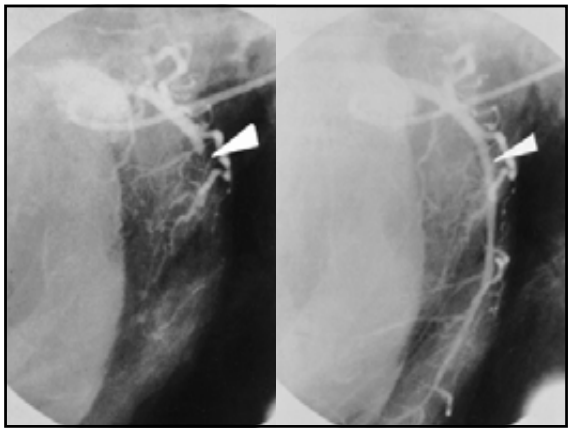

Journal of Clinical Anesthesia
Case report
Acute coronary syndrome and myocardial infarction after orthopedic surgery in a patient with a recently placed drug-eluting stent


CASE REPORTS
Late Thrombosis of a Drug-eluting Stent Presenting in the Perioperative Period


Drug-eluting Coronary Stents
What Are the Risks?







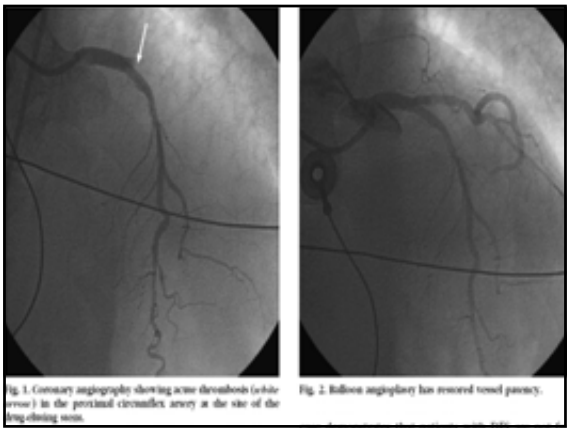
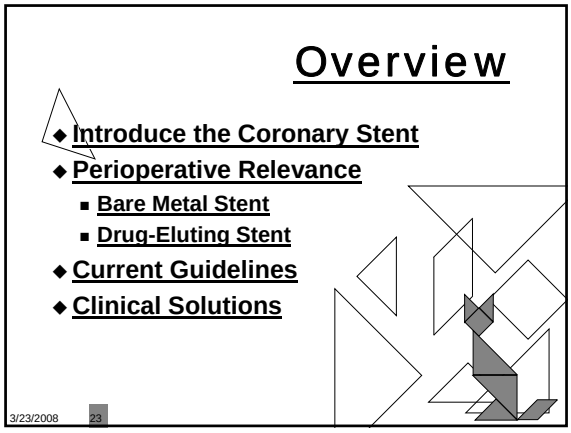


Fig. 1. Coronary angiography showing acute thrombosis (*white arrow*) in the proximal circumflex artery at the site of the drug-eluting stent.

Fig. 2. Balloon angioplasty has restored vessel patency.



Clinical Outcome of Patients Undergoing Non-Cardiac Surgery in the Two Months Following Coronary Stenting

Stephanie H. Wilson, MBBS, FRACP,* Panayotis Fasseas, MD,† James L. Orford, MBChB, MPH,‡ Ryan J. Lennon, MS,§ Terese Horlocker, MD,‖ Nina E. Charnoff, MD,‖ Steven Melby, RN,¶ Peter B. Berger, MD, FACC¶

Darlinghurst, Australia; Milwaukee, Wisconsin; Surrey, England; and Rochester, Minnesota

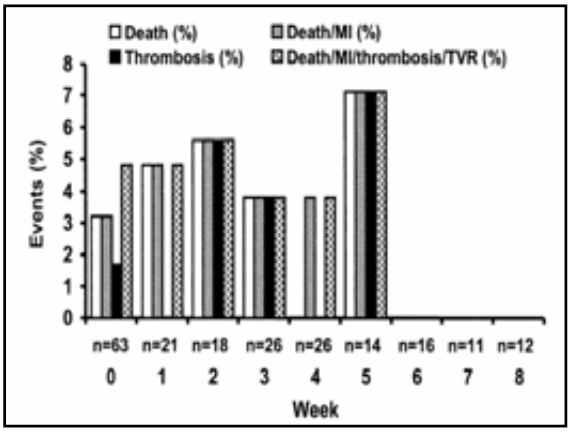
OBJECTIVES We sought to determine the frequency and timing of complications at our institution when surgery was performed within two months of coronary stent placement.

BACKGROUND The optimal delay following coronary stent placement prior to non-cardiac surgery is unknown.

METHODS We analyzed the Mayo Clinic Percutaneous Coronary Intervention and Surgical databases between 1990 and 2000 and identified 207 patients who underwent surgery in the two months following successful coronary stent placement.

RESULTS Eight patients (4.0%) died or suffered a myocardial infarction or stent thrombosis. All 8 patients were among the 168 patients (4.8%, 95% confidence interval [CI] 2.1 to 9.2) undergoing surgery six weeks after stent placement; the frequency of these events ranged from 3.8% to 7.1% per week during each of the six weeks. No events occurred in the 39 patients undergoing surgery seven to nine weeks after stent placement (0%, 95% CI 0.0 to 9.0).

CONCLUSIONS These data suggest that, whenever possible, non-cardiac surgery should be delayed six weeks after stent placement, by which time stents are generally endothelialized, and a course of antiplatelet therapy to prevent stent thrombosis has been completed. (J Am Coll Cardiol 2003;42:234–40) © 2003 by the American College of Cardiology Foundation



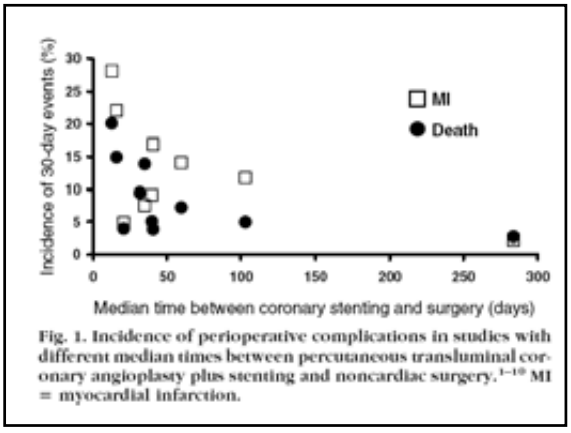


Fig. 1. Incidence of perioperative complications in studies with different median times between percutaneous transluminal coronary angioplasty plus stenting and noncardiac surgery.[1–10] MI = myocardial infarction.

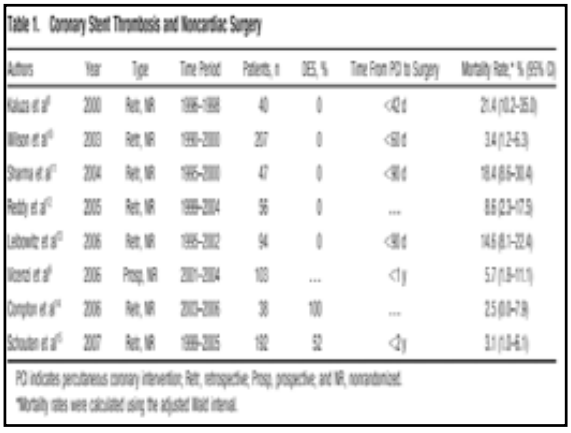


Table 1. Coronary Stent Thrombosis and Noncardiac Surgery

Authors	Year	Type	Time Period	Patients, n	DES, %	Time From PCI to Surgery	Mortality Rate,* % (95% CI)
Kaluza et al[8]	2000	Retr, NR	1996–1998	40	0	<42 d	21.4 (10.2–35.0)
Wilson et al[9]	2003	Retr, NR	1999–2000	207	0	<30 d	3.4 (1.2–6.3)
Sharma et al[7]	2004	Retr, NR	1995–2000	47	0	<90 d	19.4 (8.6–30.4)
Reddy et al[10]	2005	Retr, NR	1999–2004	56	0	…	8.6 (2.3–17.5)
Leibowitz et al[6]	2006	Retr, NR	1995–2002	94	0	<90 d	14.6 (8.1–22.4)
Wenzl et al[5]	2006	Prosp, NR	2001–2004	103	…	<1 y	5.7 (1.9–11.1)
Compton et al[4]	2006	Retr, NR	2003–2006	38	100	…	2.5 (0.6–7.9)
Schouten et al[3]	2007	Retr, NR	1999–2005	192	52	<1 y	3.1 (1.3–6.1)

PCI indicates percutaneous coronary intervention; Retr, retrospective; Prosp, prospective; and NR, nonrandomized.
*Mortality rates were calculated using the adjusted Wald interval.

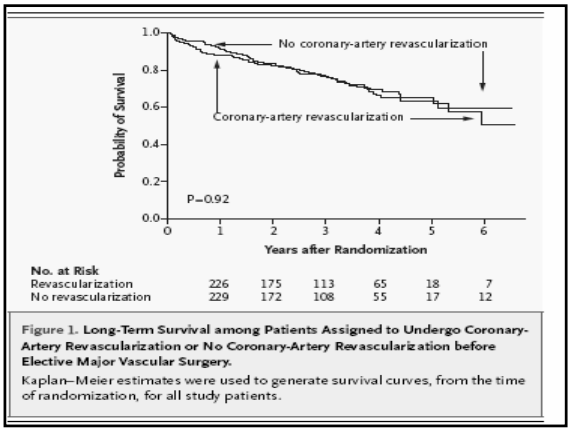


Figure 1. **Long-Term Survival among Patients Assigned to Undergo Coronary-Artery Revascularization or No Coronary-Artery Revascularization before Elective Major Vascular Surgery.**

Kaplan–Meier estimates were used to generate survival curves, from the time of randomization, for all study patients.

On the basis of the coronary angiogram, a patient was eligible for the study if one or more major coronary arteries had a stenosis of at least 70 percent and were suitable for revascularization. Local investigators decided which revascularization procedure to use, either percutaneous coronary intervention or CABG. Although percutaneous coronary intervention and CABG are considered equivalent before major noncardiac operations,[15] the potential long-term advantage of CABG among patients with diabetes and multivessel disease was recognized.[16] Anatomical exclusion criteria were a stenosis of the left main coronary artery of at least 50 percent, a left ventricular ejection fraction of less than 20 percent, and severe aortic stenosis.

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Case Report

Successful management of patients with a drug-eluting coronary stent presenting for elective, non-cardiac surgery

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This paper describes the management of three patients for elective surgery with drug-eluting stents in the coronary circulation. The risks posed at the time of surgery by such patients include acute coronary syndromes, as a result of stent thrombosis, after cessation of anti-platelet therapy and excessive bleeding from continued anti-platelet therapy. We describe a regime for the management of such patients that successfully avoided these risks in three patients with paclitaxel drug-eluting stents requiring elective non-cardiac surgery.

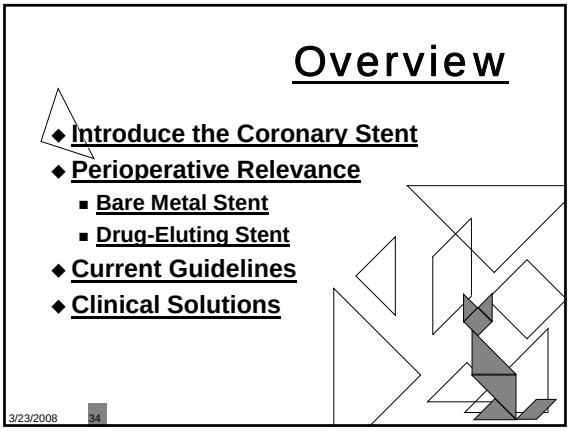
Br J Anaesth 2007; **98**: 19–22

Keywords: blood, coagulation; heart, coronary occlusion; surgery, preoperative period

Accepted for publication: November 23, 2006

Table 1 Perioperative drug guideline for patients undergoing non-cardiac surgery

5 days before surgery
Cease clopidogrel
3 days before surgery
Admit to hospital
Commence tirofiban infusion
Commence unfractionated heparin infusion
6 h before surgery
Cease tirofiban infusion
Cease heparin infusion
First postoperative day
Start loading dose of clopidogrel
Second postoperative day
Commence maintenance dose of clopidogrel
Aspirin continued throughout



Overview

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3/23/2008 34

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REVIEW ARTICLE

Coronary artery stents and non-cardiac surgery

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The safety of interventional cardiology has developed significantly over the last two decades with the introduction of coronary angioplasty and stenting, with the associated antiplatelet medications. Acute coronary stent occlusion carries a high morbidity and mortality, and the adoption of therapeutic strategies for prophylaxis against stent thrombosis has major implications for surgeons and anaesthetists involved in the management of these patients in the perioperative period. Currently, there is limited published information to guide the clinician in the optimal care of patients who have had coronary stents inserted when they present for non-cardiac surgery. This review examines the available literature on the perioperative management of these patients. A number of key issues are identified: the role of surgery in percutaneous coronary intervention for coronary revascularization in the preoperative period; the different types of coronary stents currently available; the emerging issues related to drug-eluting stents; the pathophysiology of coronary stent occlusion; and the recommended antiplatelet regimes that the patient with a coronary stent will be receiving. The role of preoperative platelet function testing is also discussed, and the various available tests are listed.

Appropriate management by all the clinicians involved with patients with coronary stents undergoing a variety of non-cardiac surgical procedures is essential to avoid a high incidence of postoperative cardiac mortality and morbidity. This review examines the evidence available for the perioperative strategies aimed at reducing adverse outcomes in a number of different clinical scenarios.

Br J Anaesth 2007; **98**: 160–74

Keywords: anaesthetic techniques, regional; coronary stenosis, drug therapy; platelet aggregation inhibitors, therapeutic use; stents; surgery, non-cardiac

Prevention of Premature Discontinuation of Dual Antiplatelet Therapy in Patients With Coronary Artery Stents

A Science Advisory From the American Heart Association, American College of Cardiology, Society for Cardiovascular Angiography and Interventions, American College of Surgeons, and American Dental Association, With Representation From the American College of Physicians*

Cindy L. Grines, MD, FACC; Robert O. Bonow, MD, FAHA, FACC; Donald E. Casey, Jr, MD, MPH, MBA, FACP; Timothy J. Gardner, MD, FAHA, FACC, FACS; Peter B. Lockhart, DDS, FDS RCSEd; David J. Moliterno, MD, FAHA, FSCAI, FACC; Patrick O'Gara, MD, FAHA, FACC; Patrick Whitlow, MD, FAHA, FACC

Abstract—Dual antiplatelet therapy with aspirin and a thienopyridine has been shown to reduce cardiac events after coronary stenting. However, many patients and healthcare providers prematurely discontinue dual antiplatelet therapy, which greatly increases the risk of stent thrombosis, myocardial infarction, and death. This advisory stresses the importance of 12 months of dual antiplatelet therapy after placement of a drug-eluting stent and educating the patient and healthcare providers about hazards of premature discontinuation. It also recommends postponing elective surgery for 1 year, and if surgery cannot be delayed, considering the continuation of aspirin during the perioperative period in high-risk patients with drug-eluting stents. (*J Am Coll Cardiol* 2007;49:734–9)

Key Words: AHA Scientific Statements ■ thrombosis ■ myocardial infarction ■ stents ■ myocardial stunning

TABLE 1. After Bare-Metal Stent Placement, Aspirin Plus Thienopyridine Reduces Cardiac Events Compared With Aspirin Alone or With Oral Antithrombins

Study	No. of Pts Studied	No. of Pts Treated	MACE, %*			P
			ASA Thienopyridine	ASA Warfarin	ASA Alone	
ISAR (32)	517	626	1.6	6.2	...	0.01
FANTASTIC (33)	473	485	5.7†	8.6†	...	0.37
STARS (34)	1653	1965	0.5	2.7	3.6	0.0001
MATTIS (35)	350	350	5.6	11.0	...	0.07
Hall et al (36)	226	358	0.8	...	3.9	0.1

MACE indicates major adverse cardiovascular events; Pts, patients; ASA, aspirin; ISAR, Intracoronary Stenting and Antithrombotic Regimen trial; FANTASTIC, Full ANTicoagulation versus ASpirin TiClopidine after stent implantation; STARS, STent Anticoagulation Regimen Study; and MATTIS, Multicenter Aspirin and Ticlopidine Trial after Intracoronary Stenting.

*Cardiac death, acute MI, or repeat target-vessel revascularization at 30 days (except for the FANTASTIC study).

†Death, MI, or stent occlusion at 6 weeks.

Adapted from ten Berg et al (1).

TABLE 2. Predictors of DES Thrombosis: Considerations for Prolonged Dual Antiplatelet Therapy

Clinical	Angiographic
Advanced age	Long stents
Acute coronary syndrome	Multiple lesions
Diabetes	Overlapping stents
Low ejection fraction	Ostial or bifurcation lesions
Prior brachytherapy	Small vessels
Renal failure	Suboptimal stent results

To eliminate premature discontinuation of thienopyridine therapy, this advisory group gives the following recommendations.

1. Before implantation of a stent, the physician should discuss the need for dual antiplatelet therapy. In patients not expected to comply with 12 months of thienopyridine therapy, whether for economic or other reasons, strong consideration should be given to avoiding a DES.
2. In patients who are undergoing preparation for percutaneous coronary intervention and are likely to require invasive or surgical procedures within the next 12 months, consideration should be given to implantation of a bare-metal stent or performance of balloon angioplasty with provisional stent implantation instead of the routine use of a DES.
3. A greater effort by healthcare professionals must be made before patient discharge to ensure patients are properly and thoroughly educated about the reasons they are prescribed thienopyridines and the significant risks associated with prematurely discontinuing such therapy.
4. Patients should be specifically instructed before hospital discharge to contact their treating cardiologist before stopping any antiplatelet therapy, even if instructed to stop such therapy by another healthcare provider.
5. Healthcare providers who perform invasive or surgical procedures and are concerned about periprocedural and postprocedural bleeding must be made aware of the potentially catastrophic risks of premature discontinuation of thienopyridine therapy. Such professionals who perform these procedures should contact the patient's cardiologist if issues regarding the patient's antiplatelet therapy are unclear, to discuss optimal patient management strategy.
6. Elective procedures for which there is significant risk of perioperative or postoperative bleeding should be deferred until patients have completed an appropriate course of thienopyridine therapy (12 months after DES implantation if they are not at high risk of bleeding and a minimum of 1 month for bare-metal stent implantation).
7. For patients treated with DES who are to undergo subsequent procedures that mandate discontinuation of thienopyridine therapy, aspirin should be continued if at all possible and the thienopyridine restarted as soon as possible after the procedure because of concerns about late-stent thrombosis.
8. The healthcare industry, insurers, the US Congress, and the pharmaceutical industry should ensure that issues such as drug cost do not cause patients to prematurely discontinue thienopyridine therapy and to thus incur catastrophic cardiovascular complications.

PCI Focused Update

2007 Focused Update of the ACC/AHA/SCAI 2005 Guideline Update for Percutaneous Coronary Intervention

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

2007 Writing Group to Review New Evidence and Update the ACC/AHA/SCAI 2005 Guideline Update for Percutaneous Coronary Intervention, Writing on Behalf of the 2005 Writing Committee

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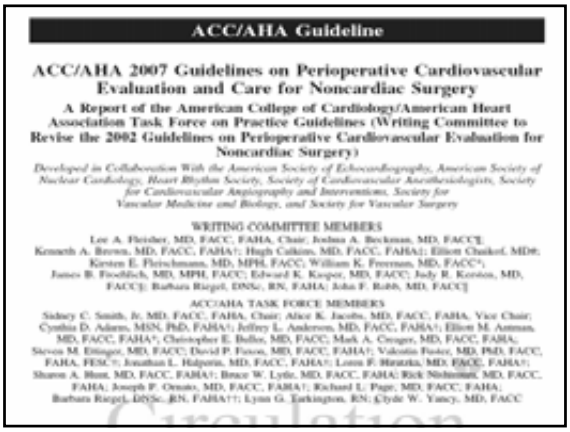

ACC/AHA Guideline

ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, and Society for Vascular Surgery

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ACC/AHA GUIDELINE

ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery)

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, and Society for Vascular Surgery

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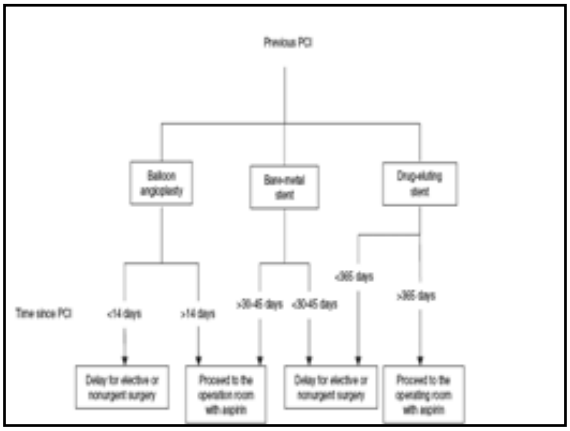

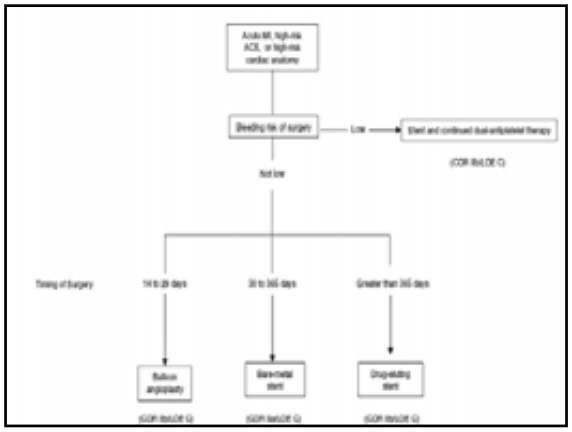

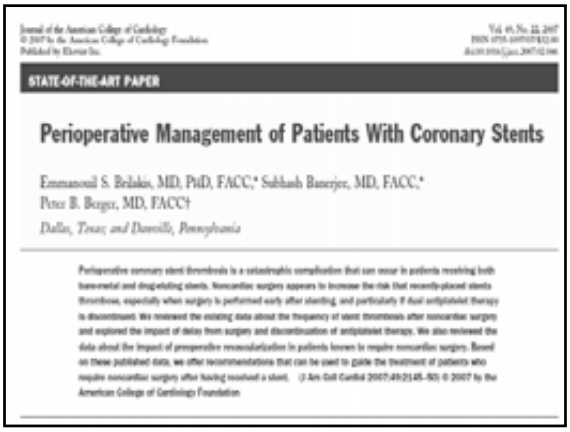

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STATE-OF-THE-ART PAPER

Perioperative Management of Patients With Coronary Stents

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Perioperative coronary stent thrombosis is a catastrophic complication that can occur in patients receiving both bare-metal and drug-eluting stents. Noncardiac surgery appears to increase the risk that recently-placed stents thrombose, especially when surgery is performed early after stenting, and particularly if dual antiplatelet therapy is discontinued. We reviewed the existing data about the frequency of stent thrombosis after noncardiac surgery and explored the impact of delay from surgery and discontinuation of antiplatelet therapy. We also reviewed the data about the impact of preoperative revascularization in patients known to require noncardiac surgery. Based on these published data, we offer recommendations that can be used to guide the treatment of patients who require noncardiac surgery after having received a stent. (J Am Coll Cardiol 2007;49:2145–50) © 2007 by the American College of Cardiology Foundation

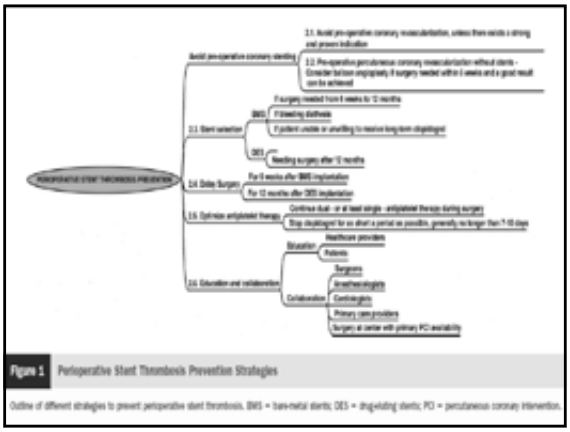

Table 2. Assessing the Risk of Surgery and Possible Stent Thrombosis

Risk of Stent Thrombosis	Risk of Surgical Bleeding: High	Moderate	Low
High	Stop all OAAs	Continue at least 1 OAA if possible	Continue all OAAs
	Consider short-acting IV antiplatelet agents while off OAAs	Consider short-acting IV antiplatelet agents while off OAAs	Proceed with surgery
	Proceed with surgery	Proceed with surgery	—
	Restart OAAs as soon as possible after surgery	Restart OAAs as soon as possible after surgery	—
Moderate	Stop all OAAs	Continue 1 OAA if possible	Continue all OAAs
	Proceed with surgery	Proceed with surgery	Proceed with surgery
	Restart OAAs as soon as possible after surgery	Restart OAAs as soon as possible after surgery	—
Low	Stop all OAAs	Stop all OAAs	Continue 1 OAA if possible
	Proceed with surgery	Proceed with surgery	Proceed with surgery
	Restart OAAs as soon as possible after surgery	Restart OAAs as soon as possible after surgery	Restart OAAs as soon as possible after surgery

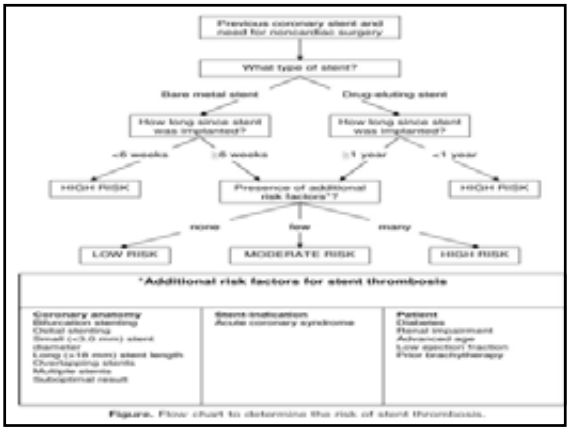

Figure. Flow chart to determine the risk of stent thrombosis.