The Management of Patients on Dual Antiplatelet Therapy Undergoing Orthopedic Surgery

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Statement of Need

As the incidence of patients on dual antiplatelet therapy after PCI using stenting has increased in orthopedics, the lack of consensus on guidelines for use/discontinuation of dual antiplatelet therapy in the perioperative setting has been identified as a patient safety issue.

Target Audience

This activity is targeted at primary care physicians, specialty physicians, orthopedic surgeons, general medicine physicians, residents, and fellows.

Objectives

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- Assess the risks and discuss the options with a cardiologist on the use of dual-antiplatelet therapy in a perioperative setting prior to orthopedic surgery
- Determine the appropriate timing for discontinuation of dual antiplatelet therapy in patients prior to orthopedic surgery
- Discuss with patients the risk associated with orthopedic surgery after PCI using either drug eluting stents (DES) or bare metal stents (BMS)
- Decipher the timing of orthopedic surgery after percutaneous coronary intervention with either bare metal stents or drug eluting stents

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Abstract Cardiovascular disease is prevalent in patients undergoing orthopedic surgery. Many patients who have undergone previous percutaneous coronary intervention (PCI) with stenting are on dual antiplatelet therapy in order to minimize the risk of stent thrombosis. The optimal management of these patients in the perioperative setting remains unclear. We aim to provide information about the management of patients who have undergone a PCI with stents who are subsequently indicated for an orthopedic procedure. We will review the concerns from a cardiologist's and orthopedic surgeon's perspective in regards to the management of these patients in the perioperative setting. In addition, the current American Heart Association, American College of Cardiology, Society for Cardiovascular Angiography and Interventions, and American College of Surgeons guidelines are reviewed. The decision to discontinue dual antiplatelet therapy in a patient who has undergone a PCI with stent should be made only after careful review of the risks for thrombosis and bleeding. Best practice suggests that these risks should be jointly assessed by the orthopedic surgeon and cardiologist. Those patients with stents at high risk of thrombosis should have surgery delayed if possible. There is little data supporting a significantly increased bleeding risk associated with mortality in orthopedic patients when antiplatelet therapy is continued perioperatively.

Keywords antiplatelet therapy · coronary artery disease · orthopedic surgery · myocardial infarction

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Introduction

Percutaneous coronary intervention (PCI) by percutaneous transluminal coronary angioplasty has been used as a method for coronary revascularization for decades. Unacceptably high rates of restenosis due to atherogenesis at the sight of plaque rupture lead to the evolution of PCI with bare metal stents (BMS). Although atherogenesis was less of an issue with BMS, it was noted that intimal hyperplasia within the stent caused restenosis. This led to the development of drug eluting stents (DES). Drug eluting stents release an anti-proliferative agent into the stent lumen to reduce occurrence of the intimal hyperplasia seen in BMS. The majority of stents used today in PCI are DES [1, 2].

A rare, but severe complication after coronary stent implantation is stent thrombosis which can occur in both stent types. Therefore, dual antiplatelet therapy is used after stent placement to minimize the incidence of thrombosis. Dual antiplatelet therapy is defined as the administration of aspirin and a thienopyridine class agent such as clopidogrel (Plavix), ticlopidine (Ticlid), and prasugrel (Effient) simultaneously and has been shown to reduce the incidence of thrombotic complications. In patients with bare metal stents, the incidence of acute thrombosis is reduced to <1% with dual antiplatelet therapy for 4–6 weeks after stent placement as opposed to a 3.8–7.1% risk without dual antiplatelet agents [3, 4].

Dual antiplatelet therapy may be required for a year or longer after DES placement, but limited data exist with regard to the risk of acute thrombosis after 1 year of uninterrupted dual platelet therapy. Noncardiac surgery appears to increase the risk of thrombosis of stents particularly if surgery is performed early after stent placement. Early after stent placement, the arterial lumen undergoes endothelialization, and it is likely that during this period, dual antiplatelet therapy is critical to the patency of the vessel. Often, dual antiplatelet therapy is discontinued in the perioperative period due to the bleeding risk associated with its use. The temporary discontinuation of antiplatelet therapy in addition to the prothrombotic state of surgery may be factors which play a role in the risk of early stent

thrombosis [5–9]. This is of particular concern for those patients with a history of PCI with stents because of the prothrombotic state and increased demand on the cardio-pulmonary system resulting from the orthopedic procedure.

From an orthopedic surgeon's perspective, perioperative bleeding risk is a valid concern. In particular, bleeding bone surfaces created in many orthopedic procedures including total hip and knee arthroplasty, open reduction, and repair of fractures as well spinal decompression and fusion can result in catastrophic complications such as epidural hematoma, sciatic hematoma, and compartment syndrome.

We aim to review the most recent data on the frequency of stent thrombosis after noncardiac surgery and explore the impact of timing of surgery in relation to stent placement and discontinuation of dual antiplatelet therapy. We also aim to review current methods in the literature presented for prevention of thrombosis in high risk patients.

Search strategy and criteria

We performed a PUBMED based data search for the topic “antiplatelet therapy” and “noncardiac surgery.” As of September 19, 2009, this lead to a total of 19 hits which included publications from 2002 to 2009. Of the 19 hits, three papers were excluded for being written in French, German, or Japanese. This left 16 papers, nine of them which were reviews and seven which were retrospectively or prospectively collected data on the topic of interest.

Risk of thrombosis in noncardiac surgery

The American College of Cardiology (ACC)/American Heart Association (AHA) guidelines currently recommends delaying elective noncardiac surgery for 1 year after PCI with a DES. Despite these recommendations, the literature reviewed for this report does not document a clear risk of thrombosis associated with the discontinuation of dual antiplatelet therapy in the 1-year period after PCI for NCS.

Rabbitts et al. from the Mayo clinic performed a retrospective review of 520 patients undergoing noncardiac surgery (NCS) within 2 years from DES placement and assessed their risk of major adverse cardiac events (MACEs) based on time between PCI and NCS [10]. The time points were stratified into 3-month periods based on

time after PCI (i.e., 0–90, 91–180, 181–365, 366–730 days). They found that the frequency of MACEs was not significantly associated with the time between PCI and NCS. Instead, patient characteristics were identified that were associated with MACEs such as advanced age and previous history of myocardial infarction as well as emergent surgeries.

The time between PCI and NCS was also examined in 899 patients who had PCI with BMS [11]. This study concluded that NCS delayed until 90 days or more after PCI with BMS was associated with the lowest risk of in-hospital MACEs (10.5% versus 2.8% rates of MACEs). Bleeding events had no significant associations with the duration of time between PCI and NCS or the use of antiplatelet therapy in the week before surgery. All the patients in this study had dual antiplatelet therapy for 4–6 weeks after the PCI.

Additional studies have compared the incidence of MACEs in patients with drug eluting stents or bare metal stents that occurred after temporarily discontinuing dual antiplatelet therapy for NCS. Kim et al. compared the outcomes of 239 patients undergoing NCS and previously treated with BMS ($n = 101$) or DES ($n = 138$) [12]. In this study, all patients undergoing surgery stopped antiplatelet therapy 5–7 days before and restarted it 1–3 days after elective NCS. They found that 2.2% of patients with DES developed postoperative cardiac events and none in the BMS group, a difference which was not statistically significant. The time interval between stent implantation and surgery in those with cardiac events was 6, 264, and 367 days in patients with DES. Although the numbers were not sufficient for drawing conclusions, it was interesting to note that no events occurred when dual antiplatelet therapy was stopped 365 days or more following stent placement.

It is clear that within the literature studied, there is no definitive agreement on a relationship between the lengths of time after percutaneous coronary intervention that NCS can safely be performed. Studies to elucidate this time-dependent thrombosis risk may also be hard to design because of the lack of uniformity in the time on dual antiplatelet therapy required by different stents types. For example, a patient with a BMS may be on dual antiplatelet therapy for 1 month, while those with DES may be on dual antiplatelet therapy for at least 1 year.

Schouten et al. conducted a study on 192 patients undergoing NCS after PCI with BMS or DES and divided their analysis to those undergoing early surgery versus late surgery. Early surgery was defined as NCS during the time in which dual antiplatelet therapy was required. According to their working definition in a patient with a BMS, early surgery would be within 1 month of stent implantation or in a patient with a DES, early surgery would be within 3–6 months of implantation [13]. According to this classification, 30 out of 192 patients underwent early surgery. There were five MACEs in the first 30 postoperative days, four of which were in the early surgery group and one in the late group (13.3% event rate in the early surgery versus 0.6% in the late surgery; $p=0.002$). Out of the 192 patients,

91 had an interruption in their antiplatelet therapy. There was no statistically significant difference in surgical risk stratification between those who had antiplatelet therapy interrupted and those who had it continued. However, the interruption was associated with a significantly higher incidence of MACE (5.5% versus 0%, $p=0.023$). The premature cessation of dual antiplatelet therapy was also shown to be detrimental with an incidence of MACE of 30.7% versus 0% in those who had it continued ($p=0.026$) regardless of stent type.

Bleeding risk on dual antiplatelet therapy

Although the literature suggests that there is an increase in surgical blood loss associated with any single antiplatelet agent as well as dual antiplatelet therapy, there is insufficient evidence to suggest that this increase in blood loss is associated with patient mortality in orthopedic surgery [3].

A recent review of the use of antiplatelet agents in surgery found that in the current literature, the average surgical blood loss increased by aspirin use was 2.5–20%. With dual antiplatelet therapy, this was increased to 30–50% [3]. This increase in bleeding was not associated with any increase in surgical mortality.

The Mayo clinic assessed 899 patients who had PCI with BMS [11]. Bleeding events had no significant associations with the duration of time between PCI and NCS. Factors which were significantly associated with bleeding events were previous MI ($p=0.016$), emergency surgery ($p=0.016$), risk classification of surgery ($p<0.001$), and the use of general anesthesia ($p=0.002$). Antiplatelet use before surgery had no significant association with postoperative bleeding events. The incidence of bleeding was 5% versus 4% versus 5.4% when antiplatelet agent was used within 7 days versus 4% if stopped more than 7 days prior to surgery or 5.4% if there was no use within 30 days of the time of surgery. An additional study [10] reported the experience in 520 patients who had PCI with DES who discontinued dual antiplatelet therapy at varying time points before NCS. There was no difference seen in adverse bleeding events or transfusion requirements between discontinuation of thienopyridine use within 7 days, 7–30 days, or >30 days prior to surgery.

Strategies for preventing stent thrombosis in noncardiac surgery

Several reports have specifically described methods of preventing stent thrombosis in noncardiac surgery among patients recently treated with coronary stents. The strategies can be divided into two main approaches with three different possibilities. One approach is to continue dual antiplatelet therapy through surgery. The second approach is to bridge the cessation of a thienopyridine class agent with a short acting glycoprotein IIb–IIIa inhibitor (Gp IIb–IIIa inhibitor) or antithrombin and then restart thienopyridine as soon as possible after surgery. The third approach is to discontinue the thienopyridine agent before surgery and

restart it as soon as possible after surgery. These strategies are based on data associating the use of dual antiplatelet therapy with bleeding [14–16]. One of these studies reported on seven patients at high risk for both perioperative bleeding and stent thrombosis [14]. In these patients, the perioperative and postoperative time interval of dual oral antiplatelet therapy interruption was bridged using a short acting intravenous GP IIb–IIIa inhibitor. Platelet function was monitored by adenosine diphosphate (ADP) induced aggregometry, and all patients were noted to have a range of platelet inhibition between 57% and 100% directly before surgery. All patients were restarted on dual antiplatelet therapy 24–48 h after surgery. All the patients at 3-month follow-up showed good clinical outcomes without evidence of stent thrombosis.

Discussion

From an orthopedic surgeon's perspective, perioperative bleeding risk is a concern that is as important as thrombosis due to the risk of PE and deep venous thrombosis (DVT) associated with orthopedic surgery. Traditionally, the choice of anticoagulation to minimize the risk of thrombosis is matched by the bleeding risks associated with its use.

Today, orthopedic surgeries are at an all time high as the numbers of patients who are in need of joint replacement surgery among other orthopedic procedures are increasing with the increasing life expectancy. A portion of the increase in life expectancy can be due to the advances in the treatment of coronary artery disease by percutaneous methods. People today are living more active lives with less cardiac morbidity in part due to percutaneous coronary interventions.

Inevitably, the proportion of patients in need of orthopedic surgery with a previous history of PCIs is also increasing and therefore challenges the orthopedic surgeon to balance anticoagulant use and bleeding risk. The question for the orthopedic surgeon is how long after PCI with a stent can dual anticoagulation be stopped safely? What is the risk of thrombosis when dual antiplatelet therapy is discontinued? What is the bleeding risk associated with dual antiplatelet therapy? How will this effect patients undergoing neuraxial anesthesia? And lastly, what can be done today with the evidence available to assure the patient will safely undergo an orthopedic surgery without having a MACE? Despite the dilemma, there has yet to be one article in the literature which specifically addresses the orthopedic patient population. All of the studies published to date address all surgical procedures as “noncardiac surgery” which includes all surgical procedures from low to high risk [10, 11, 17]. Therefore, it is difficult to interpret the findings of the literature and translate them into the orthopedic setting without some reservations.

Nonetheless, there are lessons to be learned from the available literature. The risk of thrombosis after PCI with stent is real and potentially catastrophic. It is estimated that the incidence of MACE is approximately 4–5%, and 45% of these events can result in death [3].

Orthopedic surgeons must be aware of this risk and formulate their surgical plan and perioperative management accordingly. A team approach which includes the cardiologists' concerns for stent thrombosis as well as the orthopedic surgeons' concerns for bleeding should be discussed and weighed. This more often than not will require a case by case approach since decisions will be based on a patient's medical history, type of stent placed, as well as type of orthopedic surgery planned. Nuances regarding the actual stent itself are of particular concern to the cardiologist, especially since the size and length of the stent, why the stent was placed, and which specific vessel into which it was placed are associated with more high risk patients. According to the ACC guidelines, orthopedic surgery is considered to be an intermediate risk procedure. In our review, emergent NCS regardless of type was itself associated with an increased risk for MACEs [10, 11, 16, 18]. In the era of damage control orthopedics as well as the uniformity of findings suggesting emergency surgery as a risk factor for stent thrombosis, emergent surgery may not always be best for the patient. In orthopedic surgery, compartment syndrome, acute cord compression, and acute hematoma evacuation may still require emergent surgery. However, fractures without evidence of neurovascular compromise in a hemodynamically stable patient may not need emergent fixation for patients with a history of PCI and stent. In such situations, it may be prudent to pursue non-operative interventions until a 1 year course of dual antiplatelet therapy has been completed since the time of PCI before seeking NCS.

Although some studies suggest an increase in intraoperative blood loss, this is minimal, and there is no evidence in the orthopedic literature associating excessive blood loss from aspirin use as a cause of mortality [3, 14].

For those patients undergoing surgery with spinal anesthesia, there is insufficient evidence in the literature to prove a significant increase in the incidence of epidural hematoma after spinal anesthesia. Although multiple reports in the literature have correlated higher incidences of epidural hematoma in those patients on anticoagulation, none has proven them to be causative [19]. The difficulty in performing a study to prove causation in this instance is related to the relatively rare incidence of epidural hematomas making the number needed for such a study unrealistic. The risk of spinal hematomas associated with neuraxial anesthesia is reported to be approximately one in 150,000 for epidural and one of 220,000 for spinal anesthesia [19, 20]. Designing a study with sufficient power to prove a causal relationship between neuraxial anesthesia and the incidence of spinal hematomas is unlikely to be feasible.

Reports of successful spinal anesthesia in the setting of dual antiplatelet therapy have been reported, and one study examining the outcomes of over 1,200 epidural steroid injections in 1,000 patients on NSAIDs has demonstrated that antiplatelet therapy does not increase the risk of spinal hematoma associated with spinal or epidural anesthesia and analgesia [19, 20].

Currently at our institution, all patients with a history of ischemic heart disease on aspirin at 81 mg are encouraged to

continue it throughout the perioperative period. Patients on dual antiplatelet therapy (Plavix, Ticlid) require a pre-operative cardiology consultation and a decision with regard to the timing of surgery, and the management of these medications in the perioperative setting is discussed between the cardiologist, surgeon, and anesthesiologist [21]. At our institution, Plavix is stopped 7 days and Ticlid 14 days prior to a major surgical procedure (although based on half-life of plavix, it can be stopped 5 days prior). Dipyridamole (a less potent antiplatelet agent compared to thienopyridines) could act as a replacement medication throughout the perioperative period. The drug's shorter half-life makes it safe to continue up to 12 h before surgery, minimizing the window when a patient is at high thrombosis risk. Currently, there is insufficient evidence to recommend the use of dipyridamole for these purposes. In addition, intravenous Gp IIa/IIIb inhibitors can also be used and have been reported in the literature [14]. Low molecular weight heparin (LMWH) has also been suggested as a possible anti-thrombotic bridge after the cessation of Plavix. However, LMWH does not have an antiplatelet mechanism of action, and it may result in a pro-coagulant rebound once stopped [5, 19, 22]. It should be noted that Warfarin does not reduce the risk of stent thrombosis or restenosis and therefore is not a substitute for antiplatelet therapy. With this in mind, the timing of re-initiating post-operative dual antiplatelet therapy must be weighed with the need for postoperative DVT prophylaxis with Warfarin.

There is still much that is unknown in regards to bleeding risk associated with dual antiplatelet therapy use in the orthopedic setting. Further studies will need to be performed specific to orthopedic surgery patients in order to shed light on the perioperative risk of thrombosis and bleeding risk associated with stents and dual antiplatelet therapy. Specifically, in future studies it would be most helpful if patients with PCI with stents undergoing orthopedic surgery could be randomized to the three different strategies of managing thrombosis risk and MACEs analyzing factors such as the time since PCI, the type of antiplatelet therapy, and the type of orthopedic procedure. The rates of bleeding complications should be collected. More evidence is necessary in deciphering the exact perioperative management of these patients in the orthopedic setting.

References

1. Newsome LT, Kutcher MA, Royster RL. Coronary artery stents: Part I. Evolution of percutaneous coronary intervention. *Anesth Analg*. 2008;107(2):552–569.
2. Newsome LT, Weller RS, Gerancher JC, Kutcher MA, Royster RL. Coronary artery stents: II. Perioperative considerations and management. *Anesth Analg*. 2008;107(2):570–590.
3. Chassot PG, Delabays A, Spahn DR. Perioperative antiplatelet therapy: the case for continuing therapy in patients at risk of myocardial infarction. *Br J Anaesth*. 2007;99(3):316–328.
4. Merritt JC, Bhatt DL. The efficacy and safety of perioperative antiplatelet therapy. *J Thromb Thrombolysis*. 2002;13(2):97–103.
5. Beving H, Zhao C, Albage A, Ivert T. Abnormally high platelet activity after discontinuation of acetylsalicylic acid treatment. *Blood Coagul Fibrinolysis*. 1996;7(1):80–84.

6. Sharrock NE, Finerty E. Hip replacement, hip seeding, and epidural anaesthesia. *Lancet*. 2005;365(9464):1011–1012.
7. Sharrock NE, Go G, Harpel PC, Ranawat CS, Sculco TP, Salvati EA. The John Charnley Award. Thrombogenesis during total hip arthroplasty. *Clin Orthop Relat Res*. 1995;319:16–27.
8. Sharrock NE, Go G, Sculco TP, Ranawat CS, Maynard MJ, Harpel PC. Changes in circulatory indices of thrombosis and fibrinolysis during total knee arthroplasty performed under tourniquet. *J Arthroplasty*. 1995;10(4):523–528.
9. Lotrionte M, Biondi-Zoccai GG. The hazards of discontinuing acetylsalicylic acid therapy in those at risk of coronary artery disease. *Curr Opin Cardiol*. 2008;23(5):487–493.
10. Rabbitts JA, Nuttall GA, Brown MJ, et al. Cardiac risk of noncardiac surgery after percutaneous coronary intervention with drug-eluting stents. *Anesthesiology*. 2008;109(4):596–604.
11. Nuttall GA, Brown MJ, Stombaugh JW, et al. Time and cardiac risk of surgery after bare-metal stent percutaneous coronary intervention. *Anesthesiology*. 2008;109(4):588–595.
12. Kim HL, Park KW, Kwak JJ, et al. Stent-related cardiac events after non-cardiac surgery: drug-eluting stent vs. bare metal stent. *Int J Cardiol*. 2008;123(3):353–354.
13. Schouten O, van Domburg RT, Bax JJ, et al. Noncardiac surgery after coronary stenting: early surgery and interruption of antiplatelet therapy are associated with an increase in major adverse cardiac events. *J Am Coll Cardiol*. 2007;49(1):122–124.
14. Bigalke B, Seizer P, Geisler T, Lindemann S, Gawaz M, May AE. Perioperative antiplatelet therapy in patients at risk for coronary stent thrombosis undergoing noncardiac surgery. *Clin Res Cardiol*. 2009;98(5):335–339.
15. Schouten O, Bax JJ, Poldermans D. Management of patients with cardiac stents undergoing noncardiac surgery. *Curr Opin Anaesthesiol*. 2007;20(3):274–278.
16. Sharma AK, Ajani AE, Hamwi SM, et al. Major noncardiac surgery following coronary stenting: when is it safe to operate? *Catheter Cardiovasc Interv*. 2004;63(2):141–145.
17. Doser M, Eberle B. Preoperative preparation of patients with cardiovascular disease for noncardiac surgery. *Ther Umsch*. 2009;66(7):525–530.
18. Rajamanickam A, Singh V, Aneja A. When is it appropriate to stop antiplatelet therapy in a patient with a drug-eluting stent prior to noncardiac surgery? IMPACT consults. Proceedings of the 2nd Annual Cleveland Clinic Perioperative Medicine Summit. *Cleve Clin J Med*. 2006;73 Electronic Suppl 1:S7–9.
19. Horlocker TT. Thromboprophylaxis and neuraxial anesthesia. *Orthopedics*. 2003;26(2 Suppl):s243–9.
20. Horlocker TT, Bajwa ZH, Ashraf Z, et al. Risk assessment of hemorrhagic complications associated with nonsteroidal antiinflammatory medications in ambulatory pain clinic patients undergoing epidural steroid injection. *Anesth Analg*. 2002;95(6):1691–7, table of contents.
21. Piriou V. Management of coronary risk patients before anesthesia. *Presse Med*. 2009;38(7–8):1110–1119.
22. DiGiovanni CW, Restrepo A, Gonzalez Della Valle AG, et al. The safety and efficacy of intraoperative heparin in total hip arthroplasty. *Clin Orthop Relat Res*. 2000;379:178–185.

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Please read each question and circle the correct answer

- 1) What is the risk of stent thrombosis if AHA (American Heart Association) Guidelines regarding the recommended use of dual antiplatelet therapy are adhered to?
 - a. <1%
 - b. 2%
 - c. 5%
 - d. 10%
 - e. None of the Above
- 2) A 75 year old woman 6 months status post a Left Anterior Descending Artery revascularization with a Drug Eluting Stent on dual anti-platelet therapy presents for elective knee replacement surgery. You advise her:
 - a. Proceed with surgery on her current therapy
 - b. Proceed with surgery on aspirin without a thienopyridine
 - c. Proceed with surgery on a thienopyridine without aspirin
 - d. Postpone surgery until at least 1 year after the stent was implanted
- 3) A 75 year old woman 6 months status post a Left Anterior Descending Artery revascularization with a Bare Metal Stent on dual anti-platelet therapy presents for elective knee replacement surgery. You advise her:
 - a. Proceed with surgery on her current therapy
 - b. Proceed with surgery on aspirin without a thienopyridine
 - c. Proceed with surgery on a thienopyridine without aspirin
 - d. Postpone surgery until at least 1 year after the stent was implanted
- 4) A 75 year old woman 6 months status post a Left Anterior Descending Artery revascularization with a Drug Eluting Stent on dual anti-platelet therapy presents for emergent hip open reduction and internal fixation. You advise her:
 - a. Proceed with surgery on her current therapy
 - b. Proceed with surgery on aspirin without a thienopyridine
 - c. Proceed with surgery on a thienopyridine without aspirin
 - d. Postpone surgery until at least 1 year after the stent was implanted
- 5) What is the estimated incidence of an epidural hematoma from neuroaxial anesthesia?
 - a. 1/150,000
 - b. 1/220,000

- c. 1/100
d. 1/10,000
e. None of the Above
- 6) What is the estimated incidence of a major adverse cardiac event when undergoing surgery within one year after PCI with Stent?
- a. 4-5%
b. 7-10%
c. 10-15%
d. 15-20%
e. None of the above
- 7) Significant blood loss leading to mortality is associated with the continued use of antiplatelet therapy during orthopaedic surgery
- a. True
b. False
- 8) A 70 year old man 3 weeks status post an anterior myocardial infarction necessitating implantation of 3 sequential Drug Eluting Stents in his proximal, mid, and distal Left Anterior Descending Artery presents following a fall from which he sustained a hip fracture; he requires urgent surgical therapy without which he will be bed-bound and high risk for mortal complications. You advise:
- a. Proceed with surgery on his current therapy
b. Proceed with surgery on aspirin without a thienopyridine
c. Proceed with surgery on a thienopyridine without aspirin
d. Postpone surgery until at least 1 year after the stent was implanted
- 9) Aspirin use is associated with an increased risk for epidural hematoma
- a. True
b. False
- 10) A 70 year old man 3 weeks status post an anterior myocardial infarction necessitating implantation of 3 sequential Drug Eluting Stents in his proximal, mid, and distal Left Anterior Descending Artery presents following a fall from which he sustained a hip fracture; he requires urgent surgical therapy without which he will be bedbound and high risk for mortal complications. You advise:
- a. Proceed with surgery on his current therapy
b. Proceed with surgery with subcutaneous Enoxaparin bridge off aspirin and the thienopyridine
c. Proceed with surgery with oral Dipyridamole bridge off aspirin and the thienopyridine
d. Proceed with surgery with intravenous Glycoprotein IIb/IIIa bridge off aspirin and the thienopyridine

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How likely are you to implement the following strategies in your practice:

(Scale: 1= Not At All Certain; 7= Very Certain)

Assess the risks and discuss the options with a cardiologist on the use of dual-antiplatelet therapy in a perioperative setting prior to orthopaedic surgery. 1 2 3 4 5 6 7
□ □ □ □ □ □ □

Determine the appropriate timing for discontinuation of dual anti-platelet therapy in patients prior to orthopaedic surgery 1 2 3 4 5 6 7
□ □ □ □ □ □ □

Discuss with patients the risk associated with orthopaedic surgery after PCI using either drug eluting stents (DES) or bare metal stents (BMS) 1 2 3 4 5 6 7
□ □ □ □ □ □ □

Determine the timing of orthopaedic surgery after percutaneous coronary intervention with either bare metal stents or drug eluting stents 1 2 3 4 5 6 7
□ □ □ □ □ □ □

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Was the learning format(s) for this activity appropriate for the content being presented?

☐ Yes ☐ No

What new information do you feel that this CME activity should have provided in order to improve your:

Competence _____
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