Perioperative Management of Cardiovascular Medications

Carmine D’Amico, D.O.

Overview

- Learning objectives
- Beta-blockers
- Statins
- Alpha-2 agonists
- Calcium channel blockers
- ACE inhibitors and ARB’s
- Anticoagulants
- Antiplatelet agents
- Clinical case scenarios
Abbreviations

- **ACC**: American College of Cardiology
- **AHA**: American Heart Association
- **ACE**: Angiotensin-converting enzyme
- **ARB**: Angiotensin receptor blocker
- **MACE**: Major adverse cardiac event(s)

(Cont.)

Abbreviations (cont.)

- **RCRI**: Revised Cardiac Risk Index
- **ACS**: Acute coronary syndrome
- **PCI**: Percutaneous coronary intervention
- **DAPT**: Duel antiplatelet therapy
- **BMS**: Bare metal stent
- **DES**: Drug-eluting stent
Perioperative Management

Learning Objectives

1. Discuss the perioperative management of the following classes of medication in patients undergoing noncardiac surgery:
   • Beta-blockers
   • Statins
   • Alpha-2 agonists
   • Calcium channel blockers
   • ACE inhibitors and ARB’s
   • Anticoagulants
   • Antiplatelet agents

Learning Objectives (cont.)

2. Apply this information to clinical scenarios.
Perioperative Management

**Beta-blockers**

- Based on most recent ACC/AHA guidelines:
  - Should **not** be initiated on the day of surgery!
  - Should be continued in patients who have been on beta-blockers chronically
  - **It may be reasonable to begin β-blockers preoperatively***:
    - In patients with intermediate- (moderate) or high-risk myocardial ischemia noted on preoperative stress testing
    - In patients with 3 or more RCRI risk factors

*may be started 2-7 days prior to surgery, although few data suggest starting β-blockers > 30 days prior to surgery is preferred

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**Revised Cardiac Risk Index**

<table>
<thead>
<tr>
<th>Two or more of the following risk factors make a patient “high risk.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-risk surgery (intraperitoneal, intrathoracic, or supra-inguinal vascular procedures)</td>
</tr>
<tr>
<td>History of ischemic heart disease</td>
</tr>
<tr>
<td>History of congestive heart failure</td>
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<tr>
<td>History of cerebrovascular disease</td>
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<tr>
<td>Preoperative treatment with insulin</td>
</tr>
<tr>
<td>Preoperative serum creatinine &gt;2.0 mg/dL</td>
</tr>
</tbody>
</table>
Perioperative Management

Statins

• Based on most recent ACC/AHA guidelines:
  • Should be continued in patients who have been on statins chronically
  • *It is reasonable* to begin statins preoperatively in patients undergoing vascular surgery.
  • Preoperative initiation of statin therapy *may be considered* in patients scheduled for elevated-risk procedures who have clinical indications for initiation of statin therapy.

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Alpha-2 agonists

• Based on most recent ACC/AHA guidelines:
  • Preoperative initiation of an alpha-2 agonist for prevention of cardiac events *is not recommended.*
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**Calcium channel blockers**

- Based on most recent ACC/AHA guidelines:
  - Limited data
  - “A large-scale trial is needed to define the value of these agents.”

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**ACE inhibitors and ARB’s**

- Based on most recent ACC/AHA guidelines:
  - It is reasonable to continue these agents perioperatively.
  - If they are held before surgery, it is reasonable to restart them as soon as clinically feasible postoperatively.
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**Anticoagulants**

- **Based on most recent ACC/AHA guidelines:**
  - It is reasonable to continue anticoagulation throughout the perioperative period for low bleeding risk procedures.
  - For intermediate- and high-risk procedures, the timing of anticoagulant discontinuation and need for “bridging” therapy depends on the risk of thrombosis while off anticoagulants vs. procedural bleeding risk.

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**PERIOPERATIVE MEDICAL INTERVENTION WHEN CONSIDERING NONCARDIAC SURGERY**

<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>Beta-blockers</td>
<td>- Start in intermediate- to high-risk patients</td>
</tr>
<tr>
<td>Statins</td>
<td>- Should not start on day of surgery</td>
</tr>
<tr>
<td>Alpha-agonist</td>
<td>- Should not be withdrawn if taken chronically</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>- Continued in patients with clinical indications, undergoing elevated-risk procedures</td>
</tr>
</tbody>
</table>

- Anticoagulant initiation not recommended prior to noncardiac surgery.

- Continued, or if held before surgery, restart postoperatively as soon as clinically feasible.

- Continued when the risk of increased bleeding outweighs the risk of increased bleeding.

Anticoagulants (cont.)

• Temporary interruption of oral anticoagulant therapy for invasive procedures:
  • For nonvalvular atrial fibrillation, short-term interruption of oral anticoagulant therapy is safe for most patients, provided that they have not previously suffered a stroke.
  • For patients at higher thromboembolic risk who are undergoing high risk procedures, “bridging” with a parenteral anticoagulant becomes a stronger consideration.

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Anticoagulants (cont.)

• Temporary interruption of oral anticoagulant therapy for invasive procedures (cont.):
  • Warfarin
    • Number of days warfarin must be withheld prior to procedure depends on that individual’s usual maintenance dose
    • Check INR prior to procedure to assure subtherapeutic level
  • Dabigatran
    • If CrCl > 50 ml/min, stop dabigatran at least 1-2 days prior to procedure
    • If CrCl < 50 ml/min, stop dabigatran at least 3-5 days prior to procedure
Anticoagulants (cont.)

**Temporary interruption of oral anticoagulant therapy for invasive procedures (cont.):**

- **Apixaban**
  - For moderate-high-bleeding risk procedures, stop apixaban at least 48 hours prior to the procedure.
  - For low bleeding-risk procedures, stop apixaban at least 24 hours prior to the procedure.

- **Rivaroxaban & edoxaban**
  - Stop rivaroxaban and edoxaban at least 24 hours (> 48 hours for procedures in which hemostatic control is essential) prior to the procedure.

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Perioperative Management

Cardiology > Prevention

Another NOAC, Bevyxxa, Approved; PCSK9 Vaccine; HF and Diabetes

Recent developments of interest in cardiovascular medicine

by Crystal Phend, Senior Associate Editor, MedPage Today June 26, 2017

The FDA approved direct factor Xa inhibitor betrixaban (Bevyxxa) for the prophylaxis of venous thromboembolism in adults hospitalized for an acute medical illness at risk due to moderate or severe restricted mobility and other risk factors. The recommended dose is an initial single dose of 160 mg then 80 mg once daily for 35 to 42 days.
Anticoagulation for Prosthetic Valves

Risk factors include AF, previous thromboembolism, LV dysfunction, hypercoagulable condition, and older-generation mechanical AVR.

AF indicates atrial fibrillation; ASA, aspirin; AVR, aortic valve replacement; INR, international normalized ratio; LMWH, low-molecular-weight heparin; MVR, mitral valve replacement; PO, by mouth; QD, every day; SC, subcutaneous; TAVR, transcatheter aortic valve replacement; UFH, unfractionated heparin; and VKA, vitamin K antagonist.

Figure Legend:
Anticoagulation for Prosthetic Valves

Risk factors include AF, previous thromboembolism, LV dysfunction, hypercoagulable condition, and older-generation mechanical AVR.

AF indicates atrial fibrillation; ASA, aspirin; AVR, aortic valve replacement; INR, international normalized ratio; LMWH, low-molecular-weight heparin; MVR, mitral valve replacement; PO, by mouth; QD, every day; SC, subcutaneous; TAVR, transcatheter aortic valve replacement; UFH, unfractionated heparin; and VKA, vitamin K antagonist.
Perioperative Management

Anticoagulants (cont.)

“Risk factors” on previous slide include:

• Atrial fibrillation
• Previous thromboembolism
• LV dysfunction
• Hypercoagulable condition
• Older-generation mechanical valve prosthesis

Cardiovascular Case for questions 1 & 2

Use the following case for the next two questions:

A 46-year-old female presents for preoperative evaluation prior to elective total abdominal hysterectomy. Her medical history is significant for uterine fibroids, hypertension, and paroxysmal atrial fibrillation. An echocardiogram performed last month revealed normal left ventricular systolic function, mild tricuspid regurgitation, trace mitral regurgitation, and no significant structural abnormalities. Her medications include warfarin 2 mg PO daily and atenolol 25 mg PO BID. Her INR is 2.8. The remainder of her lab work (CBC and CMP) is within normal limits. Physical examination reveals: blood pressure 126/82 mmHg, pulse 80 bpm, and respirations 12 per min. There is no jugular venous distension, lungs are clear to auscultation bilaterally (no crackles or wheezes), cardiac rhythm is regular and there is no S3, S4, murmur, or rub. There is no peripheral edema.
Cardiovascular Case 1

Question 1

Which of the following is the most appropriate recommendation regarding anticoagulation prior to surgery?

A. Discontinue warfarin now, as anticoagulation is not indicated in this patient.

B. Discontinue warfarin four days prior to scheduled surgery. Check the INR daily. When the INR is < 2, begin enoxaparin 1 mg/kg SQ BID and continue it until the morning of surgery.

C. Discontinue warfarin four days prior to scheduled surgery. Check the INR the morning of scheduled surgery. Proceed with surgery if the INR is < 2.

D. Continue warfarin through the day before scheduled surgery. Withhold warfarin on the morning of surgery and initiate a continuous intravenous infusion of unfractionated heparin, which may then be discontinued on call to the operating room.
Cardiovascular Case 1

Question 2

Provided that the surgery was uneventful, which of the following is the most appropriate recommendation regarding anticoagulation postoperatively?

A. Do not resume anticoagulation postoperatively, as it is not indicated in this patient.

B. Resume warfarin as soon as the surgeon feels that the patient is at a low risk for bleeding. Discharge the patient when the INR is ≥ 2.

C. Begin enoxaparin 1 mg/kg SQ BID and resume warfarin 2 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding. Check the INR daily. Discontinue enoxaparin and discharge the patient when the INR is ≥ 2.

D. Begin enoxaparin 1 mg/kg SQ BID and resume warfarin 2 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding. Check the INR daily until the INR is ≥ 2. Discontinue enoxaparin after 10 doses regardless of INR.
Cardiovascular Case for questions 3 & 4

Use the following case for the next two questions:

A 66-year-old male presents for preoperative evaluation prior to elective total right knee arthroplasty. His medical history is significant for DJD, type II diabetes mellitus, and paroxysmal atrial fibrillation. An echocardiogram performed three months ago revealed mild left ventricular systolic dysfunction (LVEF 45%), mild mitral regurgitation, trace tricuspid regurgitation, and mild thickening of the aortic valve without stenosis. His medications include rivaroxaban 20 mg PO daily, metformin 500 mg PO BID, sitagliptin 100 mg PO daily, metoprolol 25 mg PO BID, and acetaminophen 650 mg PO q 6 hrs. PRN pain. His preoperative lab work (including PT/INR, CBC, and CMP) are within normal limits. Physical examination reveals: Temperature 97.8°F, blood pressure 122/76 mmHg, pulse 68 bpm, and respirations 14 per min. There is no jugular venous distension, lungs are clear to auscultation bilaterally, cardiac rhythm is regular, a soft S4 is present, and there is no S3. A grade 2/6 pansystolic murmur is heard at the cardiac apex. Abdominal exam is unremarkable. With the exception of mild swelling of the right knee, there is no peripheral edema.

Cardiovascular Case 2

Question 3

Which of the following is the most appropriate recommendation regarding anticoagulation prior to surgery?

A. Discontinue rivaroxaban now, as anticoagulation is not indicated in this patient.

B. Discontinue rivaroxaban 48 hours prior to scheduled surgery. Begin enoxaparin 1 mg/kg SQ BID 24 hours after the last rivaroxaban dose. Discontinue enoxaparin on the morning of surgery.

C. Discontinue rivaroxaban 48 hours prior to scheduled surgery. Order a factor Xa inhibition assay on the morning of scheduled surgery. Proceed with surgery if the assay reveals subtherapeutic factor Xa inhibition.

D. Discontinue rivaroxaban 48 hours prior to scheduled surgery.
Cardiovascular Case 2

Question 3

Which of the following is the most appropriate recommendation regarding anticoagulation prior to surgery?

A. Discontinue rivaroxaban now, as anticoagulation is not indicated in this patient.

B. Discontinue rivaroxaban 48 hours prior to scheduled surgery. Begin enoxaparin 1 mg/kg SQ BID 24 hours after the last rivaroxaban dose. Discontinue enoxaparin on the morning of surgery.

C. Discontinue rivaroxaban 48 hours prior to scheduled surgery. Order a factor Xa inhibition assay on the morning of scheduled surgery. Proceed with surgery if the assay reveals subtherapeutic factor Xa inhibition.

D. Discontinue rivaroxaban 48 hours prior to scheduled surgery.

Question 4

Provided that the surgery was uneventful, which of the following is the most appropriate recommendation regarding anticoagulation postoperatively?

A. Do not resume anticoagulation postoperatively, as it is not indicated in this patient.

B. Resume rivaroxaban 20 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding. Obtain a factor Xa inhibition assay daily after resuming rivaroxaban. Discharge the patient when the assay reveals therapeutic factor Xa inhibition.

C. Begin enoxaparin 1 mg/kg SQ BID and resume rivaroxaban 20 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding. Discontinue enoxaparin after four days, as it takes five half-lives to achieve steady state with rivaroxaban.

D. Resume rivaroxaban 20 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding.
Cardiovascular Case 2

Question 4

Provided that the surgery was uneventful, which of the following is the most appropriate recommendation regarding anticoagulation postoperatively?

A. Do not resume anticoagulation postoperatively, as it is not indicated in this patient.

B. Resume rivaroxaban 20 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding. Obtain a factor Xa inhibition assay daily after resuming rivaroxaban. Discharge the patient when the assay reveals therapeutic factor Xa inhibition.

C. Begin enoxaparin 1 mg/kg SQ BID and resume rivaroxaban 20 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding. Discontinue enoxaparin after four days, as it takes five half-lives to achieve steady state with rivaroxaban.

D. Resume rivaroxaban 20 mg PO daily as soon as the surgeon feels that the patient is at a low risk for bleeding.

https://youtu.be/-4EDhdAHrOg
Antiplatelet agents

Based on most recent ACC/AHA guidelines:

- For elective (non-urgent, non-emergent) noncardiac noncarotid surgery in patients who have **not** had previous coronary stenting:
  - Initiation or continuation aspirin is **not beneficial**
  - “It may be reasonable to continue aspirin (low-dose) perioperatively when the risk of increased cardiac events outweighs the risk of increased bleeding.”

(cont.)
**CENTRAL ILLUSTRATION:** Antiplatelet Therapy Considerations in Post-PCI Patients During Noncardiac Surgery


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**Supplemental Figure 1: Guideline Recommendations On Timing of Non-cardiac Surgery Post-PCI**

Post-PCI patients referred for elective NCS

- **BMS**
  - NCS<30d
  - NCS≥30d

- **DES**
  - NCS<3m
  - NCS=3-6m
  - NCS>6m

PCI: percutaneous coronary intervention; NCS: non-cardiac surgery and procedures; BMS: bare-metal stents; DES: drug-eluting stents; d: days; m: months. Figure adapted from 2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease. Green color box indicates class III guideline recommendation or harm, yellow indicates IIb and green indicates class I recommendation.
2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease

FIGURE 1 Master Treatment Algorithm for Duration of P2Y12 Inhibitor Therapy in Patients With CAD Treated With DAPT

Legend for the preceding figure:

Colors correspond to class of recommendation in Table 1. Clopidogrel is the only currently used P2Y12 inhibitor studied in patients with SHD undergoing PCI. Aspirin therapy is almost always continued indefinitely in patients with CAD. Patients with a history of ACS >1 year prior who have since remained free of recurrent ACS are considered to have transitioned to SHD. In patients treated with DAPT after DES implantation who develop a high-risk of bleeding (e.g., treatment with oral anticoagulant therapy), are at high risk of severe bleeding complication (e.g., major interventional surgery), or develop significant overt bleeding, discontinuation of P2Y12 inhibitor therapy after 3 months for SHD or after 6 months for ACS may be reasonable. Arrows at the bottom of the figure denote that the optimal duration of prolonged DAPT is not established. ACS indicates acute coronary syndrome; BMS, bare metal stent; CARG, coronary artery bypass graft surgery; CAD, coronary artery disease; DAPT, dual antiplatelet therapy; DES, drug-eluting stent; Hx, history; lytic, fibrinolytic therapy; NSTE-ACS, non-ST-elevation acute coronary syndrome; PCI, percutaneous coronary intervention; SHD, stable ischemic heart disease; S/P, status post; and STEMI, ST-elevation myocardial infarction.


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**FIGURE 6** Treatment Algorithm for the Timing of Elective Nonsurgical Surgery in Patients With Coronary Stents

A few more Cardiovascular Case Presentations...

Management of DAPT in noncardiac surgery patients...

The following cases were taken from...

Review Topic of the Week

Use of Antiplatelet Therapy/DAPT for Post-PCI Patients Undergoing Noncardiac Surgery

Sohbath Banerjee, MD,1,2* Dominick J. Angiolillo, MD, PhD,1,3 William E. Boden, MD,1 Joseph G. Murphy, MD,1
Sheenam Khalili, MD,1,4 Ahmed A. Hanan, MD, PhD,1 Robert A. Harrington, MD,1 Sunil V. Rao, MD1,5

Abstract

Dual antiplatelet therapy (DAPT) is prescribed to millions of patients worldwide following coronary stenting. DAPT is indicated to lower the risk of ischemic events, such as myocardial infarction, including stent thrombosis, ischemic stroke, or death from cardiovascular causes. A significant number of these patients undergo noncardiac surgery and may require DAPT interruption. This poses a significant clinical dilemma because DAPT interruption exposes patients to the potential risk of stent thrombosis, perioperative myocardial infarction, or both. Conversely, continuing DAPT may be associated with excess bleeding complications. Observational data in this area are conflicting, and there are no randomized clinical trials to guide practitioners' decision making. On the basis of predominantly consensus recommendations, various strategies for managing DAPT during the perioperative period have been proposed. This review presents 3 commonly encountered clinical scenarios that lead into an evidence-based discussion of practical strategies for managing perioperative antiplatelet therapy in patients following percutaneous coronary intervention. J Am Coll Cardiol 2017;69:1841-60. Published by Elsevier on behalf of the American College of Cardiology Foundation.
**CASE 1.** A 52-year-old man with no significant past medical history is admitted for evaluation of painless rectal bleeding. Colonoscopy shows stage I transverse colon carcinoma with near lumen obstruction. The patient experiences retrosternal chest discomfort while in recovery, relieved partially with sublingual nitroglycerin, accompanied by 2 mm of ST-segment depression in leads V₁₋₃, an elevated troponin I level consistent with the diagnosis of non-ST-segment elevation acute coronary syndrome (NSTE-ACS), and a stable hemoglobin value. The cardiology consult team recommends coronary angiography, which is performed the following day. It reveals preserved left ventricular systolic function and a severe proximal left anterior descending coronary artery (LAD) stenosis. Your interventionalist reaches out to you for guidance on how to best address this “on-table” coronary revascularization dilemma and ensuing questions surrounding dual antiplatelet therapy (DAPT) recommendations preceding the patient’s colon surgery, which, by all measures, cannot be postponed indefinitely.

<table>
<thead>
<tr>
<th>Case 1</th>
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<tbody>
<tr>
<td><strong>Clinical problem</strong> Post-colonoscopy NSTE-ACS with high-grade proximal LAD stenosis</td>
</tr>
<tr>
<td><strong>Management options</strong></td>
</tr>
<tr>
<td>(a) Medical management of NSTE-ACS with IV nitroglycerin, aspirin, and beta-blockers as tolerated and recommend urgent colectomy during this hospital admission</td>
</tr>
<tr>
<td>(b) Perform LAD PCI with a BMS followed by treatment with daily low-dose aspirin (81 mg) and clopidogrel (75 mg) after a loading dose, and a recommendation for colectomy in 6 weeks</td>
</tr>
</tbody>
</table>

(cont.)
### What the experts say…

**Case 1**

<table>
<thead>
<tr>
<th>Clinical problem</th>
<th>Proposed strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-colonoscopy NSTE-ACS with high-grade proximal LAD stenosis</td>
<td>Balloon angioplasty of the proximal LAD lesion followed by treatment with daily low-dose aspirin (81 mg) and clopidogrel (75 mg) after a loading dose and defer colectomy for at least 2 weeks</td>
</tr>
</tbody>
</table>
**Case 2.** A 72-year-old obese woman, with a history of type 2 diabetes mellitus, prior MI, and 4-vessel CABG 5 years ago, presents for pre-operative evaluation before an elective right knee replacement surgery to treat her longstanding disabling osteoarthritis. Since CABG, she has undergone 3 PCI procedures and received 12 coronary DES implants, the latest approximately 14 months ago (3 DES to the right coronary artery). She is currently on low-dose aspirin and ticagrelor.

Which of the following options is the preferred perioperative antiplatelet management strategy: 1) advise against knee surgery; 2) perform myocardial perfusion imaging with pharmacological stress and, if low to intermediate risk, stop ticagrelor, proceed with surgery on aspirin, and resume clopidogrel soon after NCS; 3) stop aspirin and ticagrelor, and restart both agents as soon as feasible post-operatively; or 4) continue DAPT during scheduled NCS?

<table>
<thead>
<tr>
<th>Case 2</th>
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<tbody>
<tr>
<td>Elective knee surgery for disabling osteoarthritis in a 72 year old patient with diabetes mellitus, prior MI, CABG, and most recent PCI 14 months ago with 3 DES. She is currently on low dose aspirin and ticagrelor</td>
</tr>
<tr>
<td>(a) Advise against knee surgery</td>
</tr>
<tr>
<td>(b) Myocardial perfusion imaging with pharmacologic stress and if low to intermediate risk, stop ticagrelor, proceed with surgery on aspirin, and resume clopidogrel soon after NCS</td>
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(cont.)
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<tr>
<td>(c) Stop aspirin and ticagrelor and restart both agents as soon as feasible post-operatively</td>
</tr>
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<td>(d) Continue DAPT during scheduled NCS</td>
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**What the experts say…**

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</tr>
<tr>
<td>Strategy to withhold ticagrelor 5 days prior to NCS and continue low-dose aspirin perioperatively following a low or intermediate risk stress myocardial perfusion imaging may be the best course of action</td>
</tr>
</tbody>
</table>
References


References (cont.)


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