Timing of Surgery After Percutaneous Coronary Intervention

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Bayview/EVMS/Sentara

Outline/Highlights

- Timing of elective surgery
- What to do with medications
  - Stopping anti-platelet meds
  - When to restart
- Post operative concerns

Peri-op DES: Scope of the Problem

- In the US over 600,000 percutaneous coronary interventions (PCI) are done every year

- The majority of PCIs involve drug eluting stent placement

Peri-op DES: Scope of the Problem

- About 5% of patients undergoing PCI will need non-cardiac surgery within 1 year
- About 30,000 procedures annually
- Roughly 1% of elective non-cardiac surgery pts. had PCI in the preceding year

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Developed in Collaboration With the American College of Surgeons, American Society of Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, and Society of Cardiovascular Anesthesiologists

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Table 1. Applying Class of Recommendation and Level of Evidence

CLASS (STRENGTH) OF RECOMMENDATION

CLASS I (STRONG) — Benefit >>> Risk

Suggested phrases for writing recommendations:
- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

CLASS IIa (MODERATE) — Benefit >> Risk

Suggested phrases for writing recommendations:
- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

CLASS IIb (WEAK) — Benefit ≥ Risk

Suggested phrases for writing recommendations:
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

CLASS III: No Benefit (MODERATE) — Benefit = Risk

(Generally, LOE A or B use only)

Suggested phrases for writing recommendations:
- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

CLASS III: Harm (STRONG) — Risk > Benefit

Suggested phrases for writing recommendations:
- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

LEVEL (QUALITY) OF EVIDENCE‡

LEVEL A

- High-quality evidence‡ from more than 1 RCTs
- Meta-analyses of high-quality RCTs
- One or more RCTs corroborated by high-quality registry studies

LEVEL B-R (Randomized)

- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

LEVEL B-NR (Nonrandomized)

- Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies
- Meta-analyses of such studies

LEVEL C-LD (Limited Data)

- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

LEVEL C-EO (Expert Opinion)

Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR I and IIa; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

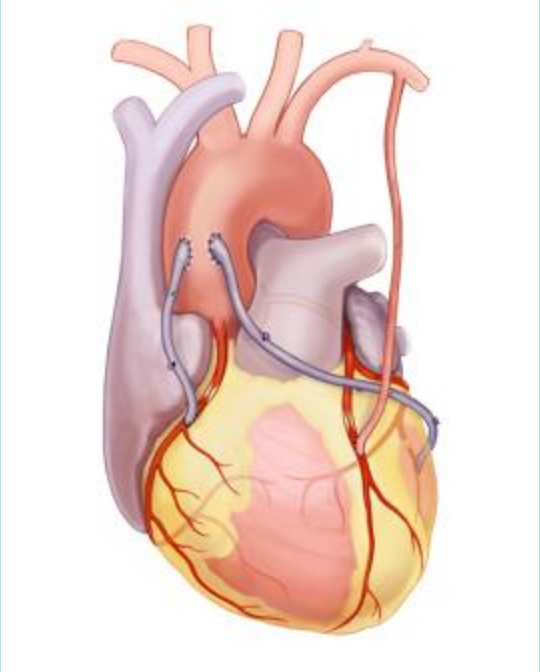
‡ The method of assessing quality is evolving, including the application of standardized, widely used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

Coronary Revascularization

- **Class I:**
  1. Revascularization before noncardiac surgery is recommended in circumstances in which revascularization is indicated according to existing CPGs. (Appendix 3)

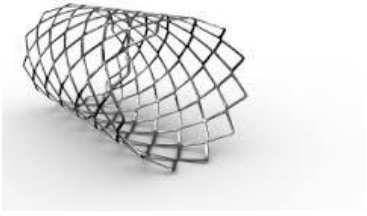
     - Unprotected Left Main Disease
     - 3 Vessel CAD with or without proximal LAD Disease
     - 2 Vessel Disease with Proximal LAD Disease
     - 1 Vessel Disease with Proximal LAD disease



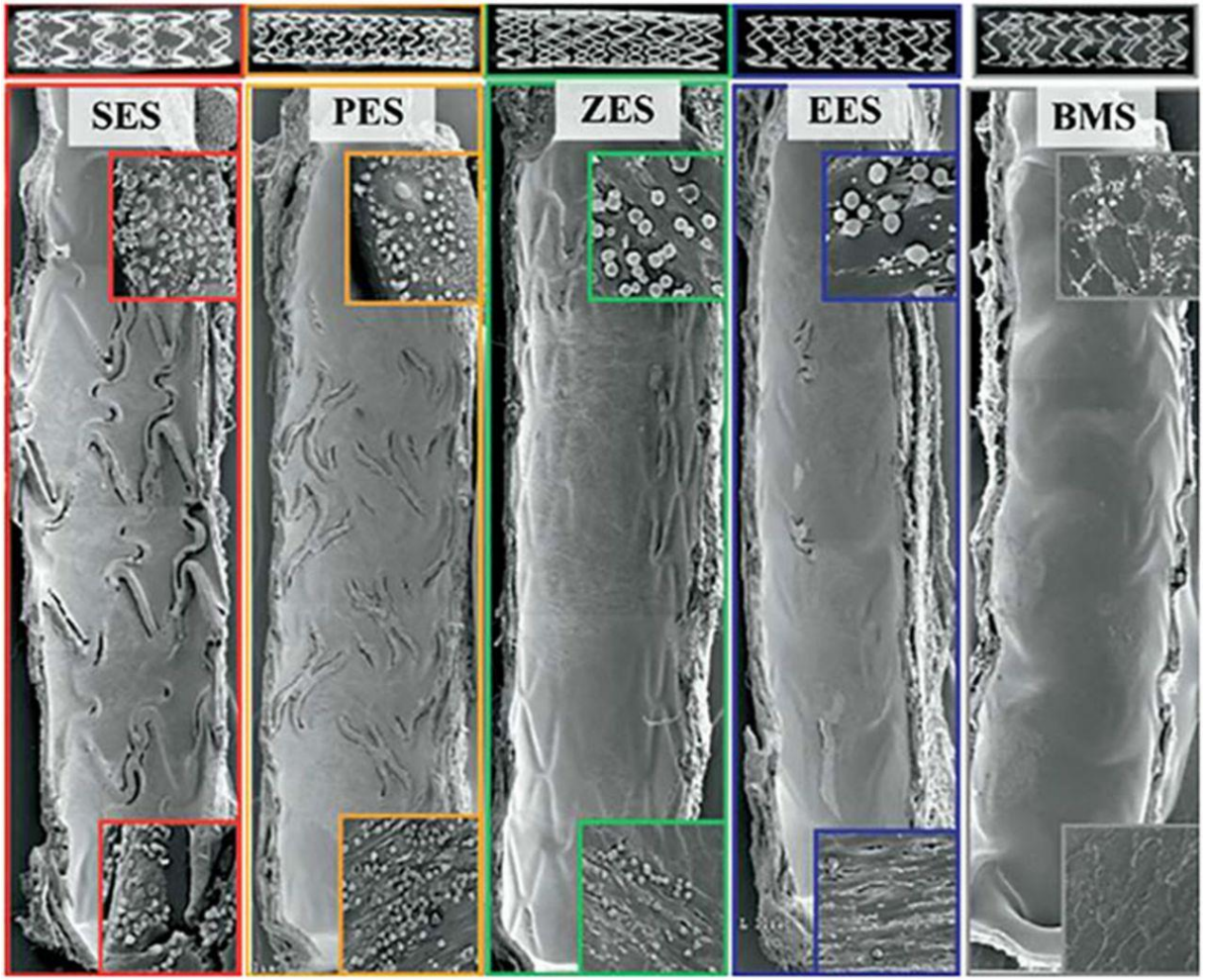
- **Class III: No Benefit/Harm**
  1. It is not recommended that routine coronary revascularization be performed before noncardiac surgery to reduce perioperative cardiac events

Bare Metal vs Drug Eluting Stents

US FDA approval	Stent	Manufacturer	Generation	Type of stent: Platform	Drug eluted	
2000	Bx Velocity	Cordis, Bridgewater, NJ	First	BMS: 316L Stainless steel	N/A	BMS
2002	Liberté →VeriFLEX*	Boston Scientific, Natick, MA	First	BMS: 316L Stainless steel	N/A	
2003	Vision	Guidant/Abbott, Indianapolis, IN	Second	BMS: Cobalt chromium	N/A	
2003	Driver/Integrity	Medtronic, Minneapolis, MN	Second	BMS: Cobalt chromium	N/A	
Trials underway	Omega	Boston Scientific, Natick, MA	Third	BMS: Platinum chromium	N/A	
2003†	Cypher	Cordis, Bridgewater, NJ	First	DES: 316L Stainless steel	Sirolimus	DES
2004	Taxus Express	Boston Scientific, Natick, MA	First	DES: 316L Stainless steel	Paclitaxel	
2008	Taxus Liberté	Boston Scientific, Natick, MA	First	DES: 316L Stainless steel	Paclitaxel	
2008	Endeavor	Medtronic, Minneapolis, MN	Second	DES: Cobalt chromium	Zotarolimus	
2008	Xience V/Prime	Guidant/Abbott, Indianapolis, IN	Second	DES: Cobalt chromium	Everolimus	
2008	Promus	Boston Scientific, Natick, MA	Second	DES: Cobalt chromium	Everolimus	
2011	Promus Element	Boston Scientific, Natick, MA	Third	DES: Platinum chromium	Everolimus	
2012	Taxus Element	Boston Scientific, Natick, MA	Third	DES: Platinum chromium	Paclitaxel	
2013	Resolute Integrity	Medtronic, Minneapolis, MN	Third	DES: Cobalt chromium	Zotarolimus	



Stent Endothelialization Varies



Noncardiac Surgery in Patients With Stents

Table 1. Patient Characteristics at the Time of Surgery, Overall and by 30-Day Postoperative MACE

	No. (%)		
	Overall	No MACE	MACE
Overall	41 989	40 009 (95.3)	1980 (4.7)

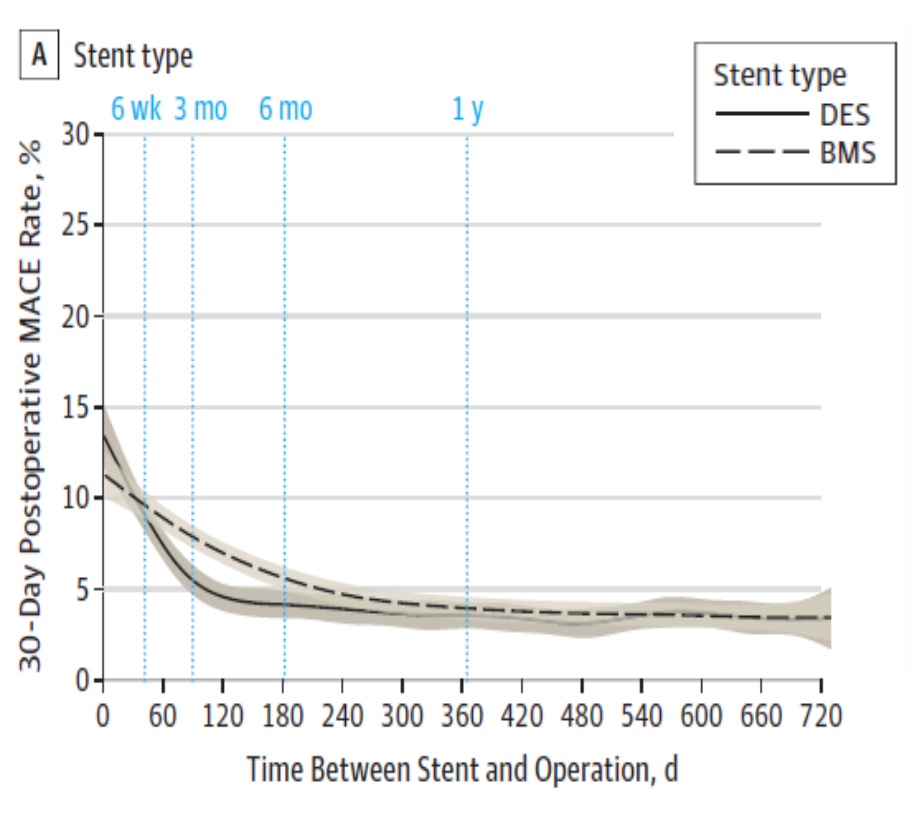


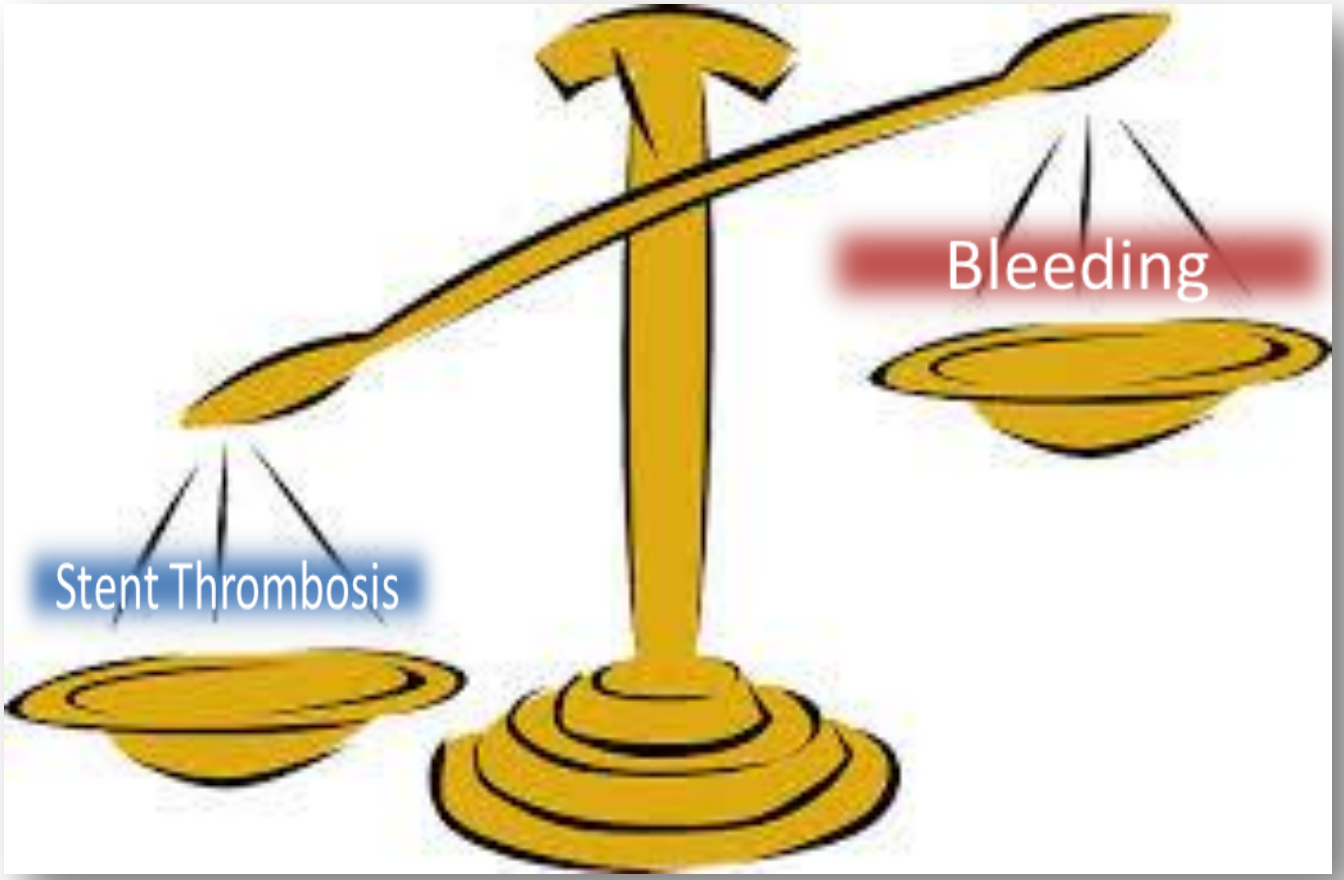
Table 3. Best-Fit Model of Perioperative Major Adverse Cardiac Event[a]

	OR (95% CI)	*P* Value	Partial Effects Analysis[b] $\chi^2 - df$	Rank
Admission status				
Outpatient	1 [Reference]			
Elective inpatient	2.42 (2.10-2.79)	<.001	388.9	1
Nonelective inpatient	4.77 (4.07-5.59)			
Myocardial infarction in past 6 mo				
No	1 [Reference]	<.001	230.0	2
Yes	2.63 (2.32-2.98)			
Revised cardiac risk index				
1	1 [Reference]			
2	1.50 (1.31-1.73)	<.001	119.6	3
≥3	2.13 (1.85-2.44)			
Stent type				
Bare metal	1 [Reference]	.08	2.1	12
Drug-eluting	0.91 (0.83-1.01)			

Choosing Appropriate PCI Intervention in a patient who we know will need Surgery

- *Urgent Surgery*
  - Consider CABG combined with noncardiac surgery
- *Surgery 2-6 weeks with high bleeding risk*
  - Consider balloon angioplasty with provisional BMS
- *Surgery in 1-12 months*
  - Consider BMS and 4-6 weeks of ASA and P2Y12 inhibitor with continuation of ASA perioperatively
- *Surgery > 12 Months or low bleeding risk*
  - PCI and DES with prolonged aspirin and P2Y12 platelet receptor-inhibitor

You must balance…



Peri-op Management of DES

- Currently no definitive standard of care, mostly expert opinion
- Without good prospective data, management is carried out on individual case basis
- Length of stent, location, bifurcation, multi-vessel

POOR RISK MANAGEMENT

Jut not thinking it all the way through

Perioperative Beta-Blocker Therapy

Recommendations	COR	LOE
Beta blockers should be continued in patients undergoing surgery who have been on beta blockers chronically.	I	B^{SR}
It is reasonable for the management of beta blockers after surgery to be guided by clinical circumstances, independent of when the agent was started.	IIa	B^{SR}
In patients with intermediate- or high-risk myocardial ischemia noted in preoperative risk stratification tests, it may be reasonable to begin perioperative beta blockers.	IIb	C^{SR}
In patients with 3 or more RCRI risk factors (e.g., diabetes mellitus, HF, CAD, renal insufficiency, cerebrovascular accident), it may be reasonable to begin beta blockers before surgery.	IIb	B^{SR}

These recommendations have been designated with a SR to emphasize the rigor of support from the ERC's systematic review. See the ERC systematic review report, "Perioperative beta blockade in noncardiac surgery: a systematic review for the 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery" for the complete evidence review on perioperative beta-blocker therapy.

Perioperative Statin Therapy

Recommendations	COR	LOE
Statins should be continued in patients currently taking statins and scheduled for noncardiac surgery.	I	B
Perioperative initiation of statin use is reasonable in patients undergoing vascular surgery.	IIa	B
Perioperative initiation of statins may be considered in patients with clinical indications according to GDMT who are undergoing elevated-risk procedures.	IIb	C

2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease

Developed in Collaboration with American Association for Thoracic Surgery, American Society of Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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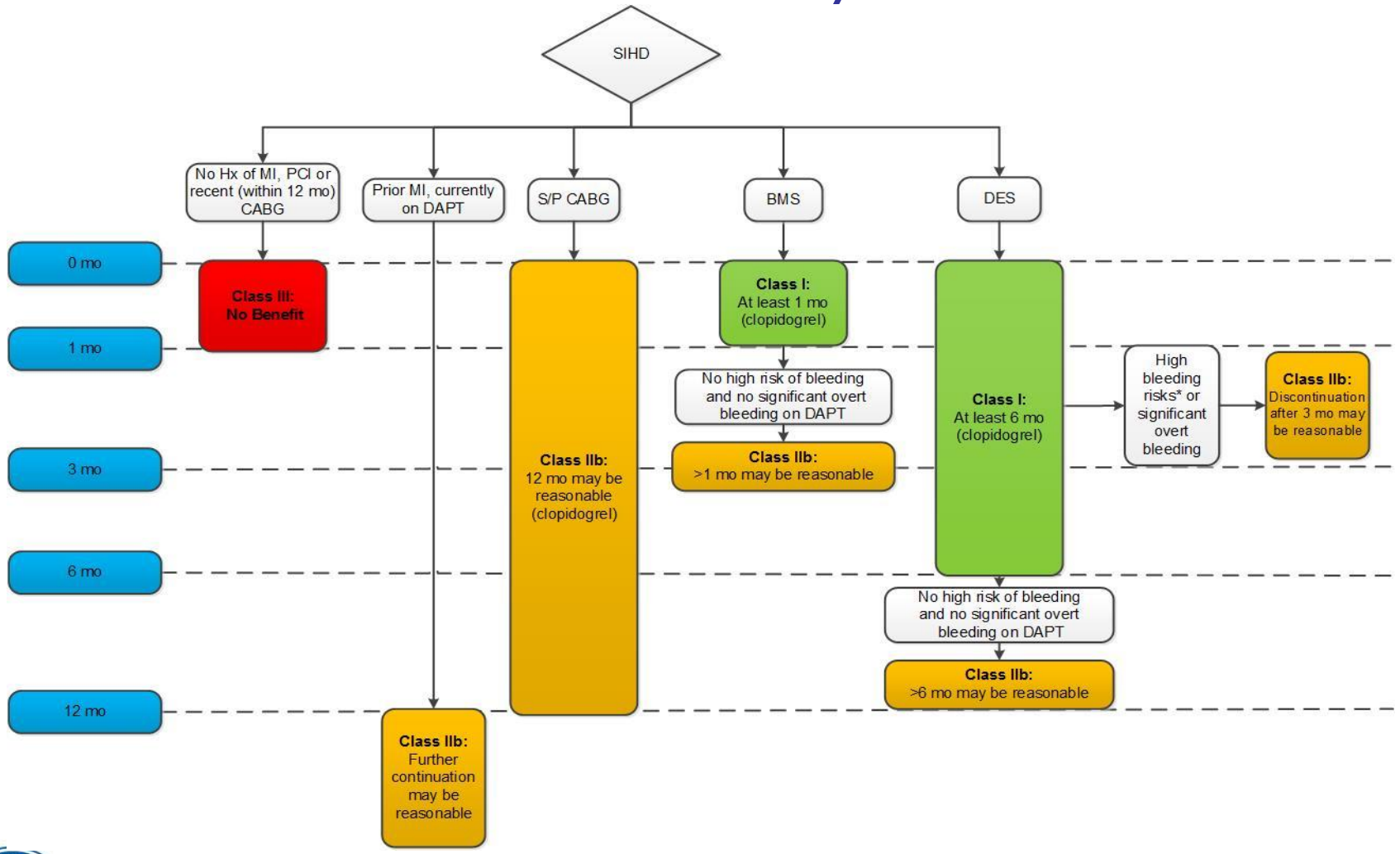
Figure 4. Treatment Algorithm for Duration of $P2Y_{12}$ Inhibitor Therapy in Patients With SIHD (Without ACS Within the Past Several Years)



Recommendations for Duration of DAPT in Patients with SIHD

COR	LOE	Recommendations
I	A	In patients with SIHD treated with DAPT after BMS implantation, $P2Y_{12}$ inhibitor therapy (clopidogrel) should be given for a minimum of 1 month.
I	B-R SR	In patients with SIHD treated with DAPT after DES implantation, $P2Y_{12}$ inhibitor therapy (clopidogrel) should be given for at least 6 months.
I	B-NR	In patients treated with DAPT, a daily aspirin dose of 81 mg (range, 75 mg to 100 mg) is recommended.
IIb	A SR	In patients with SIHD being treated with DAPT for an MI that occurred 1 to 3 years earlier who have tolerated DAPT without a bleeding complication and who are not at high bleeding risk (e.g., prior bleeding on DAPT, coagulopathy, oral anticoagulant use), further continuation of DAPT may be reasonable.

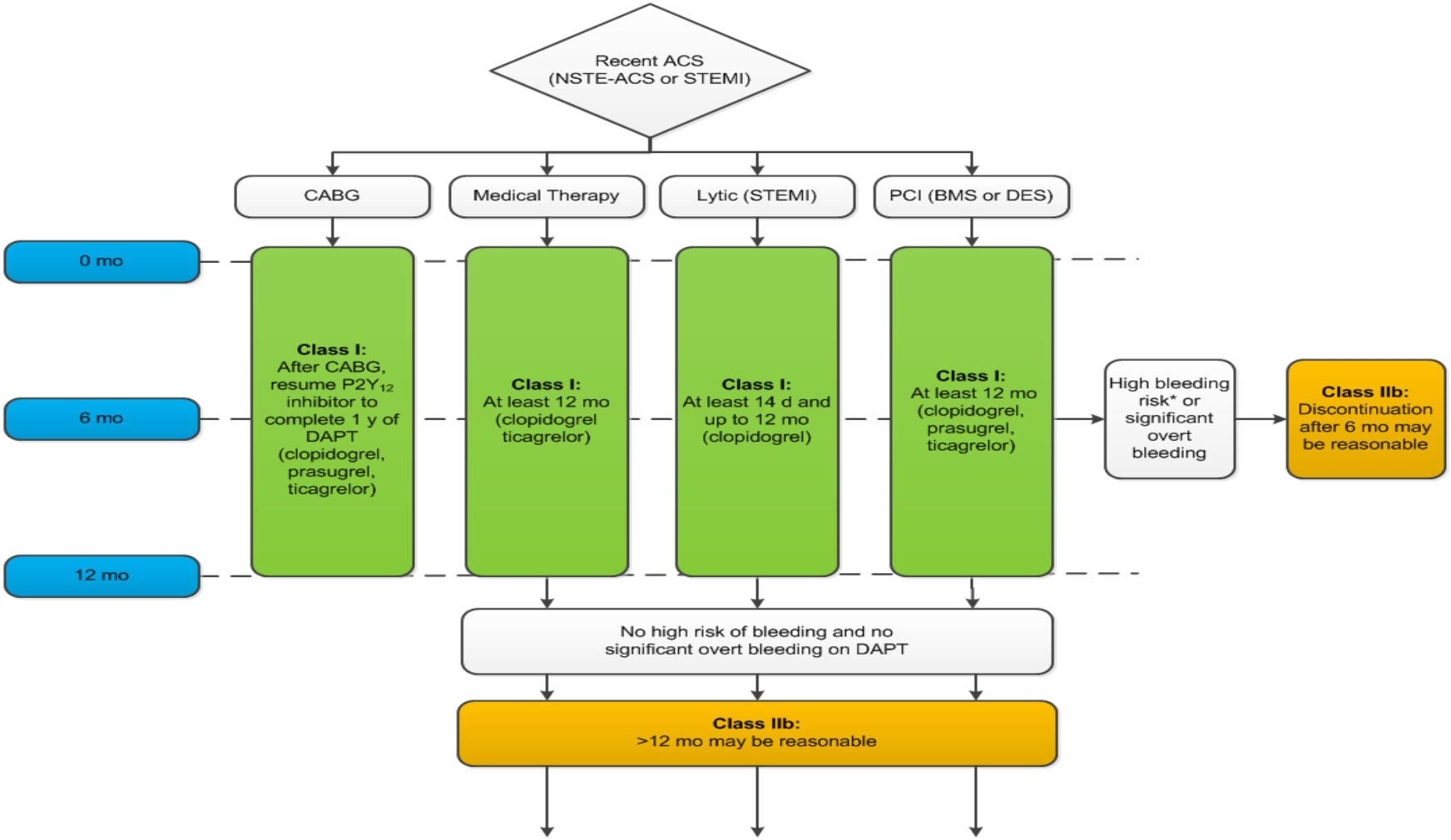
SR indicates systematic review.

Recommendations for Duration of DAPT in Patients with SIHD (cont'd)

COR	LOE	Recommendations
IIb	A [SR]	In patients with SIHD treated with BMS or DES implantation who have tolerated DAPT without a bleeding complication and who are not at high bleeding risk (e.g., prior bleeding on DAPT, coagulopathy, oral anticoagulant use), continuation of DAPT with clopidogrel for longer than 1 month in patients treated with BMS or longer than 6 months in patients treated with DES may be reasonable.
IIb	C-LD	In patients with SIHD 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 intracranial surgery), or develop significant overt bleeding, discontinuation of $P2Y_{12}$ inhibitor therapy after 3 months may be reasonable.
IIb	B-NR	In patients with SIHD, treatment with DAPT (with clopidogrel initiated early postoperatively) for 12 months after CABG may be reasonable to improve vein graft patency.
III: No Benefit	B-R	In patients with SIHD without prior history of ACS, coronary stent implantation, or recent (within 12 months) CABG, treatment with DAPT is not beneficial.

SR indicates systematic review.

Figure 5. Treatment Algorithm for Duration of $P2Y_{12}$ Inhibitor Therapy in Patient With Recent ACS (NSTE-ACS or STEMI)



Duration of DAPT in Patients With ACS Treated With PCI

COR	LOE	Recommendations
I	B-R	In patients with ACS treated with DAPT after BMS or DES implantation, $P2Y_{12}$ inhibitor therapy (clopidogrel, prasugrel, or ticagrelor) should be given for at least 12 months.
I	B-NR	In patients treated with DAPT, a daily aspirin dose of 81 mg (range, 75 mg to 100 mg) is recommended.
IIa	B-R	In patients with ACS treated with DAPT after coronary stent implantation, it is reasonable to use ticagrelor in preference to clopidogrel for maintenance $P2Y_{12}$ inhibitor therapy.
IIa	B-R	In patients with ACS treated with DAPT after coronary stent implantation, who are not at high risk for bleeding complications and who do not have a history of stroke or TIA, it is reasonable to choose prasugrel over clopidogrel for maintenance $P2Y_{12}$ inhibitor therapy.

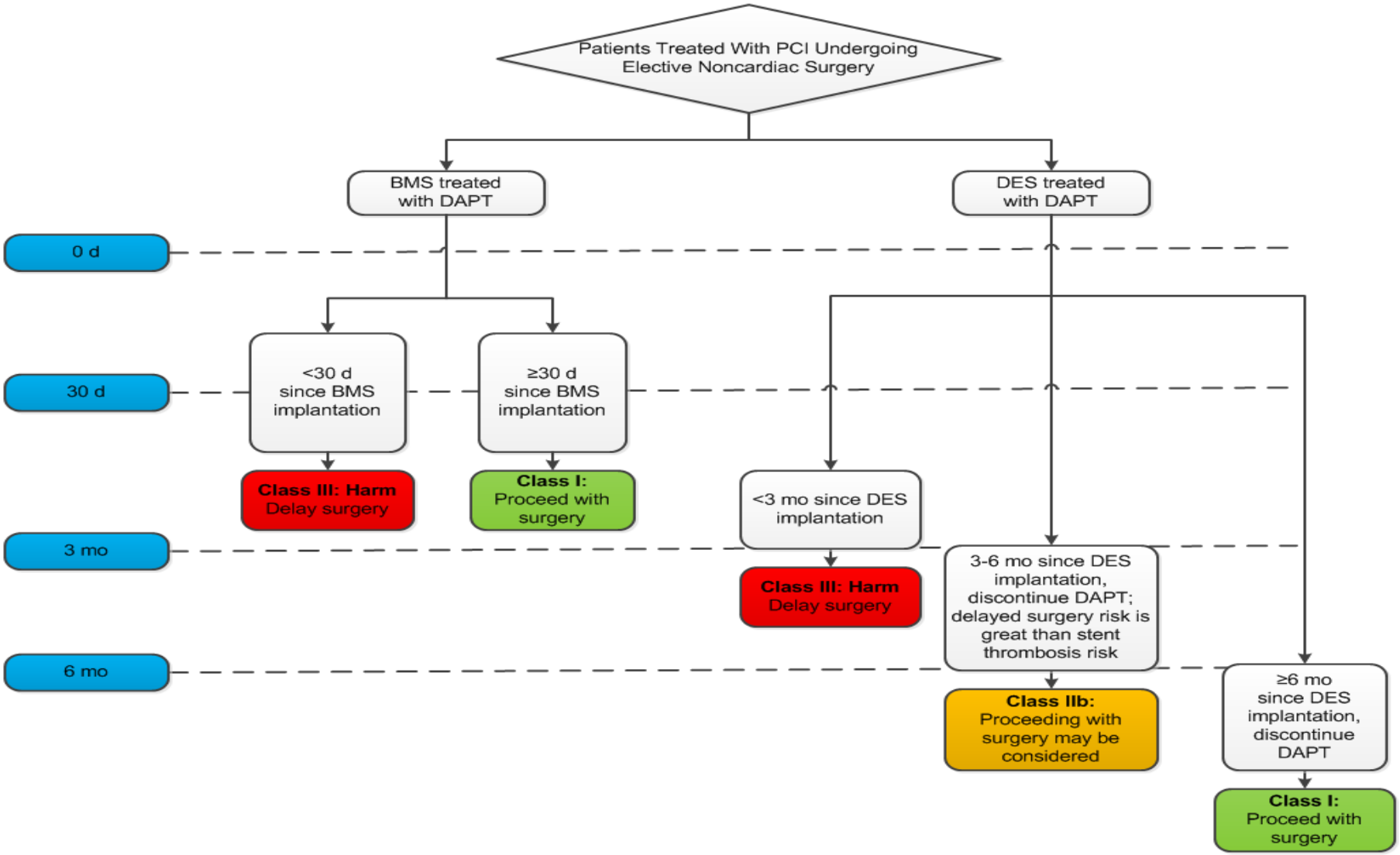
Perioperative Management–Timing of Elective Noncardiac Surgery in Patients Treated With PCI and DAPT

COR	LOE	Recommendations
I	B-NR	Elective noncardiac surgery should be delayed 30 days after BMS implantation and optimally 6 months after DES implantation.
I	C-EO	In patients treated with DAPT after coronary stent implantation who must undergo surgical procedures that mandate the discontinuation of $P2Y_{12}$ inhibitor therapy, it is recommended that aspirin be continued if possible and the $P2Y_{12}$ platelet receptor inhibitor be restarted as soon as possible after surgery.
IIa	C-EO	When noncardiac surgery is required in patients currently taking a $P2Y_{12}$ inhibitor, a consensus decision among treating clinicians as to the relative risks of surgery and discontinuation or continuation of antiplatelet therapy can be useful.

Perioperative Management–Timing of Elective Noncardiac Surgery in Patients Treated With PCI and DAPT (cont'd)

COR	LOE	Recommendations
IIb	C-EO	Elective noncardiac surgery after DES implantation in patients for whom $P2Y_{12}$ inhibitor therapy will need to be discontinued may be considered after 3 months if the risk of further delay of surgery is greater than the expected risks of stent thrombosis.
III: Harm	B-NR	Elective noncardiac surgery should not be performed within 30 days after BMS implantation or within 3 months after DES implantation in patients in whom DAPT will need to be discontinued perioperatively.

Figure 6. Treatment Algorithm for the Timing of Elective Noncardiac Surgery in Patients With Coronary Stents



Anti-Platelet Agents

$P2Y_{12}$ Inhibitors or ADP Receptor Inhibitors

Thienopyridines (ORAL)

- Ticlid (ticlopidine)
- Plavix (clopidogrel)
- Effient (prasugrel)

Non-thienopyridines (ORAL)

- Brilinta (ticagrelor)

IV P2Y12 Inhibitors

Cangrelor (Kengreal) -IV administration, 3 to 5 minute half life; BRIDGE Trial ongoing

IV Anti-Platelet Medications
Glycoprotein IIb/IIIa Inhibitors

ReoPro (abciximab) – monoclonal ab, cath lab drug

Aggrastat (tirofiban)

Integrlin (eptifibatide)

- Synthetic peptides, competitive binding to platelet
- Platelet transfusions don't help – (out competed)
- Short ½ life – gone in 2 to 4 hours

Anti-platelet medications

- Consider “bridging therapy” with IV administration of IIb/IIIa inhibitor (short half-life) in certain situations
- If bridging, start IV IIb/IIIa 2-3 days prior to surgery

Strategies for Peri-op Management of DES

- “Bridging Therapy” with GP IIb/IIIa inhibitor
- Has NOT been rigorously studied
- Integrilin or Aggrastat, NOT ReoPro
- Stop Plavix 5-7 days pre-op
- Admit 2-3 days pre-op and start IIb/IIIa
- Continue aspirin throughout if possible
- Restart Plavix as soon as possible post-op

Strategies for Peri-op Management of DES
Post Op issues

- Resumption of DAPT as soon as possible
  - Using bolus dose of $P2Y_{12}$ inhibitor
- Intensive post–op monitoring if off DAPT
- Prompt evaluation and intervention for stent thrombosis or any bleeding

Strategies for Peri-op Management of DES
Post-op Stent Thrombosis

- Usually presents as ST elevation MI
- Fibrinolytic therapy is contraindicated
- Primary PCI is the treatment of choice
- When DAPT is interrupted prematurely for surgery it should be done at hospitals with 24 hour cath/PCI availability

Post operative concerns

- Close monitoring for bleeding
- Chest pain, hypotension, tachycardia all need very prompt attention
- Elective surgery should be done at hospital with 24 hour availability of PCI capable cath lab

Post operative concerns

- Close monitoring for bleeding
- Chest pain, hypotension, tachycardia all need very prompt attention
- Elective surgery should be done at hospital with 24 hour PCI capable cath lab availability

Strategies for Peri-op Management of DES
Post-op Bleeding

- Platelet transfusion is only somewhat effective with $P2Y_{12}$ agents
- It's not effective with Integrilin or Aggrastat, but with short ½ life normal platelet function is restored in about 6 hours
- RBC transfusion as needed

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