



UTAH SOCIETY OF
HEALTH-SYSTEM PHARMACISTS

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Should DAPT be BYPASSED after CABG?

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Disclosure

Relevant Financial Conflicts of Interest

- CE Presenter, Brita Jensen, PharmD:
 - None
- CE mentor, Joshua Jacobs, PharmD, BCCP:
 - None
- CE mentor, Kimberly Terry, PharmD, BCCCP, BCPS:
 - None

Off-Label Uses of Medications

- None



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Abbreviations

AA: Arachidonic Acid	LIMA: Left Internal Mammary Artery
ACCF: American College of Cardiology Foundation	LV: Left Ventricle
ACS: Acute Coronary Syndrome	LVEF: Left Ventricular Ejection Fraction
ADP: Adenosine Diphosphate	MACE: Major Adverse Cardiac Events
AHA: American Heart Association	MOA: Mechanism of Action
ASA: Aspirin	MI: Myocardial Infarction
CABG: Coronary Artery Bypass Grafting	MSCTA: Multislice Computed Tomography Angiography
CAD: Coronary Artery Disease	PCI: Percutaneous Coronary Intervention
cAMP: Cyclic Adenosine Monophosphate	PDE: Phosphodiesterase
COX-1: Cyclooxygenase-1	RIMA: Right Internal Mammary Artery
CPB: Cardiopulmonary Bypass	SHD: Stable Ischemic Heart Disease
DAPT: Dual Antiplatelet Therapy	STEMI: ST-Elevation Myocardial Infarction
EACTS: European Association for Cardio-Thoracic Surgery	SVG: Saphenous Vein Graft
EAS: European Society of Cardiology	T/R: Thromboxane Receptor
Gp IIb/IIIa: glycoprotein IIb/IIIa receptor	TXA ₂ : Thromboxane A ₂
LAD: Left Anterior Descending Artery	

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Learning Objectives- Technician

1. Explain the potential benefit of antiplatelet therapy in patients post CABG.
2. Recognize typical dosing strengths for antiplatelet therapies.
3. Differentiate between the different P2Y₁₂ inhibitor agents available.



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Learning Objectives- Pharmacist

1. Review the pathophysiology of graft thrombosis following CABG.
2. Identify the potential risks associated with using or not using antiplatelet therapy in these patients.
3. Compare and contrast primary literature regarding antiplatelet therapy after CABG.
4. Assess patient characteristics that would favor dual antiplatelet therapy in patients who undergo a CABG.



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Ischemic Heart Disease

Stable Ischemic Heart Disease

- Leading cause of global mortality
- Presentation:** Chronic stable angina
- Etiology:** atherosclerotic plaque (stable)
- Treatment:** guideline directed medical therapy or revascularization

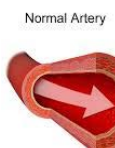
Acute Coronary Syndrome

- Presentation:** Angina with radiation to arms, shoulders, back, abdomen or jaw
- Etiology:** Rupture of unstable atherosclerotic plaque and subsequent thrombus formation resulting in acute myocardial ischemia
- Treatment:** Urgent reperfusion therapy with guideline directed medical therapy

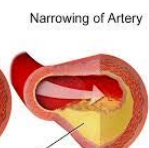
Fitz T, et al. Heart. 2017;97:1-9. Daskal PP, et al. In: D'Onofrio JT, et al. Pathophysiology. 11e. 7

Types of Ischemic Heart Disease

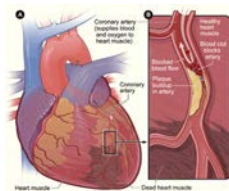
Normal Artery



Narrowing of Artery



Lipid deposit of plaque



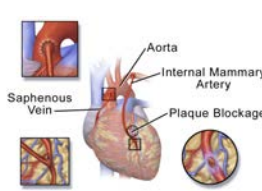
Coronary artery disease

Acute Coronary Syndromes

http://www.heart.org/ST225491881276_16x17px_CAD_3.jpg (Accessed 9/18/2019). 8

Introduction to CABG

- CABG: Coronary Artery Bypass Grafting
 - Improves blood supply to coronary circulation
 - Relieves chest pain and angina
 - Reduces risk of death from coronary artery disease
- >400,000 CABG procedures are performed annually
- Gold-standard for treatment of severe multi-vessel disease (3 vessels or 2 including proximal LAD) or left main disease

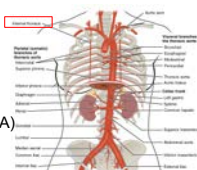



Coronary Artery Bypass Surgery

Mazzoni T, et al. Am J Surg. 2016;151:2285-2291. Lohrke M, et al. J Thorac Dis. 2016; 10(5): 1590-1591. 9

The Procedure

- Sternotomy and division of the sternum is done exposing the heart
- Harvested vascular conduits available are:
 - Saphenous Vein Grafts (SVG)
 - Left Internal Mammary Artery (LIMA)
 - Right Internal Mammary Artery (RIMA)
 - Radial Artery
 - Gastroepiploic Artery

Mazzoni T, et al. Am J Surg. 2016;151:2285-2291. 10

Comparison of Grafts

RIMA/LIMA

- Left intact from origin with opposite end sewn into the coronary artery below blockage
- Resistant to late failure
- Left > Right

SVG

- Commonly used
- Easy to harvest through minimally invasive procedures
- Variable quality and size of veins making them vulnerable to failure

Radial Artery

- More resistant to development of atherosclerosis
- Susceptible to spasm

Gastroepiploic Artery

- Technically difficult
- Least common
- Susceptible to spasm

Mazzoni T, et al. Am J Surg. 2016;151:2285-2291. 11

Graft Patency Rates

Graft	Early Patency (1-year)	Midterm Patency (5-7 years)	Late Patency (≥10 years)
SVG	81-97.9%	75-86%	50-60%
RIMA/LIMA	93-96%	88-98%	85-95%
Radial Artery	89-92%	90-98%	89-91%
Gastroepiploic Artery	92-97%	80-90%	62%

SVGs are more likely to fail due to thrombotic occlusions due to stasis within the graft from:

- Kinks from excessive length of graft
- Smaller diameter or poor vein pathology
- Poor distal runoff

Mazzoni T, et al. Am J Surg. 2016;151:2285-2291. 12

On vs. Off Pump

On-Pump

- Uses cardiopulmonary bypass machine (more traditional method)
- Graft procedure is conducted while the heart is arrested
- Once complete, body is removed from cardiopulmonary bypass machine

Off-Pump

- Does not use CPB machine
- Heart remains pumping during grafting
- Theoretical prothrombotic risk

Shaw, M.T. et al. *Curr J Heartb Sci.* 2014;8(2):184-192.

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On- Versus Off- Pump

On-Pump

- Advantages:
 - More complete revascularization
 - Preferred in emergent situations
 - Relieves workload on heart
 - Familiarity of the procedure among surgeons

Off-Pump

- Advantages:
 - Decreased inflammatory response
 - Ideal for patients at risk of complications from on-pump CABG
 - Aortic calcification
 - Liver cirrhosis
 - Poor pulmonary or renal function
 - History of strokes

Shaw, M.T. et al. *Curr J Heartb Sci.* 2014;8(2):184-192.
McKevenagh P. et al. *Catheter Ther.* 2017;8:203-223.

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On- Versus Off- Pump

On-Pump

- Disadvantages:
 - Adverse outcomes due to systemic inflammatory response
 - Circulating blood in contact with cardiopulmonary bypass

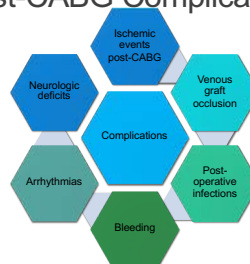
Off-Pump

- Disadvantages:
 - Technically difficult
 - Contraindicated
 - Hemodynamic instability
 - Poor quality target vessels
 - Small target vessels

Shaw, M.T. et al. *Curr J Heartb Sci.* 2014;8(2):184-192.
McKevenagh P. et al. *Catheter Ther.* 2017;8:203-223.

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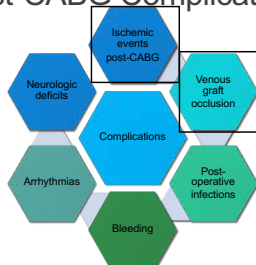
Post-CABG Complications



Koehn A. et al. *Circulation.* 2010;121:927-934.
Ludovic M. et al. *J Thorac Dis.* 2014;10(2):1402-1407.

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Post-CABG Complications



Koehn A. et al. *Circulation.* 2010;121:927-934.
Ludovic M. et al. *J Thorac Dis.* 2014;10(2):1402-1407.

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Graft Failure

Adverse cardiac events

- Recurrent angina
- Need for repeat revascularization
- Myocardial infarction

Rate of failure at 1 year is between 10-25%

McKevenagh P. et al. *Catheter Ther.* 2017;8:203-223.

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Graft Failure- SVG Pathogenesis

Early (<1 month)	<ul style="list-style-type: none"> Due to technical failure or thrombosis Harvesting complications: <ul style="list-style-type: none"> Hypoxia Platelet adhesion Thrombosis Stress on vessel walls <ul style="list-style-type: none"> Endothelial damage Increased nitric oxide levels Vasospasms
Intermediate (1 month-1 year)	<ul style="list-style-type: none"> Progressive intimal hyperplasia secondary to exposure to arterial pressure
Late (>1 year)	<ul style="list-style-type: none"> Progressive atherosclerosis

Stavakis M, et al. Circulation. 2017;136:1748-1761. Mikravangh P, et al. Coronary Ther. 2017;8:203-223.

Predisposing Characteristics for Graft Failure

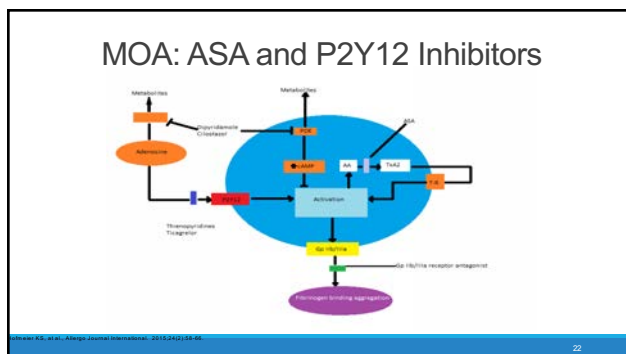
Patient-related	Graft-related	Surgical-related
<ul style="list-style-type: none"> Age Female Gender LV Dysfunction Renal Insufficiency Diabetes 	<ul style="list-style-type: none"> Coronary Flow Graft Type 	<ul style="list-style-type: none"> Graft Kinking Graft and Artery Size Mismatch Poor Vessel Targets

Mikravangh P, et al. Coron Ther. 2017;8:203-223.

Review of Antiplatelet Agents

Class	Drug	Route	Maintenance Dosing	Reversibility	Mechanism of Action
COX-1 Inhibitor	Aspirin	Oral	81-325 mg	Irreversible	Inhibition of COX-1 and subsequent TXA ₂ -dependent platelet function
P2Y ₁₂ inhibitors	Clopidogrel (Plavix)	Oral	75 mg daily	Irreversible	Inhibit ADP-dependent platelet function by modification of the P2Y ₁₂ receptor
	Prasugrel (Effient)	Oral	10 mg daily	Irreversible	
	Ticagrelor (Brilinta)	Oral	90 mg twice daily	Reversible	
	Cangrelor (Kengreal)	IV	4 mcg/kg/minute	Reversible	

Parvizi C, et al. Eur Heart J. 2011;32:2022-2033.



Guidelines for DAPT Use Post CABG

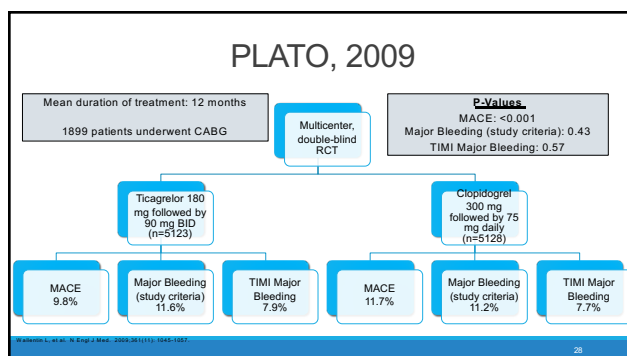
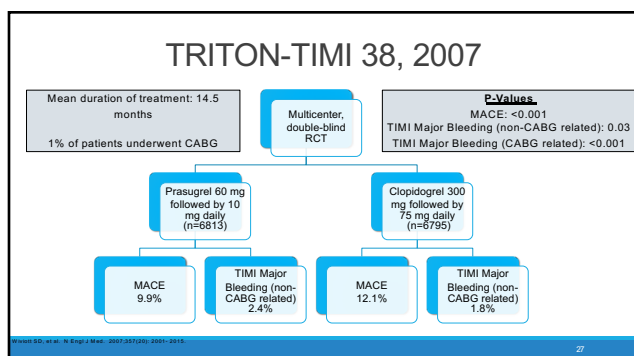
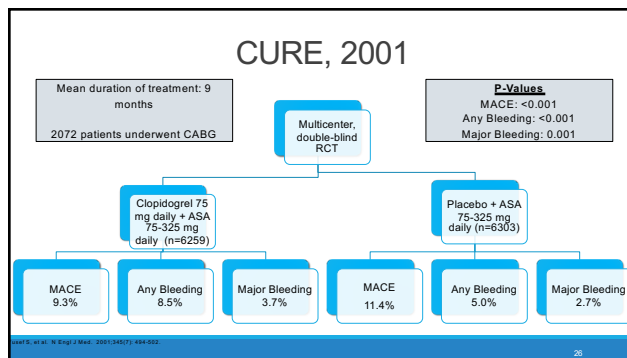
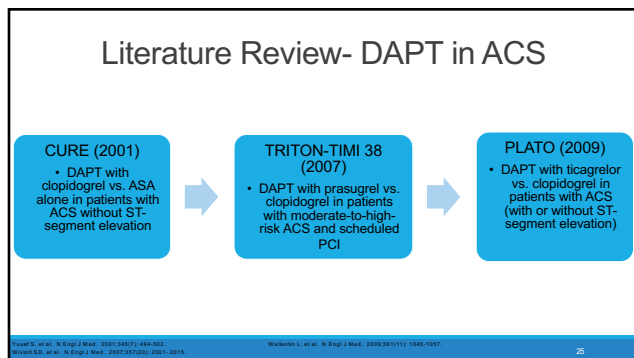
2015 AHA	Off-Pump CABG	2016 ACC/AHA	Stable CAD
	<ul style="list-style-type: none"> "After off-pump CABG, dual antiplatelet should be administered for 1 year with combined aspirin (81-162 mg daily) and clopidogrel 75 mg daily to reduce graft occlusion" (Class I recommendation) 		<ul style="list-style-type: none"> "In patients with SIHD, DAPT for 12 months after CABG may be reasonable to improve vein graft patency" (Class IIb recommendation)

Levine GN, et al. J Am Coll Cardiol. 2016;58(10):1082-1115. Vaguepraj M, et al. Eur Heart J. 2016;37(1):206.

Guidelines for DAPT Use Post CABG

2016 ACC/AHA	ACS	2017 ESC/EACTS	ACS
	<ul style="list-style-type: none"> "In patients with ACS being treated with DAPT who undergo CABG, P2Y₁₂ inhibitor therapy should be resumed after CABG to complete 12 months of DAPT therapy after ACS" (Class I recommendation) 		<ul style="list-style-type: none"> "In patients with ACS treated with DAPT, undergoing CABG, and not requiring long-term OAC therapy, resumption of P2Y₁₂ inhibitor as soon as deemed safe after surgery and continuation up to 12 months is recommended" (Class I recommendation)

Levine GN, et al. J Am Coll Cardiol. 2016;58(10):1082-1115. Vaguepraj M, et al. Eur Heart J. 2016;37(1):206.



Gurbuz et al., 2006

Postoperative clopidogrel improves mid-term outcome after off-pump coronary artery bypass graft surgery: a prospective study

Design	Prospective, cohort study
N	• 591
Inclusion Criteria	• Off-pump CABG by a single surgeon
Interventions	• Clopidogrel 75 mg daily plus ASA 325 mg on day 1, followed by 81 mg daily • ASA 325 mg daily
Duration	• 30 days or longer
Outcomes	• Angina • Death • Congestive heart failure • Myocardial infarction • Re-intervention • Sudden cardiac death

Gurbuz AT, et al. Eur J Cardiothorac Surg. 2006; 29:190-193.

Gurbuz et al., 2006

Outcome	Clopidogrel plus ASA	ASA alone	P-value
Angina	1.8%	8.6%	0.001
Death	2.2%	8.3%	0.0001
Myocardial Infarction	-	3.4%	0.001
Congestive Heart Failure	0.3%	1.5%	0.114
Reintervention	0.6%	6.8%	0.0001
Sudden Cardiac Death	-	1.9%	0.013
Bleeding Complications	1.8%	3.3%	0.8
Major Bleeding	2	2	--
Minor Bleeding	5	8	--

Gurbuz AT, et al. Eur J Cardiothorac Surg. 2006; 29:190-193.

Gurbuz et al., 2006

- Conclusions**
 - Clopidogrel plus ASA after off-pump CABG resulted in reduced mortality, symptom recurrence, and adverse events compared to ASA alone
 - No significant difference in incidence of minor or major bleeding complications in the two groups
- Limitations**
 - Small sample size
 - Single center, single surgeon
 - Selection bias

Gurbuz AT, et al. Eur J Cardiothorac Surg. 2006; 29:190-194.

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CRYSSA, 2012

Aspirin plus clopidogrel for optimal platelet inhibition following off-pump coronary artery bypass surgery: results from the CRYSSA randomized study

Design	Single-center, prospective randomized controlled study
N	• 300
Inclusion Criteria	• Isolated CABG for stable CAD with at least one SVG • Off-pump CABG
Notable Exclusion Criteria	• Emergency operations for ACS or failed PCI • Platelets <70/mm ³ • Renal failure (Scr >2.0 mg/dL) • Diabetic patients
Interventions	• Aspirin 100 mg daily • Aspirin 100 mg plus clopidogrel 75 mg daily • Therapy in both groups was initiated once chest tube drainage was ≤50 mL/h for 2 hours
Duration	• 12 months
Primary Outcome	• Platelet function
Secondary Outcomes	• Graft occlusion at 12 months • Major or minor bleeding • MACE

Marino VA, et al. Heart. 2012; 98:1710-1715.

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CRYSSA, 2012

Outcome	ASA	ASA plus Clopidogrel	P-value
ASA Resistance*	32.6%	32.0%	0.7
Graft Occlusion	27%	15.2%	0.02
Major Bleeding	1.3%	1.3%	1
MACE	9.3%	4.7%	0.10

*ASA resistance was defined as persistently impaired drug response after 1 week of treatment based on ASA Reaction Units (ARUs).

Marino VA, et al. Heart. 2012; 98:1710-1715.

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CRYSSA, 2012

- Conclusions**
 - ASA and clopidogrel had a synergistic effect resulting in reduced vein graft occlusion
 - Antiplatelet resistance was a predictor of graft occlusion
 - Combined clopidogrel and ASA overcome drug resistance without an increase in bleeding rates
 - No significant difference in MACE
- Limitations**
 - Strict exclusion criteria
 - Excluded patients with diabetes
 - Small patient population

Marino VA, et al. Heart. 2012; 98:1710-1715.

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Gao et al., 2010.

Aspirin plus clopidogrel therapy increases early venous graft patency after coronary artery bypass surgery

Design	Prospective, randomized controlled trial
N	• 249
Inclusion Criteria	• Patients undergoing primary isolated CABG with or without CPB • On- and off-pump
Notable Exclusion Criteria	• Abnormal platelets • Prior CABG or cardiac surgery • LVEF < 30% • Liver disease • Need for VKA
Interventions	• ASA 100 mg plus clopidogrel 75 mg • ASA 100 mg alone
Duration	• 3 months
Primary Outcome	• Incidence of graft occlusion at 3 months
Secondary Outcomes	• Incidence of MACE events (composite of cardiogenic death, MI, need for revascularization)

Gao G, et al. J Am Coll Cardiol. 2010; 56:1039-43.

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Gao et al., 2010.

Outcome	ASA plus Clopidogrel	ASA Alone	P-value
Incidence of graft occlusion at 3 months	6.5%	10.3%	Not reported
Graft patency for SVG	91.6%	85.7%	0.043
MACE	No significant difference found		

Gao G, et al. J Am Coll Cardiol. 2010; 56:1039-43.

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Gao et al., 2010.

- Conclusions**
 - No significant difference in the two groups regarding MACE
 - DAPT significantly increased venous graft patency at 3 months compared to ASA alone
- Limitations**
 - Single center
 - No placebo control
 - Analyzed using MSCTA
 - Subjective determination if vein was occluded or not
 - Small sample size
 - Short follow-up (3 months)

Wang D, et al. J Am Coll Cardiol. 2010; 56:1429-37

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DACAB Trial, 2018

Effect of ticagrelor plus aspirin, ticagrelor alone, or aspirin alone on saphenous vein patency 1 year after coronary artery bypass grafting

Design	Randomized, multicenter, open-label trial
N	• 500 patients
Inclusion Criteria	• Age 18-80 • Indication for elective CABG
Exclusion Criteria	• Urgent revascularization • Need for DAPT or VKA • Serious bleeding risk
Interventions	• Ticagrelor 90 mg BID + ASA 100 mg daily • Ticagrelor 90 mg BID alone • ASA 100 mg alone
Duration	• 1 year
Primary Outcome	• SVG patency 1 year post-CABG
Secondary Outcomes	• Time to first MACE (composite CV death, nonfatal MI, or nonfatal stroke) • Freedom from angina after 1 year • Incidence of atrial fibrillation within 7 days post-CABG

Wang D, et al. JAMA. 2018; 318(16):1677-1686

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DACAB Trial, 2018

Outcome	Ticagrelor + ASA	Ticagrelor Alone	ASA Alone	P-value
On-Pump	91.74%	84.16%	83.21%	--
SVG patency 1 year post-CABG	88.7%	82.8%	76.5%	Ticagrelor + ASA vs. ASA alone; p<0.001 Ticagrelor alone vs. ASA alone; p=0.10
Incidence of MACE	1.8%	2.4%	5.4%	--
Bleeding events	1.8%	1.2%	0%	--

Wang D, et al. JAMA. 2018; 318(16):1677-1686

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DACAB, 2018

- Conclusions**
 - Ticagrelor + ASA was superior to ASA alone in maintaining SVG patency
- Limitations**
 - Open-label trial
 - Low event rates for MACE did not achieve statistical power

Wang D, et al. JAMA. 2018; 318(16):1677-1686

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Kim et al., 2009

Aspirin and clopidogrel use in the early postoperative period following on-pump and off-pump coronary artery bypass grafting

Design	Meta-analysis
N	• 15,067
Inclusion Criteria	• 18 years old or older • Received perioperative ASA
Exclusion Criteria	• Clopidogrel started in preoperative period or late postoperative period • Hospitalization >1 week prior to CABG • Concomitant valvular procedure
Interventions	• ASA plus clopidogrel • ASA alone
Duration	• Not provided
Primary Outcome	• In-hospital mortality
Secondary Outcomes	• 30-day readmission rate • Ischemic or thrombotic events • Bleeding events

Kim DR, et al. J Thorac Cardiovasc. 2009; 138(3):1377-1384

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Kim et al., 2009

Outcome	Clopidogrel + ASA	ASA Alone	P-value
In-hospital mortality	0.95%	1.78%	0.048
In-hospital mortality or 30-day readmission rate	8.11%	8.51%	0.118
Ischemic or thrombotic events	1.29%	1.53%	0.960
In-hospital mortality or ischemic/thrombotic events	2.17%	3.09%	0.322
Bleeding events	4.19%	5.17%	0.029

Kim DR, et al. J Thorac Cardiovasc. 2009; 138(3):1377-1384

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Kim et al., 2009

- Conclusions**
 - DAPT had a decreased in-hospital mortality rate compared to ASA alone
 - The rate of bleeding events was decreased in the patients in the DAPT group compared to ASA
- Limitations**
 - Observational, retrospective analysis
 - Lack of detailed clinical information

Kim DJ, et al. J Thorac Cardiovasc. 2009; 129(2): 227-234

Sorensen et al., 2011

Efficacy of post-operative clopidogrel treatment in patients revascularized with coronary artery bypass grafting after myocardial infarction

Design	Retrospective, nationwide registry study
N	3545
Inclusion Criteria	Admitted with first-time MI Revascularized by CABG within 180 days and surviving 30 days after discharge
Exclusion Criteria	None listed
Interventions	Clopidogrel No clopidogrel (+/- ASA)
Primary Outcome	All-cause mortality
Secondary Outcomes	Combined recurrent MI or death from any cause Recurrent MI Bleeding events Cardiovascular and non-cardiovascular deaths

Sorensen K, et al. J Am Coll Cardiol. 2011; 57:1202-1209

Sorensen et al., 2011

Outcome	Clopidogrel	No Clopidogrel	P-value
All-Cause Mortality	1.5%	5.3%	<0.0001
Cardiovascular Death	50.0%	76.5%	0.03
Recurrent MI	2.7%	2.9%	0.81
Bleeding Events	4.9%	4.7%	0.73

Sorensen K, et al. J Am Coll Cardiol. 2011; 57:1202-1209

Sorensen, 2011

- Conclusions**
 - Among patients with MI admission revascularized with CABG, patients treated with clopidogrel had reduced death or recurrent MI.
- Limitations**
 - Observational study
 - Short follow-up
 - Determination of clopidogrel use based on pharmacy information
 - Low fatal event rate
 - Not all patients were on ASA

Sorensen K, et al. J Am Coll Cardiol. 2011; 57:1202-1209

Nocerino et al., 2013

Meta-analysis of effect of single versus dual antiplatelet therapy on early patency of bypass conduits after coronary artery bypass grafting.

Design	Meta-analysis
N	958 (5 studies)
Inclusion Criteria	Randomized trial comparing single vs. DAPT for ≥30 days Graft patency as an endpoint
Exclusion Criteria	Nonrandomized trials
Interventions	DAPT vs. SAPT 4 studies compared ASA to ASA plus clopidogrel 1 study compared clopidogrel to ASA plus clopidogrel
Duration	≥30 days (30 days - 12 months)
Primary Outcome	Overall graft patency
Secondary Outcomes	Safety assessments

Nocerino AG, et al. Ann J Cardiol. 2013;112:1076-1079

Nocerino et al., 2013

Outcome	SAPT	DAPT	P-value
Overall Graft Patency	92.3	95.0	0.005
Venous Graft Patency	89.2%	93.4%	0.003
Arterial Graft Patency	97.3	97.7	--
Bleeding	5.8%	6.3%	0.85

Nocerino AG, et al. Ann J Cardiol. 2013;112:1076-1079

Nocerino et al., 2013

Conclusions

Limitations

- DAPT resulted in improved overall graft patency
- Statistically significant for vein grafts
- No difference in arterial grafts
- No significant difference in overall bleeding events between SAPT and DAPT

- Small number of studies (5)
- Variations in duration of therapy
- Not all studies had the same comparator groups

Nocerino et al. Am J Cardiol. 2013;112:1070-1073

Summary of the Literature- DAPT Effects

Study	n	Study Drugs	Duration	Pump Type	MACE or Mortality	SVG Patency	Bleeding	Comments
Gurbuz et al. (2008)	591	CLO + ASA vs. ASA	≥30 days	Off Pump	↓	×	↓	
CRYSSA (2012)	300	CLO + ASA vs. ASA	12 months	Off Pump	↓	↑	■	
Gao et al. (2010)	249	CLO + ASA vs. ASA	3 months	On and Off Pump	■	↑	×	
DACAB et al. (2018)	500	TIC + ASA vs. TIC vs. ASA	12 months	Not Specified	↓	↑	↑	MACE and Bleeding did not have statistical significance
Kim et al. (2008)	15,067	CLO + ASA vs. ASA	N/A	On and Off Pump	↓	×	↓	
Nocerino et al. (2013)	958	CLO + ASA vs. CLO or ASA	≥30 days	Not Specified	×	↑	↑	Increased: ↑ Decreased: ↓ No difference: ■ Not studied: ×

CLO= clopidogrel, ASA= aspirin, TIC= ticagrelor

Conclusions/Recommendations

1. Absolute Recommendation:

- The following patients should be on DAPT, preferably with clopidogrel 75 mg daily for 12 months:
 - CABG following ACS
 - Off-pump CABG

2. High level of evidence to recommendation:

- The following patients should be considered for DAPT treatment post-CABG for at least 12 months to improve graft patency and decrease risk of MACE.
 - CABG with SVT

Test Questions

1. Why should antiplatelet therapy be considered post-CABG?

A. To prevent future ischemic events
 B. To prevent graft occlusion
 C. To prevent future revascularization
 D. All of the above

Test Questions

2. Match the correct dosing to the correct antiplatelet medications.

Aspirin	75 mg daily
Clopidogrel	81-325 mg daily
Ticagrelor	90 mg twice daily

Test Questions

3. Which antiplatelet represents the generic form of "Plavix"?

A. Clopidogrel
 B. Prasugrel
 C. Ticagrelor
 D. Aspirin

Test Questions

4. In the pathophysiology of a SVG occlusion, what occurs as a result of shear stress which results in decreased graft patency?

- A. Endothelial damage, decreased nitric oxide levels, and increased vasospasms
- B. Endothelial damage, increased nitric oxide levels, and increased vasospasms
- C. Endothelial damage, decreased nitric oxide levels, and decreased vasospasms
- D. Endothelial damage, increased nitric oxide levels, and decreased vasospasms



Test Questions

5. RC is a 57 year old female status post off-pump CABG for multi-vessel CAD. Her PMH includes tobacco use, hypertension, hyperlipidemia, and CAD. What type of antiplatelet therapy (single antiplatelet (SAPT) or DAPT) would she qualify for and why?

- A. SAPT; DAPT is only necessary in on-pump CABG
- B. DAPT; her initial presentation was ACS
- C. DAPT; off-pump CABG puts her at a thrombotic state
- D. SAPT; she doesn't have an indication for DAPT



Test Questions

6. Which outcome has not been shown to be improved with DAPT post CABG?

- A. Bleeding
- B. SVG Occlusion
- C. MACE
- D. All of the above



Test Questions

7. TC is a 73 year old male status post CABG with initial presentation of ST-elevated myocardial infarction. His PMH includes type 2 diabetes mellitus, hyperlipidemia, hypertension, and asthma. Which characteristic would give him an indication for DAPT therapy?

- A. Type 2 diabetes mellitus
- B. Age
- C. DAPT therapy not indicated
- D. ST- elevated myocardial infarction



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