

Table 1. Graft patency after CABG

Graft	At 1 year	At 4-5 years	At >=10 years
Saphenous vein graft	75-95%	65-80%	30-70%
Radial artery	94%	90%	70%
Left IMA	>95%	95%	90%
Right IMA	>95%	>90%	80%

Average percentages from various publications.

Table 2. Technical Aspects of CABG

ACC/AHA/SCAI 2021 GL on revascularization.

GENERAL PROCEDURAL ISSUES FOR CABG

Factors for Consideration by the Heart Team

Coronary Anatomy

- Left main disease
- Multivessel disease
- High anatomic complexity (i.e., bifurcation disease, high SYNTAX score)

Comorbidities

- Diabetes
- Systolic dysfunction
- Coagulopathy
- Valvular heart disease
- Frailty
- Malignant neoplasm
- End-stage renal disease
- Chronic obstructive pulmonary disease
- Immunosuppression
- Debilitating neurological disorders
- Liver disease/cirrhosis
- Prior CVA
- Calcified/porcelain aorta
- Aortic aneurysm

Procedural Factors

■ Local and regional outcomes

■ Access site for PCI

■ Surgical risk

■ PCI risk

Patient Factors

■ Unstable presentation or shock

■ Patient preferences

■ Inability or unwillingness to adhere to DAPT

■ Patient social support

■ Religious beliefs

■ Patient education, knowledge, and understanding

CVA indicates cerebrovascular accident; DAPT, dual antiplatelet therapy; PCI, percutaneous coronary intervention; and SYNTAX, Synergy Between PCI With TAXUS and Cardiac Surgery.

Recommendation for Predicting Patient Risk of Death With CABG

In patients who are being considered for CABG, calculation of the STS risk score to help stratify patient risk

1 B-NR

Assessment of Risk Factors Not Quantified in the STS Score***Risk Factor******Assessment Tool***

Cirrhosis

Model for End-Stage Liver Disease (MELD) score

Frailty

Gait speed

Malnutrition

Malnutrition Universal Screening Tool

STS indicates Society of Thoracic Surgeons.

Perioperative Considerations in Patients Undergoing CABG

For patients undergoing CABG, establishment of multidisciplinary, evidence-based Perioperative management programs to optimize analgesia, minimize opioid exposure, prevent complications and to reduce time to extubation, length of stay, and health care costs.

I B-NR

Bypass Conduits in Patients Undergoing CABG

In patients undergoing isolated CABG, use of a radial artery in preference to a saphenous vein conduit to graft the second most important, significantly stenosed, non-LAD vessel to improve long-term cardiac outcomes.

I B-R

In patients undergoing CABG, an IMA, preferably the left, to bypass the LAD when bypass of the LAD is indicated to improve survival and reduce recurrent ischemic events.

I B-NR

In patients undergoing CABG, bilateral IMA grafting by experienced operators in appropriate patients to improve long-term cardiac outcomes.

IIa B-NR

Best Practices for the Use of Bypass Conduits in CABG

Objectively assess palmar arch completeness and ulnar compensation before harvesting the radial artery. Use the arm with the best ulnar compensation for radial artery harvesting.
Use radial artery grafts to target vessels with subocclusive stenoses.
Avoid the use of the radial artery after transradial catheterization.
Avoid the use of the radial artery in patients with chronic kidney disease and a high likelihood of rapid progression to hemodialysis.
Use oral calcium channel blockers for the first postoperative year after radial artery grafting.
Avoid bilateral percutaneous or surgical radial artery procedures in patients with coronary artery disease to preserve the artery for future use.
Harvest the internal mammary artery using the skeletonization technique to reduce the risk of sternal wound complications.
Use an endoscopic saphenous vein harvest technique in patients at risk of wound complications.
Use a no-touch saphenous vein harvest technique in patients at low risk of wound complications.
Use the skeletonized right gastroepiploic artery to graft right coronary artery target vessels with subocclusive stenosis if the operator is experienced with the use of the artery.

CABG indicates coronary artery bypass graft.

Use of Epiaortic Ultrasound in Patients Undergoing CABG

In patients undergoing CABG, the routine use of epiaortic ultrasound scanning to evaluate the presence, location, and severity of plaque in the ascending aorta to reduce the incidence of atheroembolic complications.

IIa B-NR

Use of Cardiopulmonary Bypass in Patients Undergoing CABG

In patients with significant calcification of the aorta, use of techniques to avoid aortic manipulation (off-pump techniques or beating heart) to decrease the incidence of perioperative stroke when performed by experienced surgeons.

IIa B-R

In patients with significant pulmonary disease, off-pump surgery to reduce perioperative risk when performed by experienced surgeons.

IIB B-R

ESC/EACTS 2018 GL on revascularization.

Recommendations on procedural aspects of coronary artery bypass grafting

General considerations

Complete myocardial revascularization.^a

I-B

Minimization of aortic manipulation.

I-B

Routine intraoperative graft flow measurement.

IIa-B

CT scans of the ascending aorta in patients over 70 years of age and/or with signs of extensive generalized atherosclerosis.

IIa-C

Epiaortic ultrasound to identify atheromatous plaques and select the optimal surgical strategy, prior to aortic manipulation.

IIa-C

Conduit selection

Arterial grafting with IMA to the LAD system.	I-B
Additional arterial graft in appropriate patients.	IIa-B
Use of the radial artery over the saphenous vein in patients with high-grade coronary artery stenosis. ^b	I-B
BIMA grafting in patients who do not have a high risk of sternal wound infection. ^c	IIa-B

Vessel harvesting

Skeletonized IMA dissection in patients with a high risk of sternal wound infection.	I-B
Endoscopic vein harvesting, if performed by experienced surgeons, to reduce the incidence of wound complications.	IIa-A
No-touch vein harvesting when an open technique is used.	IIa-B

Minimally invasive techniques

Off-pump CABG and preferably no-touch techniques on the ascending aorta, by experienced operators, in patients with significant atherosclerotic aortic disease.	I-B
Off-pump CABG for subgroups of high-risk patients by experienced off-pump teams.	IIa-B
Where expertise exists, minimally invasive CABG through limited thoracic access in patients with isolated LAD lesions or in the context of hybrid revascularization.	IIa-B
Hybrid procedures, defined as consecutive or combined surgical and percutaneous revascularization, in specific patient subsets at experienced centres.	IIb-B

BIMA = bilateral internal mammary artery; CABG = coronary artery bypass grafting; CT = computed tomography; IMA = internal mammary artery; LAD = left anterior descending coronary artery.

a: Definitions of complete revascularization are provided in section 5.3.1.3.

b: Particularly in patients with poor vein grafts. The radial artery should not be used if previously catheterized, if the Allen test is positive or if calcific degeneration is present.

c: Patients with diabetes mellitus, chronic pulmonary obstructive disease, previous mediastinal radiation, and obesity, particularly when multiples of these are present.

Recommendations on the management of carotid stenosis in patients undergoing coronary artery bypass grafting

In patients scheduled for CABG, the indication (and if so the method and timing) for carotid revascularization should be individualized after discussion within a multidisciplinary team, including a neurologist.	I-C
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In patients scheduled for CABG, with recent (<6 months) history of TIA/stroke:

- Carotid revascularization in patients with 50 - 99% carotid stenosis. I Ia-B
- Carotid revascularization with CEA as first choice in patients with 50 - 99% carotid stenosis. I Ia-B
- Carotid revascularization is not recommended in patients with carotid stenosis <50%. I III-C

In neurologically asymptomatic patients scheduled for CABG:

- Carotid revascularization in patients with bilateral 70 - 99% carotid stenosis or 70 - 99% carotid stenosis and contralateral occlusion. I Ib-C
- Carotid revascularization in patients with a 70 - 99% carotid stenosis, in the presence of one or more characteristics that may be associated with an increased risk of ipsilateral stroke,^a in order to reduce stroke risk beyond the perioperative period. I Ib-C
- Routine prophylactic carotid revascularization in patients with a 70 - 99% carotid stenosis is not recommended. I III-C

CABG = coronary artery bypass grafting; CEA = carotid endarterectomy; TIA = transient ischaemic attack.

a: Contralateral TIA/stroke, ipsilateral silent infarction on cerebral imaging, intraplaque haemorrhage or lipid-rich necrotic core on magnetic resonance angiography, or any of the following ultrasound imaging findings: stenosis progression (>20%), spontaneous embolization on transcranial Doppler, impaired cerebral vascular reserve, large plaques, echolucent plaques, or increased juxta-luminal hypoechogenic area

Preoperative strategies to reduce the incidence of stroke in patients undergoing coronary artery bypass grafting

In patients undergoing CABG, carotid DUS in patients with recent (<6 months) history Of stroke/TIA. I-B

In patients with no recent (<6 months) history of TIA/stroke, carotid DUS may be considered before CABG in the following cases: age ≥ 70 years, multivessel coronary artery disease, concomitant LEAD, or carotid bruit. I Ib-B

Screening for carotid stenosis is not indicated in patients requiring urgent CABG with no recent stroke/TIA. I III-C

CABG = coronary artery bypass grafting; DUS = duplex ultrasound; LEAD = lower extremity artery disease; TIA = transient ischaemic attack.

Recommendations on repeat revascularization

Early post-operative ischaemia and graft failure

Coronary angiography post-CABG is recommended for patients with: I-C

- symptoms of ischaemia and/or abnormal biomarkers suggestive of perioperative MI
- ischaemic ECG changes indicating large area of risk
- new significant wall motion abnormalities
- haemodynamic instability.

Emergency reoperation or PCI is decided upon by ad hoc consultation in the Heart I-C

Team, based on the feasibility of revascularization, area at risk, comorbidities, and clinical status.

Disease progression and late graft failure

Repeat revascularization in patients with a large area of ischaemia or severe symptoms despite medical therapy. I-B

If considered safe, PCI should be considered as first choice over CABG. IIa-C

Procedural aspects of the revascularization modalities

CABG

IMA is the conduit of choice for redo CABG in patients in whom the IMA was not used previously. I-B

Redo CABG for patients without a patent IMA graft to the LAD. IIa-B

PCI

Distal protection devices for PCI of SVG lesions. IIa-B

PCI of the bypassed native artery rather than PCI of the bypass graft. IIa-C

Table 3. Pharmacotherapy of CABG

ACC/AHA/SCAI 2021 GL on revascularization.

Insulin Infusion and Other Measures to Reduce Sternal Wound Infection in Patients

Undergoing CABG

- In patients undergoing CABG, an intraoperative continuous insulin infusion should be initiated to maintain serum glucose level <180 mg/dL to reduce sternal wound infection. I B-R
- In patients undergoing CABG, use of continuous intravenous insulin to achieve and maintain an early postoperative blood glucose concentration of <180 mg/dL while avoiding hypoglycemia to reduce the incidence of adverse events, including deep sternal wound infection. I B-R
- In patients undergoing CABG, a comprehensive approach to reduce sternal wound infection is recommended. I B-NR
- In patients undergoing CABG, the usefulness of continuous intravenous insulin designed to achieve a target intraoperative blood glucose concentration <140 mg/dL is uncertain. IIb B-R

Best Practices to Reduce Sternal Wound Infection in Patients Undergoing CABG

Perform nasal swab testing for <i>Staphylococcus aureus</i> . ⁸
Apply mupirocin 2% ointment to known nasal carriers of <i>S aureus</i> . ⁸
Apply preoperative intranasal mupirocin 2% ointment to those patients whose nasal culture or PCR result is unknown. ⁸
Redose prophylactic antimicrobials for long procedures (>2 half-lives of the antibiotic) or in cases of excessive blood loss during CABG. ^{10,11,27}
Measure perioperative HbA _{1c} . ³¹
Treat all distant extrathoracic infections before nonemergency surgical coronary revascularization. ¹⁹
Advise smoking cessation before elective CABG surgery. ⁷
Apply topical antibiotics (vancomycin) to the cut edges of the sternum on opening and before closing in cardiac surgical procedures involving a median sternotomy. ^{4,22}
Use skeletonized harvest of IMA in BIMA grafting. ¹⁶
Do not continue prophylactic antibiotics beyond 48 hours. ^{9,11}

BIMA indicates bilateral internal mammary artery; CABG, coronary artery bypass graft; HbA_{1c}, glycated hemoglobin A_{1c}; IMA, internal mammary artery; and PCR, polymerase chain reaction.

ACC/AHA/SCAI 2021 GL on revascularization.

Antiplatelet Therapy in Patients Undergoing CABG

Patients undergoing CABG who are already taking daily aspirin preoperatively, should continue taking aspirin until the time of surgery to reduce ischemic events.	I B-R
In patients referred for urgent CABG, clopidogrel and ticagrelor should be discontinued for at least 24 hours before surgery to reduce major bleeding complications.	I B-NR
In patients undergoing CABG, discontinuation of short-acting glycoprotein IIb/IIIa inhibitors (eptifibatide and tirofiban) for 4 hours and abciximab for 12 hours before surgery to reduce the risk of bleeding and transfusion.	I B-NR
In patients undergoing elective CABG who receive P2Y ₁₂ receptor inhibitors before surgery, discontinue clopidogrel for 5 days, ticagrelor for 3 days, and prasugrel for 7 days before CABG to reduce risk of major bleeding and blood product transfusion.	IIa B-NR
In patients undergoing elective CABG who are not already taking aspirin, the initiation of aspirin (100–300 mg daily) in the immediate preoperative period (<24 hours before surgery) is not recommended.	III B-R (No benefit)

Beta Blockers and Amiodarone in Patients Undergoing CABG

In patients undergoing CABG, who do not have a contraindication to beta blockers, administration of beta blockers before surgery to reduce the incidence of postoperative atrial fibrillation.	IIa B-R
In patients undergoing CABG, preoperative amiodarone to reduce the incidence of postoperative atrial fibrillation.	IIa B-R
In patients undergoing CABG, who do not have a contraindication to beta blockers, preoperative use of beta blockers in reducing in-hospital and 30-day mortality rates.	IIb B-NR
In patients undergoing CABG, the role of preoperative beta blockers for the prevention of acute postoperative myocardial ischemia, stroke, AKI, or ventricular arrhythmia is uncertain.	IIb B-NR

Beta Blockers for the Prevention of Atrial Fibrillation After CABG

In patients after CABG, beta blockers should be started as soon as possible to reduce the incidence or clinical sequelae of postoperative atrial fibrillation	I B-R
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PHARMACOTHERAPY IN PATIENTS AFTER REVASCULARIZATION

Antiplatelet Therapy in Patients After CABG

In patients undergoing CABG, aspirin (100–325 mg daily) should be initiated within 6 hours postoperatively and then continued indefinitely to reduce the occurrence of SVG closure and adverse cardiovascular events. I A

In selected patients undergoing CABG, DAPT with aspirin and ticagrelor or clopidogrel for 1 year to improve vein graft patency compared with aspirin alone IIb B-R

Beta Blockers for the Prevention of Atrial Fibrillation After CABG

In patients after CABG, beta blockers should be started as soon as possible to reduce the incidence or clinical sequelae of postoperative atrial fibrillation I B-R

Table 4. Pharmacotherapy for PCI

ESC/EACTS 2018 GI on revascularization. Recommendations for antithrombotic treatment in stable coronary artery disease patients undergoing percutaneous coronary intervention

Pre-treatment and antiplatelet therapy

Treatment with 600 mg clopidogrel in elective PCI patients once the coronary anatomy is known. I-A

Pre-treatment with clopidogrel if the probability of PCI is high. IIb-C

In patients on a maintenance dose of 75 mg clopidogrel, a new loading dose of 600 mg once the indication for PCI is confirmed. IIb-C

Peri-interventional treatment

Aspirin is indicated before elective stenting. I-A

Oral loading dose of aspirin (150–300 mg p.o. or 75–250 mg i.v.) if the patient is not pre-treated. I-C

Clopidogrel (600 mg loading dose, 75 mg daily maintenance dose) for elective stenting. I-A

Glycoprotein IIb/IIIa antagonists only for bail-out. IIa-C

Prasugrel or ticagrelor in specific high-risk situations of elective stenting (e.g. history of stent thrombosis or left main stenting). IIb-C

Unfractionated heparin as the standard anticoagulant (70–100 U/kg). I-B

Bivalirudin (0.75 mg/kg bolus, followed by 1.75 mg/kg/h for up to 4 h after the procedure) in the case of heparin-induced thrombocytopenia. I-C

Enoxaparin (i.v. 0.5 mg/kg) as an alternative agent. IIa-B

Cangrelor in P2Y₁₂-inhibitor naïve patients undergoing PCI. IIb-A

Post-interventional and maintenance treatment

Life-long single antiplatelet therapy, usually aspirin. I-A

Instruction of patients about the importance of complying with antiplatelet therapy is recommended. I-C

In patients treated with coronary stent implantation, DAPT consisting of clopidogrel in addition to aspirin for 6 months, irrespective of the stent type.^a I-A

In patients with SCAD treated with BRS, DAPT for at least 12 months and up to the presumed full absorption of the BRS, based on an individual assessment of bleeding and ischaemic risk. IIa-C

In patients with SCAD treated with DCB, DAPT for 6 months. IIa-B

In patients considered at high bleeding risk (e.g. PRECISE-DAPT >_25), DAPT should be considered for 3 months.^b IIa-A

In patients who have tolerated DAPT without a bleeding complication and who are at low bleeding risk but high thrombotic risk, continuation of DAPT with clopidogrel for >6 months and up to 30 months. IIb-A

In patients in whom 3 month DAPT poses safety concerns, DAPT for 1 month. IIb-C

a: These recommendations refer to stents that are supported by large-scale randomized trials with clinical endpoint evaluation leading to an unconditional CE mark.

b: The evidence supporting this recommendation comes from two studies where the zotarolimus-eluting Endeavour stent was investigated in conjunction with a 3 month DAPT regimen.

BRS = bioresorbable scaffold; CAD = coronary artery disease; DAPT = dual antiplatelet therapy; DCB = drug-coated balloon; i.v. = intravenous; MI = myocardial infarction; PCI = percutaneous coronary intervention; p.o. = orally; PRECISE-DAPT = PREdicting bleeding Complications In patients undergoing Stent implantation and subSequent Dual Anti Platelet Therapy; SCAD = stable coronary artery disease.

ESC 2023 GL on diabetes. Recommendations for antithrombotic therapy in patients with diabetes and acute or chronic coronary syndrome without indications for long-term oral anticoagulation

ASA at a dose of 75–100 mg o.d. is recommended in patients with diabetes and previous MI or revascularization (CABG or stenting). ^{291,325,326}	I	A
In patients with ACS and diabetes who undergo PCI, a P2Y ₁₂ receptor inhibitor (ticagrelor or prasugrel) is recommended in addition to ASA (75–100 mg o.d.), maintained over 12 months. ^{310–312,314}	I	A
Clopidogrel 75 mg o.d. following appropriate loading (e.g. 600 mg or at least 5 days already on maintenance therapy) is recommended in addition to ASA for 6 months following coronary stenting in patients with CCS, irrespective of stent type, unless a shorter duration is indicated due to the risk or occurrence of life-threatening bleeding. ^{327–332}	I	A
Clopidogrel is recommended as an alternative in case of ASA intolerance. ³³³	I	B
In patients with diabetes and ACS treated with DAPT who are undergoing CABG and do not require long-term OAC therapy, resuming a P2Y ₁₂ receptor inhibitor as soon as deemed safe after surgery and continuing it up to 12 months is recommended. ^{315,334,335}	I	C
Prolonging DAPT beyond 12 months after ACS should be considered for up to 3 years in patients with diabetes who have tolerated DAPT without major bleeding complications. ^{c,317,318,336}	IIa	A
Adding very low-dose rivaroxaban ^d to low-dose ASA for long-term prevention of serious vascular events should be considered in patients with diabetes and CCS or symptomatic PAD without high bleeding risk. ^{304,305}	IIa	B

ACS, acute coronary syndrome; ASA, acetylsalicylic acid; b.i.d., twice a day; CABG, coronary artery bypass graft; CCS, chronic coronary syndrome; DAPT, dual antiplatelet therapy; MI, myocardial infarction; OAC, oral anticoagulant; o.d., once daily; PAD, peripheral arterial disease; PCI, percutaneous coronary intervention.

^cIn case of ticagrelor, a reduced dose (60 mg b.i.d.) should be used.

^dRivaroxaban 2.5 mg b.i.d.

ESC 2023 GL on diabetes. Recommendations for antithrombotic therapy in patients with diabetes and acute or chronic coronary syndrome and/or post- percutaneous coronary intervention requiring long- term oral anticoagulation

In patients with AF and receiving antiplatelet therapy, eligible for anticoagulation, and without a contraindication, ^c NOACs are recommended in preference to a VKA. ^{339,340,343}	I	A
In patients with ACS or CCS and diabetes undergoing coronary stent implantation and having an indication for anticoagulation, triple therapy with low-dose ASA, clopidogrel, and an OAC is recommended for at least 1 week, followed by dual therapy with an OAC and a single, oral, antiplatelet agent. ^{339–342,344,345}	I	A
In patients with ACS or CCS and diabetes undergoing coronary stent implantation and having an indication for anticoagulation, prolonging triple therapy with low-dose ASA, clopidogrel, and an OAC should be considered up to 1 month if the thrombotic risk outweighs the bleeding risk in the individual patient. ^{341–344}	IIa	C
In patients with ACS or CCS and diabetes undergoing coronary stent implantation and having an indication for anticoagulation, prolonging triple therapy with low-dose ASA, clopidogrel, and an OAC up to 3 months may be considered if the thrombotic risk outweighs the bleeding risk in the individual patient. ^{341–344}	IIb	C

ACS, acute coronary syndrome; AF, atrial fibrillation; CCS, chronic coronary syndrome; NOAC, non-vitamin K antagonist oral anticoagulant; OAC, oral anticoagulant; PCI, percutaneous coronary intervention; VKA, vitamin K antagonist.

^cContraindications to NOACs are prosthetic mechanical heart valve, mitral stenosis, and creatinine clearance below the approved threshold for the specific NOAC.

ESC 2023 GL on diabetes. Recommendations for gastric protection in patients with diabetes taking antithrombotic drugs

When antithrombotic drugs are used in combination, proton pump inhibitors are recommended to prevent gastrointestinal bleeding. ^{337,347,348,351–353,355}	I	A
When a single antiplatelet or anticoagulant drug is used, proton pump inhibitors should be considered to prevent gastrointestinal bleeding, considering the bleeding risk of the individual patient. ^{338,347,348,351,352}	IIa	A
When clopidogrel is used, omeprazole and esomeprazole are not recommended for gastric protection. ³⁵⁶	III	B

ACC/AHA/SCAI 2021 GL on revascularization.

Aspirin and Oral P2Y12 Inhibitors in Patients Undergoing PCI

In patients undergoing PCI, a loading dose of aspirin, followed by daily dosing, to reduce ischemic events. I B-R

In patients with ACS undergoing PCI, a loading dose of P2Y12 inhibitor, followed by daily dosing, to reduce ischemic events.* I B-R

In patients with ACS undergoing PCI, use ticagrelor or prasugrel in preference to clopidogrel to reduce ischemic events, including stent thrombosis. IIa B-R

In patients undergoing PCI who have a history of stroke or transient ischemic attack, prasugrel should not be administered. III B-R (Harm)

*Contraindications to ticagrelor: previous intracranial hemorrhage or ongoing bleeding. Contraindications to prasugrel: previous intracranial hemorrhage, previous ischemic stroke or transient ischemic attack, or ongoing bleeding. Prasugrel should be used with caution at a lower dose in patients ≥ 75 years of age or with a body weight < 60 kg.

Oral and Parenteral Antiplatelet Agents for Patients Undergoing PCI

Drug	Loading Dose	Maintenance Dose
Oral antiplatelet agents		
Aspirin	Loading dose of 162-325 mg orally ¹¹ Aspirin may be chewed to achieve faster action	Maintenance dose of 75-100 mg orally daily ^{24,25}
Clopidogrel	Loading dose of 600 mg orally ¹⁹ A lower loading dose of 300 mg should be considered in patients after fibrinolytic therapy ⁶	Maintenance dose of 75 mg orally daily ³⁴
Prasugrel	Loading dose of 60 mg orally ²⁰	Maintenance dose of 10 mg orally daily ²⁰ In patients with body weight <80 kg, a maintenance dose of 5 mg orally daily is recommended ²⁵ In patients ≥75 years of age, a dose of 5 mg orally daily can be used if deemed necessary ³⁵
Ticagrelor	Loading dose of 180 mg orally ¹⁴ Ticagrelor may be chewed to achieve faster action	Maintenance dose of 90 mg orally twice a day ¹⁴
Intravenous antiplatelet agents		
Abciximab (GPI)*	Bolus of 0.25 mg/kg ³⁶	Maintenance of 0.125 µg/kg/min infusion (maximum 10 g/min) for 12 h. ³⁶
Eptifibatide (GPI)	Double bolus of 180 µg/kg (given at a 10-min interval) ³⁷	Maintenance infusion of 2.0 µg/kg/min for up to 18 h ³⁷
Tirofiban (GPI)	Bolus of 25 µg/kg over 3 min ³⁸	Maintenance infusion of 0.15 µg/kg/min for up to 18 h ³⁸
Cangrelor	Bolus of 30 µg/kg ³⁹	Maintenance infusion 4 µg/kg/min for at least 2 h or duration of the procedure, whichever is longer ³⁹

GPI indicates glycoprotein IIb/IIIa inhibitor; and PCI, percutaneous coronary intervention.

*Abciximab may not be readily available to clinicians in the United States.

Intravenous P2Y₁₂ Inhibitors in Patients Undergoing PCI

In patients undergoing PCI who are P2Y₁₂ inhibitor naïve, intravenous cangrelor I Ib B-R
to reduce periprocedural ischemic events.

Intravenous Glycoprotein IIb/IIIa Inhibitors in Patients Undergoing PCI

In patients with ACS undergoing PCI with large thrombus burden, no-reflow, I Ia C-LD
or slow flow, intravenous glycoprotein IIb/IIIa inhibitor agents to improve procedural success.

Heparin, Low-Molecular-Weight Heparin, and Bivalirudin in Patients Undergoing PCI

In patients undergoing PCI, administration of intravenous unfractionated heparin (UFH) I C-EO
to reduce ischemic events.

In patients with heparin-induced thrombocytopenia undergoing PCI, I C-LD
bivalirudin or argatroban to replace UFH to avoid thrombotic complications.

In patients undergoing PCI, bivalirudin as an alternative to UFH to reduce I Ib A
bleeding.

In patients treated with upstream subcutaneous enoxaparin for unstable angina I Ib B-R
or NSTEMI, use intravenous enoxaparin at the time of PCI to reduce ischemic events.

In patients on therapeutic subcutaneous enoxaparin, in whom the last dose III B-R
was administered within 12 hours of PCI, UFH should (Harm)
not be used for PCI and may increase bleeding.

Anticoagulant Dosing During PCI*

Dosing of Parenteral Anticoagulants During PCI		
Drug	Patient Has Received Previous Anticoagulant Therapy	Patient Has Not Received Previous Anticoagulant Therapy
UFH	Additional UFH as needed (eg, 2000–5000 U) to achieve an ACT of 250–300 s*	70–100 U/kg initial bolus to achieve target ACT of 250–300 s*
Enoxaparin	For previous treatment with enoxaparin, if the last SC dose was administered 8–12 h earlier or if only 1 SC dose of enoxaparin has been administered, an IV dose of 0.3 mg/kg of enoxaparin should be given ^{42–45} If the last SC dose was administered within the previous 8 h, no additional enoxaparin should be given	0.5–0.75 mg/kg IV bolus
Bivalirudin	For patients who have received UFH, repeat ACT If ACT is not in therapeutic range, then give 0.75 mg/kg IV bolus, then 1.75 mg/kg/h IV infusion	0.75 mg/kg bolus, 1.75 mg/kg/h IV infusion
Argatroban	200 µg/kg IV bolus, then 15 µg/kg/min IV infusion	350 µg/kg, then 15 µg/kg/min IV infusion

ACS indicates acute coronary syndrome; ACT, activated clotting time; CTO, chronic total occlusion; PCI, percutaneous coronary intervention; and UFH, unfractionated heparin.

*Target ACTs for UFH dosing shown for HemoTec (GmbH, Switzerland) or I-Stat (Abbott) device. For Hemochron ACT (Werfen) devices, ACT goals are 50 s higher. In the case of CTO or ACS, consider higher target ACT. If IV glycoprotein IIb/IIIa receptor inhibitor is planned, target ACT 200–250 s.^{26,27,31,40–42}

Aspirin and Oral P2Y₁₂ Inhibitors in Patients Undergoing PCI

In patients undergoing PCI, a loading dose of aspirin, followed by daily dosing, to reduce ischemic events. I B-R

In patients with SIHD undergoing PCI, a loading dose of clopidogrel, followed by daily dosing, to reduce ischemic events. I C-LD

Dual Antiplatelet Therapy in Patients After PCI

In selected patients undergoing PCI, shorter duration DAPT (1–3 months), with subsequent transition to P2Y₁₂ inhibitor monotherapy to reduce the risk of bleeding events. IIa A

Intravenous Glycoprotein IIb/IIIa Inhibitors in Patients Undergoing PCI

In patients with SIHD undergoing PCI, the routine use of an intravenous glycoprotein IIb/ IIIa inhibitor agent is not recommended III B-R
(No benefit)

Dual Antiplatelet Therapy in Patients After PCI

In selected patients undergoing PCI, shorter duration DAPT (1–3 months), with subsequent transition to P2Y₁₂ inhibitor monotherapy to reduce the risk of bleeding events. IIa A

Beta Blockers in Patients After Revascularization

In patients with SIHD and normal left ventricular function, the routine use of chronic oral beta blockers is not beneficial to reduce cardiovascular events after complete revascularization. III C-LD
(No benefit)

Table 5. AF in patients undergoing PCI**ESC 2020 GL on AF. Recommendations in AF patients with a CCS undergoing PCI**

After uncomplicated PCI, early cessation (<1 week) of aspirin and continuation of dual therapy with OAC for up to 6 months and clopidogrel if the risk of stent thrombosis^a is low or if concerns about bleeding risk^b prevail over concerns about risk of stent thrombosis,^a irrespective of the type of stent used. I-B

Triple therapy with aspirin, clopidogrel, and an OAC^c for longer than 1 week when risk of stent thrombosis^a outweighs the bleeding risk,^b with the total duration (<1 month) decided according to assessment of these risks, and the treatment plan should be clearly specified at hospital discharge. IIa-C

a Risk of stent thrombosis encompasses: (i) risk of thrombosis occurring, and (ii) risk of death should stent thrombosis occur, both of which relate to anatomical, procedural, and clinical characteristics. Risk factors for CCS patients include: stenting of left main stem or last remaining patent artery; suboptimal stent deployment; stent length >60 mm; diabetes mellitus; CKD; bifurcation with two stents implanted; treatment of chronic total occlusion; and previous stent thrombosis on adequate antithrombotic therapy.

b Bleeding risk in AF patients may be assessed using the HAS-BLED score, which draws attention to modifiable bleeding risk factors; those at high risk (score >3) can have more frequent or early review and follow-up. Bleeding risk is highly dynamic and does not remain static, and relying on modifiable bleeding risk factors alone is an inferior strategy to evaluate bleeding risk.

c When dabigatran is used in triple therapy, dabigatran 110 mg b.i.d may be used instead of 150 mg b.i.d, but the evidence is insufficient.

CCS = chronic coronary syndrome; CKD = chronic kidney disease; DAPT = Dual antiplatelet therapy; HAS-BLED = Hypertension, Abnormal renal/liver function, Stroke, Bleeding history or predisposition, Labile INR, Elderly (>65 years), Drugs/alcohol concomitantly; INR = international normalized ratio; NOAC = non-vitamin K antagonist oral anticoagulant; o.d. = omni die (once daily); OAC = oral anticoagulant; PCI=percutaneous coronary intervention; TTR = time in therapeutic range; VKA = vitamin K antagonist.

ACC/AHA/SCAI 2021 GL on revascularization. Antiplatelet Therapy in Patients With Atrial Fibrillation on Anticoagulation After PCI

In patients with atrial fibrillation who are undergoing PCI and are taking oral anticoagulant therapy, discontinue aspirin treatment after 1 to 4 weeks while maintaining P2Y12 inhibitors in addition to a non-vitamin K oral anticoagulant (rivaroxaban, dabigatran, apixaban, or edoxaban) or warfarin to reduce the risk of bleeding. I B-R

In patients with atrial fibrillation who are undergoing PCI, are taking oral anticoagulant therapy, and are treated with DAPT or a P2Y12 inhibitor monotherapy, choose a non-vitamin K oral anticoagulant over warfarin to reduce the risk of bleeding. IIa B-R

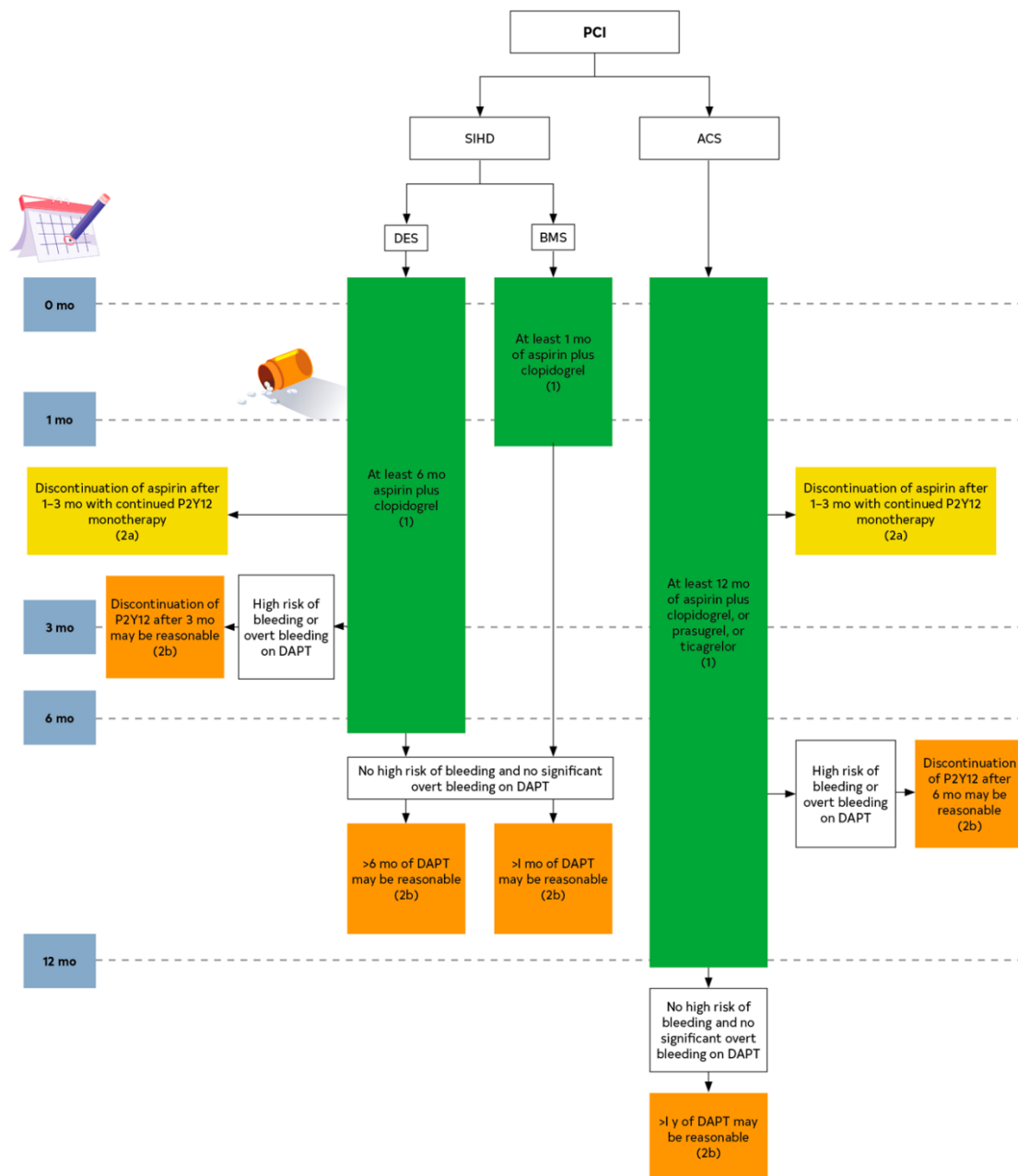


Figure 1. ACC/AHA/SCAI 2021 GL on revascularization. Use of DAPT for Patients After PCI.

ACS indicates acute coronary syndrome; BMS, bare metal stent; DAPT, dual antiplatelet therapy; DES, drug-eluting stent; P2Y12, platelet adenosine diphosphate P2Y12 receptor; PCI, percutaneous coronary intervention; and SIHD, stable ischemic heart disease.

This algorithm is adapted from the 2016 DAPT guideline and includes new recommendations from this guideline for the care of patients with CAD. It is not meant to encompass every patient scenario or situation, and clinicians are encouraged to use a Heart Team approach when care decisions are unclear and to see the accompanying supportive text for each recommendation.

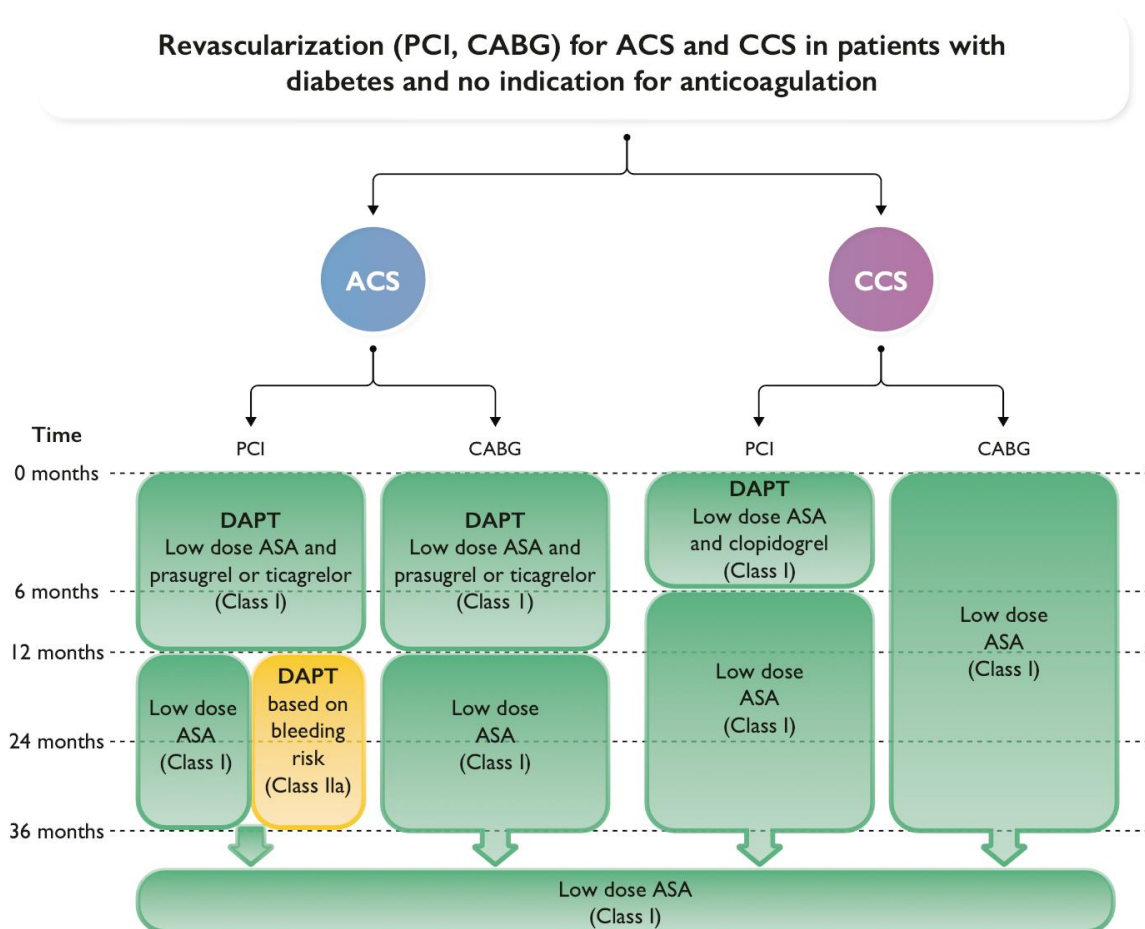


Figure 2. ESC 2023 GL on diabetes. Recommendations for antiplatelet therapy in patients with diabetes with acute or chronic coronary syndrome undergoing percutaneous coronary intervention or coronary artery bypass grafting without indications for long-term oral anticoagulation.

ACS, acute coronary syndrome; ASA, acetyl-salicylic acid; CABG, coronary artery bypass graft; CCS, chronic coronary syndrome; DAPT, dual antiplatelet therapy; PCI, percutaneous coronary intervention.

Table 6. Technical aspects of PCI**ESC/EACTS 2018 GL on revascularization.****Recommendations on functional testing and intravascular imaging for lesion assessment**

FFR or iwFR to assess the haemodynamic relevance of intermediate-grade stenosis, when evidence of ischaemia is not available. I-A

FFR-guided PCI in patients with multivessel disease undergoing PCI. IIa-B

IVUS to assess the severity of unprotected left main lesions. IIa-B

FFR = fractional flow reserve; iwFR = instantaneous wave-free ratio; IVUS = intravascular ultrasound; PCI = percutaneous coronary intervention.

Recommendation for patients on metformin

Check renal function if patients have taken metformin immediately before angiography and withhold metformin if renal function deteriorates. I-C

Recommendations for the prevention of contrast-induced nephropathy***Patients undergoing coronary angiography or MSCT***

All patients are assessed for the risk of contrast-induced nephropathy. I-C

Adequate hydration. I-C

Patients with moderate or severe CKD (National Kidney Foundation stages 3b and 4)

Use of low-osmolar or iso-osmolar contrast media. I-A

Minimize the volume of contrast media. I-B
(Total contrast volume/GFR $<3.7^a$)

Pre-treatment with high-dose statins in statin-naïve patients. IIa-A
(Rosuvastatin 40/20 mg or atorvastatin 80 mg).

Pre- and post-hydration with isotonic saline should if the expected contrast volume is >100 mL. IIa-C
1 mL/kg/h 12 h before and continued for 24 h after the procedure
(0.5 mL/kg/h if LVEF $<35\%$ or NYHA >2).

Tailored hydration regimens^b as an alternative to the pre- and post-hydration regimen. IIb-B

Patients with severe CKD (National Kidney Foundation stage 4)

Prophylactic haemofiltration 6 h before complex PCI may be considered. IIb-B
Fluid replacement rate 1000 mL/h without negative loss and saline hydration continued for 24 h after the procedure.

Haemodialysis is not recommended as a preventive measure. III-B

CKD = chronic kidney disease; GFR = glomerular filtration rate; LVEF = left ventricular ejection fraction; MSCT = multi-slice computed tomography; NYHA = New York Heart Association; PCI = percutaneous coronary angiography.

a: Example: 370 mL of contrast medium in a patient with a GFR of 100 mL/min will yield a ratio of 3.7.

b: Options are: infusion of normal saline adjusted to central venous pressure or furosemide with matched infusion of normal saline.

Recommendations on repeat revascularization

Procedural aspects of the revascularization modalities

PCI

Distal protection devices for PCI of SVG lesions. IIA-B

PCI of the bypassed native artery rather than PCI of the bypass graft. IIA-C

Restenosis

DES for the treatment of in-stent restenosis of BMS or DES. I-A

Drug-coated balloons for the treatment of in-stent restenosis of BMS or DE. I-A

In patients with recurrent episodes of diffuse in-stent restenosis, CABG should be considered by the Heart Team over a new PCI attempt. IIA-C

IVUS and/or OCT to detect stent-related mechanical problems leading to restenosis. IIA-C

BMS = bare-metal stent; CABG = coronary artery bypass grafting; DES = drug-eluting stent; ECG = electrocardiogram; IMA = internal mammary artery; IVUS = intravascular ultrasound; LAD = left anterior descending artery; MI = myocardial infarction; OCT = optical coherence tomography; PCI = percutaneous coronary intervention; SVG = saphenous vein graft.

Recommendations on intravascular imaging for procedural optimization

IVUS or OCT in selected patients to optimize stent implantation. IIA-B

IVUS to optimize treatment of unprotected left main lesions. IIA-B

IVUS = intravascular ultrasound; OCT = optical coherence tomography.

Recommendations on choice of stent and access site

DES are recommended over BMS for any PCI irrespective of: I-A

- clinical presentation
- lesion type
- planned non-cardiac surgery
- anticipated duration of DAPT
- concomitant anticoagulant therapy.

Radial access as the standard approach, unless there are overriding procedural considerations. I-A

BRS are currently not recommended for clinical use outside of clinical studies. III-C

BMS = bare-metal stents; BRS = bioresorbable scaffolds; DAPT = dual antiplatelet therapy; DES = drug-eluting stents; PCI = percutaneous coronary intervention.

Recommendations on specific lesion subsets

Stent implantation in the main vessel only, followed by provisional balloon angioplasty with or without stenting of the side branch, for PCI of bifurcation lesions. I-A

Percutaneous revascularization of CTOs in patients with angina resistant to medical therapy or with a large area of documented ischaemia in the territory of the occluded vessel. IIa-B

In true bifurcation lesions of the left main, the double-kissing crush technique may be preferred over provisional T-stenting. IIb-B

CTO = chronic total occlusion; PCI = percutaneous coronary intervention.

ESC 2023 GL on diabetes. Recommendations for revascularization in patients with diabetes

Similar revascularization techniques are implemented (e.g. the use of DES and the radial approach for PCI, and the use of the left internal mammary artery as the graft for CABG) in patients with and without diabetes I A

ACC/AHA/SCAI 2021 GL on revascularization.

Recommendation for Defining Coronary Artery Lesion Complexity: Calculation of the SYNTAX Score

In patients with multivessel CAD, an assessment of CAD complexity, such as the SYNTAX score, may be useful to guide revascularization 2b B-NR

Recommendations for the Use of Coronary Physiology to Guide Revascularization With PCI

In patients with angina or an anginal equivalent, undocumented ischemia, and angiographically intermediate stenoses, the use of fractional flow reserve (FFR) or instantaneous wave-free ratio (iFR) is recommended to guide the decision to proceed with PCI. 1 A

In stable patients with angiographically intermediate stenoses and FFR >0.80 or iFR >0.89, PCI should not be performed 3 B-R
No benefit

Recommendation for Intravascular Ultrasound to Assess Lesion Severity

In patients with intermediate stenosis of the left main artery, intravascular ultrasound (IVUS) is reasonable to help define lesion severity 2a B-NR

Radial and Femoral Approaches for PCI

In patients with ACS undergoing PCI, a radial approach in preference to a femoral approach to reduce the risk of death, vascular complications, or bleeding. I A

In patients with SIHD undergoing PCI, a radial approach to reduce access site bleeding and vascular complications. I A

Choice of Stent Type

In patients undergoing PCI, DES should be used in preference to BMS to prevent restenosis, MI, or acute stent thrombosis. I A

Use of Intravascular Imaging

In patients undergoing coronary stent implantation, IVUS for procedural guidance, particularly in cases of left main or complex coronary artery stenting, to reduce ischemic events. IIa B-R

In patients undergoing coronary stent implantation, OCT as an alternative to IVUS for procedural guidance, except in ostial left main disease. IIa B-R

In patients with stent failure, IVUS or OCT to determine the mechanism of stent failure. IIa C-LD

Thrombectomy

In patients with STEMI, routine aspiration thrombectomy before primary PCI is not useful (No benefit) III A

Treatment of Calcified Lesions

In patients with fibrotic or heavily calcified lesions, plaque modification with rotational atherectomy can be useful to improve procedural success. IIa B-R

In patients with fibrotic or heavily calcified lesions, plaque modification with orbital atherectomy, balloon atherotomy, laser angioplasty, or intracoronary lithotripsy to improve procedural success. IIb B-NR

Treatment of Saphenous Vein Graft (SVG) Disease (Previous CABG)

In select patients with previous CABG undergoing PCI of a SVG, the use of an embolic protection device, when technically feasible, to decrease the risk of distal embolization. IIa B-R

In patients with previous CABG, if PCI of a diseased native coronary artery is feasible, choose PCI of the native coronary artery over PCI of the severely diseased SVG. IIa B-NR

In patients with a chronic occlusion of a SVG, percutaneous revascularization of the SVG should not be performed. III C-LD (No benefit)

Treatment of CTO

In patients with suitable anatomy who have refractory angina on medical therapy, after treatment of non-CTO lesions, the benefit of PCI of a CTO to improve symptoms is uncertain. IIb B-R

Treatment of Patients With Stent Restenosis

In patients who develop clinical in-stent restenosis (ISR) for whom repeat PCI is planned, a DES to improve outcomes if anatomic factors are appropriate and the patient is able to comply with DAPT. I A

In symptomatic recurrent diffuse ISR with an indication for revascularization, IIa C-EO

CABG over repeat PCI to reduce recurrent events.

In recurrent ISR, brachytherapy to improve symptoms. I Ib B-NR

Hemodynamic Support for Complex PCI

In selected high-risk patients, elective insertion of an appropriate hemodynamic support device as an adjunct to PCI may be reasonable to prevent hemodynamic compromise during PCI. I Ib B-R

Recommendations for Patients With Complex Disease

In patients who require revascularization for significant left main CAD with high-complexity CAD, choose CABG over PCI to improve survival 1 B-R

In patients who require revascularization for multivessel CAD with complex or diffuse CAD (e.g., SYNTAX score >33), choose CABG over PCI to confer a survival advantage 2a B-R

Recommendation for DAPT Adherence

In patients with multivessel CAD amenable to treatment with either PCI or CABG who are unable to access, tolerate, or adhere to DAPT for the appropriate duration of treatment, CABG in preference to PCI 2a B-NR

Defining Coronary Artery Lesion Complexity: Calculation of the SYNTAX Score

In patients with multivessel CAD, an assessment of CAD complexity, such as the SYNTAX score, may be useful to guide revascularization I Ib B-NR

Use of Coronary Physiology to Guide Revascularization With PCI

In patients with angina or an anginal equivalent, undocumented ischemia, and angiographically intermediate stenoses, use fractional flow reserve (FFR) or instantaneous wave-free ratio (iFR) to guide the decision to proceed with PCI. I A

In stable patients with angiographically intermediate stenoses and FFR >0.80 or iFR >0.89, PCI should not be performed III B-R

Intravascular Ultrasound to Assess Lesion Severity

In patients with intermediate stenosis of the left main artery, intravascular ultrasound (IVUS) to help define lesion severity IIa B-NR

Recommendations for Patients With Previous CABG

In patients with a patent LIMA to the LAD who need repeat revascularization, if PCI is feasible, choose PCI over CABG 2a B-NR

In patients with refractory angina on GDMT that is attributable to LAD disease, choose CABG over PCI when an internal mammary artery (IMA) can be used as a conduit to the LAD 2a C-LD

In patients with complex CAD, choose CABG over PCI when an IMA can be used as a conduit to the LAD 2b B-NR

Revascularization in Older Patients

In older adults, as in all patients, the treatment strategy for CAD should be based I B-NR

on an individual patient's preferences, cognitive function, and life expectancy.

Revascularization in Patients With SCAD

In patients with SCAD who have haemodynamic instability or ongoing ischaemia despite conservative therapy, revascularization if feasible. IIb C-LD

Routine revascularization for SCAD should not be performed. III C-LD
(Harm)

Revascularization in Patients with Diabetes

In patients with multivessel CAD with the involvement of the LAD, who are appropriate candidates for CABG, CABG (with a LIMA to the LAD) in preference to PCI to reduce mortality and repeat revascularizations. 1 A

In patients who have multivessel CAD amenable to PCI and an indication for revascularization and are poor candidates for surgery, PCI can be useful to reduce long-term ischemic outcomes 2a B-NR

In patients who have left main stenosis and low- or intermediate-complexity CAD in the rest of the coronary anatomy, PCI may be considered an alternative to CABG to reduce major adverse cardiovascular outcomes 2b B-R

Revascularization in Patients With Cardiac Allografts

In patients with cardiac allograft vasculopathy and severe, proximal, discrete coronary lesions, revascularization with PCI. IIa C-LD

Recommendations for Revascularization in Pregnant Patients

In STEMI not caused by spontaneous coronary artery dissection (SCAD), perform primary PCI as the preferred revascularization strategy 2a C-LD

In NSTEMI-ACS, an invasive strategy is reasonable if medical therapy is ineffective for the management of life-threatening complications 2a C-LD

Revascularization in patients with chronic kidney disease

In patients with CKD undergoing contrast media injection for coronary angiography, measures should be taken to minimize the risk of contrast-induced acute kidney injury (AKI) 1 C-LD

Best Practices in the Catheterization Laboratory for Patients With CKD Undergoing Angiography

- Assess the risk of contrast-induced AKI before the procedure (1-3)
- Administer adequate preprocedural hydration (19,20)
- Record the volume of contrast media administered, and minimize contrast use (18,22,23)
- Pretreat with high-intensity statins (21,24,25)
- Use radial artery if feasible (31-33)
- Do not administer N-acetyl-L-cysteine to prevent contrast-induced AKI (38-40)
- Do not give prophylactic renal replacement therapy (41,42)
- Delay CABG in stable patients after angiography beyond 24 hours when clinically feasible (43-45)

AKI indicates acute kidney injury; CABG, coronary artery bypass graft; and CKD, chronic kidney disease.

Table 7. ESC 2026 GL on CKD. Recommendations to support safe use of contrast in chronic kidney disease

Avoiding delays in procedures and interventions that use contrast agents is recommended for patients with CKD to ensure timely diagnosis and treatment.	I	C
Use of iso-osmolar or low-osmolar iodinated contrast media in combination with contrast-sparing protocols and techniques is recommended in patients with an eGFR <30 mL/min/1.73 m ² not on dialysis undergoing coronary angiography or vascular procedures to reduce the risk of CI-AKI. ^{731,732,734-736}	I	A
Use of group two or three gadolinium-based contrast agents is recommended in patients with an eGFR <30 mL/min/1.73 m ² for MRI scans requiring such contrast due to the low risk of toxicity (nephrogenic systemic fibrosis). ^{762,763}	I	B2
An integrated assessment of risk based on current eGFR, specific patient risk factors, as well as the planned procedure should be considered to identify patients with CKD at high risk of harm associated with CI-AKI. ^{726,727,772}	IIa	C
Peri-procedural intravenous hydration may be considered in patients with an eGFR <30 mL/min/1.73 m ² not on dialysis, undergoing any procedure requiring administration of iodinated contrast to reduce the risk of CI-AKI. ^{722,745,750,773}	IIb	C
Prophylactic haemodialysis is not recommended in patients with CKD to prevent CI-AKI, as this has been associated with harm. ⁷⁵⁷⁻⁷⁶⁰	III	B2

CI-AKI, contrast-induced acute kidney injury; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; MRI, magnetic resonance imaging.

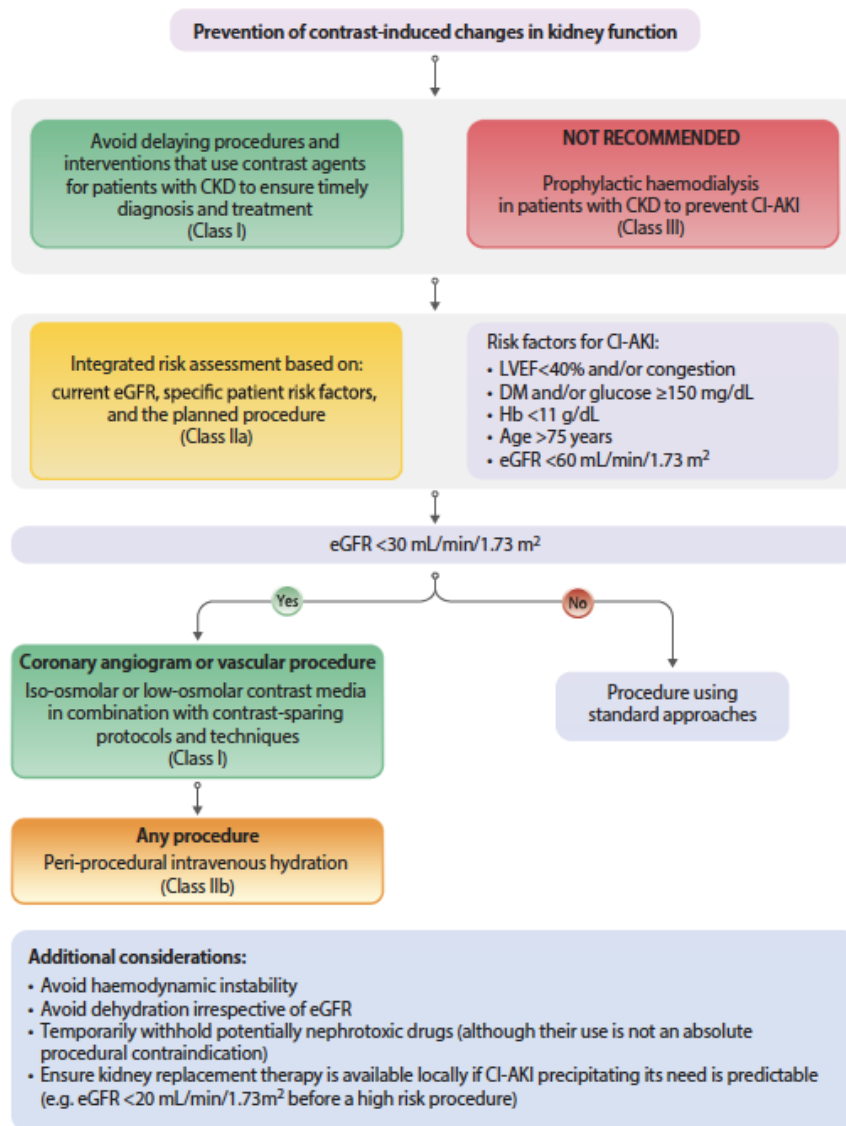


Figure 3. ESC 2026 GL on CKD. Algorithm to support safe use of contrast in chronic kidney disease.

CI-AKI, contrast-induced acute kidney injury; CKD, chronic kidney disease; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; Hb, haemoglobin; LVEF, left ventricular ejection fraction.

Table 8. ACC/AHA/SCAI 2021 GL on revascularization. Life style changes and follow-up after revascularization

Cardiac Rehabilitation and Education

In patients who have undergone revascularization, a comprehensive cardiac rehabilitation program (home based or center based) should be prescribed either before hospital discharge or during the first outpatient visit to reduce deaths and hospital readmissions and improve quality of life. I A

Patients who have undergone revascularization should be educated about CVD risk factors and their modification to reduce cardiovascular events. I C-LD

Smoking Cessation in Patients After Revascularization

In patients who use tobacco and have undergone coronary revascularization, a combination of behavioral interventions plus pharmacotherapy is recommended to maximize cessation and reduce adverse cardiac events. I A

In patients who use tobacco and have undergone coronary revascularization, smoking cessation interventions are recommended during hospitalization and should include supportive follow-up for at least 1 month after discharge to facilitate tobacco cessation and reduce morbidity and mortality. I A

Psychological Interventions in Patients After Revascularization

In patients who have undergone coronary revascularization who have symptoms of depression, anxiety, or stress, treatment with cognitive behavioral therapy, psychological counseling, and/or pharmacological interventions is beneficial to improve quality of life and cardiac outcomes. I B-R

In patients who have undergone coronary revascularization, screen for depression and refer or treat when it is indicated to improve quality of life and recovery. IIb C-LD

Assessment of Outcomes in Patients After Revascularization

With the goal of improving patient outcomes, cardiac surgery and PCI programs should participate in state, regional, or national clinical data registries and receive periodic reports of their risk-adjusted outcomes as a quality assessment and improvement strategy. I B-NR

With the goal of improving patient outcomes, it is reasonable for cardiac surgery and PCI programs to have a quality improvement program that routinely
1) reviews institutional quality programs and outcomes, 2) reviews individual operator outcomes, 3) provides peer review of difficult or complicated cases, and 4) performs random case reviews. IIa C-LD

Smaller volume cardiac surgery and PCI programs may consider affiliating with a high volume center to improve patient care. IIb C-EO

Table 9. ESC/EACTS 2018 GL on revascularization.**Recommendations for operator/institutional volume in myocardial revascularization****CABG**

CABG should be performed at institutions with annual institutional volumes of ≥ 200 CABG cases. IIA-C

PCI

PCI for ACS should be performed by trained operators with annual volumes of ≥ 75 procedures at institutions performing ≥ 400 PCIs per year with an established 24 h/7 day service for the treatment of patients with ACS. IIA-C

PCI for SCAD should be performed by trained operators with annual volumes of ≥ 75 procedures at institutions performing ≥ 200 PCIs per year. IIA-C

Institutions with annual volumes of < 400 PCIs should collaborate in networks with higher-volume institutions (> 400 PCIs per year), with shared written protocols and exchange of operators and support staff. IIA-C

PCI for LM should be performed by trained operators with an annual volume of ≥ 25 LM PCI cases per year. IIA-C

Non-emergency high-risk PCI procedures—such as for LM disease, single remaining patent coronary artery, and complex chronic total occlusions—are only performed by adequately experienced operators at centres that have access to circulatory support and intensive care treatment. IIA-C

ACS = acute coronary syndromes; CABG = coronary artery bypass grafting; LM = left main; PCI = percutaneous coronary intervention; SCAD = stable coronary artery disease.

Recommendations for training in myocardial revascularization**Training in CABG**

Trainees in cardiac surgery and interventional cardiology should follow a competency-driven residency programme with regular evaluation of progression. I-C

Trainees in cardiac surgery should perform ≥ 200 CABG procedures under supervision before being independent. IIA-C

Training in PCI

Trainees in interventional cardiology should perform ≥ 200 PCI procedures as first operator, with one-third of PCI procedures in emergency or ACS patients under supervision, before being independent. IIA-C

Trainees in interventional cardiology should complete formal training according curriculum to a 1–2 year at institutions with ≥ 800 PCIs per year and an established 24 h/7 day service for the treatment of patients with ACS. IIA-C

ACS = acute coronary syndrome; CABG = coronary artery bypass grafting; PCI = percutaneous coronary intervention.

Recommendations for outcome registration, monitoring, and benchmarking

Specific quality performance measures for CABG should be adopted at a national level to allow outcome monitoring and benchmarking. I-C

National societies should establish national databases on CABG practice and outcomes. I-C

CABG outcome data should be reported by hospitals to national databases. I-C

Strategies for follow-up and management in patients after myocardial revascularization

After CABG or PCI for AMI, participation in a cardiac rehabilitation programme to improve patient outcomes. I-A

Secondary prevention measures, including medical therapy and lifestyle changes, are started and reinforced after myocardial revascularization. I-A

Patients are re-evaluated after myocardial revascularization (e.g. at 3 months and thereafter, at least on an annual basis) in order to reassess symptoms and adherence to secondary prevention measures, and reinforce medical therapy and lifestyle changes when appropriate. I-C

Symptomatic patients

Coronary angiography in patients with intermediate- to high-risk findings^a at stress testing. I-C

An imaging stress test in patients with prior revascularization over stress ECG. IIa-B

Asymptomatic patients

Surveillance by non-invasive imaging-based stress testing in high-risk patient subsets 6 months after revascularization. IIb-C

After high-risk PCI (e.g. unprotected LM stenosis), late (3–12 months) surveillance angiography, irrespective of symptoms. IIb-C

Routine non-invasive imaging-based stress testing 1 year after PCI and >5 years after CABG. IIb-C

AMI = acute myocardial infarction; CABG = coronary artery bypass grafting; ECG = electrocardiogram; LM = left main; PCI = percutaneous coronary intervention.

a: Intermediate- and high-risk findings at stress imaging are ischaemia at low workload with exercise stress testing, early-onset ischaemia with pharmacological stress testing, an inducible wall motion abnormality, or a reversible perfusion defect in $\geq 10\%$ of LV myocardium.