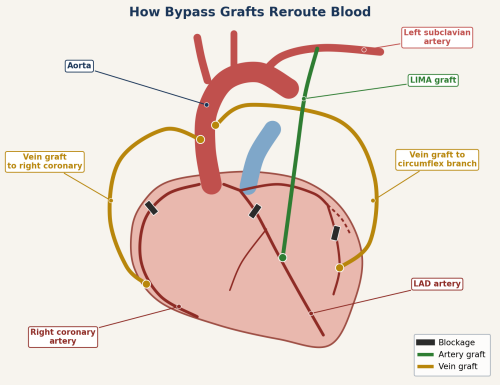
Coronary Artery Bypass Surgery (CABG)

Grafts, Newer Techniques, and the Heart Team Decision

Bypass surgery builds new paths for blood around blocked heart arteries. Learn the grafts, the techniques, and who benefits.



Online: https://go.riasalimd.com/cabg-guide

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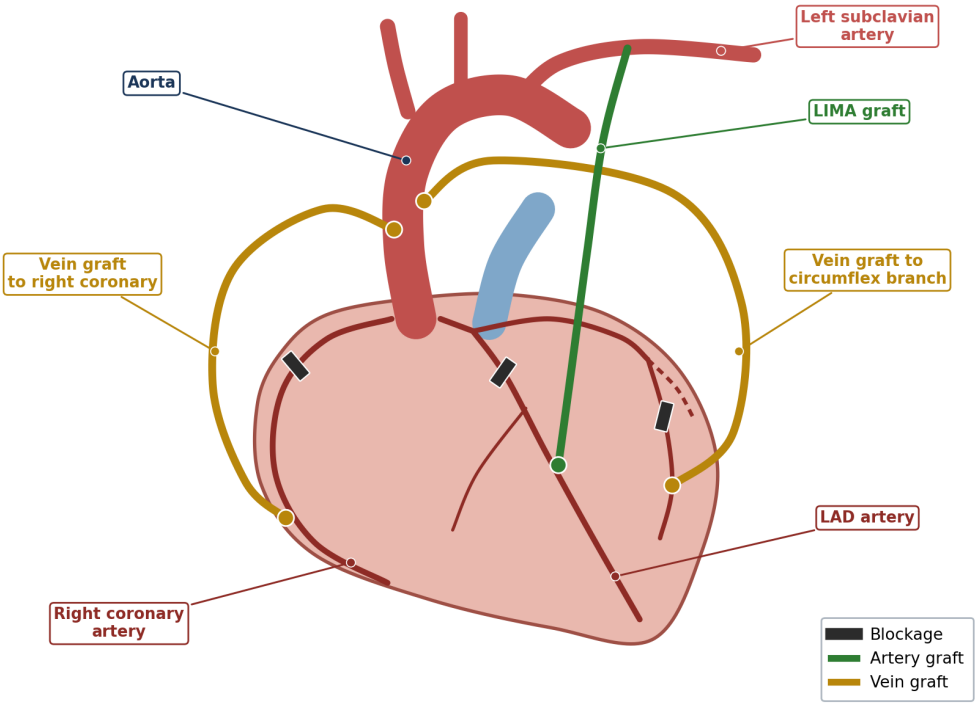
Names & Terms You Will Hear

Term	Meaning
CABG ("cabbage")	Coronary artery bypass grafting. Most people say it like the vegetable.
Heart bypass, coronary bypass, bypass surgery	Everyday names for the same operation.
Surgical revascularization	Restoring blood flow to the heart muscle with surgery. Stents (PCI) are the other kind of revascularization.
Graft (conduit)	The healthy blood vessel used to build the new path around a blockage.
LIMA or LITA	Left internal mammary artery, also called the left internal thoracic artery. Same artery, two names. It runs inside the chest wall, next to the breastbone.
IMA or ITA	Internal mammary or internal thoracic artery, on either side.
RIMA or RITA	The right internal mammary (thoracic) artery.
BIMA or BITA	Bilateral internal mammary (thoracic) arteries. Both the left and right arteries are used as grafts.
SVG	Saphenous vein graft. A long vein taken from the inner leg.
Radial artery graft	An artery taken from the thumb side of the forearm.
GEA	Gastroepiploic artery. An artery along the stomach. It is rarely used as a graft.
LAD	Left anterior descending artery. It runs down the front of the heart and feeds a large share of the heart muscle.
Anastomosis	The stitched joint where a graft meets an artery.
On-pump and off-pump	On-pump uses a heart-lung machine while the heart is still. Off-pump is done on the beating heart.
Sternotomy	Opening the breastbone (sternum) to reach the heart.

Term	Meaning
MIDCAB	Minimally invasive direct coronary artery bypass. A small cut between the left ribs, usually for one LIMA graft to the LAD.
Robotic-assisted CABG or TECAB	Bypass done with robot arms through small ports. TECAB means totally endoscopic coronary artery bypass.
Hybrid coronary revascularization	A LIMA graft to the LAD by surgery, plus stents in the other arteries.
Heart Team	The cardiac surgeon, interventional cardiologist, and your general cardiologist, deciding with you.
SYNTAX score and STS score	SYNTAX grades how complex your blockages are. The STS score estimates the risk of the surgery itself.

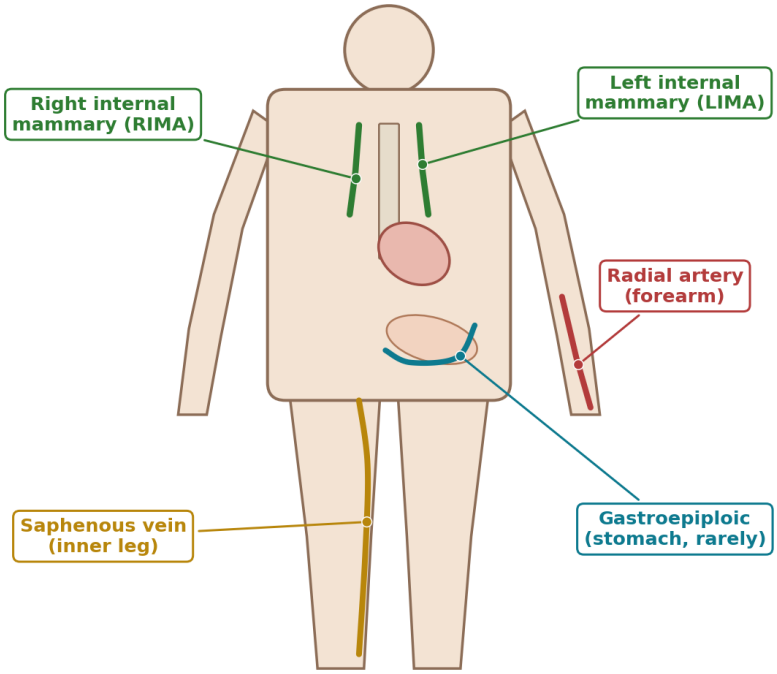
What Is Coronary Artery Bypass Surgery?

- Coronary artery bypass grafting, or CABG, is heart surgery. It builds new paths for blood around blocked heart arteries.
- The coronary arteries feed the heart muscle. Plaque can narrow or block them. Then the muscle gets too little oxygen.
- The surgeon uses a healthy blood vessel, called a graft. One end is sewn to the artery past the blockage. Blood then flows around the narrow spot.
- Artery grafts come from inside the chest wall or from the forearm. Vein grafts usually come from the leg.
- Most bypass operations are done through the breastbone. Some people can have smaller cuts or robotic help.
- Bypass does not remove plaque. It detours around it. Medicines and healthy habits are still needed for life.
- Life after surgery has its own guide. See our Recovery After Bypass Surgery guide.



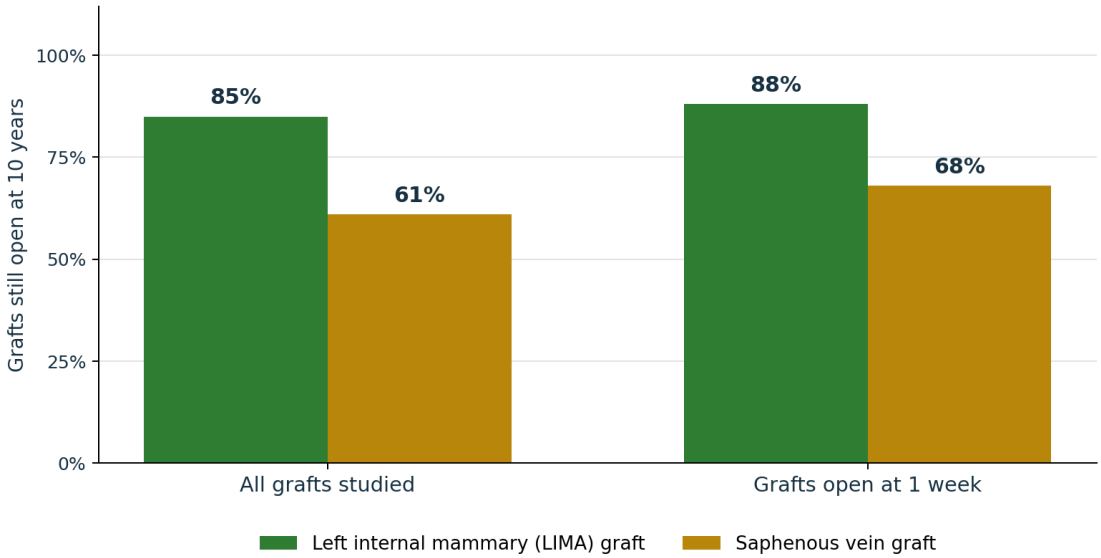
An example of a triple bypass, front view. The LIMA stays attached to its own artery at the top and is sewn to the LAD past the blockage. Two vein grafts run from the aorta to arteries on each side of the heart.

Where Bypass Grafts Come From



Where grafts come from. The mammary arteries run inside the chest wall. The radial artery comes from the forearm, the saphenous vein from the inner leg, and, rarely, the gastroepiploic artery from along the stomach.

Grafts Still Open After 10 Years (VA Cooperative Study)



Grafts still open at 10 years in a VA study (Goldman, 2004). The right-hand pair counts only grafts that were open 1 week after surgery.

Graft Types Compared (green: artery grafts with the strongest record; teal: artery grafts with trade-offs; gold: vein grafts; gray: rarely used)

Graft	Where It Comes From	How Long It Lasts	Trade-Offs
LIMA to the LAD (the gold standard)	Inside the left chest wall, beside the breastbone	The longest-lasting graft. 85% were open at 10 years in a VA study.	Stays attached to its own artery at the top. Best used on the LAD.
RIMA, or both mammary arteries (BIMA)	Inside the right chest wall	An artery graft that tends to stay open longer than a vein graft.	The 2021 US guideline calls the right mammary artery biologically equivalent to the LIMA. Using both was linked with longer survival in observational studies, but ART found similar 10-year survival. Breastbone wound problems were higher (3.5% vs 1.9%).
Radial artery	Thumb side of the forearm	Fewer blocked grafts and fewer heart events than vein grafts (RADIAL analysis). The 2021 US guideline prefers it over a vein for the second most important blocked artery after the LAD.	Can spasm (tighten), so surgeons use anti-spasm medicines. Before taking it, the team checks that the hand gets enough blood from the other forearm artery.
Saphenous vein (SVG)	Inner leg, ankle to groin	61% were open at 10 years in a VA study.	Long and easy to use for several grafts. More likely to narrow over time.
No-touch saphenous vein	Same vein, taken with its cushion of tissue	Fewer closed grafts in one large trial (PATENCY), but not in another (SWEDEGRAFT).	More leg wound problems at 3 months in SWEDEGRAFT (24.7% vs 13.8%).
Gastroepiploic artery (GEA)	Along the stomach	Rarely used today.	Requires working in the upper abdomen.

Why It Matters

- For some patterns of blockage, bypass helps people live longer than stents do.
- In the SYNTAX trial, people with three blocked arteries did better with bypass. At 10 years, 21% had died after bypass versus 28% after stents.
- In people with diabetes and several blocked arteries, bypass lowered death, heart attack, or stroke. At 5 years, the rate was 18.7% versus 26.6% with stents (FREEDOM).
- Bypass also led to fewer repeat procedures than stents in several large trials.
- But bypass is major surgery. Early stroke risk is higher than with stents, and recovery takes longer.
- That trade-off is why a Heart Team, together with you, makes the choice.

How the Heart Team Weighs Bypass Against Other Options

Points Toward Bypass Surgery

- Left main blockage with more complex disease
- Three blocked arteries, especially with diabetes
- High SYNTAX score (complex blockages)
- Weak pump from blocked arteries (low EF)
- Stents cannot fix all the important blockages

Points Toward Stents or Medicines

- One or two simpler blockages
- Low SYNTAX score
- Surgery risk too high (frailty, porcelain aorta)
- No good arteries beyond the blockages to graft to
- Stable symptoms well controlled by medicines

No single item decides. The Heart Team weighs your artery map, your heart pump, your surgical risk, and your own goals together.

Who Benefits Most: Left Main Disease

- The left main artery feeds most of the left side of the heart. A blockage here puts a lot of muscle at risk.
- The 2021 US revascularization guideline says bypass is indicated for significant left main disease, to improve survival compared with medicines alone.
- It calls stents a reasonable option for selected people whose left main disease has low to medium complexity and suits either approach.
- For left main blockages of low or medium complexity, stents are also an option. In EXCEL, death, stroke, or heart attack at 5 years was similar (22.0% stents vs 19.2% bypass).
- In NOBLE, bypass had fewer major events at 5 years (19% vs 28%). This was mainly fewer heart attacks and repeat procedures. Death rates were the same.

Who Benefits Most: Three Blocked Arteries

- All three main heart arteries are narrowed.
- In SYNTAX, 10-year survival was better with bypass for this group. 21% had died after bypass, versus 28% after stents.
- The 2021 US guideline is more cautious. For stable disease, normal pump function, and three blocked arteries, it says bypass may be reasonable to improve survival. A survival benefit with stents is uncertain.
- It bases the choice on how complex the disease is, what is technically possible, and a Heart Team discussion.

Who Benefits Most: Diabetes With Several Blocked Arteries

- The 2021 US guideline says people with diabetes and three blocked arteries should have bypass. Stents may be considered if surgery is a poor option.
- In FREEDOM, bypass lowered death, heart attack, or stroke at 5 years (18.7% vs 26.6% with stents).
- Stroke was more common after bypass (5.2% vs 2.4%). Your team weighs both sides.
- Learn more in our Diabetes and the Heart guide.

Who Benefits Most: A Weak Heart Pump From Blocked Arteries

- This is called ischemic cardiomyopathy. The ejection fraction (EF) is 35% or less.
- In STICH, bypass plus medicines did not clearly lower death at about 5 years (36% vs 41%).
- With about 10 years of follow-up (STICHES), fewer people died after bypass (58.9% vs 66.1%). The benefit took years to show.
- See our HFrEF guide and Understanding Ejection Fraction guide.

Who Benefits Most: When Stents Cannot Finish the Job

- Some blockages are long, heavily calcified, fully closed, or sit at branch points.
- Stents may not be able to treat every important blockage well.
- Bypass may restore flow more completely in these cases. The Heart Team compares the likely result of each option.

When Bypass May Not Be the Best Fit

- Simpler disease in one or two arteries, where stents often work well.
- A very high surgical risk: frailty, severe lung or kidney disease, a porcelain aorta, prior chest radiation, or scarring from past chest surgery.
- No good target arteries past the blockages for a graft to reach.
- Stable symptoms that medicines control well. In ISCHEMIA, starting with medicines did not raise heart attack or death risk. See our Stable Angina guide.
- Your own informed choice. Declining surgery is a valid decision.
- When surgery is turned down, high-risk complex PCI (stents with extra planning and support) may be another option our practice offers.

Complexity matters, but it is not the whole story. In SYNTAX, the 5-year benefit of bypass grew as the SYNTAX score rose (see the cards below). But at 10 years, the survival advantage of bypass did not grow in a steady line across the three SYNTAX bands. The pattern of disease mattered more. With three blocked arteries, fewer people died after bypass (21% vs 28%). With left main disease, death rates were the same (28% vs 27%). So the score is one input. Your artery pattern, pump function, diabetes, surgical risk, and goals all count.

The core trade-off. Bypass asks more of you up front: major surgery, a higher early stroke risk, and a longer recovery. In return, for the right patterns of disease, it lasts longer, needs fewer repeat procedures, and can help people live longer. Stents flip that balance. The Heart Team's job is to match the option to your arteries, your heart, and your goals.

SYNTAX Score Bands and 5-Year Results in the SYNTAX Trial

Low: 22 or less	Intermediate: 23 to 32	High: 33 or more
• Simpler blockages	• Moderately complex blockages	• Complex, widespread blockages
• Similar major events: 28.6% bypass vs 32.1% stents	• Fewer major events with bypass: 25.8% vs 36.0%	• Fewer major events with bypass: 26.8% vs 44.0%
• Stents are often a fair choice	• A true judgment call for the Heart Team	• Bypass is usually favored if surgery risk is acceptable

What Raises the Risk of Surgery

These factors raise the risk of the operation itself. The STS risk calculator combines them into one estimate for you.

Factor	Why It Raises Surgical Risk
Older age or frailty	Less reserve to heal and regain strength after major surgery.
Weak heart pump (low ejection fraction)	Raises the risk of surgery. Yet these patients may also gain the most from it.
Kidney disease or dialysis	Kidney function can worsen after heart surgery.
Lung disease	Breathing can be slower to recover after time on a ventilator.
Diabetes or obesity	Raise the risk of wound problems, especially at the breastbone.
Prior heart surgery	Scar tissue makes a second operation harder. Working grafts can be injured.
Porcelain aorta	Heavy calcium in the aorta makes clamping unsafe and raises stroke risk.
Prior chest radiation	Radiation scars and stiffens tissue. Healing can be slower.
Emergency surgery or a recent heart attack	An urgent operation carries more risk than a planned one.
Prior stroke or blocked arteries elsewhere	Signals widespread artery disease and a higher stroke risk.

The Heart Team and Shared Decisions

- Your Heart Team includes a cardiac surgeon, an interventional cardiologist, and your general cardiologist. Most of all, it includes you.
- The STS score estimates the risk of the surgery itself. It uses factors like those in the table above.
- The 2021 US guideline says surgical decisions should include your STS risk score.
- The SYNTAX score grades how complex your blockages are. The guideline calls its role less clear, because doctors can score the same angiogram differently and it leaves out clinical factors.
- SYNTAX II adds age, kidney function, EF, lung disease, and more.
- Bypass tends to last longer and needs fewer repeat procedures. Stents mean less upfront risk and a faster recovery.
- Stroke risk is higher early after bypass. Repeat procedures are more common after stents.
- Your goals matter. Some people value durability most. Others value a quick recovery.

Questions to ask your Heart Team:
What is my SYNTAX score, and what is my STS risk?
Which grafts would you use, and why?
Could I have off-pump, no-touch aorta, or smaller-incision surgery?
What would stents achieve for me? What if I choose medicines alone?
How many of these operations does your team do each year?

How Bypass Surgery Is Done

- First, a coronary angiogram maps the blockages. A pressure wire may also check how much each one limits flow.
- You are fully asleep under general anesthesia, with a breathing tube.
- In the usual approach, the surgeon opens the breastbone. This is called a sternotomy.
- Most operations use a heart-lung machine. It pumps blood and adds oxygen while the heart is still. This is on-pump surgery.
- Some surgeons sew the grafts on the beating heart instead. This is off-pump surgery.
- The surgeon takes the grafts and sews each one to an artery past its blockage.
- Vein and radial grafts are sewn to the aorta at their top end. The LIMA usually stays attached to its own artery at the top.
- When the grafts are done, the breastbone is closed with wires. You wake up in the intensive care unit.

Techniques and Where the Evidence Stands (green: standard and well studied; gold: good option for selected patients; orange: still being studied)

Technique	What It Means	Where the Evidence Stands
On-pump bypass	A heart-lung machine takes over while the heart is still.	The standard, most studied approach. In the VA ROOBY trial, 5-year survival was better than off-pump.
Off-pump bypass	Grafts are sewn on the beating heart.	In CORONARY (4,752 patients), results at 5 years were similar to on-pump. In ROOBY, more people died by 5 years off-pump (15.2% vs 11.9%). Surgeon experience matters.
No-touch aorta (anaortic) bypass	Off-pump bypass that never clamps or stitches the aorta.	There are no large randomized trials of its effect on stroke. The 78% lower stroke risk comes from a pooled analysis of 13 observational studies (37,720 patients). A small randomized trial (192 patients) found less confusion after surgery.

Technique	What It Means	Where the Evidence Stands
MIDCAB	A small cut between the left ribs, usually for a LIMA graft to the LAD.	An option for a single LAD graft in selected patients. The breastbone stays whole.
Robotic-assisted bypass or TECAB	Robot arms work through small ports in the chest.	In 2,397 selected patients: 0.8% died and 1.0% had a stroke; 11.5% switched to a larger cut. Offered at few centers.
Hybrid revascularization	A LIMA graft to the LAD, plus stents in the other arteries.	Tested mostly in small trials. A randomized trial in the US and Canada enrolled only 200 patients. Its best role is still being studied.
Total arterial bypass	All grafts are arteries, with no vein grafts.	The 2021 US guideline says more than 2 artery grafts may add a late survival benefit. ART found no 10-year survival difference with both mammary arteries. The ROMA trial is still enrolling.

New Directions: What Is Being Studied

- More artery grafts: the ROMA trial is testing whether two or more artery grafts help people live longer. It is still enrolling, with results expected after 2029.
- No-touch vein harvest: two large trials disagree. Researchers are pooling patient data to settle the question.
- Robotic and small-incision bypass: newer robots are in use. They are still offered at a limited number of centers.
- Hybrid revascularization: it pairs the longest-lasting graft with modern stents. Larger trials are still needed.
- Ask whether any of these fits you. Being studied means the answer is not yet settled.

Recovery at a glance. The hospital stay, breastbone healing, and cardiac rehab each have their own timeline. You will protect your breastbone for several weeks, take daily medicines to protect your grafts, and start cardiac rehab. For the full plan, see our Recovery After Bypass Surgery guide.

Getting Ready for Surgery

These steps help your body get ready and heal. Use them alongside the medicines your team prescribes.

- Stop smoking or vaping now. Every smoke-free day helps healing.
- Walk each day if your team says it is safe. Stronger muscles help recovery.
- Keep your blood sugar in range. High sugar slows wound healing.
- Bring a full medicine list. Ask which blood thinners to stop, and when.
- Plan for help at home during the first weeks.
- Ask about cardiac rehab before you leave the hospital.
- Write down your questions for the Heart Team. Bring a family member to the visit.

After Bypass: Keeping Grafts Open and Preventing New Blockages

- Bypass fixes blood flow, not the disease. Two things can still happen over time.
- Vein grafts can build up their own plaque and clots. This is called vein graft disease.
- Your own arteries that were not bypassed can also form new blockages.
- The steps below lower both risks. Your team will tailor them to you.
- For healing, breastbone care, and your first weeks at home, see our Recovery After Bypass Surgery guide.

Stop Smoking for Good

- The 2021 US revascularization guideline notes that smoking after a heart procedure is linked with worse outcomes.
- It recommends quit-smoking medicines for every smoker who is trying to quit. Ask about them, along with counseling.
- In a 30-year study, people who quit after bypass lived about 3 years longer than those who kept smoking (20.0 vs 17.0 years).
- In a recent Swedish registry, people still smoking after bypass had a higher risk of death than former smokers.

Medicines That Protect Your Grafts and Arteries

- Aspirin is the base. The 2023 chronic coronary disease guideline recommends low-dose aspirin (75 to 100 mg) for most people who do not take a blood thinner.
- Some people also take a second antiplatelet medicine, such as ticagrelor, for a time. In one trial, adding it to aspirin kept more vein grafts open at 1 year (88.7% vs 76.5%).
- A pooled analysis found fewer failed vein grafts with this pairing, but more bleeding events (22.1% vs 8.7% of patients).
- Take these exactly as your team directs. Do not stop them on your own.
- A high-intensity statin is standard. In the Post CABG trial, lowering LDL to about 93 to 97 mg/dL slowed plaque in vein grafts. Plaque grew in 27% of grafts, versus 39% with less lowering.
- The same lower LDL also slowed new plaque in the patients' own left main artery.
- Aim low. For most people after bypass, US expert guidance (the 2022 ACC pathway) counts prior bypass as a very high-risk condition and aims for LDL below 55 mg/dL, with at least a 50% drop from where you started.
- If your LDL stays at 55 or higher on a statin, other cholesterol medicines such as ezetimibe or a PCSK9 inhibitor can be added. Your team sets your exact goal.

Lowering the Risk That Remains

- Even with LDL, blood pressure, and blood sugar at goal, some risk remains. Your team may look at a few more causes.
- Inflammation in the artery wall helps plaque grow. The 2023 US guideline allows low-dose colchicine (0.5 mg a day) for people who stay at very high risk despite their other medicines.
- In the LoDoCo2 trial, major heart events (such as heart attack, stroke, or a needed procedure) happened in 6.8% of people taking colchicine versus 9.6% taking a placebo.
- Colchicine interacts with some common medicines and has a narrow safe dose range, so it is started only after a careful medicine review.
- Some chest pain comes from an artery squeezing shut for a while (spasm). It often happens at rest, at night or early in the morning, and eases with nitroglycerin. Calcium channel blockers can prevent these spells. Tell your team about any chest pain at rest.

Blood Pressure, Diabetes, Food, and Weight

- Keep your blood pressure and blood sugar at the goals your team sets.
- Limit sodium to less than 2,300 mg a day. This lowers blood pressure and heart risk.
- Some diabetes medicines, such as SGLT2 inhibitors and semaglutide, also help the heart. Ask if one fits you.
- Eat heart-healthy food, stay active every day, and work toward a healthy weight.
- See our Diabetes and the Heart guide for more.

Cardiac Rehab

- Cardiac rehab is supervised exercise plus education and support, after you go home.
- The 2021 US revascularization guideline says center-based rehab lowers readmissions, repeat heart events, and deaths.
- The 2023 chronic coronary disease guideline says people who have had bypass should enroll.
- In a US Medicare study, people who used rehab after bypass were less likely to die within 2 years.
- See our Cardiac Rehab guide.

Risks, Benefits, and Alternatives

Every choice has trade-offs. Use this table to start the shared decision conversation.

Option	Risks	Benefits	Alternatives
Standard bypass (breastbone opened, heart-lung machine)	Major surgery. Stroke, bleeding, infection, irregular heartbeat, or kidney injury. Weeks of recovery.	Longest track record. Fewer repeat procedures than stents. Longer life for some patterns, such as three-vessel disease or diabetes.	Off-pump or smaller-incision bypass; stents (PCI); medicines alone.
Off-pump or no-touch aorta bypass	Harder to do; surgeon experience matters. One VA trial found more deaths at 5 years.	No heart-lung machine. Fewer strokes without aortic clamping in pooled observational studies; no large randomized trial.	Standard on-pump bypass; stents.
Small-incision, robotic, or hybrid bypass	Selected patients and centers only. About 1 in 9 robotic cases switched to a larger cut.	Smaller cuts; the breastbone may stay whole. Hybrid patients returned to work sooner in one small trial.	Standard bypass; stents.
Stents (PCI)	More repeat procedures, and for some patterns more heart attacks. Blood thinners needed after.	No chest incision and a much faster recovery. Lower early stroke risk than bypass.	Bypass surgery; medicines alone.
Medicines alone	The blockages remain. Chest pain may continue or return.	No procedure risk. In stable disease, starting with medicines did not raise the risk of heart attack or death (ISCHEMIA).	Bypass or stents if symptoms or anatomy call for it.

The Evidence, Trial by Trial

Trial (Year)	Compared	Key Result
SYNTAX (2009)	Stents vs bypass, three-vessel or left main disease	At 1 year, more major events with stents (17.8% vs 12.4%), mostly repeat procedures (13.5% vs 5.9%). More stroke with bypass (2.2% vs 0.6%).
SYNTAX 5-year (2013)	Same patients	Fewer major events with bypass at intermediate and high SYNTAX scores. Similar results at low scores.
SYNTAXES (2019)	Same patients, 10 years	Three-vessel disease: 21% died after bypass vs 28% after stents. Left main: 28% vs 27%, no difference.
FREEDOM (2012)	Stents vs bypass, diabetes with multivessel disease	Death, heart attack, or stroke at 5 years: 18.7% bypass vs 26.6% stents. Stroke 5.2% vs 2.4%.
EXCEL (2019)	Stents vs bypass, left main of low or medium complexity	Death, stroke, or heart attack at 5 years: 19.2% bypass vs 22.0% stents, not a significant difference.
NOBLE (2020)	Stents vs bypass, left main disease	Major events at 5 years: 19% bypass vs 28% stents. Death was the same (9% vs 9%).
STICH (2011)	Bypass plus medicines vs medicines alone, EF 35% or less	No significant difference in death at about 5 years (36% vs 41%).
STICHES (2016)	Same patients, about 10 years	Fewer deaths with bypass (58.9% vs 66.1%). The benefit took years to appear.
ISCHEMIA (2020)	Procedure first vs medicines first, stable disease	No reduction in heart attack or death over a median 3.2 years.
ART (2019)	Both mammary arteries vs one	No difference in death at 10 years (20.3% vs 21.2%).
RADIAL (2018)	Radial artery vs vein grafts, 6 trials	Fewer heart events and fewer blocked grafts with radial grafts. No difference in death.

Trial (Year)	Compared	Key Result
ROOBY (2017)	Off-pump vs on-pump	More deaths at 5 years off-pump (15.2% vs 11.9%).
CORONARY (2016)	Off-pump vs on-pump	No difference in major events at 5 years (23.1% vs 23.6%).
PATENCY (2025)	No-touch vs usual vein harvest	Fewer closed vein grafts at 3 years (5.7% vs 9.0%).
SWEDEGRAFT (2025)	No-touch vs usual vein harvest	Not better for vein graft failure. More leg wound problems (24.7% vs 13.8%).

Common Misconceptions

Myth	Reality
Bypass surgery cures my heart disease.	Bypass reroutes blood around blockages. The disease that caused them is still there, and grafts can narrow too. In one VA study, 61% of vein grafts were still open at 10 years. Daily medicines and healthy habits protect your grafts.
A triple or quadruple bypass means my heart is worse off.	The number counts the grafts you need. It reflects your artery map, not how well you will do. What matters is that every important area gets good blood flow.
Stents are always as good as bypass, with an easier recovery.	Recovery is easier with stents. But for three blocked arteries, and for diabetes with several blockages, bypass gave better long-term results in large trials.
Robotic bypass is always the better choice.	Robotic and small-incision bypass suit selected patients at experienced centers. In a review of 2,397 robotic cases, about 1 in 9 had to switch to a larger incision.
I am too old for bypass.	Age alone does not decide. The Heart Team looks at frailty, other illnesses, your STS risk score, and your goals.
Every graft works just as well.	Grafts differ. The LIMA sewn to the LAD is the gold standard. Artery grafts tend to stay open longer than vein grafts.

Possible Complications

Knowing what can go wrong helps you spot problems early. Most complications are uncommon, especially with treatment.

Where / What	What Can Happen
Brain: stroke	Stroke risk is higher early on with bypass than with stents. In SYNTAX, stroke at 1 year was 2.2% after bypass versus 0.6% after stents. In FREEDOM, stroke at 5 years was 5.2% versus 2.4%.
Brain: confusion after surgery	Some people feel foggy or confused for a few days, most often older adults. Tell your team if it does not improve.
Heart rhythm: atrial fibrillation	A common irregular heartbeat after bypass. In a pooled analysis of 207 studies, about 1 in 4 people (24%) had it after bypass. See the section on atrial fibrillation below.
Heart: graft narrowing or closure	Grafts can narrow over time. In a VA study, 85% of mammary artery grafts and 61% of vein grafts were still open at 10 years.
Heart: heart attack around surgery	A heart attack can occur during or soon after surgery. The team watches heart tests closely.
Chest: breastbone wound problems	The breastbone can heal poorly or get infected. Using both mammary arteries raised this risk (3.5% versus 1.9% in the ART trial). In a pooled analysis, diabetes, obesity, and using both mammary arteries were among the strongest risk factors for breastbone infection.
Leg or arm: graft-site wound problems	The leg cut can heal slowly or get infected. In one trial, 13.8% of people had a leg wound problem at 3 months with the usual vein harvest.
Blood: bleeding	Some people need a blood transfusion. A few need a return trip to the operating room to stop bleeding.
Kidneys	Kidney function can drop after surgery, more often when it was weak before. Your team watches your kidney blood tests closely.

Where / What	What Can Happen
Lungs	Pneumonia or fluid around the lungs can occur. Deep breathing and early walking help prevent problems.
Death	Across the US, about 2 to 3 in 100 people die around the time of a first bypass done on its own. In national STS data from 2011 to 2020, the rate was 1.7% for men and 2.8% for women. Your own risk may be lower or higher. Your team estimates it with the STS risk calculator.

Atrial Fibrillation After Bypass: What to Expect

- Atrial fibrillation (AFib) is a fast, irregular heartbeat. It is common after bypass.
- A pooled analysis of 207 studies found it in about 1 in 4 people (24%) after bypass. Across all heart surgery, the figure is similar (26%).
- It is more likely with older age, heart failure, lung or kidney disease, and a larger left atrium.
- Your team watches for it and treats it in the hospital.
- Heart monitors placed during surgery found at least one episode in about half of people (48%) within a year. But most AFib time happened in the first week, and it was rare after the first month.
- Even so, AFib after bypass has been linked with more strokes later. In the ART trial, strokes by 10 years were 6.3% with AFib versus 3.7% without.
- In a Swedish registry, people with AFib after bypass also had more heart failure stays and more AFib later, but not a higher death rate.
- Whether to use a blood thinner is decided case by case. Ask your team about your plan.

Points to Know

If you remember nothing else, remember these key points.

- Bypass builds a detour around blockages. It does not remove the plaque.
- The LIMA graft sewn to the LAD is the gold standard. It tends to last the longest.
- Bypass helps most with left main disease, three blocked arteries (especially with diabetes), complex blockages, and a weak pump from blocked arteries.
- For simpler disease, stents or medicines may work just as well, with an easier recovery.
- Bypass has a higher early stroke risk but fewer repeat procedures over time.
- Robotic, hybrid, and all-artery bypass help selected people. Some are still being studied.
- Decide with a Heart Team: a surgeon, an interventional cardiologist, your cardiologist, and you.

When to Call Us - and When to Call 911

If you are not sure, call. We would rather hear from you twice than miss a real problem.

- Before surgery: chest pain or pressure that does not go away with rest, call 911.
- Before surgery: chest pain that is new, worse, or comes on with less effort, call us the same day.
- After surgery: a fever, or redness, swelling, or drainage from any incision, call us.
- After surgery: a clicking or shifting feeling in the breastbone, call us.
- A fast or irregular heartbeat, or new shortness of breath, call us. If it is severe, call 911.
- Sudden weakness on one side, a drooping face, or trouble speaking, call 911.
- A leg that becomes very swollen, red, or painful, call us.
- Questions about your choice or your Heart Team visit, call us. We welcome these questions.

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Related Guides From Our Practice

- For recovery, breastbone care, and life after surgery, see our Recovery After Bypass Surgery guide.
- For stents and PCI, the main alternative to bypass, see our Angioplasty and Stents guide.
- For the test that maps your blockages, see our Coronary Angiogram guide.
- For pressure-wire testing of blockages, see our FFR and iFR guide.
- For chest pain from narrowed arteries, see our Stable Angina guide.
- For the disease behind the blockages, see our Coronary Artery Disease guide.
- For a weak heart pump, see our HFrEF guide.
- For the EF number, see our Understanding Ejection Fraction guide.
- For diabetes and heart disease, see our Diabetes and the Heart guide.
- For exercise and recovery after bypass, see our Cardiac Rehab guide.
- If valve surgery is also needed, see our Surgical Valve Replacement guide.

Trusted Resources

The links below are the trusted resources Dr. Ali used to write this guide and that he recommends you visit for more information. Each is a clickable link in the digital version and a Short.io tracked URL on the printed version.

- Cleveland Clinic - Coronary Artery Bypass Graft (CABG) Surgery - Patient-friendly overview of bypass surgery, grafts, and recovery.
- NHLBI - Coronary Artery Bypass Grafting - US National Heart, Lung, and Blood Institute explanation of CABG, types, and risks.
- MedlinePlus - Coronary Artery Bypass Graft - US National Library of Medicine topic page with links to trusted CABG resources.
- MedlinePlus Medical Encyclopedia - Heart Bypass Surgery - Step-by-step description of the operation and what to expect.
- STS Operative Risk Calculator - The Society of Thoracic Surgeons tool your surgeon may use to estimate surgical risk.

Sources Used to Build This Guide

Every recommendation in this guide is grounded in one or more of the studies, guidelines, or trusted resources below. Short links are tracked so Dr. Ali can see which references patients are reading; nothing personally identifying is captured.

- 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization (Lawton et al., Circulation 2022; PMID 34882435) *[Guideline]*
  Governing US revascularization guideline. Patient text closely paraphrases, and attributes to 'the 2021 US revascularization guideline', its Top 10 Take-Home Messages #3 (left main), #4 (triple-vessel, normal EF), #5 (radial artery preferred for the second most important target), #9 (diabetes with triple-vessel disease), #10 (STS score; SYNTAX usefulness less clear), its section text on BIMA and more than 2 arterial conduits, its radial-harvest table (palmar arch and ulnar compensation assessed before harvest), and sections 15.1 (cardiac rehab) and 15.2 (smoking cessation). Wording supplied by the orchestrator from the ahajournals full text on 2026-09-27; no class-of-recommendation numbers are printed. Errata: Circulation 2022;145:e772.
- 2023 AHA/ACC Multisociety Guideline for the Management of Patients With Chronic Coronary Disease (Virani et al., Circulation 2023; PMID 37471501) *[Guideline]*
  Frames the medicines-first, team-based, shared decision-making approach to stable coronary disease that sits alongside revascularization decisions.
- Initial Invasive or Conservative Strategy for Stable Coronary Disease (ISCHEMIA; Maron et al., NEJM 2020; PMID 32227755) *[Clinical Study]*
  Source for the statement that, in stable disease with moderate or severe ischemia, an initial invasive strategy did not reduce ischemic events or death over a median 3.2 years compared with medicines first (145 vs 144 deaths).
- PCI versus CABG for Severe Coronary Artery Disease (SYNTAX; Serruys et al., NEJM 2009; PMID 19228612) *[Clinical Study]*
  1-year results: major adverse events 17.8% PCI vs 12.4% CABG, repeat revascularization 13.5% vs 5.9%, stroke 2.2% CABG vs 0.6% PCI.
- CABG versus PCI in Three-Vessel and Left Main Disease: 5-Year Follow-up of the SYNTAX Trial (Mohr et al., Lancet 2013; PMID 23439102) *[Clinical Study]*
  5-year MACCE by SYNTAX-score group: low 28.6% CABG vs 32.1% PCI (not significant); intermediate 25.8% vs 36.0%; high 26.8% vs 44.0%. Also 5-year heart attack 3.8% vs 9.7% and repeat revascularization 13.7% vs 25.9%.
- PCI versus CABG in Three-Vessel or Left Main Disease: 10-Year Follow-up of SYNTAX (SYNTAXES; Thuijs et al., Lancet 2019; PMID 31488373) *[Clinical Study]*
  10-year death overall 28% PCI vs 24% CABG (not significant); three-vessel disease 28% vs 21% (CABG survival benefit); left main 27% vs 28% (no difference).
- SYNTAX Score Predicts Major Bleeding Following Drug-Eluting Stent Implantation (Iijima et al., Rev Esp Cardiol 2015; PMID 25155630) *[Clinical Study]*
  Verified statement of the SYNTAX-trial score bands used in this guide: low 22 or less, intermediate 23 to 32, high 33 or more. Cited for the band cut-offs only.
- Development and Validation of SYNTAX Score II (Farooq et al., Lancet 2013; PMID 23439103) *[Clinical Study]*
  Source for SYNTAX score II adding clinical factors (age, kidney function, ejection fraction, left main disease, vascular disease, sex, lung disease) to the anatomic score.

- Strategies for Multivessel Revascularization in Patients with Diabetes (FREEDOM; Farkouh et al., NEJM 2012; PMID 23121323) *[Clinical Study]*
  5-year death, heart attack, or stroke 26.6% PCI vs 18.7% CABG; stroke 5.2% CABG vs 2.4% PCI.
- Five-Year Outcomes after PCI or CABG for Left Main Coronary Disease (EXCEL; Stone et al., NEJM 2019; PMID 31562798) *[Clinical Study]*
  Left main disease of low or intermediate complexity: death, stroke, or heart attack 22.0% PCI vs 19.2% CABG (not significant); death from any cause 13.0% vs 9.9%; repeat revascularization 16.9% vs 10.0%.
- PCI versus CABG for Unprotected Left Main Stenosis: Updated 5-Year Outcomes from NOBLE (Holm et al., Lancet 2020; PMID 31879028) *[Clinical Study]*
  5-year MACCE 28% PCI vs 19% CABG; death 9% vs 9%; non-procedural heart attack 8% vs 3%; repeat revascularization 17% vs 10%.
- Coronary-Artery Bypass Surgery in Patients with Left Ventricular Dysfunction (STICH; Velazquez et al., NEJM 2011; PMID 21463150) *[Clinical Study]*
  EF 35% or less: death 36% CABG vs 41% medicines alone at a median 56 months (p=0.12, not significant).
- Coronary-Artery Bypass Surgery in Patients with Ischemic Cardiomyopathy (STICHES; Velazquez et al., NEJM 2016; PMID 27040723) *[Clinical Study]*
  Median 9.8-year follow-up: death 58.9% CABG vs 66.1% medicines alone (p=0.02); cardiovascular death 40.5% vs 49.3%.
- Randomized Trial of Bilateral versus Single Internal-Thoracic-Artery Grafts (ART 5-year interim; Taggart et al., NEJM 2016; PMID 27959712) *[Clinical Study]*
  Sternal wound complications 3.5% with two internal mammary grafts vs 1.9% with one; sternal reconstruction 1.9% vs 0.6%.
- Bilateral versus Single Internal-Thoracic-Artery Grafts at 10 Years (ART; Taggart et al., NEJM 2019; PMID 30699314) *[Clinical Study]*
  10-year death 20.3% bilateral vs 21.2% single (not significant) by intention to treat; 13.9% of the bilateral group received only one mammary graft and 21.8% of the single group also received a radial graft.
- Radial-Artery or Saphenous-Vein Grafts in Coronary-Artery Bypass Surgery (RADIAL patient-level analysis; Gaudino et al., NEJM 2018; PMID 29708851) *[Clinical Study]*
  Six randomized trials, 1,036 patients: radial grafts had fewer adverse cardiac events (HR 0.67) and less graft occlusion (HR 0.44) than vein grafts, with no difference in death.
- Arterial Grafts for Coronary Bypass: A Critical Review After the Publication of ART and RADIAL (Gaudino et al., Circulation 2019; PMID 31934782) *[Review]*
  Source for the framing that arterial grafts stay open longer than vein grafts, while whether this adds survival for most patients is still unclear.
- ROMA trial record: Randomized Comparison of the Clinical Outcome of Single Versus Multiple Arterial Grafts (ClinicalTrials.gov NCT03217006; verified 2026-09-27) *[Clinical Study]*
  Live verification that ROMA is still RECRUITING (planned 4,300 patients, age 70 or younger), estimated primary completion 2029-12-31, with no results posted. Supports 'being studied' language.
- Randomized Comparison of Single versus Multiple Arterial Grafts: the ROMA Trial Rationale and Study Protocol (Gaudino et al., Eur J Cardiothorac Surg 2017; PMID 29059371) *[Clinical Study]*
  Published ROMA design: one internal mammary artery to the LAD in all patients, with a radial artery or second mammary artery vs vein grafts to the other arteries.
- Long-Term Patency of Saphenous Vein and Left Internal Mammary Artery Grafts after CABG: VA Cooperative Study (Goldman et al., J Am Coll Cardiol 2004; PMID 15582312) *[Clinical Study]*

10-year patency 85% for internal mammary grafts vs 61% for vein grafts; for grafts open at 1 week, 88% vs 68%. Source of the patency chart.

- Five-Year Outcomes after On-Pump and Off-Pump Coronary-Artery Bypass (ROOBY-FS; Shroyer et al., NEJM 2017; PMID 28813218) *[Clinical Study]*
  5-year death 15.2% off-pump vs 11.9% on-pump; major adverse events 31.0% vs 27.1%.
- Five-Year Outcomes after Off-Pump or On-Pump Coronary-Artery Bypass Grafting (CORONARY; Lamy et al., NEJM 2016; PMID 27771985) *[Clinical Study]*
  4,752 patients: 5-year composite of death, stroke, heart attack, kidney failure, or repeat revascularization 23.1% off-pump vs 23.6% on-pump (no difference).
- CABG With and Without Manipulation of the Ascending Aorta: A Network Meta-Analysis (Zhao et al., J Am Coll Cardiol 2017; PMID 28231944) *[Review]*
  13 studies, 37,720 patients: anaortic off-pump CABG had the lowest 30-day stroke risk, 78% lower than conventional on-pump CABG. Presented in patient text as a pooled analysis of observational studies with no large randomized trial of stroke (framing per Dr. Ali's 2026-09-27 review; the PubMed abstract does not itself state the design of the pooled studies).
- No-Touch versus Conventional Vein in CABG: Three-Year Follow-up of the PATENCY Trial (Tian et al., BMJ 2025; PMID 40306935) *[Clinical Study]*
  2,655 patients: 3-year vein graft occlusion 5.7% no-touch vs 9.0% conventional. An erratum was published (BMJ 2026;394:e100400); the abstract figures used here are from the current PubMed record.
- No-Touch Vein Grafts in Coronary Artery Bypass Surgery: A Registry-Based Randomized Clinical Trial (SWEDEGRAFT; Thelin et al., Eur Heart J 2025; PMID 39969129) *[Clinical Study]*
  902 patients: no-touch harvesting was not superior for vein graft failure (19.8% vs 24.0%, not significant) and had more leg wound complications at 3 months (24.7% vs 13.8%).
- No-Touch vs Conventionally Harvested Saphenous Veins for CABG: Individual Patient Data Meta-Analysis Protocol (Gregg et al., CJC Open 2026; PMID 42146283) *[Review]*
  Documents that the two largest recent no-touch trials disagree and that a pooled patient-level analysis is under way. Supports 'being studied' language.
- Robotic Totally Endoscopic CABG: Systematic Review of Clinical Outcomes from the Past Two Decades (Gobolos et al., Innovations 2019; PMID 30848708) *[Review]*
  2,397 selected patients: conversion to a larger incision 11.5%, perioperative death 0.8%, stroke 1.0%, new atrial fibrillation 13.3%, mean hospital stay 5.8 days.
- Randomized Trial of Surgical vs Percutaneous vs Hybrid Revascularization in Multivessel Disease (HREVS; Ganyukov et al., J Interv Cardiol 2020; PMID 31969796) *[Clinical Study]*
  Small randomized trial (155 patients) of CABG vs hybrid vs multivessel PCI. Supports the statement that hybrid revascularization has mostly been tested in small studies.
- Hybrid Coronary Revascularization Trial record (ClinicalTrials.gov NCT03089398; verified 2026-09-27) *[Clinical Study]*
  Live verification that this randomized hybrid trial (sites in the US and Canada) is COMPLETED with an actual enrollment of 200 patients. Supports the statement that large hybrid trials are lacking.
- Postoperative Atrial Fibrillation Incidence After Cardiac Surgery: Systematic Review and Meta-Analysis (Perezgrovas-Olaria et al., J Am Heart Assoc 2023; PMID 37776213) *[Review]*
  59 studies, 197,774 patients: pooled incidence of new atrial fibrillation after cardiac surgery 26% (range 7.3% to 53.1%).

- STS Adult Cardiac Surgery Database Operative Risk Calculator (Society of Thoracic Surgeons) *[Tool]*
  The surgical risk calculator named in the Heart Team section (page title verified 2026-09-27).
- Operative Outcomes of Women Undergoing Coronary Artery Bypass Surgery in the US, 2011 to 2020 (Gaudino et al., JAMA Surg 2023; PMID 36857059) *[Clinical Study]*
  STS Adult Cardiac Surgery Database, 1,297,204 primary isolated CABG patients 2011 to 2020: unadjusted operative mortality 2.8% in women vs 1.7% in men. Source of the national 'about 2 to 3 in 100' band. Chosen because the full text of the most recent STS ACSD annual report (Hui et al., Ann Thorac Surg 2026, 2026 Update on Outcomes and Research) was not retrievable and its abstract gives no mortality figure.
- Intraoperative Anemia Mediates Sex Disparity in Operative Mortality After Coronary Artery Bypass Grafting (Harik et al., J Am Coll Cardiol 2024; PMID 38418006) *[Clinical Study]*
  Second STS ACSD cohort (1,434,225 isolated primary CABG, 2011 to 2022) confirming operative mortality 2.8% in women vs 1.7% in men.
- Incidence and Predictors of Postoperative Atrial Fibrillation Following CABG Surgery: A Meta-Analysis of 207 Studies (Farzaneh et al., Acta Cardiol 2026; PMID 42240420) *[Review]*
  CABG-specific AF incidence 24% (95% CI 23% to 26%) across 180,223 patients; predictors include age, heart failure, COPD, kidney disease, and larger left atrium.
- Long-Term Continuous Monitoring of New-Onset Atrial Fibrillation After Coronary Artery Bypass Grafting (Herrmann et al., JAMA 2025; PMID 41065638) *[Clinical Study]*
  Insertable monitors in 198 patients: new-onset AF in 48% within 1 year, but median AF burden 368 minutes in days 1 to 7, 13 minutes in days 8 to 30, and 0 minutes after day 30.
- New-Onset Atrial Fibrillation After CABG and Long-Term Outcome: SWEDEHEART (Taha et al., J Am Heart Assoc 2021; PMID 33251914) *[Clinical Study]*
  24,523 Swedish CABG patients: AF within 30 days in 30.0%; linked with ischemic stroke, heart failure hospitalization, and recurrent AF, but not all-cause mortality.
- Postoperative Atrial Fibrillation and Long-Term Risk of Stroke After Isolated CABG (Benedetto et al., Circulation 2020; PMID 33017213) *[Clinical Study]*
  ART post hoc analysis: AF after CABG in 24.3%; 10-year stroke 6.3% with AF vs 3.7% without.
- Three Life-Years Gained From Smoking Cessation After Coronary Artery Bypass Surgery: A 30-Year Follow-up Study (van Domburg et al., Am Heart J 2008; PMID 18760128) *[Clinical Study]*
  Life expectancy 20.0 years in quitters vs 17.0 years in persistent smokers after CABG.
- Smoking and Long-Term Risks for Morbidity and Mortality After Coronary Artery Bypass Grafting (Johansson et al., Int J Cardiol Cardiovasc Risk Prev 2025; PMID 41466831) *[Clinical Study]*
  SWEDEHEART, 27,434 CABG patients: current smokers vs former smokers had higher all-cause mortality (aHR 1.53).
- The Effect of Aggressive Lowering of LDL Cholesterol Levels and Low-Dose Anticoagulation on Obstructive Changes in Saphenous-Vein Coronary-Artery Bypass Grafts (Post CABG Trial, NEJM 1997; PMID 8992351) *[Clinical Study]*
  LDL 93 to 97 vs 132 to 136 mg/dL: vein grafts with atherosclerosis progression 27% vs 39%. Also the source that vein graft obstruction arises from atherosclerosis and thrombosis. An erratum exists.
- Effect of an Aggressive Lipid-Lowering Strategy on Progression of Atherosclerosis in the Left Main Coronary Artery: Post CABG Trial (White et al., Circulation 2001; PMID 11723015) *[Clinical Study]*
  Aggressive LDL lowering also slowed atherosclerosis progression in the native left main artery. Source for 'your own arteries can still form new blockages'.

- Effect of Ticagrelor Plus Aspirin, Ticagrelor Alone, or Aspirin Alone on Saphenous Vein Graft Patency 1 Year After CABG (DACAB; Zhao et al., JAMA 2018; PMID 29710164) *[Clinical Study]*
  1-year vein graft patency 88.7% with ticagrelor plus aspirin vs 76.5% with aspirin alone.
- Association of Dual Antiplatelet Therapy With Ticagrelor With Vein Graft Failure After CABG: Systematic Review and Meta-analysis (Sandner et al., JAMA 2022; PMID 35943473) *[Review]*
  4 RCTs: vein graft failure per graft 11.2% vs 20% with ticagrelor DAPT vs aspirin; BARC 2, 3, or 5 bleeding 22.1% vs 8.7%.
- The ABCs of the 2023 AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline for the Management of Patients With Chronic Coronary Disease (Khorsandi et al., Clin Cardiol 2024; PMID 38766996) *[Review]*
  Open-access (PMC11103637) summary of the 2023 guideline, read in full: low-dose aspirin 75 to 100 mg as single antiplatelet therapy, LDL thresholds (70 and 55 mg/dL) on a background of high-intensity statin, sodium under 2,300 mg/day, SGLT2 inhibitor and semaglutide benefits, and that patients after CABG should enroll in cardiac rehab.
- Cardiac Rehabilitation Reduces 2-Year Mortality After Coronary Artery Bypass Grafting (Bauer et al., Ann Thorac Surg 2023; PMID 37392993) *[Clinical Study]*
  Medicare CABG cohort: cardiac rehab use associated with lower 2-year mortality (IPTW 4.8 percentage-point reduction).
- Risk Factors for Sternal Wound Infection After Open-Heart Operations: A Systematic Review and Meta-Analysis (Chen et al., Int Wound J 2024; PMID 37909266) *[Review]*
  Diabetes, obesity, and bilateral internal thoracic artery use were among the most robust independent risk factors for sternal wound infection.
- Optimal Management of Radial Artery Grafts in CABG: Patient and Target Vessel Selection and Anti-Spasm Therapy (Schwann et al., J Card Surg 2018; PMID 29370589) *[Review]*
  Review supporting radial artery spasm as a recognized issue managed with anti-spasm therapy.
- Reducing Delirium and Cognitive Dysfunction After Off-Pump Coronary Bypass: A Randomized Trial (Szwed et al., J Thorac Cardiovasc Surg 2021; PMID 31685272) *[Clinical Study]*
  Single-center RCT, 192 patients: anaortic off-pump CABG had less postoperative delirium (12.5% vs 35.9%) than conventional off-pump CABG. It did not test stroke.
- 2022 ACC Expert Consensus Decision Pathway on the Role of Nonstatin Therapies for LDL-Cholesterol Lowering (Lloyd-Jones et al., JACC 2022; PMID 36031461) *[Guideline]*
  Very high-risk ASCVD (prior CABG is a listed high-risk condition): goal >=50% LDL-C reduction and LDL-C <55 mg/dL; add nonstatin therapy at >=55. Read on jacc.org 2026-09-27.

About This Guide

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Reviewer note: Reviewed against the Cleveland Clinic CABG page, the NHLBI coronary artery bypass grafting page, and the MedlinePlus heart bypass surgery article. Ours adds: an anatomic diagram of a LIMA graft and two vein grafts; a graft-by-graft comparison table with 10-year patency data; a technique table with the evidence status of off-pump, no-touch aorta, robotic, hybrid, and all-arterial bypass; SYNTAX-band results; a Heart Team framework naming who benefits and who may not; and a trial-by-trial evidence table.

Disclaimer

This guide is for educational purposes only and does not replace medical advice from your physician. Recommendations may not apply to every patient. Always follow the specific instructions of Dr. Ali and your care team. In an emergency call 911 or go to the nearest emergency department.

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