

AFTER THE BYPASS: KEEPING YOUR PATIENT HEALTHY

Undergoing coronary artery bypass grafting can be associated with a number of potential complications and concerns for the patient. It is imperative to be able to address any fears the patient may have, recognize any postsurgical problems and devise an appropriate plan to return the patient to a normal lifestyle in as short a time as possible.

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The majority of physicians will, at one point in their medical training, have encountered patients following coronary artery bypass grafting (CABG), typically in the immediate postoperative milieu. This setting may be the intensive care unit (ICU) or an intermediate-care or step-down unit (SDU).

While a familiarity with immediate postoperative complications (e.g., arrhythmias or pulmonary edema) is essential, few physicians other than cardiovascular surgeons or cardiologists receive any formal training concerning postoperative and postdischarge management, complications and typical patient concerns.

The aim of this article is to provide a framework around these issues from both the physician's and the patient's point of view.

Table 1		
MAJOR POSTOPERATIVE COMPLICATIONS PRIOR TO DISCHARGE		
Complication	Incidence	Comments
Perioperative MI ¹⁸	2-6% overall	Significantly higher risk with repeat bypass operations
CHF ²	2.4% overall	1.6% for first bypass: 7.8% for second bypass
Arrhythmia ²	13.6% overall	10-40% supraventricular arrhythmia; 2% ventricular arrhythmia
Hemorrhage ²	5.6%	Requiring re-exploration
Infections	4.0%	1.5-2% requiring débridement
Stroke ¹⁰	6.1%	3.1% death/physical impairment; 3% impairment of intellectual function
GI dysfunction ¹⁹	2.3%	Bleeding very rare; cholecystitis and intestinal ischemia predominate
Acute renal failure ²	0.7%	Rarely requires long-term dialysis
MI?Myocardial infarction CHF?Congestive heart failure GI?Gastrointestinal		

**IMMEDIATE POSTOPERATIVE CONCERNS:
THE PHYSICIAN'S VIEW**

Routine surveillance for arrhythmias, congestive heart failure

(CHF), surgical bleeding or infection and postoperative myocardial infarction (MI) are the goals of the first stage of postoperative care. While any of these events may occur at a later time, the likelihood is that any significant complications will be recognized while the patient is still in the ICU ([Table 1](#)).

A significant number of patients return to the clinic unprepared for the long postoperative course, spotted with the various "minor" sequelae that we have come to accept as a standard recovery.

The issues outlined in [Table 2](#) are concerns of patient and physician alike. In our experience, a significant number of patients return to the clinic unprepared for the long postoperative course, spotted with the various "minor" sequelae that we have come to accept as a standard recovery. "Minor" is in the eye of the beholder, however, and

such recognized symptoms as chest-wall hyperesthesia can cause significant discomfort and anxiety to a patient who is recovering from an otherwise successful procedure.

FATIGUE IS COMMON

All patients will feel some degree of fatigue after surgery. The stress of the operation and disrupted sleep-wake cycles will cause mental fatigue, while physical exhaustion will result from wound healing and postoperative anemia. Patients should be reassured and told to expect significant fatigue for at least two weeks after discharge, with gradual improvement over the following month.

ACTIVITIES UPON DISCHARGE?

The most frequent patient concerns upon discharge relate to resumption of regular activities. Commonly accepted recuperation periods are as follows:

- **Driving.** Recreational driving can be resumed at four weeks; commercial driving should be resumed only after three

The most important factors determining return to work after cardiac surgery are the length of time spent inactive presurgery, patient age and anxiety level six weeks after the

months.[1](#)

procedure.

- **Sexual activity** typically requires 5 metabolic equivalents (METs) to perform and can be resumed gradually over four weeks or earlier, once sternal pain and healing has been resolved. In terms of physical exertion alone, most CABG patients can expend 5 METs without risk after discharge. The optimal position for intercourse would be free of strain on the rib cage and pectoral muscles.
- **Showering.** Patients may resume showering immediately.
- **Lifting** should be limited to light weights (< 5 kg) for four to six weeks. This restriction is primarily indicated to allow for complete sternal healing.
- **Return to work.** The timetable for a patient to return to his or her work is extremely variable. The standard delay is six to eight weeks after surgery, depending on the type of work that the patient performs. Intensive manual labor should be avoided until a postdischarge exercise stress test can be performed. White-collar or sedentary jobs can be resumed earlier than the typical waiting time, depending on the physical and psychologic state of the patient. The most important factors determining return to work after cardiac surgery are the length of time spent inactive presurgery, patient age and anxiety level six weeks after the procedure.[2](#)

Rehabilitation schedule. Phase I rehabilitation (ICU to discharge). Intensive mobilization should be instituted while the patient is in the ICU, beginning with active leg exercises. Upon transfer to the SDU and the surgical ward, the patient should be encouraged to ambulate with increasing frequency and duration. Incentive spirometry should also be performed frequently.

Table 2

MOST COMMON POSTSURGICAL PATIENT CONCERNS

Activities

- Fatigue
- Activities of daily living
- Sexual relations
- Driving
- Return to work

Sternal wound healing and instability

Pain

- Chest pain
- Recurrent angina

Neuropsychologic changes

- Stroke
- Headache
- Visual changes
- Neuropathies (arm/leg weakness's)
- Depression
- Sleep disorders

Medications

- Antiarrhythmics
- Antianginals
- Antiplatelet agents
- Lipid-lowering medications

Miscellaneous

- Vocal changes
- Fever
- Leg swelling

Table 3

OUTPATIENT CARDIAC RISK CATEGORIES FOR EXERCISE

	Low Risk	Intermediate Risk	High Risk

NYHA Class	1 or 2	1 or 2	3
Exercise capacity	>6 METs	5-6 METs	<5 METs
Peak heart rate	375% of age-predicted maximum	>120 beats/min (off drugs)	<120 beats/min (off drugs)
CHF	None	None	Ejection fraction <30, S3
Angina	None	Stable angina on exertion	Silent ischemia with exertion
BP response to exercise	Normal systolic response	Normal systolic response	No raise in systolic BP
Heart rhythm	No evidence of PVCs or ventricular tachycardia	No evidence of ventricular tachycardia	Complex or frequent PVCs
Self-monitoring	Capable	Capable	Unlikely

Note: Very high-risk patients (i.e., those with ventricular arrhythmias or hypotension with exertion) should not be enrolled in general outpatient exercise programs

Adapted from: Haskell W: Safety of outpatient cardiac exercise programs. Clinics in Sports Medicine 1984; 3:455-69.

NYHA - New York Heart Association

MET - Metabolic equivalent of the task

CHF - Congestive heart failure

BP - Blood pressure

PVC - Premature ventricular contraction

Involvement of a physiotherapist is essential to teach appropriate stretching and breathing exercises as well as to develop a graded aerobic exercise program. Early active ambulation programs are believed to be responsible for the marked decrease in postoperative deep-venous thrombosis and pulmonary emboli.[3](#)

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Phase II rehabilitation (discharge to 3-6 months). Cardiac rehabilitation programs have recently become an area of increased research, given the significant benefits of a relatively inexpensive intervention. Multiple studies have shown substantial benefit in exercise capacity, weight loss, lipid values and psychosocial parameters.^{4,5} Programs are now being developed for the full range of post-CABG patients, from

low- to high-risk categories ([Table 3](#)).

Low- and intermediate-risk patients should be assigned upon discharge to a walking program with increasing duration and intensity over the following four to six weeks. Patients can be taught a rating of perceived exertion (RPE) scale during Phase I rehabilitation, and can then use this scale and their heart rates as guides to monitor the intensity of their exertion. Even low-risk patients will have significant variability in their baseline exercise capacities; thus, these self-motivated Phase II exercise programs should be individually tailored to the patient before discharge.

High-risk patients should ambulate to a lesser extent until a postdischarge, symptom-limited stress test is performed at four to eight weeks. At this time, more formal exercise guidelines can be established. If a higher-risk patient wishes to exercise lightly before his or her exercise stress test, a good rule of thumb is to limit exertion to a maximal heart rate of 10-15 beats/min higher than the resting heart rate.²

Risks associated with supervised cardiac rehabilitation programs are minimal. The Cedar Sinai Research Group found that cardiac arrest rates of currently approved programs range from one in 67,126 to one in 120,000 patient-exercise hours.⁶ Despite this minimal risk, it is recommended that such exercise centers have emergency resuscitation equipment on hand. Direct supervision by a physician does not appear to be mandatory for these Phase II exercise programs. The degree of medical supervision should be individualized to each patient's clinical status by a qualified team

that is trained in cardiac rehabilitation.

Should patients of either category wish to join a formal cardiac rehabilitation program, frequent follow-up visits with their physicians and exercise specialists will be beneficial. Cardiac rehabilitation programs encompass multiple cardiac risk factors. Feedback regarding weight loss, smoking cessation, changes in lipid profile and improving exercise capacity can strengthen a patient's resolve to continue with positive lifestyle modifications. Patients will also obtain clearer guidelines regarding exercise limits and will, thereby, feel more confident while exercising. Anxiety regarding exercising is one of the key reasons that many cardiac and postsurgical patients become increasingly sedentary.

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Other physical activities - e.g., swimming, golf, rollerblading - can be resumed by six to eight weeks after surgery. It may be advisable to perform a symptomlimited exercise stress test prior to any particularly vigorous activity. Less strenuous household activities, such as cleaning or gardening, can be resumed by most patients unless specific contraindications exist.

STERNAL INSTABILITY AND DISCHARGE

A mild degree of asymmetry of the thorax and sternum is normal after CABG, and minor degrees of sternal instability are also common in the early postoperative period. Patients may describe clicking or even movement of the edges of the sternum with chestwall motion. The majority of cases of initial sternal instability will resolve with time adequate for complete bone healing; however, reapproximation of the sternal edges may be required if symptomatic instability were to continue for several months after CABG.

If an unstable sternum or painful sternal closure wires are associated with purulent discharge and

Skin staples may not fully approximate the wound edges on occasion, leaving a portion of an incision open to heal by secondary intention. This process can

fever, immediate referral back to the cardiovascular surgeon is warranted to rule out sternal infection or mediastinitis.

take longer to heal than most patients realize, and reassurance is often necessary. Minor amounts of discharge are normal at the sternal and vein-graft incisions, even if there is normal skin apposition. Providing that the

discharge is not associated with systemic signs of infection or spreading cellulitis, reassurance and local care are all that is necessary. A short course of an oral antibiotic with skin flora coverage may be necessary for a limited superficial wound infection.

Healing sternal and vein-graft incisions can often cause significant itchiness. Many patients will attest to the benefit of topical application of vitamin E cream or oil onto healing incisions, despite the lack of evidence in the medical literature to support this claim. If keloid formation is noted, steroid intradermal injections or creams may be beneficial.

If an unstable sternum or painful sternal closure wires are associated with purulent discharge and fever, immediate referral back to the cardiovascular surgeon is warranted to rule out sternal infection or mediastinitis. A surgical examination with a computerized tomography scan is the most effective manner to evaluate for deep-wound infection. If present, sternal infection will require intravenous antibiotics and possibly surgical debridement.

WHAT ABOUT CHEST PAIN?

Incisional and sternal pain is another common problem post-CABG. Patients are typically discharged on a short course of analgesics, but they should expect some degree of continued musculoskeletal discomfort for several weeks. Costochondritis is another frequent after-effect of sternotomies and can be responsible for pleuritic discomfort. On occasion, an occult rib fracture may also cause pleuritic chest-wall pain. Sternal pain of any etiology can be easily mistaken for angina, which can provoke significant anxiety. Prior to discharge, it is advantageous to warn a

patient in advance that chest pain aggravated by sudden movement, breathing and coughing is probably musculoskeletal in nature.

Internal mammary grafts are also associated with a unique pain syndrome. Symptoms range from numbness to pinprick to severe hypersensitivity of the skin overlying the sternum. The etiology of this syndrome is hypothesized to be related to the severing of anterior intercostal nerves during internal mammary-artery harvesting, or it may simply result from poor blood supply to the sternum.⁷ To some degree, this may be analogous to reflex sympathetic dystrophy syndrome (RSDS), which is characterized by pain and vasomotor changes (typically of an extremity) following trauma. Treatment of chest-wall pain includes transcutaneous nerve stimulation (TENS), thoracic ganglia blocks, acupuncture, desensitization therapy and tricyclic antidepressants. Response to these therapies is variable. Standard analgesics have not been shown to be helpful in relieving this pain syndrome.

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While anecdotal data indicate that the degree of chest pain decreases with time, there are little long-term data regarding treatment and prognosis.

Pericarditis may be encountered post-CABG, causing pleuritic pain and discomfort. Pericardial effusion rarely leads to hemodynamic significance and usually does not require pericardiocentesis; nonsteroidal anti-inflammatory drugs are the treatment of choice. Pleural effusion is common after CABG, more so in recipients of internal mammary grafts. The typical presenting complaints associated with pleural effusion are shortness of breath and, less frequently, pleuritic discomfort.

Recurrent angina is uncommon immediately after successful CABG, but second bypasses and incomplete revascularizations tend to provide suboptimal relief of symptoms. Early graft closure is a recognized complication at one month in 10-15% of cases; however, symptoms do not necessarily present immediately.

Nonetheless, up to 20-30% of patients will experience recurrent angina within the first year of CABG.⁸ Should exertional or rest angina occur within the early postoperative period, aggressive investigation is warranted. Stress testing has been shown to be less reliable towards detection of disease bypass grafts; nuclear scans or angiography can be of more benefit. Coronary angioplasty and stents have been successful in restoring patency to diseased venous or arterial grafts, but longterm results are less favorable.⁹

NEUROLOGIC AND PSYCHOLOGIC CHANGES

Stroke. Adverse cerebral outcomes following surgery can be divided into two categories of impairment. The first group is comprised of fatal stroke or stroke causing physical impairment. This can be seen in 3.1% of patients following CABG. Following this type of insult to the central nervous system (CNS), only 32% of patients will be discharged home directly from the hospital.¹⁰

The more common types of CNS dysfunction are subtle cognitive and intellectual deficits of attention span, concentration and learning ability. Estimates as to the frequency of these complications range from 3% to 80%, due to the various methods used in postoperative assessment. Clinical assessments by ward physicians reveal the 3% incidence quoted above,¹⁰ while utilization of standardized questionnaires and testing methods have estimated that up to 79% of patients have some form of cognitive decline.¹¹ These deficits may not be apparent to the patients themselves, and may only be revealed to the follow-up physician by a family member. The majority of patients will recover fully from milder forms of cognitive dysfunction.¹²

Head and neck pain are infrequent sequelae to CABG; they are more commonly exacerbations of pre-existing conditions, but can be iatrogenic. Headaches may be induced by vasodilatory drugs such as nitroglycerin and by cessation of agents such as beta-blockers. Neck pain may occur as a result of cervical trauma during general anesthesia or from central-line complications perioperatively.

Visual changes are common postoperatively, with a 4.5% incidence of decreased visual acuity and a 3% incidence of field deficits. Abnormalities observed with a detailed ophthalmologic examination are found even more commonly, from 25% to 100% depending on the mechanism used for evaluation.⁹ Microemboli from the oxygenator, bypass pump and native vasculature are the sources most frequently implicated. The majority of these microscopic abnormalities are asymptomatic. Ten per cent of postoperative visual-field deficits will persist to six months' follow-up.

Neurologic abnormalities. Nerve damage is not infrequent after cardiac surgery, with the majority being peripheral and brachial neuropathies. Brachial plexus injuries occur more frequently in men, and are seen in up to 8% of postoperative patients.¹² Motor paralysis and weakness of the upper extremity are the most frequent symptoms. Symptoms also include palsies of the ulnar and median nerves (specifically the C8 and T1 nerve roots), which can comprise weakness of the flexor muscles of the forearm and hand and much of the sensation of the palmar surface of the hand. Mechanical stresses on an abducted arm can result in stretching and compression of the plexus, especially if prolonged or wider sternal retraction is necessary. Brachial plexus injuries tend to heal; only 32% of presenting cases in one study continued to show symptoms at six months.¹²

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Peripheral neuropathies are found in 6% to 13% of patients after CABG. Upper-extremity nerves are affected more commonly than lower-extremity nerves. The ulnar nerve is the most frequently involved due to both physical compression of the ulnar groove of the arm on the operating table and involvement of the brachial plexus. Long-term involvement of peripheral nerves is uncommon

(approximately 2.3% of cases).¹² Lower-extremity nerve injuries can include the saphenous, peroneal and the lateral cutaneous nerve of the thigh.

Depression is extremely common after bypass grafting and major coronary events. The authors of one study found a 20% incidence of depression after a cardiac event.

Depression is extremely common after CABG and major coronary events. The authors of one study found a 20% incidence of depression after a cardiac event,¹³ and it is believed that depression is significantly underestimated in this population. Psychiatric involvement may be necessary; however, pharmacotherapy may not be required

for this type of reactive depression. Cardiac rehabilitation programs are believed to be of benefit in improving depressive symptoms?likely due to a patient's better understanding of the disease and rehabilitation process. This can lead to an empowerment phenomenon, allowing the patient a degree of control and influence over his or her cardiac disease.

Sleep disturbances are a frequent complaint postoperatively, occurring in over 50% of surveyed patients.¹⁴ Causes of fragmented nighttime sleep include incisional pain, difficulty finding a comfortable position and nocturia. Changes in sleep habits in hospital (daytime napping) and withdrawal from nighttime sedatives also contribute to difficulty sleeping after discharge. These problems can continue for more than six months, and addressing all of the above issues may be necessary to improve sleep habits.

MEDICATIONS TO CONSIDER

Antiarrhythmics. Supraventricular tachyarrhythmias (SVTs) are frequently encountered in the first four to five days following CABG. Atrial fibrillation, flutter and premature complexes occur for multiple reasons, including pain, hypoxia, volume overload, electrolyte abnormalities and atrial ischemia. With resolution of these factors, SVTs generally resolve prior to discharge. Many

patients may require transient antiarrhythmics, such as digoxin or sotalol, for control of these rhythms, and some patients may even be discharged with prescriptions for regular doses of these medications.

Given the benign nature of most postoperative SVTs and the significant proarrhythmic effects of medications such as sotalol, a medication review should be part of every first follow-up visit. Should the patient have no further history or clinical evidence of palpitations and arrhythmia, the antiarrhythmics can be stopped. If continued beta-blockade is preferred, sotalol can be switched to a more traditional Class II agent.

Antianginals. Following successful CABG, patients may have most, if not all, of their antianginals discontinued. Some of these agents, however, may be maintained for their antihypertensive effects.

Antiplatelet agents, such as acetylsalicylic acid, have been shown to significantly decrease the incidence of vein-graft occlusion within the first year postoperatively,[15](#) and should probably be given indefinitely.

Lipid-lowering agents. Aggressive lipid lowering in hypercholesterolemic patients has been shown to decrease the rate of obstructive changes on saphenous-vein grafts following CABG. According to current studies, reducing levels of lowdensity lipoprotein cholesterol to 2.6 mmol/L or lower appears to be the optimal strategy.[16](#)

MISCELLANEOUS

Leg swelling is a universal postoperative problem that resolves in a majority of patients after a short course of diuretics. This problem can persist indefinitely, however, in individuals who are prone to venous insufficiency or, more commonly, in a leg from which vein grafts were taken. Standard management includes compressive stockings, leg elevation and avoidance of prolonged standing and frequent ambulation. Sudden increases in swelling

should trigger a work-up for deep-venous thrombosis.

Fever. While common in the ICU or SDU, fever is always abnormal after the patient returns home. Pneumonia/ atelectasis, urinary-tract infections and wound infections are the most common causes of postoperative fever; noninfectious causes include intravenous-line phlebitis, drug fevers, pericarditis and pulmonary emboli. Patients should be informed prior to discharge to seek prompt evaluation for any postoperative fever.

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Vocal changes are common immediately after extubation, and can be prolonged in a minority of patients. True vocal-cord paralysis is rare (0.4-1.1%) and is permanent in even fewer cases.¹⁷ Persistence of voice problems after one month should prompt referral to an otolaryngologist.

CONCLUSION

Following coronary bypass, many patients are unprepared for a relatively long recovery period. Some patients may also be unaware that the true success of the operation is only partially dependent on the technical results of the procedure. Indeed, active rehabilitation and aggressive medical management in the postoperative period is critical to long-term success of a coronary bypass operation.

Risk-factor and lifestyle modifications, such as quitting smoking and daily exercise, will prolong the beneficial effects of bypass surgery, and should be an integral part of primary-care intervention.

Armed with a better knowledge of typical postoperative sequelae, practitioners and patients alike can better manage the challenging recovery from bypass surgery. Patients should be aware of serious signs and symptoms such as fever and purulent drainage, and should be sufficiently informed to recognize musculoskeletal discomfort as being benign. Knowledge of the more uncommon complications and their course will enable appropriate specialist referral as

needed. Risk-factor and lifestyle

modifications, such as quitting smoking and daily exercise, will prolong the beneficial effects of bypass surgery, and should be an integral part of primary-care intervention.

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