

Management of Patients Post MI

This article provides readers with the necessary pharmacologic information for treating post-MI patients. Appropriate use of current drugs is discussed, as well as how best to follow your patient.



By Robert C. Welsh, MD, FRCPC

Despite significant advancements in medical and revascularization therapy, cardiovascular disease remains the leading cause of morbidity and mortality in developed nations. In the first year following an acute ST elevation myocardial infarction (ST-AMI), further complications of ischemic heart disease (IHD) are common

(Table 1).¹ Although extensive clinical investigation has demonstrated the benefit of medical therapy, it appears significant gaps between proven therapy and actual care remain. A multifaceted approach that is individualized to each patient, therefore, is required. The goal of post ST-AMI management is to limit subsequent cardiovascular events, while maintaining the patient's highest functional capacity and quality of life. This article will review the appropriate management of patients post ST-AMI from the first day of admission through the subsequent year.

About the author...



Dr. Welsh is an international cardiologist and is co-director of the University of Alberta Hospital Chest Pain Program.

Risk Assessment

Appropriate risk stratification of patients with ST-AMI requires vigilance during hospitalization and beyond. After effective reperfusion and/or completion of myocardial necro-

Case

Mr. Smith, a 63-year-old man, presented to the emergency department complaining of a band-like chest pressure (present for the last 90 minutes) associated with mild nausea and diaphoresis. He denied past medical problems, recently stopped smoking (two months) and his father died at age 55 from a heart attack.

The patient was noted to be in moderate distress, with a blood pressure of 170/92 mmHg and a heart rate of 90 beats per minute. The jugular venous pressure was 4 cm above the sternal angle and lungs were clear to auscultation and percussion. The apical impulse was within normal limits with normal heart sounds and no audible murmurs. The 12-lead ECG showed 2.5 mm of ST segment elevation in the precordial leads (V1 to V4). A chest X-ray demonstrated no obvious abnormalities, with normal cardiac contours and no pulmonary edema.

Mr. Smith was diagnosed with an acute anterior wall ST elevation myocardial infarction (MI) and was treated 45 minutes after presentation with acetylsalicylic acid (ASA), fibrinolysis, a beta blocker and therapeutic anti-coagulation. His symptoms subsided and the ECG normalized over the subsequent 75 minutes. In hospital, he remained asymptomatic with no recurrent symptoms and had a peak creatinine kinase (CK) of 1,150 (CK-MB 150). After successful completion of a low level stress test four days after admission, he was discharged from hospital to be followed by his family physician.



What are the appropriate investigations and medical therapies for this patient?

Discussion on page 44

sis (lack of effective reperfusion) close clinical, hemodynamic and electrocardiographic observation is required for the next 24 to 48 hours. Recurrent ischemia, hemodynamic instability and/or significant arrhythmia identify a high-risk subset of patients who require medical stabilization and further urgent diagnostic investigation. During progressive mobilization in the convalescent period and after hospital discharge, ongoing assessment for symptoms and/or signs of recurrent ischemia and left ventricular dysfunction (LVD) are necessary to ensure long-term patient stability (Table 2).

Exercise stress testing (EST) after ST-AMI provides the following:

- Prognostic information for the risk of subsequent cardiovascular events;
- An assessment of functional capacity; and
- A measure of the efficacy of current therapy.

Patients with poor functional capacity and high-risk features during EST have the highest incidence of complications and warrant further investigation (Table 3). The optimal timing and ideal exercise protocol remains unresolved. Traditionally, submaximal EST is undertaken. This incorporates a series of predefined end points to identify the highest risk category of patients, but does not fully test functional capacity. A subsequent symptom-limited EST is required after hospital discharge. Symptom-limited EST provides a more complete assessment of functional capacity and residual ischemia, and can be completed safely. However, it may lead to unnecessary referral for invasive testing, due to resolving electrocardiogram (ECG) abnormalities after ST-AMI. Guidelines specify an EST should be performed on all eligible patients, either prior to discharge or in the early post-discharge period.² Non-invasive testing with nuclear perfusion imaging or stress echocardiography have potential advantages over standard ECG EST, but due to significant incremental cost and lim-

Table 1

One Year Events Post ST-AMI

Event	Patients %
One-year mortality	19%
Cardiac catheterization	31%
Percutaneous coronary angioplasty	15%
Coronary artery bypass	8%

ST-AMI = acute ST elevation myocardial infarction

Adapted from: Pilote L, Lavoie F, Ho V, et al: Changes in the treatment and outcomes of acute myocardial infarction in Quebec, 1988-1995. *Can Med Assoc J* 2000; 163(1):31-6.

ited availability, they are typically reserved for patients with uninterpretable ECG's or the inability to exercise.

Clinical evidence of LVD is one of the most powerful predictors of future cardiac events. A left ventricular ejection fraction (LVEF) of < 40% is associated with a mortality rate three times as high as patients without LVD (LVEF < 40% versus > 40%, mortality 26.6% versus 7.2%, $P = 0.0001$).³ Due to the availability and accuracy of echocardiography, it remains the most common means of determining LV function, although the prognostic value of clinical examination (as well as angiographic and nuclear assessments) have also been demonstrated. If LVD is documented, it is essential to maximize appropriate medical therapies and investigate for potentially reversible medical conditions (*i.e.*, residual myocardial ischemia) in an attempt to modulate the patient's morbidity and mortality risk.

In the early reperfusion era (1980-1995), research has shown routine cardiac catheterization after ST-AMI does not improve patient outcomes. In contrast, recent investigations among high-risk patients with non-ST elevation acute coronary syndromes (unstable angina and non-ST elevation AMI) demonstrat-

Table 2

Risk Stratification: A Continuous Process

	Risk Assessment	Diagnostic Approach
24 to 48 hours	<ul style="list-style-type: none"> • Recurrent ischemia • Recurrent infarction • Hemodynamic instability • Arrhythmia 	<ul style="list-style-type: none"> • Cardiac catheterization • Echocardiogram • Prolonged ECG monitoring
Convalescence pre-discharge	<ul style="list-style-type: none"> • Assess residual ischemic burden • Left ventricular dysfunction (degree of myocardial necrosis) 	<ul style="list-style-type: none"> • Low-level stress test • Symptom-limited stress test • Echocardiogram • ECG change, CK elevation
Post-discharge	<ul style="list-style-type: none"> • Clinical angina • Clinical CHF 	<ul style="list-style-type: none"> • EST, perfusion imaging • Stress echo • Echocardiography

ECG: electrocardiogram CK: creatine kinase EST: exercise stress test CHF: congestive heart failure

ed benefit from an aggressive approach (22% RR, 3.5% ARR, $P = 0.025$, end point = death, MI and repeat hospitalization).⁴ Significant debate about the impact of aggressive *versus* conservative management of patients with aborted or relatively small ST-AMI following reperfusion therapy, is ongoing. Until this concept is appropriately tested, surveillance for clinical indications for cardiac catheterization should continue to guide invasive investigation.

Medical Therapy

Large, randomized trials have identified an armamentarium of therapeutic options proven to reduce morbidity and mortality in the post ST-AMI patient. Despite dissemination of this information, evidence suggests approx-

imately one-third of patients do not receive proven therapy after discharge. Furthermore, even in patients discharged on appropriate medications, a significant number discontinued therapy within the first year. A significant impact on patient outcomes could be achieved simply by ensuring appropriate medical interventions are initiated and maintained.

Anti-Platelets and Anti-Coagulants

Acetylsalicylic acid (ASA) remains the single most cost-effective therapy for acute and chronic management of patients after MI and should be given to all patients, unless contraindications exist. In six ran-

domized trials of ASA in patients after AMI, meta-analysis reveals a reduction in vascular mortality of 13%, non-fatal reinfarction of 31%, and nonfatal stroke of 42%.⁵ Other anti-platelet agents have not been studied specifically in patients after ST-AMI, but a significant amount of information has been obtained with the adenosine diphosphate receptor blockers (thenopyridines, ticlopidine and clopidogrel) in patients with IHD.

A recently published trial assessed the combination of ASA and clopidogrel, as compared to ASA alone, in patients with acute coronary syndromes. A reduction in cardiovascular events with the combination therapy was documented.⁶ Although this combination cannot be recommended routinely after ST-AMI, it represents a reasonable addition among high-risk patients with recurrent ischemia or documented severe coronary artery disease (CAD). Monotherapy with clopidogrel is an effective alternative to be used in patients with intolerance or absolute contraindications to ASA.

The known pathophysiological correlation of plaque rupture and occlusive thrombus formation as the inciting event in ST-AMI would suggest a reduction of cardiovascular events with long-term anticoagulation. Unfortunately, the clinical data has demonstrated conflicting results and, as such, routine oral anticoagulation is not currently recommended. Oral anticoagulation is recommended in patients with atrial fibrillation and, although research is limited, it is recommended over a period of three months in patients with moderate to severe LVD and/or documented LV mural thrombus.¹ Novel oral anti-thrombotic therapy, currently being developed, may provide safe and effective long-term therapy, but requires dedicated assessment in the future.

Table 3

High-Risk Features of an Exercise Stress Test

- Early diagnostic ECG changes (< 3 minutes)
- Prolonged changes in recovery (> 5 minutes)
- Hypotensive systolic blood pressure response
- Ventricular arrhythmias (ventricular fibrillation or ventricular tachycardia)
- Poor functional class

Nitroglycerin Derivatives, Beta Blockers and CCBs

Nitroglycerin derivatives were the first available anti-ischemic therapy and remain effective for the acute relief of angina, as well as prophylactic therapy prior to exertion. Although they provide symptomatic relief, long-term therapy has not demonstrated a reduction in cardiovascular events. Therefore, nitroglycerin should be available to all patients with IHD to treat acute episodes of angina. It can be used prior to exertion or in sustained release preparations on a prophylactic basis in patients with symptomatic angina.

Beta blockers decrease heart rate, blood pressure (BP), myocardial contractility and improve ventricular diastolic relaxation, thereby producing a reduction in myocardial oxygen consumption. The acute and chronic benefit of beta blockers initiated at the time of presentation with an ST-AMI and continued thereafter, has been clearly demonstrated. Due to the consistence of clinical benefit, patients with relative contraindications should start beta blocker therapy at low dose, with gentle titration, in an attempt to institute therapy. In post ST-AMI patients with documented LVD (LVEF < 40%) the Effects of Carvedilol on Mortality and Morbidity in Patients with LV

Dysfunction After MI (CAPRICORN) study demonstrated carvedilol reduced clinical events. Once patients are clinically stable, therefore, attempts to initiate beta blockers should be undertaken.⁷ Beta blockers remain the foundation of medical therapy post ST-AMI and all patients should be treated, unless contraindications exist.

Although calcium channel blockers (CCBs) have not been shown to reduce cardiovascular events, they are effective anti-anginal and BP-lowering therapy and should be considered second-line agents for patients intolerant to beta blockers.

Patients with refractory ischemia on a maximal tolerated dose of beta blocker may be considered for combination therapy with dihydropyridine CCBs.

Research has demonstrated significant benefit from ACE inhibitor therapy in patients with LVD or symptomatic CHF following ST-AMI.

ACE Inhibitors and ARBs

Research has demonstrated significant benefit from angiotensin converting enzyme (ACE) inhibitor therapy in patients with LVD or symptomatic congestive heart failure following ST-AMI. Furthermore, the benefit of ACE inhibitors has recently been demonstrated in high-risk patients (> 55 years) with vascular disease or diabetes and one other risk cardiovascular risk factor, without known LV dysfunction (17.8% placebo *versus* 14.0% ramipril, RR 0.78, $P = < 0.001$, end points = MI, stroke, CV death).⁸ Although this study did

not include patients post ST-AMI, the magnitude of evidence in conjunction with other trials clearly demonstrates the benefit of ACE inhibitors in patients with documented CAD. ACE inhibitors, therefore, should be used in all patients post ST-AMI with documented LV dysfunction or symptomatic CHF, and considered in other patients with appropriate high-risk clinical characteristics (hypertension, diabetes mellitus, aged > 55).

Despite pre-emptive anticipated benefit of ARBs, studies to date have failed to demonstrate superiority of these agents over ACE inhibitors. Research in CHF would suggest ACE inhibitors remain first-line and preferred therapy. Although ARBs have essentially the same contraindications, they are a reasonable alternative therapy in patients with documented LVD and intolerance to ACE inhibitors due to severe intractable cough.

Management of Dyslipidemia

Epidemiological data and intervention trials have demonstrated the clear relationship of elevation of total cholesterol, low density lipoprotein (LDL) cholesterol, triglycerides, and low levels of high density lipoprotein (HDL) cholesterol, with adverse cardiovascular events. The Scandinavian Simvastatin Survival Study validated the cholesterol hypothesis, demonstrating that total cholesterol and LDL cholesterol reduction in patients with CAD was associated with a 30% reduction in all-cause mortality.⁹ Subsequent studies have documented benefit across the spectrum of IHD patient risk and degree of cholesterol elevation.

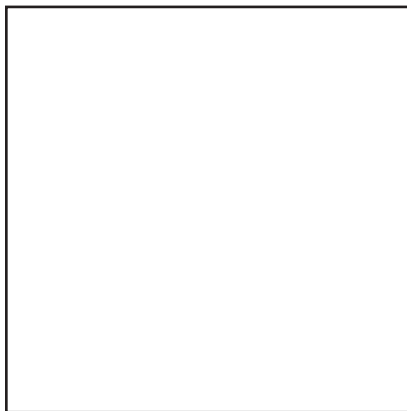
The benefit of early initiation of statin therapy post ST-AMI remains unstudied, with the most compelling evidence arising from the Myocardial Ischemia Reduction with Aggressive Cholesterol Lowering (MIRACL)

study.¹⁰ This study looked at acute coronary syndrome patients with unstable angina and non-ST elevation who were treated early with atorvastatin. It demonstrated a risk reduction of 16% at 16 weeks of follow-up in the combined primary end point of death, non-fatal MI, resuscitated cardiac arrest or recurrent symptomatic angina requiring hospitalization (95% CI 0%-30%, $P = 0.048$). All patients with CAD should be counseled on appropriate dietary changes and initiated on therapy to obtain a goal LDL < 2.5 mmol/L, a total cholesterol/HDL ratio < 4 mmol/L and a triglyceride level < 2.0 mmol/L, as outlined in the Canadian Working Group on Hypercholesterolemia and Other Dyslipidemias.¹¹



Medical Management After Revascularization

Although coronary artery bypass surgery and percutaneous coronary intervention improve myocardial perfusion, they clearly fail to modify the atherosclerotic process. Saphenous vein coronary artery bypass grafts tend to rapidly develop arteriosclerosis, therefore, after coronary artery bypass grafting, risk factor reduction and secondary prevention is paramount to reduce subsequent clinical events. After percutaneous coronary intervention involving stent implantation, combined anti-platelets therapy with ASA and clopidogrel is required for two to four weeks to prevent acute stent occlusion during the critical period of re-endothelialization. Subsequently, long-term proven medical therapy and risk factor modification is required.



Patients should receive an exercise prescription at the time of hospital discharge.

Cardiac Rehabilitation and Lifestyle Modification

Formal cardiac rehabilitation programs with multidisciplinary assessment are the ideal means to provide patient education, risk factor modification, clinical assessment and a supervised exercise progression. These programs should be recommended to all patients where available, as they have been shown to serve the following functions:

- Improve functional capacity;
- Decrease emotional distress;
- Reduce cardiac mortality; and
- Improve patient compliance.

Case Discussion

Mr. Smith was admitted to hospital with anterior ST elevation MI with effective reperfusion and moderate CK elevation. He was treated with ASA, a beta blocker, and an angiotensin converting enzyme inhibitor. His fasting cholesterol 12 hours after presentation was abnormal (total cholesterol 6.59 mmol/L, low density lipoprotein 4.80 mmol/L, high density lipoprotein 0.77 mmol/L and triglycerides 2.25 mmol/L) and statin therapy was initiated. During the initial cardiac rehabilitation assessment, he completed a symptom-limited stress test without symptoms or electrocardiogram evidence of ischemia. An echocardiogram demonstrated normal left ventricular function.

Patients should receive an exercise prescription at the time of hospital discharge, based on a three-phase graded approach. The first phase is initiated in-hospital, based on progression from bed rest to activities of daily living prior to discharge. Phase two encompasses the time from hospital discharge over the next 10 weeks, with progression of activity to walking at a reasonable pace (5 km/hr to 7 km/hr). The final phase includes return to full exercise capacity after completion of a symptom-limited exercise stress test. Although controversy exists regarding the intensity and duration of exercise required to positively impact patient outcomes, it appears the benefit is incremental. It is generally recommended that patients exercise 30 to 45 minutes three or four times per week.

Smoking cessation is associated with improved clinical outcomes and during every patient contact the physician must stress its importance. During hospitalization, short-term administration of anxiolytics or clonidine, in selected patients, may be useful to suppress withdrawal symptoms, although data is limited. Once patients have obtained clinical stability, dedicated programs with nicotine replace-

ment or bupropion therapy, have been shown to help smokers quit.

Pre-Discharge Counseling

Since a significant number of patients with ST-AMI have no past medical history, the physician should allow them the opportunity to ask practical questions concerning return to normal function. After acute MI, patients cannot drive for at least four weeks and thereafter recommendations should be based on individual patient characteristics. Commercial vehicle operators cannot drive for three months post AMI and occupations associated with passenger transport typically require a negative EST prior to return to work. Patients with evidence of clinical instability should not be allowed to drive until appropriate management improves their clinical situation.

Decisions to return to employment are based on multiple factors including clinical, socioeconomic and the specific work requirements. Although it is important to allow appropriate physical and psychological recovery, return to a fully functional position is the goal of all individu-

als. Patients should be clinically stable and capable of achieving approximately six metabolic equivalents of exercise, approximately equivalent to climbing two flights of stairs at a reasonable pace, prior to return to sexual activity.

Conclusion

The medical management of patients after ST-AMI remains less than ideal, with a significant number of patients discharged without the benefit of appropriate therapy, and others discontinuing therapy within the first year. Although “best therapy” requires a significant number of medications, it is necessary to achieve optimal clinical outcomes. It is essential that a combined effort be undertaken to educate and manage these patients, including family physicians, cardiac rehabilitation personnel, general internists and cardiologists. *Read*



Decisions to return to employment are based on multiple factors including clinical, socioeconomic and the specific work requirements.

References

- Pilote L, Lavoie F, Ho V, et al: Changes in the treatment and outcomes of acute myocardial infarction in Quebec, 1988-1995. *Can Med Assoc J* 2000; 163(1):31-6.
- Ryan TJ, Antman EM, Brooks NH, et al: 1999 update: ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction: Executive Summary and Recommendations: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). *Circulation* 1999; 100(9):1016-30.
- Ross AM, Coyne KS, Moreyra E, et al: Extended mortality benefit of early postinfarction reperfusion. GUSTO-I Angiographic Investigators. *Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries Trial*. *Circulation* 1998; 97(16):1549-56.
- Cannon CP, Weintraub WS, Demopoulos LA, et al: Comparison of early invasive and conservative strategies in patients with unstable coronary syndromes treated with the glycoprotein IIb/IIIa inhibitor tirofiban. *N Engl J Med* 2001; 344(25):1879-87.
- Becker RC: Antiplatelet therapy in coronary heart disease: Emerging strategies for the treatment and prevention of acute myocardial infarction. *Arch Pathol Lab Med* 1993; 117(1):89-96.
- Yusuf S, Zhao F, Mehta SR, et al: Effects of clopidogrel in addition to aspirin in patients with acute coronary syndromes without ST-segment elevation. *N Engl J Med* 2001; 345(7):494-502.
- Dargie HJ: Effect of carvedilol on outcome after myocardial infarction in patients with left-ventricular dysfunction: The CAPRICORN randomised trial. *Lancet* 2001; 357(9266):1385-90.
- Yusuf S, Sleight P, Pogue J, et al: Effects of an angiotensin-converting-enzyme inhibitor, ramipril, on cardiovascular events in high-risk patients. The Heart Outcomes Prevention Evaluation Study Investigators. *N Engl J Med* 2000; 342(3):145-53.
- Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: The Scandinavian Simvastatin Survival Study (4S). *Lancet* 1994; 344(8934):1383-9.
- Schwartz GG, Olsson AG, Ezekowitz MD, et al: Effects of atorvastatin on early recurrent ischemic events in acute coronary syndromes. The MIRACL study: A randomized controlled trial. *JAMA* 2001; 285(13):1711-8.
- Fodor JG, Frohlich JJ, Genest JJ, et al: Recommendations for the management and treatment of dyslipidemia. Report of the Working Group on Hypercholesterolemia and Other Dyslipidemias. *Can Med Assoc J* 2000; 162(10):1441-7.