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The PAIN Pathway for the Management of Acute Coronary Syndrome

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Acute coronary syndrome (ACS) subsumes a spectrum of clinical entities, ranging from unstable angina to ST-elevation myocardial infarction [1]. The management of ACS is deservedly scrutinized, as it accounts for 2 million hospitalizations and a remarkable 30% of all deaths in the United States each year [2]. Clinical guidelines on the management of ACS, which are based on clinical trials, have been updated and published [3, 4].

Large-scale registries—the NRMI [5], CRUSADE [6], and GRACE [7] registries—have consistently demonstrated a major gap between ACS management guidelines and their practical application in the real world. Accordingly, a major message that emerges from these quality-improvement registries is that there is an urgent need to incorporate the evidence-based guidelines into our daily management of ACS. In an attempt to achieve this goal, we have developed a new pathway for the management of ACS at our institution, St. Luke's Roosevelt Hospital Center (SLRHC), which is a university hospital of Columbia University College of Physicians and Surgeons. The necessity to develop such a pathway at our institution is compelling yet typical of the need at many similar medical centers.

The evidence-based information obtained from the large-scale clinical trials and from the guidelines is increasingly complex. Specifically, it has become exceedingly difficult for all house staff and emergency room staff to grasp all of the subtleties in the management of ACS patients. To address this problem, we have developed a unified pathway for the management of patients presenting with acute chest pain or its equivalent.

The pathway has been designated by the acronym PAIN (Priority risk, Advanced risk, Intermediate risk and Negative/low risk), which reflects a patient's most immediate risk stratification upon admission (Fig. 2.1). This risk stratification reflects a patient's 30-day risks for death and myocardial infarction after the initial ACS event.

The PAIN pathway is color-coded (P, red; A, yellow; I, yellow; N, green) and will guide patient management according to a patient's risk stratification. These colors—similar to the road traffic light code—have been chosen as an easy reference for the provider about the sequential risk level of patients with ACS [8].

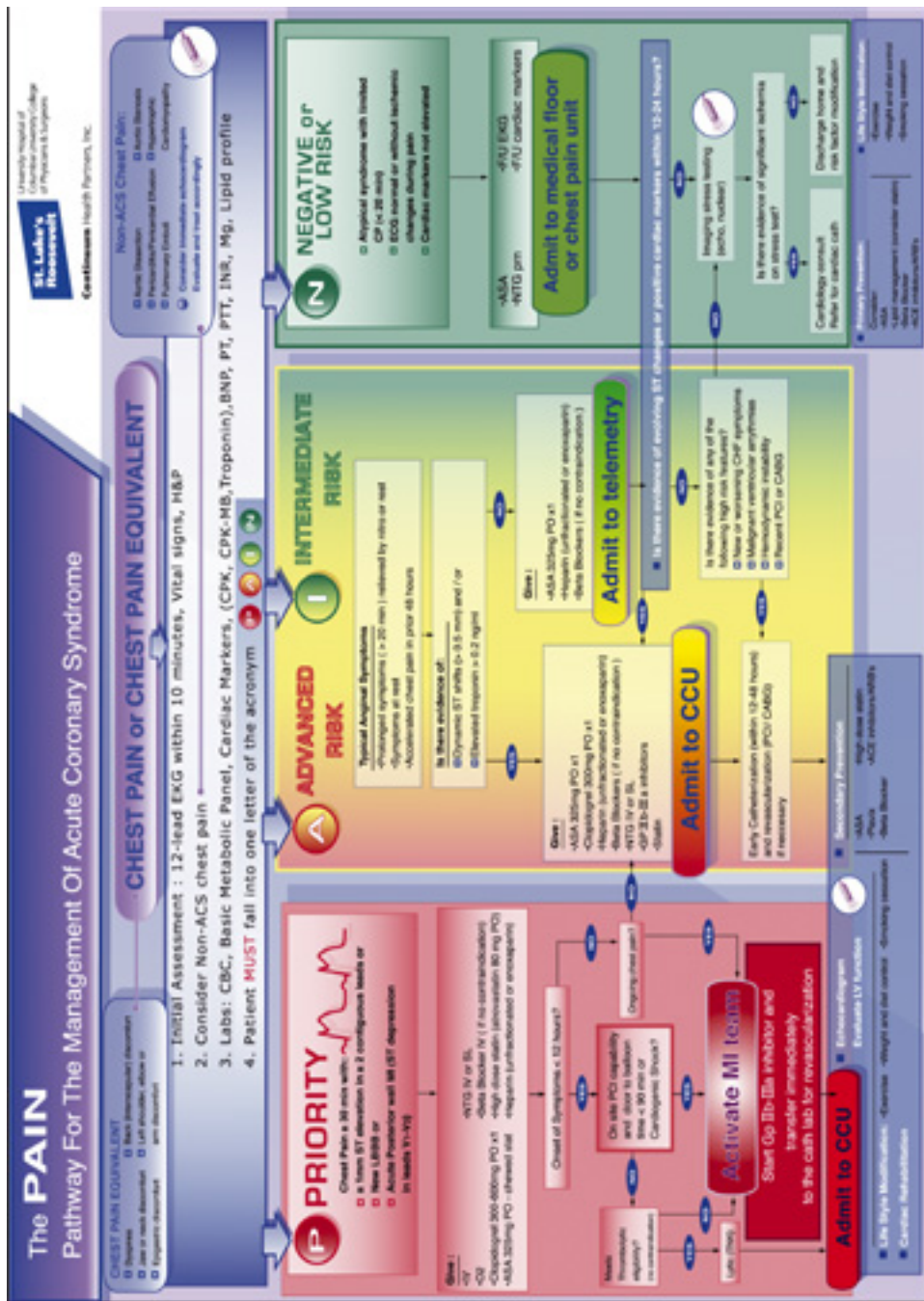


FIGURE 2.1. The PAIN pathway for the management of ACS.

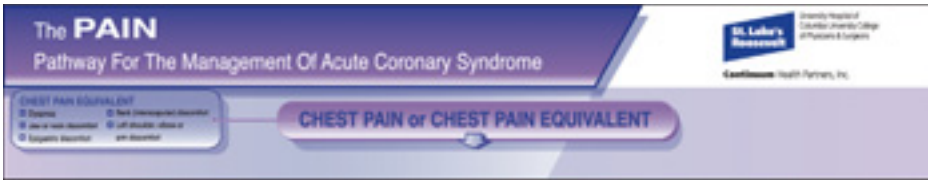


FIGURE 2.2. Chest pain and chest pain equivalent symptoms.

The Goals of the PAIN Pathway and a Road Map to this Acute Coronary Syndrome Book

Initial Assessment of Patients with Chest Pain or Chest Pain Equivalent

Patients who present to emergency departments with chest pain or chest pain equivalent will be enrolled into this pathway.

Figure 2.2 shows the chest pain equivalent symptoms. The initial assessment is seen in Figure 2.3. A detailed description of emergency department assessment is provided in Chapter 5. All patients should have an electrocardiogram (ECG) performed within 10 minutes as well as detailed history and physical exam.

Non-ACS chest pain should be excluded urgently. This includes aortic dissection, pericarditis and pericardial effusion, pulmonary emboli, aortic stenosis, and hypertrophic cardiomyopathy. If any of these emergency conditions is suspected, we recommend obtaining immediate echocardiogram or computed tomography (CT) and to treat accordingly.

Our recommended initial laboratory tests include complete blood count, basic metabolic panel, cardiac markers (to include CPK, CPK-MB, troponin), BNP, PT, PTT, INR, magnesium, and a lipid profile.

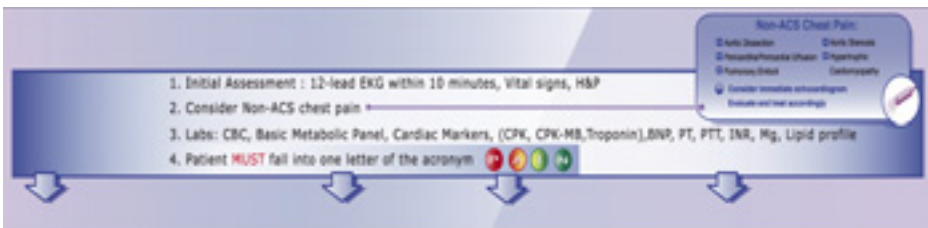


FIGURE 2.3. Initial assessment of patients with chest pain.

Initial Management of *PRIORITY* Patients (Patients with ST-Elevation Myocardial Infarction)

PRIORITY patients are those with symptoms of chest pain or chest pain equivalent lasting longer than 30 minutes with one of the following ECG criteria for acute myocardial infarction:

1. ST elevation ≥ 1 mm in two contiguous leads; or
2. New left bundle branch block; or
3. Acute posterior wall myocardial infarction (ST-segment depression in leads V_1 – V_3).

The initial treatment of these patients includes obtaining an intravenous line, providing oxygen, treating patients with oral aspirin (chewable 325 mg, stat), clopidogrel (300 mg or 600 mg loading dose), and intravenous beta-blocker (if no contraindication), heparin (unfractionated or enoxaparin), nitroglycerin, and oral high-dose statin (Fig. 2.4). A detailed dosing and the rationale for this management appear in Chapter 6.

The key question for further management of these patients is the duration of the patients' symptoms. For patients whose symptoms exceed 12 hours, presence of persistent or residual chest pain determines the next strategy. If there is no evidence of continued symptoms, these patients will be treated as if they had been risk stratified with the Advanced Risk group.

For patients whose symptoms are less than 12 hours or with ongoing chest pain, the decision for further management is based on the availability of on-site

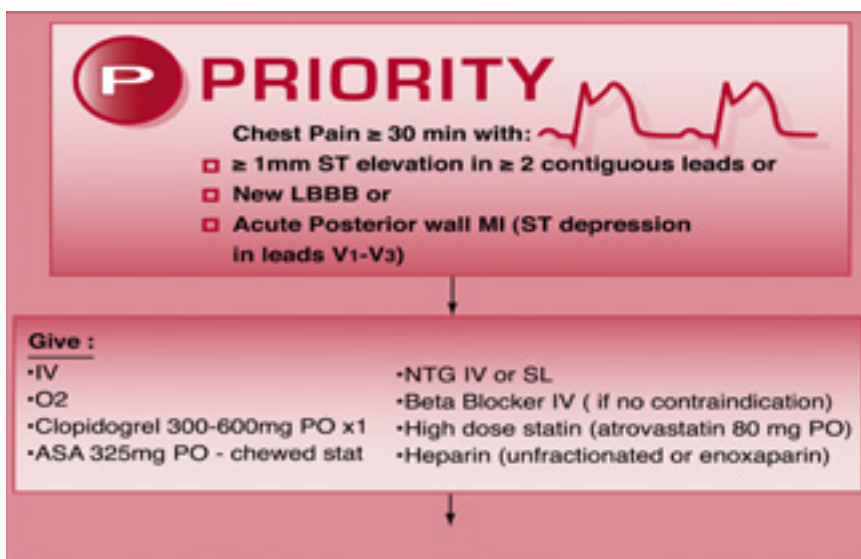


FIGURE 2.4. The initial management of PRIORITY patients (patient with ST-elevation myocardial infarction).

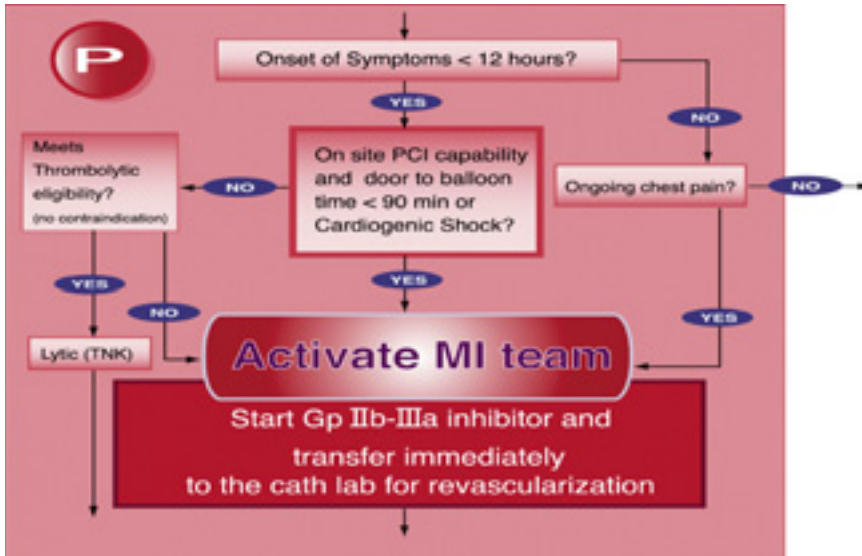


FIGURE 2.5. Advanced management of PRIORITY myocardial infarction patients with expected door to balloon time of less than 90 minutes.

angioplasty (PCI) capability with expected door to balloon time of less than 90 minutes or the presence of cardiogenic shock. A detailed discussion of cardiogenic shock appears in Chapter 13.

Patients with expected door to balloon time of less than 90 minutes should be started on intravenous treatment of glycoprotein IIb/IIIa inhibitors and they should be transferred immediately to the cardiac catheterization lab for revascularization. The myocardial infarction (MI) team is activated for this group of patients (Fig. 2.5).

At our institution, a single call made by the emergency department physician to the page operator activates the MI team, which includes the following health care providers:

1. The interventional cardiologist on-call
2. The director of the cardiac care unit (CCU)
3. The cardiology fellow on-call
4. The interventional cardiology fellow on-call
5. The cath lab nurse on-call
6. The cath lab technologist on-call
7. The CCU nursing manager on-call
8. The senior internal medicine resident on-call.

Activating this group of people has been extremely successful at our institution and has reduced markedly our door to balloon time. These strategies have been recently shown to decrease door to balloon time in the range of 8 to 19 minutes [9].

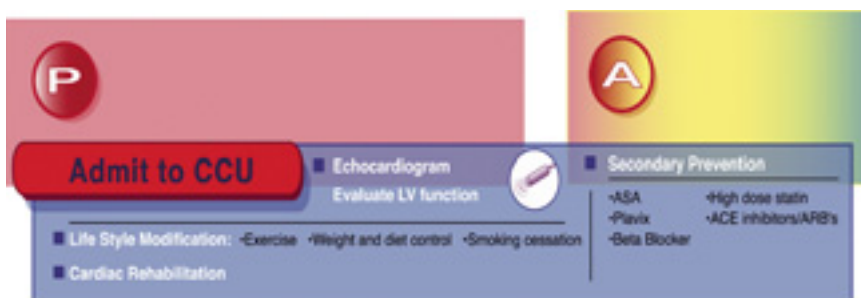


FIGURE 2.6. CCU management and secondary prevention for patients with PRIORITY myocardial infarction.

For hospitals with no PCI capability or in situations when door to balloon time is expected to exceed 90 minutes, we recommend thrombolytic therapy if there are no contraindications.

CCU Management and Secondary Prevention for Patients with PRIORITY Myocardial Infarction

Patients with PRIORITY myocardial infarction should be admitted to the CCU (Fig. 2.6). A detailed description of CCU management appears in Chapter 6. All patients should have an echocardiogram to evaluate left ventricle systolic and diastolic function and to exclude valvular abnormality and pericardial involvement (as described in Chapter 14). We recommend a minimum CCU stay of 24 hours to exclude arrhythmia complication (as described in Chapters 16 to 18) or mechanical complication (as described in Chapter 11). For patients with no evidence of mechanical complications or significant arrhythmia, secondary prevention drugs should be started, including aspirin, clopidogrel, high-dose statin, beta-blocker, and angiotensin-converting enzyme (ACE) inhibitor or angiotensin receptor blocker.

Most patients can be discharge within 48 hours with recommendation for lifestyle modification including exercise, weight and diet control, smoking cessation (Chapter 26), and cardiac rehabilitation. Secondary prevention drugs should be continued on discharge as discussed in Chapter 25.

Management of Advanced Risk ACS

Typical anginal symptoms are required to be present in patients, who will enroll into the Advanced Risk or the Intermediate Risk groups. These symptoms include:

1. Prolonged chest pain (>20 minutes) relieved by nitroglycerine or rest;
2. Chest pain at rest; or
3. Accelerated chest pain within 48 hours.

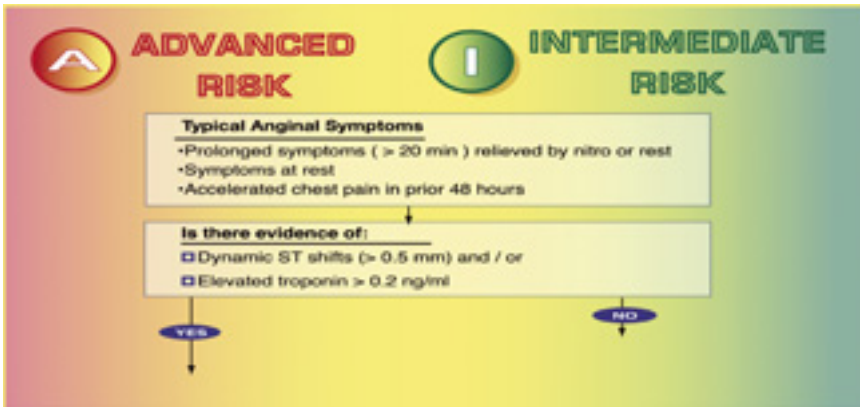


FIGURE 2.7. Risk stratification as Advanced Risk ACS.

In order to qualify for the Advanced Risk group, patients must have either dynamic ST changes on the electrocardiogram (>0.5mm) and/or elevated troponin (>0.2ng/mL) (Fig. 2.7).

A detailed description of the management of Advanced Risk patients appears in Chapter 7. We recommend that patients be admitted to the CCU and be treated with aspirin, clopidogrel, heparin, glycoprotein IIb/IIIa inhibitor, beta-blocker, statin, and nitroglycerin if there are no contraindications (Fig. 2.8).

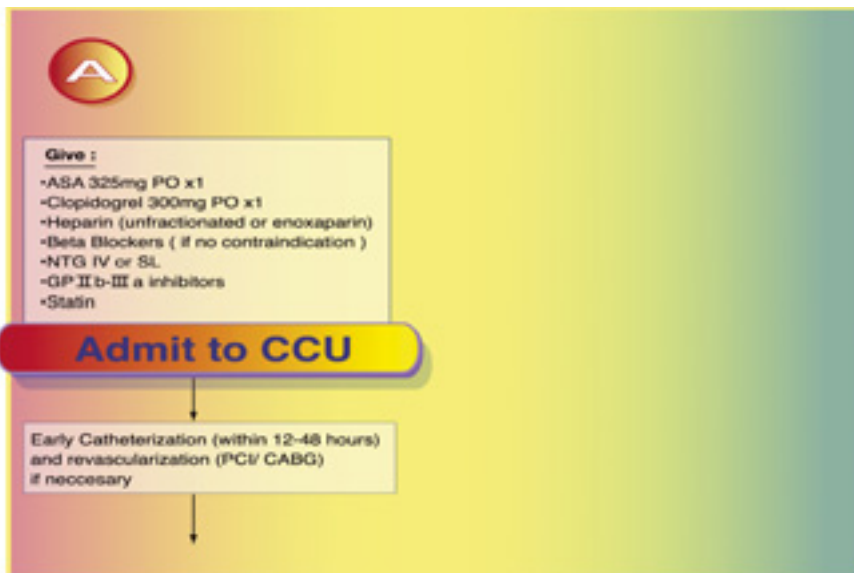


FIGURE 2.8. Management of patients with Advanced Risk ACS.

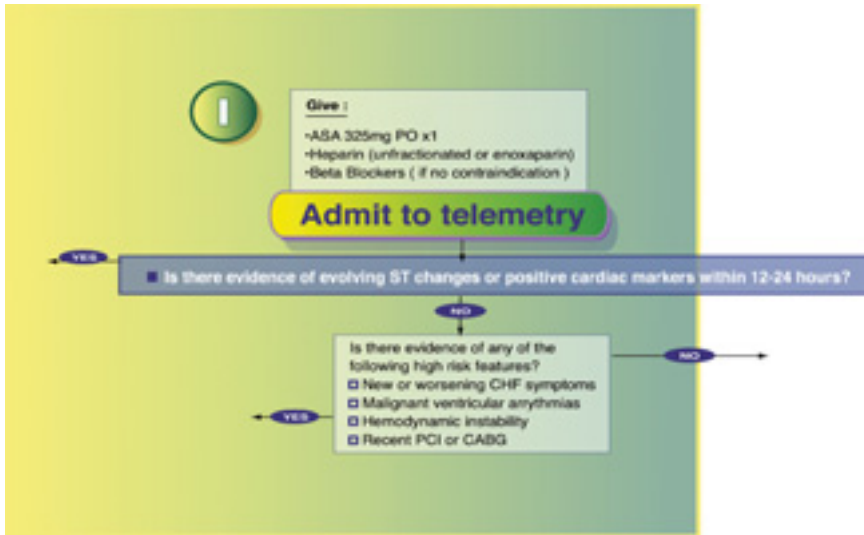


FIGURE 2.9. Management of patients with Intermediate Risk ACS.

These patients should have early cardiac catheterization within 12 to 48 hours and revascularization by PCI or coronary artery bypass surgery (CABG) if necessary. All patients should have an echocardiogram to evaluate left ventricular function. Recommendation for secondary prevention medication, lifestyle modification, and cardiac rehabilitation should be provided similar to the patients in the PRIORITY risk group (Fig. 2.6).

Management of Intermediate Risk Group

Both Intermediate Risk group and Advanced Risk patients present to the hospital with typical anginal symptoms. Compared with the Advanced Risk patients, the Intermediate Risk patients *do not* have evidence of dynamic ST changes on the electrocardiogram or evidence of positive cardiac markers (see Chapter 8). These patients should be admitted to the telemetry floor and be given aspirin, heparin, and beta-blocker (Fig. 2.9). We recommend a minimum telemetry stay of 12 to 24 hours. If during this period of time there is evidence of dynamic ST changes on the electrocardiogram or evidence for positive cardiac markers, the patients should be treated as if they had been stratified to the Advanced Risk group.

The Intermediate Risk group patients are assessed again for the following high risk features:

1. New or worsening heart failure symptoms;
2. Malignant ventricular arrhythmias;
3. Hemodynamic instability; or
4. Recent (<6 months) PCI or CABG.

If there is evidence of any of these high-risk features, we recommend to transfer the patient for cardiac catheterization within 12 to 48 hours and for revascularization by PCI or CABG if necessary. Patients with no evidence of high-risk features should be referred for cardiac imaging stress testing (stress echocardiography or stress nuclear test).

Management of Negative or Low Risk Group Patients

These patients have atypical symptoms and do not have significant ischemic ECG changes during pain and do not have elevated cardiac markers.

These patients should be treated only with aspirin and given sublingual nitroglycerin if needed. If a decision was made to admit them to the hospital, they should be admitted to a chest pain unit or to a regular medical floor. They should be followed up for 12 to 24 hours with repeated ECG and cardiac markers (Fig. 2.10). If there is evidence of evolving ST changes on the electrocardiogram or evidence of positive cardiac markers, the patients would be treated aggressively as with the Advanced Risk patients.

If there are no significant ECG changes and all cardiac markers are negative, we recommend cardiac imaging stress testing (by stress echocardiography or stress nuclear test) (Fig. 2.11). Evidence of significant ischemia on any of these stress imaging modalities will be followed by a referral for cardiac catheterization.

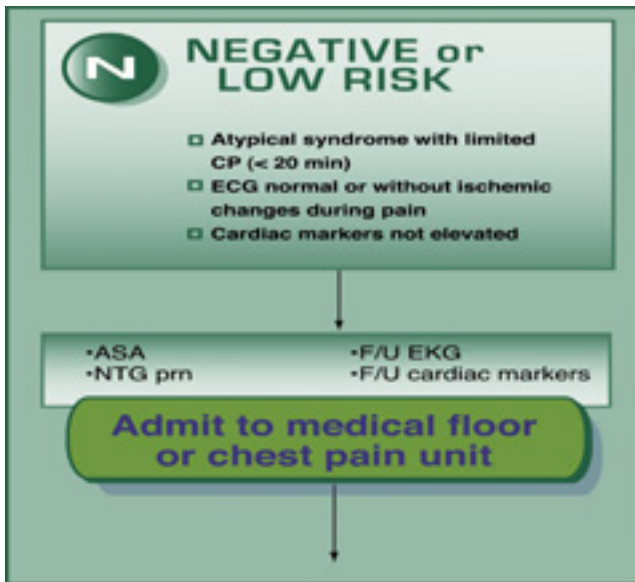


FIGURE 2.10. Initial management of patients with Negative or Low Risk ACS.

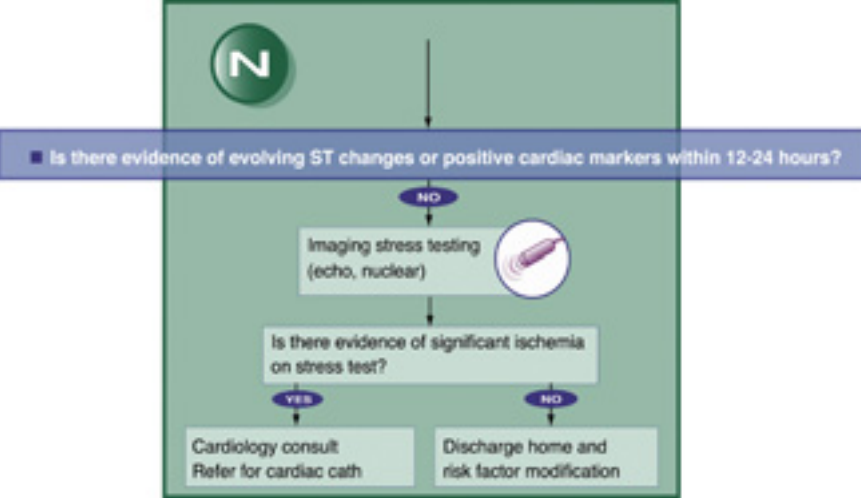


FIGURE 2.11. Risk stratification of Low Risk patients by using cardiac imaging stress testing.

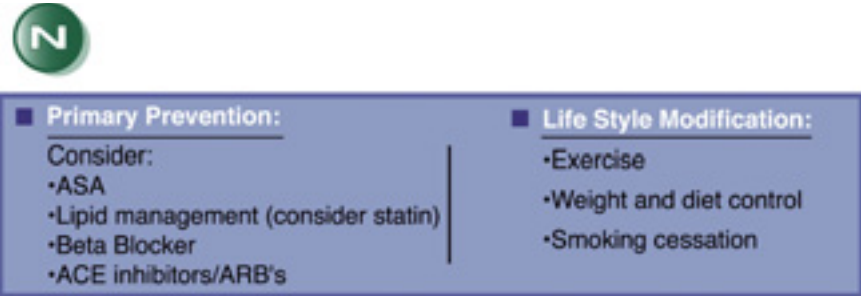


FIGURE 2.12. Primary prevention for Low Risk patients.

If there is no evidence of significant ischemia on stress testing, the patients will be discharged home with a recommendation for risk-factor modification to include primary prevention medication and lifestyle modification (Fig. 2.12).

In summary, we believe that this comprehensive yet simple pathway will be able to bridge the gap between the complex evidence-based guidelines and practical management of patients with ACS.

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