

# Chapter 64

## Approach to NSTEMI in the ICU



### 64.1 Introduction

NSTEMI, a variant of acute coronary syndrome (ACS), presents with myocardial damage evidenced by elevated troponins, yet lacks the hallmark ST-segment elevation on ECG. The pathophysiology of NSTEMI involves a mismatch between myocardial oxygen supply and demand. This imbalance is often due to partial occlusion of a coronary artery by a thrombus superimposed on a disrupted atherosclerotic plaque. However, other mechanisms such as plaque instability, vasospasm, myocarditis, or even non-atherosclerotic causes like pulmonary embolism can also precipitate NSTEMI. Understanding these varied etiologies is crucial for distinguishing NSTEMI from other forms of ACS and tailoring appropriate management strategies [1–3] [Ref: Algorithm 64.1].

### 64.2 Detailed Pathophysiology

The fundamental issue in NSTEMI is the insufficient oxygen delivery to meet the myocardial metabolic demands. Plaque instability leads to endothelial disruption, exposing subendothelial collagen and initiating platelet aggregation and thrombus formation. This process can result in transient or incomplete occlusion of the coronary artery, leading to ischemia and myocardial injury. Vasospasm, often induced by endothelial dysfunction or exposure to vasoconstrictive substances, can further reduce coronary blood flow. Non-atherosclerotic causes, such as myocarditis or pulmonary embolism, can mimic NSTEMI by causing myocardial strain or injury through inflammatory processes or increased right ventricular workload, respectively.

### 64.3 Risk Stratification

Accurate risk assessment is essential for guiding both therapeutic choices and prognostic conversations in patients with NSTEMI. The GRACE (Global Registry of Acute Coronary Events) score remains a widely validated tool for estimating six-month mortality, incorporating parameters such as patient age, heart rate, systolic blood pressure, serum creatinine, cardiac arrest on arrival, ST-segment shifts, elevated cardiac biomarkers, and Killip classification. Nevertheless, exclusive reliance on GRACE may overlook specific clinical subtleties.

To enhance clinical decision-making, additional scoring systems like TIMI (Thrombolysis In Myocardial Infarction) and HEART (History, ECG, Age, Risk factors, Troponin) are often employed. The TIMI score includes variables such as patient age, history of coronary artery disease, recent aspirin use, frequency of angina, ECG changes, and biomarker elevation. In contrast, the HEART score evaluates a combination of clinical history, electrocardiographic findings, patient age, traditional risk factors, and troponin levels, categorizing patients into low, moderate, or high risk for adverse cardiac outcomes.

By combining these scoring systems, clinicians can better identify patients who may benefit from early invasive strategies versus those who might be managed conservatively. For example, a patient with a low GRACE score but high TIMI or HEART scores might warrant more aggressive intervention than initially anticipated.

Bleeding risk assessment is equally crucial, particularly in older adults, patients with renal dysfunction, or those with a history of bleeding disorders. The CRUSADE score evaluates factors such as hematocrit levels, creatinine clearance, heart rate, systolic blood pressure, signs of congestive heart failure, and sex to predict the likelihood of in-hospital major bleeding. The ARC-HBR (Academic Research Consortium-High Bleeding Risk) criteria provide a standardized definition of high bleeding risk, incorporating clinical and laboratory parameters.

Balancing ischemic and bleeding risks is essential when selecting antithrombotic therapies. Overlooking bleeding risk can lead to severe complications, including intracranial hemorrhage or gastrointestinal bleeding, which can be as detrimental as ischemic events. Therefore, a dual assessment of both ischemic and bleeding risks ensures a more tailored and safer therapeutic approach.

### 64.4 Management Strategies

Management of NSTEMI in the ICU should be individualized based on the patient's overall risk profile, comorbidities, and preferences. For low-risk patients—those with low scores on risk stratification tools and no significant hemodynamic instability—a conservative management approach may be appropriate. This strategy includes pharmacotherapy aimed at stabilizing the plaque, preventing thrombus propagation, and alleviating symptoms.

**Oxygen Therapy:** Supplemental oxygen is indicated for patients whose arterial oxygen saturation drops below 90%, those in respiratory distress, or when clinical signs suggest hypoxemia.

**Pain Management:** For patients with non-ST-elevation acute coronary syndromes experiencing persistent ischemic chest discomfort, sublingual nitroglycerin (0.3–0.4 mg) may be administered at five-minute intervals, up to three doses. If chest pain continues and there are no contraindications, intravenous nitroglycerin may be considered. When further analgesia is required, intravenous morphine (1–5 mg) can be used cautiously with close monitoring of blood pressure, with repeat dosing every 5–30 mins as necessary.

**Beta-Blockers:** Oral beta-blockers should be initiated within the first 24 h in clinically stable patients who do not show evidence of heart failure, reduced cardiac output, elevated risk of cardiogenic shock, or any other contraindications. Options include metoprolol succinate, carvedilol, or bisoprolol.

**Calcium Channel Blockers (CCBs):** In cases where beta-blockers are unsuitable, non-dihydropyridine CCBs like verapamil or diltiazem may be employed, provided the patient has preserved left ventricular function and no high-risk features such as significant AV block, prolonged PR interval, or predisposition to shock.

**Statins:** High-intensity statin therapy should be initiated or continued in all patients diagnosed with NSTE-ACS unless there is a specific contraindication.

**ACE Inhibitors:** These agents are recommended for long-term therapy in patients with reduced left ventricular ejection fraction (<40%), hypertension, diabetes, or stable chronic kidney disease, provided there are no contraindications to their use. **Aldosterone receptor blockers (ARBs):** In cases where ACE inhibitors are contraindicated or not tolerated, ARBs can be considered as an appropriate alternative.

## 64.5 Antiplatelet Therapy

Aspirin continues to serve as the foundation of antiplatelet treatment in acute coronary syndromes. It is typically initiated with a loading dose of 162–325 mg, followed by a daily maintenance dose ranging from 75–100 mg. Dual antiplatelet therapy (DAPT), involving the addition of a second agent, enhances platelet inhibition and is recommended for up to 12 months in patients with NSTE-ACS.

The choice among P2Y<sub>12</sub> inhibitors—clopidogrel, ticagrelor, and prasugrel—should consider bleeding risk, drug interactions, and coexisting conditions. Ticagrelor is preferred in many cases due to its rapid onset and reversible action, though it may not be ideal in patients with reactive airway disease or bradycardia. Prasugrel, while potent, is generally not recommended for individuals over 75 years or those with a history of cerebrovascular events due to increased bleeding risk.

- Clopidogrel: Loading dose of 300–600 mg, followed by 75 mg once daily.
- Ticagrelor: Loading dose of 180 mg, followed by 90 mg twice daily.

## 64.6 Anticoagulation

Anticoagulants work synergistically with antiplatelet agents by inhibiting the coagulation cascade.

Unfractionated heparin (UFH) is a commonly used agent, particularly in patients with renal dysfunction, because of its short half-life and the ability to reverse its effects with protamine.

- Dose: Start with 60 IU/kg (max 4000 IU) as an IV bolus, followed by 12 IU/kg/hour (max 1000 IU/hour) as continuous infusion, adjusted based on aPTT levels. Therapy is usually maintained for 48 h or until PCI is completed.

Low molecular weight heparin (enoxaparin) provides more stable pharmacokinetics but requires renal dose adjustment.

- Dose: 1 mg/kg subcutaneously every 12 h; reduce to once daily if creatinine clearance is below 30 mL/min. A 30 mg IV loading dose may be administered initially in select patients.

Fondaparinux, a selective factor Xa inhibitor, is associated with a lower bleeding risk and is suitable for many NSTE-ACS patients, except during PCI where catheter thrombosis risk necessitates adjunctive UFH or bivalirudin.

- Dose: 2.5 mg subcutaneously once daily until PCI or hospital discharge.
- Bivalirudin is reserved for patients undergoing early invasive strategies.
- Dose: Begin with a 0.10 mg/kg IV bolus, followed by infusion at 0.25 mg/kg/hour, maintained until angiography or PCI. Glycoprotein IIb/IIIa inhibitors are used selectively alongside DAPT in this context.

For intermediate to high-risk patients, timely invasive strategies are crucial. Hemodynamically unstable patients—those with persistent chest pain, arrhythmias, heart failure, or signs of cardiogenic shock—should undergo immediate coronary angiography followed by revascularization as appropriate. Stable patients with elevated risk scores but without ongoing ischemia may benefit from an early invasive approach within 24–72 h. This timing allows for optimization of medical therapy, correction of modifiable risk factors, and thorough patient assessment.

Balancing the urgency of invasive procedures with the patient's bleeding risk is essential. Strategies to minimize bleeding include using radial artery access during PCI, selecting appropriate antithrombotic regimens, and careful monitoring of anticoagulation levels. Multidisciplinary discussions involving cardiologists, intensivists, and pharmacists can help tailor the best approach for each patient.

## 64.7 Biomarker Utility and Diagnostic Algorithms

The advent of high-sensitivity cardiac troponin (hs-cTn) assays has significantly improved the early diagnosis of NSTEMI. These assays can detect minute elevations in troponin levels within hours of myocardial injury, enabling rapid rule-in or rule-out protocols. Early detection allows for prompt initiation of therapy, which is critical in reducing myocardial damage and improving outcomes.

In practice, a serial measurement protocol is often employed. Troponin levels are measured at presentation and repeated after 1–3 h. A significant rise or fall in troponin levels supports the diagnosis of acute myocardial injury. This dynamic assessment is particularly valuable in patients with chronic elevations of troponin due to renal failure or other chronic conditions.

Dynamic ECG monitoring complements biomarker assessment. Transient ST-segment changes, T-wave inversions, or new bundle branch blocks can provide evidence of ongoing ischemia, even when initial ECGs are inconclusive. Continuous ECG monitoring in the ICU allows for the detection of arrhythmias or ischemic episodes that might otherwise go unnoticed.

In patients with suspected ACS but nondiagnostic initial findings, combining hs-cTn assays with risk scores like TIMI or HEART can improve diagnostic accuracy. For example, a low HEART score combined with negative serial hs-cTn measurements can safely identify patients at low risk, potentially reducing unnecessary hospital admissions and invasive procedures.

Advanced imaging modalities, such as echocardiography or cardiac MRI, can further aid in diagnosis. Echocardiography can detect wall motion abnormalities indicative of ischemia, while cardiac MRI can assess myocardial viability and detect areas of infarction or inflammation.

Incorporating these diagnostic tools into a systematic algorithm enhances the clinician's ability to stratify risk accurately, initiate appropriate therapy promptly, and improve patient outcomes.

## 64.8 Monitoring and Secondary Prevention

Assessing left ventricular function before discharge is crucial for prognostication and guiding long-term therapy. Echocardiography provides valuable information on ventricular function, regional wall motion abnormalities, and potential complications like heart failure or valvular dysfunction. Routine imaging, especially in high-risk patients, can identify secondary complications that may require additional interventions.

Beyond left ventricular function assessment, secondary prevention is critical to reduce recurrence and improve survival:

- Beta-blockers: Unless contraindicated, to lower oxygen demand and arrhythmia risk.
- ACE inhibitors/ARBs: For LVEF  $\leq 40\%$ , diabetes, hypertension, or CKD.
- Statins: High-intensity therapy for all, aiming for LDL-C  $\leq 55$  mg/dL and  $\geq 50\%$  reduction.

MRAs (Mineralocorticoid receptor antagonists): For LVEF  $\leq 40\%$  with HF or diabetes, if renal function permits.

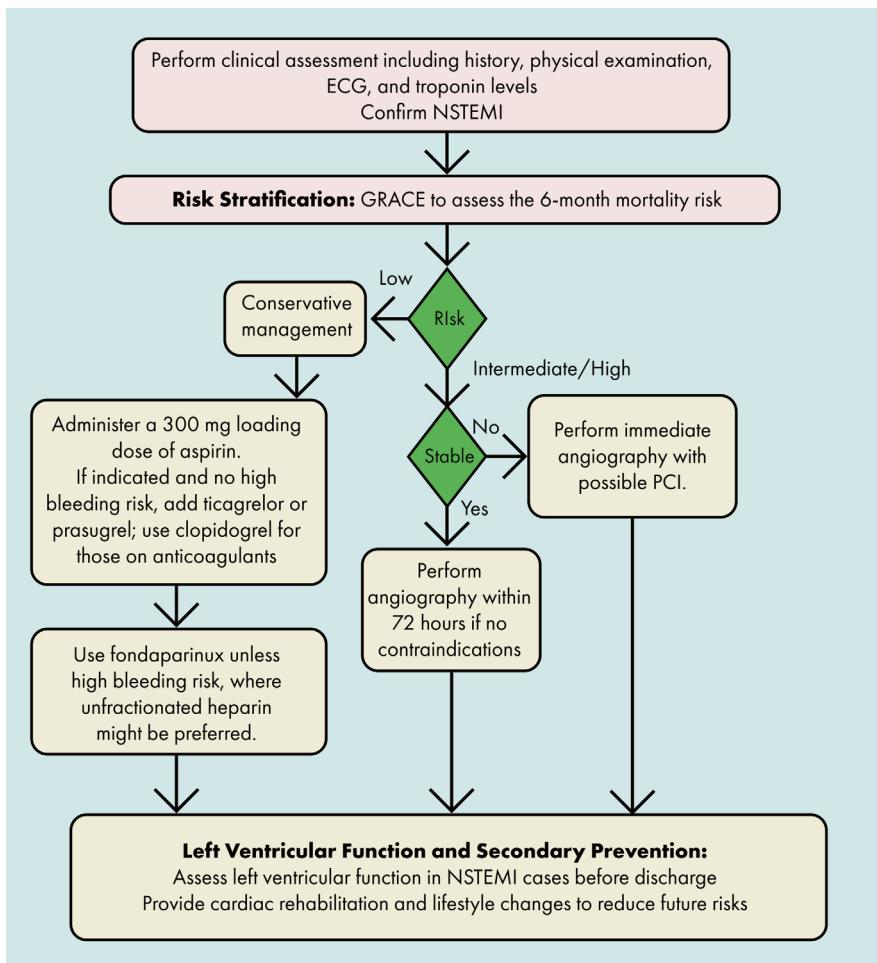
- Antiplatelet therapy: Continue DAPT up to 12 months, then lifelong aspirin. Lifestyle: Smoking cessation, diet, exercise, and cardiac rehabilitation.

## 64.9 Interprofessional Care Coordination

Effective management of NSTEMI necessitates a coordinated interprofessional approach. Collaboration among cardiologists, intensivists, nurses, pharmacists, and rehabilitation specialists ensures that care pathways are standardized and that diagnostics and management are timely. Such coordination enhances patient outcomes by ensuring continuity of care from the ICU to discharge and beyond.

## 64.10 Conclusion

Managing NSTEMI in the ICU requires a comprehensive approach that encompasses detailed pathophysiological understanding, meticulous risk stratification, tailored therapeutic interventions, and robust secondary prevention strategies. By integrating various risk assessment tools, clinicians can fine-tune treatment plans to balance ischemic and bleeding risks effectively. Advances in biomarker assays and diagnostic algorithms have improved early detection and management decisions. Ongoing monitoring and interprofessional collaboration are essential for optimizing patient outcomes and preventing recurrent events. Timely risk stratification, appropriate use of antithrombotic therapy, and coordinated multidisciplinary care are central to improving NSTEMI outcomes in critically ill patients.

**Algorithm 64.1: Approach to NSTEMI in the ICU****Bibliography**

- Amsterdam EA, Wenger NK, Brindis RG, Casey DE Jr, Ganiats TG, Holmes DR Jr, et al. AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130(25):e344–426.
- Collet JP, Thiele H, Barbato E, Barthelemy O, Bauersachs J, Bhatt DL, et al. 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. *Eur Heart J*. 2021;42(14):1289–367.
- Byrne RA, Rossello X, Coughlan JJ, Barbato E, Berry C, Chieffo A, et al. ESC Guidelines for the management of acute coronary syndromes. *Eur Heart J*. 2023;44(38):3720–826.