The University of Santo Tomas Hospital (USTH) 2022 Institutional Chest Pain Pathway: Approach to Diagnosis, Risk Stratification, and Management

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ABSTRACT

This clinical pathway for the diagnosis and risk stratification of patients presenting with acute chest pain, including acute coronary syndromes, provides recommendations and algorithms for clinicians to diagnose, risk stratify, and manage acute chest pain in adult patients. The writing committee reviewed existing international and local guidelines. Modifications to the algorithm following face-to-face and virtual meetings resulted in expert decisions written as recommendations and presented in a flow diagram format. The USTH Chest Pain Pathway provides guidance based on current guidelines and recommendations on assessing and evaluating acute chest pain, tailored to local needs and institution-specific facilities. We recommend its use to ensure quality patient care in the hospital.

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INTRODUCTION

Acute chest pain is one of the most common presenting symptoms in the emergency department (ED) which accounts for 6% of ED attendances and 27.4% of medical admissions [1-2]. In the Philippines, there is a paucity of data on the incidence and causes of chest pain. However, studies have shown that among patients admitted for acute coronary syndrome, typical angina was the predominant complaint in 79% of Filipino patients [3-4].

Acute coronary syndrome (ACS) is a primary concern in patients presenting with chest pain. Only 22% of them are eventually confirmed to have ACS [5]. About 50% to 76% are diagnosed with non-cardiac causes such as gastroesophageal diseases, pleurisy, pneumonia, chest-wall syndromes, or pulmonary embolism [2, 5-6]. Although most patients do not have a life-threatening condition, assessing patients presenting with chest pain in the ED remains a challenge among physicians. Hence, it is vital to efficiently recognize and accurately diagnose patients at high risk for ACS who require emergent treatment and low-risk patients who do not need admission. Such a strategy is essential in reducing the burden of coronary artery disease, limiting unnecessary diagnostic work-up, and preventing inadvertent hospital discharge of patients with ACS.

Chest pain pathways are crafted primarily to improve the management of patients with acute chest pain. They provide guidance on rapid and efficient evaluation, early identification of ACS, high-quality care, and cost-effectiveness. Chest pain pathways emphasize protocol-based, systematic management to promote the optimal application of current recommendations and standards of care [7,8].

This institutional pathway aims to develop an evidence-based guide for the diagnosis, risk stratification, and management of patients presenting with acute chest pain; and to provide current information on the appropriate application of the recommendations, hence, providing an improved, organized, and efficient strategy for patients with and without ACS. The authors recognize existing gaps and specific unanswered issues in the management of ACS as the science continues to evolve. The physician's best judgment and decision are still crucial in this emergency.

METHODOLOGY

The recommendations listed in this pathway are based on literature from research involving human subjects, published in English, and indexed in the MEDLINE (through PubMed) database. Key search terms were: angina, chest pain syndromes, myocardial injury, myocardial ischemia, myocardial infarction, stable angina, unstable angina, coronary heart disease, coronary artery disease, acute coronary syndrome, risk stratification, diagnostic pathway, clinical decision pathway, algorithm, emergency department, and emergency care. Twenty-seven records were identified through PubMed database searching. Nineteen papers formed the basis for this clinical pathway after duplicates, and those that did not meet the target population, interventions, or outcomes criteria were excluded. This pathway is representative of all the selected references.

A writing committee was convened and met face to face and virtually. The committee met twelve times to formulate, revise and finalize the pathway and to provide expert choices and recommendations based on a review of scientific evidence, current clinical practice, and available resources in the hospital. The acute chest pain algorithm is written and presented in a flow diagram format. Each additional table includes a recommendation-specific supportive text in the diagnosis, risk stratification, and management of this common ED chief complaint.

DEFINITION OF ACUTE CHEST PAIN

This section defines the terms used to ensure uniformity of understanding and application of the different algorithms. Acute chest pain shall refer to new onset or a change in pattern, intensity, or duration of chest pain compared to prior chest pain episodes. In contrast, stable chest pain is chronic and associated with consistent precipitants such as exertion or emotional stress. Chest pain may be described as pressure, tightness, squeezing, heaviness, or burning in character. For this reason, "chest discomfort" may be an acceptable alternative term [9].

ACS typically presents as acute retrosternal chest discomfort, pressure, squeezing, gripping, heaviness, and tightness. Chest pain equivalents could be dyspnea, epigastric pain, and pain in the left arm [9-10]. Chest pain descriptors that may suggest a low likelihood of ischemia are sharp, fleeting, pleuritic, or positional [9].

EMERGENCY CARE: INITIAL EVALUATION AND MANAGEMENT

The History and Physical examination

This article refers to chest pain, chest discomfort, or chest pain equivalents as "chest pain." In patients presenting to the ED with acute chest pain, the initial assessment should aim to rapidly identify patients with life-threatening conditions to facilitate the initiation of appropriate interventions. The ED physician must obtain a focused history and physical examination. Anginal chest pain is retrosternal chest discomfort that increases in intensity over several minutes and is usually precipitated by stress (physical or emotional) or occurring at rest (as in the case of ACS) with characteristic radiation to the left arm, neck, or jaw. Shortness of breath, nausea or vomiting, lightheadedness, confusion, presyncope or syncope may also accompany the chest pain. Vague abdominal symptoms are common among people with diabetes, women, and the elderly [9]. A thorough evaluation of cardiovascular risk factors, review of systems, past medical history, and family and social history should complement the assessment of presenting symptoms. Furthermore, integration of a comprehensive history and physical examination with ancillary findings can aid in the delineation of life-threatening non-ischemic cardiac causes, such as acute aortic syndromes, pulmonary embolism, and myopericarditis, from non-cardiac causes. Specific clues may help arrive at a diagnosis in a patient with acute chest pain (Table 1).

The 12-lead Electrocardiogram

An initial 12-lead electrocardiogram (ECG) should be obtained and interpreted within 10 minutes of arrival (figure 1). This step is essential because of its capacity to recognize and triage patients with ST-elevation myocardial infarction (STEMI) and thus implement and ensure timely reperfusion therapy, thus improving outcomes in these patients [11]. However, if the initial ECG is nondiagnostic, serial ECGs to detect potential ischemic changes should be performed, especially when clinical suspicion of ACS is high. The ECG should be repeated after a 10-minute interval, especially if chest pain recurs or persists.

On the other hand, in patients with intermediate-to-high clinical suspicion for ACS in whom initial ECG is nondiagnostic, supplemental ECG leads V7 to V9 are reasonable to rule out posterior myocardial infarction (MI). Lastly, if the 12-lead ECG shows an acute inferior MI, then recording of additional right precordial leads (V3R and V4R) should be considered to identify concomitant right ventricular infarction [9-10].

Emergency pharmacological treatment

Admit patients with ACS to the chest pain unit (CPU). Initiate optimal management. Administer dual antiplatelet therapy such as aspirin, a P2Y12 inhibitor, and an anticoagulant. Give sublingual nitroglycerine and morphine to alleviate the chest pain. Start high-intensity statin therapy (Table 2). These drugs are easy to administer, do not require complex dosing schemes or laboratory tests, cause minimal to no undesirable complications, and do not interfere with the diagnostic strategy planned for the patient.

Establish intravenous access and institute continuous electrocardiographic (ECG) monitoring. Provide supplemental oxygen (O2) for oxygen saturation of <90% or partial arterial oxygen (PaO2) pressure of <60mmHg. Request high-sensitivity troponin I (hsTrop-I) at 0-hour [9].

Evaluation of Acute Chest Pain With Nonischemic Cardiac Causes

In patients with acute chest pain wherein other potentially life-threatening non-ischemic cardiac conditions are expected (i.e. aortic pathology, pulmonary embolism, valvular heart diseases, myopericarditis), further diagnostic work-up is recommended to provide an accurate approach to management.

Acute aortic syndrome

Patients with acute aortic syndrome (e.g., aortic dissection) present with acute, sudden, severe chest

Table 1. Clinical Features of the different etiologies of acute chest pain.

Clinical Syndrome	Findings
Emergency	
Acute Coronary Syndrome	Diaphoresis, tachypnea, tachycardia, hypotension, crackles, S3, mitral regurgitation murmur; examination may be normal in uncomplicated cases
Pulmonary embolism	Tachycardia and dyspnea; pain with inspiration
Aortic dissection	Connective tissue disorders (e.g., Marfan syndrome), extremity pulse differential; Severe and abrupt onset chest pain, pulse differential, and widened mediastinum on chest x-ray; Syncope, aortic regurgitation
Esophageal rupture	Emesis, subcutaneous emphysema, pneumothorax, unilateral decreased or absent breath sounds
Other	
Non-coronary cardiac: aortic stenosis (AS), aortic regurgitation (AR), hypertrophic cardiomyopathy (HCM)	AS: Characteristic systolic murmur, *tardus* or *parvus* carotid pulse AR: Diastolic murmur at the right of the sternum, rapid carotid upstroke HCM: increased or displaced left ventricular impulse, prominent a wave in jugular venous pressure, systolic murmur
Pericarditis	Fever, pleuritic chest pain, increased in a supine position, friction rub
Myocarditis	Fever, chest pain, heart failure, S3
Esophagitis, peptic ulcer disease, gall bladder disease	Epigastric tenderness Right upper quadrant tenderness, Murphy sign
Pneumonia	Fever, localized chest pain, may be pleuritic, friction rub may be present, regional dullness to percussion, egophony
Pneumothorax	Dyspnea and pain on inspiration, unilateral absence of breath sounds
Costochondritis, Tietze syndrome	Tenderness of costochondral joints
Herpes zoster	Pain in a dermatomal distribution, triggered by touch; characteristic rash (a unilateral and dermatomal distribution)

Source: 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/ SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

pain radiating to the back in 80 to 90% of cases [9]. The diagnostic modality of choice in stable patients is computed tomography (CT) aortogram (Class 1, C). If CT aortogram is contraindicated or unavailable, a transesophageal echocardiogram (TEE) or cardiac magnetic resonance (CMR) should be performed to make the diagnosis (Class 1, C) [9].

Pulmonary embolism

Diagnosis of pulmonary embolism can be challenging since clinical signs and symptoms may be nonspecific. Dyspnea followed by chest pain, typically pleuritic, are the most common presenting symptoms. CT angiography (CTA) using pulmonary embolism (PE) protocol is the diagnostic modality of choice in stable patients (Class I, B), while ventilation-perfusion scanning is a second-line alternative in the acute setting [9].

Myocarditis and Pericarditis

Acute chest pain due to pericarditis and myocarditis, classically presents with chest pain that is sharp and pleuritic which improves on sitting up or leaning forward. On physical examination, pericardial friction rub may be audible. Cardiac magnetic resonance (CMR) with gadolinium contrast is a Class 1B recommendation to distinguish myopericarditis from other causes. A transthoracic echocardiogram (TTE) is useful in demonstrating the presence of

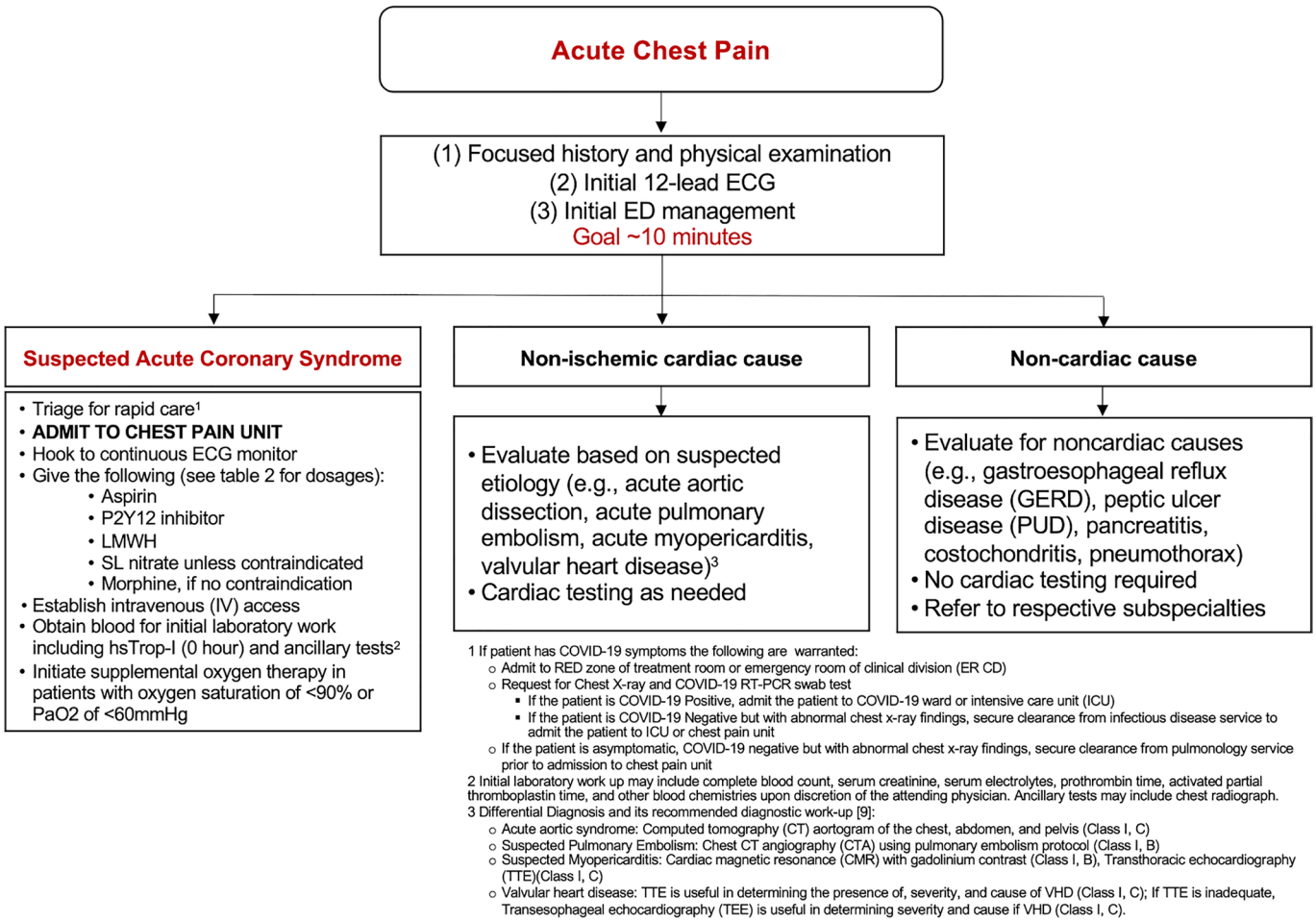

Figure 1. Clinical assessment of patients presenting with acute chest pain in the emergency department.

ventricular wall motion abnormality, pericardial effusion, or restrictive pathology (Class 1C) [9].

Other clinically important causes of chest pain

Lastly, chest pain may also occur in the presence of valvular heart disease particularly aortic valve and mitral valve stenosis with secondary pulmonary hypertension. It may also occur after papillary muscle rupture secondary to myocardial infarction or in acute degenerative mitral valve pathology. In terms of diagnostics, transthoracic echocardiogram (TTE) is useful in assessing valvular anatomy because of its availability and is therefore considered the first-line test in these patients (Class 1C) [9]. In cases wherein TTE is inadequate, TEE is useful in determining the severity and cause of VHD. Alternatively, CMR imaging may be considered over TTE or if TEE is nondiagnostic (Class 2a) (figure 1)[9].

Chest pain unit

Chest pain units are areas of emergency medical care dedicated to improving the management of patients with acute chest pain or any other symptom suggestive of ACS. It can be located adjacent to the ED, in an actual physical area, or just as a working process within the ED. A group of trained staff act synchronously to achieve a rapid and efficient evaluation, prompt recognition of ACS, and cost-effectiveness [12].

Screening for COVID-19

The Infection Prevention And Control Committee (IPCC) of the University of Santo Tomas Hospital (USTH) established a Pathway for Emerging and Re-emerging Infections (PERI) for Coronavirus Disease 2019 (COVID-19). It aims to triage patients in the emergency room to designated units (chest pain

Table 2. Dose regimen of pharmacologic therapies in acute coronary syndrome patients.

Antiplatelet drugs	
Aspirin	Initial oral LD of 150 to 300 mg (or 75 to 250 mg IV), and an MD of 75 to 100 mg OD for long-term treatment
P2Y12 receptor inhibitors	
Clopidogrel	LD of 300 to 600 mg orally, followed by an MD of 75 mg OD, with no specific dose adjustment in CKD patients.
Ticagrelor	LD of 180 mg orally, followed by an MD of 90 mg BID, no specific dose adjustment in CKD patients.
Anticoagulant drugs	
Unfractionated heparin (UFH)	Dose in primary PCI: 70 – 100 IU/kg IV bolus when no GP IIb/IIIa inhibitor is planned 50-70 IU/kg IV bolus with GP IIb/IIIa inhibitors Dose in patients receiving fibrinolytic therapy or in patients not receiving reperfusion therapy: 60 IU/kg IV bolus with a maximum of 4000 IU followed by an IV infusion of 12 IU/kg with a maximum of 1000 IU/hour for 24 to 48 hours. Target aPTT: 50 – 70 seconds or 1.5 to 2.0 times that of control to be monitored at 3, 6, 12, and 24 hours.
Low molecular weight heparin (LMWH) (Enoxaparin)	**In patients <75 years of age**, give 30 mg IV bolus followed 15 minutes later by 1 mg/kg SC every 12 hours until revascularization or hospital discharge for a maximum of 8 days; **In patients >75 years of age**, No IV bolus; start with first SC dose of 0.5 mg/kg with a maximum of 75 mg per injection for the first two SC doses
Fondaparinux	Dose in patients receiving fibrinolytic therapy or in patients not receiving reperfusion therapy: 2.5 mg IV bolus followed by an SC dose of 2.5 mg OD up to 8 days or hospital discharge *Not recommended for primary PCI*
Anti-ischemic Therapy	
Nitrates	Initial administration of rapidly acting nitroglycerin SL or buccal, 0.4 mg at 5-minute intervals times 3 doses IV nitroglycerine: 5 to 10 µg/ min, titrated to a maximum of 200 µg/min as needed until relief of pain; maintain SBP of at least 90 to 100 mmHg
Beta - Blockers	Metoprolol tartrate 25 to 50 mg every 6 hours for 2 to 3 days as tolerated then switch to 100 mg BID Carvedilol initially 6.25 – 50 mg BID Bisoprolol 5 – 10 mg OD Esmolol at 50 to 250 ug/kg/min may be used in patients with relative contraindications to the administration of a beta blocker and in whom HR slowing is considered highly desirable.
Morphine	An initial dose of 4 to 8 mg IV, followed by doses of 2 to 8 mg IV repeated at 5 to 15 minutes intervals until the pain is relieved or side effects emerge—hypotension, depression of respiration, or vomiting.
Lipid - Lowering agents	
Statins	Atorvastatin 80mg/tab upon admission then OD Rosuvastatin 20mg/tab upon admission then OD
Fibrinolytic agents	
Streptokinase	1.5 million units over 30 to 60 minutes IV

Table 2. Dose regimen of pharmacologic therapies in acute coronary syndrome patients.(continued)

Alteplase (tPA)	15 mg IV bolus 0.75 mg/kg IV over 30 minutes (up to 50 mg) then 0.5 mg/kg IV over 60 minutes (up to 35 mg)
Others	
Oxygen	Oxygen is indicated in patients with hypoxemia (SaO2 < 90% or PaO2 < 60 mmHg) Routine oxygen is not recommended in patients with SaO2 > 90%

Legend: LD = Loading dose; MD = Maintenance dose; OD = Once daily; BID = twice daily; CKD = Chronic Kidney disease; SC = subcutaneous; IV = intravenous; SL = sublingual
Sources: (1) 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation; (2) 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation.

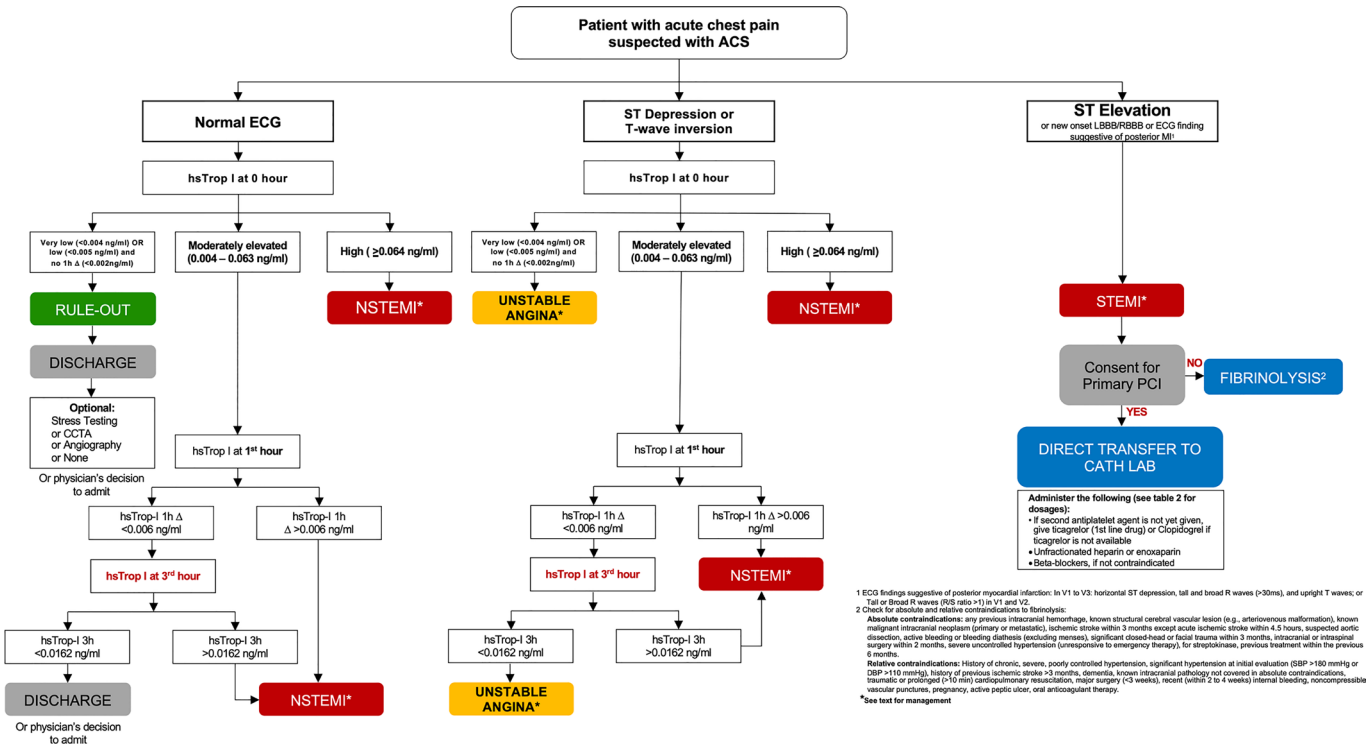

Figure 2. Diagnosis and Risk Stratification of patients with suspected acute coronary syndrome.

unit, COVID ward, or intensive care unit [ICU]) for further evaluation and management [13].

The following conditions are part of the preliminary screening of patients presenting with chest pain before transfer to the designated units:

1. All patients in the ER with fever (i.e. temperature ≥ 37.6°C) or any respiratory symptoms or influenza-like-illness (e.g. cough of <14 days duration, colds/nasal congestion, sore throat, headache, myalgia, arthralgia, malaise, easy fatigability, nausea, vomiting, diarrhea of <7 days duration, impaired sense of smell or taste) shall be advised to wear procedural or surgical masks if not yet done. A yellow trash bin shall be readily available for proper disposal of used masks [13].
2. If the patient has fulfilled the criteria for suspect/ probable/ confirmed COVID-19 case or is a close Contact, he/she shall be placed immediately in the ER isolation room or red zone. AIRBORNE and CONTACT precautions shall be implemented [13].

Risk stratification and Management of Patients with Suspected Acute Coronary Syndrome

Patients with acute chest pain and suspected ACS entail a spectrum of differential diagnoses (ischemic or non-ischemic or noncardiac causes)

and stratification into low, intermediate, or high-risk groups once ST-elevation myocardial infarction (STEMI) has been excluded. This stratification guides physicians in their subsequent management.

Clinical pathways which include troponin results, structured and/or validated scoring of clinical variables, and ECG interpretation, can provide significant points for patient risk stratification and alternative diagnoses. Moreover, it provides clinicians with faster diagnostic decisions thereby rapidly "ruling in" or "ruling out" acute myocardial injury; and aiding in accelerating progress to the next step in clinical management.

First major decision: Is immediate PCI warranted?

The priority is to identify the patients who need urgent transfer to the catheterization and intervention unit for percutaneous coronary intervention (PCI) (figure 2). The following are the key recommendations:

- For patients with ST-segment elevation myocardial infarction (STEMI), primary PCI, is the preferred reperfusion strategy, recommended within 12 hours of symptom onset, provided it can be performed within 120 minutes from STEMI diagnosis by an experienced team. If timely primary PCI cannot be performed after STEMI diagnosis, administer fibrinolytic therapy within 12 hours of symptom onset in patients without contraindications. The maximum target delay time is 10 minutes. For patients with symptoms of >12 hours, do primary PCI strategy if the following are present: (1) ECG evidence of ongoing ischemia; (2) ongoing or recurrent pain and dynamic ECG changes; (3) ongoing or recurrent pain, symptoms, and signs of heart failure, shock, or malignant arrhythmias [14].
- For patients with non-ST elevation ACS (NSTE-ACS), do immediate invasive strategy (i.e., coronary angiogram) with the intent to do revascularization in under 2 hours from first medical contact in patients with at least one of the very-high-risk criteria: (1) hemodynamic instability, (2) cardiogenic shock, (3) recurrent or refractory chest pain despite medical treatment, (4) life-threatening arrhythmias, (5) mechanical complications of myocardial infarction, (6) acute heart failure related to NSTE-ACS, and (7) ST-segment depression >1 mm in 6 leads plus ST-segment elevation in leads aVR and or V1. Depending on the coronary anatomy, do either PCI, coronary artery bypass graft (CABG), or continuing medical therapy [10, 15].

Management of patients presenting with hemodynamic instability (i.e. resuscitated cardiac arrest) and concomitant NSTE–ACS, warrants individualized decisions according to their neurologic status and level of critical state [10]. Hence, the option of performing delayed intervention may be considered in these instances. This is supported by the randomized Coronary Angiography after Cardiac Arrest (COACT) trial, which stated that an unselected immediate invasive strategy is not superior to a delayed invasive strategy in patients who had an out-of-hospital cardiac arrest and had no signs of STEMI [16]. Therefore, it is reasonable to delay the performance of invasive coronary angiography (ICA) among NSTE-ACS patients who will need immediate hemodynamic stabilization first such as cardiogenic shock management and mechanical ventilation support [17].

Decision Pathway for Non-ST Elevation Acute Coronary Syndrome

Once STEMI has been excluded, patients may be triaged according to their ECG findings and cardiac biomarkers result. The preferred biomarker is cardiac troponin (cTn) I or T because of its high sensitivity and specificity for myocardial tissue damage. The diagnostic accuracy of cardiac troponins for the detection of myocardial infarction shortens the time interval to the second cardiac troponin determination. This means a reduction in the delay to diagnosis, shorter stays in the emergency room, and lower hospitalization costs [15].

The latest European Society of Cardiology (ESC) Non-ST-segment elevation ACS guidelines give a IA recommendation for the use of high-sensitivity cardiac troponin (hs-cTn) as the standard biomarker for clinical practice and a class IB recommendation for the application of two main novel algorithms with cardiac biomarkers for the management of patients with acute chest pain [10]. In patients presenting with suspected non-ST-segment elevation ACS, it is recommended to use the 0/1 hour algorithm (best option, blood draw at 0 and 1 hour) or the 0/2 hour algorithm (second-best option, blood draw at 0 and 2 hours). These algorithms have been derived,

developed, and well-validated in large multicenter cohorts [17-21]. In a study by Badertscher P, et al, they reported that the 0/1 hour ESC algorithm is as effective as the 0/3 hour in ruling in or ruling out acute myocardial infarction (AMI) with a very high negative predictive value [23]. Moreover, clinicians should be familiar with the analytical performance and the 99th percentile upper reference limit that defines myocardial injury for the cTn assay used at their institution. The high-sensitivity Troponin-I (hsTrop-I) Abbott assay is currently being used in our institution. Therefore, cut-off concentrations of such assay are used. The availability of cTn has rendered creatine kinase myocardial (CK-MB) isoenzyme and myoglobin not useful for the diagnosis of acute myocardial injury [9-10]. It is noteworthy that the algorithms should always be integrated with a detailed clinical assessment and 12-lead ECG, and repeat blood sampling is mandatory in case of ongoing or recurrent chest pain [10].

If both the 0- and 1-hour troponin levels of the patient are inconclusive and the clinical presentation is highly suggestive of ACS, then a third measurement of cardiac troponin at the third hour (3 h) is warranted [10]. The cut-off levels for hsTrop-I at 3 h are still in development [10]. However, in a retrospective study by Kim et al, a rise and/or a fall in hs-Troponin I of >0.0162 ng/mL at 3 h was found to be useful in identifying patients with acute myocardial infarction [24]. This finding was the basis of our cut-off for hsTrop-I at 3 h.

Once a diagnosis of NSTE-ACS has been established, patients must be risk stratified to either ***very high-risk, high-risk***, or ***low-risk*** NSTE-ACS to guide clinicians in the treatment strategy and timing of invasive strategy (i.e. revascularization through PCI or CABG depending on the lesion morphology and patient's risk profile) (figure 3) [10].

As mentioned above, ***very high-risk*** NSTE-ACS patients need an immediate invasive strategy followed by revascularization (either PCI or CABG) if the anatomy is suitable, preferably within 2 hours from first medical contact. If the NSTE-ACS patient belongs to the ***high-risk*** stratification [established NSTEMI diagnosis, dynamic new or presumably new contiguous ST/T-segment changes (symptomatic or silent), resuscitated cardiac arrest without ST-segment elevation or cardiogenic shock and Global Registry of Acute Coronary Events (GRACE) score of >140], the invasive strategy may be scheduled within 24 hours. However, if the patient lacks very high or high-risk stratification features, a selective invasive strategy may be scheduled before discharge.

Once the diagnosis of an acute NSTE-ACS is made, early management of the patient involves the concurrent attainment of several goals, including relief of ischemic chest pain, evaluation of the hemodynamic state, correction of abnormalities that are present, prevention of early sequelae of ACS (i.e., recurrent myocardial infarction, heart failure, arrhythmias, and death), determination of the optimal timing of cardiac catheterization and potential percutaneous coronary intervention, and initiation of antithrombotic therapy. These early diagnostic and therapeutic interventions are followed by the initiation of short- and long-term interventions aimed at improving in-hospital and long-term outcomes. A summary of the benefits of the pharmacologic and non-pharmacologic interventions is shown (Table 3).

Decision Pathway for Patients with Normal ECG and Normal Troponin

In patients with normal or no ischemic changes on 12-lead ECGs, normal hs-cTn, and chest pain-free for several hours, stress imaging can be performed during the hospitalization or shortly after discharge. Stress imaging is preferred over exercise ECG due to its high diagnostic accuracy [28]. It has been shown in studies that normal stress testing has a high negative predictive value for ischemia and is associated with excellent patient outcomes [29-30].

Furthermore, if the patient still has ongoing or recurrent chest pain, but the hsTrop-I is inconclusive at 0/1 h, cardiac troponin at the third hour is usually required to identify appropriate patients for early discharge and outpatient management [10].

Key Messages

- Immediate recognition of patients with acute chest pain and suspected ACS is warranted in the ED. Clinicians must efficiently distinguish these patients from those with non-critical syndromes to prevent unwarranted, ineffective, and uneconomical hospitalization and extensive diagnostic work-up.
- A focused history and physical examination and 12-lead ECG should be obtained and interpreted within 10 minutes of the patient's arrival at the

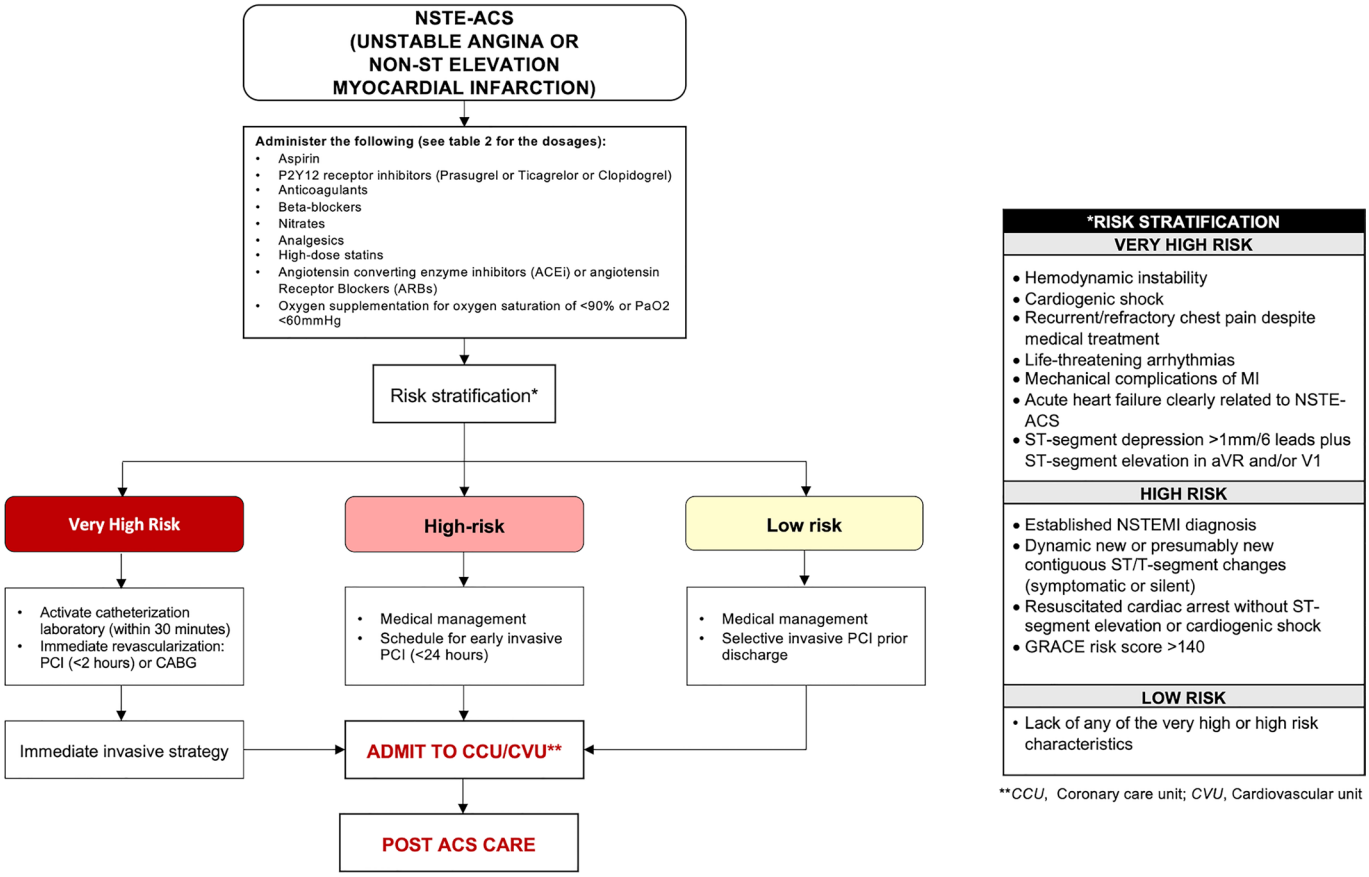

Figure 3. Risk stratification and management of Non-ST elevation Acute Coronary Syndrome.

emergency room. Cardiac biomarker hsTroponin-I should be obtained immediately.

- Patients suspected of acute coronary syndrome should be admitted to the chest pain unit, a physical area, or a working process within the emergency room.
- Standard medical therapies should be initiated in patients suspected to have ACS which include antithrombotic therapy (aspirin, P2Y12 inhibitor, anticoagulant), nitrates, morphine, beta-blockers, high-intensity statins, and oxygen if O2 saturation is <90%.
- Primary PCI is indicated in STEMI patients with symptoms of ischemia of <12 hours duration. It must be performed within 120 minutes of STEMI diagnosis. Fibrinolysis is indicated if primary PCI is not feasible.
- Patients with NSTE-ACS should be risk stratified for an invasive approach to either *very high risk, high risk,* or *low-risk* NSTE-ACS. An immediate invasive approach within 2 hours from medical contact is recommended in patients with very high-risk features. In other clinical presentations, a selective invasive approach may be performed according to non-invasive testing or clinical risk assessment.
- The hsTrop I 0/1 hour algorithm in conjunction with clinical and ECG findings is recommended in patients with suspected NSTE-ACS to rapidly "rule in" or "rule out" ACS and identify patients safe for early discharge and outpatient management.

Limitations

This pathway is specifically directed toward the diagnosis and management of acute chest pain. It excludes patients with chronic coronary syndromes. This guideline is evidence-based. However, some recommendations are influenced by the opinions and clinical experience of the writing committee, and available resources of the institution.

Gaps in knowledge

- Clinical risk stratification and decision tools will likely continue to grow in popularity because of their ease of application. However, large randomized controlled trials (RCTs) to determine improvement of outcomes are needed prior to wide-

Table 3. Benefits of Pharmacologic and Non - Pharmacologic interventions

Non-pharmacologic interventions	
A focused history and physical examination and interpretation of 12-Lead ECG within 10 minutes of patient's arrival at the ED	Identify and triage patients with ST elevation that warrants urgent coronary revascularization.
HsTroponin I at 0/1 hour algorithm	Used in conjunction with clinical and ECG findings; and allows the rapid identification of patients safe for early discharge and outpatient management.
NSTE - ACS risk stratification	Guides treatment strategy for Invasive PCI.
Pharmacologic Interventions	
Aspirin (ASA)	Reduce adverse clinical events in the first months of treatment. ASA also reduces the frequency of ischemic events in secondary prevention [10].
P2Y12 receptor inhibitors (Clopidogrel, ticagrelor)	Addition to aspirin reduced the risk of cardiovascular death, MI, or urgent revascularization 30 days after the PCI by 30% [10].
Nitrates	Symptom relief but no benefit in mortality.
Beta-blockers	Decrease mortality and/or cardiovascular events Decreases myocardial oxygen demand, inhibits fatal arrhythmias, and improves ventricular remodeling [10].
Lipid-lowering agents Statin	Reduce both short-term and long-term adverse outcomes such as subsequent cardiovascular mortality, myocardial infarction, stroke, and revascularization[10].
Ezetimibe	The composite primary end-point of cardiovascular death, myocardial infarction (MI), hospital admission for unstable angina, coronary revascularization, or stroke was significantly lower in the combined treatment (non-statin agent plus statin) arm compared with the statin-only arm (IMPROVE-IT TRIAL) [26].
Angiotensin-converting enzyme (ACE) inhibitors	Reduce mortality, MI, stroke, and heart failure among patients with left ventricular dysfunction, previous vascular disease, and high-risk diabetes [10].
Revascularization (NSTE - ACS)	The risk-adjusted mortality is reduced by more than 50% in patients with cardiogenic shock [10]. Similarly, early versus delayed revascularization significantly reduced MI in long-term follow-up but no difference in mortality was observed [27].
Revascularization (STE - ACS)	Revascularization of the infarct-related artery (IRA) has been shown to decrease mortality, reinfarction, and development of heart failure in patients presenting with STEMI [14].
Fibrinolytic therapy (Streptokinase, Alteplase)	An important reperfusion strategy in settings where primary PCI cannot be offered in a timely manner, and prevents 30 early deaths per 1000 patients treated within 6 h after symptom onset [14]. Absolute benefit is seen in patients at highest risk, including the elderly, and when treatment is offered <2 h after symptom onset [14].

spread implementation. There is a paucity of local setting RCTs that support and validate the use of risk stratification scoring systems of different hospital institutional pathways.

- Additional testing on the 3rd hour is recommended if the first two cardiac troponin measurements of the 0 h/1 h algorithm are not conclusive and the clinical condition is still suggestive of ACS. However, there are no updated recommendations on what constitutes an abnormal 3rd-hour hs-cTn value. Hence, future researches should be directed towards this objective.
- The present institutional pathway is intended to standardize and improve the quality of care for chest pain patients. However pre-discharge evaluation and follow-up care are not included and

must be considered as an important future improvement of the pathway.
- A registry with specific quality performance indicators is recommended to evaluate the delivery of health services.
- The decision on the timing of ICA in NSTE-ACS patients with hemodynamic instability was explained and supported by the COACT trial. However, the safety and effectiveness of routine vs. selective invasive assessment of frail patients (i.e. elderly, critically ill, immunocompromised) presenting with NSTE-ACS lacks supporting literature, hence the need for further evaluation.

Conflict of Interest

The contributing authors declare no conflict of interest related to this clinical pathway.

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