

Chest pain units. Organization and protocol for the diagnosis of acute coronary syndromes

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The two main goals of chest pain units are the early, accurate diagnosis of acute coronary syndromes and the rapid, efficient recognition of low-risk patients who do not need hospital admission. Many clinical, practical, and economic reasons support the establishment of such units. Patients with chest pain account for a substantial proportion of emergency room turnover and their care is still far from optimal: 8% of patients sent home are later diagnosed of acute coronary syndrome and 60% of admissions for chest pain eventually prove to have been unnecessary.

We present a systematic approach to create and manage a chest pain unit employing specialists headed by a cardiologist. The unit may be functional or located in a separate area of the emergency room. Initial triage is based on the clinical characteristics, the ECG and biomarkers of myocardial infarct. Risk stratification in the second phase selects patients to be admitted to the chest pain unit for 6-12 h. Finally, we propose treadmill testing before discharge to rule out the presence of acute myocardial ischemia or damage in patients with negative biomarkers and non-diagnostic serial ECGs.

Key words: *Unstable angina. Diagnosis. Chest pain. Coronary artery disease. Myocardial infarction. Emergency room.*

Unidades de dolor torácico. Organización y protocolo para el diagnóstico de los síndromes coronarios agudos

Los dos objetivos primordiales de las unidades de dolor torácico son la detección temprana y efectiva del síndrome coronario agudo y la identificación rápida y eficiente de los pacientes de bajo riesgo que pueden ser tratados de forma ambulatoria. La necesidad de su creación se apoya en diversas razones de carácter clínico, práctico y económico. Los pacientes que acuden al servicio de urgencias con dolor torácico suponen una proporción significativa del volumen de urgencias y su atención aún dista de ser óptima: el 8% son dados de alta sin que se diagnostique el síndrome coronario agudo que en realidad padecen y en un 60% de los ingresos hospitalarios por dolor torácico finalmente se demuestra que no tenían un síndrome coronario agudo.

La Sección de Cardiopatía Isquémica y Unidades Coronarias de la SEC propone un protocolo de funcionamiento de las unidades de dolor torácico, bien sean funcionales o físicas, ubicadas en el área de urgencias, atendidas por personal especializado y dirigidas por un cardiólogo. Se contempla como procedimiento de evaluación inicial la clínica, el electrocardiograma y los marcadores bioquímicos de necrosis. El segundo paso, la estratificación del riesgo, permite seleccionar a los pacientes que serán ingresados en la unidad de dolor torácico durante 6-12 h. Finalmente, se propone la realización de un test de provocación de isquemia, generalmente una prueba de esfuerzo, antes del alta de la unidad para descartar la presencia de cardiopatía isquémica en los pacientes con marcadores bioquímicos negativos y electrocardiogramas no diagnósticos.

Palabras clave: *Angina inestable. Diagnóstico. Dolor torácico. Enfermedad coronaria. Infarto de miocardio. Urgencias.*

*Members listed in Appendix.

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INTRODUCTION

The management of patients seen in emergency services (ES) for chest pain suggestive of acute coronary insufficiency raises an important problem of care for several different reasons. The first is its magnitude: chest pain is one of the most common reasons for consultation, representing 5% to 20% of the patients seen

ABBREVIATIONS

PTCA: percutaneous transluminal coronary angioplasty
 CK: creatine phosphokinase
 ECG: electrocardiogram
 EST: electrocardiographic stress test.
 ES: emergency service
 CPU: chest pain unit(s)

in the ES of general hospitals. In about 50% of cases, the clinical picture is initially indicative of acute coronary syndrome, but the diagnosis finally confirmed in less than half of these patients. As a consequence, a large number of hospital admissions for suspected coronary artery disease originating from the ES could be avoided with a more exact initial diagnosis. On the other hand, between 2% and 10% of patients who are released from ES because the origin of pain is finally considered non-coronary present acute myocardial infarction, with a high rate of mortality, twice that of patients who are hospitalized. This type of error generates 20% to 39% of claims in American ES.

The second reason is the importance of quickly reaching decisions in these patients, since the effectiveness of thrombolytic treatment and primary angioplasty is conditioned by the promptness with which these treatment are used in the course of myocardial infarction; advancing treatment by one hour could save 1.5 lives per 1000 treated patients. In addition, in several studies it has been demonstrated that not all patients who have an indication for reperfusion receive adequate treatment. In Spain, the average delay in treatment after the patient reaches the hospital is close to 60 min, with wide variations between communities; in any case, it is longer than the time recommended in therapeutic guidelines. Finally, the development of new therapeutic guidelines for unstable angina, including the use of antagonists of the glycoprotein receptor IIb/IIIa and coronary angioplasty, has demonstrated the need for rapid selection of the patients who can benefit from more intensive treatment.

In the last two decades, different solutions have been proposed to improve the diagnosis of chest pain in ES, including the use of diagnostic protocols, the formation of multidisciplinary teams and the admission of patients to specific areas. This last solution, which is fast gaining acceptance, is known by the name of chest pain units or centers (CPU). This article presents the background, diagnostic and therapeutic procedures, and operating protocols for CPU developed by a Grupo de Trabajo de la Sección de Cardiopatía Isquémica y Unidades Coronarias de la

Sociedad Española de Cardiopatía as a guideline for the much-needed and imminent creation of CPU in Spain.

ORGANIZATIONAL ASPECTS

Inclusion criteria

The care of patients with chest pain or any other symptom indicative of coronary artery ischemia is based on a rapid classification into groups of different risk. This is done using simple clinical findings and an electrocardiogram (ECG), which must be obtained in the first 10 min after the patient arrives at the hospital. This initial evaluation and classification must be completed quickly in the emergency area; for hospitals that do not have an emergency area, an alternative option is to carry it out directly in the CPU. In other cases, the risk assessment is carried out by extrahospital emergency care services.

The first classification contemplates four risk levels, which are summarized in Table 1. The first group is formed by patients who present prolonged precordial pain and ST-segment elevation or hemodynamic instability, and require urgent admission to the coronary unit. The treatment of these patients and their admission should not be delayed by other diagnostic maneuvers. The patients in the second group have a compatible clinical condition and, usually, depression of the ST segment or changes in the T waves indicative of ischemia. They must be hospitalized in the coronary unit or cardiology area, depending on their clinical status. The patients of the third group, with an ECG that is normal or non-diagnostic of ischemia, in which the existence of coronary artery disease cannot be excluded definitively, can benefit from a strategy of rapid diagnosis with complementary tests that allow the presence of coronary heart disease to be confirmed or excluded, thus avoiding unnecessary admissions as well as inappropriate releases. This diagnostic process is carried out in the CPU. Finally, in the patients in the

TABLE 1. Fast classification of patients with acute chest pain

Groups of risk	Clinical manifestations consistent with ACS	Electrocardiogram	Destination/admission
1	Yes	ST elevation or LBBB	Coronary Unit
2	Yes	ST depression or negative T	Coronary Unit/ward
3	Yes	Normal or non-diagnostic	Chest Pain Unit
4	No	Normal or non-diagnostic	Discharge/other areas

LBBB indicates left bundle-branch block, and ACS, acute coronary syndrome.

fourth group, the clinical manifestations and ECG initially establish another clear cause of pain and they are referred or treated as needed.

Functional requirements

The organization of the CPU varies according to the objectives and characteristics of the hospitals where they are to be located. However, the following five elements describe below are considered fundamental for its effectiveness and correct operation.

Physical space

The CPU can be organized *a)* as entities in a space physically separate from the ES, or *b)* as part of the observation unit within the ES (what we would call functional CPU). This modality is considered more suitable for hospitals with a smaller emergency load. In the first case, the CPU must be located near the ES to facilitate the fast and unobstructed access of patients.

The number of beds in a CPU is calculated according to the size of the hospital and number of emergencies seen annually. Thus, a referring hospital for a health area (250 000 inhabitants) care with about 9000 monthly emergencies; of these, 200-250 a month will be patients with chest pain, half of which will be suitable candidates for hospitalization in the CPU for an average of 17 h. Therefore, one or two beds per 50 000 emergencies/year are needed. For the referral hospital, with around 96 000 annual emergencies, between two and four beds are needed (grade I recommendation with level C evidence, according to usual scale).

The CPU must be equipped with noninvasive arterial pressure monitoring for each patient and continuous electrocardiographic monitoring with automatic detection of arrhythmias, as well as a defibrillator and cardiopulmonary resuscitation material. A central monitoring station is not absolutely essential (grade I recommendation).

Personnel

The team in charge of the patient's care must be formed by physicians from the emergency area and cardiologists, as well as nurses who have received the necessary training in the examination of patients with coronary pain, basic ECG concepts, and the basics of cardiovascular therapy and cardiopulmonary resuscitation. In addition, it is essential that all people involved in the care of these patients form part of the team (personnel of emergency extrahospital services, the physicians who perform ischemia detection tests, personnel of the emergency room laboratory and hemodynamics laboratory, etc).

At minimum, one cardiologist will be needed to integrate information, plan, and interpret the tests of in-

duction of myocardial ischemia and determine the final destiny of patients. The number of nurses needed is calculated as one per 6 beds. The other auxiliary and administrative personnel can be affiliated with the CPU or shared with ES, depending on how large it is.

Definition of responsibilities

As occurs in any multidisciplinary team, in order to avoid conflicts the tasks and responsibilities of each member of the team must be defined well and appear in a manual for operating procedures previously agreed upon by the different services.

A cardiologist of the cardiology service or section must have ultimate responsibility and head the team. The main functions of the cardiologist are coordination between the different groups of professionals involved in the CPU, the review and update of protocols / clinical guidelines of the CPU (for which the formation of an interdisciplinary committee that meets periodically is recommended), and the selection and training of the CPU personnel.

Written guidelines

The CPU will have to define and develop a consensus with all the departments and medical services of the center (emergency, intensive care unit, cardiology, internal medicine), protocols for action with respect to the patient with chest pain for fast screening with a high sensitivity and specificity of patients in the ES in order to achieve a correct diagnostic orientation, adequate risk stratification, and prompt treatment as quickly as possible. The control of times, measures for improvement, and coordination of all areas involved is a priority task of the CPU.

Quality control

Since this is an area where therapeutic decisions are critical, a log must be kept to enable continuous evaluation of the effectiveness of the CPU and the quality of care provided. Action times, the percentage of patients correctly treated, and the percentage of diagnostic errors are examples of parameters that should be recorded. This continuous observation of unit activities should lead to improvement and modifications in the organization and guidelines.

DIAGNOSTIC PROCEDURES

Electrocardiogram

The 12-lead ECG is a simple, fast, and effective test for the diagnosis of patients with chest pain because it allows the identification of patients with a possible acute coronary syndrome who can benefit from early

TABLE 2. Comparison of cardiac biochemical markers

Marker	Advantages	Disadvantages	Comments
CK-MB	Widely used Inexpensive technique Detection of reinfarction	Low specificity in the presence of striate muscle lesions Low sensitivity for early AMI (<6 h) and small areas of myocardial damage	Widely used in clinical practice Acceptable in most clinical situations
CK-MB isoforms	Early detection of AMI	Specificity profile similar to CK-MB Requires special experience in determination techniques	Not widely used, limited to research centers
Myoglobin	High sensitivity Early detection of AMI Negative test excludes AMI in the first 12 h	Very low specificity in cases of striate muscle lesion	More widely used than CK-MB isoforms Easily used for the early diagnosis of AMI
Troponins	More sensitive and specific than CK-MB Useful in selecting treatment	Low sensitivity in the very early phase of AMI (<6 h) Low sensitivity for detecting small reinfarctions	Serial determinations very useful in the diagnosis and prognosis of ACS without ST-segment elevation

CK-MB indicates MB fraction of creatine kinase; AMI, acute myocardial infarction; other abbreviations as in Table 1.

reperfusion. In addition, it provides prognostic information that can modify clinical decision-making in the context of chest pain. Therefore, consensus is universal regarding the need to perform an ECG on all patients with non-traumatic chest pain in the first 10 min after arrival at ES (level A evidence).

The ECG must be interpreted directly by an experienced physician, automatic interpretation systems should not be relied on. Studies made in the group of patients who presented myocardial infarction not identified in the ES conclude that 25% were due incorrect ECG interpretation. The adequate analysis of the ECG by ES physicians is more important than ever, due to its paramount value in the decision to use thrombolytic treatment. In this sense, networked direct ECG visualization procedures are useful in the hospital because they facilitate access by all the professionals implicated as well as immediate interpretation by qualified professionals.

Continuous monitoring of ST segment could be useful in certain subgroups of patients. There are still not enough studies that have validated this technique, although some scientific societies (like the European Society of Cardiology) include it in their recommendations for the approach to acute coronary syndrome. Less frequently used ECG leads, like the posterior or right ventricular leads, can improve the electrocardiographic visualization of the posteroinferior zone of the heart. Nevertheless, there is no evidence that the systematic recording of additional leads significantly enhances the diagnostic capacity of conventional ECG.

PORTABLE RADIOLOGY

Since all non-traumatic chest pain without evidence of myocardial ischemia can have other causes, a chest radiograph must be made during the period of obser-

vation in the CPU. As a matter of course, this study must be made with portable equipment instead of moving the patient to other hospital departments, especially if it is obtained soon after the patient's arrival at the hospital.

BIOLOGICAL MARKERS

The cardiac biochemical markers are myocardial intracellular macromolecules that pass into the interstice, and then into the bloodstream, if the integrity of the cellular membrane is lost. When detected in peripheral blood, they are useful for establishing the diagnosis and prognosis of ischemic myocardial damage. The most frequently used markers for this purpose are myoglobin, creatine phosphokinase (CK) and its different fractions (CK-MB and its isoforms), and the cardiac troponins. In Tables 2 and 3 are presented, respectively, their comparative clinical characteristics and times of appearance and permanence in blood.

These markers have an important role in the process that leads to the diagnosis and prognosis of the patient with chest pain in the CPU, but must be integrated with the other clinical procedures used in decision-making with this type of patients. The results of the determination have to be available within 30-60 min of extracting the sample. Techniques have been developed that allow several markers to be determined simultaneously in the ES at the bedside of the patient.

The European and American Societies of Cardiology consider troponin determination to be the procedure of choice, for which a blood sample must be obtained at 6 h and 12 h of admission. In case of very early admission (before 6 h), a myoglobin determination could be carried out, and in cases of recurrent ischemia after acute infarction (< 2 weeks), a determination of CK-MB. The Sociedad Española de

Cardiología recommends serial determinations of troponins and CK-MB (mass) at admission. In case of early negative troponin or borderline normal values, they recommend repeating the determination at 6-9 h (grade IIa recommendation). If a troponin determination is not available, it is necessary to determine CK-MB (mass), CK-MB (activity), or total CK (by this order of priority).

STRESS TEST

Once the selection of patients who present clinical and electrocardiographic data of acute myocardial ischemic syndrome is made, an important group of patients is left with an intermediate or low risk of later coronary complication (less than 7% acute myocardial infarction and less than 15% unstable angina). In this subgroup, the performance of a graduated exercise stress test (EST) has been proposed, which is a useful test available in most hospitals. This recommendation is based on the high negative predictive value of a negative EST in these patients (grade I recommendation with level B evidence) and the prognostic information that it provides. Nevertheless, considering that the prevalence of coronary disease is low in this group of patients with intermediate-to-low risk of coronary artery disease, the probability of positive false results is high. In cases of doubtful or inconclusive results, more specific tests of ischemia induction become necessary.

All patients with chest pain potentially due to an ischemic myocardial etiology, in which acute coronary syndrome and any other chest pain secondary to severe pathology (pulmonary embolism, aortic dissection, esophageal rupture, pneumothorax) has been excluded by means of physical examination, chest X-ray, basic laboratory tests, serial ECG, and biochemical markers of myocardial necrosis, are considered apt for undergoing study by early EST in the CPU. They must also be capable of walking or exercising on a bicycle ergometer and not present ECG disturbances that make it difficult or impossible to safely interpret the test (bundle-branch block, left ventricular hypertrophy with overload, digitalis effect, and others).

The test can be made once the 6 to 9-hour observation period concludes and, in any case, within the first 24 h. The routine protocol of each hospital should be used. A maximum effort test should be attempted, that is, one that concludes with positivity, symptoms that preclude continuing, or reaches the maximum frequency (220-age in years) for the patient, which is the moment in which the sensitivity of the test increases. The finalization criteria coincide with those established in the Clinical Practice Guidelines of the Sociedad Española de Cardiología for effort tests (Table 4). The criteria of electrical positivity are the usual ones: changes in ST (ST depression of 1 mm or more, flat or with a descending slope, or a 1-mm elevation 80 ms after point J).

TABLE 3. Times of appearance and permanence of cardiac biochemical markers in blood

	Interval until initial elevation (h)	Interval until peak level	Duration of plasma elevation
Myoglobin	1-4	6-7 h	24 h
CK-MB	3-12	24 h	48-72 h
CK-MB isoforms	2-6	12-16 h	18-24 h
Troponin T	3-12	0.5-2 days	5-14 days
Troponin I	3-12	24 h	5-10 days

OTHER TESTS FOR THE DETECTION AND INDUCTION OF ISCHEMIA

Although the EST is the first diagnostic step in patients admitted to the CPU, thanks to the ease with which it is carried out and its availability, it has limitations derived from its low sensitivity and specificity in certain groups of patients (disturbances in the baseline ECG, drugs, female sex, or insufficient level of effort). In these cases other induction tests can be considered, by image association (ultrasonic or radionuclide), based on the possibilities of detecting disturbances in myocardial perfusion (perfusion radionuclide scan) or ventricular function (stress echocardiography), and both in baseline conditions and with dynamic or pharmacological overload.

Stress echocardiography

TABLE 4. Criteria for interrupting stress test (SEC directives ²⁶)

<i>Absolute criteria</i>
Reiterated desire of the subject to stop the test
Progressive anginal chest pain
Decrease or non-increase of systolic pressure in spite of increased load
Severe/malignant arrhythmias
Tachycardic atrial fibrillation
Frequent, progressive, multiform ventricular extrasystoles
Runs of ventricular tachycardia, flutter, or ventricular fibrillation
Central nervous system symptoms
Ataxia
Dizziness
Syncope
Signs of poor perfusion: cyanosis, pallor
Poor electrocardiographic signal that interferes with control of tracing
<i>Relative criteria</i>
Marked ST or QRS (major axis changes)
Fatigue, tiredness, dyspnea, and claudication
Non-severe tachycardias, including paroxysmal supraventricular tachycardia
Bundle-branch block that simulates ventricular tachycardia

This ultrasound imaging technique allows the observation of reversible defects of regional ventricular perfusion: disturbances in segmental contractility (decreased endocardial excursion) and decreased systolic thickening of the myocardium after overloading by physical exercise or drugs (dobutamine or dipyridamole). Dipyridamole echography is particularly advisable because it is easily used in such units. Its diagnostic effectiveness is superior to that of EST and similar, in general terms, to that of perfusion radionuclide scan.

Its main indications are summarized in Table 5. Several circumstances can directly influence the choice of stress echocardiography as the first diagnostic step (grade I/II recommendation; B/C level evidence) in the patients of a CPU, such as female sex, left bundle branch block, arterial hypertension, and pacemaker carriers.

Myocardial radionuclide scan

The indications of myocardial radionuclide scan for diagnosis and risk stratification of ischemic heart disease in the CPU are similar to those contemplated for stress echocardiography (Table 6). The radiotracers most often used are thallium-201 and Tc (sestamibi and tetrofosmin); their diagnostic performance is similar, although the technetium compounds have more diagnostic precision in stress studies. It is recommended that the imaging technique used be ECG-synchronized tomographic sections (gated SPECT). This technique allows the movement and systolic thickening of

the ventricular walls to be assessed (which is useful for differentiating zones of physiological attenuation and septal defects in LBBB), which can be assessed quantitatively using the polar map.

Recently, two strategies have been designed to increase the speed of diagnosis and optimize the combined use in a single study of both techniques in the CPU. One is to inject sestamibi radiotracer during the episode of chest pain (therefore, without stress) and acquire images at 1 or 2 h. The other is to inject it immediately after the echocardiographic stress study when the study has been non-diagnostic (a submaximal test or one without ischemia) and/or when the echo stress tech is interrupted by angina, ST changes, or the appearance of ventricular arrhythmia. Both strategies can be complementary, have a similar cost-effectiveness, and enable clear differentiation of patients at low and high risk in the CPU.

TREATMENTS

The patient admitted to the CPU has a low or intermediate probability of presenting serious cardiovascular complications; therefore, the patient is potentially severe, thus raising more of a diagnostic than therapeutic problem. Nevertheless, it seems logical to initiate treatment when the patient is admitted to the CPU. This treatment must be effective for acute coronary syndrome, the most frequent cause of severe chest pain in ES, easy to administer, not require complex dosing schemes or laboratory tests, cause as few undesirable effects as possible, and not interfere with the diagnostic strategy planned for the patient.

TABLE 5. Indications for stress echocardiography for the diagnosis of ischemic heart disease

Grade I recommendations

Populations in which the electrocardiographic stress test (EST) has limited utility: patients with suspected coronary disease and/or pathological baseline ECG and inconclusive EST
Need to specify the location and extension of myocardial ischemia
Discrepancy between clinical manifestations and EST (asymptomatic with positive EST, or suggestive pain with negative EST)
Patients unable to do physical exercises (dobutamine)

Degree IIa recommendations

Assessment of the functional meaning of a coronary lesion
Women with an intermediate probability

Grade IIb recommendations

Diagnosis of myocardial ischemia in selected patients with a high or intermediate probability of coronary disease

Grade III recommendations

Systematic assessment of all patients with normal ECG
Assessment of asymptomatic persons with a low probability of coronary disease

Peripheral vein cannulization

A high percentage of patients (approximately 50%) seen in the ES for chest pain are hospitalized later. For that reason, cannulization of a peripheral vein in such patients is a relatively innocuous procedure that is useful if complications exist, and allows easy blood sam-

TABLE 6. Indications for myocardial radionuclide scan in the diagnosis of ischemic heart disease

Grade I recommendations

Symptomatic patients an electrocardiographic stress test (EST) not made due to incapacity for exercise, inconclusive EST, ECG abnormalities, or discrepancies between clinical manifestations and EST

Degree IIa recommendations

Women with an intermediate probability of coronary disease

Grade IIb recommendations

Diagnosis of myocardial ischemia in patients with high or intermediate probability of coronary disease

pling without interfering with the diagnostic process of the patient (grade I recommendation).

OXYGEN THERAPY

No evidence exists of the usefulness of oxygen during the patient's stay in the CPU; which undermines opinions that it should be used systematically. Others recommend it only in patients who present dyspnea or a saturation of less than 89% in the pulse oximeter. Considering that oxygen treatment is symptomatic and it does not affect prognosis, the latter position seems appropriate.

PHARMACOLOGICAL TREATMENTS

Anti-platelet aggregation agents

The use of agents to inhibit platelet aggregation is indicated in all acute coronary syndromes diagnosed. Aspirin is probably the drug most often used in the CPU in any patient suspected of pain due to an acute myocardial ischemia syndrome. In patients with a low probability of this syndrome and no added cardiovascular risk factors, the use of aspirin does not seem justified, as long as evaluation tests can be made quickly. An initial dose of 160 to 325 mg is usually recommended, preferentially in chewable form to obtain a rapid antiplatelet effect. It should not be used if it is suspected that pain could be secondary to acute aortic syndrome until this possibility has been excluded. Aspirin treatment can be continued in patients who were taking it before admission. In the case of allergy or aspirin intolerance, alternative antiplatelet treatments exist, like thienopyridines or trifusal.

Other intravenous antiplatelet agents, like the glycoprotein IIb/IIIa inhibitors, are not indicated in the CPU because their use is limited to high-risk patients, who should be hospitalized in the coronary unit.

Anticoagulants

No definite guidelines exist for the use of heparin in the CPU, with only one study recommending their administration at the discretion of the treating physician. If the decision is made to use them, low-molecular-weight heparins are an excellent alternative because of their ease of use and effectiveness similar to unfractionated heparin. In any case, they should not be used before a confirmed diagnosis of acute coronary syndrome has been obtained.

Nitrates

Only short-acting nitrates should be used, generally sublingual, to alleviate chest pain. A favorable response to the administration of these drugs supports the

diagnosis of myocardial ischemia, although it should not be considered as the only criterion, since other diseases respond to this drug. Long-acting and intravenous nitrates should not be used because they can interfere with the results of stress testing. No study has evaluated the effectiveness of nitrates in the control of symptoms or the prognosis of patients cared for in the CPU.

Beta-blockers

No bibliographic information exists regarding the use of beta-blockers in the CPU. Since they can reduce the diagnostic sensitivity of ischemia induction tests, especially the stress test and dobutamine stress echocardiogram, their use should be avoided. Nevertheless, it is not justified to discontinue treatment in patients taking these drugs for another reason, due to the rebound phenomenon that can appear after its suppression.

Calcium antagonists

The use of calcium antagonists is not justified in patients admitted to the CPU, unless they were taking them before admission for another reason.

Treatment at discharge

The treatment of the patient will depend on the decision reached in the light of the diagnosis and prognosis established during the patient's stay in the CPU. If the patient is hospitalized with the diagnosis of acute coronary syndrome, the treatment and strategy specified in the corresponding clinical practice guidelines will be applied. In contrast, if no evidence of ischemic heart disease is found after completing the pertinent studies, the patient is released without medical treatment. If further study with complementary tests is planned, the patient should continue treatment with aspirin until a diagnosis is reached. The moment of discharge is an excellent occasion for advising the patient on opportune primary or secondary prevention measures.

PROPOSED PROTOCOL

The experiences published with CPU differ in many aspects, including the types of patients selected and protocols used. In addition, few contemplate all the different aims of the CPU: fast treatment of acute infarction with ST elevation, risk stratification in unstable angina/infarction without ST elevation, identification of patients at intermediate risk of suffering ischemic complications, and rapid diagnosis of patients with non-cardiac pain. Although most publications refer to patients with a non-diagnostic ECG, the

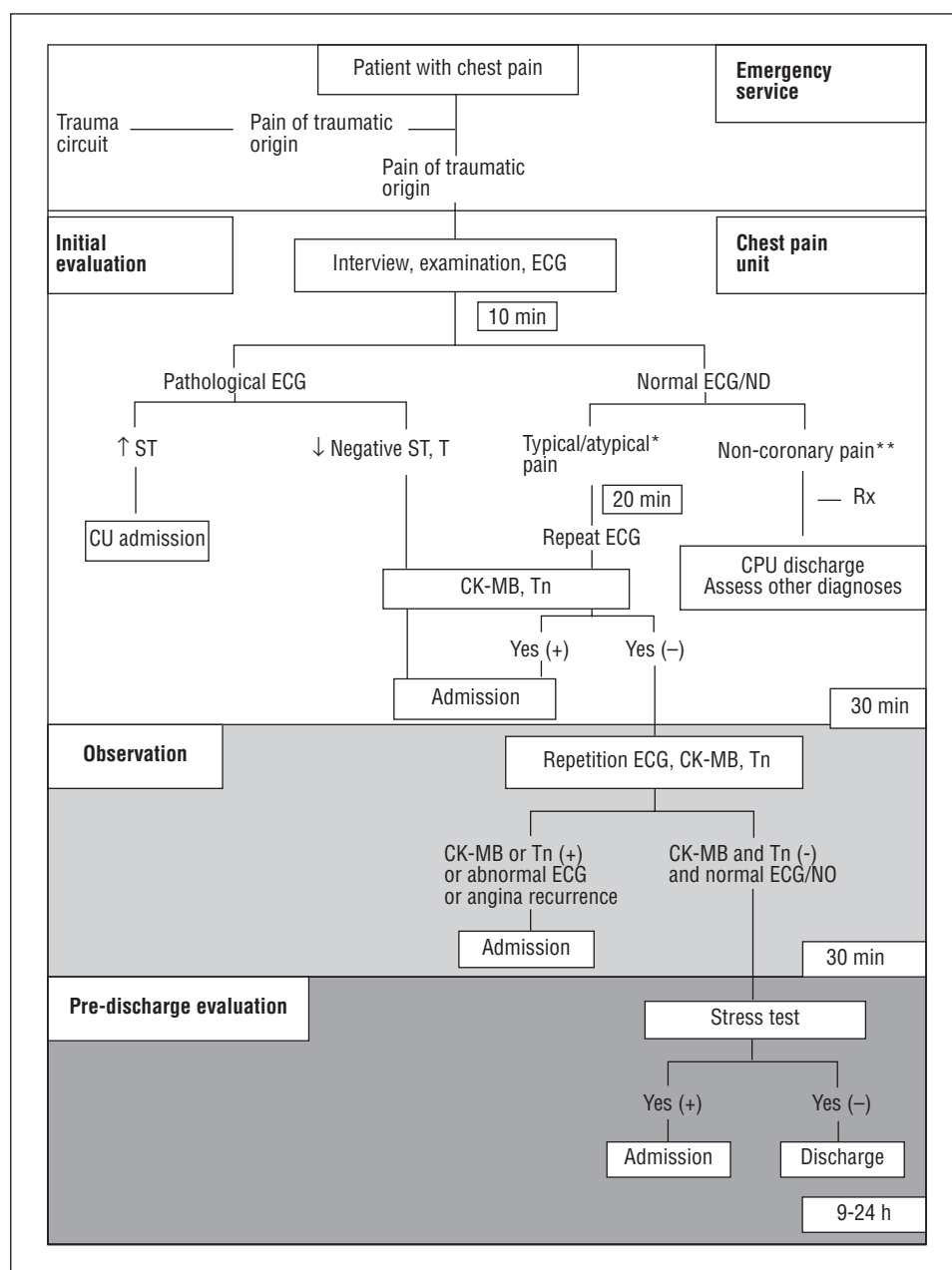


Fig. 1. Proposed protocol for the management of patients seen in the emergency service for chest pain (see explanation in text). CK-MB indicates MB fraction of creatine kinase; ECG, electrocardiogram; ND, non-diagnostic; Rx, chest X-ray; Tn, troponins; CU, coronary unit; CPU, chest pain unit.

*Consider admission in case of possible coronary pain in the presence of risk markers: history of infarction, coronary angioplasty or surgery, heart failure or peripheral vasculopathy.

**Exclude aortic dissection and pulmonary thromboembolism.

studies coincide in indicating that a CPU facilitates the appropriate treatment of patients with chest pain, saves unnecessary admissions, and allows patients to be released more safely.

Given the differences existing between hospitals, a single protocol cannot be established. In addition, it should be considered that the organization of the CPUs created is going to be highly variable, ranging from CPUs of an exclusively functional nature focusing on a certain type of patients to structural CPUs designed for the evaluation, diagnosis, and treatment of all patients who arrive at ES with chest pain. In view of these considerations, the protocol summarized in Figure 1 is proposed. It is based on the clinical ma-

nifestations, ECG, and stress test and contemplates three different periods.

Initial assessment

The importance of obtaining the clinical history, physical examination, and ECG within 10 min of the patient's arrival and the initial risk stratification within 30 min is emphasized.

Anamnesis and physical examination

It is fundamental to obtain an exact and rapid clinical history. The type of pain, its duration, form and

moment in which it is triggered, presence of vegetative symptoms, accompanying conditions (heart failure, acute lung edema, syncope, arrhythmias), ischemic threshold, and mode of presentation must be analyzed. It is necessary to underline that symptoms often are not absolutely typical, and that the fact that the patient presents atypical characteristics does not absolutely exclude the coronary origin of the pain (up to 15% of patients suffering acute myocardial infarction show tenderness). One of the main causes of error is the epigastric location of pain. Finally, it must be remembered that older patients, diabetics, and patients with heart failure may be seen for symptoms other than chest pain.

The medical history should include coronary risk factors (age, sex, diabetes, dyslipemia, arterial hypertension, smoking), other arteriopathies (cerebrovascular accident, intermittent claudication), and ischemic heart disease, especially previous infarction, angioplasty, or surgery. In addition, it is necessary to exclude drug abuse (mainly cocaine).

The physical examination is often normal and does not exclude in any case the existence of a severe acute pathology. On the contrary, the finding of abnormality (e.g., signs of heart failure) not only confirms the diagnostic suspicion, but also implies a less favorable prognosis.

Electrocardiogram

The electrocardiogram is one of the mainstays of diagnosis and risk stratification in acute coronary syndromes. Nevertheless, poor interpretation of the ECG is one of the most frequent causes of error. In the first place, it must be remembered that a normal ECG in no way excludes the presence of severe cardiovascular pathology (e.g., aortic dissection). Also, many patients with acute coronary syndrome may have an ECG at admission that is normal or minimally changed that may be inadvertent to physicians without sufficient experience. Finally, with some frequency ECG disturbances exist (bundle branch block, pacemaker, previous infarction) that make it difficult to reach a diagnosis; although in these cases the probability that chest pain is of coronary origin is greater.

Analysis at the time of admission

The biochemical markers of necrosis serve to confirm the diagnosis relatively late (> 60 min). In any patient with non-traumatic chest pain, in addition to basic laboratory tests (differential blood count, blood glucose, creatinine, ionogram), myocardial injury markers must be requested. It is necessary to consider that the troponins (T or I) are very specific but do not rise until after the first 6 h of pain, which is why they can be normal without excluding acute infarction if the

pain motivating admission is of recent onset. Of the classic markers, CK-MB (mass) is the most useful. It is necessary to emphasize that initially negative values do not exclude acute coronary disease, so tests should be repeated at 6-9 h of admission.

Chest radiograph

The chest radiograph should be part of the initial examination, although its practice does not have to delay treatment in cases in which the medical history and ECG result in a diagnosis of acute coronary syndrome. In some patients it can be diagnostic (pneumothorax, pleural effusion, etc), although it is normal with relative frequency (even in aortic dissection).

Observation in the chest pain unit

With the initial clinical evaluation we can classify patients into three main groups:

1. Patients presenting an acute coronary syndrome (with or without ST-segment elevation).
2. Patients with chest pain of clearly non-cardiac origin (e.g., pneumothorax, thromboembolic disease, digestive pathology, etc)
3. Patients with chest pain of uncertain origin.

In the first two cases, after the diagnosis is reached specific treatment must be applied in accordance with the etiology of the process and in accordance with protocols for care. In the case of acute coronary syndrome, the corresponding Clinical Practice Guidelines should be followed. Patients with ST elevation should receive prompt coronary reperfusion treatment (fibrinolysis or angioplasty), without awaiting test results, whereas patients with ST depression must be hospitalized and initiate treatment for unstable angina/infarction without ST elevation. In the case of left bundle-branch block, its moment of appearance should be evaluated; if it is of recent appearance and the clinical manifestations are indicative of infarction, patients should receive reperfusion treatment and be hospitalized in the coronary unit.

Patients with non-coronary pain (a sharp pain in ribs, of stabbing nature, brief [seconds] or constant in duration [> 24 h], that varies with breathing or postural movements, etc. must be released from the CPU after excluding serious pathologies like aortic dissection, pulmonary thromboembolism, and cardiac tamponade. In these patients, a chest X-ray should be performed to exclude other non-coronary diseases, but CK-MB or troponins do not have to be determined because they yield little in this population and delay patient release.

Once patients with pain of another cause are excluded and treatment is begun in those that present acute coronary syndrome, approximately one-third of the

patients still will not have a clear diagnosis and constitute a population that should be followed-up in the CPU in most protocols. The recommended period of observation ranges from 6 h to 12 h.

The ECG must be repeated 15-20 min after admission to exclude ischemic changes. If the ECG continues to be normal, the patient should remain in observation and the ECG and necrosis markers should be repeated at 6-8 h. In contrast, if ischemic changes appear in the ECG, markers become positive, or angina appears again, these patients must be hospitalized.

Pre-discharge evaluation

Approximately 70% of patients admitted to the CPU complete the 6 to 12-hour observation period, have negative markers of necrosis, and do not present changes in serial ECGs or signs of hemodynamic instability. However, up to 3% may have an acute coronary syndrome and should not be released. For this reason, most protocols include a test to induce ischemia. The conventional stress test, radionuclide stress test, and echocardiography after pharmacological stress induction are used for this purpose. Of all of them, the conventional stress test has the advantage of simplicity and easy availability, which is why it is listed in the protocol as the first choice.

Depending on the type of patients selected, 10% to 25% will have positive results, 70% negative results, and approximately 20% inconclusive results. Nevertheless, the positive predictive value of the test is low in these patients. All the studies coincide in indicating that the negative predictive value is over 98% in these circumstances, which means that patients can be released with a high degree of safety.

Some patients are incapable of carrying out a stress test adequately and ischemia must be induced by pharmacological means, especially dipyridamole. There are few studies of drug-induced stress and echocardiography or tomographic perfusion radionuclide scans in patients with chest pain admitted to a CPU and the number of patients is small. Therefore, no data exist supporting their use instead of the conventional stress test and they are only considered indicated if the patient has physical limitations that prevent him or her from carrying out exercise correctly. In cases in which this is not possible, patients should be seen by a cardiologist within 72 h.

CONCLUSIONS

The management of patients with chest pain in the ES is an important challenge for the emergency specialist as well as the cardiologist. Following the experience of other countries, the Working Group sponsored by the Section of Ischemic Heart Disease and Coronary Units of the SEC propose the creation of

CPUs in Spanish hospitals. These CPUs should be formed by a multidisciplinary team under the supervision of a cardiologist, for the purpose of optimizing the diagnosis and treatment of patients with chest pain, so that the hospitalization of patients with mild pathologies can be avoided and the diagnosis of acute coronary syndrome can be promptly to avoid incorrect discharges.

Decisions must be taken based initially on the clinical manifestations, ECG, and biochemical markers of myocardial damage; after the observation period, a stress test should be performed according to established protocols.

APPENDIX

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