Chest Pain Units. A Modern Way of Managing Patients with Chest Pain in the Emergency Department

Roberto Bassan

Rio de Janeiro, RJ - Brazil

It is estimated that 5 to 8 million individuals with chest pain or other symptoms suggestive of myocardial ischemia are seen each year in emergency departments (ED) in the United States [1,2], which corresponds to 5 to 10% of all visits [3,4]. Most of these patients are hospitalized for evaluation of possible acute coronary syndrome (ACS). This generates an estimated cost of 3 - 6 thousand dollars per patient [5,6]. From this evaluation process, about 1.2 million patients receive the diagnosis of acute myocardial infarction (AMI), and just about the same number have unstable angina. Therefore, about one half to two thirds of these patients with chest pain do not have a cardiac cause for their symptoms [2,3]. Thus, the emergency physician is faced with the difficult challenge of identifying those with ACS - a life-threatening disease - to treat them properly, and to discharge the others to suitable outpatient investigation and management.

To establish the correct diagnosis and the appropriate treatment for patients with chest pain is one of the most important problems facing not only physicians and hospitals but also the payers – government, health-insurance companies, or health maintenance organizations. Emergency physicians are traditionally recommended to act on behalf of patients' health and safety. Therefore, incapable of establishing with certainty the etiologic diagnosis of chest pain patients using history, physical examination and electrocardiography (ECG) data, physicians are pressured to admit these patients to the coronary care unit. As most of these patients do not have cardiovascular disease, this results in the expenditure of some 5 to 8 billion dollars in cost for unnecessary hospital admissions in the United States [2,7,8].

However, even with this exaggerated effort to identify cases of ACS, an average of 2 - 3% of patients with chest pain who actually have AMI are unintentionally released from the EDs in the United States, and this rate may go up to 11% at some centers [8-10]. This amounts to some 40,000 individuals each year. In countries where emergency physicians have less expertise in dealing with chest pain patients or are less aggressive in admitting them to the hospital, this rate could reach 20% [11].

At the same time, physicians have been pressured by health insurance companies and hospital managers to avoid admitting patients who have an unclear diagnosis [12]. Retrospective denial of payment by insurers for hospitalized patients who end up not having ACS makes the admission of low-risk patients problematic. The release of patients with AMI represents a significant medico-legal risk for emergency physicians, with 20% of malpractice dollar settlements each year in the United States being associated with the misdiagnosis of AMI [13,14].

For all the previously mentioned reasons, physicians are faced with the problem of admitting most patients coming to the ED with chest pain, or releasing those that have a very low likelihood of a life-threatening disease, yet they may in fact have ACS with a resulting complication. Thus, most emergency physicians in the United States admit virtually all patients who have any possibility of ACS due to knowledge of the following information. First, some 15 to 30% of such patients actually do have ACS [15,16]. Second, just about one half of patients with AMI have the classic change of ST-segment elevation on the admission ECG [17,18]. Third, less than 50% of patients having AMI without ST-segment elevation have an abnormal admission serum creatine kinase-MB (CK-MB) level [19-21].

Therefore, the evolution of Chest Pain Units has been recognized as a reasonable and viable approach to deal with these patients in the ED in a cost-effective way [12,22], as we will discuss in this report.

Chest pain units - Since the early 1960s, coronary care units have been the ideal setting for managing patients with a clear-cut diagnosis of AMI. The excellent results observed in these units, particularly with early recognition and

Pró-Cardíaco Hospital, Rio de Janeiro
Mailing address: Roberto Bassan - Hospital Pró-Cardíaco - Rua General Polidoro, 192 - 22280-000 - Rio de Janeiro, RJ – Brazil – E-mail: procep@uninet.com.br

treatment of cardiac arrhythmias and cardiac arrest, led physicians to begin admitting patients with suspected ACS [23,24]. The result of this more liberal approach was more than one half of admitted patients did not have a final diagnosis of ACS [24]. Consequently, high-cost hospital beds were filled by emergency physicians with low-risk patients, resulting in saturation or overflow of the coronary care units, with suboptimal use of medical resources, and high costs associated with this evaluation.

Chest Pain Units or Centers can be defined as a new area of emergency medical care devoted to improving management of patients with acute chest pain or any other symptom suggestive of ACS. The main objectives of these units are to provide (1) easy and friendly admission for the patient presenting to the ED, (2) priority and rapid access to the medical staff in the ED, and (3) an organized and efficient strategy of medical care within the ED, including diagnosis and treatment, aimed at dispensing the best possible medical care at the lowest possible cost.

Chest Pain Units can be located in or adjacent to the ED, in a true physical area, or just as a working process within the emergency center. What is essential is that a group of trained and qualified personnel act in synchrony when receiving a patient with chest pain to achieve the previously mentioned objectives: rapid and efficient evaluation, early identification of ACS, high-quality care, and cost-effectiveness [2,3,25,26].

One of the keys to the success of the Chest Pain Units is the use of systematic diagnostic algorithms and specific management protocols [3,26]. The use of Chest Pain Units has resulted in improved care of patients with and without ACS, as depicted in table I and discussed as follows.

Pre-hospital delay (procrastination of patients with ACS in coming to the ED) is a worldwide problem and responsible for about 50% of AMI deaths [27,28]. Many studies have demonstrated that the mean time-interval between symptom onset and hospital arrival in patients with AMI is 2 to 3 hours [2,29]. This delay may lead to prehospital death and may be the reason for ineligibility for thrombolytic therapy in many patients with AMI [30,31] . Chest Pain Units can be an instrument for patient education, particularly for those needing risk factor modification or symptom recognition [2,3].

In-hospital delay, the time interval between hospital arrival and diagnosis with initiation of specific therapy (also known as door-to-needle time), is another problem that affects most of the hospitals around the world, even in developed countries. This time frame is about 1 hour [2,29]. One of the most important reasons for this delay is lack of priority in the initial assessment of chest pain patients, which are frequently passed by on behalf of those with trauma, gastrointestinal bleeding, etc. Chest Pain Units perform an important and unique role in reducing this delay through its action to prioritorize high-risk individuals and to use protocols to evaluate and treat patients [2,3,12,26], as recommended by the National Heart Attack Alert Program [31].

Inappropriate hospital release of patients with AMI and unstable angina is a serious problem in emergency medicine that has been persistent over time [9,10,32,33]. As previously mentioned, diagnostic error in these cases has ranged from zero to more than 10% in renowned medical institutions [10]. Through the training of its personnel and the use of careful and systematic diagnostic strategies, Chest Pain Units can decrease inappropriate AMI release to less than 1%.

Excessive and unnecessary hospitalizations in high-complexity, high-cost units, such as coronary care units, are a frequent problem in medical practice, especially when physicians are in need of a bed for their patients with known AMI. Chest Pain Units act to buffer the coronary care units by evaluating patients with an unclear diagnosis, therefore reducing the rate of low-risk admissions and, consequently, increasing the availability of beds for those who really need them [26,34].

The high costs of contemporary medicine have proved to be an important economic burden for society. Money used unwisely for the management of low-risk chest pain patients could be better used in high-risk patients. Cost-containment measures make Chest Pain Units more attractive not only to administrators but also to physicians as well, because low-risk patients can also be thoroughly and adequately evaluated in this setting [10]. Chest Pain Units have been demonstrated to reduce these costs, mainly through reduction in duration of hospital stay and the number of diagnostic tests ordered, especially those that have little or no diagnostic yield [5,7,28,35-38]. Diagnostic algorithms or protocols are important tools to attain such efficiency. As they also improve the quality of medical care, Chest Pain Units promote an unquestionable salutary shift in the cost-benefit relationship.

Diagnostic strategies for chest pain patients - Chest pain is a symptom associated with multiple pathologic entities, some benign [39]. However, emergency physicians are usually concerned primarily with those that are life-threatening, namely ACS, pulmonary embolism, and aortic dissection. Although none of these are the most frequent cause of chest pain in the ED, AMI and unstable angina are quite common in this setting (10 to 30% of cases). Pulmonary embolism and aortic dissection have an incidence of less than 1%.

The history is an extremely valuable tool in the differential diagnosis of chest pain [39-43]. The association of chest pain characteristics and admission ECG changes, with or without the information of patient's age, risk factors profile, and past history, has enabled investigators to create proba-

Table I - Aims of chest pain

1. Reduce prehospital delay of chest pain patients.
2. Reduce in-hospital delay for identifying and treating ACS patients.
3. Prevent inappropriate release of ACS patients.
4. Reduce unnecessary hospitalization rate for non-ACS patients
5. Reduce medical costs in the assessment of chest pain patients.

ACS- acute coronary syndrome.

bilistic algorithms or clinical prediction rules to estimate the chance of ACS or AMI in these patients [16,21,39,44,45]. The diagnostic accuracy of these tools has been confirmed in several studies [46-49] and recommended in 1 guideline [50].

Determination of pretest probability of ACS is important in establishing diagnostic strategies that are most cost-effective. Thus, patients with a high probability should be thoroughly investigated, whereas patients with a low probability of ACS may need less extensive and costly investigation in the emergency setting. Several strategies have been proposed and used in different centers [8,21,44,51-53], but they all have in common the need for a diligent and careful determination of the pretest probability of disease and the proper allocation of resources. Figure 1 depicts the diagnostic strategies used in the Pro-Cardiaco Hospital, establishing different diagnostic pathways according to the pretest probability of ACS. Characterization and classification of chest pain type and admission ECG (tabs. II and III) are crucial steps to correctly stratify the probability of ACS in these patients. Thus, route 1 is the pathway for high-probability patients, whereas route 2 is for those with intermediate probability and route 3 for those with low probability [21,34]. A previously published study from our group validated the discriminatory property of this model, as depicted by the observed rates of AMI and unstable angina in those routes of 74% and 17%, 17% and 43%, and 2% and 7%, respectively [34].

Table II - Classification and definitions of chest pain types used in the Chest Pain Unit of Pró-Cardíaco Hospital

Chest Pain Types	Definition
Type A (definite angina)	Chest pain that makes the physician certain of the diagnosis of ACS, independently of other tests.
Type B (probable angina)	Chest pain that makes ACS the main diagnostic hypothesis, but needing other tests to confirm it.
Type C (probable not angina)	Chest pain that does not make ACS the main diagnostic hypothesis, but needing other tests to rule it out.
Type D (definite not angina)	Chest pain that does not include ACS as a cause (D_1= without diagnosis on admission; D_2= with diagnosis)
AMI-type	Chest pain suggestive of AMI by its character, location, intensity, duration (≥30min) and other symptoms and signs.
Non AMI-type	Chest pain that does not fit the definition of AMI-type.

ACS- acute coronary syndrome; AMI- acute myocardial infarction.

Table III - Classification and definitions of the admission electrocardiogram (ECG) pattern used in the Chest Pain Unit of Pró-Cardíaco Hospital

ECG Types	Definition
ST-segment elevation	Positive deviation of J-ST >0.1mV in ≥ 2 leads of the frontal plane or >0.2mV in leads of the horizontal plane.
ST-segment depression	Negative deviation of J- ST ≥0.1mV in ≥ 2 leads, or T-wave inversion in ≥2 leads.
Left bundle branch block	In sinus rhythm, QRS duration ≥ 120 ms with QS or rS in V_1 and intrinsecoid deflection ≥60 ms in L_1, V_5 or V_6, and absence of Q-waves in these leads.
Normal/nonspecific	Absence of changes, or changes of lesser intensity of the above-mentioned ones, even in the presence of old pathologic Q-waves.

Developing a protocol for the Chest Pain Unit - Any diagnostic protocol or algorithm for assessing patients who come to the ED with chest pain must be based on the interpretation of chest pain characteristics and admission ECG, which can be made by experienced and trained emergency physicians and nurses. With these data one can make an accurate estimate of the risk (or probability) of ACS [34,39,40,54]. However, diagnostic confirmation most of the time requires the use of other laboratory examinations.

Serum markers, such as myoglobin, CK-MB, and troponins I and T are necessary to detect myocardial necrosis and to risk-stratify these patients [5,19,55]. The duration of myocardial necrosis markers screening should not be less than 3 hours and generally between 6 and 9 hours after admission to the Chest Pain Center. Ideally, 3 serial measurements should be obtained until at least 12 hours after pain onset [19-21,24,51,55].

Patients with a diagnosis of AMI or high-risk unstable angina confirmed at this point should be admitted to the hospital, but their antiischemic therapy should be initiated in the ED.

Remaining patients with a negative series of myocardial necrosis markers still require an evaluation for acute cardiac ischemia without infarction. ST-segment trend monitoring, two-dimensional echocardiography, and rest myocardial perfusion scintigraphy have been systematically used [42,51,52].

Sensitivity of rest tetrofosmin or sestamibi SPECT for detecting AMI has ranged from 90 to 100%, with a negative predictive value of 99% [44,57-60], whereas the rest echocardiogram is between 47 - 93% and 86 - 99 %, respectively [34,51,61-63]. The diagnostic accuracy of ST- segment trend monitoring is still under investigation [64,65].

Graded exercise testing, with or without myocardial radionuclide scintigraphy or stress echocardiography, can be performed to further risk-stratify these patients in whom AMI or rest myocardial ischemia has been ruled out [34,35,51,66]. Although these tests are important tools to assist in the diagnosis of residual myocardial ischemia and, therefore, unstable angina, they also contribute to assess prognosis in acute chest pain patients. A negative exercise test is associated with minimal (<2%) chance of death or AMI in the following year [5,44,57,58,63,67-69]. Thus, provocative testing becomes extremely important in completing the Chest Pain Unit evaluation in these patients.

Therefore, the Chest Pain Units provide a thorough evaluation for patients with chest pain presenting to the ED. This investigation is aimed at detecting not only myocardial

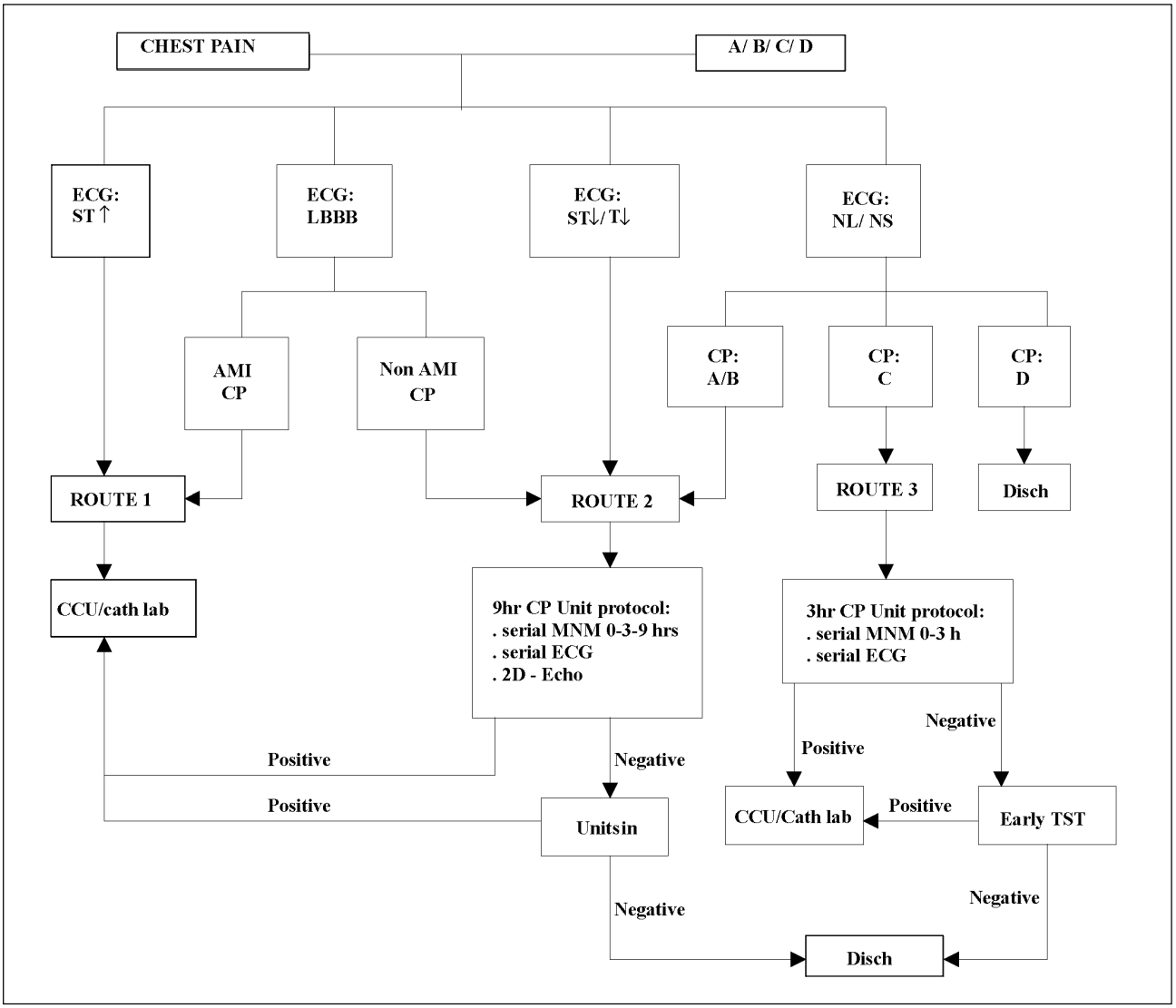

Fig. 1 - Pro-Cardiaco Hospital Diagnostic Algorithm. AMI- acute myocardial infarction; Cath lab- catheterization laboratory (if available and indicated); CCU- coronary care unit; CP- chest pain (A- definite angina, B- probable angina, C- probable not angina, D- definite not angina); Disch- discharge; ECG- electrocardiogram; Echo- echocardiogram; LBBB- left bundle-branch block; MNM- myocardial necrosis markers; NL/NS- normal/nonspecific; TST- treadmill stress test.

necrosis, but also rest and exercise-induced ischemia. Patients with a negative evaluation that encompasses these 3 objectives have a very low risk for complications after discharge from the Chest Pain Unit.

Chest Pain Units in Brazil - The first Chest Pain Unit in our country was developed in 1996 at Pró-Cardíaco Hospital, a private, clinical emergency care institution in the city of Rio de Janeiro. Chest pain is responsible for some 20% of all ED visits in that hospital, a rate remarkably higher than that seen in general EDs.

The Chest Pain Unit was initially seen with restrictions and disbelief by attending physicians and health insurers due to the systematic diagnostic protocol, supposedly more costly and cumbersome than the traditional ED evaluation. However, a rapid change of opinion occurred as results and benefits of the new method of patient assessment were appreciated. A data bank, prospectively obtained, allowed generation of important scientific information that were was immediately released to the medical community [11,18,20,21,34,69], confirming reports of other institutions and validating its own efficacy.

Following this pioneering experience, other institutions established their own Chest Pain Units. In 1998, 4 of them were functioning in Brazil and in 2001 a total of 30 were known, located in 13 states, most of them in medium-sized cities and small hospitals (figs. 2 and 3). It is important to emphasize that an estimated 1000 Chest Pain Units exist at the present time in the United States [7], which represents almost 20% of all the 4,300 EDs in that country.

Conclusion - The introduction of Chest Pain Units in the management of patients that come to the ED with chest pain has permitted the diagnosis of ACS to be made outside the coronary care unit in a more rapid and accurate way, thus optimizing assessment and treatment of these

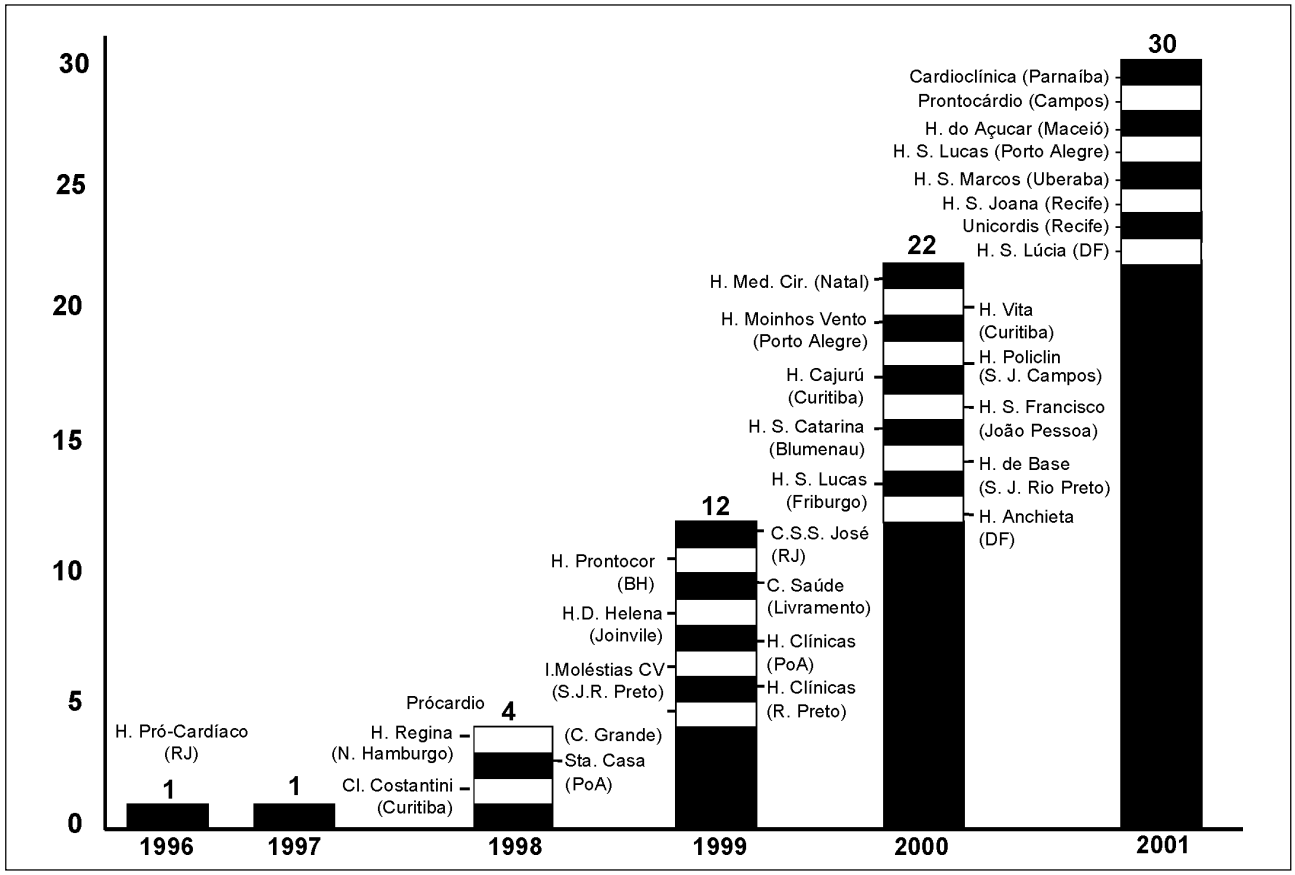

Fig. 2 - Development of Chest Pain Units in Brazil (up to July 2001).

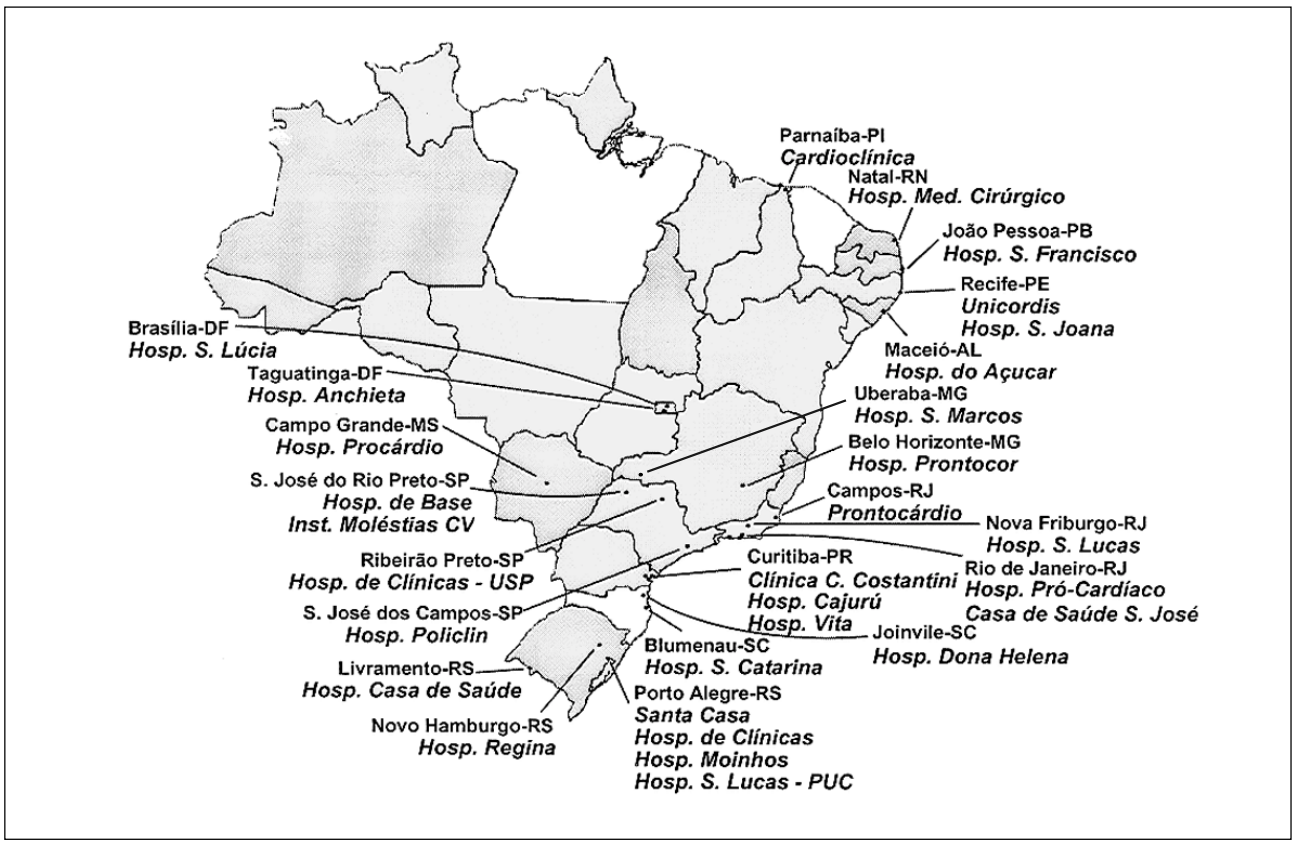

Fig. 3 - Distribution of Chest Pain Units in Brazil (up to July 2001).

patients. Conversely, it has allowed individuals with chest pain from other causes to be investigated in a less complex and inexpensive environment, releasing them safely from the hospital. The final consequence of the proper use of Chest Pain Units has been a significant reduction in diagnostic errors, decreased hospital admissions with occupancy of coronary care unit beds by higher risk patients, and more appropriate diagnostic testing. Finally, Chest Pain Units provide more cost-effective care. Therefore, Chest Pain Units have come to serve as a contemporary medical practice that provides high quality, efficient care at a reduced cost.

References

1. Stussman BJ. National Hospital Ambulatory Medical Care Survey: 1995 emergency department summary. Advance data from vital and health statistics. No. 285. Hyattsville, Md: National Center for Health Statistics, 1997 (DHHS publication no. (PHS) 97-1250).
2. Ewy GA, Ornato JP. 31st Bethesda Conference. Emergency Cardiac Care (1999). J Am Coll Cardiol 2000; 35: 825-80.
3. Graff L, Joseph T, Andelman R, et al. American College of Emergency Physicians Information Paper: chest pain units in emergency departments – a report from the short-term observation section. Am J Cardiol 1995; 76: 1036-9.
4. Zalenski RJ, Rydman RJ, McCarren M, et al. Feasibility of a rapid diagnostic protocol for an emergency department chest pain unit. Ann Emerg Med 1997; 29: 99-108.
5. Farkouh ME, Smars PA, Reeder GS, et al. A clinical trial of a chest pain observation unit for patients with unstable angina. N Engl J Med 1998; 339: 1882-8.
6. Lee TH, Goldman L. Evaluation of the patient with acute chest pain. N Engl J Med 2000; 342: 1187-95.
7. Zalenski RJ, Rydman RJ, Ting S, Kampe L, Selker HP. A national survey of emergency department chest pain centers in the United States. Am J Cardiol 1998; 81: 1305-9.
8. Storrow AB, Gibler WB. Chest pain centers: diagnosis of acute coronary syndromes. Ann Emerg Med 2000; 35: 449-61.
9. McCarthy BD, Beshansky JR, D´Agostino RB, Selker HP. Missed diagnosis of acute myocardial infarction in the emergency department: results from a multicenter study. Ann Emerg Med 1993; 22: 579-82.
10. Pope JH, Aufderheide TP, Ruthazer R, et al. Missed diagnosis of acute cardiac ischemia in the emergency department. N Engl J Med 2000; 342: 1163-70.
11. Bassan R, Scofano M, Gamarski R, Pimenta L, Volschan A, Clare C. How many patients with acute myocardial infarction are at risk of being erroneously discharged from the emergency room? Eur Heart J 2000; 21(suppl): 19.
12. Gibler WB. Chest pain units: Do they make sense now? Ann Emerg Med 1997; 29: 168-71.
13. Rusnak RA, Stair TO, Hansen K, Fastow JS. Litigation against the emergency physician: common features in cases of missed myocardial infarction. Ann Emerg Med 1989; 18: 1029-34.
14. Karcz A, Holbrook J, Burke MC, et al. Massachusetts emergency medicine closed malpractice claims: 1988-1990. Ann Emerg Med 1993; 22: 553-9.
15. Lee TH, Juarez G, Cook EF, et al. Ruling out acute myocardial infarction. A prospective multicenter validation of a 12-hour strategy for patients at low risk. N Engl J Med 1991; 324: 1239-46.
16. Selker HP, Griffth JL, D'Agostino RB. A tool for judging coronary care admission appropriateness, valid for real-time and retrospective use. A time-insensitive predictive instrument (TIPI) for acute cardiac ischemia: a multicenter study. Med Care 1991; 29: 610-627 (Erratum, Med Care 1992; 30: 188).
17. Rude RE, Poole K, Muller JE, et al. Electrocardiographic and clinical criteria for recognition of acute myocardial infarction based on analysis of 3697 patients. Am J Cardiol 1983; 52: 936-42.
18. Bassan R, Scofano M, Mesquita E, Dohmann HF, Sanmartin C, Clare C. Diagnostic accuracy of the ECG for acute myocardial infarction and unstable angina: experience in a chest pain unit. Ann Emerg Med 1999; 34(part 2): S-64.
19. Gibler WB, Young GP, Hedges JR, et al. Acute myocardial infarction in chest pain patients with nondiagnostic ECGs: serial CK-MB sampling in the emergency department. Ann Emerg Med 1992; 21: 504-12.
20. Bassan R, Gamarski R, Pimenta L, Scofano M, Fabricio M, Macaciel R. How many CK-MB determinations are necessary to rule out acute myocardial infarction in patients without ST-segment elevation? Ann Emerg Med 1999; 34 (part 2): S-47.
21. Bassan R, Gamarski R, Pimenta L, et al. Eficácia de uma estratégia diagnóstica para pacientes com dor torácica e sem supradesnível do segmento ST na sala de emergência. Arq Bras Cardiol 2000; 74: 405-11.
22. Newby LK, Mark DB. The chest pain unit - ready for prime time? N Engl J Med 1998; 339: 1930-2.
23. Lown B, Vasaux C, Hood Jr WB, Fakhro AM, Kaplinsky E, Roberge G. Unresolved problems in coronary care. Am J Cardiol 1967; 20: 494-508.
24. Roberts R, Kleiman NS. Earlier diagnosis and treatment of acute myocardial infarction necessitates the need for a "new diagnostic mind-set". Circulation 1994; 89: 872-81.
25. Gibler WB. Chest pain evaluation in the ED: beyond triage (editorial). Am J Emerg Med 1994; 12: 121-2.
26. Gibler WB. Evaluating patients with chest pain in the ED: improving speed, efficiency, and cost – effectiveness, or teaching an old dog new tricks (Editorial). Ann Emerg Med 1994; 23: 381-2.
27. Bahr RD. Chest pain center: moving toward proactive acute coronary care. Int J Cardiol 2000; 72: 101-10.
28. McGovern PG, Pankow JS, Shahar E, et al, for the Minnesota Heart Survery Investigators. Recent trends in acute coronary heart disease – mortality, mobidity, medical care, and risk factors. N Engl J Med 1996; 334: 884-90.
29. Kereiakes DJ, Weaver WD, Anderson JL, et al. Time delays in the diagnosis and treatment of acute myocardial infarction: a tale of eight cities. Report from the prehospital study group and the Cincinnati Heart Project. Am Heart J 1990; 120: 773-80.
30. Anderson HV, Willerson JT. Thrombolysis in acute myocardial infarction. N Engl J Med 1993; 329: 703-9.
31. National Heart Attack Alert Program Coordinating Committee 60 Minutes to Treatment Working Group. Emergency department: rapid identification and treatment of patients with acute myocardial infarction. Ann Emerg Med 1994; 23: 311-29.
32. Schor S, Behar S, Modan B, Barell V, Drory J, Kariv I. Disposition of presumed coronary patients from an emergency room. A follow-up study. JAMA 1976; 236: 941-3.
33. Lee TH, Rouan GW, Weisberg MC, et al. Clinical characteristics and natural history of patients with acute myocardial infarction sent home from the emergency room. Am J Cardiol 1987; 60: 219-24.
34. Bassan R, Scofano M, Gamarski R, et al. Dor torácica na sala de emergência. A importância de uma abordagem sistematizada. Arq Bras Cardiol 2000; 74: 13-21.
35. Gomez MA, Anderson JL, Karagounis LA, Muhlestein JB, Mooers FB. An emergency department-based protocol for rapidly ruling out myocardial ischemia reduces hospital time and expense: results of a randomized study (ROMIO). J Am Coll Cardiol 1996; 28: 25-33.
36. Hoekstra JW, Gibler WB, Levy RC, et al. Emergency – department diagnosis of myocardial infarction and ischemia; a cost analysis of two diagnostic protocols. Acad Emerg Med 1994; 1: 103-10.
37. Roberts RR, Zalenski RJ, Mensah EK, et al. Costs of an emergency department – based accelerated diagnostic protocol vs hospitalization in patients with chest pain: a randomized controlled trial. JAMA 1997; 278: 1670-6.
38. Graff LG, Dallara J, Ross MA, et al. Impact on the care of the emergency department chest pain patient from the chest pain evaluation registry (CHEPER) study. Am J Cardiol 1997; 80: 563-8.
39. Panju AA, Hemmelgarn BR, Guyatt GH, Simel DL. Is this patient having a myocardial infarction? JAMA 1998; 280: 1256-63.
40. Diamond GA, Forrester JS. Analysis of probability as an aid in the clinical diagnosis of coronary artery disease. N Engl J Med 1979; 300: 1350-8.
41. Berger JP. Right arm involvement and pain extension can help to differentiate coronary diseases from chest pain of other origin: a prospective emergency ward study of 278 consecutive patients admitted for chest pain. J Intern Med 1990; 227: 165-72.
42. Ryan TJ. Refining the classification of chest pain: a logical next step in the evaluation of patients for acute cardiac ischemia in the emergency department. Ann Emerg Med 1997; 29: 166-8.
43. Hutter Jr AM, Amsterdam EA, Jaffe AS. 31st Bethesda Conference: Emergency Cardiac Care (1999). Task Force 2: Acute Coronary Syndromes; Section 2B-Chest discomfort evaluation in the hospital. J Am Coll Cardiol 2000; 35: 853-62.
44. Tatum JL, Jesse RL, Kontos MC, et al. Comprehensive strategy for the evaluation and triage of the chest pain patient. Ann Emerg Med 1997; 29: 116-25.
45. Goldman L, Cook EF, Brand DA, et al. A computer protocol to predict myocardial infarction in emergency department patients with chest pain. N Engl J Med 1988; 318: 797-803.
46. Pozen MW, D'Agostino RB, Selker HP, Sytkowski PA, Hood Jr WB. A predictive

instrument to improve coronary care unit admission practices in acute ischemic heart disease. A prospective multicenter clinical trial. N Engl J Med 1984; 310: 1273-8.
47. Goldman L, Cook EF, Johnson PA, Brand DA, Rouan GW, Lee TH. Prediction of the need for intensive care in patients who come to emergency department with acute chest pain. N Engl J Med 1996; 334: 1498-504.
48. Aufderheide TP, Rowlandson I, Lawrence SW, Kuhn EM, Selker HP. Test of the acute cardiac ischemia time-insensitive predictive instrument (ACI-TIPI) for prehospital use. Ann Emerg Med 1996; 27: 193-8.
49. Zalenski RJ, McCarren M, Roberts R, et al. An evaluation of a chest pain diagnostic protocol to exclude acute cardiac ischemia in the emergency department. Arch Intern Med 1997; 157: 1085-91.
50. Selker HP, Zalenski RJ, Antman EM, et al. An evaluation of technologies for identifying acute cardiac ischemia in the emergency department: executive report of a National Heart Attack Alert Program Working Group report. Ann Emerg Med 1997; 29: 1-12.
51. Gibler WB, Runyon JP, Levy RC, et al. A rapid diagnostic and treatment center for patients with chest pain in the emergency department. Ann Emerg Med 1995; 25:1-8.
52. Christian TF, Clements IP, Gibbons RJ. Noninvasive identification of myocardium at risk in patients with acute myocardial infarction and nondiagnostic electrocardiograms with technetium-99m-sestamibi. Circulation 1991; 83: 1615-20.
53. Nichol G, Walls R, Goldman L, et al. A critical pathway for management of patients with acute chest pain who are at low risk for myocardial ischemia: recommendations and potential impact. Ann Intern Med 1997; 127: 996-1005.
54. Lee TH. Chest pain in the emergency department: uncertainty and the test of time. Mayo Clinic Proc 1999; 66: 963-5.
55. Young GP, Gibler WB, Hedges JR, et al. Serial creatine kinase-MB results are a sensitive indicator of acute myocardial infarction in chest pain patients with nondiagnostic electrocardiograms: the second emergency medicine cardiac research group study. Acad Emerg Med 1997; 4: 869-77.
56. The Joint European Society of Cardiology/American College of Cardiology Committee. Myocardial infarction redefined. Eur Heart J 2000; 21: 1502-13.
57. Varetto T, Cantalupi B, Altieri A, Orlandi C. Emergency room technetium-99m sestamibi imaging to rule out acute myocardial ischemic events in patients with nondiagnostic electrocardiograms. J Am Coll Cardiol 1993; 22: 1804-8.
58. Hilton TC, Thompson RC, Williams HJ, Saylors R, Fulmer H, Stowers SA. Technetium-99m sestamibi myocardial perfusion imaging in the emergency room evaluation of chest pain. J Am Coll Cardiol 1994; 23: 1016-22.
59. Kontos MC, Jesse RL, Schmidt KL, Ornato JP, Tatum JL. Value of acute rest sestamibi perfusion imaging for evaluation of patients admitted to the emergency department with chest pain. J Am Coll Cardiol 1997; 30: 976-82.
60. Heller GV, Stowers SA, Hendel RC, et al. Clinical value of acute rest technetium-99m tetrofosmin tomographic myocardial perfusion imaging in patients with acute chest pain and nondiagnostic electrocardiograms. J Am Coll Cardiol 1998; 31: 1011-7.
61. Sabia P, Afrookteh A, Touchstone DA, et al. Value of regional wall motion abnormality in the emergency room diagnosis of acute myocardial infarction: a prospective study using two-dimensional echocardiography. Circulation 1991; 84: 185-92.
62. Peels CH, Visser CA, Kupper AJ, Visser FC, Roos JP. Usefulness of two-dimensional echocardiography for immediate detection of myocardial ischemia in the emergency room. Am J Cardiol 1990; 65: 687-91.
63. Kontos MC, Arrowood JA, Paulsen WHJ, Nixon JV. Early echocardiography can predict cardiac events in emergency department patients with chest pain. Ann Emerg Med 1998; 31: 550-7.
64. Fesmire FM, Percy RF, Bardoner JB, Wharton DR, Calhoun FB. Usefulness of automated serial 12-lead ECG monitoring during the initial emergency department evaluation of patients with chest pain. Ann Emerg Med 1998; 31: 3-11.
65. Jernberg T, Lindahl B, Wallentin L. ST-segment monitoring with continuous 12-lead ECG improves early risk stratification in patients with chest pain and ECG nondiagnostic of acute myocardial infarction. J Am Coll Cardiol 1999; 34: 1413-9.
66. Kirk JD, Turnipseed S, Lewis WR, Amsterdam EA. Evaluation of chest pain in low-risk patients presenting to the emergency department: the role of immediate exercise testing. Ann Emerg Med 1998; 32: 1-7.
67. Kamaran M, Teague SM, Finkelhor RS, Dawson N, Bahler RC. Prognostic value of dobutamine stress echocardiography in patients referred because of suspected coronary artery disease. Am J Cardiol 1995; 76: 887-91.
68. Colon III PJ, Mobarek SK, Milani RV, et al. Prognostic value of stress echocardiography in the evaluation of atypical chest pain patients without known coronary artery disease. Am J Cardiol 1998; 81: 545-51.
69. Macaciel R, Bassan R, Gamarski R, Scofano M, Vivacqua R, Mesquita ET. Prognostic value of treadmill stress testing in patients admitted to the emergency room with chest pain. Eur Heart J 2001; 22(suppl): 34.

Errata

Na Correlação Anatomoclínica, publicada em Arq Bras Cardiol 2002; 78: 600-6, a legenda correta da figura 3 foi impressa erroneamente. A correta é "Fotomicrografia do pulmão, exibindo granuloma (G) com numerosas células gigantes multinucleadas (pequenos asteriscos). Hematoxilina-eosina, objetiva 4X.