CHEST PAIN CENTERS - MOVING TOWARD PROACTIVE ACUTE CORONARY CARE

INTRODUCTION

Worldwide, ischemic heart disease remains the leading cause of death [1]. In the majority of developed countries, cardiovascular disease is the major cause of death, disability, lost productivity and reduced quality of life in adults [2]. In the US, acute myocardial infarction has remained the leading cause of death since the beginning of the century, presently resulting in more than 500 000 deaths annually [3]. Acute myocardial infarctions also result in consequential morbidity in the form of additional complications, such as congestive heart failure, cardiogenic shock and dysrhythmias. Unstable angina presents as frequently as acute myocardial infarctions, has a high risk of progression to myocardial infarction or death, and has a comparable impact on healthcare resources. However, unstable angina also offers the opportunity to intercede and minimize or even avoid progression to myocardial infarction.

Despite significant advances in the diagnosis and management of heart disease, which have produced dramatic improvements in the patient's prognosis, the mortality and morbidity associated with myocardial infarctions remain high. Key to the success of current treatments is early intervention and rapid initiation of therapy. The earlier one can detect the development of a potential cardiac event, the greater the likelihood that one can intervene successfully, reducing or avoiding the crisis event. Once a cardiac event occurs, shortening the interval between onset of symptoms and initiation of treatment correlates directly with smaller infarct size, reduced complications, and ultimately higher survival. Mortality for patients receiving treatment within 70 min of the cardiac event is 1.6%, as compared with 6% for patients treated within 6 h [4].

Unfortunately, medical intervention in acute coronary syndromes is frequently ineffective because treatment, for various reasons, is delayed. The first barrier to effective treatment can occur when a patient waits too long after symptom onset to present to the emergency department - whether from ignorance of the symptomatology or reluctance to admit a cardiac origin. The median time from onset of chest pain to arrival at the emergency department exceeds 2 h [5]. The second barrier can be found in a busy emergency department; if the patient is not in obvious distress, a significant amount of time may elapse between the patient's arrival at the emergency department and initiation of treatment [6]. Finally, patients may not receive timely treatment when they are mistakenly sent home. Approximately 5% of patients with myocardial infarctions (in the US, this is more than 35 000 annually) are incorrectly diagnosed and mistakenly discharged from the hospital - only to be later admitted with severe and possibly fatal infarctions [7-10].

Therefore, achieving optimal clinical outcomes requires informed patients recognizing cardiac symptoms and seeking treatment immediately and physicians rapidly and accurately diagnosing and treating the patients. Chest pain centers were developed specifically to overcome the previously mentioned barriers and provide better care [11, 12].

Working within the emergency department, chest pain centers provide highly trained specialists to evaluate and treat patients who present with chest pain, distinguishing them from the emergency departments, which have a more trauma-oriented focus. Chest pain centers seek to reduce the mortality and morbidity currently associated with myocardial
infarctions by improving patient response to chest pain, improving diagnosis and reducing the 'door-to-needle time,' promoting earlier intervention for patients with prodromal symptoms, and reducing or eliminating the release of patients at risk [11-13]. Chest pain centers often provide programs to educate the community to identify early heart attack symptoms (prodromal symptoms) and encourage them to present promptly for evaluation at the clinic - rather than waiting until the pain is severe and life threatening. As patients and physicians recognize the importance of anginal pain as a prodromal symptom of infarction, the treatment paradigm may be shifted from damage control using thrombolytic therapy to preventive intervention - the use of antithrombotic and antiplatelet agents, possibly including the new glycoprotein GP Ilb/IIa receptor antagonists. Additionally, cardiac care at chest pain clinics is enhanced by a willingness to treat and manage patients with ischemic disease who do not present with an acute myocardial infarction [11-13]. This represents the majority of chest pain patients, since only 10-15% of those presenting to the emergency department are diagnosed as having a myocardial infarction [14-16]. A patient who presents with chest pain and is curtly dismissed from a busy emergency department will be unwilling to risk such embarrassment the next time chest pain develops. Ironically, by providing earlier and improved care for chest pain patients, the clinics are also proving to be very cost-effective - patients who previously would have been admitted to rule out the possibility of myocardial infarction (ROMI) are now evaluated and often released for later follow-up by the clinic.

HISTORY OF CORONARY CARE IN THE UNITED STATES

In the early 1960s, there was no established treatment strategy for dealing with heart attack patients in the US [17]. Patients with crushing chest pain and evidence of myocardial infarction were admitted to the hospital for supportive care, but little could be done to halt the heart attack or minimize damage to the heart muscle. The development of the first coronary care unit (CCU) in a community hospital in Bethany, Kansas, by Hughes Day, MD, USA, marked a revolutionary change in provision of care. Within 6 years, every hospital in the US had a coronary care unit [18].

Early coronary care units treated patients suffering myocardial infarctions by providing prompt resuscitation for ventricular fibrillation and later prevented this lethal dysrhythmia with administration of intravenous lidocaine. Overall, during the 'dysrhythmia phase' of coronary care, mortality from heart attacks was reduced from 30 to 15% [19]. Development of the Swan-Ganz catheter, which allowed measurement of cardiac dysfunction and monitoring of inotropic therapy for shock and congestive heart failure, further reduced mortality related to heart attacks to 12% [19], but care was still palliative.

Thrombolytic therapy, the next major advance in cardiac care, dramatically changed the treatment of myocardial infarction to positive heart attack care. Opening coronary vessels within less than 6 h following acute thrombotic occlusion further reduced mortality to 6% and reduced infarct size significantly [4]. Further study revealed that
earlier administration of thrombolytic therapy (within 70 min of symptom onset) could reduce mortality to 1.2%. Equally impressive, now progression to a full myocardial infarction often can be avoided [4]. This changed the basic treatment paradigm - by earlier intervention, physicians could mitigate or even prevent the progression of the acute coronary syndrome.

Coronary care units stimulated astonishing progress in the diagnosis and treatment of heart attacks, creating a 'high-tech' and extremely expensive environment. Unfortunately, coronary care units are often crowded with patients to rule out myocardial infarction. The next major improvement in cardiac care will be triage-oriented: insuring that appropriate medical therapy reaches the people who need it, while identifying low and moderate-risk patients to reduce unnecessary hospital admissions. Only 25% of heart attack patients actually receive thrombolytic therapy, and only 10% receive it within the 'golden first hour' when it achieves its greatest therapeutic effect [20]. Thus, only 2-3% of all heart attack patients receive optimal benefit from thrombolytic reperfusion. Further, it has been estimated that 5% of myocardial infarction patients are inadvertently released from emergency departments, and 16% of those subsequently die [7, 8].

DEVELOPMENT OF CHEST PAIN CENTERS

Chest pain centers developed as a strategy to reduce mortality and morbidity from myocardial infarction and to educate the public on the benefits of seeking help when chest pain first occurs [11-13]. Consequently, chest pain centers focused initially on 'fast-track' protocols, developed to rapidly and accurately diagnosis and treat patients with an infarction and administer thrombolytic therapy, with the target of a 30-min door-to-needle time. Since up to 70% of coronary care patients are discharged without a myocardial infarction, chest pain centers offered a lower cost facility that provided thorough evaluation, using standardized protocols to avoid inappropriate discharge. Finally, both goals of the chest pain centers were supported by an underlying strategy to educate the community about heart attacks, how to recognize the early warning signs of an impending infarction and when to seek help. Community education is a critical factor in reducing morbidity and mortality since the 'heart' of the heart attack problem is in the community [21].

TREATMENT PROTOCOLS FOR CHEST PAIN PATIENTS

When patients present to an emergency department with chest pain, the first step is to determine if they are experiencing a myocardial infarction, since action must take place immediately if myocardial damage is to be minimized. To assure rapid treatment many hospitals developed 'fast track' protocols to facilitate thrombolytic therapy for appropriate patients with myocardial infarction. Unfortunately, despite guidelines and protocols promoting rapid administration of thrombolytic therapy, few hospitals consistently achieve this goal. The myocardial infarction triage and intervention (MITI) [4] trial evaluated heart attack care in hospitals, observing that hospitals provided better cardiac care when involved in a research study compared with when they were not in a clinical study. These inconsistencies within the same emergency departments highlighted the fact that 'preparedness' is a critical component of heart attack care and that emergency departments need some form of sustaining influence to maintain vigilance and provide optimal cardiac care.

However, optimal cardiac care is not achieved solely through guidelines for thrombolytic therapy. Annually, over 5.5 million patients in the US present to the emergency department with chest pain, but eventually only 10-15% are diagnosed with an acute myocardial infarction [15,16]. Although management strategies for patients with myocardial infarction are well defined [22,23], treatment of chest pain patients with atypical or nondiagnostic symptoms is less clear. When unsure of a definitive diagnosis many physicians will admit the patient to the coronary care unit to be safe. An estimated 50-60% of emergency department chest pain patients are admitted to coronary care units and most are found to be free of cardiac disease.

This conventional approach to treating patients with undiagnosed chest pain, however, contains major shortcomings. First, although the incidence of myocardial infarction patients misdiagnosed has been reduced, an estimated 5% of chest pain patients fall through the cracks and are mistakenly sent home where they experience a myocardial
infarction. Of this number, approximately 16% will die from complications associated with their heart attack [7-10]. Second, this is an expensive way to treat chest pain patients. Approximately 70% of patients admitted to coronary care units do not develop a myocardial infarction during observation and are discharged with no significant disease found [9,15]. In the US alone, these 'unnecessary' admissions account for an estimated 1.6 million hospital days and a total cost exceeding $4 billion annually [24].

Chest pain centers address the shortcomings in the conventional approach by presenting an effective strategy for managing both sets of patients with chest pain. Patients presenting to chest pain centers with chest pain or discomfort are subject to a comprehensive and systematic triage plan [25]. In addition to promoting fast track treatment protocols for opening blocked coronary vessels, through the appropriate use of thrombolytic therapy or angioplasty, the triage plan aids the clinician in attaining a 'proper diagnosis.' Chest pain patients with an uncertain diagnosis are no longer automatically admitted to cardiac care, but are observed, evaluated and placed into one of five clinical tracks, depending on the probability of myocardial ischemia (Fig. 1).

The chest pain center provides standardized, yet accelerated protocols for a quicker more precise evaluation of patients than does the traditional inpatient [11, 12]. Patients in these units undergo a series of protocol-driven tests that quickly provides sufficient evidence to definitively rule out a myocardial infarction. Additionally, serial testing of patients for biochemical markers of cardiac damage allows risk stratification of the group, facilitating appropriate treatment. Whether they enter chest pain centers or the emergency department, patients with obvious signs of acute myocardial infarction and ST segment elevation are placed in Track I and require prompt treatment with thrombolytic agents. After initiating therapy, usually within 30 min of arrival, patients are admitted to the coronary care unit. Achieving this goal is estimated to have an annual life savings potential of 15 000 additional patients [26].

Track II represents patients with non-Q-wave myocardial infarction (NQMI), or severe progressive unstable angina (UA). A high rate of mortality can be associated with these patients, and they are treated and stabilized in chest pain centers until they can be admitted into the coronary care unit. The patient can be 'cooled down' through the appropriate use of aspirin, heparin and, most recently, GP IIb/IIIa platelet receptor inhibitors, pending decisions regarding cardiac catheterization and patient management. Recent clinical trials suggest that the appropriate use of GP IIb/IIIa receptor inhibitors may reduce progression to myocardial infarction, reduce the magnitude of an infarction that still occurs, and improve outcomes if angioplasty, with or without stenting, is part of the treatment regimen [27-33]. Other studies are underway to evaluate the appropriate use of these agents with thrombolytics. The primary concern when combining potent antiplatelet and antithrombotic agents will be the increased risk of major bleeding, intracranial hemorrhage, or thrombocytopenia. If a surgical procedure is required, the antiplatelet therapy should be discontinued, and platelet infusion may be necessary. Chest pain center specialists can treat these patients effectively without compromising later treatment options.

A second level of care provided by chest pain centers involves the evaluation of
patients with potential myocardial ischemia. After acute myocardial infarction is ruled out, chest-pain patients are further evaluated and differentiated, based on the likelihood of myocardial ischemia. Patients are assigned to Track III (moderate probability) or Track IV (low probability) (Fig. 1). Since some 40-60% of acute myocardial infarction patients have experienced prodromal symptoms in the week before the acute event, effective management of these Track III and IV patients offers the greatest likelihood of avoiding infarction. Early and effective management, both behavioral and pharmacological, of these individuals may forestall or possibly avoid acute incidents. At the same time, the observation period allows identification of the higher risk patients in Track III who may eventually be admitted to the coronary care unit, but can be treated appropriately until that decision is clear. The remaining patients in Track III and IV denote a group that has experienced an ischemic episode and are more likely to benefit from observational management of their disease. Because of the fear inherent in this type of event these patients are 'teachable.'

Track III and IV patients (60% of presenters) have become, perhaps, the most important subset of patients in chest pain center strategy. Although, the majority of these patients can be safely discharged for outpatient follow-up, a small percentage of myocardial infarction patients show atypical presentations.

Traditionally, these patients were released, with the inherent risk of post-discharge infarction, or required a 2- to 3-day inpatient stay in the coronary care unit. However, after a 6- to 8-h period in the chest pain clinic, with the use of biochemical markers and possibly stress testing, 80% of these patients can be safely discharged. The overall goal of chest pain centers is to keep accidental discharge of patients with myocardial infarction to less than 0.1%. This high quality care is provided at one-half the cost of a traditional rule-out [34]. Track V patients (15% of presenters) represent a group of patients that may, or may not, have experienced a cardiac event. If the chest pain can be determined to be non cardiac, often by obtaining a complete clinical and patient history (for example, establishing that the patient had been hit in the chest with an elbow during a ball game), the patients are sent home. The importance of good interviewing skills should not be overlooked with any of these groups. To avoid accepting a cardiac origin for their pain, patients will often offer plausible explanations once the pain has past.

Triage of chest pain patients represents another milestone in the treatment of acute ischemic coronary syndromes. Chest pain centers provide for the rapid treatment of patients with acute myocardial infarction, but promote the more aggressive treatment of patients with unstable angina or even early stages of ischemic disease. This opens the possibility of a more aggressive community awareness program for early recognition of prodromal symptoms since chest pain centers are more capable than emergency departments or hospitals to sort out low-probability ischemic patients and handle large numbers of patients. Thus, as the paradigm shifts to early intervention, heart attack avoidance care can be emphasized, although this may result in larger number of patients presenting to chest pain centers with milder symptoms of chest pain (Fig. 2). Chest pain centers are designed to use standardized protocols to efficiently and accurately diagnose and treat these patients, without being overburdened.
PATIENT EDUCATION

Heart attacks often are fatal because patients come to the emergency department too late - presenting the clinician with the final stages of a progressive ischemic syndrome. To reduce patient delays in seeking treatment, the community must become aware that heart attacks need not kill, and even may be avoided, if addressed in their initial presentation [35]. Thus, the third contribution of chest pain centers is the prevention of myocardial infarctions through community education.

A questionnaire was recently sent to community-based cardiologists and reported a consensus (80%) opinion that the public is not aware of the importance of early chest symptoms [13]. Thus, community education programs should emphasize the benefits of recognizing the early warning signs of a heart attack - the heart attack can be more easily treated, and possibly prevented, if patients seek early treatment and not wait until the symptoms become debilitating.

Although prodromal symptoms have been described in the literature for the last 75 years, effective early intervention to reduce the progression to an acute myocardial infarction is recent. Approximately 50% of patients with heart attacks report that they had prodromal anginal symptoms before the acute event [36]. In the GUSTO II study, 44% of the 4000 patients with myocardial infarction reported intermittent symptoms over a 2-week period prior to their heart attack [37]. The mortality difference in the GUSTO II trial between patients with myocardial infarction and prodromal unstable angina was 5.2 versus 3.28%. Thus, more patients may be saved with intervention at the prodromal unstable angina stage, as opposed to waiting for the infarction to occur. Further, the most cost-effective way to ‘treat’ a myocardial infarction may be to avoid it.

Prodromal symptoms, however, present as mild chest discomfort and can be deceiving, in that they are brief and often intermittent (stuttering) in their presentation [16]. Since most people equate a myocardial infarction with severe chest pain, the mild intermittent prodromal symptoms are often ignored, delaying time-critical treatment. To benefit from early intervention, adults should be taught to recognize these subtle prodromal symptoms and the importance of seeking help when they occur in themselves, family or friends.

By concentrating on early heart attack care, the speed and accuracy of diagnosis has improved, and the ‘door to needle’ time has been substantially reduced - often to under 30 min. The next major improvement in care will come from moving treatment further ‘upstream’ - reducing the delay from the onset of symptoms to presentation at chest pain centers. The benefits will be two-fold: earlier treatment of patients with myocardial infarction can reduce the severity of the infarction and limit tissue necrosis, while earlier aggressive treatment can now reduce the development of subsequent infarcts. This is also true for patients presenting with unstable angina and NQMI. Although clinical trial designs and measured outcomes differ significantly, Table 1 suggests that adding a GP IIb/IIIa inhibitor to current therapy is likely to save another 15 lives/infarctions per thousand patients treated.

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<th>Table 1</th>
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<td>Pooled clinical outcomes in trials of platelet GP IIb/IIIa receptor inhibitors for the treatment of unstable angina and non-Q-wave myocardial infarction.</td>
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<tr>
<th>Trial</th>
<th>Active agent</th>
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<th>Placebo (%)</th>
<th>GP IIb/IIIa treated (%)</th>
<th>Absolute difference (%)</th>
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<tr>
<td>PARAGON</td>
<td>Lamifiban</td>
<td>2282</td>
<td>11.7</td>
<td>10.3</td>
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<tr>
<td>PRISM</td>
<td>Tirofiban</td>
<td>3231</td>
<td>7.0</td>
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<tr>
<td>PRISM-PLUS</td>
<td>Tirofiban</td>
<td>1570</td>
<td>11.9</td>
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Chest pain centers are strategically designed to be user-friendly facilities for patients experiencing an early manifestation of ischemic heart disease [35]. Chest pain, or central chest discomfort, should be treated as a predictive tool for an impending acute event [38]. Designating chest pain as a risk factor may help to overcome resistance to early intervention. Making the chest pain centers receptive to all chest pain patients, regardless of cardiac origin, will increase the likelihood that patients will visit chest pain centers ‘just to be safe.’ Concerns that this approach would result in ‘chest pain hysteria’, flood emergency departments with ROMI patients, and increase medical costs have proven unfounded. By offering a comprehensive approach, chest pain centers provide prompt and efficient detection and treatment for myocardial infarction and ischemia.

MEDICAL OUTCOMES

Although thrombolytic therapy and primary angioplasty for thrombolytic ineligible patients have reduced mortality following acute myocardial infarction, consistent benefits have not yet been achieved. Delay in treatment, a major determinant of patient outcome, raises the mortality associated with heart attacks four-fold [39].

The best improvement in morbidity and mortality associated with myocardial infarction will be achieved when patients with prodromal unstable angina receive optimal treatment protocols, including antiplatelet and antithrombotic agents that are currently available to prevent progression to an acute myocardial infarction. Chest pain centers can accomplish this by providing a facility where patients come in at the earliest symptom of chest pain, are evaluated in a user-friendly environment, and promptly receive appropriate treatment.

The identification of a low-probability myocardial ischemic disease category (Track IV) is a pivotal aspect of the strategy employed by chest pain centers to reduce heart attack mortality. Development of this track, along with a community awareness campaign, opened the emergency room door to a large number of patients who present with mild chest pain symptoms. If these patients receive treatment at the prodromal unstable angina stage, mortality can be reduced by 50% [40].

ECONOMIC OUTCOMES

The goals of chest pain centers are to triage and evaluate patients, provide rapid patient treatment, and optimize resource utilization. Chest pain centers do not require separate facilities and can coexist within the emergency department, requiring only an area where patients can be observed. The initial change must occur in the clinician's mindset - patients must be observed as long as necessary. This is a major deviation from the emergency room mentality that stresses rapid stabilization and processing of patients; in the absence of acute or traumatic injury, the patients - usually are discharged. However, in the chest pain center, patients with moderate-to-low risk of acute ischemic coronary syndromes may be observed, treated, and evaluated for up to 9 h, with stress testing or sequential biochemical markers tested before a decision is made.

Studies evaluating the cost of heart attack care of low-probability ischemic patients have demonstrated a reduction in costs per patient between $1000 and $3000 (Table 2). Chest pain centers provide rapid and safe evaluation and appropriate treatment of chest pain patients at costs of between 20 and 50% of the typical 1- to 3-day inpatient work-up. Additionally, chest pain centers reduce the number of hospital admissions for patients who are eventually diagnosed with pain of non cardiac origin - admissions that are estimated to cost $3.5 billion annually [45,48]. Careful screening of cardiac patients allows for approximately 80% of patients with low-to-moderate risk of ischemia to be
CONCLUSION

Modeled on the success of the coronary care units, chest pain centers provide a comprehensive management strategy for the evaluation, triage, and appropriate treatment of chest pain patients [14]. Newer treatment options offer greater benefits to early, aggressive intervention. Chest pain centers also educate patients about prodromal symptoms and emphasize the benefits of early treatment, before progression to an acute myocardial infarction.

The rapid growth in the number of chest pain centers has been driven by reports that demonstrate this approach to be not only highly effective in treating acute myocardial infarction patients but also a cost-effective method of evaluating ischemia patients with low-to-moderate risk of a heart attack. Chest pain centers also promote highly aggressive cardiac outreach programs that encourage patients with early chest pain to come in for evaluation and treatment if necessary [11,50].

The ultimate success of chest pain centers will be demonstrated by a significant decrease in the mortality associated with heart attacks. Achieving this goal will require consistent rapid evaluation and treatment of infarction patients; detection of atypical infarcts and unstable angina; earlier intervention with newer therapeutic agents; reduction of the event-to-door time; and intervention during prodromal episodes. These latter strategies require educational campaigns to promote the need to recognize and seek treatment for prodromal symptoms. The strategy of the chest pain center is aimed at the most vulnerable phase of the heart attack cycle - the prodromal unstable angina phase - and can reshape our approach to solving the heart attack problem.

References


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