SPECIAL ARTICLE

The 2004 ACC/AHA Guidelines: A perspective and adaptation for Canada by the Canadian Cardiovascular Society Working Group

Paul W Armstrong MD[1], Peter Bogaty MD[2], Christopher E Buller MD[3], Paul Dorian MD MSc[4], Blair J O'Neill MD[5]

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Major changes in acute ST elevation myocardial infarction (STEMI) management prompted a comprehensive rewriting of the American College of Cardiology/American Heart Association Guidelines. The Canadian Cardiovascular Society (CCS) participated in both the writing process and the external review. Subsequently, a Canadian Working Group (CWG), formed under the auspices of the CCS, developed a perspective and adaptation for Canada. Herein, accounting for specific realities of the Canadian cardiovascular health system, is a discussion of the implications for prehospital care and transport, optimal reperfusion therapy and an approach to decision making regarding reperfusion options and invasive therapy following fibrinolytic therapy. Major recent developments regarding indications for implantable cardioverter defibrillator(s) (ICDs) also prompted a review of indications for ICDs and the optimal timing of implantation given the potential for recovery of left ventricular function. At least a 40-day, preferably a 12-week, waiting period was judged to be optimal to evaluate left ventricular function post-STEMI. A recommended algorithm for the insertion of an ICD is provided.

Implementation of the new STEMI guidelines has substantial implications for resources, organization and priorities of the Canadian health care system. While on the one hand, the necessary incremental funding to provide tertiary and quaternary care and to support revascularization and device implantation capability is desirable, it is equally or more important to develop enhanced prehospital care, including the capacity for early recognition, risk assessment, fibrinolytic therapy and/or triage to a tertiary care centre as part of an enlightened approach to improving cardiac care.

Key Words: *Implantable cardioverter defibrillator; Myocardial infarction; Reperfusion*

Les lignes directrices 2004 de l'ACC et de l'AHA : Un point de vue et une adaptation pour le Canada par le groupe de travail de la Société canadienne de cardiologie

Des changements importants dans la prise en charge de l'infarctus du myocarde avec élévation du segment ST (IMÉST) a donné lieu à une refonte complète des lignes directrices de l'*American College of Cardiology* et de l'*American Heart Association*. La Société canadienne de cardiologie (SCC) a participé à la fois au processus de rédaction et à l'examen externe. Par la suite, un groupe de travail canadien (GTC), formé sous les auspices de la SCC, a élaboré un point de vue et une adaptation pour le Canada. Le présent article, tenant compte des réalités propres au système canadien de santé cardiovasculaire, traite des répercussions pour les soins préhospitaliers et le transport, de la thérapie de reperfusion optimale et de la démarche pour la prise de décision au sujet des possibilités de reperfusion et de traitement effractif après une thérapie fibrinolytique. De nouvelles données récentes au sujet des indications pour installer un ou plusieurs défibrillateurs internes à synchronisation automatique (DISA) ont également suscité une analyse des indications de DISA et du moment optimal de l'implantation compte tenu du potentiel de récupération de la fonction ventriculaire gauche. Une attente d'au moins 40 jours, et de 12 semaines de préférence, était jugée optimale pour évaluer la fonction ventriculaire gauche après un IMÉST. L'algorithme recommandé pour insérer un DISA est fourni.

L'adoption des nouvelles lignes directrices sur l'IMÉST a des répercussions substantielles en matière de ressources, d'organisation et de priorités pour le système de santé canadien. Le financement incrémentiel nécessaire pour offrir les soins tertiaires et quaternaires et pour soutenir la revascularisation et la capacité d'implantation de l'instrument est souhaitable, mais il est tout aussi important, sinon plus, de prévoir des soins préhospitaliers accrus, y compris la capacité de dépistage rapide, d'évaluation du risque, de thérapie fibrinolytique ou de triage vers un centre de soins tertiaires dans le cadre d'une démarche éclairée pour améliorer les soins cardiaques.

Dramatic changes in the approach to the management of patients with ST elevation myocardial infarction (STEMI) have prompted a comprehensive review and major rewriting of new American College of Cardiology (ACC)/American Heart Association (AHA) guidelines (1). Canadian Cardiovascular Society (CCS) participation in developing new ACC/AHA guidelines for the management of patients with STEMI was invited in fall 2001, and one of us (PWA) participated as part of a 15-member committee to develop these guidelines in accordance with recognized procedures (2). The process has been well described elsewhere, but in this instance it required extensive work, a review of the literature, development of contemporary recommendations, peer and task force review by 43 external reviewers, resolution of over 2000 peer-reviewed comments, and final board, legal and pharmacological review in advance of the current electronic and print publication. As

[1]*University of Alberta, Edmonton, Alberta;* [2]*Quebec Heart Institute/Laval Hospital, Sainte-Foy, Quebec;* [3]*Department of Medicine, Division of Cardiology, University of British Columbia and St Paul's Hospital, Vancouver, British Columbia;* [4]*Department of Medicine, St Michael's Hospital, University of Toronto, Toronto, Ontario;* [5]*Dalhousie University, Halifax, Nova Scotia*

Correspondence and reprints: Dr Paul W Armstrong, VIGOUR Centre at University of Alberta, 251 Medical Sciences Building, Edmonton, Alberta T6G 2H7. Telephone 780-492-0591, fax 780-492-9486, e-mail paul.armstrong@ualberta.ca

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this process matured and the guidelines were finalized, it became clear, based on the content of the guidelines and an external review by an additional CCS representative (PB), that a perspective for Canada would be useful. Accordingly, a Canadian Working Group (CWG) was formed under the auspices of the CCS to review the guidelines, and to provide interpretation and adaptation, where appropriate, for Canadian practice. Two interventional cardiologists (CEB and BJO) and an electrophysiologist (PD) provided the necessary balance in developing a perspective and adaptation of the ACC/AHA STEMI guidelines for Canada.

The CWG took into account specific realities of the culture and delivery of cardiovascular health care in Canada in adapting the important work of the ACC/AHA STEMI Guidelines Committee, and this perspective and adaptation has been approved by the Council of the CCS. In particular, it focuses on the following areas: strategies for prehospital care and emergency triage; choice of optimal reperfusion therapy (ie, fibrinolysis and percutaneous coronary intervention [PCI]); the approach to intervention following fibrinolysis; indications for implanting cardio defibrillators following STEMI; and the role of noninvasive testing following STEMI.

We have also indicated how implementation of the ACC/AHA guidelines could constructively modify patient and health care professional education and training; enhancement of technology to improve in-field recognition, care and triage of STEMI patients; communication and networking of health care facilities involved in STEMI management, with particular emphasis on optimal timing and appropriateness of interinstitutional transportation of STEMI patients; and the establishment of national performance standards and a process for regular audit and feedback.

IMPLICATIONS FOR PREHOSPITAL CARE AND EMERGENCY MEDICAL SERVICES TRANSPORT

Emphasis on reducing the delay to first medical contact is unquestionably a key factor affecting patient outcome irrespective of health care jurisdiction. Although the desirability of calling 911 if symptoms suggestive of STEMI develop is emphasized, geographical realities and the distribution and capacity of current emergency medical services (EMS) in Canada are such that there may be instances where family or friends are better able to facilitate rapid transport (see Appendix, point i). Nevertheless, all regional health authorities should implement coordinated comprehensive paramedical systems to enhance the prehospital diagnosis, management and triage to the most appropriate health care facility. Because many patients with established angina do not show improvement in their chest discomfort for at least 5 min and require more than one nitroglycerin, we also believe that relaxing the time window from 5 min to 10 min before calling 911 may be reasonable (see Appendix, points i and ii).

The new guidelines contain many recommendations that imply the capacity for safe emergent or urgent access to specialized tertiary care. Because tertiary care is highly centralized in Canada, some guideline implementations have broad implications for in-field diagnosis, treatment and triage, and extend to all modes of ambulance transport ranging from land and regional transport (usually helicopter) to provincial and interprovincial air transport (usually fixed-wing). Accordingly, regional health authorities and other stakeholders should examine the design, resourcing and performance of their current systems for patient transportation. In some instances, this will require improved delivery of existing capabilities and competencies, whereas in others, new capacity will be required. Algorithms facilitating the diagnosis of STEMI, using in-field electrocardiographic diagnosis, the capacity for electrocardiogram (ECG) transmission, and prompt, accurate physician interpretation and communication will be cornerstones of such a strategy. Such a program should have the capacity to identify high-risk patients and those ineligible for fibrinolysis to facilitate direct transportation of such patients to a previously alerted expert primary PCI facility. The adoption of such an approach will require consideration of the volume of expected patients, geographical considerations associated with distance and mode of transportation, implications for hospital beds and return/repatriation of patients to a primary referring institution, and broader implications for EMS.

OPTIMAL REPERFUSION STRATEGY

Major discussion occurred as it relates to the emphasis on primary PCI (see Appendix, point iii). Although a systematic review of PCI versus fibrinolysis suggests that primary PCI is the superior option, this has been criticized on methodological grounds (3,4). If PCI is superior to fibrinolysis in reducing mortality, the magnitude of that superiority is likely to be modest and not greater than the margin of benefit produced by accelerated recombinant tissue plasminogen activator versus streptokinase or by prehospital versus in-hospital fibrinolysis (5). The CWG believes that in appropriately selected patients, especially within the first 3 h after symptom onset, fibrinolysis provides at least a comparable standard of care to primary PCI. Some jurisdictions with well-developed EMS transport and PCI facilities will develop efficient 24 h/7 day primary angioplasty programs, and the CWG supports this strategy with appropriate metrics to ensure high compliance to the 90 min window for routine STEMI treatment. Nevertheless, if both options are equally and promptly available, the CWG believes that in most jurisdictions, it is reasonable to favour fibrinolysis in the majority of low-risk cases and to prefer PCI in higher-risk cases. In general, high-risk STEMI is characterized by those with cardiogenic shock or Killip class III; other high-risk features include extensive anterior myocardial infarction (MI) and older age (ie, 75 years and over). There is some evidence to support a greater margin of benefit of PCI over fibrinolysis in patients presenting more than 3 h after symptom onset (6,7).

A clinical algorithm (Figure 1) has been developed for the treatment of STEMI and addresses a number of the aforementioned issues. It implies that the clinical diagnosis of STEMI is not in doubt and assumes the application of clinical judgement in comparing risks and benefits, taking into account not only the risk of MI and fibrinolysis but also the likelihood of achieving rapid transfer to a skilled PCI facility. If the diagnosis is uncertain, additional efforts, including serial electrocardiography, a review of previous ECGs or echocardiography, may be required. Appropriate expedited transport, analogous to that applied to STEMI patients who are ineligible for fibrinolysis, along with urgent catheterization and mechanical intervention may be desirable. Of the fibrin-specific fibrinolytic agents available, bolus drugs are preferred given their ease of administration, facilitating more rapid treatment and a reduced risk of medication errors. The CWG favours these agents over streptokinase

for high-risk STEMI patients but believes that streptokinase is an acceptable alternative for lower risk patients, especially older patients (75 years and over) for whom a significant risk for cerebral bleeding exists; in this circumstance, streptokinase may be preferable to fibrin-specific agents if PCI is not readily available or appropriate.

The CWG underscores the fact that the new guidelines define time from symptom onset to first medical contact rather than to arrival at the hospital. In instances where interhospital transfer occurs, the point of first medical contact at the other facility needs to be accounted for in the triage strategy. Except in extraordinary circumstances, a door-to-needle time of 30 min is considered maximally acceptable for fibrinolysis; ideally, it should be less (ie, 15 min to 20 min). Similarly, for primary PCI, the maximally acceptable door-to-balloon time should be 90 min; ideally, this should be 40 min to 60 min. Irrespective of the mode of reperfusion, each centre should, at least quarterly, evaluate its times to treatment and other measures of performance in a transparent fashion to ensure optimal adherence to guidelines. Sources of avoidable delay should be identified and corrected so that treatment strategies can be continuously improved. Specific quality indicators recorded for all STEMI transports (emphasizing diagnosis to fibrinolysis and to balloon time and safety during transport) should exist and be reviewed regularly. These performance standards effectively preclude adopting a routine strategy of primary PCI for STEMI where transport requires a driving time from first medical contact to PCI centre exceeding 60 min (at all times and in all conditions). Any transport by fixed-wing aircraft or transfer by rotary-winged aircraft from an off-hospital heliport or using central dispatch (thereby requiring a two-leg trip) would trigger similar restrictions.

Administering fibrinolytic therapy to STEMI patients carries with it not only a responsibility to evaluate the success of reperfusion but also a need to be vigilant for recurrent ischemia and the potential for reinfarction, especially within the first 36 h to 48 h after therapy when this risk is greatest. Patients qualifying for rescue PCI within 6 h of symptom onset should be provided access to priority emergency transport to a PCI facility.

HEMODYNAMICALLY COMPROMISED PATIENTS

All patients developing incipient shock or frank cardiogenic shock due to pump failure or mechanical complications should be identified promptly. With few exceptions, these patients should be referred immediately to a tertiary centre capable of performing PCI and cardiac surgery. The time window for benefit from emergency revascularization in patients with cardiogenic shock extends at least 36 h post-STEMI. Thus, the development of shock beyond the 6 h to 12 h time window for routine reperfusion therapy should not prevent referral and transport in this very high-risk group. Where emergency revascularization is under consideration for treatment of cardiogenic shock in the elderly, clinicians should consider the patient's premorbid medical conditions and functional status, as well as the patient's wishes (8,9). The land- and air-based ambulance systems in Canada should be equipped and resourced to respond in a prioritized fashion to such demands (as in rescue PCI discussed above). Furthermore, EMS providers and tertiary care institutions should strongly consider developing balloon pump transport capability.

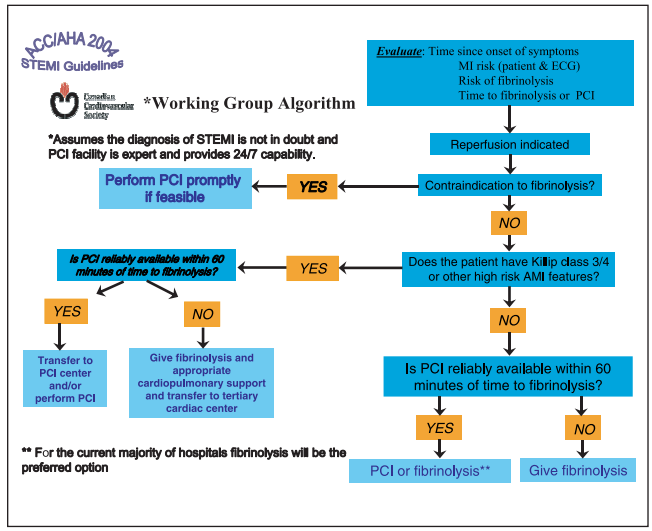

Figure 1) *The Canadian Working Group's clinical algorithm for ST elevation myocardial infarction (STEMI). The algorithm applies to patients presenting within 12 h of symptom onset with STEMI; it assumes that the diagnosis of STEMI is not in doubt and indicates that for the current majority of hospitals caring for nonhigh-risk STEMI patients, fibrinolysis is the preferred option. ACC American College of Cardiology; AHA American Heart Association; AMI Acute myocardial infarction; ECG Electrocardiogram; PCI Percutaneous coronary intervention*

POST-STEMI MANAGEMENT

The CWG recommends that noninvasive assessment following STEMI is an important and often underutilized option of value in assessing risk, as well as in providing an exercise prescription (see Appendix, point iv). Routine coronary angiography in low-risk patients is not recommended. Noninvasive testing may also be useful in prioritizing the timing and need for angiography and the urgency with which revascularization should be performed.

Cardiac catheterization following STEMI frequently leads to PCI or coronary artery bypass graft surgery, particularly when driven by provokable or recurrent ischemia, left ventricular dysfunction or other high-risk features. To avoid unnecessary costs and delays, air transport of patients for coronary angiography after STEMI to tertiary hospitals capable of cardiac surgery should occur. Air transport to stand-alone diagnostic facilities is strongly discouraged.

Education for STEMI patients around the time of discharge is unquestionably deserving of a more concerted and systematic approach. In particular, the CWG agrees that selected family members or friends should be apprised of CPR training and information concerning the use of an automated external defibrillator. However, the availability of such programs and resources is inadequate to meet the attendant demands of a class I recommendation for all STEMI patients, and the psychosocial implications of such a widespread recommendation are unknown. Accordingly, the CWG recommends such referrals, especially in target high-risk post-STEMI subgroups (see Appendix, points ii and v).

Whereas the CWG agrees with systematic referral for rehabilitation in appropriate patients, we also appreciate that less than 20% of eligible patients currently participate in outpatient

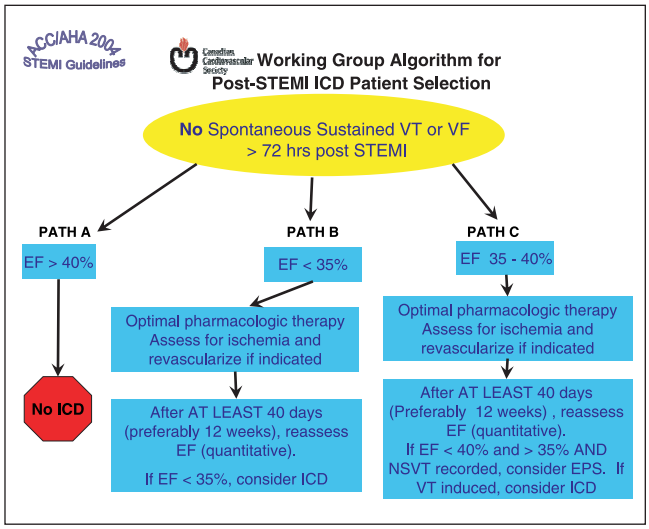

Figure 2) *The Canadian Working Group's algorithm for the selection of patients for implantable cardioverter defibrillator (ICD) implantation post-ST elevation myocardial infarction (STEMI). ACC American College of Cardiology; AHA American Heart Association; EF Ejection fraction; EPS Electrophysiological stimulation; NSVT Nonsustained ventricular tachycardia; VF Ventricular fibrillation; VT Ventricular tachycardia*

cardiac rehabilitation programs in Canada, and many of these are delivered in a nonstandardized, uncoordinated fashion. This issue has been appropriately identified and recommendations have been made for the enhancement of cardiac rehabilitation as a secondary prevention strategy (10).

CARDIOVERSION, DEFIBRILLATION AND IMPLANTABLE CARDIOVERTER DEFIBRILLATORS

Because rapid restoration of sinus rhythm for sustained ventricular tachycardia and ventricular fibrillation is a high priority, and additional risk from a higher initial energy shock is unproven, the CWG favoured a higher initial energy based on the benefit to risk ratio. Evidence is currently insufficient to recommend that all intensive care units be equipped with biphasic shock energy defibrillators, but if these are available, they should clearly be used in preference to monophasic devices (see Appendix, point vi).

Extensive discussion and additional consultation (see Acknowledgements) was undertaken as it relates to the ACC/AHA recommendations for implantable cardioverter defibrillator (ICD) implementation in patients after STEMI. Evidence continues to emerge on this issue and, like the ACC/AHA Committee, the CWG recognizes the dynamic evolution of recovery of left ventricular function in the first three months after MI, as well as uncertainties regarding the impact of optimal pharmacological management and the time taken to achieve it. Recent data from the Defibrillator in Acute Myocardial Infarction Trial (DINAMIT) (11) in high-risk post-MI patients (within 40 days of MI) with a reduced ejection fraction (35% or less) failed to show a treatment benefit from ICD implantation. Given these findings and the ascertainment bias inherent in early monitoring of ECG and LV function following MI, the CWG was uncertain regarding the potential benefit of ICDs implanted into patients believed to be at high risk early post-MI. Because patients in published trials of prophylactic ICDs were generally enrolled late (mostly one year or more after their most recent MI), extrapolation to the early post-MI period may not be warranted. Hence, we suggest that at least a 40-day, preferably a 12-week, waiting period is a reasonable compromise with respect to evaluation of left ventricular function post-STEMI. This time frame also permits evaluation of other comorbidities and factors that may influence long-term survival (refer to Appendix, point vii) (12,13). A recommended algorithm for the evaluation of such patients is provided in Figure 2.

With respect to the use of pacemakers post-STEMI, the CWG suggests that the indication for dual-chambered pacemakers be individualized given the absence of evidence from a large, randomized clinical trial that there is superiority of this approach on relevant major clinical end points (refer to Appendix, point viii). Further, with respect to the need for permanent ventricular pacing for "persistent and symptomatic" second- or third-degree atrioventricular block (refer to Appendix, point ix), the CWG cautions that heart block in inferior MI usually resolves within two weeks or more. Also, the CWG finds no evidence at this time to support biventricular pacing early post-STEMI when indications for permanent pacing exist in the early post-MI period.

IMPLICATIONS FOR THE FUTURE OF CANADIAN CARDIOVASCULAR CARE

It is clear from the guidelines that a bewildering array of new options has emerged for the care of patients with STEMI. The 2004 ACC/AHA guidelines (1) constitute a remarkably comprehensive and authoritative document that will be exceedingly useful to all stakeholders. The collaboration afforded the CCS to participate in the process is an excellent and welcome precedent. Implementation of the guidelines has substantial implications for the Canadian health care system as it relates to its resources, organization and priorities. While on the one hand, the necessary incremental funding to resource tertiary and quaternary care, and to support revascularization and device implantation capability, is unquestionably desirable, it is equally or more important to stress the development of enhanced prehospital care that includes the capacity for early recognition, risk assessment, fibrinolytic therapy and/or triage to a tertiary care centre as part of an enlightened approach to improving cardiac care.

APPENDIX
References to the appropriate sections in the American College of Cardiology (ACC)/American Heart Association (AHA) Guidelines

i) III.B. Patient Education for Early Recognition and Response to STEMI
ii) VII.L.1. Patient Education Before Discharge
iii) VI.C.3.f. Percutaneous Coronary Intervention (Primary PCI subsection)
iv) VII.K.1.a. Role of Exercise Testing
v) IV.A. Out-of-Hospital Cardiac Arrest
vi) VII.G.1.a Ventricular Fibrillation and VII.G.1.b Ventricular Tachycardia
vii) VII.G.1.e. ICD Implantation in Patients After STEMI
viii) VII.G.3.b. Pacing Mode Selection in Patients with STEMI
ix) VII.G.3.b Permanent Pacing for Bradycardia or Conduction Blocks Associated With STEMI

ICD Implantable cardioverter defibrillator; PCI Percutaneous coronary intervention; STEMI ST elevation myocardial infarction

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CONFLICT OF INTEREST: As per the ACC/AHA guidelines, all members of the writing group have submitted a disclosure showing any relationships that might be perceived as real or potential conflicts of interest to the secretariat of the Canadian Cardiovascular Society.

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