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Changing strategies in the management of acute myocardial infarction in modern China

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Summary Ischaemic heart disease (IHD) is a common condition in China, accounting for more than 700,000 deaths each year mainly due to acute myocardial infarction (MI). Currently there is no nationally representative registry in China to provide data about the epidemiology, clinical management and prognosis of patients with MI. The present review has used information from a few large nationwide randomised trials and some small regional registries to assess the patterns of management of MI in China.

As in many other countries, the management of acute MI in China has undergone a significant transformation during recent decades, due chiefly to an evidence-based approach to cardiovascular medicine. Antiplatelet therapy is now routinely given to almost all patients admitted with acute MI, using not only aspirin but increasingly combining it with clopidogrel. The overall use of reperfusion therapy is also consistent with that reported in Western populations, even though primary PCI is much less frequently used and the type of fibrinolytic agents commonly used may be less optimal in terms of the achieved patency rate of the infarct related artery. Anticoagulant therapy and ACE inhibitors are also used routinely in hospital, with about three-quarters of patients receiving such treatments consistently across different types of hospitals or regions. The use of beta-blocker therapy for acute MI in China has conventionally involved oral agents with little use of initial intravenous regimens, and this approach seems adequate for most patients with acute MI given the findings of the large COMMIT/CCS-2 trial in China. As a result of improved treatments, the hospital mortality for acute MI has declined significantly since the early 1990s.

Despite a significant improvement in the general care of MI, there is still substantial under-, over- and inappropriate treatment of many patients in China. Further

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improvements, especially with respect to long-term management after MI, will rely not only on better implementation of the many established cost-effective treatments but also on improvements in the medical care system and more active engagement of the medical profession to improve risk factor management, such as smoking cessation.

Introduction

Worldwide, over 15 million people die from cardiovascular disease every year, with about half due to acute myocardial infarction (MI) [1]. During the past few decades, the disease rate has declined substantially in most developed countries, but it is rising steadily in many developing countries, especially in China, as a consequence of rapid changes in lifestyle and dietary patterns. Ischaemic heart disease (IHD) has emerged as a leading cause of premature death in China, accounting for more than 700,000 deaths annually [2], with particularly high rates in urban cities such as Beijing, where the mortality rate from IHD increased by 40% during 1984—1999 [3]. Hospital registration data from selected regions showed that in 2004 IHD accounted for about 5% of total hospital bed days in large or medium-sized cities, whereas in rural county hospitals, it accounted for about 3% [4]. With an ageing population and a projected substantial rise in disease rate in China, the burden of MI is going to increase substantially over the next few decades [5].

One of the key measures in combating the increasing burden of MI in China is to provide evidence-based care to patients in a timely and cost-effective fashion. During the last two decades, the treatment of acute MI in China has undergone remarkable transformation, as in many other countries, driven chiefly by increasing awareness of therapies that have been shown by large-scale randomised trials to improve outcomes and that have subsequently been promoted by expert panels and national guidelines. This report examines recent trends in the management of acute MI in China, based on data from large nationwide randomised trials and regional registries, and discusses areas for further improvement.

General management of acute MI in hospital

The concept of the coronary care unit (CCU) was introduced into China during the early 1970s, and this, together with the use of defibrillation, rapidly led to a halving of in-hospital mortality following acute MI [6]. Between the late 1970s and early 1990s, there was little further improvement, with hospital mortality from MI persisting at 12—15% [6,7]. However, since the early 1990s the introduction and widespread use of various treatments with proven effectiveness has revolutionised the management of acute MI in China, resulting in further considerable improvement in patient outcome. Consequently, hospital mortality for acute MI has halved since the early 1990s (Table 1 and Fig. 1) [7,8]. There has also been a significant and continuous decline in the length of hospital stay, from an average of 4 weeks in the early 1990s down to about 2 weeks 10 years later (Fig. 2). This may be attributed in part to the increasing use of effective interventions to limit infarct size and recurrent ischaemia (Table 1), and in part to the implementation of various quality control measures to improve hospital efficiency.

Reperfusion therapy

Because acute MI is a time-dependent process, the speed in restoring the patency of the coronary arteries and subsequent reperfusion of the myocardium, using fibrinolytic therapy or percutaneous coronary intervention (PCI), is critical in limiting myocardial injury and reducing mortality [9,10]. Fibrinolytic therapy started to be used regularly in China during the early 1990s following publication of a number of major randomised trials. In the first Chinese Cardiac Study (CCS-1) that took place during 1990—1995 involving some 15,000 patients with acute MI recruited from 650 hospitals, about one quarter of patients with acute MI received fibrinolytic therapy in hospital [7]. By contrast, in the large COMMIT/CCS2 (ClOpidogrel and Metoprolol in Myocardial Infarction Trial/Second Chinese Cardiac Study) that took place 10 years later in 1250 hospitals throughout China, 56% of the patients with confirmed acute MI received immediate iv fibrinolytic therapy in hospital (Table 1), with the rate rising to 68% among those presenting within 12 h of symptom onset [8]. The use of fibrinolytic therapy was higher in men (58%) than

Table 1 Comparisons of hospital treatments for acute MI between patients enrolled in CCS-1 and COMMIT/CCS-2 at two time periods

	CCS-1	COMMIT/CCS-2
Year of study	1990–1995	1999–2005
No. of hospitals involved	650	1200
No. of provinces involved	30	30
No. of patients recruited	~15,000	~46,000
Patients' characteristics		
Female (%)	26	28
Mean age (yrs)	61.2	61.3
Killip class II/III (%)	30	25
Previous MI (%)	12	8
Previous hypertension (%)	40	43
Hospital treatments		
Fibrinolytic (%)	26	56
Aspirin[a] (%)	74	~100
ACE-I[b] (%)	50	68
Beta-blocker[c] (%)	23	50
Heparin (%)	25	75
Nitrate (%)	~95	94
Anti-arrhythmic (%)	47	23
Diuretic (%)	20	26
Calcium antagonist (%)	55	12
Hospital mortality in controls (%)	~12	~8
Mean days of hospital stay in survivors	~28	~15

[a] In COMMIT/CCS-2 aspirin was provided as a background treatment to all patients.
[b] In CCS-1, ACE inhibitor was given as the trial treatment to half of the patients.
[c] In CCS-1 oral agent only was given. In COMMIT/CCS-2 a beta-blocker (intravenous then oral) was given as part of trial treatment to half of the patients.

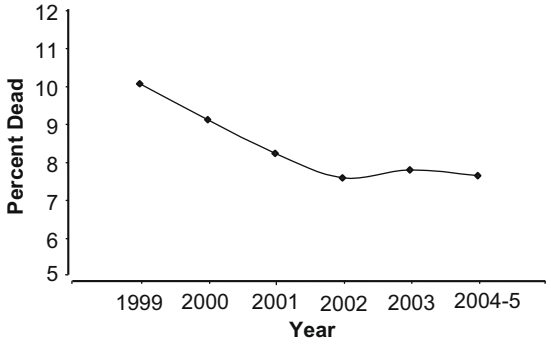

Figure 1 Standardised in-hospital mortality among patients enrolled in COMMIT/CCS-2 by study year.

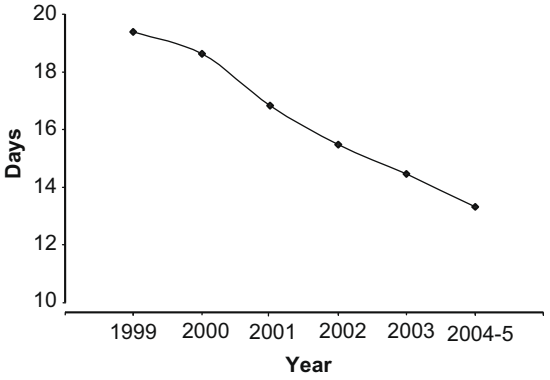

Figure 2 Duration of hospital stay among survivors in COMMIT/CCS-2 by study year.

in women (50%), and in younger patients (61% at age <55) than in older patients (34% at age >75) (Table 2 & Fig. 3), but did not appear to differ significantly between different types of hospital (Table 2). Similar findings have also been reported in other large randomised trials of acute MI in China during recent years [11]. Although patients enrolled into randomised trials tend to be highly selective and may not necessarily represent those seen in routine clinical practice, these findings were highly consistent with those reported in a small regional registry [12], and were also largely compatible with recent data reported in Western populations [13–15]. Despite the rapid increase in use of fibrinolytic therapy, the regimens and dosages typically used in many Chinese hospitals may not necessarily be the most optimal, partly due to economic constraints and partly due to concerns about excessive bleeding in Chinese patients.

Table 2 Standardized proportions of patients receiving various treatments by sex, age and types of hospitals in the COMMIT/CCS-2 trial [8]

Hospital treatments[a]	Sex		Age groups				Levels of hospital[b]			Overall
	Male (n = 31793)	Female (n = 12155)	<55 (n = 13175)	55—64 (n = 11666)	65—74 (n = 14184)	75+ (n = 4923)	I (n = 7758)	II (n = 23206)	III (n = 12984)	(n = 43948)
Fibrinolytic	57.7	50.0	60.5	57.8	51.1	32.2	58.1	54.9	56.3	55.9
Anticoagulants	75.3	74.0	76.4	74.0	74.6	71.3	78.7	70.2	82.1	75.2
ACI inhibitor	68.8	66.8	66.5	68.0	69.2	67.1	72.6	64.4	73.0	68.4
Anti-arrhythmic	23.9	20.0	22.0	22.1	22.1	20.6	21.7	23.4	22.8	22.9
Nitrates (oral or i.v.)	94.4	93.9	93.8	94.3	94.5	94.0	93.0	94.0	95.9	94.4
Diuretics	22.9	25.8	16.2	22.4	29.9	34.7	22.9	22.6	25.4	23.5
Calcium antagonist	11.2	12.2	12.0	12.4	11.5	10.0	11.8	10.8	12.3	11.4

[a] Restricted only to patients with confirmed STEMI enrolled in the trial, with 1904 patients with another diagnosis excluded from the analysis.
[b] Hospitals in China are generally classified into 3 levels, with level I being small community hospitals with only basic facilities and level III being major tertiary referral centres in provincial capitals or major cities.

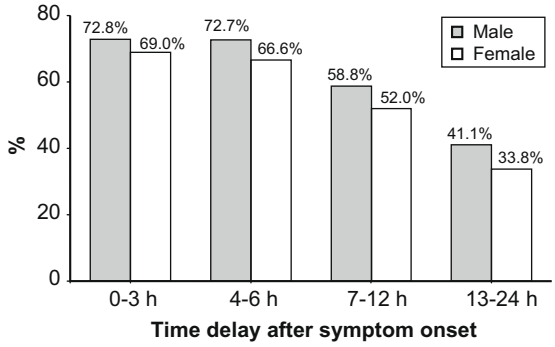

Figure 3 Proportion of patients who received fibrinolytic therapy, by time delay and sex in COMMIT/CCS-2, adjusted for age.

The most commonly used fibrinolytic agent in China is urokinase (UK), with less than 10% of fibrinolytic therapy used in COMMIT/CCS2 trial involving other agents such as tissue plasminogen activators (tPA) or streptokinase (SK). Similarly, in CREATE (The Clinical Trial of Reviparin and Metabolic Modulation in Acute Myocardial Infarction Treatment and Evaluation), an international trial that also included some 7500 patients with acute MI recruited from 274 hospitals in China, of the patients who received fibrinolytic therapy, 87% received UK, 10% SK and 3% t-PA [11]. The standard recommended dose for UK in acute MI is 1.5 mU, which would typically achieve infarct artery patency of grade 2 or 3 in about 50% of patients within 90 min of starting therapy [16]. This compares unfavourably with the higher patency rate that can be achieved with some of the newer fibrinolytic agents such as r-tPA, even at relatively lower doses [16]. In a randomised trial comparing the efficacy of standard dose UK with reduced dose rtPA involving some 350 acute MI patients in China, a reduced dose of only 50 mg of rtPA produced a much better rate (79%) of infarct artery patency (TIMI grade 2 or 3) compared with that for standard dose UK (53%). It is of note that the rate of patency achieved with 50 mg rtPA in Chinese patients was similar to that achieved with 100 mg dose typically used in Western populations, lending some support to the proposition that appropriate dosing of fibrinolytics might require adjustment on the basis of ethnicity [17].

Early coronary revascularisation requires a complex infrastructure, which is only possible in populations with adequate health care resources. Cardiac intervention with percutaneous transluminal coronary angioplasty (PTCA) was introduced into China during the mid-1980s. During the subsequent 15 years there was a gradual increase in the

number of cases undergoing PTCA, reaching about 8000 cases by 1999 for the whole of China. Since 2000, the use of PTCA in China has accelerated significantly due to increasing investment in infrastructure and training, driven chiefly by hospitals rather than by government, and by 2005 the number of PTCAs performed had increased 11-fold compared with 1999 [18,19]. During the same period, percutaneous coronary intervention (PCI) also became more widely used in China. In 2001 an estimated 3000 cases received emergency PCI, and the number had increased more than 5-fold by 2005, especially in large or medium-sized urban areas [18,19].

Despite the rapid increase in the use of PCI, fibrinolytic therapy remains the primary choice of reperfusion therapy for acute MI in most hospitals in China. In CREATE, 63% of the Chinese patients admitted within 12 h of symptom onset received reperfusion therapy, with about 15% involving direct PCI [11]. A recent report from a small registry of acute MI involving 20 hospitals from 5 regions of China showed the use of primary PCI as a reperfusion therapy among those admitted within 12 h ranged from 2% to 35% among different hospitals. [12] The typical time delay from admission to reperfusion (door-to-needle) was about 65 min for fibrinolytic therapy and about 110 min (door-to-cath) for primary PCI, [20] similar to that reported in the USA in the early 1990 s [13]. It is of particular note that the time delay for reperfusion therapy after admission was about twice as long in large teaching or municipal hospitals as in small county hospitals for both fibrinolytic therapy (~80 min vs. ~40 min) and primary PCI (~135 min vs. ~60 min) [11]. Similar findings were also reported in another registry of patients with MI [20].

Antiplatelet therapy

Following the publication of the ISIS-2 trial results demonstrating the highly significant effectiveness of aspirin in the emergency treatment of acute MI [9], antiplatelet therapy soon became used routinely in China. By the early 1990 s, about 75% of patients admitted to hospital with acute MI received aspirin as part of emergency treatment [7]. More recent data from large nationwide randomised trials and regional registries have shown consistently that about 95% of patients admitted to hospital with acute MI or other coronary syndrome received emergency antiplatelet therapy with little variations between different regions or types of hospitals (Table 1) [11,12,20]. The pattern of antiplatelet therapy used in China is highly consistent with that reported in Western populations [13–15].

There are two main pathways involved in platelet activation and aggregation. Aspirin acts mainly by blocking the thromboxane-mediated pathways, whereas clopidogrel acts mainly by blocking the ADP-mediated aggregation pathway. Simultaneous inhibition of both pathways with the combination of clopidogrel and aspirin should produce greater antiplatelet effects than either drug alone, leading to further improvement in prognosis. To test this hypothesis reliably in the setting of acute MI, a large randomised trial (COMMIT/CCS-2) of combined antiplatelet therapy was conducted in China during 1999–2005 involving a total of 1250 hospitals throughout China [8]. Overall 45,852 patients within 24 h of suspected acute MI onset were randomised to receive 75 mg clopidogrel daily or matching placebo in addition to aspirin 162 mg daily for about 2 weeks in hospital. The trial demonstrated that addition of clopidogrel to aspirin safely reduces mortality and major morbidity in hospital in a wide range of patients with acute MI (Fig. 4). Although the absolute benefits of adding a few weeks of clopidogrel to aspirin (and other standard treatments) are only moderate, avoiding about 10 events per 1000 treated, they were largely independent of, and hence additional to, those of other standard treatments (such as fibrinolytic and anticoagulant therapy). Furthermore, the

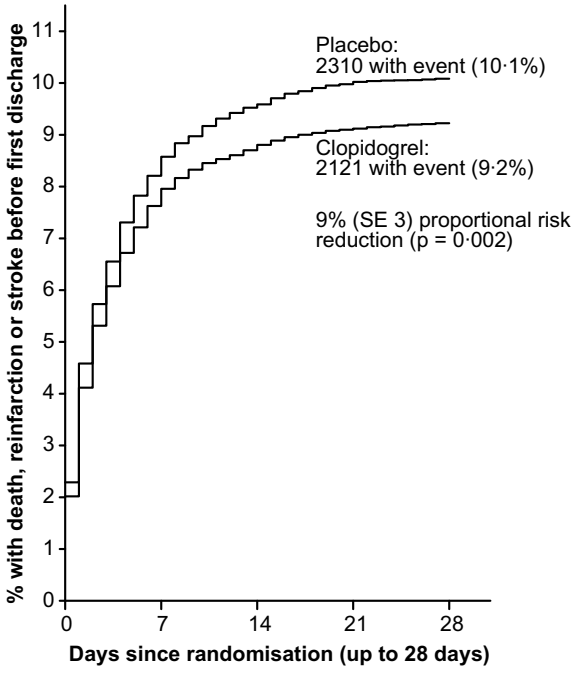

Figure 4 Effects of clopidogrel on death, reinfarction, or stroke before first discharge from hospital. Time-to-event analyses based on first relevant event during scheduled treatment period. Mean treatment duration in survivors was 14.9 days.

Table 3 Effects of metoprolol on main clinical events for patients with acute MI in COMMIT/CCS-2

Event	Metoprolol (*N* = 22 929)	Placebo (*N* = 22 923)	Odds ratio (95% CI)	Absolute difference per 1000 (SE)	*p*-Value
Co-primary outcomes					
Composite[a]	2166 (9.4%)	2261 (9.9%)	0.96 (0.90—1.01)	−4.2 (2.8)	0.10
Death	1774 (7.7%)	1797 (7.8%)	0.99 (0.92—1.05)	−1.0 (2.6)	0.69
Death, by recorded cause					
Arrhythmia	388 (1.7%)	498 (2.2%)	0.78 (0.68—0.89)	−4.8 (1.3)	0.0002
Shock[b]	496 (2.2%)	384 (1.7%)	1.29 (1.13—1.47)	4.9 (1.3)	0.0002
Neither	890 (3.9%)	915 (4.0%)	0.97 (0.89—1.07)	−1.1 (1.8)	0.55
Secondary outcomes					
Reinfarction	464 (2.0%)	568 (2.5%)	0.82 (0.72—0.92)	−4.5 (1.4)	0.001
Ventricular fibrillation[c]	581 (2.5%)	698 (3.0%)	0.83 (0.75—0.93)	−5.1 (1.6)	0.001
Other cardiac arrest[d]	685 (3.0%)	632 (2.8%)	1.08 (0.97—1.21)	2.3 (1.6)	0.14
Cardiogenic shock[e]	1141 (5.0%)	885 (3.9%)	1.30 (1.19—1.41)	11.2 (1.9)	<0.00001
Death, reinfarction, cardiac arrest or shock	2501 (10.9%)	2465 (10.8%)	1.02 (0.96—1.08)	1.5 (2.5)	0.54

[a] Death, reinfarction, ventricular fibrillation or other arrest (irrespective of any mention of shock).
[b] Excludes 185 (87 metoprolol vs. 98 placebo) deaths with both arrhythmia and shock recorded as causes.
[c] Includes VF as recorded or any death with arrhythmia recorded as a cause.
[d] Includes other arrest as recorded or any death with asystole recorded as a cause (excluding any with VF or death with arrhythmia as a cause).
[e] Including cardiogenic shock as recorded or any death from shock (irrespective of whether other causes were also recorded).

use of clopidogrel in acute MI, as with aspirin, does not require careful monitoring and given the short treatment duration and fairly low cost as well as relevance of local evidence, clopidogrel soon became widely used in patients with acute MI in China after the publication of this landmark trial. In China there are more than 1 million new cases of MI each year, and if half of them are treated with combined antiplatelet therapy in hospital for a few weeks, then based on the evidence from ISIS-2 and COMMIT (Table 3) some 25,000 major vascular events can be avoided.

Beta-blocker therapy

Early beta-blocker therapy has been widely recommended as part of the emergency treatment of acute MI since the 1980 s, based on findings from more than two dozen randomised trials conducted in fairly low risk patients [21,22]. Despite these recommendations, there has been substantial uncertainty for many years about the value of adding early beta-blocker therapy to current standard intervention (eg, aspirin and fibrinolytic therapy) in acute MI, with wide variation in patterns of routine use within and between different countries. More recently, concerns were also raised about the potential hazards of intravenous rather than oral beta-blocker therapy in acute MI based on clinical observational studies in the USA [23]. In China, beta-blocker therapy started to be used for emergency treatment of acute MI during the 1980s, but its routine use was rather limited, partly because the evidence from previous trials was less convincing and involved exclusively non-Chinese populations, and partly because there was a widely held view in China of poor tolerability to beta-blocker therapy among ethnic Chinese compared with Western populations, which was mainly based on findings from a small pharmacodynamic study in the USA [24]. Data from large randomised trials in China showed that in the early 1990s only less than one quarter of patients with acute MI routinely received a beta-blocker in hospital, involving almost exclusively oral agents with very little use of iv beta-blockers (Table 1) [7]. Moreover, the standard oral dose was typically less than half that used in Western populations, not only for treating acute MI but also in other situations where beta-blocker therapy is clearly indicated such as long-term secondary prevention after unstable angina, MI and treatment of hypertension.

To assess the balance of risks and benefits of adding early intravenous then oral beta-blocker therapy to current standard therapies in a wide range of patients with acute MI, 45,852 patients recruited into the COMMIT trial were also randomly allocated, using a 2 × 2 factorial design, to metoprolol (up to 15 mg intravenous then 200 mg oral daily) or matching placebo for an average of 2

Table 4 Treatment patterns for patients with acute coronary syndromes in China based on data from two registries in selected hospitals in China

Treatments	OASIS_China registry [24] (n = 2290)		CPACS registry [19] (n = 2973)	
	In hospital	At discharge	In hospital	At discharge
Aspirin (%)	94.5	93.8	97.1	93.2
Clopidogrel (%)	—	—	52.7	44.9
Unfractionated heparin (%)	14.1	—	17.9	—
Low molecular weight heparin (%)	46.8	—	74.9	—
ACE inhibitor (%)	59.1	57.0	76.3	69.2
Beta-blocker (%)	67.6	65.2	75.6	71.7
Calcium antagonist (%)	57.5	54.5	38.1	28.4
Lipid lowering agent (%)	—	47.2	84.8	81.5
Angiotensin receptor blocker (%)	—	—	9.2	8.1
No. of hospitals and years surveyed	38, 1999—2001		51, 2004—2005	

weeks in hospital [25]. This large Chinese trial involved nearly twice as many patients and more than three times as many deaths as all previous such trials combined, and showed that allocation to the metoprolol regimen produced a highly significant 15—20% proportional reduction in the risk of reinfarction and of ventricular fibrillation, corresponding to 5 fewer having reinfarction and 5 fewer having ventricular fibrillation per 1000 patients treated for about 2 weeks in hospital. However, these benefits were counterbalanced by 11 more per 1000 developing cardiogenic shock (Table 4). The excess of cardiogenic shock occurred mainly during days 0—1 after admission when the haemodynamic condition is less stable, whereas the reduction in reinfarction and ventricular fibrillation emerged more gradually. Consequently, the overall effect on death, reinfarction, arrest, or shock was significantly adverse during days 0—1 and significantly beneficial thereafter. In the COMMIT/CCS-2 study, titration of the intravenous regimen, according to the effects on blood pressure and heart rate, resulted in doses of metoprolol being given in this Chinese population that were similar to that in the previous MIAMI trial in a European population [21], and compliance with the oral metoprolol regimen in the study was also similar to that in MIAMI, suggesting that, contrary to previous beliefs, a beta-blocker is well tolerated by most Chinese patients. The results of COMMIT/CCS-2 confirm some of the previous concerns about beta-blocker therapy, but reduce others, and should help to guide more appropriate use of early beta-blocker therapy in acute MI not only in China but also elsewhere. Given the excess of cardiogenic shock, immediate beta-blocker therapy cannot be recommended routinely. Instead, it may generally be more prudent to start beta-blocker therapy only after the patient's haemodynamic condition has stabilised after MI, with the aim of preventing reinfarction and sudden cardiac death during the later period of hospital stay.

ACE inhibitor

ACE inhibitors (ACE-I) have been used widely in China since the mid-1990s not only for treating acute MI but also for long-term secondary prevention after MI. Data from large nationwide randomised trials and regional registries showed consistently that about three-quarters of patients with acute MI receive ACE-I therapy in hospital, with little variation between different regions or between types of hospitals [8,11,20]. The high usage of ACE-I in acute MI compares favourably with that reported in other countries [13—15], and probably can be attributed chiefly to the results of CCS-1, a large trial that tested the effects of ACE-I in 650 hospitals throughout China (Table 1) [7], and the effective dissemination of the findings from this and other similar trials. The widespread use of ACE-I in hospital also leads to a high proportion of surviving MI patients being discharged on long-term ACE-I. There is evidence that currently more than half of the patients with acute MI are discharged from hospital with ACE-I, usage being similar in patients with STEMI or NSTEMI [12,20].

Anticoagulant and other therapy

During the past two decades, the routine use of anticoagulant therapy in acute MI has increased markedly in China. During the early 1990s only

about one quarter of patients with acute MI received such therapy [7], but it increased to about 75% of patients 10 years later (Table 1) [8,20]. This rapid increase coincided with more widespread use of fibrinolytic therapy and coronary interventions during the same period in China. The most commonly used anticoagulant therapy now in China is low molecular weight heparin, with about 20% of anticoagulant therapy still involving unfractionated heparin [20].

A number of other therapies have also been used in acute MI for a prolonged period of time, but the general patterns of their use in routine practice in China have changed significantly, partly due to new evidence from large trials about their effectiveness and partly due to the improvement in patient prognosis. Comparing the treatment patterns among patients enrolled into large randomised trials between two time periods (1990–1995 and 2000–2005) [7,8,11], the use of antiarrhythmic agents and of calcium antagonists decreased significantly in China (Table 1), whereas for nitrates (oral or intravenous) and diuretics there was little change in routine use. These trends were similar to those observed in Western populations [13–15]. On the other hand, lipid lowering therapy has become more widely used during the last 10 years, and there is evidence that in large- or medium-sized hospitals, about three quarters of patients with MI receive statin therapy in hospital [20], a pattern similar to that in many other countries [13–15].

Management of patients with non-ST elevation acute coronary syndromes

With the exception of reperfusion therapy, in China the general management of patients with acute coronary syndromes (ACS), such as non-ST elevation MI or unstable angina is broadly similar to that for STEMI (Table 5). Although not directly comparable, the data from two registries carried out at two different periods showed that combined antiplatelet therapy and lipid lowering therapy have become widely used in China during recent years for patients with ACS, not only in hospital but also for long-term secondary prevention [20,26]. In addition certain treatments such as calcium antagonists are becoming less widely used whereas other newer therapies such as angiotension receptor blockers are being gradually introduced into clinical practice. This changing pattern of management for ACS in China, at least in many large- or medium-sized hospitals, is generally consistent with various evidence-based recommendations.

Table 5 Effects of aspirin and clopidogrel on death, reinfarction and stroke in hospital based on findings from ISIS-2 and COMMIT/CCS-2

Trial	Treatment group	Event rate	Absolute benefit
ISIS-2	Placebo	14%	~40 per 1000
		↓	
	ASA	10%	
COMMIT/CCS-2	ASA	10%	~10 per 1000
		↓	
	ASA + Clopidogrel	9%	

Events prevented with ASA + Clopidogrel vs. nil: ~50 per 1000 treated for a few weeks.

Long-term secondary prevention after MI

With regard to the long-term management of patients after MI, a number of treatments such as antiplatelet agents, ACE-I, beta-blocker and lipid lowering are of proven value in reducing recurrent episodes and mortality. Although these treatments have also been used routinely in China for patients with MI at hospital discharge, the long-term adherence to such therapies in China is relatively poor, due chiefly, perhaps, to the lack of primary care and of adequate health insurance coverage for many patients. Recent data from registries in China showed that about three-quarters of patients with acute coronary syndrome were discharged on what may be considered an optimum combination of an antiplatelet, statin plus at least one of the agents involving a beta-blocker and an ACE-I or ARB [20]. Despite this, the medication rates would typically drop by 20–50% within 2 years after discharge [27], with the biggest drop being for lipid lowering therapy. Even among those who remained on lipid lowering therapy, the standard dose used for a statin tended to be lower compared with that recommended, due partly, perhaps, to the relatively lower mean LDL level among patients with MI in China compared with that in Western populations. Although statin is the most commonly used lipid lowering agent in China, other locally manufactured agents, eg, Xuezhikang, are also used. Xuezhikang is an extract of cholestin from *Monascus purpureus* (red yeast rice or Hongqu) containing high concentrations of lovastatin and has been shown in a randomised trial of 4870 Chinese patients with history of IHD to be associated with reductions of 45% in total coronary events and 33% in total mortality [28]. The effects were, however, disproportionably greater than expected

from the lipid difference achieved with Xuezhikang (~0.5 mmol/l) based on findings from several statin trials [29], and this has been readily attributed to the potential pleiotropic effects of the agent [28].

Future challenges for the management of MI in China

Despite the significant improvement in the general care of MI and the existence of national guidelines, there is still substantial under-, over- and inappropriate treatment of many patients with MI in China, with large variations in management among different hospitals and regions. Further improvements will rely not only on better implementation of the many established cost-effective treatments but also on the improvement of the medical care system and active engagement with society.

Because most acute MI deaths occur before the patient reaches hospital, public education to increase awareness of the condition and encourage patients to seek care earlier, along with improvements in prehospital diagnosis and care, can be expected to yield major benefits in China. Hospital emergency departments, especially those with a high patient throughput, need to streamline further the care of patients so that the time delay before reperfusion therapy can be minimised, perhaps with the creation of a ''green channel'' to expedite the reperfusion process as has already been implemented successfully in many hospitals in China. Currently the duration of hospital care for patients with acute MI is still much longer than that in Western populations. Increased use of risk stratification assessment, based on data from studies of Chinese patients, to identify subsets of patients at different levels of risk and to adjust treatment and care accordingly would help save substantial resources. Although eligible to receive effective therapies, many patients with acute MI are still not treated with the most basic therapies such as fibrinolytic therapy, beta-blockers, and ACE inhibitors. Research on how to apply continuous quality improvement to coronary care, as has been done successfully in many Western populations, should help improve clinical outcomes. Establishment of a nationwide registry of MI with periodic surveys of hospital management of MI and of long-term secondary prevention after MI is also urgently needed. This could help assess the quality of care and identify ''evidence-practice'' gaps so as to reinforce evidence-based clinical practice. To reduce the disease burden in the population, one of the great opportunities lies in prevention through lifestyle modifications, and cardiologists should not only provide ''reactive'' medical care but also be actively involved in providing health education and risk factor counselling, especially with respect to cessation of smoking, which remains extremely prevalent among Chinese male patients. Advanced technology, whether cost-effective or not, is extremely seductive, especially when reviewed as ''state of the art'' by colleagues in affluent countries and many hospitals in China have strived to introduce modern technologies and expensive procedures, with many unnecessary examinations for patients. A more balanced approach should be adopted, with more emphasis on providing community-based primary health care and risk management. Inadequacy of government investment in the health sector also needs to be addressed urgently in order to improve health equality in the population. Despite the annual increase in the government's investment in the health care sector, its share of total health expenditure more than halved during the last few decades, from 36% in 1980 to 17% in 2004 [30]. Consequently, the household payments for medical costs more than doubled during the same period, from 22% to 54% of the total health expenditure. Without the introduction of a more broad and reasonable health insurance system, hospital care for MI as well as long-term management after MI are unlikely to improve substantially for the majority of patients, as medical costs often exceed their economic means.

Summary

Despite various limitations of the data sources used for this review, current available evidence shows that there has been considerable improvement in the general care of patients with acute MI in China over the last two decades, and that the current patterns of hospital management for MI are largely compatible with those reported in many Western populations. Many of the barriers in the hospital care of MI are related chiefly to the choices of treatments available and their presumed cost-effectiveness in the current socio-economic climate in China. Further improvement to reduce the ''evidence-practice'' gap will require not only better delivery of proven therapies in a cost-effective and timely manner but also substantial reform of the health care system in China, to improve equal access to care for the general population.

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