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Decline in 20-year mortality after myocardial infarction in patients with chronic kidney disease: evolution from the prethrombolysis to the percutaneous coronary intervention era

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Cardiovascular disease is the main cause of death in patients with chronic kidney disease (CKD). Here we measured temporal trends in treatment and mortality after myocardial infarction (MI) depending on kidney function at presentation in 12,087 patients admitted for MI to a coronary care unit from 1985 to 2008. The patients were categorized into those with normal kidney function (estimated glomerular filtration rate over 90 ml/min per 1.73 m^2), and those with CKD as defined by Kidney Foundation practice guidelines, with 8632 patients (71%) at CKD stages 2–5. Use of evidence-based care increased over time in all CKD stages. Mortality rates fell over the entire time period. When comparing data from 2000–2008 to that from 1985–1990, adjusted 30-day mortality fell both in patients with CKD stages 4–5 (adjusted odds 0.33, 95% confidence interval 0.18–0.60) and in those without kidney impairment (adjusted odds 0.21, 95% confidence interval 0.10–0.42). This mortality decrease was sustained during long-term follow-up. There was no significant interaction between kidney function and decade of admission. Overall, median survival was over 20, 15, 8, and 1.8 years for patients with normal kidney function, stage 2, stage 3, and stage 4–5 CKD, respectively. Thus, during the past 25 years, treatment of patients with a MI improved substantially with a concomitant decline in mortality. Although our findings were similar for all stages of kidney function, the prognosis remains poor for patients with stage 4–5 CKD.

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Cardiovascular disease is the single largest cause of death in patients with renal impairment or progressive primary renal disease, and these cardiovascular deaths often occur before end-stage renal failure has been reached.[1] Studies of myocardial infarction (MI) have reported that MI patients with renal dysfunction have a worse in-hospital survival.[1–5] Furthermore, recent data suggest that such patients are less likely to receive evidence-based therapies, although increased usage of evidence-based medical treatment has significant potential to reduce mortality in MI patients with renal dysfunction.[6,7]

Within the past 25 years, major improvements in the treatment of MI have been implemented, including thrombolytic therapy and primary percutaneous coronary intervention for ST-elevation MI (STEMI), as well as more intensive management according to individual risk assessment in patients with a non-STEMI (NSTEMI).[8] A longitudinal analysis of MI patients with different stages of renal dysfunction will identify temporal changes in the use of treatment modalities, as well as temporal trends in early and late outcomes according to renal function.

Against this background, the aims of our study were threefold. First, to determine inequalities and changes in medical care in patients with MI with different levels of renal dysfunction over a 24-year period. Second, to compare temporal trends in mortality according to renal function for patients admitted with a MI. Third, to quantify the effect of different stages of renal impairment on short- and long-term mortality after MI.

RESULTS

Patient characteristics

A total of 12,087 patients were included, of whom 5598 (46%), 2504 (21%), and 530 (4%) had stage 2, stage 3, and stage 4–5 chronic kidney disease (CKD), respectively (Table 1). A total of 92,712 person-years were analyzed. The number of patients and total number of events after MI according to decade of hospitalization and renal function is shown in Table 2.

Table 1 | Baseline characteristics and clinical presentation of patients hospitalized for myocardial infarction according to renal function at hospitalization

	Renal function (eGFR) on admission				
	Normal (⩾90)	Stage 2 CKD (60–89)	Stage 3 CKD (30–59)	Stage 4–5 CKD (<30)	*P* for trend
No. of patients	3455 (29%)	5598 (46%)	2504 (21%)	530 (4%)	
Baseline					
Age (± s.d.)	53 ± 10	63 ± 11	69 ± 10	68 ± 11	<0.001
Gender (female)	19%	27%	40%	37%	<0.001
Cardiac history					
Previous MI	30%	34%	39%	40%	<0.001
Previous PCI	15%	15%	12%	12%	<0.01
Previous CABG	7%	10%	13%	12%	<0.001
Risk factors					
Hypertension	31%	35%	41%	56%	<0.001
Diabetes	13%	13%	17%	24%	<0.001
Hyperlipidemia	29%	28%	22%	22%	<0.001
Family history	32%	27%	19%	14%	<0.001
Current smoker	47%	30%	20%	16%	<0.001
Anemia	19%	21%	34%	69%	<0.001
eGFR (median, IQR)	102 (94–114)	76 (69–83)	52 (45–57)	21 (12–27)	<0.001
Diagnosis					
STEMI	53%	43%	44%	49%	<0.001
Medication at ICCU discharge					
Ca antagonist	19%	26%	30%	32%	<0.001
Diuretics	8%	12%	27%	30%	<0.001
Nitrates	10%	15%	20%	25%	<0.001
Antiarrhythmics	3%	4%	7%	8%	<0.001

Abbreviations: Ca antagonist, calcium antagonist; CABG, coronary artery bypass surgery; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate in ml/min per 1.73 m^2; ICCU, intensive coronary care unit; IQR, interquartile range; MI, myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-elevation MI.

Table 2 | Study population outline: the number of patients at risk and total number of events after myocardial infarction stratified by decade of hospitalization and renal function

	Decade of hospitalization for myocardial infarction		
	1985–1990	1990–2000	2000–2008
Total no. of events/no. at risk			
Renal (dys)function			
Normal (⩾90)	172/343	372/1183	179/1929
Stage 2 CKD (60–89)	667/1073	953/1824	452/2701
Stage 3 CKD (30–59)	520/607	697/900	370/997
Stage 4–5 CKD (<30)	99/105	191/209	139/216

Abbreviation: CKD, chronic kidney disease.

With increasing renal impairment, patients were older, more often female, and more often had a history of MI or coronary artery bypass surgery, hypertension, diabetes, and anemia. In contrast, with increasing renal impairment, patients were less often current smokers, less often had hypercholesterolemia, or a family history of previous MI (Table 1). With time, more patients presented with normal renal function and less with stage 3 to 5 CKD (Figure 1).

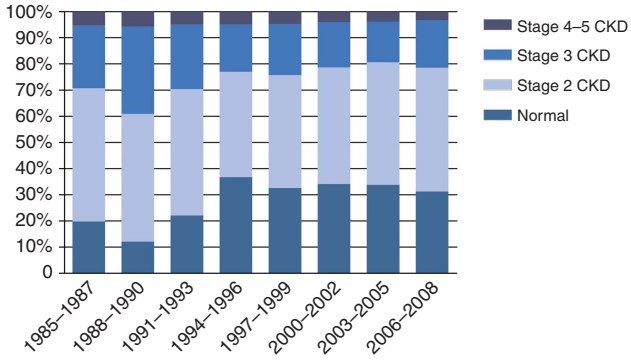

Figure 1 | Distribution of study population according to renal function and study period.

Medical and invasive treatment during the study period

The use of reperfusion therapy (either by thrombolytic therapy or primary percutaneous coronary intervention) increased over time in all four groups according to renal function with STEMI ($P<0.001$). However, patients with stage 4–5 CKD in particular were less likely to receive reperfusion therapy during the entire study period as compared with patients with normal renal function ($P<0.001$; Figure 2a). In addition, prescription of evidence-based medical care (class 1A), including aspirin, B-blockers, and statins, increased over time, but was less frequent in patients with stage 4–5 CKD ($P<0.001$ for all; Figure 2b and c). Prescription of other medical therapy with a lower level of evidence for the treatment of MI, including calcium antagonists, nitrates, and diuretics at intensive coronary care unit discharge, was higher in patients with renal impairment (Table 1).

Temporal trends in mortality

In the overall study population, Kaplan–Meier short-term (30-day) mortality decreased from 10% in 1985–1990 to 4% in 2000–2008. The magnitude of this decrease was comparable for the merged group of patients with stage 2–5 CKD (estimated glomerular filtration rate (eGFR) <90 ml/min per 1.73 m^2): their 30-day mortality decreased from 11% in 1985–1990 to 6% in 2000–2008. Similarly, for the study population as a whole, the 5-year Kaplan–Meier mortality decreased from 24% in 1985–1990 to 19% in 2000–2008; for patients with stage 2–5 CKD, a reduction in 5-year mortality was observed from 26% in 1985–1990 to 24% in 2000–2008.

From 1985 to 2008, the adjusted risk of 30-day mortality decreased by about 60% in the whole study population (adjusted odds ratio 0.40, 95% confidence interval (CI): 0.32–0.49). Although there was no statistical heterogeneity in this temporal mortality decrease among all four subgroups