

# The Munich Myocardial Infarction Registry

Translating the European Society of Cardiology (ESC) and European Association for the Study of Diabetes (EASD) guidelines on diabetes, pre-diabetes, and cardiovascular disease into clinical practice

OLIVER SCHNELL, MD<sup>1</sup>  
WOLFGANG OTTER, MD<sup>2</sup>  
EBERHARD STANDL, MD<sup>1</sup>

**D**iabetes and cardiovascular diseases are closely connected fields of medicine. Diabetes is a major risk factor and cause of cardiovascular disease and many patients with cardiovascular disorders, not the least coronary heart disease, have glucometabolic perturbations (1). Diabetic patients without a previous myocardial infarction have a risk for cardiac mortality of 20% over 7 years, which is largely equal to the risk of nondiabetic patients after myocardial infarction (3). Furthermore, the risk for cardiovascular mortality in diabetic patients with acute myocardial infarction over a time period of 7 years has been observed to be up to 45% (3).

In diabetic patients with acute myocardial infarction, hospital mortality has also been reported to be substantially enhanced (4). A twofold increase in total hospital mortality has been reported in these patients (5). In 1999, the Munich Myocardial Infarction Registry reported a nearly threefold increase in hospital mortality within 24 h after admission (6). A total of 14% of diabetic patients with acute myocardial infarction died within the first 24 h compared with 5% in nondiabetic patients (6). The Munich Myocardial Infarction Registry focuses on the inpatient management of acute myocardial infarction.

## UNDERUSE OF HOSPITAL-BASED TREATMENT STRATEGIES

— Although mortality-reducing effects of evidence-based treat-

ment like reperfusion are equally beneficial in patients with and without diabetes, evidence-based treatment has formerly somehow been demonstrated to be less used in diabetic patients (4,6,7). The initial analysis of the Munich Myocardial Infarction Registry confirmed the underuse of early treatment strategies in diabetic patients (6). Coronary angiography, percutaneous transluminal balloon coronary angioplasty, and stenting were performed less frequently in diabetic patients than in nondiabetic patients (6). The underuse had also been reported in previous registries: the Swedish registry (Register of Information and Knowledge about Swedish Heart Intensive Care Admission [RIKS-HIA]) included patients with myocardial infarction, who were admitted between 1995 and 1998 (7). The Augsburg MONICA registry, which investigated patients from 1985 to 1992, also observed underuse of treatment strategies (4). It has been hypothesized, that the resistance to use advanced treatment options partially contributes to the poorer outcome in diabetic patients compared with nondiabetic patients (4,7).

## STRATEGIES FOR HOSPITAL-BASED CARE: INTERDISCIPLINARY COLLABORATION

— In view of the frequently reported poorer hospital outcome together with a reduced intensity of early treatment, clinical structures need to aim at overcoming the unfavorable constellation in diabetic patients.

The initiation of a joint task force of diabetologists, internists, and cardiologists is the key element to achieve an improvement in diabetes care for hospitalized patients. For the outpatient care of the patients, a close cooperation with primary care physicians also needs to be envisaged.

In the Munich Myocardial Infarction Registry, the cooperation focuses both on the treatment of hyperglycemia and the optimization of early treatment strategies targeting coronary occlusion (8). The recent European Society of Cardiology (ESC) and European Association for the Study of Diabetes (EASD) joint guidelines on diabetes, pre-diabetes, and cardiovascular diseases emphasize the need for a cooperation and give practical advice on how to achieve the earliest diagnosis of both diabetes and cardiovascular disease together with optimized treatment approaches (9,10).

## INTENSIFICATION OF TREATMENT STRATEGIES AND REDUCTION OF MORTALITY

— In the Munich Myocardial Infarction Registry, therapeutic approaches were intensified as a result of the activities of the joint task force of diabetologists, internists, and cardiologists (Fig. 1) (8). Initially, coronary angiography, transluminal balloon coronary angioplasty, and stenting were performed less frequently in diabetic patients than in nondiabetic patients. Because of the activities of the task force, the performance of these therapeutic options were substantially increased to levels comparable with those of nondiabetic patients (Fig. 1) (8). In addition, GbIIb/IIIa receptor agonists were administered more frequently and glucose-insulin was initiated to improve metabolic control (8).

The intensification of treatment approaches translated into a significant reduction of early hospital mortality in diabetic patients within 2 years (Fig. 2) (8). In diabetic patients, total hospital mortality decreased by 44% and 24-h mor-

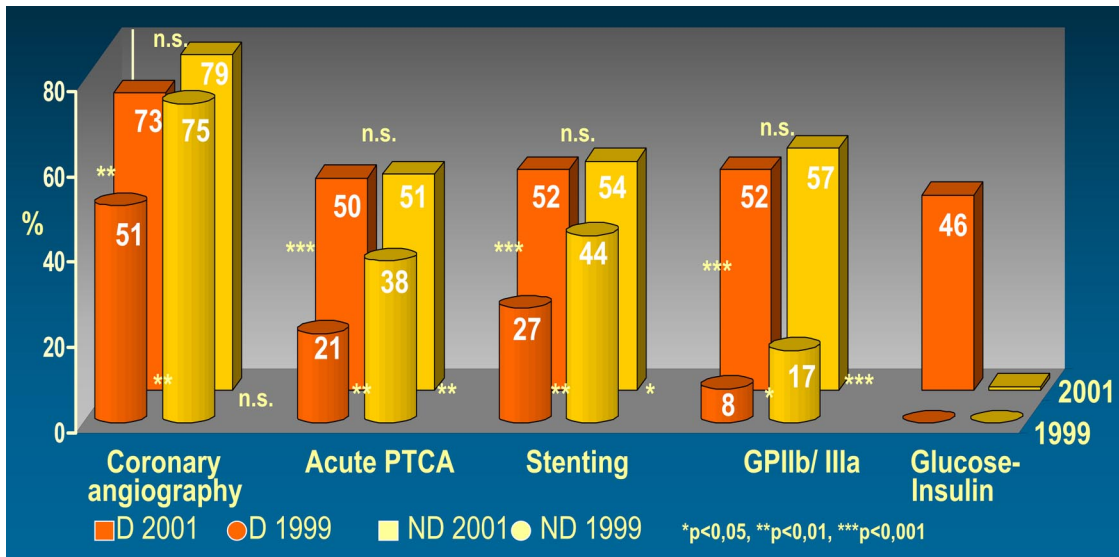
From the <sup>1</sup>Diabetes Research Institute, Munich/Neuherberg, Germany; and the <sup>2</sup>Center of Internal Medicine, Unterschleissheim/Munich, Germany.

Corresponding author: Oliver Schnell, oliver.schnell@lrz.uni-muenchen.de.

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**Figure 1**—The Munich Myocardial Infarction Registry: Intensification of treatment approaches in 2001 versus 1999 (8). D, diabetes; ND, no diabetes.

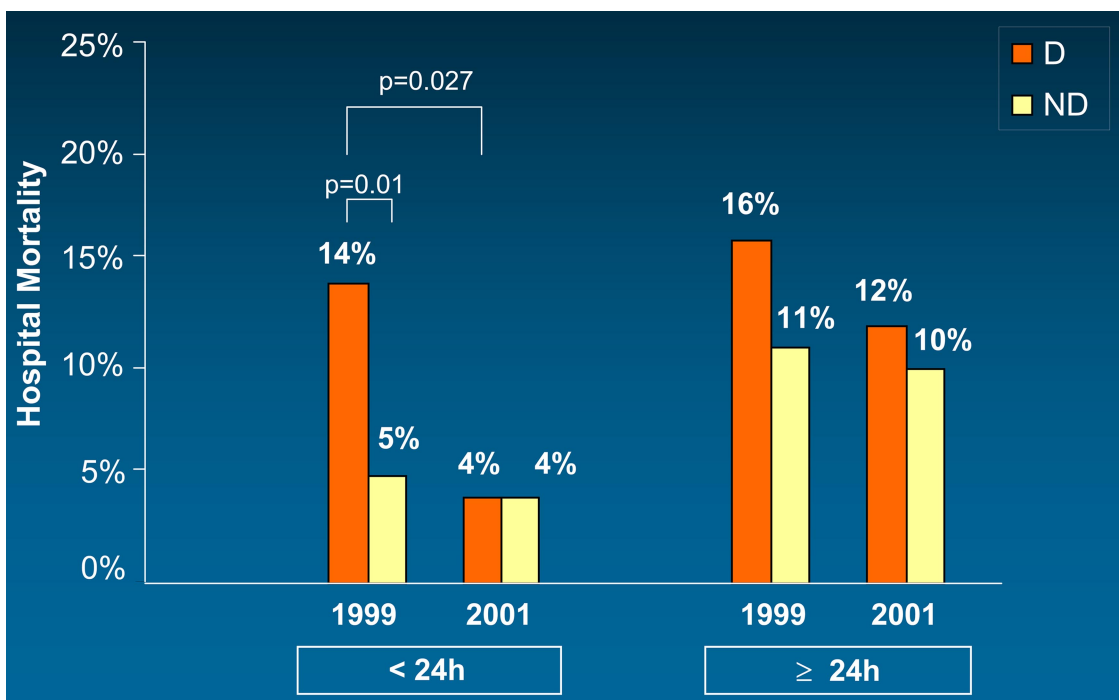
tality decreased by 67%. Hospital mortality among nondiabetic subjects, however, did not change significantly (Fig. 2) (8).

The increase in the number of therapeutic approaches in diabetic patients with acute myocardial infarction (also when adjusted for age, sex, and other clinical variables) is associated with a reduction in mortality (8).

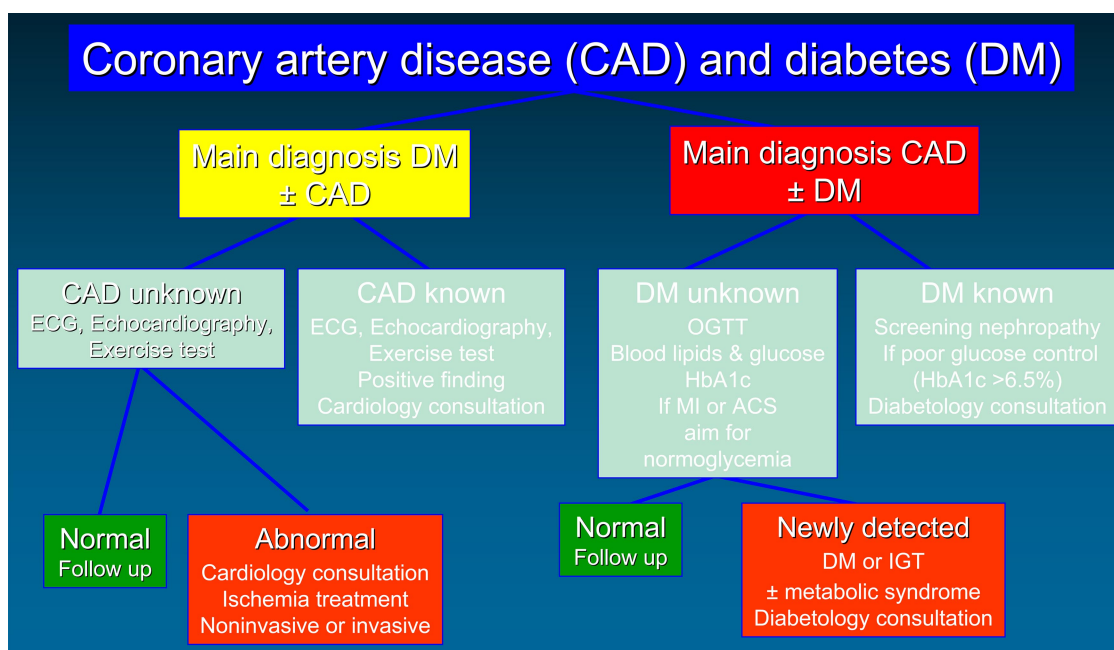
#### EARLY DIAGNOSIS AND INTENSIVE TREATMENT

There is evidence that early hospital mortality can be reduced by a combination of multiple approaches both targeting vessel occlusion and hyperglycemia (8). It seems that insulin therapy in the acute setting is essential and contributes to the success (18). The NICE-SUGAR study emphasizes the need to avoid

hypoglycemic episodes during acute treatment in the intensive care unit. In the study, intensive glucose control was associated with a higher mortality (27.5%) compared with a conventional glucose control (24.9%). Severe hypoglycemia was >13-fold higher in the intensive glucose control group than in the conventional glucose control group (0.5 vs. 6.8%) (16). This may



**Figure 2**—The Munich Myocardial Infarction Registry: Reduction of hospital mortality in patients with acute myocardial infarction (8). D, diabetes; ND, no diabetes.



**Figure 3**—Investigational algorithm of the ESC/EASD guidelines (9,10). ACS, acute coronary syndrome; ECG, electrocardiogram; MI, myocardial infarction.

have largely contributed to the increase in mortality.

These aspects are also incorporated in the ESC and EASD guidelines on diabetes, pre-diabetes, and cardiovascular disease, which recommend both earliest diagnostic procedures and therapeutic approaches (Fig. 3) (9,10).

**SILENT DIABETES**— It is clear today that glucose metabolism is altered in a large proportion of patients with acute myocardial infarction and no previous diagnosis of diabetes (16). In these patients, 35 and 40% of patients present with impaired glucose tolerance at discharge and after 3 months, respectively, and 31 and 25% have undiagnosed diabetes (16). The high prevalence of impaired glucose tolerance and diabetes has been confirmed by the Euro Heart Survey (13).

The joint guidelines of the ESC and EASD on diabetes, pre-diabetes, and cardiovascular disease therefore recommend performing an oral glucose tolerance test in all patients with coronary artery disease and no previous diagnosis of diabetes (Fig. 3) (9,10).

### THE MUNICH MYOCARDIAL INFARCTION REGISTRY: CURRENT AND FUTURE DIRECTION

A key element of the Myocardial Infarction Registry is that it enables the visualization of the quality of care of diabetic patients and shows poten-

tial for an optimization (6,8,11). A registry certainly requires team building and the readiness to change structures and initiate clinical pathways (Table 1).

We need to be aware that it is not a single approach making all the difference in diabetic patients with acute myocardial infarction. It is the use of multiple advanced treatment strategies that enable a substantial reduction of hospital mortality in patients. Interventions targeting both arterial occlusion and metabolic disturbances need to be applied with comparable emphasis (Table 1). Resistance to early diagnostic and therapeutic interventions in diabetic patients needs to be further reduced in the advanced treatment of a diabetic patient.

Intensification of multiple advanced therapeutic strategies in diabetic patients with acute myocardial infarction enables a reduction in hospital mortality to a level that is comparable to those of nondiabetic pa-

tients. We should apply our current knowledge and evidence to achieve this favorable situation for every diabetic patient with acute myocardial infarction (Table 1).

In light of the recent findings in ACCORD/VADT/ADVANCE (17–19), it needs to be emphasized that prevention of hypoglycemia may also be regarded as a key element of a successful approach in the hospital. The practical implications of these recent study results for today's blood glucose-lowering therapy are not only the need to avoid side effects such as hypoglycemia but also the need to prevent weight gain (17–19).

**THE ESC AND EASD GUIDELINES ON DIABETES, PRE-DIABETES, AND CARDIOVASCULAR DISEASE: AN OVERVIEW**— The emergence of new interdisciplinary guid-

**Table 1**—Munich Myocardial Infarction Registry: Key lessons and recommendations

- Underuse of early treatment approaches in diabetic patients with acute myocardial infarction is not justified.
- Intensification of early treatment strategies leads to an improvement of hospital outcome in diabetic patients with acute myocardial infarction.
- Earliest diagnosis of diabetes and pre-diabetes with patients with acute myocardial infarction and no previous diagnosis of diabetes is essential.
- Registry enables the visualization of the quality of care and opens potentials of an improvement of the management of the patients.
- Joint task forces of diabetologists and cardiologists are strongly recommended.

From Refs. 6, 8, and 11.

**Table 2—Guidelines on diabetes, pre-diabetes, and cardiovascular diseases: the top 10 recommendations**

1. Reach all treatment targets to reduce cardiovascular risk, including targets on glycemic control.
2. Screen for diabetes and impaired glucose tolerance in all patients with established cardiovascular disease (whether acute or chronic) by means of an oral glucose tolerance test, as well as in all high-risk individuals (e.g., as defined by risk score tools).
3. Lifestyle counseling (150 min of physical activity per week, weight loss of 5–7%, smoking cessation) is the cornerstone in the prevention of diabetes and cardiovascular disease and the foundation of any multifactorial intervention to reduce cardiovascular risk.
4. Whenever possible, patients with diabetes and acute coronary syndromes should be offered early angiography and mechanical revascularization, together with all other standard guideline-based treatment recommendations.
5. Treatment decisions regarding revascularization in patients with diabetes should favor coronary artery bypass surgery over percutaneous coronary intervention (PCI).
6. When PCI with stent implantation is performed in a diabetic patient, drug-eluting stents should be used.
7. Specific risk assessment of patients with diabetes and cardiovascular disease should include appropriate investigation for cardiac autonomic dysfunction, heart failure, arrhythmias, hypotension, peripheral vascular disease (Doppler index), and (micro-)albuminuria.
8. Strict blood glucose control with intensive insulin therapy improves mortality and morbidity of adult critically ill patients as well as of adult cardiac surgery patients.
9. Multifactorial therapy (lipid normalization, tight control of hypertension, near-normal glucose control, anti-platelet therapy) is cost-effective in preventing complications in patients with diabetes and cardiovascular disease.
10. An integrated approach of cardiologists and diabetologists is mandatory for the benefit of the millions of patients with diabetes, pre-diabetes, and cardiovascular disease. The new concerted joint guidelines of the EASD and the ESC are a base on which to create a comprehensive and interdisciplinary treatment service.

From Ref. 16.

ance from a collaboration between the EASD and the ESC is therefore an important and noteworthy step in the development of “joined-up thinking” in this arena of medicine. The guidelines focus on both inpatient and outpatient management of diabetes and cardiovascular disease.

The full-text versions were published in the journal *Diabetes, Metabolism and the Heart* for the area of diabetology and in the *European Heart Journal* for the area of cardiology (9,10).

These guidelines are unique in the sense that they represent the opinion of leading specialists appointed jointly by two major professional organizations. In addition to the medical professions, the implementation meeting welcomed pharmaceutical industrial representation, in recognition of the contributions of industry to postgraduate medical education.

A large part of the guidelines is devoted to the proper management of patients with diabetes and various cardiovascular disease manifestations. The need for lifestyle and dietary advice and strict treatment targets for blood glucose, A1C, blood pressure, and blood lipids were reviewed. The care of diabetic patients with acute coronary syndromes and those in need for revascularization is discussed, and some aspects of health economy and diabetes are summarized.

The need for further improvement of routine practice in these respects was highlighted by a consideration of data from the recent European Heart Survey on Diabetes and the Heart. From this survey, it is clear that risk factor management

and glucose control among European patients with diabetes and cardiovascular disease are frequently below the standards advocated in the guidelines.

As already remarked, diabetes and pre-diabetes are painless and remain undetected if not investigated. Screening for elevated glucose (pre-diabetes) is therefore important for prognostic reasons. Proposed screening methods, as outlined in the guidelines, vary. At a population level, simple web-based questionnaires may inform people on their actual risk and motivate those who need to improve their lifestyle to take steps that may avoid future development of the disease. Individuals at a particular high risk (for example, those with a strong family history, established cardiovascular disease, adiposity, or previous gestational diabetes) should be screened with oral glucose tolerance tests at defined intervals. (Postload values are more predictive than fasting values.)

If a pre-diabetic state is detected, a modest weight reduction (of the order of 10%), combined with a more physically active lifestyle, may prevent or retard the development of overt diabetes. Drugs such as metformin or acarbose may be used if lifestyle advice fails.

Table 2 summarizes the content of the pocket version of these new guidelines on diabetes, pre-diabetes, and cardiovascular diseases and lists the top 10 recommendations of this interdisciplinary approach to improve the outcome of the high-risk patients with both diabetes and cardiovascular diseases (20).

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