Significance of MUGA after Intracoronary Thrombolysis and after Bypass Surgery

D. Emrich and H. Schicha

Department of Nuclear Medicine University of Goettingen, F.R.G.

One of the big problems in medicine today is the imbalance between primary diagnostics and control of therapy. Careful monitoring of therapeutic measures can contribute to improve the cost benefit ratio to validating the effectiveness of a certain kind of therapy and by changing therapeutic strategies early and adequately. In this respect nuclear medicine has something to offer, especially in cardiology. There are three main reasons why control of therapy in cardiac diseases is highly mandatory:

1. In many countries cardiovascular diseases range on top of morbidity and mortality rates.
2. Much effort and expenditure is spent on their treatment.
3. In the past hard data to control therapy could only be obtained by invasive investigations. Since they could be applied only to a minority of patients many questions remained open in general but also in the individual case.

In the following we would like to report on two examples of investigating left ventricular function (LVF) by MUGA which shall elucidate this. The first concerns long-term control of a new kind of intervention in acute MI, i.e. intracoronary thrombolysis. The second applies to the question to what extent LVF can be controlled after bypass surgery under routine conditions.

Intracoronary thrombolysis by streptokinase in acute MI in man was applied for the first time in Goettingen by Rentrop and co-workers. From the first series we have selected those in whom a totally occluded infarct vessel was reopened. They were compared with a group who primarily had also a totally occluded infarct vessel, but were treated conservatively.

All patients had undergone angiography 1–16 hours after symptoms had started as well as 1–3 months thereafter. 16 out of 19 (84%) in whom the infarct vessel was reopened by intracoronary thrombolysis and 16 out of 23 (70%) who had been treated conservatively could be followed by MUGA up to a mean of 3 years. The course of the LVEF at rest is demonstrated in figure 1. In the beginning the means of the LVEF amounting to about 50% were nearly identical in both groups. But after 1–3 months they differed significantly by nearly 9 % amounting to 18 relative % through the increase of the global EF in patients with intracoronary thrombolysis. Although the mean EF decreased slightly in both groups during further follow up the difference remained constant. It was not any longer significant after 3 years. This may be mainly due to the greater variations of the EF which could indicate further progression of the coronary artery disease in some patients. As shown in Figure 2 in the acute state the percentage of patients

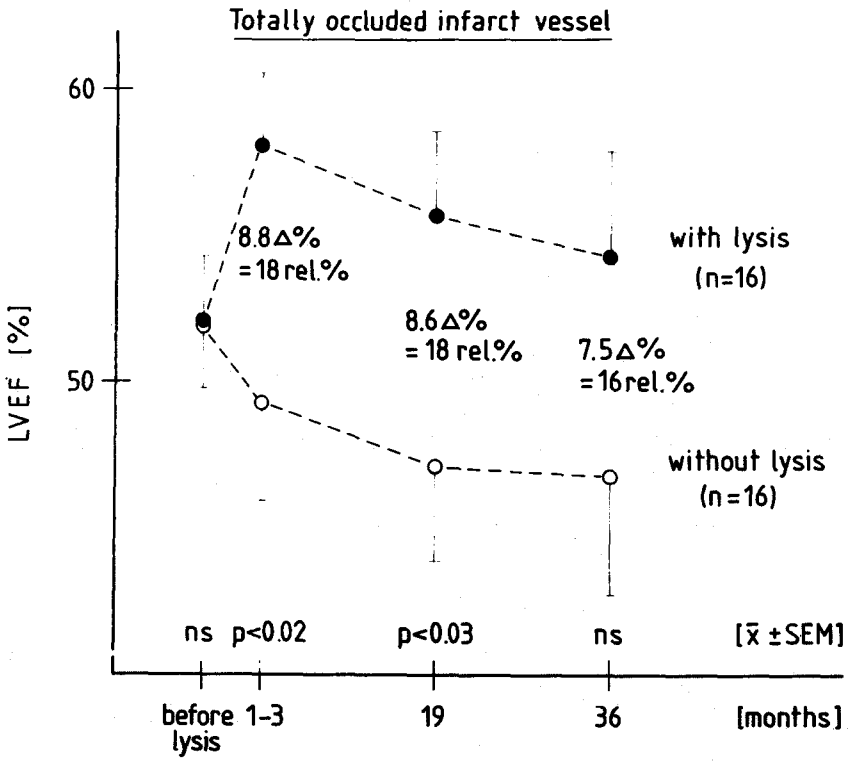

Fig. 1. Course of the means of LVEF before and up to 3 years with and without intracoronary thrombolysis in patients with acute MI and a totally occluded infarct vessel.

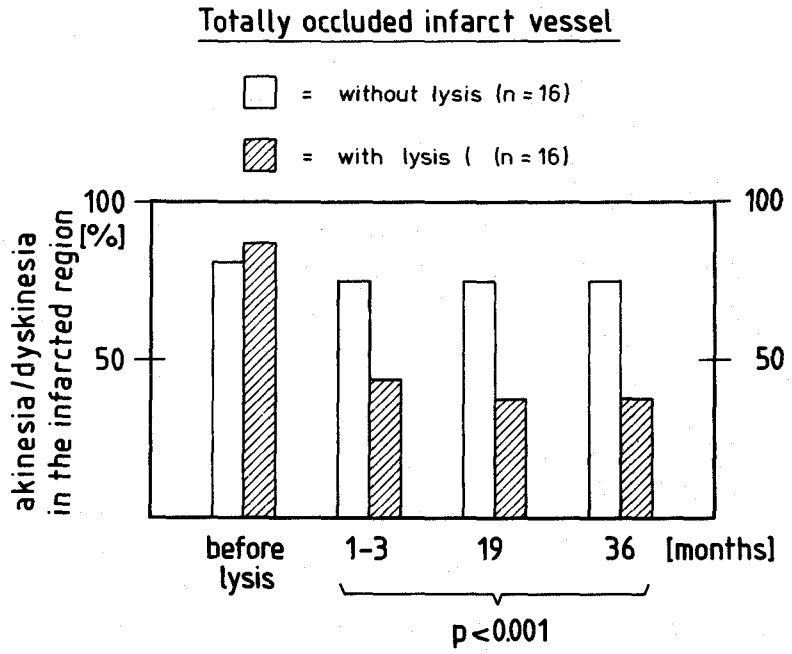

Fig. 2. Frequency of akinesia/dyskinesia up to 3 years with and without intracoronary thrombolysis in patients with acute MI and a totally occluded infarct vessel.

with severely impaired regional motility, i.e. with akinesis and with dyskinesis, was high in both groups. It amounted to 81% and 87% respectively. During the follow-up period it remained high in the patients treated conservatively but it decreased significantly to a mean of 40% in the group treated by thrombolysis and remained constant for three years.

Thus MUGA allowed to substantiate over a longer period the results by a new method to treat acute MI. This would probably not have been possible by angiography.

The group followed up after bypass operation consisted of 67 consecutive patients without aneurysmectomy. They were investigated by MUGA at rest and under exercise several days before the operation and 6 months thereafter. As shown in table 1 the composition of the group was complex concerning age, extent of the diseases and existence of a previous myocardial infarction (MI). In addition therapy with β-blockers, nitrate and calcium antagonists could not be discontinued. This resembles the situation under routine conditions. In order to perform comparisons concerning the significance of MUGA for follow-up and in order to flatten the individual status as little as possible two sets of data were compiled:

1. Clinical criteria by which the patients after operation were subdivided in those who had improved and those who had not (Table 2).
2. Criteria to judge left ventricular function at rest and during exercise before and after operation (Table 3).

If we compared the status of the global LVF preoperatively with the clinical outcome post-operatively (Fig. 3 left panel) there was no significant difference concerning the frequency of a sufficient and a non-sufficient global LVF preoperatively although 76% of the patients with sufficient LVF before operation belonged to the group with clinical improvement compared to

Table 1. Patients investigated before and after bypass operation.

1 – Vessel disease	14
2 – Vessel disease	21
3 – Vessel disease	32
No MI	26
MI anterior wall	22
MI posterior wall	22
Bypass:	
RIVA	90
Cx	43
RCA	29

N = 67; ♂ 61; ♀ 6; AGE 41 – 67 Y.

Aneurysmectomy : None

Medication : Not discontinued

Table 2. Clinical criteria after operation.

Group I (Clinically improved)

- No angina or angina only at high exercise level.
- Exercise test 100 watts without angina and without ST depression.
- No limitation in daily life and profession

Group II (Clinically not improved)

- Persisting angina
- Exercise test 100 watts with angina and/or ST depression.
- Limitation in daily life and profession.

56% in the group with impaired LVF before operation. But in 83% of those patients with sufficient global LVF postoperatively(Fig. 3 right panel) there was also clinical improvement whereas in patients with impaired LVF postoperatively only 45% showed improvement by clinical criteria. This was also true if we compared the correlation of improvement and non-improvement of the global LVF with the clinical outcome postoperatively (Fig. 4). One and two arrows up or down means amelioration and deterioration respectively by one or two points according to the criteria for LVF stated in Table 3. It can be seen that clinical improvement decreased slightly from 85% when LVF was ameliorated to 70% when it was slightly deteriorated. But it dropped significantly to zero in the 8 patients in whom LVF severely deteriorated after operation.

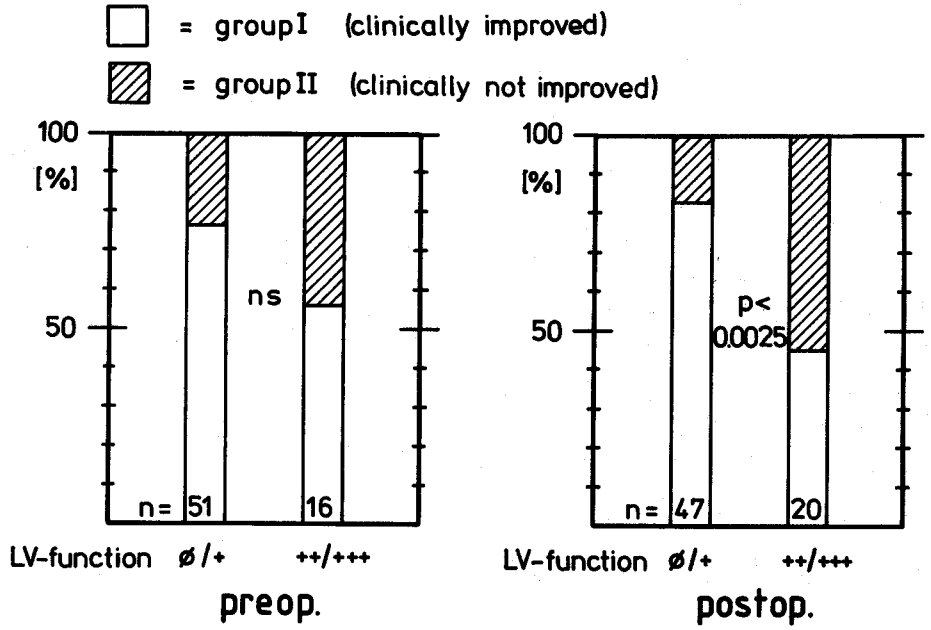

Fig. 3. Correlation between clinical outcome after bypass operation and LVF before and after operation.

Table 3. Criteria to state global LVF before and after operation.

– Rest	55%	+++
– Exercise	55%	+++
– Rest-exercise	5%	+++
Normal		ø
Slightly impaired		+++
Medium impaired		+++
Severely impaired		+++

Difference before and after bypass operation to state alteration of global LVF after operation.

The influence of a previous infarction is shown in Table 4. There was no difference concerning the percentage of amelioration, constancy and deterioration between patients without a previous MI and those with a MI of the anterior wall. This is mainly due to the fact that we excluded patients with aneurysmectomy from the study, that means patients with a large anterior infarction. But in the group with previous infarction of the posterior wall the percentage in whom LVF deteriorated after bypass operation was significantly increased. This result is important for selection of patients for bypass surgery.

Alterations in regional motility by MUGA after bypass operation are rather difficult to judge in the standard LAO position since there is a considerable percentage of patients with decreased motility of the septum. The reason for this is not finally clear. In our group disturbances of septal motility 10 days after operation were observed by MUGA in 60%. They decreased to 30%

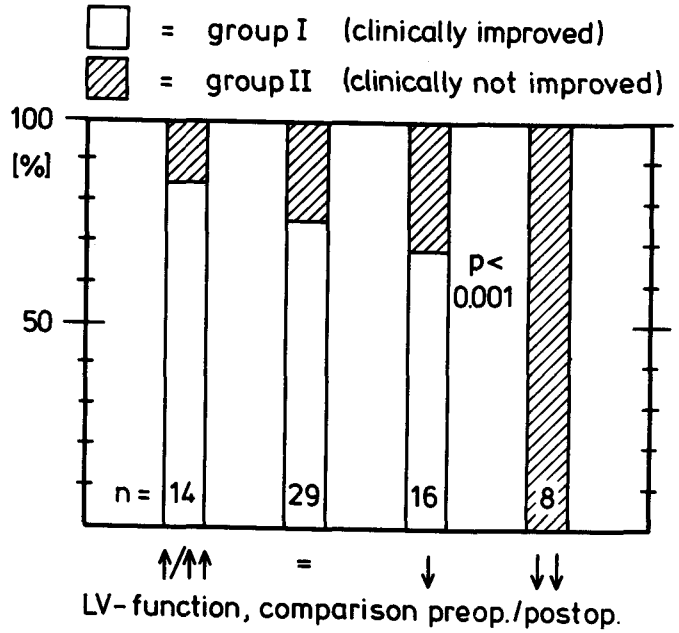

Fig. 4. Correlation between clinical outcome and change of LVF after bypass operation

Table 4. Influence of a previous MI on LVF after bypass operation.

LV function	N	Without infarction	Anterior infarction	Posterior infarction
Ameliorated	14	9 (35%)	4 (21%)	1 (5%)
Constant	27	12 (46%)	11 (58%)	4 (21%)
Deteriorated	23	5 (19%)	4 (21%)	14 (74%)*
		N = 26	N = 19	N = 29

*) p 0.001

6 months after operation. In addition disturbances of septal motility were often accompanied by hyperkinesia of the postolateral wall. There is still another reason which limits the evaluation of regional motility. All wall segments cannot be judged by one view. While one can apply two or even more views at rest this is difficult to do under exercise. The problem can partly be overcome by a bifocal collimator. But it has some disadvantages. SPECT of which one could think to apply under these circumstances makes the time of exercise intolerably long and may produce artefacts. So judgement of motility of all wall segments under exercise is still an unresolved problem in MUGA.

Twentyfive of the 67 patients (37%) were asked for reangiography postoperatively because they had still angina or LVF by MUGA was deteriorated (Table 5). But only 15 of them (60%)

Table 5. Results of reangiography in 13 patients after bypass operation, due to persisiting angina or due to deterioration of LVF. In two patients reangiography was performed since LVF was decreased before and after bypass operation.

Pat. No.	Global LVF	Angina persisting	Bypass occluded	Comments
1		+	3/4	
2		+	2/3	
3		+	2/3	
4	↓	+	2/3	
5		+	1/3	
6		+	1/2	
7		−	1/1	
8		−	1/1	
9		−	0/2	Two new stenoses
10	↓	+	0/1	New MI after op.
11		+	0/1	Reason unknown
12	CONST.	+	1/2	
13	CONST.	(+)	1/1	
14	CONST.	−	0/3	LVF before op.
15	CONST.	−	0/2	LVF before op.

aggreed to this procedure. 10 of the 15 were still symptomatic by angina. In 11 of the 15 global LVF by MUGA had deteriorated postoperatively. 8 of the 11 had still angina. The following reasons could be found out which might be responsible for deterioration of the global LVF after bypass operation: in 8 of the 11 patients in whom LVF had deteriorated occlusion of at least one bypass had occured. The 9th had two new stenoses and the 10th had aquired a MI after operation. In patient No.11 no reason could be found. There were 4 patients in whom LVF remained constant. In 2 of them one bypass was occluded. The two in whom there was no

occlusion of a bypass had already a severely decreased LVF before operation.

SUMMARY

Investigating LVF directly, quantitatively and non-invasively by MUGA helps to validate and to follow up the effectiveness of new kinds of therapy. This is performed in controlled studies comparing groups of patients as demonstrated in the case of intracoronary thrombolysis.
But it is also applicable on an individual basis. Contrary to the protocol in controlled studies medication was not discontinued in our patients before and after bypass surgery. This resembles the situation under routine conditions. Therefore the number of patients with reduced LVF was rather small before and after bypass operation. But, and this in the main result of our study, implementing MUGA for follow-up under this conditions can help:

1. To find out early those patients in whom LVF deteriorates postoperatively despite adequate medication.
2. To better define whether in cases of persistent or recurrent angina there is also deterioration of LVF.

By this means MUGA can significantly contribute to find out whether reangiography is necessary or not, a question which often is difficult to answer in those patients.