OPTIMIZING CONTRAST IN RECENT MYOCARDIAL INFARCTION USING MRI SPIN ECHO T2 WEIGHTED SEQUENCES

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Due to the different possibilities of selecting sequence parameters (TR & TE), with respect to tissue relaxation times (T1 and T2) in spin echo MRI this paper tries to specify in a practical way the significance of the "sequence weighting" in ECG gated MR images.

In the spin echo sequences, the signal intensity is given by the simplified equation (1):

$$I=N(H).1-\exp(-TR/T1).\exp(-TE/T2)$$

Previous experimental and clinical investigations have shown that both T1 and T2 are increased in recent myocardial infarction (MI). The given mean values computed on our MR imager (CGR-GE) 0.5 T are:

Myocardium	T1 ms	T2 ms
Normal	600	40
Infarcted	750	60

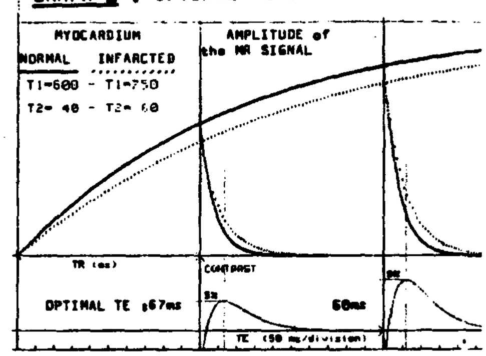
With these values and equation (1) it is possible to compute the optimal TE wich provides the best contrat between normal and infarcted myocardium. For TR value ranging from 500 to 1000ms (heart rate 60 to 120 bpm), optimal TE value is around 64 ms, corresponding to the 2nd-3rd echo of a multi-echo (TE=28ms) spin echo sequence (T2 weigthing- see graph I).

Moreover the third echo allows better MI depiction because even echo rephasing flow signals (related to infarcted wall hypo or dyskinesia) disturb MI area evaluation on the second echo. Heart rate also modifies MI contrast: for heart rate over 80 bpm (TR=750ms) only 52% of the maximum possible contrast is obtained, justifying cardiac gating on every second heart beat (see graph II).

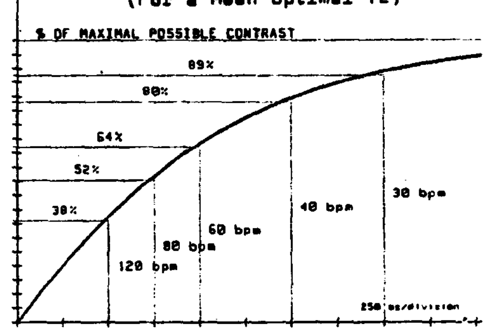
Secondly we apply these concepts to optimize contrast in the evaluation of recent MI.

31 patients with recent MI (mean delay 12.7 ± 3.5 days - 22 anterior and 9 inferior MI) were entered in the study. MI is identified as transmural myocardial areas of enhanced signal intensity. The presence of a focal region of increased signal intensity had to be seen on at least two consecutive slices and echoes to be considered as depicting the site of MI. No abnormal transmural signal was seen in a control group of ten patients imaged under the same conditions.

GRAPH 1 : OPTIMAL TE COMPUTATION



GRAPH 2 : TR INFLUENCE ON IMAGE CONTRAST (For a Mean Optimal TE)



Our result demonstrate a better sensitivity on the third echo images (27/31 - most T2 weighted) than on the second echo images (17/31).

In 12 pts, MRI MI size (planimetered on the third echo) was compared with T1201 tomoscintigraphy (using a 50% activity threshold) and LV ejection fraction (Tc-99m). Injured MRI MI size ranged from 21 to 43% (mean value 33.1±9%). An overestimating tendancy is noted with MRI sizing as compared with scintigraphy (23.8±15%). However the overall correlation between the two techniques is good: $r=0.82$ $p<0.0012$ SEE=6.5%. A less close but still significant correlation is found between MRI-MI size and LVEF ($r=-0.61$ $p<0.038$).

CONCLUSION: From our study it appears that the best strategy for MRI recent MI analysis is achieved with the use of three echo spin echo multiple slice sequences :

1. The first echo gives an optimal anatomic depiction (best N/B ratio).
2. The second echo shows low flow related signals (LV hypo or dyskinesia).
3. The third echo (the most T2 weighted) provides optimal MI contrast and therefore possible 3D MI sizing.