

Mn - DPDP가

1

: Manganese dipyridoxyl diphosphate(Mangafodipir trisodium, Teslascan, Nycomed, Mn - DPDP)가 (MRI) (MRS)

: , 4.7
 Mn - DPDP 가 MRS 1.3 ppm
 , 가 Mn - DPDP(10 μ mol, 1 ml/kg)
 가 10 , 20 , 30 , 1 , 2 , 4 , 24
 T1 -
 , MRS

: Mn - DPDP 1.3 ppm
 Mn - DPDP 가 20
 24 . Mn - DPDP T1 -
 . MRS Mn - DPDP 1.3 ppm

: Mn - DPDP MRI T1 - , MRS 1.3
 ppm

MRS Mn - DPDP가 MRI MRS 가
 . MRS MRI MRS
 가 가
 (1 - 3) (4) MRS
 가 MRS 가
 (5 - 8).
 , SPIO MRS (Lecithin: L - a - phos -
 phatidylcholine, Type IV - S: from Soybean, SIGMA+)
 (9). 3%, 5%, 10%
 MRS 0.5 ml Mn - DPDP 가 4.7
 (7). MRS (Brucker 47/30 Animal MR Spec - troscopy and
 DPDP (10 - 12) T1 - Imaging System) MRS . 1.3
 ppm
 Mn - DPDP 1.3 ppm

1 2001 10 8 2002 1 4

: Mn-DPDP가

ppm(), 2.4-2.5 ppm(/), 3.0-3.2 ppm(), 3.4-3.9 ppm(), 5.0-5.4 ppm

2.5-3 kg 가
 2 ml/kg (Ketamine, Ketamine hydrochloride 50 mg/ml)
 2 ml/kg (Rompun, Xylazine hydrochloride 20 mg/ml)
 21G (scalp needle)

PC Microsoft excel
 (PC-SAS, Ver 6.12)

ANOVA test
 0.05

Mn-DPDP 가
 가 Mn-DPDP 1ml/kg 10, 20, 30, 1, 2, 4, 24 가
 (Mettler AT 2000)

1 가 Bonferroni method

50 48
 3 ml 가 5
 (Wave length: 279.5 nm, Slit width: 0.2, Signal type: AA-BG, Signal measurement: peak area).

4.7T 3%
 638.52 0.5 ml Mn-DPDP 가
 DPDP 가 632.90 . 5%
 640.09 5% Mn-DPDP 가

1g (: nmol/g wet tissue). 가

636.18 . 10%
 645.36 0.5 ml Mn-DPDP 가
 642.39 (Fig. 2, 3). 가 가

$$= \left\{ \frac{(\text{Increasement in Mn concentration, \%})}{(\text{Control}) - (\text{Mn-DPDP})} \right\} \times 100$$

DPDP 가 Mn-DPDP가

Mn-DPDP가 MRI
 5 가

Mn-DPDP 가
 Mn-DPDP 10, 20, 30, 1, 2, 4, 24 가
 (nmol/g wet tissue) 28.7, 52.3, 60.4, 58.7,

T1- (Fig. 1).
 가 Mn-DPDP 1 ml/kg 10, 20, 30, 1, 2, 4, 24
 T1 가

$$= \left\{ \frac{(\text{Relative enhancement ratio, \%})}{(\text{Control}) - (\text{Mn-DPDP})} \right\} \times 100$$

Mn-DPDP가 MRS
 5 가 Mn-DPDP 1 ml/Kg MRI
 MRS . STEAM
 (Stimulated Echo - Acquisition Mode)
 (TR; repetition time) 3000 msec , (TE; echo time) 30 msec (voxel size)
 8 ml , (NEX) 2, 128
 3- CHES

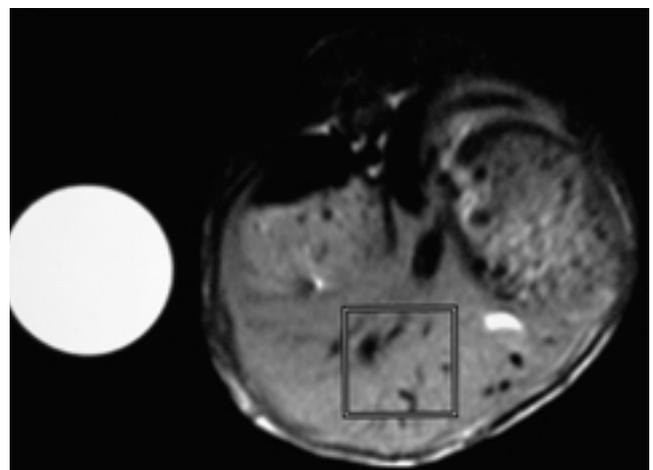


Fig. 1. T1-weighted MR scan obtained at upper abdomen level of the rabbit with prone position. Light circle is a tube filled with oil.

51.8, 44.0, 38.9, 26.6 (Fig. 4).
 가 (%) 82.2, 208.0, 215.0, 161.0, 53.3,
 35.5, -7.3 . 가 Mn-DPDP
 가 20 가
 2

가 511.7 ±
 52.0, 728.7 ± 63.9, 845.5 ± 127.3, 810.6 ± 107.5, 739.6 ±
 135.3, 685.7 ± 85.2, 652.6 ± 60.9, 562.3 ± 60.1 (p=
 0.005) (%) 42.6, 65.5, 58.6, 44.7,
 34.2, 27.7, 10.0 (Fig. 5).

Mn-DPDP가 MRI Mn-DPDP가 MRS (Fig. 6)
 Mn-DPDP 10, 20, 30, 1, 2 Mn-DPDP 10, 20, 30, 1, 2
 , 4 , 24 1.3ppm
 , 4 , 24 178.48, 114.85, 83.20, 96.10, 104.61,

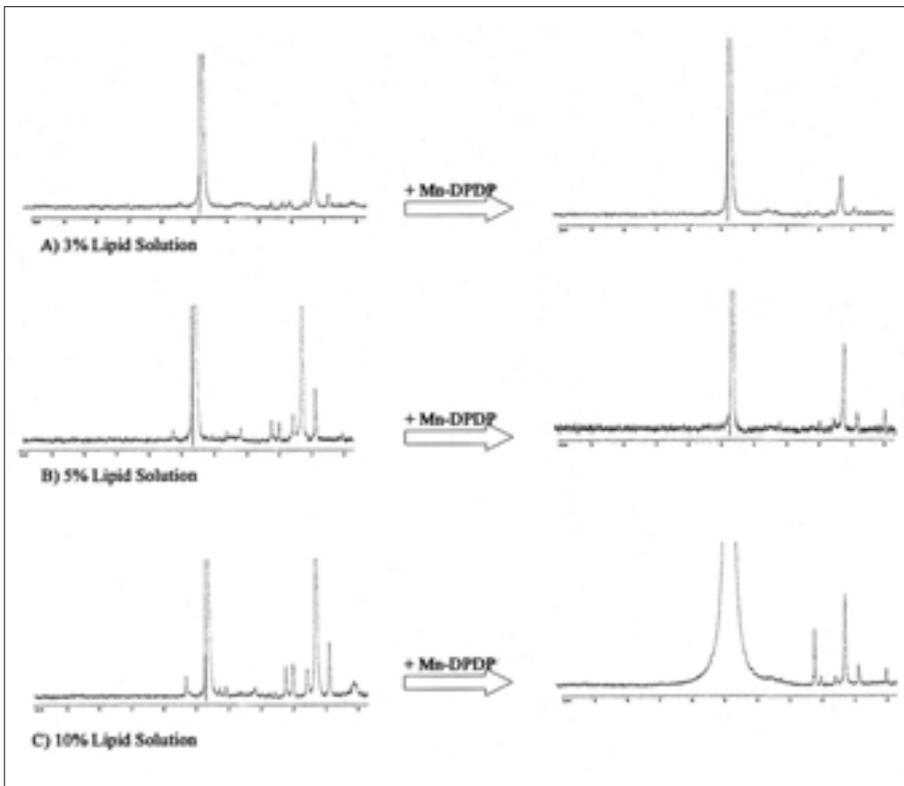


Fig. 2. Spectrum of lipid solution before and after Mn-DPDP administration on 4.7T MRS.

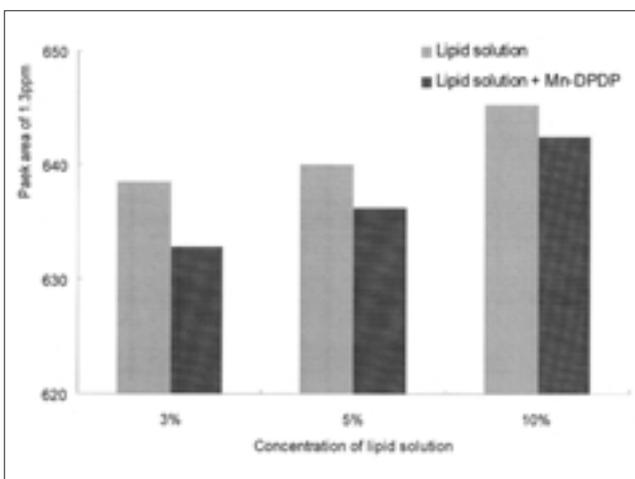


Fig. 3. The peak area of lipid at 1.3 ppm in varying composition of oil solution before and after Mn-DPDP administration.

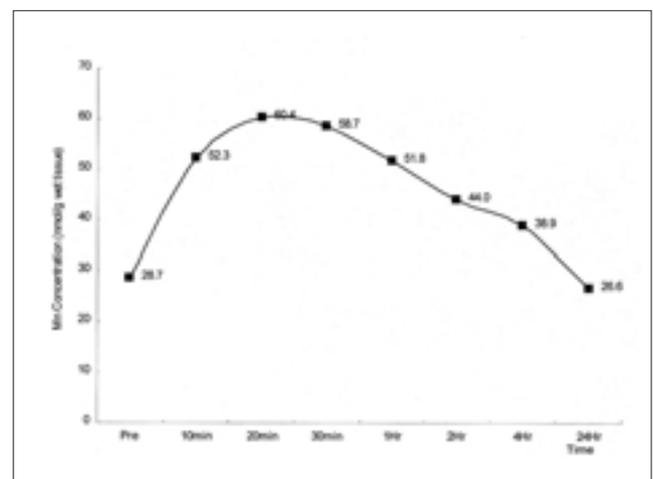


Fig. 4. Sequential change of tissue Mn concentration of rabbit liver.

: Mn-DPDP가

115.44, 129.24, 179.52 ($p=0.007$).
 2.4 - 2.5 ppm 9.01, 12.56,
 12.31, 10.76, 7.39, 11.19, 6.45, 6.71 ($p=0.407$). 3.0 -
 3.2 ppm 6.80, 12.10, 10.95, 9.23, 8.28,
 8.05, 7.33, 6.87 ($p=0.145$). 3.4 - 3.9 ppm

8.73, 11.02, 12.54, 9.48, 14.51, 5.77, 7.76, 6.60
 ($p=2.052$). 5.0 - 5.4 ppm 2.32,
 11.69, 16.26, 10.23, 9.38, 7.69, 7.21, 1.69 ($p=0.007$)
 . 2.4 - 2.5 ppm, 3.0 - 3.2 ppm, 3.4 - 3.9 ppm
 1.3 ppm

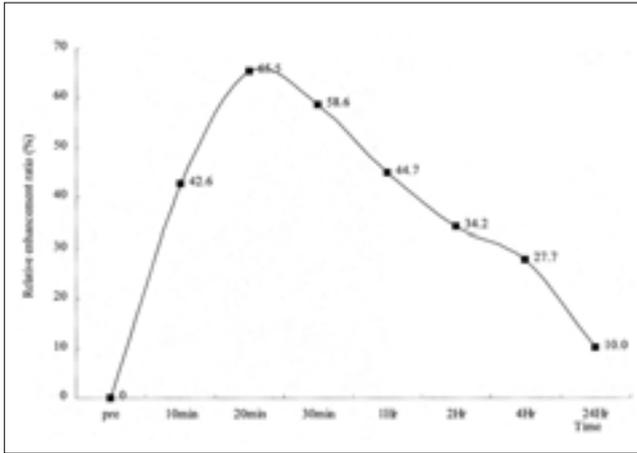


Fig. 5. Sequential change of relative enhancement ratio (%) of rabbit liver on T1 weighted MR imaging

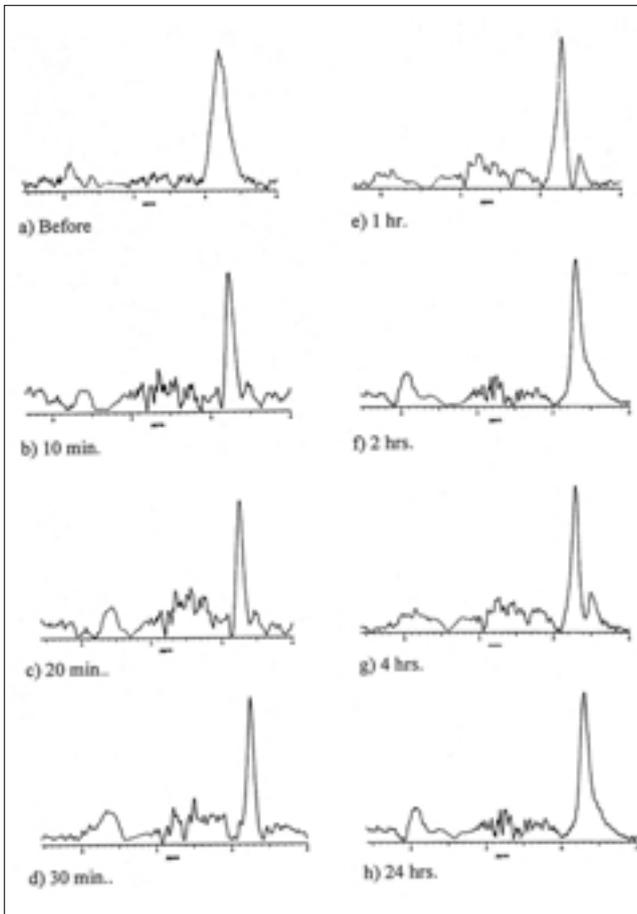


Fig. 6. Sequential change of spectrum of rabbit liver before and after Mn-DPDP administration.

20
 2 - 4 가 24
 (Fig. 7). 5.0 - 5.4 ppm
 Mn - DPDP 가 20
 2 - 4 24
 (Fig. 8). Mn -
 DPDP 10 , 20 , 30 , 1 , 2 , 4
 , 24 1.3ppm
 2.4 - 2.5 ppm 0.0488, 0.1230, 0.1956,
 0.1323, 0.0926, 0.0926, 0.0549, 0.0416 ($p=0.028$),

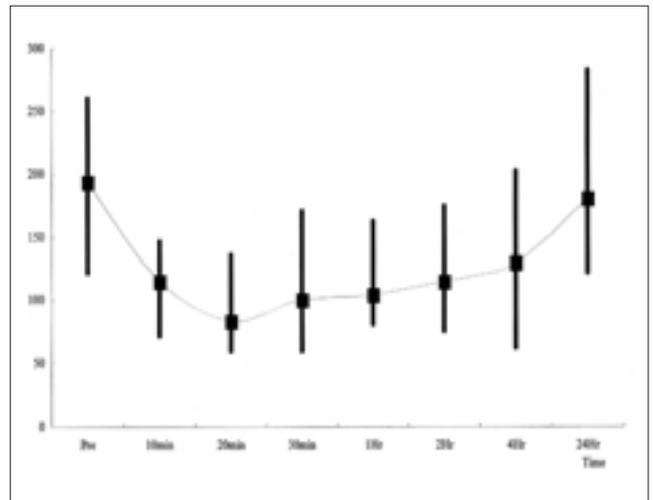


Fig. 7. The sequential change of peak area at 1.3 ppm on MRS ($p=0.007$)

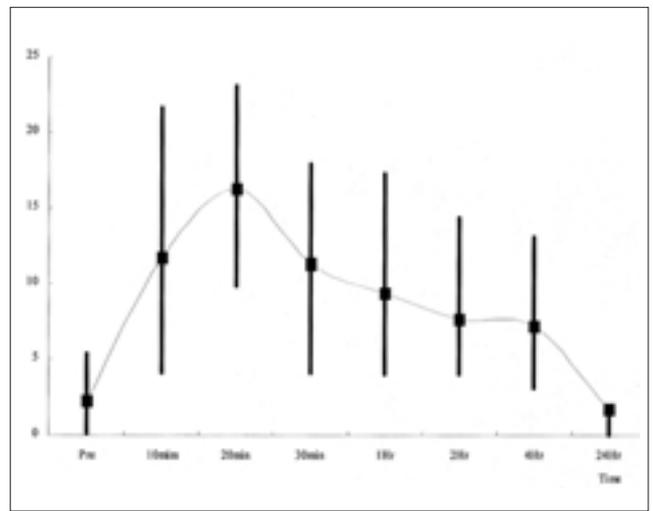


Fig. 8. The sequential change of peak area at 5.0 - 5.4 ppm on MRS ($p=0.007$)

3.0 - 3.2 ppm/1.3 ppm 0.0365, 0.0980, 가 SPIO MRS 가
 0.1053, 0.1319, 0.0877, 0.0667, 0.0637, 0.0411 ($p =$, 1.3 ppm 가
 0.217). 3.9 - 4.1 ppm/1.3 ppm 0.0506 3.9 - 4.0 ppm
 0.1024, 0.1547, 0.0993, 0.1097, 0.0589, 0.0711, 0.0464 가 가 Stanka (4)
 ($p = 0.099$), 5.0 - 5.4 ppm/1.3 ppm (7)
 0.0133, 0.1107, 0.2120, 0.1255, 0.0927, 0.0662, 0.0681, MRS 가
 0.0120 ($p = 0.007$). SPIO
 2.4 - 2.5 ppm/1.3 ppm 5.0 - 5.4 ppm/1.3 ppm 가
 . 2.4 - 2.5 ppm 5.0 - 5.4 ppm 가 가 가
 1.3 ppm 가
 . Mn - DPDP 10 , 20 , 30
 , 1 , 2 , 4 , 24 1.3 ppm
 20
 2 - 4 가 24
 . 5.0 - 5.4 ppm
 가 Mn - DPDP 가
 20 2 - 4
 24
 . 1.3 ppm
 , , ,
 가 Mn - DPDP 2가
 (Mn²⁺) DPDP 5.0 - 5.4 ppm
 . 3.0 - 3.2 ppm, 3.9 - 4.0 ppm
 T1 - 가 가 2.4 - 2.5 ppm/1.3 ppm 5.0 - 5.4
 가 (13 - 15). Mn - DPDP ppm/1.3 ppm
 가 2.4 - 2.5 ppm 5.0 -
 가 5.4 ppm 1.3 ppm
 Gd - DPDP가 5% Mn - DPDP 47% 가
 (16 - 18). Mn - DPDP T1 T2 SPIO 가
 T1 T1 - MRS 3.9 - 4.0 ppm
 가 . Petre 5.0 -
 (16) Mn - DPDP 5.4 ppm 가
 가 가 10 27.05 nmol/g, 2 21.31 nmol/g,
 24 - 3.35 nmol/g , Mn - DPDP 1.3 ppm 가
 (%) 10 MRS
 29, 2 22, 24 - 1 . 가
 Mn - DPDP 10 μ mol/Kg .
 Mn - DPDP 가
 20 가 24 Mn - DPDP
 . in vitro MRS
 가 가 4.7 T MRS
 가 가 Mn - DPDP 가
 Mn - DPDP가 Mn - DPDP 가
 0.5 ml/kg 1 ml/kg 가
 가
 (9) (SPIO) 가
 MRS MRS
 MRS 가

Influence of Mn-DPDP on MRI and Proton MR Spectroscopy of the Liver¹

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Purpose: To determine the influence of manganese dipyridoxyl diphosphate (Mn-DPDP) on MRI and proton MRS.

Materials and Methods: In an in-vitro study designed to determine changes in the lipid peak at 1.3 ppm, 4.7T MR equipment was used to obtain proton MR spectrographic images of a lipid solution of varying concentration, with and without Mn-DPDP. Before; at 10, 20, and 30 minutes; and at 1, 2, 4, and 24 hours after the IV injection of Mn-DPDP (10 μ mol, 1ml/kg), the concentration of Mn in liver tissue was measured by atomic absorption spectrometry. At the same intervals, T1-weighted MR images were obtained, the signal intensity of the liver was thus determined, and the relative enhancement ratio was calculated. MRS of rabbit liver was performed serially at the same intervals, and the peak areas of metabolites, as well as their peak areas relative to lipids, were calculated. The findings were correlated with tissue Mn concentration.

Results: At 1.3 ppm with Mn-DPDP, MRS showed that the peak area of the lipid had decreased. Tissue Mn concentration increased just after Mn-DPDP injection and peaked after 20 minutes, decreasing to a level within the normal range after 24 hours. Serial changes in the signal intensity of the liver, as seen at MRI, showed a similar pattern to that of Mn concentration. There was reverse correlation between serial change in the peak area of lipids at 1.3 ppm and Mn concentration after Mn-DPDP injection.

Conclusion: At T1-weighted MR imaging, the injection of Mn-DPDP led to the enhancement of liver tissue, and at MRS, the lipid peak at 1.3 ppm decreased. There was close correlation between these effects and tissue Mn concentration.

Index words : Magnetic resonance (MR), contrast enhancement
Magnetic resonance (MR), experimental
Magnetic resonance (MR), spectroscopy

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