

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

: 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)
. 3 - 5

PC Microsoft excel
(PC - SAS, Ver 6.12)

ANOVA test
0.05

Bonferroni method

Mn-DPDP 가
가 Mn-DPDP 1ml/kg 10 , 20 , 30 , 1 , 2 , 4 , 24 가
(Mettler AT 2000)
50 48
3 ml 가 5

(Wave length: 279.5 nm, Slit width: 0.2, Signal type: AA - BG, Signal measurement: peak area).

1g (: nmol/g wet tissue). 가

$$= \{ \frac{(\text{Increase in Mn concentration, \%})}{(\text{Control}) - (\text{Control})} \} \times 100$$

Mn-DPDP가 MRI
5 가

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

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

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 - CHESS

1.3

360

4.7T 3%
638.52 0.5 ml Mn - DPDP 가 632.90 . 5%
640.09 5% Mn-DPDP 가
636.18 . 10%
645.36 0.5 ml Mn-DPDP 가
642.39 (Fig. 2, 3). 가 가
DPDP 가 Mn-DPDP가

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,

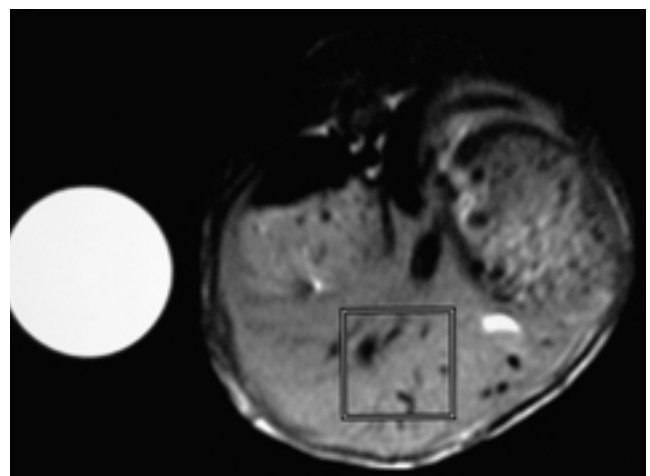


Fig. 1. T1-weighted MR scan obtained at upper abdomen level of the rabbit with prone position. Light circle is a tube filled with oil.

51.8, 44.0, 38.9, 26.6 (Fig. 4).
 가 (%) 82.2, 208.0, 215.0, 161.0, 53.3, 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)
 35.5, -7.3 . 가 Mn-DPDP (%) 42.6, 65.5, 58.6, 44.7, 34.2, 27.7, 10.0 (Fig. 5).
 가 20 가
 2
 Mn-DPDP가 MRI Mn-DPDP가 MRS (Fig. 6)
 Mn-DPDP Mn-DPDP 10, 20, 30, 1, 2 10, 20, 30, 1, 2
 , 4 , 24 1.3ppm
 , 4 , 24 178.48, 114.85, 83.20, 96.10, 104.61,

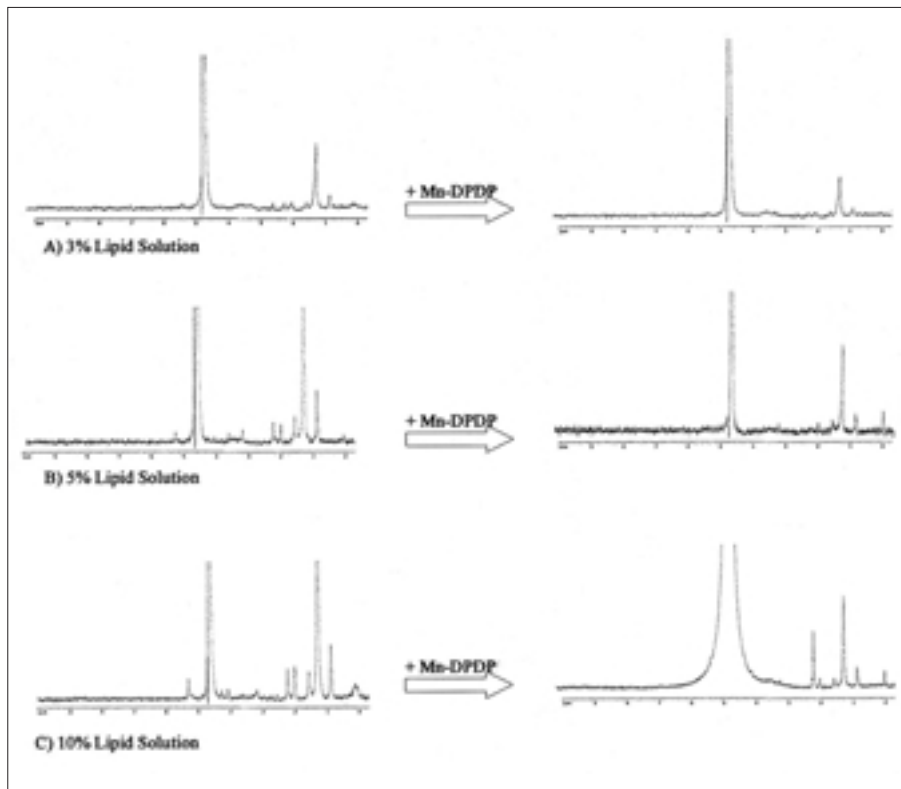


Fig. 2. Spectrum of lipid solution before and after Mn-DPDP administration on 4.7T MRS.

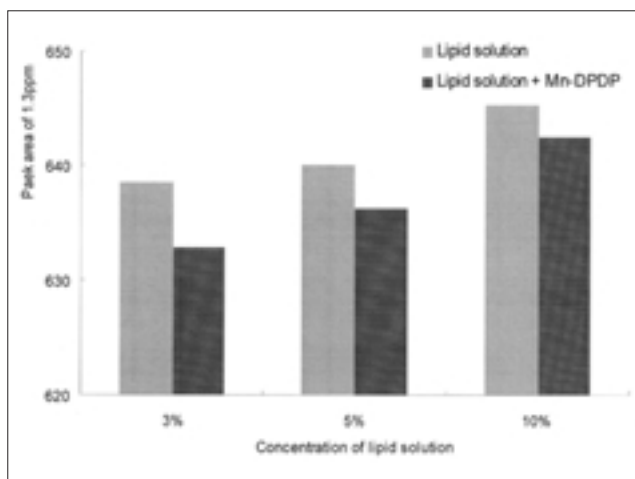


Fig. 3. The peak area of lipid at 1.3 ppm in varying composition of oil solution before and after Mn-DPDP administration.

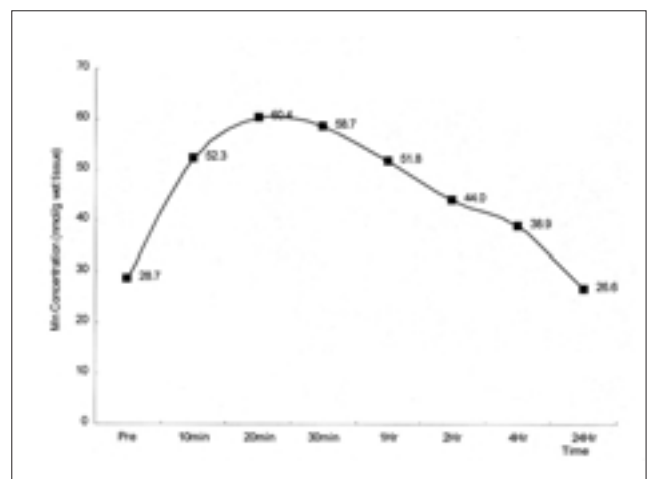


Fig. 4. Sequential change of tissue Mn concentration of rabbit liver.

: 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

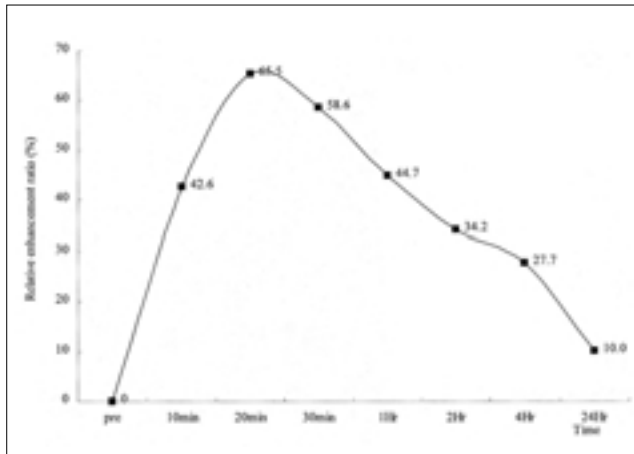


Fig. 5. Sequential change of relative enhancement ratio (%) of rabbit liver on T1 weighted MR imaging

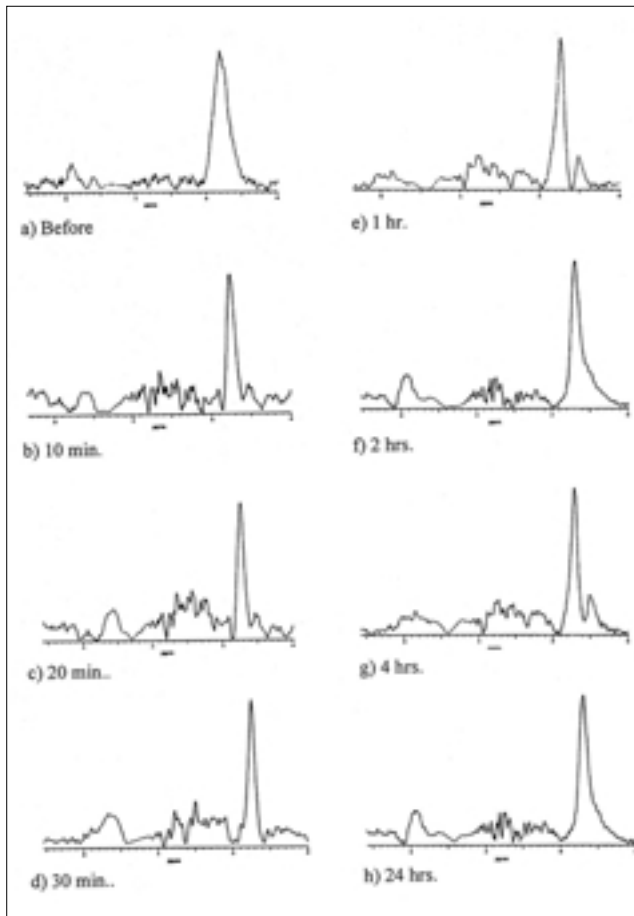


Fig. 6. Sequential change of spectrum of rabbit liver before and after Mn-DPDP administration.

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

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 ($p=0.028$),

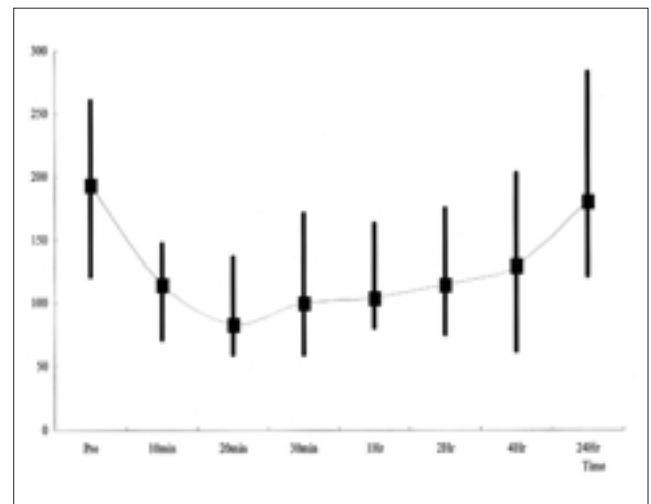


Fig. 7. The sequential change of peak area at 1.3 ppm on MRS ($p=0.007$)

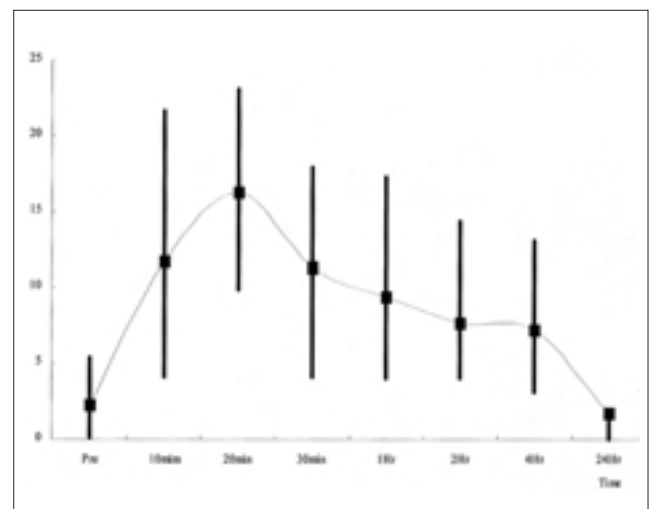


Fig. 8. The sequential change of peak area at 5.0 - 5.4 ppm on MRS ($p=0.007$)

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 ($p =$
 0.217). 3.9 - 4.1 ppm/1.3 ppm 0.0506 , 1.3 ppm 가
 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
 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 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 .
 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 4.7 T MRS
 가 가
 Mn - DPDP 가
 Mn - DPDP가
 가 .
 가
 (9) (SPIO) 가
 MRS MRS
 MRS 가

가 .
MRS (respiratory gating) ,
. MRS
가 .
가 MRS
.
MRS
가

1. Choji T, Honjou K, Suda H, et al. Detection of intrahepatic lipids by 1H-MRS studies by breath-holding & 1 cm3 VOI. *Nippon Igaku Hoshasen Gakkai Zasshi* 1992;52:107-109
2. Ling M, Brauer M. Ethanol-induced fatty liver in the rat examined by in vivo 1H chemical shift selective magnetic resonance imaging and localized spectroscopic methods. *Magn Reson Imaging* 1992; 10:663-677
3. Lee JKT, Dixon WT, Ling D, Levit RG, Murphy WA. Fatty infiltration of the liver: demonstration by proton spectroscopic imaging. *Radiology* 1984;153:195-201
4. Stanka M, Rummeny E, Reimer P, et al. *Characterization of chronic*

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

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Purpose: To determine the influence of manganese dipyrdoxyl 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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