The Usefulness of In Vitro Proton MR Spectroscopy for Characterizing and Differentiating Abdominal Body Fluids

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Purpose

The purpose of this study is to determine whether in vitro magnetic resonance spectroscopy(MRS) at a routine 1.5 Tesla MR scanner is useful as a potential tool for differentiating between abdominal fluids for the future clinical applications.

Subjects and Methods

Thirty fluid samples obtained from patients undergoing diagnostic or therapeutic percutaneous drainage of abdominal fluids were enrolled in this study. According to gross appearance, each sample was classified as either purulent fluid(n=12) or non-purulent fluid(n=18). Non-purulent fluids were subdivided into hemorrhagic fluid(n=2), serosanguinous fluid with debris(n=2), and serosanguinous fluid without debris(n=14). Biochemical analysis, cytologic analysis, and culture of the fluid were performed in all fluid samples. In vitro ^{1}H MRS was performed by using a 1.5T MR system(GE medical system, Horizon Milwaukee, US). MR spectra were obtained by using a point resolved spectroscopy(PRESS: TR/TE = 2000/30msec) with water suppression. MR spectra were analyzed on the basis of agreed consensus between a radiologist and a physicist.

Results and Discussion

MR spectra obtained from 30 samples could be classified as 8 patterns(Table 1 and Fig 1) according to the presence of succinate peak(2.4ppm), acetate peak(1.9ppm), lactate peak(1.3ppm), and lipid peak(0.9/1.3ppm).

MR spectra of purulent fluids(n=12) showed the metabolite peaks corresponding to succinate(n=9, 75%), acetate(n=10, 83%), lactate(n=11, 92%), and lipid(n=8, 67%). MR spectral patterns were classified as follows: pattern 1(n=7, 58%), pattern 2(n=2, 17%), pattern 3(n=1, 8%), pattern 6(n=1, 8%), pattern 8(n=1, 8%). MR spectra of non-purulent fluids(n=18) showed the metabolite peaks corresponding to acetate(n=1, 6%), lactate(n=6, 33%), and lipid(n=9, 50%). MR spectral patterns of non-purulent fluids were classified as follows: pattern 4(n=1, 6%), pattern 5(n=5, 28%), pattern 6(n=1, 6%), pattern 7(n=3, 17%), pattern 8(n=8, 44%). The MR spectral patterns of purulent fluids were significantly different from those of non-purulent fluids($p<0.05$).

MR spectra of benign fluids(n=23) showed the metabolite peaks corresponding to succinate(n=9, 39%), acetate(n=11, 48%), lactate(n=15, 65%), and lipid(n=13, 57%). MR spectral patterns were classified as follows: pattern 1(n=7, 30%), pattern 2(n=2, 9%), pattern 3(n=1, 4%), pattern 4(n=1, 4%), pattern 5(n=3, 13%), pattern 6(n=2, 9%), pattern 7(n=1, 4%), pattern 8(n=6, 26%). MR spectra of malignant fluids(n=7) showed the metabolite peaks corresponding to lactate(n=2, 29%) and lipid(n=4, 57%). MR spectral patterns were classified as follows: pattern 5(n=2, 29%), pattern 7(n=2, 29%), pattern 8(n=3, 43%). The significant difference between the spectral patterns of benign and malignant fluids was found($p<0.05$).

Conclusion

In vitro MRS might be useful for clinical applications by characterizing and differentiating the abdominal body fluids.

References

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Table 1. Classification of MR Spectral Patterns

MR Spectral Pattern	Resonance Detected			
	Succinate	Acetate	Lactate	Lipid
1	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	No
3	No	Yes	Yes	Yes
4	No	Yes	No	Yes
5	No	No	Yes	Yes
6	No	No	Yes	No
7	No	No	No	Yes
8	No	No	No	No

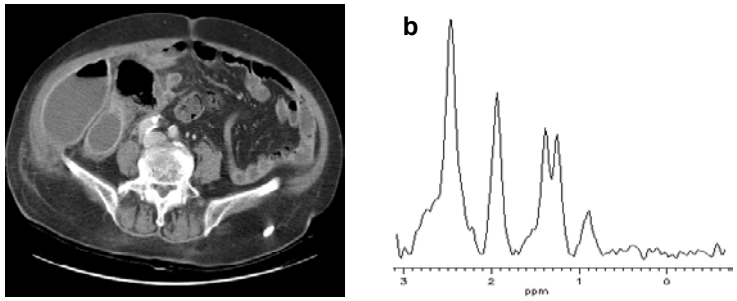

Fig. 1 A demonstration for pattern 1: purulent and benign fluid in a 71-year-old man who underwent an operation for appendicitis. CT image(a) shows an abscess with internal air-fluid level and enhancing wall in RLQ of abdomen. MR spectrum(b) shows the metabolite peaks corresponding to succinate(2.4ppm), acetate (1.9ppm), lactate(1.3ppm), and lipid(0.9/1.3ppm).