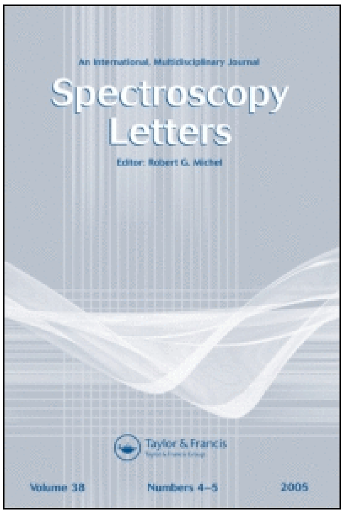

Spectroscopy Letters
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713597299

NMR Proton 1/T1 Rates in Bile Fluid

A. Yilmaz[a]; Ş Boylu[b]
[a] Department of Physics, Faculty of Science, School of Medicine, University of Dicle, Diyarbakir, Turkey [b] Department of General Surgery, School of Medicine, University of Dicle, Diyarbakir, Turkey

To cite this Article Yilmaz, A. and Boylu, Ş(1996) 'NMR Proton 1/T1 Rates in Bile Fluid', Spectroscopy Letters, 29: 7, 1317 — 1321
To link to this Article: DOI: 10.1080/00387019608007125
URL: http://dx.doi.org/10.1080/00387019608007125

SPECTROSCOPY LETTERS, 29(7), 1317-1321 (1996)

NMR PROTON 1/T1 RATES IN BILE FLUID

Key Words: NMR T1, Bile Fluid

A.Yılmaz[+] and Ş Boylu*

[+]*Department of Physics , Faculty of Science,* [*]*Department of General Surgery, School of Medicine, University of Dicle, Diyarbakır, Turkey.*

ABSTRACT

1/T1 rates in bile fluids from patients with gallstones in the gallbladder have been determined using a FT-NMR spectrometer operating at 60MHz. The inversion recovery pulse sequences (180^{o}-τ-90^{o}] were used for T1 measurements. Fluids from patients with non-obstructive, partially obstructive and complete obstructive gallstones have been studied. The mean 1/T1 in bile fluids from patients with obstructive gallstones was highly significantly different than those from patients with non-obstructive and partial obstructive gallstones, while the 1/T1 in the fluid of partially obstructive cases was significantly different than that of complete obstructive cases. This implies that in vivo MRI T1 measurements can be used for the clinical course of gallstone formation and for surgical decision about early intervention.

INTRODUCTION

Bile fluid consistes of water, solids, bile ascites, mucin and pigments, cholesterol , ester and inorganic salts. The proton NMR of bile fluid is adequate

---

*To whom all correspondence should be addressed

since it contains more than 80 % water and each water molecule contains two protons.

Magnetic resonance imaging (MRI) is extensively being used in hospitals for diagnostic purposes. MRI data are often based on a set of spin-echo images where spin-lattice relaxation time(T1) partly constitute the source of contrast(1) In addition, T1 map obtained by MRI is useful for diagnosis(2).

The 1/T1 in a fluid is known to be very sensitive to the composition of fluid(3). The composition of bile fluid changes when gallstone becomes an obstacle to the fluid flowing into gallbladder (4). In vitro NMR 1/T1 rates in bile fluid may therefore be related to the degree of obstruction in bile duct, and this may be useful for diagnostic MRI and planning surgical intervention. Although the T1 in healthy bile fluid was reported before(5), the 1/T1 rates in bile fluids from patients with gallstones have not been specifically investigated.

MATERIALS AND METHODS

The bile fluids were collected from patients with gallstone in the gallbladder during surgical operation. The bile fluid was obtained with dental needle from gallbladder. Samples were divided into three groups : fluids from patients with non-obstructive gallstone, fluids from patients with partially obstructive gallstone and fluids from patients with complete obstructive gallstone.The groups were based on the range of the obstruction in cystic duct, which was determined during operation. The groups were compared using student t-test(6).

T1 measurements were carried out on a JEOL FX-60Q FT NMR spectrometer operating at 60MHz for proton and 10mm o.d. NMR tubes were used. The inversion recovery pulse sequence was used with pulse spacing τ, being varied from 0.05s to 5s. The peak heights of magnetization recovery were normalized to the infinite τ which was 15s. Pulse repetition time was set at 20s. The magnetization decay curve was found to be a single exponential. The probe temperature was maintained at $20 \pm 0.5\ ^{o}C$ by means of a JNM-VT-3C automatic temperature controller unit. All measurements were made immediately after bile fluids were obtained. The experimental error for T_1 was about ± 0.03s.

RESULTS AND DISCUSSION

The average 1/T1 in bile fluid from patiens at each group is shown in Table 1 together with standart deviations. It is seen that 1/T1 in bile fluids from patients with non-obstructive gallstones is highly significantly different than those of other groups ($P<0.0001$), whereas 1/T1 in partially obstructive group is significantly higher than that of complete obstructive group ($p<0.001$).

The ranges of the 1/T1 rates in fluids from patients with non-obstructive, with partially obstructive and with complete obstructive gallstones were (1.07-3.47)/s, (0.66-1.07)/s and (0.39-0.46)/s, respectively. As is seen, the ranges becomes considerably smaller in the presence of an obstruction in bile duct.

In addition to many functions in intermediary methabolism, the liver plays an important role by producing bile. Normally, the bile fluid flows into gallbladder where it is stored for the use, but gallstones may impacted in cystic duct or the neck of the gallbladder, resulting in a hydrops(4). In such cases the bile is absorbed, and the gallbbladder becomes filled and distended with mucinous material. This makes up the colorless "white bile". The gallbladder also secretes calcium in the in the presence of an obstruction in the cystic duct(4). The large changes in the 1/T1 rate in bile fluid should therefore be related to the changes in composition of bile caused by an obstacle. However, other causes of obstructions are not included in this study.

Image contrast in MRI is partly dependent on T1 (7). MRI should therefore reflect the changes in the 1/T1 of bile fluid through image contrast and T1 map when clinical course of the disease is considered. The Table 1 also implies that gradually growing obstacle causes gradually decreasing 1/T1. Accordingly, A 1/T1 value corresponding to a critical degree of the obstacle may be a good indicator for planning surgical intervention.

Table 1 The average 1/T1 values of bile fluids from patients with non-obstructive, from patients with partially obstructive and from patients with complete obstructive gallstone formation. The comparisons of the groups are as follows: The 1/T1 in fluids from non-obstructive group versus the 1/T1 in fluids of partially obstructive group, 0.0001; The 1/T1 in non-obstructive group versus the 1/T1 in complete obstructive group, 0.0001; the 1/T1 in partially obstructive group versus 1/T1 in complete obstructive groupe, 0.001.

Degrees of Obstruction	Number of cases	Mean 1/T1 in bile fluids in 1/s
Non Obstructive	13	1.95 ± 0.93
Partially obstructive	17	0.86 ± 0.15
Complete obstructive	12	0. 4.2 ± 0.03

In conclusion, present study suggests that 1/T1 in bile fluid considerably changes in the presence of obstruction, and that this change may be useful for diagnostic purposes and for making decision on operation time.

REFERENCES

1. Harpen M D, Williams J P and Williams II John P, Quantitative analysis of NMR spectroscopic imaging *Phys.Med.Biol. 1987, 32: 421.*

2. Masterson M E and McGary R, Accuracy and reproducibility of image derived relaxation times on a clinical 1.5 T magnetic resonance scanner *Med. Phys. 1989, 16 (2):225.*

3. Yılmaz A, Tez M, Göral V, Boylu Ş, Kaplan A and Kavak G, NMR proton T1 measurements in peritoneal ascites, *Phys.Med.Biol. 1996, 41:1-11.*

4. Lawrence W. Way, Current Surgical Diagnosis and Treatment, 10th ed. Beirut:Appleton and Lange,1994.

5. Brown J J, Van Sonnenberg E, Gerber K H, Strich G, Wittich G R and Slutsky R A Magnetic resonance relaxation times of percutaneously obtained normal and abnormal body fluids. *Radiology .1985, 154 : 727.*

6. Zar J H, Biostatistical Analysis, New Jersey : Prentice-Hall, 1974.

7. Cohen J M, Weinreb J C and Maravilla K R Fluid collections in the intraperitoneal and extraperitoneal spaces: Comparison of MR and CT *Radiology . 1985, 155 : 705.*

Received: March 12, 1996
Accepted: April 30, 1996