

Abdominal Ultrasonography in Diabetics — A Comparison of Ultrasonographic Findings in Diabetic and Healthy Adults —

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Accepted for publication on May 22, 1998

ABSTRACT. The abdominal ultrasonographic findings of 100 diabetics underwent examination at the Kurashiki Station Clinic of Kawasaki Medical School were compared with those of 69 healthy adults (controls) 40 years of age or older. Fatty liver was the most common observation in these patients, with no significant difference between the diabetics and controls. Findings suggesting splenomegaly, gallstones, and liver cirrhosis were significantly more common in the diabetics, and the liver, and spleen showed significantly more abnormal findings. These results indicate that diabetics frequently suffer from hepatic diseases and gallstones. Abdominal ultrasonography should therefore be conducted at least once a year to detect potential complications even in symptom-free diabetics—particularly, every three months for those with chronic hepatic diseases.

Key words: diabetes mellitus — ultrasonography — statistics —
hepatocellular carcinoma — gallstones

The number of diabetics in Japan has increased rapidly as diets have become more westernized and as the population has grayed. The current incidence of diabetes is about 10% among those 40 years of age or older. Advances in diagnostic imaging modalities, including ultrasonography (US), computerized X-ray tomography (CT), and magnetic resonance imaging (MRI), have enabled physicians to conduct less invasive diagnosis, and the chance that such examinations—particularly US—will be conducted on diabetics has increased. We conducted US on diabetic outpatients at our clinic and found hepatocellular carcinoma (HCC) in two of 100 patients during the five years of our study. It is thus important in treating diabetes to determine how the frequency of complications detected by US in diabetics compares with findings for healthy adults.

SUBJECTS AND METHODS

The frequency of abnormal ultrasonographic findings and their incidence by organ were studied using an electronic convex scanner (ALOKA echo camera SSD-670 at 3.5 MHz) on 100 patients clinically diagnosed as having diabetes mellitus at the Kurashiki Station Clinic of Kawasaki Medical School between April 1992 and June 1997. Abdominal ultrasonography was carried

out with informed consent once a year or every other year on most diabetics with or without symptoms of potential complications to monitor their general condition and screen for cancer. Of the 100 diabetics, 30 were treated with diet alone, 45 with oral antidiabetes medication, and 25 with insulin.

The controls were 69 healthy adults selected from among 174 healthy adults of different ultrasonographic age who underwent US as part of regular workplace-designated physicals from April 1996 to March 1997. The 69 controls were 40 years of age or older because 96% of the diabetics in our study were within this age range and because the frequency of abnormal ultrasonographic findings increased significantly from 19.0% to 52.2% after the age of 40 in the 174 healthy adults ($p < 0.001$).

The clinical findings for the diabetics and controls are summarized in Table 1. Sixty percent of the diabetics and 66.7% of the controls were male. The diabetics ranged in age from 34 to 84 (average: 62.3 years) and the controls from 40 to 65 (average: 46.8 years). No significant differences were found between the two groups with regard to tobacco or alcohol use, a family history of cancer, the incidence of hepatic dysfunction, or positive HBs antigens. Complications and positive HCV antibodies were significantly more common in the diabetics: 79% of the diabetics had complications. i.e., hypertension (38%), hyperlipemia (22%), chronic hepatitis (9%), malignant tumor (two each gastric, rectal, and hepatocellular carcinoma; and one each renal and urinary bladder cancer, with five patients undergoing treatment, including surgery, during the study, and three completing it.) (8%), cerebrovascular disease (four cerebral infarctions, one intracerebral hemorrhage, and one subarachnoid hemorrhage) (6%), liver cirrhosis (6%), and myocardial infarction (2%). In contrast, disease was found in 13% of the controls: hypertension (5.8%), hyperlipemia (4.3%), and gastric ulcer (2.9%). HCV antibodies were positive in 15 of the 56 diabetics examined (26.8%) and none of the six controls examined.

Ultrasonographic findings for the diabetics were then compared to those for the controls. Statistical significance was determined using the chi-square test.

RESULTS

1. Case Reports

Of the 100 diabetics, 16 had chronic hepatic disease with 2 of them having HCC.

Case 1

A 60-year-old man was diagnosed as having a gastric ulcer and underwent a gastrectomy in 1969 that required blood transfusion (600ml). He appeared at our clinic on June 29, 1989, and a diagnosis of hepatitis C and diabetes was made. Regular ultrasonographic follow-up showed no evidence of findings suggesting intrahepatic tumors until July 1990. After two years and nine months, he appeared at our clinic again on April 17, 1993, because of a hepatic tumor detected at another hospital. Laboratory findings were as follows: blood sugar (BS) 185 mg/dl, SGOT 48 IU/l, SGPT 68 IU/l, gamma-GTP 174 IU/l, HCV antibodies (+), alpha-fetoprotein (AFP) 7 ng/ml, and PIVKA-2

0.4 AU/ml. Ultrasonography revealed a tumor 6 cm in diameter in the right hepatic lobe (Fig 1), and a diagnosis of HCC was made. He was treated with repeated transcatheter arterial embolization (TAE) and percutaneous ethanol injection therapy (PEIT). The patient was alive as of January 23, 1998.

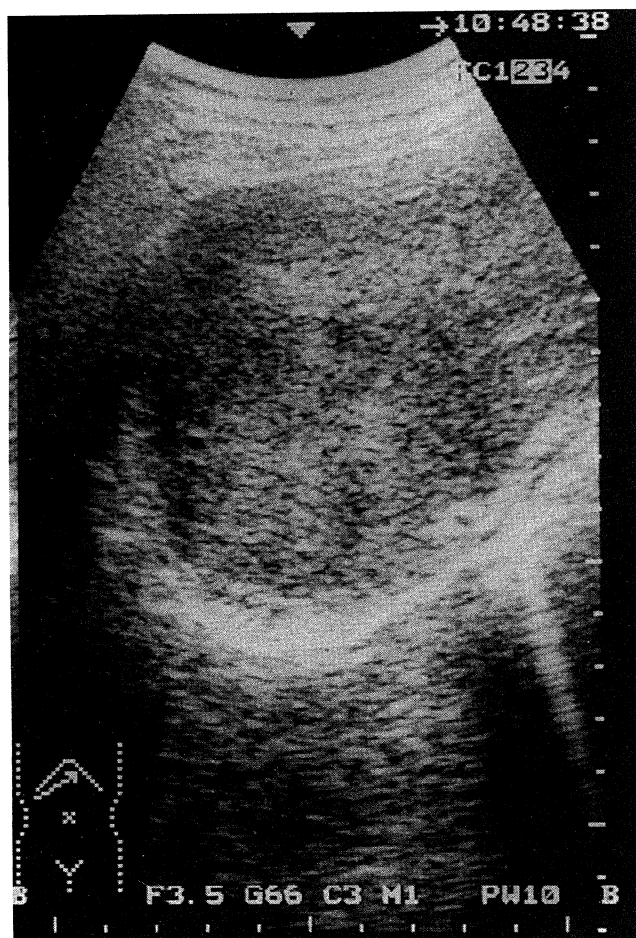


Fig 1. Ultrasonographic findings for case 1

A tumor 6 cm in diameter with a halo and a mosaic pattern echo is seen in the right lobe of the liver.

Case 2

A 64-year-old man was diagnosed as having diabetes, hepatitis, and hypertension in 1987 at a physical checkup. Regular ultrasonographic follow-up for nine years indicated no findings suggesting intrahepatic tumor. On August 3, 1996, an examination revealed a tumor 1.8 cm in diameter in the right hepatic lobe (Fig 2) and a diagnosis of HCC was made. Laboratory findings were as follows: BS 222 mg/dl, hemoglobin A_{1c} 5.7%, SGOT 24 IU/l, SGPT 60 IU/l, gamma-GTP 73 IU/l, HCV antibodies (+), and AFP 5.4 ng/ml. A PEIT plan was canceled because of the patient's left-side hemiparesis

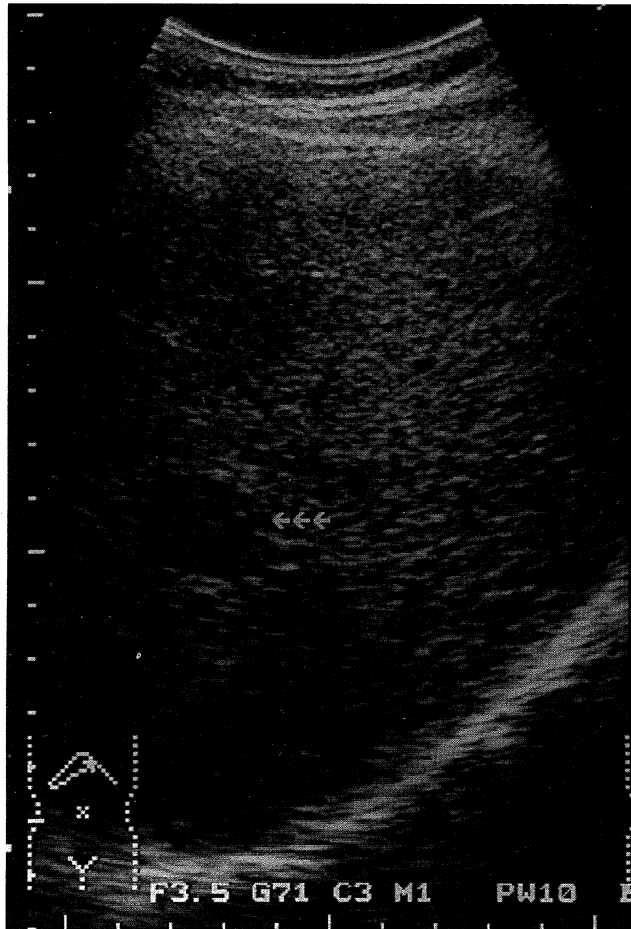


Fig 2. Ultrasonographic findings for case 2

The arrow indicates a 1.8-cm-diameter hypochoic mass lesion with a halo in the right lobe of the liver.

and difficulty in swallowing due to right putaminal hemorrhage on August 30, 1996. His nutritional state deteriorated and the tumor decreased to 1.5 cm in diameter three months after intracerebral hemorrhage. The patient was alive as of March 6, 1998.

2. Ultrasonographic Findings for Diabetics and Controls

The incidence of abnormal ultrasonographic findings by organ in the diabetics was 50% for the liver, 22% for the gallbladder, 21% for the kidneys, 20% for the prostate, and 12% for the spleen (Table 2). The incidences in the liver, spleen, and prostate were significantly higher in the diabetics than in the controls. The overall incidence was 79.0% in the diabetics and 52.2% in the controls, and was statistically significant ($p < 0.001$).

Regarding the frequency of US findings for the 100 diabetics, 32 exhibited

TABLE 1. Clinical Findings for Diabetics and Controls

Clinical Findings	DM (n=100)			NC (n=69)		
	Males (%)	Females (%)	Total (%)	Males (%)	Females (%)	Total (%)
Age/Sex						
30-39	4	0	4	0	0	0
40-49	4	4	8	46.4	24.6	71
50-59	9	11	20	15.9	5.8	21.7
60-69	26	17	43	4.3	2.9	7.2
70-	17	8	25	0	0	0
Total	60	40	100	66.7	33.3	100
Cigarette Smoking Habits	58.3	7.5	38	61.9	14.3	46
Drinking Habits	68.3	17.5	48	78.6	19	58.7
Family History of Cancer	36.7	40	38	41	57.1	46.7
Complications	80	77.5	79	15.2	8.7	13
Hepatic Dysfunction	31.7	12.5	24	32.6	0	21.7
HBV Infection	1.9	0	1.2	5	0	3.7
HCV Infection	31.4	19	26.8	0	0	0

DM: diabetes mellitus group, NC: normal control group

TABLE 2. Ultrasonographic Findings for Diabetics and Controls

US Findings	DM (n=100)	NC (n=69)	P value
Overall	79.0%	52.2%	<0.001
Liver	50.0%	31.9%	0.02
Fatty liver	32.0%	23.2%	NS
Liver cirrhosis	7.0%	0.0%	0.03
Cyst	6.0%	4.3%	NS
Chronic hepatitis	2.0%	1.4%	NS
HCC	2.0%	0.0%	NS
Hemangioma	2.0%	2.9%	NS
Gallbladder	22.0%	14.5%	NS
Gallstones	10.0%	0.0%	0.01
Cholecystectomy	9.0%	2.9%	NS
Polyp	3.0%	10.1%	NS
Kidney	21.0%	10.1%	NS
Cyst	15.0%	10.1%	NS
Nephrectomy	2.0%	0.0%	NS
Hydronephrosis	2.0%	0.0%	NS
Calcification	2.0%	0.0%	NS
Spleen	12.0%	0.0%	0.005
Splénomegaly	11.0%	0.0%	0.005
Splenectomy	1.0%	0.0%	NS
Prostate	20.0%	2.2%	0.01
BPH	10.0%	0.0%	0.03
Calcification	10.0%	2.2%	NS
Ovary	5.0%	0.0%	NS
Cyst	5.0%	0.0%	NS
Uterus	2.5%	8.7%	NS
Myoma	2.5%	8.7%	NS

DM: diabetes mellitus group, NC: normal control group,
NS: no significant difference

fatty livers, the most common finding. Fifteen had renal cysts, 11 had splenomegaly, and 10 had gallstones. A malignant tumor or HCC was found in two patients. Of the 69 healthy adults, 16 had fatty livers, seven had renal cysts, and seven had gallbladder polyps. A comparison of US findings between the diabetics and controls showed no significant difference in the incidences of fatty liver and renal cyst between the two groups, although for both the incidence was high. The incidences of splenomegaly, gallstones, prostatic hypertrophy (BPH), and liver cirrhosis were significantly higher in diabetics.

The frequency of abnormal ultrasonographic findings by treatment for diabetes was 83.3% in the diet therapy group, 80% in the oral antidiabetes medication group, and 72% in the insulin therapy group. There was no significant difference between groups.

DISCUSSION

Our results indicate that the incidences of splenomegaly, gallstones, liver cirrhosis, and BPH were higher in the diabetics than in the controls, as discussed below.

Diabetes and glucose intolerance is widely known to be associated with hepatic disorders. Transient glucone intolerance, for instance, occurs during the development of viral hepatitis and disappears with improvement in the hepatic disorder, whose mechanism remains unknown.¹⁾ The subjects in our study included 16 diabetics with chronic hepatic disease (15 with hepatitis C, and 1 with primary biliary cirrhosis). Of the 16 subjects, 12 (75%) showed abnormal ultrasonographic liver and/or spleen findings.

The relationship between gallstones and diabetes is also known. Lieber²⁾ reported gallstones to be found during autopsy in 11.6% of diabetics. Kawamoto³⁾ reported that 17.4% of diabetics had gallstones and the incidence of gallstones in healthy adults undergoing physicals was as low as 2.4%. De Santis *et al*⁴⁾ reported that the prevalence of diabetes was 4.8% in a free-living population sample and was as high as 11.6% in the patients affected with gallstones when sex, age and body mass index were matched. In these reports, researchers concluded that diabetics are likely to have gallstones. The high incidence of gallstones in diabetics is considered to be due to constrictive gallbladder dysfunction.^{5,6)} In our study, 19% of the diabetics had gallstones or a history of cholecystectomy, similar to findings by Kawamoto.³⁾ Therefore, the coexistence of gallbladder disease should be taken into account when treating diabetics.

The possible relationship between diabetes mellitus and cancer risk has long been discussed.^{7,8)} Diabetes is said to be a common complication in patients with carcinoma of the pancreas. Bell⁷⁾ reported that 30 of 390 patients with carcinoma of the pancreas (7.7%) had diabetes. Carcinoma of the pancreas was not found, however, in any of the 100 diabetics in our study. La Vecchia *et al*⁸⁾ reported that significantly elevated relative risks among subjects with diabetes were observed for cancer of the liver, pancreas, and endometrium. Our study population was too small to discuss such risks. Among the 100 diabetics in our study, however, malignant tumor was found in eight patients.

Therefore, regular cancer screening is particularly important for diabetics.

Our results showed BPH to be more common in the diabetics than in the controls — probably because 45% of the male diabetics were 65 of age or older, whereas the controls included no males over 65 years old. Age-matched controls should thus be used in further studies.

The absence of significant differences in the frequency of abnormal ultrasonographic findings between three groups of diabetics suggests that the treatment for diabetes did not influence ultrasonography, but larger studies will be needed to confirm this finding.

In summary, 79 of 100 diabetics (79.0%) showed abnormal US findings compared to 36 of 69 controls (52.2%). This was statistically significant.

Abdominal ultrasonography is currently conducted as part of workplace-designated annual physicals, and should be conducted at least once a year for diabetics likely to show abnormal US findings. Application of US for patients with chronic hepatic diseases enables us to detect small HCC. Ebara *et al*⁹⁾ stated that follow-up US should be performed every three months for patients with chronic hepatic diseases, as they found it took more than three months for the HCCs to grow from 1.5 to 2 cm in diameter, and HCCs smaller than 2 cm can be expected to be cured completely.

In case 1 of our study, for example, HCC was not found until the tumor had reached 6 cm in diameter because the patient had not come to our clinic for US in over two years. In case 2, an examination was conducted every three months and HCC with a small diameter of 1.8 cm was discovered. Abdominal ultrasonography should therefore be conducted every three months for diabetics with chronic hepatic diseases. Our study thus suggests that abdominal ultrasonography in diabetics is extremely important in detecting both common complications, such as chronic hepatic diseases and gallstones, and in detecting other potential diseases in organs including the pancreas, kidneys, prostate, and aorta while patients are still symptom-free.

ACKNOWLEDGMENTS

We wish to thank the staff of the Kurashiki Station Clinic of Kawasaki Medical School.

This study was presented at the 33rd Annual Meeting of the Chugoku Branch of the JSUM (Japan Society of Ultrasonics in Medicine) in Hiroshima on September 6, 1997.

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