Original article

AN ULTRASONOGRAPHIC STUDY OF GALL BLADDER VOLUMEAND EMPTYING IN DIABETES MELLITUS

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Abstract

Fifty two diabetic patients and 15 healthy control subjects were prospectively studied for their gall bladder function by ultrasound examination. The fasting gall bladder volume (FGBV) was calculated by using ellipse formula from the dimensions of gall bladder shadow seen on ultrasound screen in two different cuts. The contractility of gall bladder was measured by calculating post prandial ejection fraction (EF) of the gall bladder. The mean FGBV and EF in 52 diabetic patients was found to be 20.7± 10.7cc and 47.5± 23.1%, which was not significantly different from that in normal controls. Age, sex, obesity, diabetic control and presence of dyspeptic symptoms had no impact in FGBV and EF. However, diabetics with longer duration of diseases had poorer gall bladder contractility ($P<0.05$). Patients with autonomic neuropathy (AN) had significantly larger FGBV but normal contractility. Our results suggest that (a) long standing diabetics may have poor gall bladder emptying predisposing to gall stone formation, (b) patients with autonomic neuropathy have reduced tone of fasting gall bladder but normal contractility.

Key Words : Ultrasonography, Gall bladder, Diabetes mellitus, Ellipse formula, Autonomic neuropathy.

Autonomic neuropathy (AN) in diabetes mellitus (DM) may involve the gastrointestinal tract (GIT) and present with protein manifestation[1-2] Vagal parasympathetic fibers maintain gall bladder (GB) tone and influence its emptying[3-6]. GB dysfunction may occur with AN.

Abnormalities in GB size and emptying have been reported in DM[6-10] However an analysis of various clinical features of DM and its relation to GB dysfunction have not been reported. A study was conducted to compare GB volume and contractility in patients with DM, control individuals noninvasively using real time ultrasonography (US). Real time US is an inexpensive simple and reliable method of evaluating GB function[11-13].

Materials and Methods

Fifty two consecutive patients with diabetes mellitus with no biliary tract symptoms were included in the study. Diabetes mellitus was diagnosed by WHO[14] criteria. Duration of diabetes was calculated from the time of diagnosis. Patients were divided into 3 groups.

1. Patients without evidence of peripheral or autonomic neuropathy.
2. Patients with clinical evidence of peripheral neuropathy (PN) but no evidence of autonomic neuropathy.
3. Patients with autonomic neuropathy with or without PN.

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Autonomic neuropathy was considered to be present when patients had at least two abnormal cardiovascular reflexes, e.g. impaired heart rate response to Valsalva manoeuver, standing or on deep inspiration and a postural fall in systolic blood pressure of 30mm mercury[15]-[16] Peripheral neuropathy was diagnosed by impairment in fine touch, pinprick, vibration and position sence and deep iendon reflexes. Diabetic control was assessed by measuring Hb Al-C at the time of ultrasonography, a level of 7 or less was considered as good control and a value of 9 or more as poor control.

Real time ultrasonography was performed with a Toshiba sonolayer 22A linear scanner with a 3.5 MHZ probe. The greatest longitudinal and transverse and antero posterior diameter of the CB were obtained. Studies were performed after 12 hours of fasting and 60 minutes after a standard meal with 600 calories and 28 gm butter. Gall bladder volume was calculated using the ellipse formula (GBV=A/6 X Length X Width x AP Diameter of diameter)[6]. Contractility of the GB represented by the ejection fraction (EF),

$$EF = \frac{\text{(Fasting GB Volume—post prandial volume)}}{\text{Fasting GBV}} \times 100$$

Fifteen normal controls were studied in similar manner. The student's unpaired test was used for statistical analysis.

Results

Mean fasting gall bladder volume in 52 diabetic patients was found to be 20±10.7cc and the post prandial E.F. was 47.5 ±20.1, These differences was not statiscally significant The effect of age sex obesity and duration of diabetes on fasting GB volume and post prandial EF was analysed. (Table). Patients aged above and below forty had similar findings. Obesity or sex of the patient did not influence the results. Patients with diabetes of more than 3 years (n=23) has a significantly lower ejection, fraction as compared to those with a duration of disease less than 3 years (n = 24) while the fasting GB volume was similar in the two groups. Diabetes control dyspeptic symptoms, and PN also did not significantly influence the results. Patients with AN had a higher fasting GB volume though the contractility was similar to those without AN controls.

Discussion

The fasting GB volume and EF in a group of unselected diabetic patients was similar to that of healthy controls. Previous reports have implicated impaired GB contraction in the increased prevalance of gallstones in diabetic patients[17-19]. However, autopsy and imaging studies have both supported and refuted this hypothesis[7-10,17-20]. The present study also fovours the latter hypothesis and failed to find a significant abnormality in gall bladder function, in diabetics.

Patients with duration of diabetics of more than 3 years had an impaired contraction. However, this aspect was not studied in the previous reports[17]. This may explain the varying results of GB function in diabetics published to date [5,6,8,17]. Impaired GB contraction may predispose them to gallstone formation in this group of patients, due to the stasis of bile. Diabetics with autonomic neuropathy had a significantly larger fasting GB volume but normal or supranormal EF. GB emptying is considered to result from an impaired vagally mediated modulation if the contractile effect of cholecystokinin (CCK)[6].

Table 1

Mean FGBV and EF in normal controls in comparison with similar data from diabetic patients

	Number of subjects	FGBV (CC)	EF (%)
1 . Normal controls	15	18.9±11.3	50.9±15.5
2. Patients with diabetes mellitus	52	20.7 ±10.7	47.5 ±20.1
3. Statistical significance		NS	NS

Table II

FGBV and EF in patients with diabetes mellitus. The effect of duration of diabetes is analysed.

	Number of Patients	FGBV (cc)	EF (%)
Duration of Diabetes (Yrs)			
a) 3 yrs less**	29	23.0 ±12.3	56.42+17.6
b) More than 3 years**	23	17.6± 7.9	36.35±41.4
Statistical significance		NS	P=0.05

** Mean duration of diabetes in two groups (a) and (b) was 1.69 and 10-91 yrs. respectively.

Table III

FGBV and EF in patients with diabetes mellitus. The effect of presence of diabetic complications is analysed.

	Number of patients	FGBV (CC)	EF (%)
Presence of diabetic complications			
a) No complications	20	16.9± 6.8	40.5 + 40.6
b) PN but no AN	23	21.7 + 12.3	49.5 + 19.3
c) AN+PN	9	26.2+11.6	58.1 ±33.2
Statistical significance	a Vs b	NS	NS
	a Vs c	0.05	0.05

the present study, however does not support This hypothesis because, contractile function of GB was normal. However, Stone *et al*[17] have shown impaired GB emptying in DM. However the duration of diabetes was not correlated with GB function. Other studies have shown that truncal vagotomy is associated with increased fasting GB volume but normal GB contraction in response to a meal.[6,21-24]. In our study also diabetics with AN is associated with similar findings. Other features had no influence on GB function. Further studies are required to evaluate the difference in GB Function in type I and type II diabetics.

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