European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 01, 2022

A case-control evaluation of the gall bladder volume in type 2 diabetes mellitus patients using real time ultrasonography

[1]Dr.Ankitaa Thakral, [2]Dr. Varsha Gangta, [3]Dr. Harveen Kaur, [4]Dr. Govind Khatri, [5]Dr. Aditya Kaul, [6]Dr. Aastha Makkar

[1,3,4,5,6]Resident Radiodiagnosis, Department of Radio Diagnosis, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan, Himachal Pradesh, India
[2]Senior Resident Radiodiagnosis, Department of Radio Diagnosis, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan, Himachal Pradesh, India

Corresponding Author: Dr. Varsha Gangta

Abstract

Aim: To assess the gallbladder volume in T2DM patients and in healthy controls by using Ultrasonography.
Methodology: This cases control study was conducted among 50 diabetic patients enrolled from the diabetes clinic of the Medicine Department of Maharishi Markandeshwar medical college and hospital Kumarhatti, Solan, Himachal Pradesh and 50 healthy patients (control group). 30-60 year patients of type 2 diabetes mellitus diagnosed since 5 year or more and functioning gall bladder with well controlled blood sugar levels. The diagnosis of diabetes in these patients was in accordance with WHO criteria i.e., fasting plasma glucose level ≥126 mg/dl, and ≥200 mg/dl plasma glucose level after 2hr of ingestion of standardised 75gm glucose. An informed consent was taken from all the subjects in the study and control groups. All the patients were randomly selected for the study among patients regularly attending diabetic clinic of this hospital and following our criteria's of selection.
Results: Mean age of diabetic Patient was 48.5 years in study group and 53 years in control group. 46% of diabetics were males and remaining 54% were females, whereas in control group male to female ratio was equal, means 50% males and 50% females. 90% cases in control group had no gall bladder disease, while only 66% cases in group with diabetes had no gall bladder disease. In group with DM type 2, 10% had cholelithiasis, 8% had cholecystitis and 3% had sludge: while in control group, 4% had cholelithiasis, 2% had cholecystitis and 4% had sludge. The percentage of contraction of gall bladder had reduced markedly in chronic diabetics (45.6 $\pm$ 9.57) as compared to controls (65.2 $\pm$ 7.34) (p value-0.001). The fasting gall bladder volume in chronic diabetics was higher (43.47 $\pm$ 5.35) than that of controls (28.45 $\pm$ 4.26) and the difference of values was found to be highly significant (p value 0.001).
Conclusion: In patients of diabetes mellitus type 2, higher fasting gall bladder volume and decreased percentage of contraction are observed. Therefore, all T2DM patients should be evaluated using ultrasonography for the presence of increased fasting gallbladder volumes to assess the risk of progression to gall stone disease.

Keywords: Diabetes mellitus, USG, gall stone, volume

ISSN 2515-8260 Volume 09, Issue 01, 2022

Introduction

Diabetes mellitus is one of the most common endocrine disorders. Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart and gastrointestinal system.

Nowhere is the diabetes epidemic more pronounced than in India as the World Health Organization (WHO) reports show that 32 million people had diabetes in the year 2002 [1]. Type 2 diabetes mellitus (T2DM) is the major type of DM, accounting for approximately 90% of all cases [2]. It is one of the chronic non-communicable diseases (CNCDs) which have emerged as a leading global health problem. It is also a known risk factor for blindness, vascular brain diseases, renal failure and limb amputations [3].

Diabetes mellitus is characterised by metabolic abnormalities and by long term complications involving eyes, kidneys nerves and blood vessels [4]. Digestive dysfunction is also a contributor to the morbidity of the disease [5]. Diabetic subjects are found to have increased incidence of gallstones [6].

Inadequate emptying of gallbladder and increased volume has been reported [7]. Those have been attributed to cholecystomegaly and impaired motility of gall bladder, mainly due to autonomic neuropathy commonly seen in chronic diabetics. Though prolonged bile stasis is the most important factor for gallstone formation but other risk factors i.e. age, sex, obesity, genetic predisposition, drugs, parity, diet, hyperlipidaemia and ileal resection also contribute in it [8].

Individuals with diabetes mellitus are reported to have a twofold to threefold increase in the incidence of cholesterol gallstones. A frequently cited but unproven pathophysiologic mechanism for this phenomenon is reduced gallbladder muscle function, which results in stasis and allows for cholesterol gallstone crystal formation and gallstone growth. To date, gallbladder motor function has not been investigated in a well-characterized diabetic population [9]. Autonomic involvement of gastrointestinal tract especially gallbladder may result in gall bladder atony resulting in poor contraction in response to fatty meals and higher incidence of gallstones [10].

If patients with DM type 2 have an increased prevalence of gallstones and stasis is important in the pathogenesis, then a larger volume and reduced motility of gallbladder may be present in the patients with DM type 2 prior to the formation of gallstones.

Materials and Methods

This case control study was conducted among 50 diabetic patients enrolled from the diabetes clinic of the Department of Medicine, Department of Radiology Maharishi markandeshwar medical college and hospital Kumarhatti, Solan, Himachal Pradesh and 50 healthy patients (control group). The diagnosis of diabetes in these patients was in accordance with WHO criteria i.e., fasting plasma glucose level ≥126 mg/dl and ≥200 mg/dl plasma glucose level after 2hr of ingestion of standardized 75gm glucose.

An informed consent was taken from all the subjects in the study and control groups. All the patients were randomly selected for the study among patients regularly attending diabetic clinic of this hospital and following our criteria's of selection.

Inclusion criteria

- Age 30-60 year patients of.
- Type 2 diabetes mellitus diagnosed since 5 year or more.
- Functioning gall bladder with well controlled blood sugar levels.

ISSN 2515-8260 Volume 09, Issue 01, 2022

Exclusion criterion

- Patients with history of pre-existing hepatobiliary or gastrointestinal disease.
- Taking antihypertensive drugs.
- Pregnant females.

Methodology

Gallbladder volume was measured in all the subjects after 12 hours overnight fasting by using a 3.5 to 5 MHz convex transducer in Wipro GE Voluson S6 and medison accuvix ultrasound and colour Doppler machine. The greatest length (L), maximum transverse width (W) and highest anteroposterior dimensions (H) were measured and documented. Gall bladder motility was observed by measuring fasting and post meal gallbladder volumes. Post meal volume was taken one hour after giving fatty meal i.e. four slice of bread with 30 gm butter. The percentage of gallbladder contraction was calculated by the formula [11]. The results of the study have been compiled, tabulated and statistically analyzed for comparisons.

Results

Mean age of diabetic Patient was 48.5 years in study group and 53 years in control group.46% of diabetics were males and remaining 54% were females, whereas in control group male to female ratio was equal, means 50% males and 50% females.

Table 1: Demographic details

Variables		Case group (n=50)		Control group (n=50)	
		Number	%	Number	%
Age (in years)	30-40	09	18	10	20
	41-50	17	34	15	30
	51-60	24	48	25	50
Gender	Males	23	46	25	50
	Females	27	54	25	50

In our study, higher prevalence of gall bladder disease in group of chronic diabetics is seen as compared to group of controls. 90% cases in control group had no gall bladder disease, while only 66% cases in group with diabetes had no gall bladder disease. In group with DM type 2, 10% had cholelithiasis, 8% had cholecystitis and 3% had sludge: while in control group, 4% had cholelithiasis, 2% had cholecystitis and 4% had sludge.

Table 2: Prevalence of gallbladder disease among study group & control group

Groups	No Gall bladder disease	Cholelithiasis	Cholecystitis	Sludge
Chronic Diabetic (n=50)	33 (66.0%)	10 (20%)	4 (8%)	3 (6%)
Controls (n=50)	45 (90.0%)	2 (4%)	1 (2%)	2 (4%)

The percentage of contraction of gall bladder had reduced markedly in chronic diabetics (45.6 $\pm$ 9.57) as compared to controls (65.2 $\pm$ 7.34) (p value- 0.001). The fasting gall bladder volume in chronic diabetics was higher (43.47 $\pm$ 5.35) than that of controls (28.45 $\pm$ 4.26) and the difference of values was found to be highly significant (p value 0.001).

Table 3: Percentage of contraction of gall bladder volume and Fasting gall bladder volume among study group & control group

Variables	Chronic Diabetic (n=50)	Controls (n=50)
Mean percentage of gall bladder contraction (%)	45.6 ± 9.57	65.2 ± 7.34
Mean fasting gall bladder volume (in CC)	43.47 ± 5.35	28.45 ± 4.26

Discussion

Diabetics in particular those with T2DM have an increased prevalence of gallstones [12]. Diabetic subjects are reported to have a two to three fold increase in the prevalence of cholesterol gall stones [13]. Diabetes mellitus is a growing health care problem worldwide and is characterised by metabolic abnormalities and complications involving kidneys, nerves, blood vessels and the gastrointestinal tract [4].

The etiology of cholesterol gallstone disease is multifactorial. Carey and Small showed the importance of cholesterol supersaturation of bile and investigated cholesterol saturation index [14]. After the finding of an elevated cholesterol saturation index in normal subjects, attention shifted to the nucleation time [15] as a key factor in cholesterol stone formation and the identification of putative nucleation and anti-nucleating factors followed [16-18]. Stasis of the gallbladder bile plays an important role in the development of cholesterol stones by providing the time necessary for the precipitation of cholesterol crystals [23].

The main reasons for the high prevalence of gall stone disease in diabetes mellitus is due to decreased gall bladder motility, decreased postprandial cholecystokinin (CCK) release, decreased sensitivity of gall bladder smooth muscle to CCK, decreased number of CCK receptors in the gallbladder wall, supersaturation of bile and the presence of gall stones themselves [20, 21].

Gallbladder emptying in the diabetic population has been found to be decreased [22, 23]; however, this was not related to the presence or absence of diabetic neuropathy [22]. These authors found that diabetic neuropathy has a subtle effect on gallbladder emptying [22, 23] and the presence of obesity, type of diabetes and blood glucose regulation did not affect the outcome [23]. Even some studies revealed normal gallbladder emptying in patients with diabetes [24, 25].

In our study, the percentage of contraction of gall bladder had reduced markedly in chronic diabetics (45.6 ± 9.57) as compared to controls (65.2 ± 7.34) (p value- 0.001). The fasting gall bladder volume in chronic diabetics was higher (43.47 ± 5.35) than that of controls (28.45 ± 4.26). Raman *et al*. [26] who found the incidence of gallstones in diabetics to be 32% and that in healthy controls to be 6.7%. According to Stone *et al*. [27] gallbladder emptying was lower in diabetics with gallbladder disease. In a study done by Raman et [26], it was shown that percentage contraction of gallbladder was reduced in diabetes with gallbladder disease (41.84±11.74%) as compared to controls (53.07±16.31%) and diabetics without gallbladder disease (48.74±11.75%). Similar findings were produced by Gaur *et al*. [21], Pazzi *et al*. [28], Yang *et al*. [29] and Kayacetin *et al*. [30]. Thus the present study was clearly in concert with the above mentioned studies.

Conclusion

In patients of diabetes mellitus type 2, higher fasting gall bladder volume and decreased percentage of contraction are observed. Therefore, all T2DM patients should be evaluated using ultrasonography for the presence of increased fasting gallbladder volumes to assess the risk of progression to gall stone disease.

ISSN 2515-8260 Volume 09, Issue 01, 2022

References

1. Wild S, Roglic G, Green A *et al*. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care. 2004;27:1047-53.
2. Omar SM, Musa IR, El-Souli A, Adam I. Prevalence, risk factors and glycaemic control of type 2 diabetes mellitus in eastern Sudan: a community-based study. Ther. Adv. Endocrinol. 2019;10:1-8.
3. Aynalem SB, Zeleke AJ. Prevalence of Diabetes Mellitus and Its Risk Factors among Individuals Aged 15 Years and Above in Mizan-Aman Town. Int. J Endocrinol., 2018, 9317-987.
4. Daniel WF. Diabetes mellitus. In Fauci AS, Braunwald E, Isselbacher KJ, *et al*. editors. In Harrison's Principles of Internal Medicine.17thed. New York: McGraw Hill, 2009, 20-60.
5. Folwaczny C, Riepl R, Tschop M *et al*. Gastrointestinal involvement in patients with diabetes mellitus. Epidemiology, pathophysiology and clinical findings. Zeitschrift Fur Gastroenterologie. 1999;37(9):803-815.
6. Dres LA, Graciela GC. Prevalence of biliary lithiasis in diabetes mellitus. Review of Medicine Uruguay. 1999;15:49-56.
7. Chapman BA, Chapman TM, Frampton CM *et al*. Gallbladder volume: comparison of diabetics and controls. Digestive Disease and Sciences. 1998;43(2):344-348.
8. Shaffer EA. Epidemiology of gallbladder stone disease. Best Practice & Research Clinical Gastroenterology. 2006;20(6):981-96.
9. Stone BG, Gavaler JS, Belle SH, Shreiner DP, Peleman RR, Sarva RP, *et al*. Impairment of gallbladder emptying in diabetes mellitus. Gastroenterol. 1988;95(1):170-176.
10. Pal PK. Autonomic dysfunction in diabetes mellitus. IJIM special issue on diabetes, 2002, 1-8.
11. Gaur C, Mathur A, Agarwal A, Verma K, Jain R, Swaroop A. Diabetic autonomic neuropathy causing gall bladder dysfunction. The Journal of the Association of Physicians of India. 2000;48(6):603-5.
12. Chapman TMBA, Chapman CM, Frampton RJ, Chisholm RB, Allan IR, Wilson. Gallbladder volume comparison of diabetics and controls. Digestive Dis Sci. 1998;43(2):344-348.
13. Raman PG, Patel A, Gall VM. bladder disorder and Type 2 diabetes mellitus. A clinical based study. J Assoc. Phys. India. 2002;50:887-890.
14. Carey MC, Small DM. The physical chemistry of cholesterol solubility in bile: relationship to gallstone formation and dissolution in man. J Clin. Invest. 1978;61:998-1026.
15. Holan KR, Holzbach RT, Hermann RE, *et al*. Nucleation time: a key factor in the pathogenesis of cholesterol gallstone disease. Gastroenterology. 1979;77:611-617.
16. Kibe A, Holzbach RT, La Russo NF, *et al*. Inhibition of cholesterol crystal formation by apolipoproteins in supersaturated model bile. Science. 1984;225:514-516.
17. Levy PF, Smith BF, Lamont JT. Human gallbladder mucin accelerates nucleation of cholesterol in artificial bile. Gastroenterology. 1984;87:270-275.
18. Gallinger S, Taylor RD, Harvey PR, *et al*. Effect of mucous glycoprotein on nucleation time of human bile. Gastroenterology. 1985;89:648-658.
19. Jazrawi RP, Pazzi P, Petroni ML, *et al*. Postprandial gallbladder motor function: refilling and turnover in health and cholelithiasis. Gastroenterology. 1995;109:582-591.
20. Kayacetin E, Kisakol G, Kaya A, Akpinar Z. Real time sonography for screening of gallbladder motility in diabetic patients: relation to autonomic and peripheral neuropathy. Neuroendocrinol. Lett. 2003;14:73-76.
21. Gaur C, Mathur A, Agarwal A. Diabetic autonomic neuropathy causing gallbladder dysfunction. J Assoc. Physicians India. 2000;48:603-605.
22. Hahm JS, Park JY, Park KG, *et al*. Gallbladder motility in diabetes mellitus using real time ultrasonography. Am J Gastroenterol. 1996;91:2391-2394.

23. Stone BG, Gavaler JS, Belle SH, *et al*. Impairment of gallbladder emptying in diabetes mellitus. Gastroenterology. 1988;95:170-176.
24. Keshavarzian A, Dunne M, Iber FL. Gallbladder volume and emptying in insulin-requiring male diabetics. Dig Dis Sci. 1987;32:824-828.
25. DeBoer SY, Masclee AAM, Lam WF, *et al*. Effect of hyperglycaemia on gallbladder motility in type I (insulin-dependent) diabetes mellitus. Diabetologia. 1994;37:75-81.
26. Raman PG, Patel A, Mathew V. Gallbladder disorders and diabetes mellitus type-2. A clinic based study. J Assoc Physicians India. 2001;50:887-890.
27. Stone BH, Gavaler JS, Bell SH, *et al*. Impairment of gallbladder emptying in diabetics mellitus. Gastroenterology. 1988;95:170-6.
28. Pazzi P, Scagliarini R, Gamkerini S, *et al*. Review article gallbladder motor function in diabetes mellitus. Alimentary pharmacology and therapeutics. 2000;14(S)2:62-65.
29. Yang CC, Sun SS, Lin CC, *et al*. Evidence of impaired gallbladder function in patients with non-insulin dependent diabetes mellitus by quantitative cholescintigraphy. Journal of Diabetes and its Complications. 2002;16(5):7-51.
30. Kayacetin E, Kisakol G, Kaya A, *et al*. Real time sonography for screening of gallbladder motility in diabetic patients in relation to autonomic and peripheral neuropathy. Neuroendocrinology. 2003;24(1-2):73-76.