

# Ultrasonographic evaluation of gallbladder volume in type 2 diabetes mellitus patients

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## Abstract

**Background:** Type 2 diabetes mellitus (T2DM) is the most common endocrine disorder. Prevalence of gallbladder diseases in type 2 diabetes mellitus patients has reported. Hence, the present study was undertaken to assess the gallbladder volume in T2DM patients and in healthy controls by using Ultrasonography. **Materials and methods:** This study was conducted in Department of Radio-diagnostics, BGS Global Institute of Medical Sciences, Kengeri, Bangalore, Karnataka, involving 100 cases and 100 healthy controls. All the T2DM cases presenting with features suggestive of gallbladder diseases were screened by USG. A detailed physical and clinical examination was done to all the study subjects. In the present study, gray scale real time ultrasound examination was carried out using 3.5 to 10 MHz curvilinear and linear array transducers, using the instruments GE VOLUSON P8 and Samsung U50 Ultrasound scan machines. T2DM patients using antihypertensive drugs, cardiovascular diseases, pregnant ladies and malignant conditions were excluded from the study. Under aseptic conditions, 3 ml of fasting blood samples were collected from all the study subjects, allowed to stand for 30 minutes and centrifuged to obtain serum. The obtained serum sample was used for analysis of fasting blood sugar, post-prandial blood sugar, total cholesterol, triglycerides, HDLC, LDLC. **Results:** In the present study, 100 type 2 diabetes mellitus and 100 healthy controls were involved to assess the gallbladder volume by using ultrasonography. In this study, systolic (139.3±10.3 mmHg) and diastolic blood pressure (91.1±8.2 mmHg), fasting blood sugar (142.16±13.8 mg/dl), post-prandial blood sugar (168.3±14.5 mg/dl), total cholesterol (198.5±20.5 mg/dl), triglycerides (176.8±15.3 mg/dl), LDLC (132.5±4.7 mg/dl) and gallbladder volume (24.7±10.5 ml) were significantly increased in type 2 diabetes mellitus patients compared with healthy controls. However, age, BMI and HDLC were not statistically significant. **Conclusion:** All T2DM patients should be evaluated for the presence of increased fasting gallbladder volumes to assess the risk of progression to gall stone disease. Hence, simple measurement of gall bladder volume changes using USG can help us predict gall bladder function abnormalities.

**Key words:** Gallbladder volume, Ultrasonography, Type 2 diabetes mellitus.

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## INTRODUCTION

Type 2 diabetes mellitus (T2DM) is the most common endocrine disorder, characterized by deranged metabolism and long-term complications involving kidneys, eyes, nerves, gastrointestinal tract, causing morbidity and mortality. Globally, T2DM is the most common form accounting for about 90% of all the cases and is more prevalent in men than women. The prevalence of diabetes mellitus worldwide was 2.8% in 2000 and is estimated to rise to 4.4% in 2030. The total number of diabetes mellitus is projected to increase from 382 million in 2013 end to 592 million by 2035.<sup>1</sup> A few studies have reported on the prevalence of gallbladder diseases in type 2 diabetes mellitus patients.<sup>2,3</sup> This has been attributed to

cholecystomegaly and impaired gall bladder contraction. The risk factors associated are age, female sex, family history and genetic factors., obesity, rapid weight loss and physical inactivity.<sup>4,5</sup> Ultrasound is simple procedure and its accuracy of detection of gall bladder diseases is very high.<sup>5</sup> Ultrasonography as a valuable and imaging modality used to assess the gall bladder volume in T2DM patients and in controls, as it is safe, inexpensive and accurate.<sup>6</sup> Hence, the present study was undertaken to assess the gallbladder volume in T2DM patients and in healthy controls by using Ultrasonography.

**MATERIALS AND METHODS**

This study was conducted in Department of Radiodiagnosics, BGS Global Institute of Medical Sciences, Kengeri, Bangalore, Karnataka, involving 100 cases and 100 healthy controls. All the study subjects were screened by USG to assess the gallbladder volume. A detailed physical and clinical examination was done to all the study subjects. In the present study, gray scale real time ultrasound examination was carried out using 3.5 to 10 MHz curvilinear and linear array transducers, using the instruments GE VOLUSON P8 and Samsung U50 Ultrasound scan machines. T2DM patients using

antihypertensive drugs, cardiovascular diseases, pregnant ladies and malignant conditions were excluded from the study. Under aseptic conditions, 3 ml of fasting blood samples were collected from all the study subjects, allowed to stand for 30 minutes and centrifuged to obtain serum. The obtained serum sample was used for analysis of fasting blood sugar, post-prandial blood sugar, total cholesterol, triglycerides, HDLC, LDLC. Demographic details were collected.

**RESULTS**

In the present study, 100 type 2 diabetes mellitus patients and 100 healthy controls were involved to assess the gallbladder volume by using ultrasonography. In this study, systolic (139.3±10.3 mmHg) and diastolic blood pressure (91.1±8.2 mmHg), fasting blood sugar (142.16±13.8 mg/dl), post-prandial blood sugar (168.3±14.5 mg/dl), total cholesterol (198.5±20.5 mg/dl), triglycerides (176.8±15.3 mg/dl), LDLC (132.5±4.7 mg/dl) and gallbladder volume (24.7±10.5 ml) were significantly increased in type 2 diabetes mellitus patients compared with healthy controls. However, age, BMI and HDLC were not statistically significant (Table 1).

**Table 1:** Comparison of Demographic, biochemical parameters and gallbladder volume in type 2 diabetes mellitus patients and healthy controls

| Parameters   | T2DM                | Controls            | P value |
|--|---------------------|---------------------|---------|
|  | Mean ±SD<br>(n=100) | Mean ±SD<br>(n=100) |         |
| <b>Demographic characteristics</b>                   |                     |                     |         |
| Age (years)  | 45.8±8.2            | 44.2±3.8            | 0.09    |
| BMI (kg/m <sup>2</sup> )                             | 24.3±1.8            | 22.3±1.0            | 0.06    |
| Systolic BP (mmHg)                                   | 139.3±10.3          | 113.5±9.1           | 0.001   |
| Diastolic BP (mmHg)                                  | 91.1±8.2            | 77.2±7.2            | 0.001   |
| <b>Biochemical parameters and Gallbladder volume</b> |                     |                     |         |
| FBS (mg/dl)  | 142.16±13.8         | 92.56±10.2          | 0.001   |
| PPBS (mg/dl)   | 168.3±14.5          | 131.5±9.5           | 0.001   |
| Total cholesterol (mg/dl)                            | 198.5±20.5          | 148.3±15.6          | 0.001   |
| Triglycerides (mg/dl)                                | 176.8±15.3          | 99.8±8.5            | 0.001   |
| HDLC (mg/dl)   | 43.3±3.5            | 44.1±5.4            | 0.07    |
| LDLC (mg/dl)   | 132.5±4.7           | 90.7±4.3            | 0.001   |
| Gallbladder volume (ml)                              | 24.7±10.5           | 17.8±4.0            | 0.001   |

P value <0.05 considered as statistically significant

**DISCUSSION**

Gallbladder diseases are very common with different features with variable morbidity and mortality. Gallbladder diseases involves gallstones, accounts for 95% of the all gallbladder diseases and non-calculus disease are about 5%. Acute or chronic inflammations of gallbladder were also seen.<sup>7, 8</sup> 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.<sup>9,10</sup> In the present study, gallbladder volume was significantly increased in T2DM patients than the healthy controls. This study findings were supported by a study conducted by AK Agarwal *et al.* reported that significantly increased gallbladder volume in T2DM patients compared to healthy controls.<sup>2</sup> In a study conducted by Bruce A. Chapman *et al.* reported that increased gallbladder volume in T2DM

patients compared to healthy controls.<sup>11</sup> Yet, another study by R Harikiran Reddy *et al.* also reported that the gall bladder functional abnormalities are mostly seen with diabetic neuropathy. Fasting gallbladder volume was significantly increased in T2DM patients with neuropathy than in control group.<sup>12</sup> Although hypertriglyceridaemia is a known risk factor for gallstones, the implication of hypercholesterolaemia as causing gallbladder hypomotility is unsubstantiated. Thus, the present study reiterates the fact that diabetic cholecystopathy, which may predispose T2DM patients to gallstone formation. This leads to increased risk of the complications of gallstone disease *per se*, and those due to its treatment – both surgical and medical.<sup>13-15</sup>

## CONCLUSION

The present study results may conclude that increased gallbladder volume and dyslipidemia in patients with type 2 diabetes mellitus. Therefore, all T2DM patients should be evaluated for the presence of increased fasting gallbladder volumes to assess the risk of progression to gall stone disease. Hence, simple measurement of gall bladder volume changes using USG can help us predict gall bladder function abnormalities.

## REFERENCES

1. Nagaraj S, Sunitha S, Kiran, Rajeev Gandham, Wilma Delphine Silvia C. R, Nagaraja M. R, Abdul Nasar S, Biswajit Das. Study of prevalence of non alcoholic fatty liver disease in type 2 diabetes mellitus patients and variations in liver function tests, lipid profile and mean platelet volume in patients with fatty liver in comparison with patients without fatty liver. *Int J Res Med Sci.* 2016;4(3):1-6.
2. AK Agarwal, S Miglani, S Singla, U Garg, RK Dudeja, A Goel. Ultrasonographic Evaluation of Gallbladder Volume in Diabetics. *JAPI.* 2004;52:962-965.
3. Bloom A, Stachenfeld R. Diabetic cholecystomegaly. *JAMA.* 1969;208:357-359.
4. Miquel JF, Covarrubias C, Villaroel L, Mingrone G, Greco AV, Puglielli L, Carvallo P, Marshall G, Del Pino G, Nervi F. Genetic epidemiology of cholesterol cholelithiasis among Chilean Hispanics, Amerindians, and Maoris. *Gastroenterol.* 1998;115(4):937-46.
5. Laura M. Stinton and Eldon A. Shaffer. Epidemiology of Gallbladder Disease: Cholelithiasis and Cancer. *Gut and Liver.* 2012;6(2):172-187.
6. Antonio Pinto, Alfonso Reginelli, Lucio Cagini, Francesco Coppelino, Antonio Amato Stabile Ianora, Renata Bracale *et al.*, Accuracy of ultrasonography in the diagnosis of acute calculous cholecystitis: review of the literature. *Critical Ultrasound Journal.* 2013;5(1):S11:1-4.
7. Ethan A. Smith, Jonathan R. Dillman, Khaled M. Elsayes, Christine O. Menias, Ronald O. Bude. Cross-Sectional Imaging of Acute and Chronic Gallbladder Inflammatory Disease. *American Roentgen Ray Society.* 2009;192:188–196.
8. Stefan Jansen, Maciej Stodolski, Hubert Zirngibl, Daniel Gödde and Peter C. Ambe. Advanced gallbladder inflammation is a risk factor for gallbladder perforation in patients with acute cholecystitis. *World Journal of Emergency Surgery.* 2018;13(9):1-6.
9. 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.
10. Gaur C, Mathur A, Agarwal A. Diabetic autonomic neuropathy causing gallbladder dysfunction. *J Assoc Physicians India* 2000;48:603-605.
11. Chapman, B.A., Chapman, T.M., Frampton, C.M. Chisholm RJ, Allan RB, Wilsonet IR *et al.* Gallbladder Volume (Comparison of Diabetics and Controls). *Dig Dis Sci.* 1998; 43: 344-348.
12. R Harikiran Reddy Sagar S, Anusha B K and Bhagyashree sajjan. A Comparative Study of Gall Bladder Volume Among Type 2 Diabetes Mellitus Patients with Autonomic Neuropathy and Normal Healthy Individuals. *Int J Recent Sci Res.* 2020; 11(10): 39909-39911.
13. Chien-Hua Chen, Cheng-Li Lin, Chung-Y. Hsu, Chia-Hung Kao. Association Between Type I and II Diabetes With Gallbladder Stone Disease. *Front. Endocrinol.* 2018; 9:1-8.
14. Wilson IR, Hurrell MA, Pattinson NR, Chapman BA. The effect of simvastatin and bezafibrate on bile acid composition and gallbladder emptying in female non-insulin dependent diabetics. *J Gastroenterol Hepatol* 1994;9:447-51.
15. Madhumita Premkumar, Tarulata Sable. Obesity, dyslipidemia and cholesterol gallstone disease during one year of Antarctic residence. *Rural Remote Health.* 2012;12:2186.

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