Ultrasoundographic assessment of gall bladder kinetics in the elderly

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Background: The incidence of gallstones increases with age but the factors that influence gallstone formation in the elderly are poorly understood. Proposed factors include changes in bile composition and hypomotility of the gall bladder. Studies on gall bladder motility in the elderly have provided conflicting results, and none has been reported from India. Aim: To determine gall bladder contractility in healthy elderly subjects and compare it with that in young healthy volunteers. Methods: Thirty healthy elderly (above the age of 60 years) and 30 young volunteers with no abdominal complaints were studied. Using real-time ultrasonography and the ellipsoid method, gall bladder volume was measured after overnight fast and at 10, 20, 30, 40, 50 and 60 minutes after a standard fatty meal. Residual volume, delta volume and ejection fraction were calculated. Results: Mean fasting gall bladder volume in elderly subjects was higher than that in young subjects (13.5 [5.8] mL vs 10.9 [3.6] mL; p<0.05). However, there was no difference in the 60-min postprandial residual gall bladder volumes in the two groups. Change in gall bladder volume and ejection fraction were also similar in the two groups. Conclusion: There was no difference in gall bladder emptying between elderly and young subjects though the fasting gall bladder volume was higher in the elderly. [Indian J Gastroenterol 2000;19:158-160]

Key words: Aging, cholelithiasis, gall bladder emptying, ultrasonography

The incidence of biliary disease increases with age.1 Prevalence of gallstones in patients over 65 years is approximately 20%, with a range between 8% and 25%.2

The factors that promote gallstone formation in the elderly are poorly understood. Impaired gall bladder motility can contribute to biliary cholesterol hypersecretion. On the other hand, a sustained high concentration of biliary cholesterol can presumably lead to impaired gall bladder function.3 The role of gall bladder hypomotility in the formation of gallstones in the elderly has been addressed by only a few studies, with conflicting results.3,4,5 The objective of the present study was to determine gall bladder contractility in healthy elderly subjects without abdominal complaints and to compare it with that in healthy young volunteers.

Methods
Thirty persons aged 60 years and above, with no abdominal complaints, attending the Geriatric Clinic (24) or admitted in the medical wards (6) were included in the study. The clinical diagnoses of these patients were osteoarthritis, benign prostatic hyperplasia, chronic obstructive pulmonary disease and hypertension. Those with history of biliary colic, gallstone disease, cholangitis or increased serum alkaline phosphatase were excluded from the study, as were persons with diabetes, cirrhosis, obesity or malabsorption syndrome. Thirty young volunteers who had no abdominal complaints were also studied; exclusion criteria for this group were similar to those in the elderly. Informed consent was obtained from all subjects.

Detailed history was elicited with emphasis on altered bowel habits, nausea, vomiting, heartburn, waterbrash or symptoms suggestive of gallstones, biliary colic and cholangitis. History of drug intake, alcohol intake, smoking and diabetes was also included. A thorough clinical examination was performed. The following investigations were carried out: hemogram, liver function tests, renal function tests, chest X-ray and electrocardiograph.

Gall bladder kinetics
After an overnight fast, with the subject in the supine position, the greatest length (L) and transverse width (W) and AP (H) dimensions of the gall bladder were measured using real-time ultrasound scanner after freezing the image on the oscilloscope. Gall bladder volume (V) was then calculated using the ellipsoid method described by Dodds.7

\[ V = \pi (L \times W \times H)/6 \] or \[ V = 0.52 \text{ LWH} \]

Measurement of gall bladder volume by this method closely approximates the true volume, with a mean difference of about 1 mL.9 Thereafter the subject was given a standard breakfast containing approximately 600 Kcal (4 slices of bread, 25 g butter, 200 mL milk; fat 42 g, protein 19 g) and gall bladder volume estimated serially at 10, 20, 30, 40, 50 and 60 minutes. From the fasting volume (FV) and residual volume at 60 min postprandial (RV), delta volume (FV-RV) and ejection fraction (EF) were calculated, where

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Table: Mean (SD) gall bladder volume (mL) at different time points

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Elderly subjects</th>
<th>Young subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>13.5 (5.8)</td>
<td>10.9 (3.6)*</td>
</tr>
<tr>
<td>10</td>
<td>8.4 (2.2)</td>
<td>6.8 (2.8)*</td>
</tr>
<tr>
<td>20</td>
<td>7.3 (1.6)</td>
<td>6.2 (3.3)</td>
</tr>
<tr>
<td>30</td>
<td>6.1 (1.2)</td>
<td>5.6 (3.7)</td>
</tr>
<tr>
<td>40</td>
<td>5.6 (1.1)</td>
<td>4.8 (2.1)*</td>
</tr>
<tr>
<td>50</td>
<td>5.1 (1.2)</td>
<td>4.1 (1.9)</td>
</tr>
<tr>
<td>60</td>
<td>4.5 (1.1)</td>
<td>3.7 (1.9)</td>
</tr>
</tbody>
</table>

*p<0.05 compared to the elderly

EF = 1 - (RV/FFx100)

Values are expressed as mean (standard deviation). Statistical significance was analyzed by the Student's t test. The results were considered significant at 5% level.

Results

The age range of the 30 elderly subjects was 60-75 years (mean [SD] 65.8 [4.2]; 21 men) and that for the 30 control subjects was 20-40 years (26.5 [6.3]; 23 men).

Mean fasting gall bladder volume in elderly subjects was 13.5 (5.8) mL and that in young subjects was 10.9 (3.6) mL (p<0.05). Gall bladder volume was significantly higher in the elderly by 10, 40 and 50 minutes after meal (Table). The reduction in gall bladder volume in the elderly and the young was 8.9 (5.3) mL and 7.2 (2.9) mL, respectively. The corresponding ejection fractions were 64.6 (7.4)% and 65.4 (13.1)% (p=n.s).

Discussion

The techniques for evaluation of gall bladder motility are cholecystography, real-time ultrasonography and cholescintigraphy. There are several limitations in the use of cholecystography, including variable intestinal absorption of the dye, variations in hepatic metabolism of the dye, and radiation exposure to the patient. Cholecintigraphy is noninvasive, quantitative, assumes no particular geometry of the gall bladder, and has a reproducibility and inter-observer error of only 5%. However, it does not measure fasting gall bladder volume, and use of radioactivity necessitates caution for use in women in the child-bearing age group. Ultrasonography is an ideal method since there is no danger of radiation; moreover, fasting gall bladder volume, and consequent ejection fraction, can be measured. However, it needs considerable operator skill, and is subject to marked intra and inter-observer variation.

Factors other than cholesterol supersaturation of bile, such as impaired gall bladder motility, are necessary for gallstone formation. The inert gall bladder with stagnant bile is an ideal location for cholesterol crystal nucleation and growth.

Studies of gall bladder emptying in experimental animals and patients with gallstones have provided conflicting reports. Doty10 demonstrated that the gall bladder ejection fraction in response to cholecystokinin (CCK) infusion was reduced from 54% to 10% in animals that had developed cholesterol crystals. Using exogenous CCK, Fisher et al11 found no effect on gall bladder emptying in patients with cholecitiiasis. Others12,13 found decreased gall bladder emptying in patients with gallstones. However, all these investigators used different doses of CCK. More recently, Pomeranz and Shaffer14 compared 26 patients who had gallstones with 41 normal volunteers using cholescintigraphy and physiological doses of CCK infusion. They found absent or reduced emptying in 42% of patients with stones.

Gall bladder hypomotility may occur secondary to gallstone disease. On the other hand, there is an increased predisposition to gallstone formation in patients with temporary or permanent impairment of gall bladder motility. Patients receiving total parenteral nutrition do not empty their gall bladder regularly,15 and have a high incidence of biliary tract sludge and gallstones.16 Similarly, patients who have undergone major abdominal surgery necessitating a fast of at least 48 hours show an increased incidence of gallstones.17

Few workers have studied the factors causing increased occurrence of gallstones in the elderly, and the results have been inconsistent. A study from Sweden suggested that one of the factors in the age-related increase in gallstone formation is enhanced biliary cholesterol secretion.18

Boyden and Grantham,4 who used cholecystography, did the first study on gall bladder motility in the elderly in 1936. They found that the elderly tend to have larger fasting volumes but the rates of emptying and fractional emptying were not impaired. Sacchi et al19 found no significant difference between the five age groups in women, whereas in men, the higher the age, the higher the emptying rate, except for a marked fall in subjects aged 31-40 years. Khalil et al20 used ultrasonography to compare gall bladder volume and emptying in the elderly; they found no difference in fasting volume or rate of gall bladder emptying. The sensitivity of the gall bladder to CCK was, however, significantly reduced in the elderly. Using radionuclide gall bladder imaging Spellman et al19 found that age and sex had no effect on gall bladder emptying in response to CCK.

In the present study, although the fasting volume of the gall bladder was higher in the elderly, no significant difference was found in residual gall bladder volume at 60 minutes and the ejection fraction between aged and young subjects. The significance of the higher gall bladder fasting volume in the elderly needs to be evaluated.

References

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