

## Analysis of Cases of Nonvisualized Gallbladder by Ultrasonography\*

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To define the significance of nonvisualization of the gallbladder by ultrasonography, we studied follow-up data on 31 cases in which the gallbladder could not be identified despite adequate fasting. Thirty one cases of gallbladder disease included 15 cases of chronic cholecystitis due to cholelithiasis (13 cases) and choledocholithiasis (2 cases), 4 cases of cholelithiasis which were not surgerized, and 3 cases of cancer. There were 4 cases of diagnostic error in which gallbladder nonvisualization occurred despite a demonstrable lumen. The etiology of disease was not determined in the 5 remaining cases. Therefore 22 of 26 cases were found to have diseased gallbladders.

The reasons for nonvisualization of the gallbladder by ultrasonography in the 19 cases which underwent surgical exploration were: 17 cases due to chronic cholecystitis with cholelithiasis (13 cases), choledocholithiasis (2 cases) and cancer (2 cases), obliteration of the lumen due to cancer of the gallbladder in one case, and technical error due to an unusual location of the gallbladder in one case. The mechanisms of diagnostic error in 4 cases seemed technical error due to an unusual location of the gallbladder in 3 cases and the obscured gallbladder by intestinal gas in one case.

In conclusion, we feel that careful examination should be done to detect a gallbladder located unusually or obscured by intestinal gas in order to decrease the rate of diagnostic error when the gallbladder is not visualized by ultrasonography. Also, we recommend an oral cholecystography or ERCP for ultrasonic nonvisualized gallbladder.

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**Key Words:** Ultrasonography, Gallbladder, Nonvisualization

### INTRODUCTION

As recent improvements in ultrasound techniques have increased diagnostic accuracy, ultrasonography is being used as an initial screening procedure in acute and chronic biliary tract disease, especially in gallbladder disease.

Since present real-time ultrasonography shows high-quality imaging, the absence of a gallbladder image in a fasting patient must be considered pathological. The possible causes for gallbladder

nonvisualization by ultrasonography include<sup>1)</sup>: (1) congenital absence of gallbladder; (2) previous cholecystectomy; (3) physiologic contraction because the patient was not truly fasting, or a longer fast was necessary; (4) diseased gallbladder with lumen obliteration; (5) small volume gallbladder or one with an unusual shape or location; (6) obstruction of the biliary tree proximal to the cystic duct; (7) obscured gallbladder by gas-filled intestinal loops; (8) and technical error. However, in most cases, the apparently absent gallbladder is, in fact, a small, chronically infected, contracted gallbladder<sup>1-5)</sup>.

We reviewed the follow-up data on 31 cases in which the gallbladder could not be identified despite adequate fasting, to define the significance of gallbladder nonvisualization by ultrasonography.

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## MATERIALS AND METHODS

Ultrasonography was performed on 7,582 patients at Severance Hospital of Yonsei University College of Medicine from May 1980 to July 1985. All ultrasonic examinations were done with a commercially available B-mode grayscale unit at a frequency of 2.5 or 3.5 MHz and linear-array real-time transducer at a frequency of 3.5 MHz (Searle Pho/Sonic-SM alpha). Preparation for examination involved fasting for at least 8 hours prior to the examination. With the patient held in maximal inspiration, multiple serial scans of the right upper quadrant at closely spaced intervals (0.5 cm) were carried out in the transverse, oblique, and longitudinal planes. The patients were examined in the supine, decubitus, oblique intercostal, and erect positions to optimize visualization of the gallbladder.

A review of the results of 7,582 ultrasonic examinations revealed that in 78 (1.02%) cases the gallbladder lumen was not imaged. Excluded from this group were 35 cases in which the patient had undergone cholecystectomy prior to examination, and 12 cases which were not further evaluated.

The medical records and radiographic findings on oral cholecystography, intravenous (IV) cholangiography, and endoscopic retrograde cholangiopancreatography (ERCP) of the 31 cases were analyzed. Nineteen of the 31 cases underwent surgical exploration; surgical findings and pathological results were also analyzed.

## RESULTS

Of the 31 cases of gallbladder nonvisualization, 18 were male and 13 were female. The patients' ages ranged from 28 to 70 years. The peak was in the sixth decade, and most of the cases were in the range of 40 to 69 years (Table 1).

Of the 31 cases of gallbladder nonvisualization, surgery was performed in 2 with no further evaluation beyond ultrasonography. Of the remaining 29 cases, oral cholecystography was performed in 12 cases, ERCP in 11 cases, oral cholecystography and ERCP in 2 cases, oral cholecystography and IV cholangiography in 2 cases, and IV cholangiography and ERCP in 2 cases (Table 2).

Oral cholecystography was performed in 16 cases and its findings were nonvisualization of the gallbladder in 9 cases, stone in 5 cases, faint

visualization of the gallbladder in one case and normal-appearing gallbladder in one case (Table 3).

Of the 4 cases which underwent IV cholangiography, the gallbladders were nonvisualized in all. The biliary ducts were nonvisualized in 2 cases, filled with air in one case, and normal in one case (Table 4).

Of the 15 cases which underwent ERCP, gallbladders were nonvisualized in 7 cases, stones were present in 4 cases, gallbladders were con-

Table 1. Age and Sex of Patients

Age	Sex		Total
	M	F	
20 - 29	0	2	2
30 - 39	1	1	2
40 - 49	5	2	7
50 - 59	10	4	14
60 - 69	2	3	5
70 - 79	0	1	1
Total	18	13	31

Table 2. Diagnostic Methods for Evaluation of Nonvisualized Gallbladder by Ultrasonography

Oral GB	IVC	ERCP	No. of cases
+	-	-	12 ( 4)
-	-	+	11 ( 9)
+	-	+	2
+	+	-	2 ( 2)
-	+	+	2 ( 2)
-	-	-	2 ( 2)
16	4	15	31 (19)

( ) : Surgerized cases

GB : Gallbladder

IVC : Intravenous cholangiography

Table 3. Oral Cholecystography Findings

Finding	No. of cases
Stone	5
Nonvisualization	9
Faint visualization	1
Normal	1
Total	16

tracted in 2 cases and normal in 2 cases. Among the 7 cases of nonvisualized gallbladder, the findings of the common bile ducts included stones in 2 cases, cancer in one case, and normal findings in 4 cases. Of the 4 cases of gallstones, the findings of the common bile ducts included stones in two cases and normal in two cases. In the two cases presenting a contracted gallbladder, stones were found in the common bile duct, and in two cases showing a normal gallbladder, the common bile ducts were normal (Table 5).

The diagnoses for gallbladder nonvisualization, confirmed at the time of surgery in 19 cases, were contracted gallbladder due to chronic cholecystitis in 17 cases with cholelithiasis (13 cases), choledocholithiasis (2 cases) and cancer (2 cases), obliteration of the lumen due to cancer of the gallbladder in one case and technical error in one case due to an unusual location of the gallbladder in a case proven as having cancer of the bile duct at the level of the cystic duct (Table 6)

The gallbladder diseases in 31 cases of gallbladder nonvisualization included chronic cholecystitis in 15 (48.4%) cases (among these 15, cholelithiasis was present in 13 cases, and choledocholithiasis in 2 cases), cholelithiasis in 4 (12.9%) cases in which surgery was not performed, and cancer in 3 (9.7%) cases. There were 4 (12.9%) cases which showed a normal gallbladder and 5

(16.1%) cases in which the etiology was indeterminate. In 5 cases, the gallbladders were nonvisualized by oral cholecystography in 3 cases and ERCP in one case, and was faintly visualized by oral cholecystography in one case (Table 7). There were 4 cases of diagnostic error in which gallbladder nonvisualization occurred despite a demonstrable lumen: normal-appearing gallbladders were found by oral cholecystography in one case, ERCP in 2 cases, and at the time of surgery in one case.

## DISCUSSION

Since present real-time ultrasonography shows high-quality imaging, the absence of a gallbladder image in a fasting patient must be considered pathological. Hublitz et al.<sup>9</sup> reported that ultrasonic visualization of the gallbladder can be achieved with relative ease and reliability, with a 98%

Table 4. IV Cholangiography Findings

Location		No. of cases
Gallbladder	Biliary duct	
Nonvisualized	Nonvisualized	2
Nonvisualized	Air	1
Nonvisualized	Normal	1
Total		4

Table 5. ERCP Findings

Gallbladder	No. of cases	Biliary duct		
		Normal	Stone	Cancer
Nonvisualized	7	4	2	1
Stone	4	2	2	
Contracted	2		2	
Normal	2	2		
Total	15	8	6	1

Table 6. Surgical Diagnosis in 19 Cases

Diagnosis	No. of cases
Contracted GB due to	17
Chronic cholecystitis with Cholelithiasis	13
Choledocholithiasis	2
Cancer of GB	2
Obliteration of the lumen due to cancer of GB	1
Unusual location of GB with cancer of the bile duct	1
Total	19

GB : Gallbladder

Table 7. Diseases of the Gallbladder

Gallbladder	No. of cases	(%)
Chronic cholecystitis with Cholelithiasis	15	( 48.4)
Cholelithiasis	13	( 41.9)
Choledocholithiasis	2	( 6.5)
Cholelithiasis (no surgery)	4	( 12.9)
Cancer with	3	( 9.7)
Chronic cholecystitis	2	( 6.5)
Obliteration of the lumen	1	( 3.2)
Normal	4	( 12.9)
Undetermined	5	( 16.1)
Total	31	(100.0)

success rate using B-scan echography. In our study, the gallbladder was nonvisualized in 78 (1.02%) of 7582 cases. Among the 78 cases, 35 cases had previously undergone a cholecystectomy.

In most cases, the apparently absent gallbladder is, in fact, a small, chronically infected, contracted gallbladder<sup>1-5</sup>. Leopold et al<sup>6</sup>. found six patients with gallbladder nonvisualization, all of whom proved to have gallstones (100% positive accuracy). Harbin et al<sup>11</sup>. reported that 22 of 25 cases (88% positive accuracy) were found to have diseased gallbladders. Anderson and Harned<sup>5</sup> noted that 10 of 13 cases with gallbladder nonvisualization were found to have cholelithiasis (77% positive accuracy). In our study, if 5 of the 31 cases in whom the etiology of gallbladder nonvisualization were not confirmed are excluded, 22 of 26 cases (84.6% positive accuracy) were found to have diseased gallbladders (Table 7).

Ultrasonography and oral cholecystography have been compared by many authors. Detwiler and associates<sup>7</sup> reviewed the records of all patients cholecystectomized in their hospital from January 1977 to December 1979, a total of 374 patients. Seventy-six of these had both abdominal ultrasound and oral cholecystography performed preoperatively. The oral cholecystography accurately diagnosed gallbladder disease in 71 of these 76 patients, with 93.4 per cent accuracy, false positive in one patient, and false negative in 4 patients. Ultrasonography correctly predicted gallbladder disease in 66 of the 75 patients, with 86.8% accuracy, false positive in one patient, and false negatives in 9 patients. These authors recommended that ultrasound scanning should be employed as the initial screening study for all gallbladder disease, and that oral cholecystography should then follow in patients in whom ultrasonography fails to identify gallbladder calculi. Vas and Salem<sup>8</sup> also recommended cholecystosonography as the initial study in the investigation of gallbladder disease by making a comparative retrospective study of 140 patients. Ultrasound was found to be 95% accurate for gallbladder disease, with a 5% false negative rate. Oral cholecystography was 96% accurate.

Some investigators<sup>9,10</sup> have recommended the use of single-dose oral cholecystography as the routine first examination when gallbladder disease is suspected. If the gallbladder is not satisfactorily visualized on first examination, ultrasonic chole-

cystography can be done immediately. In an emergency, or for patients who might be pregnant, ultrasonic cholecystography should be available as the initial examination. In our hospital we perform ultrasonography as the initial screening test for gallbladder disease.

Harbin et al.<sup>11</sup> studied follow-up data on 25 patients whose gallbladders were nonvisualized by oral cholecystography and reported that of the 24 patients proven by surgery (22 patients) or autopsy (2 patients), the positive accuracy for 11 patients with both an abnormal cholecystogram and nonvisualization by cholecystography was 100%. In our study, of the 16 cases which underwent oral cholecystography, abnormalities were found in 15 cases such as stone in 5 cases, nonvisualization in 9 cases, and faint visualization in one case (Table 3). Of the 9 cases whose gallbladders were nonvisualized on oral cholecystography, stone were found in 4 cases, cancer in one case, a normal-appearing gallbladder by ERCP in one case, and for 3 cases no additional radiological evaluation was done. A case whose gallbladder was faintly visualized received no additional evaluation.

In general, intravenous cholangiography is indicated in diseases of the extrahepatic duct, but it should be applied when oral examination is impractical, such as, in emergencies due to time limitations, in cases of gastrointestinal irritation, withholding of oral sustenance, or the presence of nasogastric tubes. There is some disagreement concerning the utilization of intravenous cholangiography when there has been failure of the gallbladder to opacify after a second-day cholecystogram. In a series of 5,000 cases, Majahed and associates<sup>11</sup> showed such failure of opacification to represent gallbladder disease in all instances. On the other hand, Wise<sup>12</sup> has claimed that 10% of patients with gallbladder nonvisualization on oral cholecystography may have a normal intravenous cholangiogram and possibly not suffer from gallbladder disease.

In our study, intravenous cholangiography was done in 4 cases, which were confirmed by surgery to be cases of gallstone with chronic cholecystitis in 2 cases, choledocholithiasis with chronic cholecystitis in one case, and cancer of the gallbladder in one case. Intravenous cholangiography showed that the gallbladder was nonvisualized in all 4 cases, and that the biliary duct was not visualized in 2 cases, was filled with air in one

case, and was normal in one case. In two (cancer and cholelithiasis with chronic cholecystitis) of the 4 cases, a cholecystogram was performed before intravenous cholangiography showed a nonvisualized gallbladder, and two (cholelithiasis with chronic cholecystitis and choledocholithiasis with chronic cholecystitis) underwent ERCP after intravenous cholangiography showed choledocholithiasis with a contracted gallbladder, and cholelithiasis with air in the biliary duct. Therefore, intravenous cholangiography did not aid in the determination of the etiology of gallbladder nonvisualization in any of the 4 cases

Endoscopic retrograde cholangiography is valuable in gallbladder disease when jaundice is present, particularly when there is a question of a possible co-existing disease in the biliary duct. In our study, of the 15 cases which underwent ERCP, there were 7 cases of nonvisualized gallbladder, 4 cases of cholelithiasis, 2 cases of contracted gallbladder, and 2 cases of a normal appearing gallbladder. The associated findings of the biliary duct included stone in 6 cases, cancer in one case, and normal in 8 cases. In one case, the biliary duct was filled with air in addition to stones. Surgical findings in 6 of the 7 cases which showed gallbladder nonvisualization by ERCP, were cholelithiasis in 4 cases, cancer of the gallbladder in one case, and cancer of the bile duct at the level of the cystic duct with a normal sized gallbladder in one case. In the remaining case, the biliary duct was normal on ERCP. Thus ERCP helped to determine the etiology of gallbladder nonvisualization by ultrasonography in 14 (93.3%) of the 15 cases.

Nonvisualization of the cystic duct and gallbladder by ERCP represents cystic duct obstruction when adequate filling of the biliary tree is obtained<sup>13)</sup>. However, unless the biliary tree is filled to the second or third order of branches, no comment can be made on nonvisualization of the gallbladder. Sixty-three cases, whose gallbladders and cystic ducts were nonvisualized by ERCP although the rest of the biliary system was well visualized, were analyzed by Rohrmann and coworkers<sup>14)</sup>, and three groups of patients with abnormal conditions were noted: (1) those with obstructing lesions of the distal common bile duct, 35 patients, (2) those with primary lesions of the cystic duct or gallbladder, 19 patients, and (3) those with obstructing lesions about the common hepatic/cystic duct junction, 8 patients. In the second group, 19 patients had actual obstructing

lesions of the cystic duct or gallbladder, such as calculi in 14 patients, empyema of gallbladder or chronic obliterative cholecystitis in 3 patients, and carcinoma of the gallbladder in 2 patients.

Harbin et al.<sup>1)</sup> reported that 22 of 25 cases in whom the gallbladder could not be identified by cholecystosonography despite adequate fasting had diseased gallbladders with obliteration of the lumen (cholelithiasis with chronic cholecystitis in 20 cases and carcinoma in 2 cases). In our study, the 5 cases in which the etiology of gallbladder nonvisualization was not confirmed were excluded from the 31 cases, 22 of the 26 cases were found to have diseased gallbladders such as chronic cholecystitis in 15 cases (among these 15, cholelithiasis was present in 13 cases, choledocholithiasis in 2 cases), cholelithiasis in 4 cases which were nonsurgerized, and cancer in 3 cases (among these chronic cholecystitis was present in 2 cases and the lumen was obliterated in one case).

There are many causes of gallbladder nonvisualization as described in the introduction. Of the 19 cases confirmed at the time of surgery, the reasons for gallbladder nonvisualization by ultrasonography were contracted gallbladder due to chronic cholecystitis in 17 cases due to cholelithiasis (13 cases), choledocholithiasis (2 cases) and cancer (2 cases), obliteration of the lumen due to cancer of the gallbladder in one case, and technical error due to an unusual location of the gallbladder in one case proven as having cancer of the bile duct at the level of the cystic duct.

The mechanisms accounting for gallbladder nonvisualization in our 4 cases of diagnostic error seemed to be technical error due to an unusual location of the gallbladder in three cases and obscuration of the gallbladder by intestinal gas in one case. According to Doust and Mahlad<sup>15)</sup>, the causes accounting for gallbladder nonvisualization, using bistable B-mode scanning were small volume gallbladders or those with unusual shapes or locations. Harbin et al.<sup>1)</sup> reported that the mechanism accounting for gallbladder nonvisualization in 3 cases (12%) of diagnostic error is obscure, but that the possible causes are physiologic contraction of the gallbladder because the patients are not truly fasting and obscuration of the gallbladder by adjacent gas pockets in the colon or small bowel.

In conclusion, we feel that careful examination should be done to detect an gallbladder unusually located or one obscured by intertinal gas in order

to decrease the diagnostic error rate when the gallbladder is not visualized by ultrasonography. Also, we recommend oral cholecystography or ERCP for an ultrasonographically nonvisualized gallbladder.

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