The Diagnosis of Acute Cholecystitis: Sensitivity of Sonography, Cholescintigraphy and Computed Tomography

Patthisak Changphaisarnkul MD*,
Supakajee Saengruang-Orn PhD*, Trirat Boonya-Asadorn MD*

** Division of Radiology, Phramonkutklao Hospital, Bangkok, Thailand*

Objective: *To compare the sensitivity of sonographic, cholescintigraphic, and computed tomographic examination of acute cholecystitis to the pathology result, which is considered the Gold Standard.*
Material and Method: *A retrospective analytic study was conducted among 412 patients, aged between 15 and 98 years, who underwent cholecystectomy surgeries, and whose pathology results indicated acute cholecystitis between July 2004 and May 2013. The sensitivity and the differences between sensitivity of the three methods were calculated in all patients. Complicated acute cholecystitis cases were analyzed separately.*
Results: *The three methods demonstrated statistically significant differences in sensitivity (p-value = 0.017), with the cholescintigraphy as the most sensitive method (84.2%), followed by computed tomography (67.3%), and sonography (59.8%). Concerning the samples with the pathology result indicating complicated acute cholecystitis, computed tomography was statistically significantly more sensitive than sonography in detecting acute cholecystitis, whether or not the complications were identified (100% and 63.6%, respectively, with p-value = 0.0055). None of the patients with the pathology result of complicated acute cholecystitis case was examined by cholescintigraphy, thus, no calculation was possible. Regarding the ability to detect the complications of acute cholecystitis, computed tomography had a sensitivity of 35.71% (5 in 14 patients), while sonographic examinations could not detect any of the complications.*
Conclusion: *Cholescintigraphy is a more sensitive method than computed tomography and sonography, but the three methods have its own advantages, disadvantages, and limitations, which must be considered for each individual patient.*

Keywords: *Acute Cholecystitis, Sonography, Cholescintigraphy, Computed Tomography*

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Acute Cholecystitis[1] is a condition involving a sudden and severe inflammation of the gallbladder. The patients will manifest the symptoms of high fever, chills, epigastric pain or pain under the right side of the rib cage, and nausea/vomiting. Acute cholecystitis is also the most common diagnosis of the upper right abdominal pain. The condition is two to three times more prevalent in female than in male. Cholecystectomy is the treatment of choice for uncomplicated acute cholecystitis. In Phramongkutklao Hospital, there were roughly 60 to 80 cholecystectomy operations per year.

The study by HcGee et al[2] indicated that cholecystectomy was the third most common surgical procedure, following appendectomy and herniorrhaphy. Approximately 90 to 95%[1,3-5] of acute cholecystitis cases are caused by the obstruction of the cystic duct by gallstones, and the subsequent bacterial infection and inflammation of the gallbladder. Gallstone is absent in the rest 5 to 10% of the cases, which is a condition known as acute acalculous cholecystitis, which tend to be found in male elderly patients with multiple comorbids e.g., diabetes mellitus, high blood pressure, burn, prolonged fasting, hyperalimentation, and Acquired Immune Deficiency Syndrome (AIDS).

Although acute cholecystitis is the most common cause of right upper abdominal pain, further radiological investigation is still crucial, as more than one out of three patients with the chief complaint of right upper abdominal pain does not have cholecystitis. Furthermore, acute cholecystitis may develop into more serious complications[3,4], as described below.

Gangrenous cholecystitis, which is a severe inflammation that causes mural necrosis of the gallbladder, with a high chance of gallbladder perforation.

Acute emphysematous cholecystitis, which is a cholecystitis causes by gas forming organisms e.g., *Clostridium* species, *Escherichia coli*, *Klebsiella*, *Aerobacter aerogenes*, and non-hemolytic streptococci. The cystic duct will become inflamed and swollen, causing obstruction with or without the presence of

Correspondence to:
Changphaisarnkul P, Department of Radiology, Phramonkutklao Hospital, Bangkok 10400, Thailand.
Phone: +66-2-7633814 ext. 93814, Fax: +66-2-3545243
E-mail: urbandoctor@hotmail.com

gallstones. Subsequent complications include gangrenous cholecystitis and gallbladder perforation in 74% and 21% of the cases, respectively. Additionally, diabetes mellitus is also presented in approximately 30% of these cases.

Mirizzi's syndrome, which is an obstruction of the cystic duct by gallstones, causing severe inflammation that develops into a mass obstruction of the common hepatic duct (CHD). The stone can also erode into the CHD and cause cholecystocholedochal fistula. These obstruction and inflammation will enlarge the intrahepatic bile ducts. Mirizzi's syndrome should always be considered when acute cholecystitis is accompanied by biliary obstruction. This diagnosis should be made prior to surgery otherwise, the surgeon might misunderstand that the gallstone is lodged in the cystic duct.

Gallbladder perforation, which is a fatal complication, though it is rare. Timing diagnosis and treatment could reduce morbidity and mortality rate by 60% and 27%, respectively.

Diagnosis of acute cholecystitis by clinical symptoms and laboratory results alone is difficult. It is also commonly accepted that early surgery in acute cholecystitis was beneficial. Therefore, an accurate preoperative diagnosis is crucial, especially with radiological investigations, which are very helpful not only in diagnosis, but also in identifying possible complications.

Plain film abdomen[1,5] can detect the following abnormalities, gallstones, enlarged or distended gallbladder, or bowel ileus. However, these findings lack specificity in diagnosing acute cholecystitis, and the sensitivity of this radiography examination is only 15%.

Sonography[1,4,5] is often the first modality to be considered in accessing patients with right upper abdominal pain, with its high specificity and sensitivity in detecting gallstones, biliary dilatation, and features that suggest acute inflammatory disease of the biliary tract. Other findings include sonographic Murphy's sign, gallbladder wall thickening (>3 mm), enlarged or distended gallbladder, and pericholecystic fluid collection. A sonographic diagnosis of acute cholecystitis requires two majors criteria, or one major criteria with two minor criteria to be fulfilled:

Sonographic diagnostic criteria for acute cholecystitis

The major criteria are the presence of gallstone(s) or the sonographic Murphy's Sign. The minor criteria are gallbladder wall thickening >3 mm, pericholecystic fluid collection, or enlarged or distended gallbladder >4 cm.

Even though sonography is a non-invasive, painless, no-radiation modality that can be done in critical patients and possess high sensitivity and specificity in detecting gallstones, it is still dependent on the experiences and expertise of the operator, and has certain limitation in patients with obesity, ascites, and distended bowel. Furthermore, it might fail to detect small gallstones in the distal end of the common bile duct, and behind the duodenum.

Cholescintigraphy[1,3,5,6] is very helpful in diagnosing acute cholecystitis. This method is based on the principle of hepatic metabolism, in which the hepatocytes will take in the injected radioactive material, and excrete it into the biliary tract. Tc-99m is tagged with the iminodiacetic acid (IDA) derivatives, and injects into the patient. The hepatocytes then take in the materials via carrier mediated anionic clearance mechanism. Approximately 85% of these materials will be broken down by the liver, and excreted into the biliary tract while 15% will be excreted via the kidney. Should the hepatic function become impaired, the radiopharmaceutical excretion by the liver will be decreased, and the excretion via the kidney will be increased instead.

In the past, the popular IDA derivative was Tc-99m hepatobiliary iminodiacetic acid (HIDA) but nowadays, Tc-99m di-isopropyl iminodiacetic acid (DISIDA), as uses in Department of Nuclear Medicine, Phramongkutklao Hospital, has become the substance of choice. This is due to its better ability to break down and shorter time to pass through the biliary ducts to the duodenum, resulting in quicker and clearer imaging of the biliary ducts, and the feasibility of usage even in patients with a bilirubin level as high as 15 to 30 mg/dl.

Normally, after injection of Tc-99m DISIDA, its hepatic uptake would be detectable within 10 minutes, and the material would be detected in the biliary tract, gallbladder, and duodenum within 60 minutes. These findings indicate that the cystic duct is not obstructed. On the other hand, during acute cholecystitis which causes the swelling and obstruction of the cystic duct, Tc-99m DISIDA will not be able to enter the gallbladder, thus the gallbladder cannot be seen in the imaging.

The practice in Department of Nuclear Medicine, Phramongkutklao Hospital, is to administer morphine in cases Tc-99m DISIDA could be seen excreted into the duodenum, but the gallbladder was

still not visible one hour after the administration of Tc-99m DISIDA. This helps reducing the time of examination and increase the sensitivity and specificity of the investigation. Morphine is given at the dose 0.04 mg/kg body weight, slow intravenous push. The morphine would induce the contraction of the sphincter of Oddi, which consequently increase pressure inside the common bile duct, and cause a bile reflux into the gallbladder. If the cystic duct is not obstructed, the gallbladder should be visible within 30 minutes after morphine administration. On the other hand, if the cystic duct is obstructed, the gallbladder will not be visible even after morphine administration.

The advantages of cholescintigraphy are its non-invasiveness, its ability to assess the biliary functional information, and its high sensitivity and specificity. The drawbacks include false negative in acute acalculous cholecystitis, and false positive in post-cholecystectomy patients whose past history were not adequately taken, chronic cholecystitis, acute pancreatitis, post-choledochoenterostomy patients, cirrhosis, prolonged hyperalimentation, local invasive cancer, or inflammation surrounding the cystic duct, and in patients who did not fast before the examination, received parenteral nutrition, or fasted for more than 12 hours.

Computed tomography[1,3,5] is another useful examination, especially in confirming the invasive extent and the characteristic of the complications such as pericholecystic fluid, abscess, or air, and gallstones that lay outside the gallbladder. CT scan could outperform other modalities in this aspect. However, its drawbacks include its sensitivity in detecting gallstone, which is lower than sonography's, its inability to assess Murphy's sign, high cost, the requirement for contrast agents, higher radiation dosage than other modalities, and most importantly, there is no definitive criteria in diagnosing acute cholecystitis with CT scan. Nonetheless, a diagnosis can be made from the presence of gallstone(s), the gallbladder wall thickening >3 mm, there is mucosal hyperenhancement, pericholecystic fat stranding or fluid collection, or enlarged or distended gallbladder >4 cm.

Cholescintigraphy is a highly accurate examination in the diagnosis of acute cholecystitis. Sonography is widely used in the diagnosis of the disease, due to the convenience of bedside ultrasound imaging. However, computed tomography is gaining its popularity in Thailand, including in Phramongkutklao Hospital. Each method has its own advantages and drawbacks, but, as of now, there is still not enough information to identify the best and most appropriate method.

From the primary medical record reviewed, the patients with the pathology result of acute cholecystitis had always undergone at least one modality, sonography, cholescintigraphy, or computed tomography before receiving surgery. Therefore, the present study was conducted in order to evaluate the performance of the diagnostic modalities used in acute cholecystitis cases at the Phramongkutklao Hospital. The results were to be used as a reference in choosing an appropriate modality to diagnose acute cholecystitis in the future.

Objective

To compare the sensitivity of sonographic, cholescintigraphic, and computed tomographic examinations of acute cholecystitis to the pathology result, which is considered the Gold Standard.

Material and Method

This research was a retrospective analytic study.

Population and samples

The target population was patients diagnosed with acute cholecystitis that were treated with cholecystectomy by the surgeons of Department of Surgery, Phramongkutklao Hospital, whose tissue samples were analyzed, and the diagnosis of acute cholecystitis was confirmed by the pathologists of Department of Pathology, Institute of Pathology, Phramongkutklao Medical Center, between July 2004, the time that radiological results started to be archived in the computerized information system of Phramongkutklao Hospital, and May 2013.

Inclusion criteria for the samples

1. Diagnosed of acute cholecystitis.

2. Undergone at least one of the following radiological examinations, sonography, cholescintigraphy, or computed tomography; by the radiologists of Department of Radiology, Phramongkutklao Hospital.

Note: The Magnetic Resonance Imaging (MRI) was not mentioned in any clinical practice guidelines for suspected acute cholecystitis cases, in Thailand and in Phramongkutklao Hospital. No physician in the hospital has ever requested an MRI for suspected acute cholecystitis cases, thus the modality was not included in our study.

3. Treated with cholecystectomy, by the surgeons of Department of Surgery, Phramongkutklao Hospital.

4. Tissue samples analyzed, and the diagnosis of acute cholecystitis was confirmed by the pathologists of Department of Pathology, Institute of Pathology, Phramongkutklao Medical Center

Exclusion criteria

Patients who were without at least one radiological result of sonography, cholescintigraphy, or computed tomography.

Sample size determination

Mirvis et al[9] have conducted a study called "Diagnosis of Acute acalculous cholecystitis: a comparison of sonography, scintigraphy, and CT", and found that the sensitivity of sonography was 0.92, thus:

$$n = \frac{Z_\alpha^2 S(1 - S)}{d^2}$$

$$= \frac{1.96^2 \times 0.92 \times (1 - 0.92)}{0.05^2}$$

$$= 113.1$$

This research must then include at least 115 samples.

Note: Confidence level 95%, $\alpha = 0.05$ (two-side test)

$Z_\alpha = 1.96$

S = sensitivity of test = 0.92

d = margin of error = 0.05

Official procedures

The research proposal was approved by the Subcommittee of the Research Proposal Consideration, Royal Thai Army Medical Department. The names and hospital numbers of the patients underwent cholecystectomy, whose pathology results confirmed the diagnosis of acute cholecystitis, were obtained from Department of Pathology, Institute of Pathology, Phramongkutklao Medical Center.

Data collection methods

The names and hospital numbers were used in locating the radiology results of sonography, cholescintigraphy, and computed tomography. The data were analyzed to compare the sensitivity of the modalities, sonography, cholescintigraphy, and computed tomography in diagnosing acute cholecystitis. The software used in statistical analysis was statistical analysis application software.

Data analysis

Data analysis included the processing and systematic management of the data, to ensure that the results from sonography, cholescintigraphy, or computed tomography and the pathology results were being formatted in the way that allow an efficient utilization. The demographic analysis included sex and age.

The calculation of sensitivity of each modality was based on the comparison with pathology results.

$$\%\text{sensitivity} = \frac{\#\text{patients with radiologic result of acute cholecystitis}}{\#\text{patients with pathologic result of acute cholecystitis}} \times 100$$

The statistical analysis was made using the SPSS (Statistic Package for Social Science for Window) software, and the hypothesis testing accepted a statistical significance of 0.05.

Results

The retrospective analytic study of the data obtained between July 2004 and May 2013 included 412 patients with different underlying diseases that had undergone cholecystectomy, and had pathology result of acute cholecystitis. They included 222 male (53.6%) and 190 female (46.4%). Their ages were between 15 and 98 years, with the mean of 62.07 years.

Results from the analysis of all samples

Sonography showed a 59.8% sensitivity (222 patients out of 371); while cholescintigraphy: 84.2% (16 out of 19); and computed tomography: 67.3% (66 in 98) (Table 3).

From Table 3, the results from Bonferroni test indicated significant differences between each modality (p-value = 0.017) with cholescintigraphy as the most sensitive modality (84.2%), followed by computed tomography (67.3%), and sonography (59.8%).

Then, each pair of sensitivity was compared by Bonferroni test. Cholescintigraphy was statistically significant more sensitive than sonography (84.2% and 59.8%, respectively, p-value = 0.017). Computed tomography was more sensitive than sonography (67.3% and 59.8%, respectively), but without any statistical significance (p-value = 0.087). Finally, cholescintigraphy was more sensitive than computed tomography (84.2% and 67.3%, respectively), but without any statistical significance (p-value = 0.071).

Results from the analysis of samples with the pathology results of complicated acute cholecystitis

There were 29 samples with the pathology results of acute cholecystitis e.g., acute gangrenous cholecystitis, acute necrotizing cholecystitis, or acute

suppurative cholecystitis. Seventeen (58.6%) of these were male, 12 (41.4%) were female. The samples aged between 48 and 94 years (average age: 70.62 years).

Table 1. Total sample size

	Number (person)	%
Female	190	46.1
Male	222	53.9
Total	412	100.0

Of the 414 samples, some received more than one modality of radiological examination

Table 2. Number of patients by types of modality

Modality	Number (person)	%
US only	301	73.06
DISIDA only	2	0.48
CT only	39	9.47
US and DISIDA	11	2.67
US and CT	53	12.86
US, DISIDA and CT	6	1.46
Total	412	100.00

US = examined by ultrasonography; DISIDA = examined by cholescintigraphy; CT = examined by computed tomography

Table 3. Number of patients being examined by each modality (some patients might underwent more than one type of examination

	US	%	DISIDA	%	CT	%
Negative	149	40.2	3	15.8	32	32.7
Positive	222	59.8	16	84.2	66	67.3
Total	371		19		98	

Positive = result was indicative of acute cholecystitis
Negative = result was not indicative of acute cholecystitis

Table 4. Sensitivity of sonography and computed tomography in samples with the imaging result of acute cholecystitis with or without complication, and pathology result of complicated acute cholecystitis

Modality	Result			
	Negative	Positive	Total	*p*-value
CT				
Number	0	14	14	0.0055
Percentage	0.0%	100.0%	100.0%	
US				
Number	8	14	22	
Percentage	36.4%	63.6%	100.0%	

Fifteen of these samples underwent only sonography, seven underwent only computed tomography, and seven underwent both modalities, but none of them underwent cholescintigraphy.

In comparing the two modality, computed tomography and sonography, in detecting acute cholecystitis with or without complication, they demonstrated sensitivity of 100%, and 63.6% (14 in 22), respectively (Table 4). Bonferroni test indicated a statistically significant superior sensitivity of computed tomography over sonography (*p*-value = 0.0055).

In comparing the sensitivity of sonography and computed tomography in detecting the complications of acute cholecystitis, computed tomography had the sensitivity of 35.71% (5 in 14), while sonography could not detect any complications at all.

Discussion

Acute cholecystitis is an inflammation of the gallbladder. It is common condition in general population, ranked the third most common surgical condition, follow appendectomy and herniorrhaphy. It is considered the most common diagnosis of the right upper abdominal pain. Delayed diagnosis may lead to complications such as gangrenous cholecystitis, acute emphysematous cholecystitis, Mirizzi's syndrome, or gallbladder perforation.

Definitive clinical and laboratory diagnosis of acute cholecystitis is difficult. On the other hand, radiological examination could help establishing an accurate diagnosis and identify the aforementioned complications.

In Phramongkutklao Hospital, there were three imaging modalities used in diagnosing acute cholecystitis, sonography, computed tomography, and cholescintigraphy. Sonography was the most used modality. In contrast, cholescintigraphy was the least popular despite its higher sensitivity. This might due to the more complicate procedure involved, and the longer examination time.

The decision to select the modality for each individual patient depends on the surgeon, internal medicine physician, or emergency medicine physician.

The present study might be prone to sampling or selection bias as it is retrospective study, which did not allow for a randomized selection of modality for the patients.

From the results, we found that cholescintigraphy was the most sensitive modality in diagnosing acute cholecystitis, when compared with computed

tomography or sonography, which had a statistically significant lower sensitivity.

Our result correlated with the study of Kalimi et al[11] in 2001, which demonstrated a superior sensitivity of cholescintigraphy over sonography (86% and 48%, respectively), in diagnosing acute cholecystitis, even though sonography in the present study had a little better sensitivity than Kalimi's. However, this study did not include computed tomography in the comparison.

In addition, the result of the study by Freitas et al[7] in 1982 indicated that cholescintigraphy was more sensitive than sonography (98.3% compared to 81.4%), even though both modalities in our study were less sensitive. This could due to difference between diagnostic criterions of the two studies. In 1986, Mirvis et al[9] demonstrated that all three modalities, cholescintigraphy, computed tomography, and sonography had high sensitivity in detecting acute acalculous cholecystitis in 56 patients.

In present study, none of the complicated acute cholecystitis underwent cholescintigraphy. When comparing the sensitivity of the rest of the modalities in detecting acute cholecystitis with or without complications, computed tomography was statistically significantly more sensitive than sonography (100% compared to 63.2%, *p*-value = 0.0055).

Comparing the sensitivity of the two modalities in detecting complications in acute cholecystitis, computed tomography was a more sensitive method than sonography (35.71% against 0%), though not sensitive enough to be considered satisfactory. This was an aspect of our study that none of the prior researches has ever looked into.

Despite its highest sensitivity in detecting acute cholecystitis, cholescintigraphy still had its limitations e.g., more complicated procedure, the requirement of radioactive material that needed to be ordered from a private company, and had a short half-life of only 6.02 hours, impeding the ability to keep the material readily available for a prompt examination.

Thus, both computed tomography and sonography are still essential in the investigation of suspected acute cholecystitis. However, if both modalities show negative results, but clinical findings are still suggestive of acute cholecystitis, cholescintigraphy can be considered as the modality of choice.

Although computed tomography is less sensitive than cholescintigraphy, it is more sensitive than sonography, especially in detecting complications of acute cholecystitis. Therefore, if such complications were suspected, computed tomography should be considered as the proper method of investigation.

In the present study, the number of patient in each group is different, thus may lead to inconclusive results.

Recommendations

A prospective study should be conducted with subjects receiving one of the three methods of examination to prevent variation in numbers of subjects in each group. Furthermore, the three methods should be done within the same day or in short time intervals. In this study, each method was done at different time, with the timeframe between 0 and 10 days, which could cause different interpretations.

What is already known on this topic?

The previous studies show that the diagnosis of acute cholecystitis by clinical symptoms and laboratory results alone is difficult. It is also commonly accepted that early surgery in acute cholecystitis is beneficial. Therefore, an accurate preoperative diagnosis is crucial, especially with radiological investigations such as plain film abdomen, sonography, cholescintigraphy, magnetic resonance imaging, and computed tomography. Each method has its own advantages and drawbacks, but, as of now, there is still not enough information to identify the best and most appropriate method.

What this study adds?

The diagnosis of acute cholecystitis by three methods demonstrated statistically significant differences in sensitivity (*p*-value = 0.017) with the cholescintigraphy as the most sensitive method (84.2%), followed by computed tomography (67.3%), and sonography (59.8%). Concerning the samples with the pathology result indicating complicated acute cholecystitis, computed tomography was statistically significantly more sensitive than sonography in detecting acute cholecystitis, whether or not the complications were identified (100% and 63.6%, respectively, with *p*-value = 0.0055). None of the patients with the pathology result of complicated acute cholecystitis case was examined by cholescintigraphy. Regarding the ability to detect the complications of acute cholecystitis, computed tomography had a sensitivity of 35.71%, while sonographic examinations could not detect any of the complications.

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Potential conflicts of interest

None.

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การวินิจฉัยโรคของถุงน้ำดีอักเสบเฉียบพลัน: ความไวของการตรวจด้วยคลื่นเสียงความถี่สูง การถ่ายภาพสแกนระบบทางเดินน้ำดีด้วยสารกัมมันตรังสี และการตรวจเอกซเรย์คอมพิวเตอร์

ภัทธิย์ศักดิ์ ช้างไพศาลกุล, ตรีรัตน์ บุญญอัศดร, ศุภขจี แสงเรืองอ่อน

วัตถุประสงค์: เพื่อเปรียบเทียบความไวในการตรวจหาโรคถุงน้ำดีอักเสบเฉียบพลัน จากการตรวจด้วยคลื่นเสียงความถี่สูง การถ่ายภาพสแกนระบบทางเดินน้ำดีด้วยสารกัมมันตรังสี และการตรวจเอกซเรย์คอมพิวเตอร์ เทียบกับผลการตรวจทางพยาธิวิทยาซึ่งเป็นวิธีมาตรฐาน (Gold Standard)

วัสดุและวิธีการ: ศึกษาวิจัยเชิงวิเคราะห์โดยเก็บข้อมูลย้อนหลัง (retrospective analytic study) ในผู้ป่วยที่ได้รับการผ่าตัดถุงน้ำดี และมีผลทางพยาธิวิทยาเป็นถุงน้ำดีอักเสบเฉียบพลัน ตั้งแต่เดือนกรกฎาคม พ.ศ. 2547 จนถึง พฤษภาคม พ.ศ. 2556 อายุระหว่าง 15-98 ปี จำนวนทั้งสิ้น 412 ราย จากนั้นคำนวณหาความไวและความแตกต่างของความไวของการตรวจทั้ง 3 วิธี ในผู้ป่วยทั้งหมด และแยกวิเคราะห์เฉพาะกลุ่มที่เป็นถุงน้ำดีอักเสบเฉียบพลันที่มีภาวะแทรกซ้อน

ผลการศึกษา: ทั้ง 3 วิธี มีความไวในการตรวจแตกต่างกันอย่างมีนัยสำคัญทางสถิติ (p-value = 0.017) โดยการตรวจด้วยการถ่ายภาพสแกนระบบทางเดินน้ำดีด้วยสารกัมมันตรังสี มีความไวในการตรวจมากที่สุด (84.2%) รองลงมาคือ การตรวจด้วยเอกซเรย์คอมพิวเตอร์ (67.3%) และการตรวจด้วยคลื่นเสียงความถี่สูง (59.8%) และเมื่อพิจารณาเฉพาะกลุ่มตัวอย่างที่มีผลพยาธิวิทยาเป็นถุงน้ำดีอักเสบเฉียบพลันที่มีภาวะแทรกซ้อนร่วมด้วย พบว่า การตรวจด้วยเอกซเรย์คอมพิวเตอร์มีความไวในการตรวจพบถุงน้ำดีอักเสบเฉียบพลัน โดยอาจพบหรือไม่พบภาวะแทรกซ้อนก็ได้ มากกว่าการตรวจด้วยคลื่นเสียงความถี่สูง (100% และ 63.6% ตามลำดับ) อย่างมีนัยสำคัญทางสถิติ (p-value = 0.0055) ส่วนการตรวจด้วยการถ่ายภาพสแกนระบบทางเดินน้ำดีด้วยสารกัมมันตรังสี ไม่สามารถคำนวณได้เนื่องจากไม่มีผู้ป่วยที่มีผลพยาธิวิทยาเป็นถุงน้ำดีอักเสบเฉียบพลันและมีภาวะแทรกซ้อนรายใดได้รับการตรวจด้วยวิธีการนี้ และหากพิจารณาถึงความสามารถในการตรวจพบภาวะแทรกซ้อนของถุงน้ำดีอักเสบเฉียบพลัน พบว่า การตรวจด้วยเอกซเรย์คอมพิวเตอร์มีความไวในการตรวจพบภาวะแทรกซ้อนของถุงน้ำดีอักเสบเฉียบพลัน 35.71% (5 ราย ใน 14 ราย) แต่การตรวจด้วยคลื่นเสียงความถี่สูงไม่สามารถตรวจพบภาวะแทรกซ้อนได้เลย

สรุป: การถ่ายภาพสแกนระบบทางเดินน้ำดีด้วยสารกัมมันตรังสี มีความไวในการตรวจวินิจฉัยโรคถุงน้ำดีอักเสบเฉียบพลันมากกว่าการตรวจด้วยเอกซเรย์คอมพิวเตอร์ และการตรวจด้วยคลื่นเสียงความถี่สูง แต่ทั้ง 3 วิธี มีข้อดี ข้อเสีย และข้อจำกัด ในการตรวจที่แตกต่างกันไปในแต่ละวิธี ซึ่งจะต้องพิจารณาเลือกใช้วิธีการตรวจให้เหมาะสมกับสภาวะของผู้ป่วยแต่ละราย