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Radiological examinations (ultrasound) in diagnosis of acute cholecystitis

Final Master Thesis

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1 SUMMARY

Amos Gilad

Radiological examinations (ultrasound) in diagnosis of acute cholecystitis.

AIM

The goal of this study is to compare the efficacy and advantages of radiological tests (ultrasound) in the diagnosis of acute cholecystitis to other imaging modalities.

OBJECTIVES

The following are the goals of this literature review:

1. To determine the most important and effective diagnostic criteria for acute cholecystitis using ultrasound.
2. To assess the diagnostic accuracy of ultrasonography in the diagnosis of acute cholecystitis.
3. Examine the benefits and drawbacks of a US study of acute cholecystitis.
4. To compare the Ultrasound to other radiological methods around the world, such as computed tomography (CT) and magnetic resonance cholangiopancreatography (MRCP).

METHODOLOGY

This study is a literature review based on PubMed, Google Scholar, and Ovid, three significant scientific databases. During the search for articles, the following keywords and concepts were used and combined: "ultrasound", "US" "Diagnostic" "Sonography" "Effectiveness" and "Accuracy" "Acute Cholecystitis" "CT" "Magnetic Resonance" "MRCP" "PAS" "Diagnostic Criteria" "Secondary Signs" In this study, 45 Articles were used, and 15 research were chosen and analyzed based on the inclusion and exclusion criteria, all of which were less than 10 years old.

RESULTS

The sensitivity of CT for detecting AC was significantly greater than that of US: 85% versus 68% ($p = 0.043$), respectively; however, the negative predictive values of CT and US did not differ significantly: 90% versus 77% ($p = 0.24$-0.26). Because there were no false-positives, the specificity and positive predictive values for both modalities were 100%. Among the 42 patients who underwent CT and US, both modalities were positive for AC in 25 patients, CT was positive and US was negative in 10 patients, and US was positive and CT was negative in two patients; in five patients, both US and CT were negative.

CONCLUSION

CT was significantly more sensitive for diagnosing AC than US. CT and US are complementary, and the other modality should be considered if there is high clinical suspicion for AC and the results of the first examination are negative.

RECOMMENDATIONS

In patients with AC, US should be the first-line radiological modality.

Only after IE US might other imaging modalities like CT or MRCP be employed. To limit radiation exposure, low-dose CT should be used instead of normal CT.

2 ACKNOWLEDGEMENTS

This research is a part of my integrated studies in the Lithuanian university of health sciences

I'd want to convey my heartfelt gratitude to my supervisor, Dr. Kristina Žvinienė, for her invaluable assistance in completing this literature study.

Special appreciation to my family and close friends for their unwavering support and assistance throughout this trip. These 6 years and thesis would not have been feasible without them.

3 CONFLICTS OF INTERST

There are no conflicts of interest reported by the author.

4 ETHICS COMMITTEE APPROVAL

The Ethics Committee's approval is not required for this project.

5 ABBREVIATIONS LIST

AC - Acute cholecystitis

CBD – Common bile duct

CRP- C-Reactive Protein

WBC - white blood cell count

ALP- Alkaline phosphate

CT- Computed tomography

MRCP- Magnetic resonance cholangiopancreatography

NPV- Negative predictive value

PPV- Positive predictive value

RUQ- Right upper quadrant

US – Ultrasound

CBD – Common bile duct

IE- Inaccurate/Equivocal

6 TERMS

The area under the curve (AUC) is a metric that allows you to compare different tests. The more accurate the test is, the higher the value (maximum 1.0). (higher sensitivity and specificity).

"**coefficient interval"** refers to the range of variability in an experimental outcome. The upper and lower bounds of variability for your mean value are usually expressed as x percent sure.

Dose length product (mGy*cm): This is a measurement of CT tube radiation exposure/output.

False-negative: The patient has the condition, but the imaging test is negative.

False-positive: The patient's imaging test is positive, but he or she does not have the disease.

Negative predictive value(NPV): The percentage of patients with a negative result who are genuinely disease-free. True negatives divided by (True negative + False negative) equals NPV.

Positive predictive value (PPV): The percentage of patients that have positive results and actually have the condition. True positives / (False positives + True positives) = PPV

Sensitivity: A test's ability to detect real positive illness cases among all those who have the condition; Sensitivity = True positives / (True positives + False negatives).

True negatives discovered by test / (True negative + False positive) = specificity.

Specificity refers to a test's capacity to be true negative in those who do not have the condition in question.

True negative: The imaging test comes back negative, indicating that the patient does not have the disease.

True positive: The patient has the disease and the imaging test is positive.

Infundibulum: It is derived from Latin and meaning “funnel shaped”

Fundus : It is derived from Latin and meaning “bottom”

7 INTRODUCTIONS

Ultrasound (US) is a tissue-characterization imaging technique that employs high-frequency sound waves. The use of ultrasound has increased in recent years, and it is now commonly utilized to evaluate most body areas of acute cholecystitis due to the numerous benefits it provides. **[1]**

Acute cholecystitis refers to inflammation of the gallbladder, the all patients have admitted for gallbladder disease, 20% of them having an acute cholecystitis, Acute cholecystitis predominantly occurs as a complication of gallstone disease, Less often, acute cholecystitis may develop without gallstones

(a calculous cholecystitis).**[2]**

Acute cholecystitis should be suspected in a patient presenting with right upper quadrant or epigastric pain, fever, and a leukocytosis. A positive Murphy's sign on physical examination.

For this reason, is extremely important to have a good clinical diagnosis including a radiological examination to diagnose more accurately acute cholecystitis use Ultrasound (U.S) or Computer tomography (CT) avoid the number of unnecessary complications **[2]**

Ultrasonography is the best first line imaging modality of radiological examination when there is suspicion of acute cholecystitis, but not always we can visualize the cholecystitis and in cases where the doubt persists, other radiological methods are performed in addition, such as Computer tomography (CT) or Magnetic resonance cholangiopancreatography (MRCP) but their usage should be restricted. **[3]**

As a result, this literature review reviewed research and conducted a comprehensive assessment of the literature based on diagnostic accuracy rates in acute cholecystitis diagnosis criteria in the Ultrasound, as well as the use of other radiological approaches for an accurate diagnosis.

8 AIM AND OBJECTIVES

The goal of this study is to assess the effectiveness of ultrasound (US) diagnostics for acute cholecystitis and compare their efficacy and benefits to other imaging technique.

The objectives of this literature review are the following:

1. To determine the most important and effective US diagnostic criteria for acute cholecystitis.
2. To assess the diagnostic accuracy of ultrasonography in the diagnosis of acute cholecystitis.
3. Examine the benefits and drawbacks of a US study of acute cholecystitis.
4. To compare the Ultrasound to other radiological technologies used around the world, such as computed tomography (CT) and magnetic resonance cholangiopancreatography (MRCP).

9 LITERATURE REVIEW

9.1 ACUTE CHOLECYSTITIS

Acute cholecystitis is an onset of inflammation of the gallbladder **[4].**, is divided between Acalculous cholecystitis and calculous cholecystitis is most common type inflammation and gallbladder wall thickening. **[5]**

Ultrasound is the best investigation imaging to initiate diagnosis AC.

The current treatment of care in acute cholecystitis is an early laparoscopic cholecystectomy with the appropriate administration of fluid, and antibiotics. **[6]** The mortality of acute cholecystitis can be high as 90% in ill patients overall mortality is 30%.

9.2 ANATOMY

The gallbladder is a peal shape sac 8-12cm long and 4-5cm wide is a small organ lactated in right quadrant below to the liver at the junction of segment 4 and 5 . gallbladder is divided into fundus, a body and a neck or infundibulum, usually range between 7-10cm has a capacity about 50ml.

The fundus is attached to the liver's inferior border, the neck is attached to the duodenum's superior half, and the surface of the gallbladder is covered by the perineum.
The cystic artery branch of the right hepatic artery nourishes the gallbladder, while the cystic vein branch of the hepatic portal vein provides the vein. The lymph node drains to hepatic nodes.
Autonomic nerve fibers come from the celiac nerve plexus and are innervated by sensory fibers from the right phrenic nerve.
The gallbladder's major job is to store and concentrate bile as well as convey it to aid fat breakdown. A region in the neck known as "Hartmann's pouch" is known as a result of pathology in the form of dilatation or the presence of a stone **[7,8].**

9.3 ETIOPATHOGENESIS OF ACUTE CHOLECYSTITIS AND MORPHOLOGICAL CLASSIFICATION

Etiopathogenesis: Acalculous cholecystitis is caused by gallbladder stasis, hypoperfusion caused by ischemia, or infection **[9].** Gallstones, including acute and chronic cholecystits, are caused by the presence of H. pylori infection. Clostridium, Bifidobacterium, Peptostreptococcus, Bacteroides, Eubacterium, and Escherichia coli are the most frequent bacteria in the intestine. **[10].**

Gallstone impaction in the cystic duct causes calculous cholecystitis, which causes inflammation and gallbladder wall thickening.
[11].
Gallbladder cancer, Emphysematous cholecystitis, gallstone ileus, and perforation are all complications of gallstones **[12].**

Morphological classification

The progression of inflammation causes morphological changes in acute cholecystitis, which can lead to a variety of outcomes. There are four distinct morphological types of acute cholecystitis.

Gallbladder cancer

It is the most significant risk factor. Gallstones have been exposed to germs for a long time as a result of the infection. Gallbladder length more than 9.5 cm showed a five-fold increased risk of cancer macroscopically, microscopically: Long-term inflammation can produce hyperplasia and heterogeneity of the gland, which can progress to gallbladder adenocarcinoma with stromal fibrosis and gallbladder adenocarcinoma.

Emphysematous cholecystitis

The presence of gas in the gallbladder lumen microscopically caused secondary infection of the gallbladder.

Gallbladder perforation

Is the most prevalent post-surgery consequence, which can lead to ischemia and eventually necrosis of the gallbladder:

With hyperemic fluid accumulation, the fluid might expand from the gallbladder into the liver parenchyma, resulting in a liver abscess. Gangrene can develop if the tumor is located at the fundus of the gallbladder.

Gallstone ileus

Gallstone ileus causes a machinal bowel obstruction of more than 2.5cm.

Microscopically

There is a free air in the biliary tree, and the small bowel loops are dilated, and there is a big gallstone with calcification.

9.4 CLINICAL MANIFESTATIONS IN RANGES OF AGE

There are most common symptoms for acute cholecystitis:

Right upper quadrant pain, fever, and leukocytosis associated with gallbladder inflammation. **[13]**.

When the examiner palpates the area of the gallbladder right below the liver border, deeps inspiration causes the gallbladder to descend toward and press against the examiner's finger, which is the most typical symptom to diagnose AC when performing physical examination. Murphy's sign is a helpful sign that occurs in 90% of patients, with a sensitivity of 63% and specificity of 93.6 percent **[14].**

Acute cholecystitis affects 20% of the population and is three times more common in women than in males. Up to the age of 50, 95 percent of persons with acute cholecystitis have gallstones. **[15]**

Children — During childhood, AC accounts for at least 50% to 70% of the population.

The majority of AC cases have been found in children following infections such as Epstein-Barr virus and hepatitis A.

9.5 LABORATORY STUDIES AND SEVERITY OF GRADING

Laboratory tests: Laboratory tests, in addition to clinical symptoms and physical examination, are helpful in aiding the diagnosis of AC. The most common test is:

Right upper quadrant, positive for the Murphy sign, fever, high white blood cell count (WBC) 12,000–15,000/mCL, and rise in band number with left shift in simple AC, elevated C-reactive protein (CRP), elevated alkaline phosphate (ALP), and total bilirubin 1-4 mg are uncommon. **[16]**

To confirm the diagnosis, ultrasonographic indications such as gallbladder wall thickness (more than 4 to 5 mm), pericholecystic fluid, or edema are used. **[17]**

The severity of grading is divided into three categories: mild, moderate, and severe. **[18]**

Adapted from Tokyo guidelines: Table 1.

Table 1. Severity grading for acute cholecystitis.

Grade	Conditions
III (severe)	Associated with any one of the following: 1. Cardiovascular dysfunction: hypotension requiring vasopressors 2. Neurological dysfunction: decreased level of consciousness 3. Respiratory dysfunction: PaO2/FiO2 ratio < 300 4. Renal dysfunction: oliguria, creatinine > 2.0 mg/dl 5. Hepatic dysfunction: PT-INR > 1.5 6. Hematological dysfunction: platelet count < 100 000/mm^3
II (moderate)	Associated with any one of the following: 1. Elevated white blood cell count (> 18 000/mm^3) 2. Palpable tender mass in the right upper abdominal quadrant 3. Duration of complaints > 72 hours 4. Marked local inflammation (gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, peritonitis, emphysematous cholecystitis)
I (mild)	Does not meet criteria of grade III or grade II acute cholecystitis 1. Healthy patient with no organ dysfunction and mild inflammatory changes

Adapated from Tokyo guidelines.[2]

Shows: 3 Criteria's:

Mild: requirements for a healthy patient with minor inflammatory alterations and uncomplicated organ damage.

Moderate: This is a combination of the following: **[19]** Elevated CRP, right upper abdomen pain, and a problem lasting more than 72 hours. **[20]**

Severe: Criteria include cardiovascular, neurological, respiratory, renal, hepatic, and hematological organ dysfunction. **[21]**

9.6 DIAGNOSTIC IMAGING

The patient's history, clinical manifestations, laboratory tests, and the use of risk stratification scores are all relevant factors in identifying AC, but imaging methodology is crucial in making a correct diagnosis.

The most often utilized modalities for diagnosing AC are ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRCP). In youngsters, however, the use of CT and MRCP should be limited. [**22]**

9.6.1. ULTRASONOGRAPHY (US)

Sonography is a minimally invasive imaging procedure that characterizes tissue using high-frequency sound waves. **[23]** When there is a suspicion of AC, the first diagnostic imaging and most sensitive is an ultrasound.

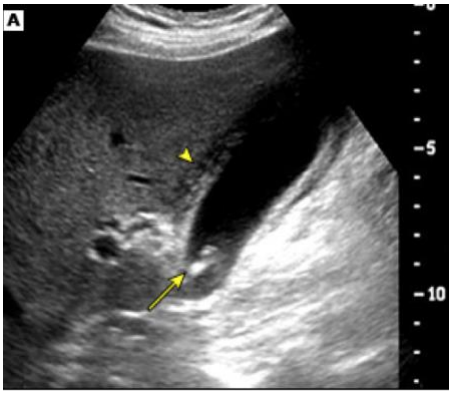
In conjunction with the sonographic Murphy sign, a thicker gallbladder wall (more than 4-5 mm) and pericholecystic fluid, it is critical to determine the blood flow by Doppler to rule out inflammation.

Ultrasonography has a sensitivity of 84 percent and a specificity of 99 percent for detecting gallstones.

The United States is the safest imaging examination, with the least amount of patient radiation exposure. It is also the quickest and easiest imaging examination.

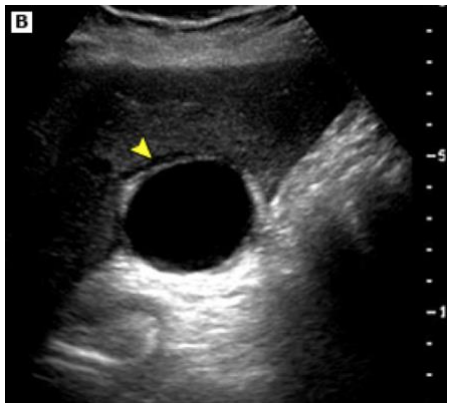
[24] With longitudinal and intercostal scans, execute a right subcostal oblique technique.

Have the following characteristics to diagnose AC:



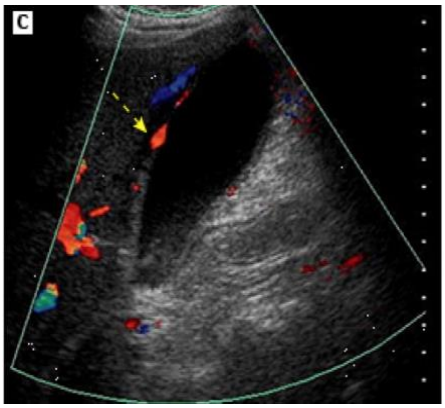
[25] fig.1

A longitudinal view reveals a little shadow cast by Stone.



[26] fig.2

In longitudinal and transverse projections, there is a thicker wall (more than 4-5 mm) with a small amount of pericholecystic fluid.



[27] – fig.3

The Doppler shows an increase in blood flow to the wall, indicating hyperemia due to an inflammatory condition..

9.6.2. COMPUTED TOMOGRAPHY (CT)

The use of a CT scan to diagnose AC is not recommended. **[28]**

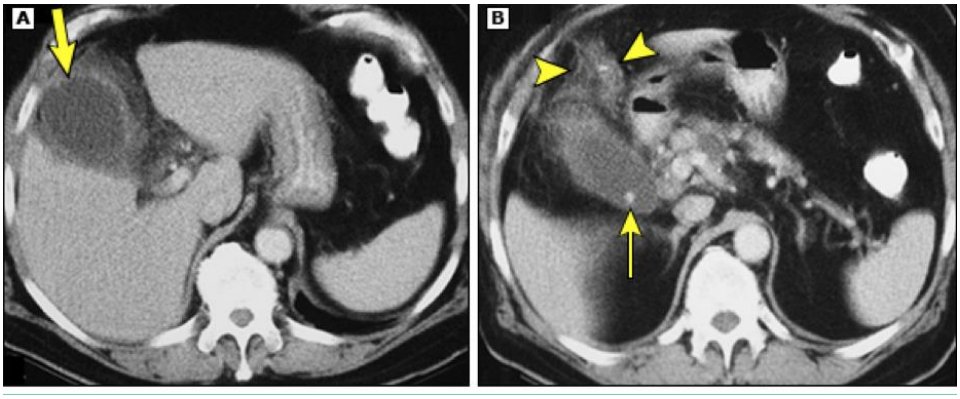
A CT scan is used to rule out complications such as peritonitis, gangrene, (emphysematous cholecystitis), and intestinal blockage (gallstone ileus).

When compared to the US, CT scans are more expensive and provide a greater risk to patients due to radiation exposure. Its sensitivity is high (94%) but its specificity is low (59%). However, it was found to be less beneficial for patients with gallstone disease.

[29]

CT, on the other hand, is a valuable imaging tool for diagnosing AC.

CT scans frequently reveal the following:

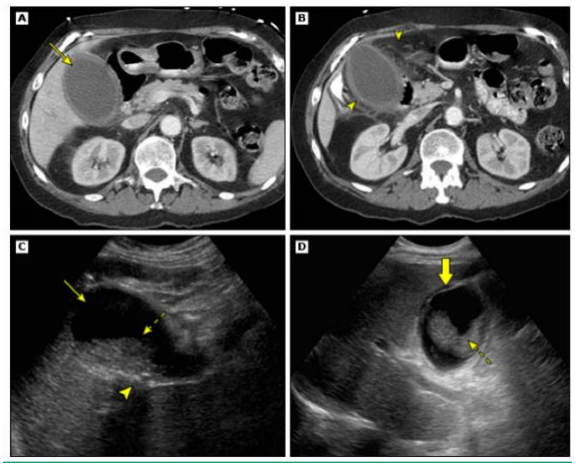


.[30] fig.4

Pericholecystic stranding, distention, high-attenuation bile, pericholecystic fluid, and subserosal edema can all be seen.

A CT scan reveals a big gallbladder with edema and thick tissue. The gallbladder's wall (thick arrow). The gallbladder is surrounded by fat, indicating inflammation (arrowheads).

A calcification stone (thin arrow) is shown.**[31]**



.[32] fig.5

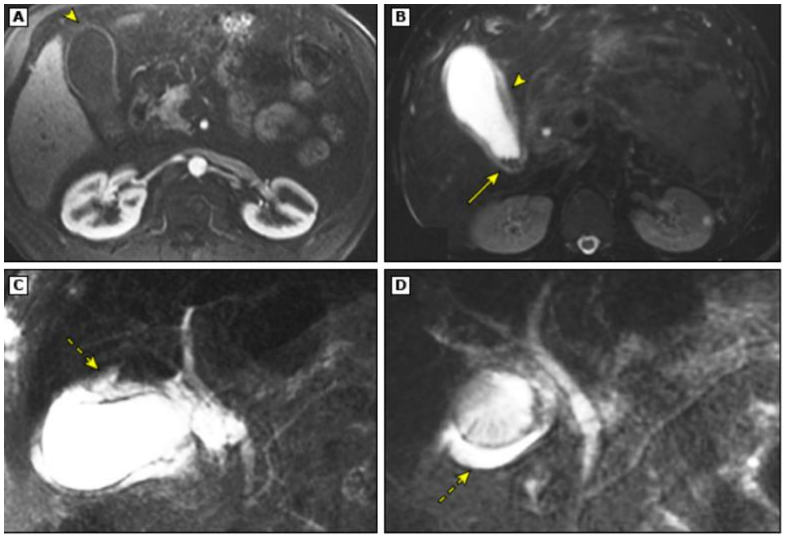
When compared to ultrasound, CT scans were found to be less helpful in detecting gallstones that are isodense with bile.

The CT scan with Fig A and B can reveal a large and thickened gallblader wall, however the US presence in fig C and D can show a huge and thickened gallblader wall with stones, as well as the amount of fluid, when compared to the CT scan: **[33]**

The most common finding in patients with AC is pericholecystic fat, according to CT scan imaging. In comparison to ultrasound, CT scans were found to be overused imaging. The main reason for this is because physicians had less experience performing ultrasounds than CT. **[34]**
Another study found that the CT is more accurate in diagnosing AC because the image in CT is much clearer than the image in ultrasound, but that ultrasound is still used as the initial test to diagnose AC. The sensitivity of US (68%) and CT (85%) for AC, compared to 81 percent for US and 94 percent for CT in previous studies [6]. CT**.[35],**

9.6.3. MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY (MRCP)

The MRCP is a method to evaluate AC that has a minimal risk of radiation and does not require contrast material, but the CT scan imaging showed pericholecystic fat.
The most significant advantage is the ability to evaluate AC using T2 weighted sequences in a flowing fluid using cross sectional and projection techniques.
[36]
The MRCP method is more expensive than the US method for detecting AC and lack of accessibility. [37]
When stones in the cystic duct, common bile duct, or gallbladder neck need to be detected, MRCP is an option to US.
However, ultrasound is more accurate in detecting gallbladder wall thickness, inflammation, and cancer. **[38]**



.[39] fig.6

Images from an MRI and MRCP scan of a patient with acute cholecystitis.
T2 weighted imaging with A-contrast enhancement and fat saturation
B- Multiple stones in a hyperemic gallbladder wall (arrowheads) (arrows)
Pericholecystic fluid accumulation (C+D).

10 RESEARCH METHODOLOGY AND METHODS

This study's approach was a literature review based on PubMed, Google Scholar, and Ovid, three significant scientific data bases. We gathered and analyzed previously published literature on this subject. The following is a list of recommendations. During the article search, the following keywords and terms were combined: "US" and "ultrasound" are two words that come to mind when thinking of the word "ultrasound "Sonography" and "Diagnostic" are two terms that are often used interchangeably. "Effectiveness" and "accuracy" "Acute Cholecystitis" is a medical term that describes the inflammation of the bile ducts. "Computed Tomography" "CT" "Magnetic Resonance Cholangiopancreatography" "MRCP" "Magnetic Resonance Cholangiopancreatography" "Diagnostic criteria" and "PAS" are two terms that are often used interchangeably. "Secondary signs"

The search for a Radiology of Acute Cholecystitis specialist began in November 2021 and lasted until February 2022. With a sample size ranging from 2935 to 104, all of the articles included in this study are less than 10 years old and are geographically diverse, with the oldest item from 2011 and the newest from 2021. The following inclusion and exclusion criteria were used to choose articles for this study:

Table 2: Inclusion and exclusion criteria followed to conduct this review.

INCLUSION CRITERIA	EXCLUSION CRITERIA
-Articles that are written in English	- Articles written in a different language
- In the last ten years, there have been a lot of articles written. The years 2011 to 2021 are included in the range.	- Articles that are more than ten years old
- Articles in their entirety	- Abstracts and not full text studies
-Research conducted on people	- Human studies were not carried out.
- Patients who had radiological imaging, such as an ultrasound, CT scan, or MRCP, and were suspected of having acute cholecystitis.	- Patients who were not suspected of having AC or who did not have diagnostic imaging done. Other non-US radiological procedures include CT and MRCP.
Prospective research Retrospective research and evaluations, Studies that are cross-sectional and blinded	Reviews conducted in a systematic manner.

US: Ultrasound, **CT**: Computed Tomography, **MRCP:** Magnetic resonance cholangiopancreatography

Data extraction:

- The study's author, year, and nation are all listed.
- Type of research
- Participants' characteristics include: (Number of people in the sample, age, average age, gender)
- US, CT, and MRCP sensitivity, specificity, PPV, and NPV with 95 percent CI P values and statistical significance of p0.043 Area under the curve (AUC)
- US, CT, and MRCP accuracy Likelihood ratio, LR (+), RL (-)
- The cost of a hospital stay and the amount of radiation emitted by a CT scan

Articles selection:

Using the Keywords and Terms in the PubMed, Ovid, and Google Scholar databases, a total of 3.876 studies were identified. After screening the titles and abstracts, applying the inclusion and exclusion criteria, and eliminating duplicate studies, a total of 224 articles were obtained and the full text was evaluated for relevance, with 209 studies being excluded based on exclusion criteria, leaving 15 studies to be included in this study.

11 RESULTS

For the results section of this review, a total of 15 quantitative studies were used.
includes characteristics of the four studies examined in relation to the goal of determining the most effective first diagnostic criteria for identifying acute cholecystitis using ultrasound imaging.
With The sensitivity 84% and specificity 99 % of ultrasonography for detection of gallstones.

U.S has Founded the safest imaging examination with lack of radiation exposure, but need more experience training to perform good diagnosis.

CT, on the other hand, is not the first line of diagnosis for AC because it is much more expensive than Ultrasound and exposes the patient to more radiation. Doctors may prefer the technique to rule out complications due to a lack of training abilities, but it is less useful for diagnosing gallstones.
Another study found that the CT is more accurate to diagnose AC because the image in CT is much clearer than the image in US, but that Ultrasound is the initial test to diagnose AC as well. The sensitivity of US (68%) and CT (85%) for AC, compared to 81 percent for US and 94 percent for CT in previous studies.

MRCP is a low-radiation technology that is more expensive than Ultrasound and CT but has been found to be extremely accurate in detecting stones in certain areas such as the cystic duct, CBD, gallbladder neck, gallbladder wall thickening, or inflammation.

12 DISCUSSION OF RESULTS

The major goal of this Master's thesis was to review many papers that described the key diagnostic criteria for AC in Ultrasound, CT's efficacy, advantages and limitations, and to compare US to other radiological modalities including CT and MRCP.
The sensitivity, specificity, PPV, and NPV of the three different radiological imaging procedures were assessed in this study to determine their efficacy based on the characteristics studied.

Sonography US is a wonderful diagnostic tool for AC complaining of pain in the RUQ region who are suspected of having AC, and it is the recommended radiological modality utilized as the first line for the diagnosis of AC due to its low cost/benefit ratio, global accessibility, and absence of radiation exposure.

Sonography has a high diagnostic accuracy for detecting acute cholecystitis. Nonetheless, compared to US imaging techniques, which can be influenced by a variety of variables, CT and MRCP have shown to have a higher diagnostic accuracy to specific areas in the gallbladder.

The diagnostic accuracy of US was reduced when it was conducted by a general radiologist. Sensitivity and specificity were statistically significant ($p<0.043$) in an AJR Am J Roentgenol 2018 [32] investigation, however De Vargas Macciucca, M., Lanciotti, S., De Cicco, M.L et al.2006 [33] study showed it.

When an attending radiologist performs US versus CT to detect complication, there is a small drop in diagnostic accuracy [36]. A general radiologist performed the ultrasound, which revealed a reduced sensitivity of 37.5 percent and a 66 percent accuracy.

Sonography reported a wide range of results for sensitivity, specificity, specificity, PPV, and NPV in this review. In a cross-sectional analysis of 468 individuals, Lee D, Appel S, Nunes L, et al 2021 [27] used US as the gold standard and initial method to diagnose AC. However, when it comes to assessing abdominal pain and consequences, CT is the first choice.

Gain was negligible ($p = 0.41$).

Although there is no substantial difference between CT and Ultrasound (80-75 percent), ultrasound is much more secure due to the lack of radiation.

Values were the followings 468 CT studies meeting criteria, 192 were read as concerning for AC. PPV of CT was 44.7% without US and 50.5% when US was positive, which amounted to an insignificant gain ($p = 0.41$).

CT perform no significant difference to compared to US (80-75%) but US much more secure with lack of radiation and risk compare to CT and less advantage to compare it to US.

CT impression, PPV increased from 45% without US to 90% with a high-confidence ultrasound impression.

Wertz JR, Lopez JM, Olson D, Thompson WM et al 2018 –

Shows completely different results.

Values were the followings in 60 patients between July 1, 2013, and July 1, 2015,

56 underwent US, 48 underwent CT, and 42 underwent both. For the same time period, 60 patients without AC underwent US and 60 patients without AC underwent CT, and these imaging studies served as comparison studies. The groups were combined for a total of 182 unique patients.

The CT shows much greater accurate than US 85% versus 68%, ($p = 0.043$).

J Clin Diagn Res. 2014 et al. Showed different results MRCP has better diagnostic accuracy in complications such as malignancy. Comparing MRCP with CT and it is seen their greater accuracy modalities regarding the accuracy, however its higher diagnostic accuracy than US and CT

Patience acceptance was compared between US and MRCP,

MRCP is alternative choice to US when need to detect stones in cystic duct, common bile duct gallbladder neck.
But US is first line method diagnosis and more accurate to detect gallbladder wall thickening or inflammation but MRCP much more expensive than U.S need more training to perform good diagnosis

STUDY LIMITATIONS

However, there are a few caveats to this assessment. To begin with, this literature review was conducted using only three databases (PubMed, Google Scholar, and Ovid). Second, there were just a few study studies on the main cholecystitis diagnostic criteria in Ultrasound. Sensitivity, specificity, PPV, and NPV were among the criteria. Furthermore, some of the studies had missing data, p values, and AUC. To sum up, there aren't a lot of studies on AC diagnostics using MRCP. The results could have been influenced by the following study limitations.

13 CONCLUSIONS

1. CT has greater diagnostic accuracy and sensitivity to diagnosis of AC, when US shows gallbladder thickened Wall (Greater than 4-5 mm) and pericholecystic fluid, important to determine by Doppler the blood flow indicate of inflammation.

2. When diagnosing AC, ultrasound has a high diagnostic accuracy and is safe for patients, but its accuracy can vary from 84 percent to 100 percent.

3. The diagnosis accuracy of MRCP and CT in the US is higher. However, CT should be used only if there is a risk of radiation exposure or if there is a desire to detect a complications.

4. US Shows is the first line and to diagnosis AC.

5. MRCP and CT much more expensive method to diagnosis AC

14 PARTICAL RECOMMENDATIONS

First of all, for patient showing atypical symptoms with RUQ pain with murphy sign, AC should be considered an option.

Second of all, sonography should be the first-line imaging modality when AC is suspected. Patients' complaints, lab tests such CRP, leukocytosis according Tokyo guideline to improve the diagnosis together with imaging.

Third, alternative radiological procedures such as repeat US, CT, or MRCP should be considered if US cannot visualize the AC or if the results are erroneous.

Fourth, because of the risk of ionizing radiation exposure, CT should only be utilized after an IE Ultrasound. It is preferable to use a low-dose CT scan because it reduces radiation exposure. However, the benefit-to-cost ratio of MRCP should be assessed in each individual patient instance.

Finally, in order to avoid missing acute cholecystitis, which can lead to serious complications, a thorough history, physical examination, laboratory results, risk stratification scores, and, most importantly, imaging diagnostics are required.

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