

# Ultrasonographic findings in right hypochondriac quadrant in patients with acute abdomen diagnosis

## Abstract

**Introduction:** Abdominal pain in the right hypochondrium (RHD) is a frequent cause for which people go to the emergency department, although acute cholecystitis is usually the main reason, there are multiple differential diagnoses, which is why it is necessary to establish a quick and accurate cause can be a clinical and imaging challenge. Ultrasound is usually the study of choice in hepatobiliary disorders, however, with DHD of other origins, where evaluation becomes a challenge for the radiologist.

**Objective:** To evaluate the relationship between pathological ultrasonographic findings with DHD in patients admitted for acute abdomen.

**Material and methods:** Descriptive cross-sectional study, in a hospital of the Mexican Social Security Institute, Puebla, Mexico, from July 2022 to June 2023, in patients aged 18 to 70 years, both sexes, admitted to the emergency room for acute abdomen. Sociodemographic and clinical variables were studied, where an ultrasonographic evaluation of all structures of the right hypochondrium was performed. Descriptive statistics and Kappa coefficient were used to evaluate the agreement between clinical diagnosis and ultrasound findings, with a significant p value <0.05, obtained using SPSS v27 and MedCalc® Statistical Software version 22.009 (MedCalc Software Ltd, Ostend, Belgium; <https://www.medcalc.org>; 2023).

**Results:** 118 patients were studied, 69 (58.5%) women and 49 (41.5%) men. The most common comorbidities in women were diabetes and hypertension 34(49.3%), 11(16.0%) respectively, while in men diabetes predominated 23(46.9%) followed by hypertension 7(14.3%). Cholecystitis emerged as the main ultrasonographic finding in both sexes, followed by a normal USG in 15(21.8%) of women and 8(16.3%) of men. Despite this, considerable agreement [ $k=0.78200$ ] Standard error 0.040, approximate significance <0.001, 95% CI 0.70302-0.86098 was found between the initial ultrasound diagnosis and the definitive clinical diagnosis.

**Conclusion:** cholecystitis is a common primary diagnosis for pain in the right upper quadrant, considering gallbladder conditions as a primary etiology, however a high percentage of patients do not present pathological findings, underlining the complexity of the diagnosis in clinical practice and the need to consider other diagnostic modalities or less conventional etiologies as causes.

**Keywords:** diagnostic congruence, ultrasonographic findings, right upper quadrant, acute abdomen

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## Introduction

Acute right hypochondrium pain is very common as a presenting symptom in hospital emergency departments and occasionally in patients initially hospitalized for unrelated disorders.<sup>1</sup>

This anatomical region houses vital structures, including the liver, gallbladder and part of the small intestine, each with their respective potential pathology. Accurate identification of the etiology of this pain is essential, as the implications for the patient's treatment and prognosis vary significantly depending on the underlying cause.<sup>2,3</sup>

In the current era, with technological advances and innovative imaging techniques, abdominal ultrasonography has emerged as a primary tool in the evaluation of abdominal pain. Its ability to provide detailed, real-time, noninvasive images makes it a first-line technique for many clinicians.<sup>4,5</sup>

Right hypochondrium pain is a frequent presentation for adult evaluations in emergency departments around the world; the presumptive working diagnosis is cholecystitis in most cases.<sup>6</sup>

Given the structures found in the right hypochondrium, the most frequent is to find some hepatic disease, such as hepatitis, hepatic steatosis, hepatic abscess, hepatic carcinoma, acute or chronic cholecystitis, cholelithiasis, acalculous cholecystitis, biliary torsion, biliary carcinoma or metastasis, postcholecystectomy complications, cholangitis, Mirizzi's syndrome, biliary necrosis, among others; However, it is also necessary to consider some gastrointestinal causes that can be reflected with pain in that region such as: colitis, especially when the inflammation is located in the right colic flexure, intestinal ischemia, gastritis or peptic ulcers, some pancreatic causes such as pancreatic head carcinoma, some thoracic causes such as pneumonia in the right lower lobe, pleural effusion or thoracic masses; and finally some urological causes such as pyelonephritis and renal abscess<sup>1,7-9</sup>; a rare cause, but which has been reported is omental infarction.<sup>10</sup>

Several imaging studies are available for the evaluation of abdominal pain. It should be taken into account that the method chosen should cause the least harm to the patient and at the same time achieve the highest degree of diagnostic accuracy.<sup>11</sup>

Computed tomography and its use to diagnose abdominal diseases has had a significant increase. For the evaluation of pain in the United States, an increase from 10% to 22% was observed between 2001 and 2005 in the evaluation of patients with pain, which has continued to increase. One of the reasons for this increase is the clear visualization of anatomical structures, fluids and masses, among others; however, this same reason is the one that has caused an overuse of tomography among patients, thus causing them to be exposed to ionizing radiation more than necessary.<sup>12</sup>

In the United States, it is estimated that each abdominal CT scan exposes the patient to an effective radiation dose of approximately 10 millisievert (mSv), compared to the annual background radiation dose of 3 mSv. For these reasons, some authors recommend that CT scans be reserved for cases in which the ultrasound diagnosis is inconclusive, or in which the pain is referred to the right lower quadrant.<sup>12</sup>

Since in many cases biliary stones are the most common presenting disease in patients with right hypochondrium pain, it is important that a differential diagnosis be made with this disorder. Ultrasound is the test of choice for the diagnosis of gallstones and cholecystitis; it is a non-invasive and cost-effective technique that does not involve radiation exposure or contrast administration; furthermore, it allows differentiation between medical and surgical causes of abdominal pain and in many cases, it is sufficient to guide the patient's treatment.<sup>11-20</sup>

For patients with probable biliary calculi disease, ultrasound should be the first-line imaging method because of its high accuracy, low cost, safety and availability. The reported sensitivity of ultrasound ranges from 80-100% and specificity from 60-100%.<sup>11</sup> For cholelithiasis a telemedicine study found sensitivity ranging from 84.2% to 99.8%.<sup>21</sup>

Among the few studies that have evaluated the clinical diagnostic congruence with ultrasound is the study by Mulmi *et al.* Their study, performed in a hospital in Nepal, aimed to determine the prevalence of abnormal ultrasound findings among patients referred for abdominal pain. The study included patients who came for care to the emergency department or who had been referred from a care clinic; all patients underwent ultrasound and the proportion in which the clinical diagnoses coincided with the ultrasound findings was evaluated; a total of 250 patients with abdominal pain aged between 3 and 87 years (mainly in the 21 to 30 years age group) participated, of whom 169 had abnormal ultrasound findings (67.6%); among the most frequent findings were: fatty liver, ureteral calculi, renal cyst, cystitis hydronephrosis, nephrolithiasis, bulky uterus, prostatic hypertrophy and appendicitis. In the clinical history, the most frequent symptom was non-specific abdominal pain (37.2%), followed by lumbar pain (14.0%), lower abdominal pain (11.6%), epigastric pain (10.0%), left flank pain (6.0%), gynecologic pain (4.0%), abdominal distention (3.6%), diffuse pain (3.2%) and right iliac fossa pain (2.4%).<sup>22</sup>

Among the diagnoses given based on clinical examination, the vast majority had peptic ulcers (41.6%), followed by renal lithiasis (11.6%), appendicitis (6.4%), cholecystitis (4.8%), cholelithiasis (4.8%), ureteral lithiasis (4.0%), ovarian cysts (3.2%) and urinary tract obstruction (3.2%). The proportion of congruence between clinical diagnosis and ultrasound findings was 22.8% (57 / 250).<sup>23</sup>

Another study that evaluated ultrasound and clinical diagnosis was performed by Nural *et al.* Its objective was to evaluate the role of ultrasound in determining the diagnosis and treatment of patients seen in the emergency room with abdominal pain, patients with atraumatic abdominal pain were included, the initial diagnosis was made by clinical history, physical examination, laboratory results and abdominal radiographs if they had been performed. Physicians

who requested an ultrasound were asked to fill out two surveys, one before the ultrasound and one after, in which they were asked about the diagnostic impression, the choice of treatment (surgical or other), the expectations of the ultrasound, the reason for choosing the ultrasound and if another ultrasound had been performed imaging study. Ultrasounds were performed by the resident physicians on duty, for those in which the resident was not sure of the diagnosis, the help of an attending physician was requested and in case of discrepancies between these two, the opinion of the attending was the one taken into account; ultrasounds were performed with an ultrasound unit (Sonolayer SSA-270A, Toshiba, Tokyo, Japan) equipped with a 3.75 MHz convex probe.

The post-ultrasound survey asked physicians whether the diagnostic suspicion had been confirmed or rejected, whether the ultrasound had contributed to the diagnosis, whether the origin of the disease and treatment had been localized, the percentage agreement of the ultrasonographic findings with the discharge diagnosis was determined by calculating the confidence interval, and the agreement of the initial clinical impression and ultrasonographic diagnosis with the discharge diagnosis was compared using McNemar's test.<sup>25</sup>

The Hospital General de Zona No. 20 of the Instituto Mexicano del Seguro Social, located in Puebla, has seen a considerable number of cases related to right hypochondrium pain. Given the high prevalence and the diversity of clinical presentations, the need arises to investigate and correlate the pathological ultrasonographic findings with the symptomatology presented by these patients.

The main objective of this study is to evaluate the relationship between pathologic ultrasonographic findings and right hypochondrium pain in patients evaluated for acute abdomen, as well as to identify patterns or trends that may optimize the medical care provided to these patients.

## Material and methods

A descriptive and prospective cross-sectional study was conducted from July 01, 2022 to June 01, 2023 by the Imaging Service of the General Hospital of Zone No. 20, Puebla, Mexico, to 118 patients aged 18 to 70 years, both sexes, admitted to the emergency department for acute abdomen, who agreed to participate in the study and signed the informed consent form. Patients with a history of abdominal surgery were excluded. Each patient who met the selection criteria was asked about sociodemographic and clinical variables such as age and comorbidities. Subsequently, a

Ultrasonographic evaluation of all the structures of the right hypochondrium (liver, hepatic flexure of the ascending colon, gallbladder, common bile duct, suprahepatic veins, etc.) in the subjects, for this purpose, the patient was placed in dorsal decubitus, with the abdomen uncovered, gel was added on the skin of the abdomen in the right hypochondrium and, with the probe, the visualization of the left hepatic lobe was started. Next, the patient was asked to breathe in so that the liver would descend for better visualization and the visualization of part of the pancreas, the inferior vena cava, the portal vein through a hepatic approach, and the suprahepatic vein that flows into the inferior vena cava was continued. Again, the patient was asked to take a deep breath to visualize the diaphragm, the right hepatic lobe, the gallbladder and to the right the right kidney. The cuts were performed longitudinally and transversally in the right hypochondrium. This procedure lasted approximately 15 minutes.

To avoid bias, once a diagnosis was made by ultrasound, the patient's final clinical diagnosis (whether clinical, surgical or

histopathological) was collected from the file and finally the diagnoses obtained by ultrasound were compared.

Descriptive statistics were used, and agreement between clinical diagnoses and ultrasound findings was assessed using the Kappa coefficient, which analyzes the ratio of the proportion of times the assessors agree (corrected for agreement under the odds) to the maximum proportion of times the assessors could agree (corrected for agreement under the odds) using the clinical diagnosis as the gold standard, with a 95% confidence interval (CI).

All inferential tests performed were considered statistically significant when a p value < 0.05 was found. Data analysis was obtained using SPSS v27 and MedCalc® Statistical Software version 22.009 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2023).

This work was evaluated and approved by the IMSS Local Health Research and Ethics Committee (R-2023-2108-003). All participants were aware of the objective of the research and cooperated freely.

### Results

The study included 118 patients who reported right hypochondrium pain. The sample consisted of 69 women (58.5%) and 49 men (41.5%).

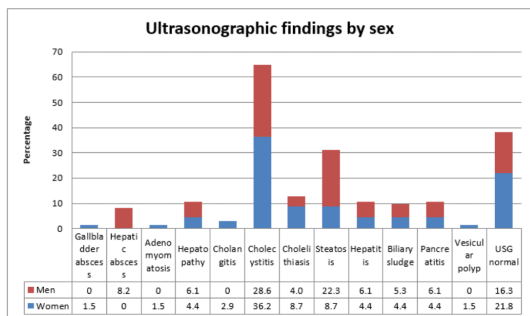
The mean age for females was 47.3 ± 2.9 years of age, while for males it was 50.2 ± 3.05 years. The comorbidities of the patients who were admitted with a diagnosis of acute abdomen are illustrated in Table I.

**Table I** Sociodemographic and clinical characteristics of the patients seen in the HGZ No.20 with diagnosis of acute abdomen (n=118).

Variable	Women (n=69)	Men (n=49)
	X ± SD	X ± SD
Age (years)	47.3 ± 2.9	50.2 ± 3.0
	Women (n=69)	Men (n=49)
	F (%)	F (%)
Comorbidities DM2 HAS		
DM2/HAS	34(49.3)	23(46.9)
DENIED	11(16.0)	7(14.3)
	9 (13.0)	11(22.4)
	15 (21.7)	8(16.4)

X, mean; SD, standard deviation; F, frequency; (%), percentage; DM2, diabetes mellitus type 2; HAS, systemic arterial hypertension.

Ultrasonographic evaluation revealed specific diseases associated with pain in the right hypochondrium. Among females, cholecystitis was the most recurrent diagnosis, being identified in 36.2% (n=25) of cases, followed by ultrasound with normal results 21.8% (n=15). In contrast to the male population where cholecystitis was found first in 28.6%(n=14), followed by steatosis 22.5% (n=49) (Figure 1).



**Figure 1** Ultrasonographic finding of patients attended at HGZ No.20 with a diagnosis of acute abdomen according to sex (n=118).

Note: Ultrasonographic evaluation revealed specific diseases associated with right hypochondrium pain in patients with right hypochondrium pain in evaluated for acute abdomen.

In order to determine the diagnostic accuracy of ultrasonography in relation to the definitive diagnosis, the Kappa coefficient was used, this index yielded a value of 0.78200, Standard Error 0.040 approximate significance <0.001, 95% CI 0.70302-0.86098 between the initial ultrasound diagnosis and the definitive clinical diagnosis, suggesting considerable agreement between the initial ultrasound diagnosis and the definitive clinical diagnosis.

### Discussion

Acute right hypochondrium pain is very common as a presenting symptom in hospital emergency departments and occasionally in patients initially hospitalized for unrelated disorders. Accurate identification of the etiology of this pain is essential, as the implications for patient management and prognosis vary significantly depending on the underlying cause.

A total of 118 patients, of both sexes, were analyzed, the mean age for females was 47.3 ± 2.9 years of age, while for males it was 50.2 ± 3.05 years. The fact that the majority of patients in this study were female 69(58.5%) versus male 49(41.5%) could be indicative of a gender predisposition toward certain abdominal conditions, particularly those related to the gallbladder. Previous studies have indicated that women are at higher risk of developing gallstones, a major cause of cholecystitis, which is consistently supported by the results of this study.<sup>4</sup>

Comorbidities, particularly DM2 and HAS, were present in almost half of both groups. These conditions are often associated with diseases of the liver and biliary system. Diabetes, for example, may predispose patients to liver disease, such as hepatic steatosis.<sup>5</sup> HAS, on the other hand, is a common comorbidity in many conditions and its presence could be an indicator of the chronicity of the underlying disease or could act as an aggravating factor in abdominal conditions.<sup>6</sup>

Cholecystitis, diagnosed in more than 36.0% of women, reinforces the idea that gallbladder disease is a predominant concern in this demographic group.<sup>7</sup> Steatosis, although present in a lower percentage, is still significant, especially considering the prevalence of DM2 in the population studied.<sup>5</sup>

However, what really stands out is the percentage of patients in whom, despite presenting symptoms, no visible disease was found on ultrasound.

This leads us to consider several possibilities: technical limitations, suggesting that the ultrasonographic equipment used may not have been sensitive enough to detect certain conditions;<sup>8</sup> functional diseases, where conditions such as the

Irritable bowel syndrome or functional dyspepsia may manifest with pain in the right hypochondrium with no imaging findings;<sup>9</sup> and non-hepatic or non-biliary etiologies, indicating that the pain may originate from adjacent structures such as the right kidney, ascending colon or musculoskeletal conditions.<sup>10-12</sup>

Finally, the Kappa coefficient is a useful tool for assessing agreement between two assessors or, in this case, two diagnostic modalities. A value of 0.78200, close to 1, indicates excellent agreement. This reinforces the idea that abdominal ultrasonography is a reliable diagnostic tool for assessing right hypochondrium pain.<sup>13,14</sup>



## Conclusion

Cholecystitis is one of the main conditions diagnosed in patients with right hypochondrium pain, especially in women. This finding emphasizes the importance of considering gallbladder conditions as a primary etiology in patients with such symptomatology, and may serve as an initial guide for medical professionals in clinical decision making; likewise, it was concluded that comorbidities such as DM2 and HAS were present in a significant proportion of patients, suggesting that these conditions may influence the onset or exacerbation of abdominal pathologies. This link may be particularly relevant in the development of liver diseases, such as steatosis.

It is important to emphasize that a non-trivial percentage of patients with right hypochondrium pain did not present pathologic ultrasonographic findings. This finding underscores the complexity of diagnosis in clinical practice and the need to consider other diagnostic modalities or less conventional etiologies.

A Kappa coefficient of 0.78200, our study demonstrated good agreement between the ultrasonographic diagnosis and the definitive diagnosis, consolidating the position of abdominal ultrasonography as a reliable tool for the evaluation of patients with right hypochondrium pain.

Despite the clear trends observed, it is essential to recognize that the relationship between right hypochondrium pain and its causes can be multifaceted and varied. The functional diseases, diseases of adjacent structures and other differential diagnoses should be kept in mind. In addition, the constant evolution of imaging technology could shed light on pathologies that were previously difficult to diagnose.

In summary, this study has added a valuable contribution to the clinical understanding of right hypochondrium pain, providing medical professionals with a further tool for effective assessment and appropriate treatment. However, as with any medical investigation, it is essential to approach diagnosis and treatment with a holistic approach, taking into account both objective findings and the individual clinical presentation of each patient.

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## Conflicts of interest

The authors declare no competing interests.

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