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Research Article

Implementation of Various Imaging Modalities in the Diagnosis of Hepatic Cystic Lesions

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Abstract:

Background: Hepatic cysts (HCs) lesions are common in clinical practice. These lesions can be benign and have no clinical significance, or they can be malignant and potentially fatal.

Aim: The current manuscript aimed to assess HCs with varying image modalities and the prevalence of it among gender as well as link the HCs with age, in the two main governmental hospitals in Taif city.

Materials and methods: 100 confirmed diagnosed HCs were retrieved from period of 2020 to 2023, through picture archiving and communication system (PACs), they divided into groups according to gender and age, as well as dividing cysts according to their radiographic appearances Microsoft Excel was used to analyzed the data achieved.

Results: The older age more than 46 years and female are more exposed to HCs than male and younger age respectively. The HCs types, appearances, classification and characterization in each image modality are tabulated in specific tables. While simple cysts were benign, complicated cysts, appeared as echinococcosis, and cystic neoplasms that, require early and accurate diagnosis.

Conclusion: The findings of current study matched the findings of previous studies. More studies are required in the highlights of current findings.

Key words: Hepatic cysts, image modalities, Gender, Taif

1.Introduction

The liver's primary function is to filter blood from the digestive system before it is passed throughout the body. The liver also detoxifies chemicals and metabolizes drugs. The liver produces bile, which is then reabsorbed by the intestines. Fundamental Proteins required for blood coagulation and other processes are also produced by the liver[1].

Liver can be affected by a variety of factors that could harm it, one of these harms is the cystic liver disease. The term "cystic liver disease or Hepatic cysts (HCs)" refers to a set of fluid-filled lesions in the liver parenchyma, also known as a group of heterogeneous lesions, widely categorized as infectious and noninfectious lesions. Ultrasound is typically the first-choice imaging modality[2].

HCs are frequently detected by chance during imaging. Because of the widespread availability and growing usage of abdominal imaging modalities, the detection of HCs is increasing. Ultrasound (US) use has nearly doubled in the last decade, while computed tomography (CT) use has tripled and magnetic resonance imaging (MRI) use has quadrupled. This enhanced detection raises two major challenges: first, determining if a lesion is benign or malignant, and second, selecting diagnostically accurate, cost-effective, and safe imaging technology [3,7].

Based on the specific characteristics of the lesions, HCs may be classified into simple and complicated cysts. Differentiation is crucial since it may suggest the need for additional diagnostics and treatments. Imaging is the primary method for differentiation. In some instances, the use of invasive tests like biopsy or resection is not necessary to accurately diagnose HCs. Characterizing HCs is fundamental which is achieved by several modalities CT, MRI, US, and contrast enhanced ultrasound (CEUS). In this research, we provide an overview about the prevalence of various types of HCs and how different imaging modalities are implemented to detect and diagnose HCs and the common gender, age group affected by HCs[2].

1.1 Literature review: Simple Hepatic Cysts

Simple hepatic cysts (also known as bile duct cysts or biliary cysts) appear as fluid-filled lesions with thin and smooth walls that lack complicated internal features like septation and mural irregularity or nodules. Simple hepatic cysts are typically asymptomatic, and accidentally discovered between third to seventh decades of life, during abdominal image technique using modalities such as MRI, CT, and Ultrasound. Simple hepatic cysts vary in types: Benign developmental hepatic lesion, Biliary hamartomas, Caroli disease, polycystic liver disease (PCLD). The radiologist needs to evaluate imaging characteristics such as the cyst location, shape, unifocal or multifocal nature, in addition to cyst complexity [3,8,11].

1.2 Benign Developmental hepatic lesion

The benign developing hepatic cyst is the second most frequent benign hepatic lesion. This benign, congenital, and developmental lesion, as its name represents, develops from the biliary endothelium that is not in contact with the biliary tree. On CT: they appear sharply defined with smooth thin walls typically lacking Sept. On MRI: On T1-weighted imaging, hepatic cysts are uniformly hypointense, and on T2-weighted imaging, they are uniformly hyperintense. Simple hepatic cysts and cystic metastases can be distinguished from one another on strongly T2-weighted MRI sequences thanks to the increase in signal intensity caused by fluid content. Gadolinium administration results in no enhancement. On US: it is characterized by a well-circumscribed anechoic lesion with enhanced sound through-transmission and no signs of mural nodularity[8].

1.3 Biliary hamartomas

bile duct hamartomas, also known as Von Meyenburg complexes, are uncommon benign abnormalities of the biliary tract that develop from embryonic bile ducts that do not involute. They tend to be asymptomatic and identified by accident during an autopsy or laparotomy. On CT: Biliary hamartomas manifest as several hypoattenuating lesions (<1.5 cm) with more irregular edges than simple hepatic cysts. On MRI: T1-weighted imaging shows biliary hamartomas to be hypointense, while T2-weighted imaging shows them to be hyperintense. Primarily cystic lesions do not respond to gadolinium, whereas primarily solid lesions do. MRCP reveals a number of cystic lesions that do not communicate with the biliary tree. On US: Biliary hamartomas occur as small well-circumscribed lesions developed throughout the liver, with hypoechoic, hyperechoic, or mixed echogenicity depending on whether the component is solid, cystic, or mixed[8].

1.4 Caroli disease

An autosomal-recessive disorder is called Caroli disease, also known as congenital, communicating, cavernous ectasia of the biliary system, is characterized by multifocal saccular dilatation of the intrahepatic bile ducts. The symptoms of Caroli disease vary depending on the kind and often appear in infancy or adolescence. The disease's greater incidence type is typically associated with periportal fibrosis, can develop to cirrhosis or portal hypertension, and Cystic renal disease, especially medullary sponge kidney. On CT: Multiple hypoattenuating cystic formations of different sizes that connect with the biliary system give a CT scan its distinctive appearance. The "central dot sign," which identifies intraluminal portal vein radicals as tiny foci of intense contrast enhancement within dilated intrahepatic bile ducts, is a finding that is highly indicative of Caroli disease. On MRI: The dilated and cystic biliary system on an MRI scan looks hyperintense on a T2-weighted image and hypointense on a T1 image. On US: Dilated intrahepatic bile ducts with intraductal calculi are seen on ultrasound. This appearance is known as "intraductal bridging." To confirm that the cystic structures are in connection with the biliary tree, ERCP and cholangiography are beneficial[8].

1.6 Complex Cyst

Complex cysts are fluid-filled hepatic lesions with the presence of one or more of the following complex characteristics: septation, internal nodularity, enhancement, calcification, wall thickening or irregularity, hemorrhagic or proteinaceous contents. since there is a potential of complex cystic hepatic lesions being caused by a wide variety of disease processes. Complex cystic liver lesions can be classified as neoplastic, infectious, or inflammatory, and Posttraumatic and Miscellaneous Cysts[8]. Clinicians should remember to rule out mucinous cystic neoplasm (MCN) and echinococcal cysts, which are infrequent causes of liver lesions but might provide distinct complications [(2,10)].

1.7 Comparison of the strengths and limitations of various diagnostic modalities for cystic liver disease

Ultrasound (US) is an inexpensive and widely available method with no radiation exposure but has limited evaluation of complex features and no contrast. Computed tomography (CT) is also inexpensive and widely available but has radiation exposure and complications from contrast agents. Magnetic resonance imaging (MRI) has no radiation exposure and contrast enhancement can provide more information but is expensive and time-consuming. Contrast-enhanced ultrasound (CEUS) has no radiation exposure, real-time imaging, and contrast enhancement capabilities, but its availability is limited. Sensitivity and specificity percentages are also provided for each modality[2].

2. Materials and Methods

We used the Picture archiving and communication systems (PACs) by using the following search terms, liver, cyst, and diagnosis. In the following hospitals, King Abdulaziz specialist hospital (KAASH) and King complex Faisal hospital. We limited our search to 100 samples collected from different modalities, including some variables, both genders, no specific age, body mass index (BMI) and cyst type, shape as well as imaging modality. Specific designed sheet to collect variable initiated before data collection period and approved by researchers and supervisor.

Exclusion criteria include any not confirmed diagnosed liver cyst or un completing or missing data as well as children and early adolescent age (≤15 years) [(13)].

The search completed from in March 2023 to records from first 2020 to March 2023. Excel Microsoft word utilized to achieve figures and generate equations and correlation factors

Ethical approval up to now not achieved from ministry of health (MOH) due to complex procedure but we are working over these procedures to achieve ethical approve to our study to enable us publish the current findings of our manuscript in an impacted science expanded journal

3. Results

The study included 100 participants, 43/47 female/male ratio, from different age (19-74y). The ages were grouped into four categories as depicted in the Figure 1,

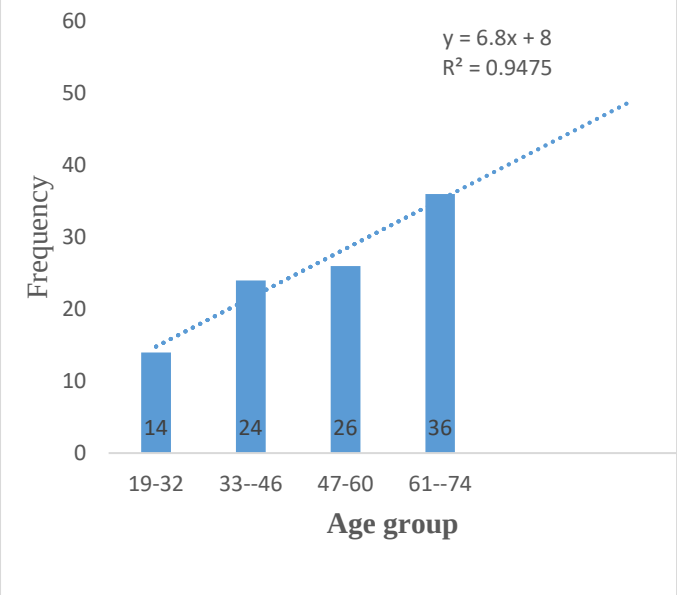

Figure1: Frequency in each group's age

The prevalence of different cyst type among male/female was 69/31 as explained in table 1, with more age group effected in each gender.

Table 1: Liver cyst among gender and more effected group age

Gender	Frequency	More affected age group
Female	43	47-59
Male	47	61-74

Table 2 Characteristic of simple cysts & complex cysts

Simple Cysts	Complex Cysts
fluid-filled lesions, thin and smooth walls, typically asymptomatic.	fluid-filled lesions, septation, internal nodularity, enhancement, calcification, wall thickening or irregularity, hemorrhagic or proteinaceous contents.

Table 3 Appearance of simple cysts & complex cysts with various modalities

Cyst type	MRI	CT	US
Simple	Non-enhancing T1: low signal T2: high signal	Nonenhancing, hypodense, smooth margins	Anechoic, homogeneous, aseptate, thin and smooth margins
Complex	T1: hypointense cyst contents T2: hyperintense with low signal border	Multilocular, mural and septal enhancement, mural thickening and/or nodules, calcifications, debris containing fluid	Irregular border, hyperechogenic septations, loculations, shadowing beyond calcifications

Table 4 Classification of simple cysts appearance in each imaging modality

Cyst classification	MRI	US	CT
Benign Developmental Hepatic Cysts	Homogeneous T1: low signal T2: high signal	well-circumscribed anechoic lesion	sharply defined, smooth wall, usually lack septa
Biliary hamartomas	Small and multiple HypoT1, hyperT2 "Starry sky" aspect No communication with the biliary tract	Small and multiple Hyperechoic Comet-tail artefacts "Snowstorm" aspect	Small and multiple Hypoattenuation Irregular shape No enhancement
Caroli disease	Same as CT Assessment of communication with the biliary tract	Diffuse aneurysmal dilatation of the biliary tract "Central dot" sign	Same as US Better visibility of the "central dot" sign Intrahepatic lithiasis
polycystic liver disease	Multiple simple hepatic cyst Compression	Multiple simple hepatic cyst Compression	Multiple simple hepatic cyst Compression

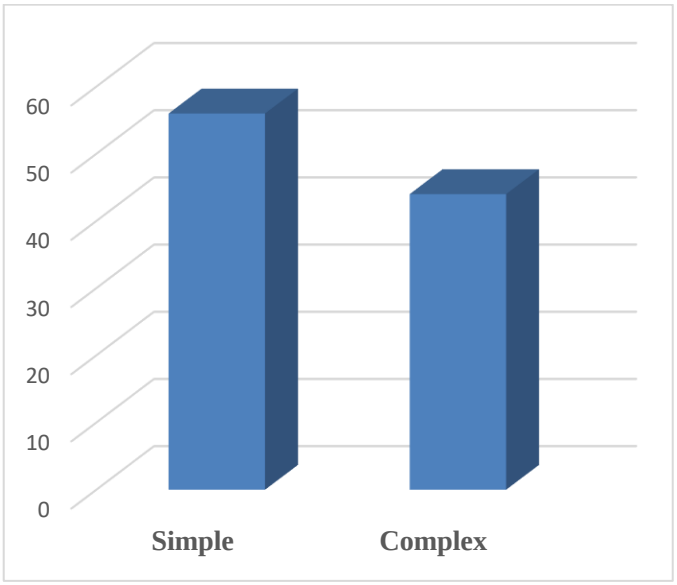

Figure 2 Frequency of cyst types according to their types

4. Discussion

The current manuscript searches the prevalence of HCs among patients in Taif city Saudi Arabia, through highlights the role of various imaging modalities in detecting HCs.

The groups age explained in figure 1 showed, four groups that affected and diagnosed by different modalities (U/S, CT and MRI), their age ranged from 19 to 74m the percentage of HCs occurrence were as follow(14, 24, 26, 36%) according to divisions of groups, From the figure mentioned, it is clear that the age factor is a main factor that can b considered in this figure, and correlation coefficient of R^2=0.94, Therefore, it can be considered that the age factor is a cause of occurrence and an increase in its numbers among the target group of the current study. The current finding agrees with the findings of Gaines & Sampson 1989 [14], who utilized only ultrasound) to search for HCs prevalence in their group, they concluded that, Simple

hepatic cysts affect 2.5% of the population and are becoming more common with age. In addition, the finding of age correlated to occurrence of HCs agrees with Blum et al., 2021 [(15)], who used different imaging modalities to detect cyst and liver tumor, they concluded that, male and older volunteers both showed a higher incidence of cysts ($p = 0.002$ and $p = 0.025$, respectively). A liver cyst was twice as likely to develop for every additional year of age.

The prevalence of HCs was more frequent in female than male for our selected sample as explained in table 1, The current finding mismatched the finding of Jennifer & Marion [(16)], who reported a novel review article to link gender with hepatic disease, and concluded that, acute liver failure, autoimmune hepatitis, benign liver lesions, primary biliary cirrhosis, and toxin-mediated hepatotoxicity are more common in women. Malignant liver tumors, primary sclerosing cholangitis, and viral hepatitis are less common in women. Women with hepatitis C virus infection have a lower rate of decompensated cirrhosis, no difference in survival from alcohol-related liver disease, and improved survival from hepatocellular carcinoma. In general, men are twice as likely as women to die from chronic liver disease and cirrhosis. Liver transplantation is less common in women than in men, with varying disease outcomes depending on the etiology. Unfortunately, the study did not focus on HCs specifically but it was look at the liver disease as general. Fortunately, the current finding of prevalence of HCs in female more than female matched a review study in 2019 by Rawia et al., [(17)], who reported, congenital cysts are more common in females between the ages of 40 and 70, whereas acquired cysts (including hydatid, traumatic, and inflammatory cysts) are more common in males between the ages of 30 and 50.

After researchers made 4 to five meets with radiologists and chief radiologist in each hospital under study, on how they diagnose the liver cyst on different imaging modalities (type radiographic appearances and how to differentiate between them? Then researchers return to literature [(1,4,9,11,12 and 17)], the researchers summarized the appearances, characterizations and classification of liver cysts to let our colleagues learn more about diagnosis and it is an opportunity to them and us before they started their internship period in hospitals

5. Conclusion

In conclusion, cystic lesions of the liver are a common finding in abdominal imaging, and accurate diagnosis is essential for appropriate patient management. The study involved 100 confirmed diagnosis HCs. Older age is more frequent affected by HCs than younger age, and the female are frequent affected by HCs. Cysts classified into simple and complex cyst. While simple cysts are usually benign, complicated cysts, echinococcosis, and cystic neoplasms require early and accurate diagnosis to ensure specific treatment.

6. Study limitations and recommendations

Ethical approval not achieved from MOH. And this sequence should be well managed in coming batch

Our study Not mentioned the size and place of liver cyst, due to limit time of research

In future there are many proposed studies regarding HCs (size, site and imaging modality as well as linkage finding of modality with laboratories investigations.

Authorship: contribution statement

Hamid Osman: Methodology, Project administration, Formal analysis, Supervision, **Bassam Althaqafi**: Data curation, Funding acquisition, Investigation, Resources, Software, Validation, Writing – original draft. **Hamad Alsuhime:** Formal analysis, Funding acquisition, Methodology, Resources. **Nawaf Hijazi:** Data curation, Project administration. **Osama Alsulimani:** Formal analysis, Software. **Mohammed Alasmari**: Validation, Writing – review & editing. **Nouf Alzahrani**: Formal analysis, Resources, Visualization. **Abdullah Majed Hakami**: Investigation, Methodology, Validation. **Khalid Asiri**: Conceptualization, Writing – original draft.

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