Correlation of radiological findings with surgical findings in hepatic hydatid disease.

A prospective study of 79 cases

Ann. Ital. Chir., 2018 89, 4: 309-314
pii: S0003469X18028798

Foued Frikha*, Aymen Trigui*, Haitham Rejab*, Nozha Toumi**, Sami Fendri*, Aida Jemal**, Mohamed Ben Amar*, Rafik Mzali*

**Department of General and Digestive Surgery, University of Sfax, Faculty of Medicine, Habib Bourguiba Hospital, Sfax, Tunisia*
***Department of Radiology, University of Sfax, Faculty of Medicine, Habib Bourguiba Hospital, Sfax, Tunisia*

Correlation of radiological findings with surgical findings in hepatic hydatid disease. A prospective study of 79 casess

OBJECTIVES: *The liver is the most frequent anatomic location of hydatid disease. Imaging modality nowadays are numerous and increasingly efficient. The objective of our study is to precise the correlation between Ultrasonography, computed tomography and intraoperative findings on the different characteristics of hepatic hydatid cyst.*
PATIENTS AND METHODS: *We conducted a prospective study including all hepatic hydatid cyst operated in 2015. We evaluated statistically, by calculating the coefficient K or the intraclass correlation coefficient, the concordance between Ultrasonography, computed tomography (CT) and intraoperative findings on the different characteristics of hepatic hydatid cyst.*
RESULTS: *In our study, we included 48 patients with 79 hepatic hydatid cysts. It was concluded that Ultrasonography performs better than CT in the study of type of cyst, pericyst, relationships with portal vein and main bile duct. While CT is better than echography in terms of number, localizations of cyst, relationship with the vena cava inferior, other localizations and the remaining liver, both examinations remain limited in the determination of pericyst characteristics and the identification of biliary fistula.*
CONCLUSION: *Ultrasonography and CT cannot provide accurate data for the study of pericyst and biliary fistula, hence requiring prospective studies of the place of MRI and intraoperative echography in this domain.*

KEY WORDS: Diagnostic, Imaging, Echinococcosis, Hepatic, Intraoperative Care

Introduction

Human hydatidosis is endemic in temperate regions where pastoralist activities are practiced. It is particularly frequent in the southern shores of the Mediterranean and especially in the Maghreb region. Hydatidosis can reach all viscera with a predilection for the liver. The objective of the imaging is to visualize the hydatid cyst, its wall, the membrane, the daughter vesicles but especially to list its relationships and its possible complications. Imaging techniques today are numerous and more and more efficient. Our objective is to determine the correlation between the characteristics of cysts and ultrasound data, computed tomography (CT) and intraoperative findings.

Patients and Methods

We carried out a prospective study including all liver hydatid cysts (LHC) operated from 01 January to 31 December 2015. We included all operated patients for liver hydatid cyst. Our aim is to determine preoperative ultrasound and CT performance for the study of the different parameters of LHC: number, size, seat, peri-

Pervenuto in Redazione Aprile 2018. Accettato per la pubblicazione Giugno 2018
Correspondence to: Dr Aymen Trigui, MD, Department of general and digestive surgery. Habib Bourguiba's teaching hospital, 3029 Sfax, Tunisia (e-mail: ayman.trigui@gmail.com)

cyst, relationships with neighboring vascular structures and biliary ducts and the study of the state of the remaining hepatic parenchyma, the common bile duct (CBD), intrahepatic biliary ducts (IBD) and other sites. References were intraoperative anatomical findings.
To evaluate the degree of agreement or "concordance" between ultrasound, CT and surgical data compared in pairs, we used the Kappa coefficient when the variables were qualitative and the Intra class correlation coefficient when the variables were quantitative. A value of 1 indicates a perfect match, a value of 0 indicates that the concordance does not exceed that one random with a correlation called excellent if K is between 1 and 0.81, good if between 0.8 and 0.61, moderate if between 0.6 and 0.21 and bad if between 0.2 and 0.

Results

We included 48 patients with a total of 79 LHCs. Patients average age is 37.7 years. They are young adults between the ages of 20 and 39 in 39.57% of cases and with a sex ratio of 0.5 (32 women and 16 men). The history of liver hydatid cyst (LHC) was found among 5 of our patients (10.4%). Pain in the right hypochondrium was the most frequent sign, found in 33 patients, in 68.75% of cases associated with right hypochondrium mass in 5 patients, fever in 3 patients, jaundice or subicterus in 2 patients and hepatomegaly in 7 patients, 1 of whom had a Budd Chiari syndrome. The clinical examination was unremarkable in 14.6% of the cases. Hydatic serology was positive among 30 patients (85.7%). Two techniques have been used: haemagglutination and Enzyme-Linked-Immuno-Sorbet-Assay (ELISA), with consistent results of both techniques, for each patient benefiting from immunological assessment.

Radiological Data

Ultrasound was performed with 47 of our patients (98% of cases) and it was possible to determine exactly the number of cysts in 39 patients, i.e. 83% of the cases. LHC average size on ultrasound was 7.92 cm, with extremes ranging from 2 to 24 cm. The pericyst was most frequently thin (85.3%).
Abdominal CT was performed for 17 patients (35.4% of cases). This examination was indicated either for the diagnosis of the pseudo-tumor hydatid cyst on ultrasound or for the determination of the exact location and precise extension of large LHCs. CT was also performed as part of the investigation of polycystic liver disease. Some complications have necessitated the practice of CT, in particular the opening of LHC in the bile ducts or the compression of the adjacent vascular structures. The average LHC size at CT was 8.67 cm. The pericyst at CT was most frequently thin (77.8%).
Liver MRI was performed for two patients only, i.e. 4.2% of cases, preceded by CT for one patient. It has been indicated for one case in the context of the exploration of a pseudo-tumor cyst and in the other case as an assessment of the extension of a hc of the myocardium.

Intraoperative Data

Surgery remains the basis of treatment for hydatid disease. Regardless of the seat, the surgery objectives are the elimination of the parasite, the treatment of the residual cavity and the management of any complications.
The number of cysts diagnosed intraoperatively among 48 patients was 79. The cyst was unique in 30 patients (62.5%), double in 7 patients (14.6%), triple in 6 patients (12.5%), 8 in 1 patient (2.1%) and 9 in 1 patient (2.1%).
The type of cysts, in intraoperative, according to the GHARBI classification, was variable with a type III predominance in 41.8% of the cases. Four cysts, i.e. 5.06% of the cases, were infected intraoperatively, one of type I, one of type III and two of type IV. None of these cysts had clinical, biological or radiological translation. The average size of LHCs per operatively is 7.23 cm,

Table I - *Intraoperative data on the type and location of hepatic hydatid cysts.*

		Intraoperative
Number of cysts		79
Type (Gharbi)	I	26
	II	5
	III	33
	IV	15
	V	0
Seat	Right liver	33
	Left liver	35
	Dome	28

Table II - *Intraoperative data on the pericyst, relationships with vascular and biliary.*

		Intraoperative
Number of cysts identified	79	
Pericyst	Thin	82.2%
	Hard	8.9%
	Calcified	8.9%
Vascular relationships	IVC	10
	HV	8
	HPV	6
Relationships with bile ducts	IEBD relationships	18
	Biliary Fistula	15

with extremes ranging from 1 to 20 cm. In intraoperative, 35 cysts were located in the left liver, i.e. 44.3% of LHCs, against 33 cysts in the right liver, i.e. 41.77% of LHCs. Localization at the dome was noted in 35.44% of the cases (Table I).
Intraoperative pericyst was most frequently flexible in 82.2% of cases, otherwise calcified in 8.9% or thick in 8.9%. Ten cysts were related to intraoperative IVC, with compression in 4 cysts. Eight cysts were related to intraoperative HV, 2 cysts of reflux type, and 2 other cysts of compression type with Budd Chiari syndrome found in one patient. Six cysts were related to intraperitoneal HPV, reflux type for 2 cysts with a portal cavernoma found in one patient, and compression type for the remaining 4 cysts.18 cysts had a relationship with intraoperative intrahepatic or extrahepatic bile ducts, of which 15 cysts were fistulized in the Intrahepatic Bile Ducts (IBD) (Table II).

Imaging. Intraoperative Correlation

We have evaluated statistically by calculating the coefficient K or intraclass correlation coefficient, the agreement between ultrasound, computed tomography (CT) and intraoperative findings related to the study of LHC characteristics (number, size, pericyst, relationships with neighboring vascular structures (IVC, HV, HPV) and bile ducts). The condition of the remaining hepatic parenchyma, gallbladder, CBD and IBD has been studied and other locations have been investigated.

Ultrasound correlation and intraoperative finding

The ultrasound aspects are very variable, and are related to the modification of intracystic pressure, the activity of proligerous membrane and the reshaping of pericyst. These aspects have been the subject of 20 classifications. GHARBI classification is used in our series. This study found a good echo-surgical correlation (K = 0.73) for LHC study.
Ultrasound also allows a relatively accurate assessment of HC dimensions and HC segmental topography, which leads to an excellent echo-surgical correlation (K = 0.92 and K = 0.90 respectively). However, for large HC, it is difficult to specify the starting point. Echo-surgical correlation was excellent in vascular relationship with a study of IVC (K = 0.94), HV (K = 1) and HPV (K = 0.92). However, this correlation was moderate (K = 0.37) in the study of relationships with the biliary duct. IBDs are usually not seen in ultrasound unless they are dilated realizing a double gun-barrel aspect. We found a good echo-surgical correlation (K = 0.65) in IBD status study (Table III).

The study concludes that the agreement between ultrasound and surgery is excellent in the study of the number, size, seat and pericyst of LHC, relationships with IVC, HV and HPV and the state of CBD. Ultrasound also allows us to have a good study of LHC type and IBD state. But, it gives an insufficient idea about the remaining liver, the relationships of the LHC with the bile ducts and the search for other locations and it does not allow to reveal the biliary fistula.

Table III - *Correlation between Ultrasonography and intraoperative findings on the different characteristics of hepatic hydatid cyst.*

	Coefficient K or coefficient of intra-class echo-intraoperative correlation
LHC Number	0.90
LHC Type	0.73
LHC Size	0.92
LHC Seat	0.90
Pericyst	0.86
Remaining Liver	0.35
Relationship with IVC	0.94
Relationship with HV	1
Relationship with HPV	0.92
Relationship with bile ducts	0.37
Biliary Fistula	0.2
CBD	1
IBD	0.65
Vesicular Lithiasis	1
Other Locations	0.48

Computed tomography correlation and intraoperative findings

CT makes it possible to specify HCs morphology and in particular their univesicular or multivesicular character, their sizes, their topographies and their calcifications. This is the most sensitive examination for early detection of calcifications.
CT also allows us to study cyst ratios with vessels and neighboring organs, the number of HCs in case of multiple hydatidosis and the remaining hepatic parenchyma. Our study found an excellent scanner-surgical correlation in the study of IVC and HV ratios (K = 1). The correlation between HPV (K = 0.78), CBD and IBD (K = 0.64 and K = 0.68) was good in relation with the vascular and biliary ratio of HC. However, this correlation was moderate in the cystic fistula study (K = 0.44) and the remaining liver study (K = 0.60) and was weak in the pericyst study (K = 0.16) (Table IV).

It is also concluded that the agreement between CT and surgery is excellent in the study of the number, size and seat of LHC, relationship with IVC and HV, LHC-type study, relationships with HPV and biliary ducts, CBD and IBD and search for other locations. However, it is limited in the study of the remaining liver, in highlighting biliary fistula and in the study of pericyst.

TABLE IV - *Correlation between computed tomography and intraoperative findings on the different characteristics of hepatic hydatid cyst.*

	K coefficient or intra-class correlation coefficient of CT-intraoperative
LHC Number	0,95
LHC Type	0,73
LHC Size	0,95
LHC Seat	1
Pericyst	0,16
Remaining Liver	0,60
Relationship with IVC	1
Relationship with HV	1
Relationship with HPV	0,78
Relationship with bile ducts	0,63
Biliary Fistula	0,44
CBD	0,64
IBD	0,68
Other Locations	0,77

Comparison of ultrasound-surgical and scanner-surgical correlations

By comparing the kappa coefficients or the ultrasound-surgical and scanner-surgical intra-class correlation coefficients in order to deduce the ultrasound-scanner-surgical correlation, there is a superiority for ultrasound in the analysis of endokytic hydrostatic debris and vesicles daughters and also in the analysis of the cyst wall and the pericyst where the scanner-surgical corroboration was bad (K = 0.16) whereas the ultrasound-surgical correlation was excellent (K = 0.86). However, the study of cystic features of the pericyst remains limited by these two examinations.

As for cyst relationships with vessels, CT is slightly better than ultrasound in the study of IVC relationships (K = 1 vs K = 0.94), which is also good for studying the relationships with the HV (K = 1) and less effective for the study of HPV relationships (K = 0.78 vs K = 0.92).

In the study of common biliary duct, ultrasound allows us to better explore it with comparison to CT (K = 1 vs K = 0.64) whereas they are of the same performance in the study of the state of the VBIH. For the study of HC relationship with biliary ducts, CT showed superiority (K = 0.63 vs K = 0.37), but these two examinations are limited in the identification of biliary fistula despite a slight superiority of CT (K = 0.44) comparing to ultrasound (K = 0.2). There was also a clear superiority of CT in the remaining liver (K = 0.6 vs K = 0.35) and disease diffusion (K = 0.77 vs K = 0.48) (Table V).

It was concluded that ultrasound performs better than CT in the study of LHC, pericyst, HPV and CBD, while CT is better than ultrasound in the study of LHCs number, size, seat, of the remaining liver, the relationship with the IVC and the study of other locations. Ultrasound and CT have the same study performance of the relations with HV. However, both examinations remain limited in the determination of pericyst characteristics and the identification of biliary fistulas.

Discussion

Human hydatidosis is endemic in temperate grazing areas. The Mediterranean region and in particular the Maghreb countries represent one of the largest centers of hydatidosis in the world [1,2].

The comparison of ultrasound and CT shows the superiority of ultrasound in the analysis of the cystic wall [3,4]. However, for the study of different characteristics of the pericyst concerning thickness and appearance, the

TABLE V - *Correlation between Ultrasonography, computed tomography and intraoperative findings on the different characteristics of hepatic hydatid cyst.*

	Coefficient K or coefficient of intra-class echo-intraoperative correlation	K coefficient or intraclass correlation coefficient CT-intraoperative
LHC Number	0,90	0,95
LHC Type	0,73	0,73
LHC Size	0,92	0,95
LHC Seat	0,90	1
Pericyst	0,86	0,16
Remaining Liver	0,35	0,60
Relationship with IVC	0,94	1
Relationship with HV	1	1
Relationship with HPV	0,92	0,78
Relationship with bile ducts	0,37	0,63
Biliary Fistula	0,2	0,44
CBD	1	0,64
IBD	0,65	0,68
Other Locations	0,48	0,77

two examinations are still limited. MRI is effective for the analysis of intrahepatic and extrahepatic venous system and for a better study of the pericyst [5,6].

HC complications are multiple and very common when increasing their size due to intimate relationships with the bile ducts and intrahepatic structures. The complications are dominated by superinfection and rupture as well as compression which accompanies especially large cysts.

Radiologically speaking, superinfection is not always obvious. Ultrasound is often not very contributory. It can show a HC with heterogeneous content and having blurred boundaries [7]. CT is suggestive of the diagnosis when it reveals a dense and heterogeneous content of HC dotted with small gaseous images or a thick cystic wall spontaneously hypodense and with blurred limits that can be enhanced after contrast ; whereas at MRI, the infected cyst defined by a very high signal in T2 of hydatic content which represents a more characteristic sign showing the superiority of MRI compared to CT [6]. In fact, the diagnosis of certainty of cystic superinfection can only be confirmed by examining the content of the cyst collected during the operation. In our series, 4 cysts (5.06%) were infected, the diagnosis was carried out only by surgery.

The compression of hepatic parenchyma, intrahepatic and extrahepatic bile ducts and intrahepatic or perihepatic vascular structures (portal trunk and its dividing branches, hepatic veins and inferior vena cava), under the effect of the pressure transmitted by the HC, is inevitable during cyst expansion. This compression is often demonstrated easily by morphological examinations. The ultrasound coupled with Doppler allows to analyze the different types of compression. In case of large cysts, CT and MRI are the best choice of intraoperative examinations to study this type of complication [8].

The opening of LHC in the biliary duct is more frequent with type III and IV of HC. It is objectified by ultrasound in 45 to 75% of the cases. It results in a collapsed aspect of the cyst, dilation of IBD and / or EBD, the presence of hydatid material in the biliary duct, and the presence of communication between the cyst and biliary duct. The complete ultrasound table containing all these signs is only found in 25% of cases. The presence of hydatic debris in the bile ducts, which is the only direct sign of rupture, is found in 25 to 66% of cases. The cyst-biliary communication is inconstantly identified because its highlighting depends on its width and its situation as well as the size of the cyst [9]. In CT, the opening of LHC in the biliary ducts can be confirmed in 77% of the cases. It is most often suspected in front of dilated bile ducts and a collapsed aspect of HC. Intracanal hydatid debris are often less obvious than in ultrasound and result in a dense bile duct content [9,10] MRI allows the diagnosis of LHC rupture in the bile duct with an estimated sensitivity of 91.7% and a specificity of 82.2% [11]. The discovery of communication between hydatid cyst and biliary duct is determined by the presence of a set of direct signs such as the visualization of the communication between the cyst and the bile duct or the parietal defect of the cyst visible on T2 weighted sequences, and indirect signs such as the deformation of cyst contours and its MRI signal and the dilation of IBD [12]. Thus, the question is raised about the role of hepatic MRI and intraoperative ultrasound in the study of cysto-biliary fistulas, especially in view of presence of liver function disturbance and the need to integrate them into standard checkup of hydatic disease to better characterize the hydatic cyst. It was concluded that, advances in medical imaging have greatly facilitated the diagnosis of liver hydatid cyst as well as its complications for a high quality pre-therapeutic evaluation. Ultrasound is the method to chose for the diagnosis of hepatic hydatidosis. CT is indicated as a second-line diagnosis for ultrasound diagnosis, especially in the case of HC of type IV or large or multiple HC. However, these two exams cannot provide precise data concerning the study of pericyst and bilio-cystic fistula hence the need to make prospective studies about the place of MRI and the intraoperative ultrasound in this area.

Riassunto

Il fegato rappresenta la più frequente sede di localizzazione delle cisti idatidee, e le modalità diagnostiche per immagini sono attualmente numerose e sempre più efficienti. Lo scopo di questo studio è quello di precisare i rapporti tra ecografia e CT da una parte, e reperti intraoperatori delle differenti caratteristiche delle cisti idatidee dall'altra.

Si tratta di uno studio prospettico che include tutte le cisti idatidee epatiche operate nel 2015, valutando statisticamente, mediante il calcolo del coefficiente K o di quello della correlazione tra classi, la concordanza tra US, CT e reperti intraoperatori riguardo alle differenti caratteristiche della cisti idatidea.

Lo studio ha incluso 48 pazienti con complessive 79 cisti idatidee epatiche. Si è conlcuso che l'ultrasonografia è più efficiente della CT per quanto riguarda il tipo di cisti, del pericistio, la relazione con la vena porta e l'epatocoledoco. Mentre la CT è migliore dell'ecografia per quanto riguarda numero e localizzazione delle citi, ed i rapporti con la vena cava inferiore, le altre localizzazioni ed il restante parenchima epatico, entrambe le metodiche restano limitate nei confronti delle caratteristiche del pericistio e l'identificazione delle fistole biliari.

Di qui l'esigenza di studi prospettici sul ruolo della RMN e dell'ecografia intraepatica per fornire dati accurati anche riguardo queste caratteristiche.

References

1. A. Zaouche KH: *Traitement chirurgical des kystes hydatiques du foie*. Techniques chirurgicales. Appareil digestif, 2006; 40:775.

2. Gharbi HA CF, Moussa N, Beelegha I, Ben Amor N, Hammou A, et al.: K*yste hydatique du foie*. Gastroenterol Clin Biol, 1995 19:110-18.

3. F Klotz XN, Debonne JM, Garcia JF, Andreu JM: *Kystes hydatiques du foie.* Encyclopédie Médico-Chirurgicale, 2000; 7-023-A-10.

4. Suwan Z: *Sonographic findings in hydatid disease of the liver: Comparison with other imaging methods*. Annals of tropical medicine and parasitology, 1995; 89(3):261-69.

5. Marti-Bonmati L, Menor Serrano F: *Complications of hepatic hydatid cysts: ultrasound, computed tomography, and magnetic resonance diagnosis.* Gastrointestinal radiolog, 1990; 15(2):119-25.

6. Taourel P, Marty-Ane B, Charasset S, Mattei M, Devred P, Bruel JM: *Hydatid cyst of the liver: comparison of CT and MRI.* Journal of computer assisted tomography, 1993; 17(1):80-5.

7. Bouhaouala MH HL: *Imagerie de la maladie hydatique.* Centre de publication universitaire, 2005; 264.

8. Bouassida SS, Mighri MM, Laajili A, Chebbi F, et al.: *Les complications pariétales du kyste hydatique du foie. À propos de deux cas en Tunisie*. Bull Soc Pathol Exot, 2012; 105:259-61.

9. Malik AA, Bari SU, Amin R, Jan M: *Surgical management of complicated hydatid cysts of the liv*er. World journal of gastrointestinal surgery, 2010; 2(3):78-84.

10. Mountassir Moujahid MTT: *Les kystes hydatiques du foie rompus dans les voies biliaires: A propos de 120 cas*. Pan African Medical Journa, 2011; 10:43.

11. Adaletli I, Yilmaz S, Cakir Y, Kervancioglu R, Bayram M: *Fistulous communication between a hepatic hydatid cyst and the gallbladder: diagnosis with MR cholangiopancreatography.* AJR American journal of roentgenology, 2005; 185(5):1211-213.

12. Erden A, Ormeci N, Fitoz S, Erden I, Tanju S, Genc Y: *Intrabiliary rupture of hepatic hydatid cysts: diagnostic accuracy of MR cholangiopancreatography.* AJR American journal of roentgenology. 2007; 189(2):W84-9.