ASSESSMENT OF THE ACCURACY OF PREOPERATIVE IMAGING METHODS IN THE DIAGNOSIS OF HEPATIC SINGLE-CHAMBER ECHINOCOCCOSIS

JOANNA HOŁODY-ZAREBA¹, KONRAD PIOTR ZAREBA², BOGUSŁAW KĘDRA²

Department of Gynecology and Obstetrics J. Śniadecki Memorial Voivodship Hospital in Białystok¹
Kierownik: prof. dr hab. M. Kinalska

2nd Chair and Department of General and Gastroenterological Surgery, Medical University in Białystok²
Kierownik: prof. dr hab. B. Kędra

Echinococcosis is an infectious disease, caused by larval stages of cestode species of the genus Echinococcus. The course of the disease is determined on the basis of the location and larval size. In 80-95% of cases echinococcosis is located in the liver and lungs, rarely in the brain. Symptoms are usually uncharacteristic for an uncomplicated disease. The diagnosis of echinococcosis is based on imaging and immunodiagnostic tests.

The aim of the study was to assess the accuracy of preoperative imaging methods in the diagnosis of hepatic single-chamber echinococcosis.

Material and methods. Amongst the 110 patients with hepatic cysts diagnosed during the period between 2000 and 2009, a group of 30 subjects with suspicion of single-chamber echinococcosis (ultrasound and CT) was isolated. The imaging methods visualized structures typical for hydatid cysts: the mother cyst with satellite cysts called “honeycomb appearance”, cysts with calcified walls and compartments, and endocyst separation called “water lily-sign”. The study group comprised 22 female and 8 male patients with an average age of 52±16.2 years. The histopathological examination of the excised cyst verified the diagnosis.

Results. Single-chamber echinococcosis was finally recognized in 19 cases, while in the 11 remaining cases the parasitic disease was excluded. The sensitivity of imaging methods was estimated at 73.7%, specificity – 88.9%, negative predictive value – 61.5%, positive predictive value – 93.3%, Youden’s factor – 0.626, and Φ index – 0.586.

Conclusions. In conclusion, the presence of an unilocular cyst with an uniform anechoic content can be a simple cyst or single-chamber echinococcus cyst. The typical, characteristic image of a hydatid cyst, such as the “water lily-sign” is rarely observed during imaging examinations. It has also been shown that cystic calcification, observed during ultrasonography and computed tomography was evidence of the parasitic character of the lesion.

Key words: single-chamber echinococcosis, ultrasonography, computed tomography

Echinococcosis is an infectious, zoonotic disease that is caused by the invasion of the larval form of Echinococcus (Taeniidae family), belonging to the Echinococcus genus. In order to close the life cycle the Echinococcus needs a definitive host. It is most commonly a carnivorous mammal, in which the mature form develops in the intestine, being capable of sexual reproduction in the intermediate host. The intermediate host is usually a herbivorous or omnivorous mammal (the human being is a contingent host), being infected after the consumption of invasive eggs. The hydatid disease may be caused by a single-chamber echinococcus – Echinococcus granulosus, multichamber echinococcus – Echinococcus multilocularis, polycyclic echinococcus – Echinococcus vogeli, and Echinococcus oligarthrus
(the latter two are not observed in Poland) (1, 2, 3). In Poland, hydatid disease is rarely observed. Most vulnerable to Echinococcus granulosus infection are the inhabitants of Podlasie. The course of the disease depends on the location and size of larvae. In 80-95% of cases echinococcosis is located in the liver and lungs, more rarely in the brain. There are no typical symptoms characteristic for uncomplicated echinococcosis (3, 4). Diagnosis is based on additional examinations. Imaging examinations such as ultrasonography, CT, and X-rays are significant, considering diagnosis (5). Serological tests are equally important in the diagnostics of echinococcosis. Direct hemagglutination and immunoenzymatic tests enable to detect anti-echinococcus IgG antibodies (3, 6).

The aim of the study was to assess the accuracy of preoperative imaging methods (ultrasonography and computer tomography) in the diagnosis of hepatic, single-chamber echinococcosis, considering patients subjected to surgical intervention, due to the presence of liver cysts. Final diagnosis was based on the histopathological result of the surgical material.

MATERIAL AND METHODS

The study patients were subjected to surgical intervention at the II Chair and Department of General and Gastroenterological Surgery, Medical University in Białystok.

Amongst the 110 patients with hepatic cysts diagnosed during the period between 2000 and 2009, a group of 30 subjects with suspicion of single-chamber echinococcosis (ultrasound and CT) was isolated. The imaging methods visualized structures typical for hydatid cysts: the mother cyst with satellite cysts called "honeycomb appearance", cysts with calcified walls and compartments, and endocyst separation called the "water lily-sign". The histopathological examination confirmed the above-mentioned diagnosis.

The study group comprised 22 female and 8 male patients (F: M =2.75:1), average age amounting to 52±16.2 years. Female patients accounted for 73.3%, while men – 26.7%. The mean female patient age was 53.1 years, while that of men – 49.3 years. Half of the population lived in the city, while the remaining half in the country. Imaging methods were performed at the Department of Radiology, University Clinical Hospital in Białystok. Ultrasound examinations were performed by means of the USG SSA 550A (Toshiba) apparatus, while CT-Aquilion 16 TSX (Toshiba). During the ultrasound examination attention was drawn to the number, location, size, and morphological features of the hepatic lesion that could speak in favor of echinococcosis (honeycomb appearance, cysts with calcified walls and compartments, endocyst separation — "water lily-sign"). The widespread and very popular Gharpi's classification was used, derived from the early eighties of the XX century, which distinguished the following features of single-chamber echinococcosis: 1) a well-demarcated cyst with a thick wall and anechoic area inside - image might correspond to a young hydatid cyst; 2) a well-demarcated cyst comprising hypoechogenic content, visible wall dissection-endocyst separation; 3) the "honeycomb appearance"; 4) irregular cyst with areas of different echogenicity, which correspond to infected polycystic lesions; 5) hyperechogenic cyst, partially or completely calcified (7).

Considering patients in whom the ultrasound image suggested the presence of single-chamber echinococcosis, abdominal CT was additionally performed. The above-mentioned is associated with the fact that computer tomography enables to visualize the contents of the cyst, the septae, liver parenchyma, and bile ducts. During abdominal CT the single-chamber cystic wall is usually hyperdense, often calcified (50%), the content of the cyst is similar to the density of water. One may often view the presence of sand inside the echinococcus cyst. The cyst is location to progeny cysts, which are separated by the cystic matrix-the “spoked wheel” sign (8, 9, 10). Figure 1 showed the hepatic echinococcus cyst on ultrasound. Figure 2 showed the hepatic single-chamber echinococcus cyst on abdominal CT.

The obtained results were subjected to statistical analysis on the basis of the STATISTICA 9.0 program. Fisher's test was used for assessment (p < 0.05 was considered as statistically significant, and the following indicators of diagnostic accuracy were determined: sensitivity, specificity, negative and positive predictive values, Φ index (value 0.1-0.3 – poor effect; 0.3-0.5 – average effect; > 0.5 – significant effect), and Youden's coefficient.
RESULTS

Based on the histopathological results single-chamber echinococcosis was diagnosed in 19 cases. In the remaining 11 patients suspicion of echinococcosis was not confirmed by histopathology. Nine patients were diagnosed with a simple hepatic cyst, while two with neoplastic disease (HCC and FHNC). Fifteen patients were diagnosed with characteristic, imaging examination, single-chamber echinococcosis features, such as capsular calcification. In only one of these patients the histopathological examination did not confirm echinococcosis presence, but only a simple cyst. A statistically significant difference in the accuracy of diagnosis was confirmed (p= 0.002), considering patients with calcification’s, as compared to those without. The diagnostic accuracy in case of calcification presence was assessed on the basis of sensitivity, estimated at 73.7%, specificity – 88.9%, NPV – 61.5%, PPV – 93.3%, Youden’s coefficient- 0.626, and Φ index – 0.586. The initial classification of liver cysts, based on abdominal imaging examinations determining the presence of calcification’s, the false negative ratio amounted to 21.4. Table 1 showed the dependency between the presence of calcification’s and final diagnosis, while tab. 2, diagnostic accuracy values during initial diagnosis of single-chamber liver echinococcosis. In 12 cases a well-demarcated cyst with anechoic content was observed during imaging examinations.

Considering the above-mentioned group the histopathological examination confirmed the presence of simple hepatic cysts in 8 patients, and single-chamber echinococcosis in the remaining four. A statistically significant difference was observed (p=0.009). Table 3 showed the dependency between a well-demarcated, anechoic cyst and final histopathological diag-

Table 1. Dependency between the presence of calcification’s on abdominal imaging examinations (ultrasound and CT) and final histopathological results

<table>
<thead>
<tr>
<th>ZCalcifications on imaging examinations</th>
<th>Histopathological result - echinococcus presence</th>
<th>Total</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(+)</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>Absence</td>
<td>5 (33,3%)</td>
<td>10 (66,7%)</td>
<td>15 (100%)</td>
</tr>
<tr>
<td>Presence</td>
<td>14 (93,3%)</td>
<td>1 (6,7%)</td>
<td>15 (100%)</td>
</tr>
<tr>
<td>Total</td>
<td>19 (63,3%)</td>
<td>11 (36,7%)</td>
<td>30 (100%)</td>
</tr>
</tbody>
</table>

Table 2. Diagnostic accuracy of imaging methods considering calcification presence in the diagnosis of echinococcosis, in relationship to final histopathological results

<table>
<thead>
<tr>
<th>Imaging methods (ultrasound, CT)</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>NPV</th>
<th>PPV</th>
<th>Youden’s coefficient</th>
<th>Φ</th>
<th>% false negative diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>73,7%</td>
<td>88,9%</td>
<td>61,5%</td>
<td>93,3%</td>
<td>0,626</td>
<td>0,586</td>
<td>21,4%</td>
</tr>
</tbody>
</table>
nosis. In one case the authors observed the presence of a "water-lily" sign, being evidence of endocystic dissection, which was confirmed by means of histopathology. In two cases the detected lesions were heterogenous, solid, difficult to differentiate between single-chamber echinococcosis and a tumor. The histopathological examination was as follows: one patient was diagnosed with HCC, while one with FHNC.

**DISCUSSION**

Echinococcosis remains one of the most important parasitic diseases in humans. The widespread of this disease throughout the world and increasing incidence of new cases brings about substantial losses, not only associated with the human health and life, but also economical losses (11, 12, 13). Therefore, it is very important to draw attention of the entire medical community to such an important problem, as the diagnosis and treatment of echinococcosis. The issue that has been addressed in this study was the imaging diagnostics of the lesion suspected of single-chamber echinococcosis. It turned out that the imaging diagnostic process is difficult and complex. Hepatic single-chamber echinococcosis requires differential diagnostics including benign lesions, such as hepatic cysts, as well as benign and malignant neoplastic lesions.

There exist many ultrasound classifications. Especially the classification proposed by Gharpi has been widely accepted (7). In 2003, the WHO proposed a six-staged international ultrasound classification of hepatic single-chamber echinococcosis, in order to unify the diagnostic criteria. The novel ultrasound classification distinguishes the following echinococcosis cysts: early, infertile (CL), active and proliferating (CE1), mostly fertile (CE2), those with damaged endocysts (CE3), or spontaneously degenerating when the cystic fluid is replaced by necrotic masses (CE4), and the echinococcosis cystic wall is subjected to calcification (CE5) (14, 15). Despite the constant changes in the ultrasound classification of cysts suspected of echinococcosis, improvement and attempts to search for objective criteria, which would enable initial, hepatic, single-chamber echinococcosis diagnosis, imaging diagnostics remains imperfect. The image of hepatic single-chamber echinococcosis is dependent of its activity, being important during imaging examinations. When analysing imaging results of hepatic cystic lesions suspected of parasitic etiology, one should consider the diversity of cysts, depending on their activity. Starting with a young, single-chamber echinococcus cyst resembling a non-parasitic simple cyst, through active forms which develop into satellite and transition cysts with endocyst separation, until inactive degenerative cysts with calcification’s. Many Authors underline that abdominal imaging examinations do not allow to distinguish a young, single-chamber echinococcus cyst from a simple hepatic cyst. The image of a well-demarcated cyst and anechoic content might suggest the possibility of a simple hepatic cyst, as well as immature parasitic cyst (16, 17).

Considering our study material comprising 30 patients, 12 were diagnosed with a well-demarcated cyst with anechoic content. Eight of these patients were diagnosed with a simple cyst. In the remaining four patients parasitic cysts were observed.

The above-mentioned results confirmed the conclusion that imaging examinations performed in the early stage of echinococcus cyst development are inconclusive. Similar diagnostic problems may be observed in case of focal hepatic lesions, both benign and malignant, which may resemble cysts. In case of two patients were unable to distinguish the heterogeneous, solid lesion observed on abdominal CT (either echinococcus cyst or tumor). The histopathological examination

<table>
<thead>
<tr>
<th>Well-demarcated cyst with anechoic content</th>
<th>Histopathological result- echinococcus presence</th>
<th>Total</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence</td>
<td>(+) 4 (33,3%)</td>
<td>12 (100%)</td>
<td>0,009</td>
</tr>
<tr>
<td>Absence</td>
<td>(-) 8 (66,7%)</td>
<td>18 (100%)</td>
<td>0,009</td>
</tr>
<tr>
<td>Total</td>
<td>n 19 (63,3%)</td>
<td>30 (100%)</td>
<td>0,009</td>
</tr>
</tbody>
</table>
proved conclusive—one patients was diagnosed with hepatocellular carcinoma, and one with focal nodular hypertrophy of the liver. It turned out that in two consecutive cases imaging examinations rendered impossible the differentiation of hepatic lesions, between neoplastic lesions and parasitic cysts during degeneration. When determining characteristic symptoms of echinococosis only one patient was diagnosed with the “water-lily” sign. An important factor worth noting was the presence of hepatic lesion calcification’s, observed on imaging examinations. The presence of the above-mentioned might be evidence of the degeneration of the single-chamber echinococcus cyst. Considering study group patients with parietal and capsular calcification’s, 93.3% of histopathological results confirmed single-chamber echinococcosis.

When determining imaging results of hepatic lesions one may come to the conclusion that degenerative single-chamber echinococcosis cysts are most commonly observed with calcification’s, rendering possible initial diagnosis. When evaluating the accuracy of imaging examinations in the diagnosis of single-chamber echinococcus cysts, the presence of calcification’s enables to initially suspect the possibility of parasitic disease. The percentage of false-positive single-chamber echinococcosis results, based on calcification presence amounted to 21.4%. According to Caremani et al., imaging methods were characterized by a sensitivity estimated at 93-98%, and specificity at 88-90% in case of single-chamber echinococcosis. In our study, sensitivity was estimated at 73.7%, specificity at 88.9%, Youden’s coefficient at 0.626, and the Φ index- 0.586 (its value indicates the high accuracy of the study) (>0.5).

CONCLUSIONS

Based on study results evaluating the accuracy of diagnostic methods, being evidence of single-chamber echinococcosis presence the following were observed:
1) parietal and capsular calcification’s observed on imaging examinations are evidence of the parasitic etiology of the cyst,
2) a well-demarcated cyst with anechoic content might be evidence of a simple hepatic cyst or immature, single-chamber echinococcus cyst,
3) the typical “water-lily” sign (endocyst separation) is rarely observed in imaging studies.

REFERENCES


Received: 28.10.2013 r.
Adress correspondence: 15-276 Białystok, ul. M. Skłodowskiej-Curie 24A
e-mail: nikt00@gazeta.pl