REVIEW

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Ovarian hydatid cyst – systematic review of clinicopathological and immunohistochemical characteristics of an unusual entity

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Abstract

Primary ovarian hydatid disease (HD) is a rare entity, produced by the larval stage of *Echinococcus granulosus*. HD commonly involves liver, lung, abdomen cavity, spleen and is unusually identified in pelvic organs. Based on our knowledge, the paper reviews 27 literature reports of ovarian HD, diagnosed during the last 20 years, providing a valuable database. Patients' ages ranged between 12–76 years, the gross appearance was that of 40–330 mm diameter hydatid cysts (HCs), 66.66% of them being primary. According to these reports, ovarian HD has non-specific clinical manifestations, such as abdominal or pelvic pain, nausea, dysmenorrhea or amenorrhea. The diagnosis may be achieved by abdominal ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI), serological exams, such as eosinophilia (in 10–30% of patients) or indirect hemagglutination and immunoglobulin (IgG) antibodies detection. Ovarian HC microscopic pattern is characterized by three layers: pericyst or adventitia (host origin), germinal layer (endocyst), and laminated membrane (ectocyst). The immunoreaction triggered by parasites is initially rich in macrophages and neutrophils, followed by eosinophils and lymphocytes, with numerous cluster of differentiation 8 (CD8)-positive T-cells in active lesions and progressive forms. Concomitant ovarian diseases are relatively rare, being represented by borderline tumors (*n*=2 cases), mucinous cystadenoma (*n*=1 case), hemorrhagic cyst (*n*=1 case), and serous adenocarcinoma (*n*=1 case). In conclusion, the ovarian location of HD should be considered in any differential diagnosis of a cystic lesion, while it does not exclude synchronous ovarian tumors. These cases reinforce the necessity of better measures of prophylaxis and screening of HD in endemic areas.

Keywords: ovarian hydatid cyst, hydatid disease, pericyst, endocyst, ectocyst, endemic areas.

Introduction

Ovarian hydatid disease (HD) is a rare, distinct clinical entity with only a few cases reported in literature [1–6]. The most frequent location of primary HD is liver, followed by lung [7]. The renal system or spleen are involved only in 2% of cases [8], while other uncommon locations represent about 10% of cases, according to literature data [8, 9]. These organs can be individually or simultaneously involved [9, 10].

Primary localization of hydatid cyst (HC) in pelvic cavity is extremely unusual, being reported in the range of 0.2–0.9% of cases and increasing to a maximum of 2.25% of cases in endemic areas [1, 11–17]. The incidence of pelvic HC in female genital tract is very rare, with a range of 0.2–4.27% of cases [7, 18–20]. Uterine [21, 22] and Fallopian tube echinococcoses [23, 24] have been rarely reported in literature.

Ovarian involvement by HD is about 0.2–2.25% [2, 5, 8, 9, 18, 25–29]. HD can occur primarily in ovary or, more frequently, in association with liver or lung echinococcosis, or in context of multiorgan hydatidosis, as only rare cases with primary ovarian HC are reported [11, 30–34].

Secondary ovarian HD [7, 35–42] occurs most frequently as a dissemination from a hepatic HC, by hematogenous, lymphatic, or peritoneal spread, due to spontaneous or traumatic cyst rupture [9, 43–45].

The ovary infection by *Echinococcus granulosus* is morphologically similar to other locations and is classified as HD, according to several specific histological findings. This lesion is characterized by the presence of a laminated membrane and of a pericystic inflammatory infiltrate eventually leading to encasement of walls with a thick fibrous tissue.

Sometimes, ovarian tumors diagnosed on the basis of clinical and radiological features may reveal ovarian HC by histopathological examination of the surgical specimen. According to our knowledge, this pathological association is quite rare.

HC etiopathogeny, locations, and clinical course

HC is a parasitic infection (zoonosis) caused by dog tapeworm (the larval stage of a cestode of *Taeniidae* family, *E. granulosus*) [17, 46–49]. Humans can be infested by four *Echinococcus* species: *granulosus*, *multilocularis*, *vogeli*, and *oligarthus* [22, 50]. *E. granulosus* is a 5 mm long worm, with a lifespan of 5–20 years [22, 49, 51, 52] and has a slow growth rate (0.53 cm/year in diameter) [53].

The life cycle of the parasite starts in dog, which is considered as a definitive host [49], while humans can occasionally be intermediate hosts, in cases when the ova

of the parasite are accidentally eaten with food (unwashed vegetables), water, by handling infected soil, or as a result of close contact with pet dogs [4, 54]. Sheep, goats, cattle, horses or swine can be also considered as intermediate hosts [49, 55].

The eggs are released in the feces of infected animals ("dog sheep cycle") [56], where they can resist for many weeks [29, 54]. The embryo, in the form of oncospheres or hexacanth [49, 54] escapes from the ova and penetrates host viscera (mostly the intestinal wall of jejunum) [22, 29, 40]. Afterwards, it enters the portal vessels and frequently reaches the liver (70–75%) [22, 29]. After liver filter, they enter the blood flow or lymphatics, and consequently form different implants [57], especially in lungs (20–30%) [29, 54], where they can grow to form mature larval HD [29, 49, 58].

HC main location is right liver lobe (52–73%) [17], followed by lungs, while other organs, such as spleen, brain, kidney, heart, thyroid, pancreas, breast, muscle, and bone are involved in approximate 10% of cases [20, 57, 59, 60]. However, some occasional locations are also reported in literature, such as subcutaneous tissue [61], axilla [60], spinal cord [62, 63], paranasal sinuses [64], orbits [65, 66], and ovaries [20].

HD is a chronic disease, with the first symptoms becoming apparent many years after contamination. Sometimes, it may take decades before a diagnosis is made [48]. Accordingly, *World Health Organization* (WHO) classifies HD into three types: active, inactive, and transition type [67].

HC epidemiology

HD has a high worldwide prevalence, almost 2 000 000–3 000 000 human cases of echinococcosis being registered in endemic regions, such as Eastern Europe, Mediterranean region (Lebanon and Greece), Australia, Argentina, Chile, Peru, Brazil, Northern China, Africa, Middle East, and New Zealand [7, 8, 17, 43, 47, 53, 68–70]. Infection with *E. granulosus* is estimated in a *WHO* study to be about 2–6% in endemic populations [71] and as high as 9.1%, in central Peruvian Andes [72].

The annual echinococcosis incidence has a variable range of $<1\times10^5$ – $>8\times10^5$ people [73], in endemic areas situated in the Mediterranean region (Greece, Bulgaria, Turkey, Spain, and Sardinia) [43, 60]. A high ovarian HD incidence has been also reported in other countries, such as Saudi Arabia [2], Ethiopia [1], India [3, 10, 32], Iran [50, 74], and Tunisia [33].

The literature data about the endemic status of HD in Romania is extremely scarce. Only 10 articles have been identified in literature, between 1978 and 2013, reporting this parasitic disease. Specific Romanian regions, such as Banat and Danube Delta [75, 76], along with the south-eastern part of the country are recognized as endemic regions, mainly of cystic echinococcosis [77–79], with an annual incidence of 5.6/100 000 population [80].

The active transmission of the parasite in Western Romania has been demonstrated by the high incidence of cystic echinococcosis in children, especially in cerebral and abdominal location, most of them originating from rural areas [77, 81].

A high incidence of children hydatidosis has been also reported in Northeastern Romania (Iaşi County), with a prevalence of 194 cases in four years, between 2008 and 2012 [82], compared to 448 HC cases identified in 30 years, in 1947–1977 [83]. Considering the high incidence in pediatric population, it seems that HD is mostly acquired during childhood.

Ovarian HC

Ovarian HD or echinococcosis is usually secondary to rupture or spillage of liver HC into the peritoneal cavity and dissemination to the pelvic organs [84].

The extensive search of well documented ovarian HC in English written publications, available in the international databases, for 20 years, between 2000 and 2019, identified 27 cases, from which 18 (66.66%) cases were primary and nine (33.33%) cases were secondary, with patients' age range between 12 and 76 years old (Table 1). The majority of cases have been reported in countries known as endemic zones, such as India, Iran, and Turkey. A single case has been diagnosed in a non-endemic Chinese region (Lijiang, Yunnan province, in southwestern part of China), but involved a patient who had business trips to endemic regions (Sichuan and Guangxi provinces, in south-central part of China) [34].

Generally, ovarian hydatidosis is asymptomatic for years because the natural evolution of the disease is slow [85]. This becomes symptomatic in superimposed infection, or in the case of cyst rupture, or as a consequence of cyst compression on the neighboring organs or tissues [17]. Hydatidosis may rarely cause death due to anaphylactic shock determined by spontaneous or traumatic rupture of the cyst [44, 86, 87].

The ovarian HD determines vague abdominal or pelvic pain, nausea, dysmenorrhea, amenorrhea, and other symptoms related to neighboring organs (urinary bladder, rectum, vessels, and ureters) compression [86, 87], along with pyrosis, anorexia, and abdominal distension [88].

The ultrasound exam orientates the diagnosis of HD as a well-delimited structure, avascular or with peripheral vascularization [4]. The abdominal ultrasound is an accessible, noninvasive screening and diagnosis method. This is performed by repetitive examinations mainly in liver hydatidosis, in endemic areas or in risk groups (rural population or professional exposure to parasite due to frequent animal contact, such as farmers, butchers, and veterinary doctors) [89].

The first ultrasonographic classification of HC has been proposed in 1981, based on five stages, from simple cyst or univesicular fluid collection, with well delimited, evident wall (stage I) to solid calcified cystic wall (stage V) [90]. A new imagistic classification of HC, based on its natural evolution, has been proposed in 2001 [91]. This is initially showing the appearance of a simple, undifferentiated cyst, analogous to other etiologies, such as congenital or tumoral, and consequently named as "cystic lesion". In evolution, the protoscoleces identification by ultrasonography is characteristic for type 1 and 2 of the disease [91]. HC type 3 is showing altered integrity of the cyst due to host response or to the anti-parasitic therapy, being labeled as transitional stage [91]. The last two types, 4 and 5, are inactive or degenerated forms of the parasite [91].

Table 1 – ***Review of ovarian HC reports***

Case No.	Type	Age [years]	Symptoms & signs	Serum tests	Imaging	Cyst size [mm]	Surgical approach	Other locations & associated diseases	ABZ therapy	Risk factors	EO count	Country	Ref
1.	P	70	abdominal distension	IHA -	US & CT	100/100/55	total cystectomy	–	NA	NA	N	Kingdom of Saudi Arabia	[2]
2.	P	12	abdominal pain & symptoms of urinary obstruction	NA	US & CT	40/60	cyst enucleation	–	pre-op and post-op	NA	icd	India	[3]
3.	P	56	stomach ache & abdominal distension	IHA +	US & CT	60/45	hysterectomy & bilateral SOE	–	post-op	cattle farm worker	N	Turkey	[4]
4.	S	24	pelvic discomfort	IHA +	US & MRI	90/100	total cystectomy	liver HC; left ovarian borderline serous cystadenoma	pre-op	NA	NA	India	[6]
5.	S	76	pelvic mass	IHA -	CT	68/62	partial cystectomy & hysterectomy	liver HC	NA	NA	N	Italy	[7]
6.	P	30	abdominal distension	NA	US	NA	total cystectomy	–	NA	NA	N	India	[10]
7.	P	36	NA	NA	NA	NA	left SOE	–	NA	NA	NA	Turkey	[16]
8.	P	55	post-menopausal metrorrhagia	NA	US & MRI	100/95	hysterectomy & right OE	hypothyroidism	post-op	rural area	N	Spain	[17]
9.	S	30	abdominal pain	NA	US	80/40	total cystectomy	liver HC; right ovarian hemorrhagic cyst	NA	NA	NA	India	[20]
10.	P	64	chronic pelvic pain	NA	US	10/70/5	hysterectomy & bilateral SOE	–	post-op	NA	N	Bulgaria	[27]
11.	P	48	abdominal distension & pain	NA	US & CT	65	hysterectomy & bilateral SOE	pararectal HC	post-op	sheep farm worker	NA	Turkey	[30]
12.	P	25	fever & abdominal pain	NA	US	80/60/40	SOE	NA	post-op	NA	icd	India	[31]
13.	P	55	abdominal pain	NA	US	40	left OE	–	NA	NA	NA	India	[32]
14.	P	32	chronic pelvic pain	IHA +	US	120/80	total cystectomy	–	without post-op treatment	sheep farm worker & dog contact	N	Tunisia	[33]
15.	P	34	occasional dysmenorrhea	NA	US & CT	100/100/50	total cystectomy	–	post-op	frequent visits in endemic regions	N	China	[34]
16.	S	60	abdominal pain	NA	US & CT	48	hysterectomy & left SOE	liver HC	NA	sheep farm worker & dog contact	NA	Iran	[40]
17.	S	66	fever, abdominal pain & discomfort	NA	US & CT	100/120/120	hysterectomy & bilateral SOE	liver & lung HC synchronous ipsilateral G3 serous adenocarcinoma	no indication	rural area	NA	Greece	[42]
18.	S	14	abdominal distension & pain	IHA -	US	88/59	total cystectomy	liver, pelvic cavity, peritoneum, mesentery & omentum HC	NA	frequent unwashed vegetables meals	NA	Iran	[43]
19.	P	44	abdominal distension	NA	US	200/40	infracolic omentectomy & total abdominal hysterectomy with bilateral SOE	omental HC	post-op	NA	NA	Turkey	[44]
20.	S	54	NA	IHA +	US & MRI	80/50 & 75/40	bilateral OE & hysterectomy	liver HC	post-op	rural area	NA	Iran	[45]
21.	S	20	epigastric pain	IHA +	US & CT	NA	no surgery	liver & peritoneum HC	applied	NA	NA	Israel	[46]
22.	P	30	amenorrhea of three months	NA	US	200/300	hysterectomy & left SOE	–	post-op	NA	N	India	[47]

Case No.	Type	Age [years]	Symptoms & signs	Serum tests	Imaging	Cyst size [mm]	Surgical approach	Other locations & associated diseases	ABZ therapy	Risk factors	EO count	Country	Ref
23.	P	42	abdominal distension & pain	NA	US & CT	155/97	hysterectomy & bilateral SOE	–	NA	NA	NA	Iran	[52]
24.	P	70	abdominal distension & anorexia	NA	US & CT	217/166/171	hysterectomy & bilateral SOE	hypertension; synchronous ipsilateral mucinous cystadenoma	post-op	rural area & cattle, dogs and cats contact	NA	India	[54]
25.	P	48	abdominal pain	NA	US	96/74/51	total cystectomy	–	post-op	NA	icd	India	[59]
26.	P	38	abdominal pain	NA	MRI	110/90/55	total cystectomy	–	pre-op	NA	N	Iran	[70]
27.	S	75	anorexia & pyrosis	NA	US & CT	210/300/330	bilateral SOE	liver HC; hypertension; dyslipidemic syndrome; hepatic steatosis; chronic hepatitis C (HCV); synchronous contralateral MBT	no indication	rural area	icd	Romania	[88]

HC: Hydatid cyst; P: Primary; S: Secondary; NA: Not available; IHA: Indirect hemagglutination (+/-); US: Ultrasonography; CT: Computed tomography; MRI: Magnetic resonance imaging; SOE: Salpingo-oophorectomy; OE: Oophorectomy; HCV: Hepatitis C virus; MBT: Mucinous borderline tumor; ABZ: Albendazole; pre-op: Preoperative; post-op: Postoperative; EO: Eosinophils; N: Normal; icd: Increased; Ref: Reference.

In some cases, the heterogeneous ultrasound findings of a large cyst corroborated with the patients' age, the rare ovarian location, along with increased value of tumor markers, carcinoembryonic antigen (CEA), cancer antigen (CA) 125, and CA19-9 may led to a malignant cystic lesion suspicion [88].

Another consideration is that computed tomography (CT) or magnetic resonance imaging (MRI) is superior in pelvic HC diagnosis, with a sensibility of 90–97% [73, 92, 93]. If CT may identify microcalcifications associated to liver cysts, a possible undiagnosed HC may be considered and ovary may represent a secondary location [88].

The relative slow growth rate of HC, of about 1–5 cm/year [73] associated to mild symptomatology may lead to a delayed diagnosis, when it reaches up to 20 cm diameter [94]. This latter characteristic has been a systematical finding in the literature reviews (Table 1), with a majority of patients showing HC of 40 [32] up to 200×300 mm [47].

The imagistic exams are completed by serological exams, such as eosinophilia in 10–30% of patients, higher in ruptured HC [95]. However, in the majority of literature reports, the eosinophils count has been normal [7, 33, 34] and, accordingly, has not proved to be a reliable diagnosis marker.

Numerous methods have emerged as valuable in echinococcosis diagnosis during the recent years, such as enzyme-linked immunosorbent assay (ELISA), latex agglutination test, immunochromatography test, indirect fluorescent antibody (IFA), immunoblotting, and indirect hemagglutination (IHA) [96–98]. Among these methods, the gold standard of serum diagnosis of hydatidosis is indirect hemagglutination, along with detection of immunoglobulin G (IgG) antibodies against cyst-fluid derived native or recombinant antigen B subunits, either in ELISA or in immunoblots [95, 98, 99]. However, due to induced immunosuppression, a negative serology of HD may be associated with pregnancy [95].

A cost-efficient method of diagnosis in endemic areas consists in IHA in ultrasound suspected HD [100]. This is also considered as a valuable method of diagnosis (Table 1), although in two cases [17, 88], the test has been missed due to initial dismiss of HD as a possible differential.

The gross findings are that of cystic ovaries of different size, with a smooth glossy surface, yellow color, while the cut sections show a thick mucoid material, with pasty consistency, and laminated appearance (Figure 1) [88].

Histologically, HC has three layers, as follows: pericyst or adventitia, laminated membrane (ectocyst), and inner germinal layer (endocyst) [4, 49]. The pericyst is formed by host cells, as a result of chronic inflammatory reaction elicited by the parasite (Figure 2) [10]. The ectocyst is located at the host–parasite interface and has a hyaline, acellular structure (Figure 3). The endocyst is formed by parasite and has a fibrous architecture [4, 10]. Sometimes, in fertile cysts, this layer gives rise to protoscoleces, which can be identified inside the cyst floating in a clear, yellowish or turbid fluid [4, 10].

Local immunoreaction in HC

Considering the known immunoreaction triggered by parasites, a strong human and intermediate host inflammatory effect, involving both cell-mediated reaction and antibody production, is also noticed in infections with helminths of echinococcosis. The initial response is rich in macrophages and neutrophils, while leukocytes, containing mainly eosinophils, associated to lymphocytes, are consecutively noticed [88, 101].

Regarding the type of lymphocytes involved, active lesions and progressive forms with periparasitic granuloma are associated with large number of cluster of differentiation (CD) 8-positive T-cells (Figure 4) [88, 102], while dead parasites or aborted lesions have an increased number of CD4-positive T-lymphocytes, suggesting their effective role in parasite destruction [88, 103]. Nonetheless, the parasite has an immunomodulatory effect on the host inflammation, with involvement of CD8 cells [88, 102].

The adventitial layer surrounding the HC contains mainly CD3-positive cells [88] (Figure 5), while CD68-positive macrophages are fewer within the inflammatory infiltrate but more numerous at the edge of the cyst and hydatid membranes [88] (Figure 6).

A relatively reduced number of CD56-positive cells are seen in the adventitial layer surrounding the HC [88], while the peripheral blood of patients contains more CD56-positive/CD8-negative [natural killer (NK)] cells, when compared to non-infected controls [104].

According to recent literature data, new means of immunoprotection performed by mononuclear phagocyte system may be nonspecifically induced in HC [101, 102, 104].

Figure 1 – ***HC: gross features in association with a synchronous ovarian epithelial cyst. HC: Hydatid cyst.***

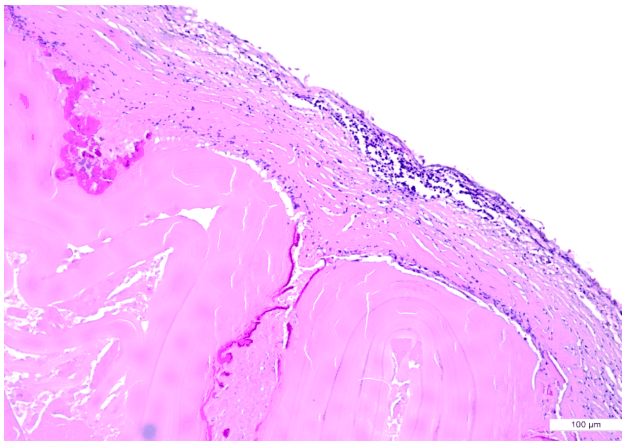

Figure 2 – ***Ovarian HC: characteristic chronic inflammatory reaction (HE staining, ×100). HC: Hydatid cyst; HE: Hematoxylin–Eosin.***

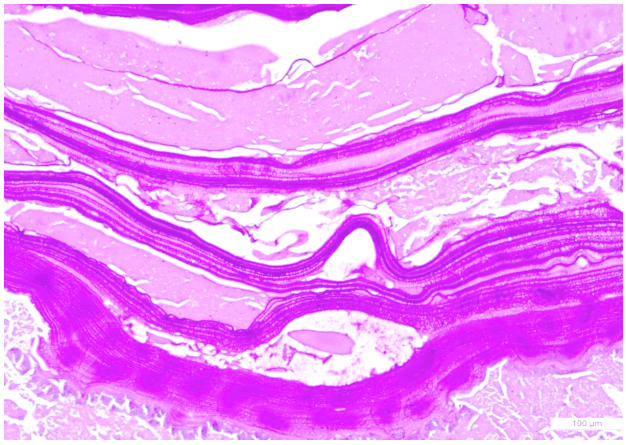

Figure 3 – ***Ovarian HC: characteristic laminated membrane (PAS staining, ×100). HC: Hydatid cyst; PAS: Periodic Acid–Schiff.***

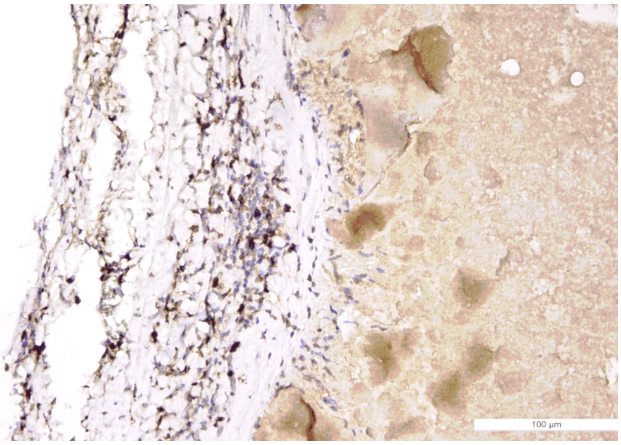

Figure 4 – ***CD8-positive cells are predominant inflammatory cells in the periphery of the collagen capsule (pericyst) (Anti-CD8 antibody immunomarking, ×200). CD8: Cluster of differentiation 8.***

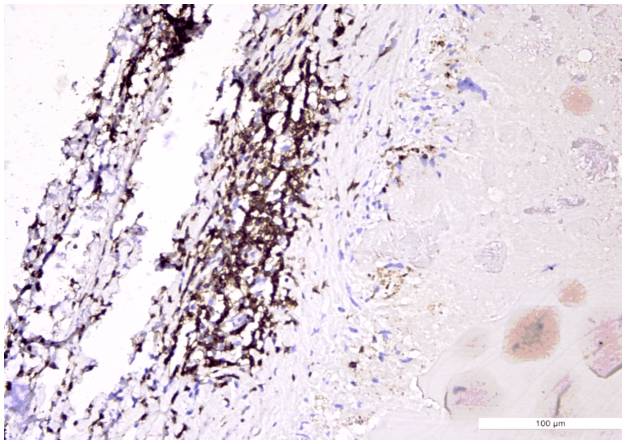

Figure 5 – ***CD3-positive cells are predominant inflammatory cells in the adventitial layer surrounding the HC (Anti-CD3 antibody immunomarking, ×200). CD3: Cluster of differentiation 3; HC: Hydatid cyst.***

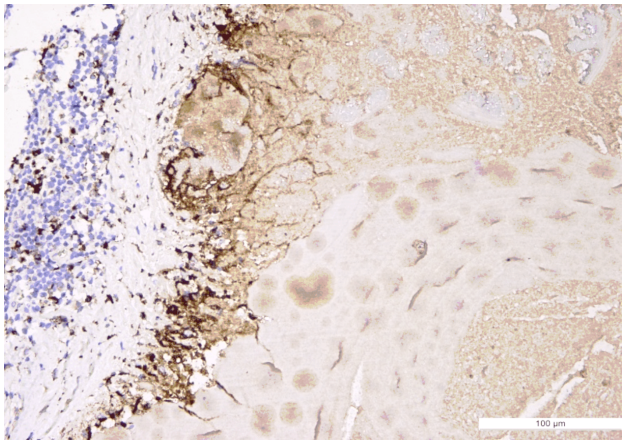

Figure 6 – ***CD68-positive cells are more numerous at the edge of the cyst and few in the inflammatory infiltrate (Anti-CD68 antibody immunomarking, ×200). CD68: Cluster of differentiation 68.***

Diagnosis and possible pathological associations

Histopathological examination may diagnose ipsilateral or contralateral association of ovarian cysts, such as ovarian borderline tumors (n=2 cases), mucinous cystadenoma (n=1 case), hemorrhagic cyst (n=1 case), and ovarian serous adenocarcinoma (n=1 case), which are diagnosed using the specific microscopic criteria.

Regarding the ovarian mucinous borderline tumors (MBTs), these are common ovarian tumors, as they account for 30–50% of all primary ovarian neoplasms [105], with less than 10% being bilateral [106]. Occasionally, MBTs may be synchronous with ovarian HD and the growing MBT may cause supplementary obstruction and compression of the neighboring tissues and organs, added to that of ovarian HD [88]. In such a case, ovarian MBTs were characterized by the usual histological features: pseudo-stratified columnar mucinous lining epithelium, atypical epithelial proliferations, no desmoplastic stroma, and no stromal invasion. By immunohistochemistry (IHC), this cystic ovarian tumor expressed cytokeratin (CK) 7 positivity, CK20 weak positivity, estrogen receptor (ER) and progesterone receptor (PR) positivity, and a variable Ki67 index (lower in benign cystadenoma-looking areas and higher in borderline complex epithelial proliferations covering the papillary surfaces) [88]. In these instances, histopathology findings corroborated with clinical, imaging, surgical examinations, and IHC findings have to exclude an appendiceal origin or a possible *pseudomyxoma peritonei* [88].

Differential diagnosis

The diagnosis may be difficult in inconclusive CT reports, with estimative values of 10–15% of false negative serological and imagistic methods [100].

The ovarian hydatidosis may mimic a polycystic disease or ovarian tumors (cystadenoma, cystadenocarcinoma) [17, 33].

On the other hand, HC do not exclude the association of ovarian tumors, as seen in reports diagnosed with synchronous contralateral serous [6] or ipsilateral MBT [88], synchronous ipsilateral mucinous cystadenoma [54], synchronous hemorrhagic cyst [20], and synchronous ipsilateral ovarian serous adenocarcinoma [42].

If a primary ovarian lesion is considered, complementary examination should not identify any other HC. In the presence of a liver lesion, ovary may be regarded as a possible secondary location [88].

Moreover, considering the natural evolution of the disease, the primary lesion could become inactive and partially calcified, being smaller than the ovarian secondary location, which may continue its development [88].

Treatment

Hippocrates was first to illustrate a liver HC and has been a pioneer of treatment [107]. Accordingly, the elective therapy of pelvic hydatidosis consists in complete resection of the cyst, by classic approach or, more recently, by minimum invasive intervention, avoiding its rupture.

The recurrence rate is approximate 2% [33]. In order to prevent the recurrence, Praziquantel or benzimidazoles [Mebendazole, Albendazole (ABZ)] administration [108], associated to periodic imagistic reevaluation is recommended. ABZ is the most useful drug, in doses of 400 mg twice/day, for one month, in 2–3 repeated cycles, with two weeks break in between them, to ensure hepatic protection [95]. ABZ is also the only therapeutic option in inoperable cases, with a success rate of 25–30% [95]. However, due to its potential teratogenic effect it cannot be used during pregnancy.

Classic surgery by bilateral salpingo-oophorectomy with preservation of the integrity of the cyst in the absence of other active lesion does not require adjuvant anti-parasitic drugs [88].

Conclusions

Although Romania, as other countries, is considered as an endemic area for hydatidosis, the ovarian location of echinococcosis is extremely rare. However, HC should be considered in any differential diagnosis of a cystic lesion. HD has to be considered even in cases with normal serological markers of hydatidosis, such as eosinophilia and hemagglutination test, as there are numerous reports of such cases. The diagnosis of HC does not exclude synchronous ovarian tumors, mainly if suggested by tumor serum markers and concomitantly highlights the necessity of accurate preoperative diagnosis and surgery, avoiding the spillage into abdominal cavity. These cases of rare ovarian HCs stress the necessity of implementation of improved measures of prophylaxis and screening of echinococcosis in endemic areas.

Conflict of interests

The authors declare that they have no conflict of interests.

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