

## ORIGINAL PAPER

doi: 10.5455/medarch.2019.73.338-343

MED ARCH. 2019 OCT; 73(5): 338-343

RECEIVED: SEP 15, 2019 | ACCEPTED: OCT 15, 2019

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# Computer Tomography (CT) Characteristics of Pulmonary Cystic Echinococcosis

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## ABSTRACT

**Introduction:** Cystic echinococcosis (CE) is a common zoonosis worldwide. The two most frequent location of CE are liver and lung. Confirmatory diagnosis of CE is routinely performed using imaging methods such as computer aided tomography and nuclear magnetic resonance in humans. **Aim:** to investigate CT scan imaging of patients with pulmonary CE in Masih Danehvare Hospital from 2011 to 2017. **Material and Methods:** This descriptive-analytic study was carried out on patients with pulmonary CE referring to Masih Danehvare Hospital. By using the convenience sampling, 195 cases were selected from eligible patients. The data collection tool was a researcher-made questionnaire that included demographic, clinical and laboratory information. Data were analyzed using SPSS software version 20. **Results:** In this study, 84.1% and 15.9% of patients were diagnosed using surgical method and CT scan, respectively. Our findings indicated CE was most commonly located in liver (28.2%) and spleen was considered as the lowest location (3.1%). Furthermore, cough was the most common clinical symptom of patients. The lower right lobe opacity was found to be higher, while and Lingula was the least frequent. **Conclusion:** According to the findings of this study, surgery is the most important diagnostic and cough method as the most common clinical symptom of the disease. Since the CE with atypical symptoms is relatively common, physicians should always consider the lung CE in differential diagnosis of localized radiological images.

**Keywords:** Pulmonary hydatid cyst, Opacity, CT scan, Clinical sign.

## 1. INTRODUCTION

Cystic echinococcosis (CE) is considered as an important zoonosis, that is endemic worldwide. Iran is considered as an endemic area for CE where hospital based records has been shown presence of CE in different regions of Iran, accounting for 1.18-3 per 100,000 individuals in the country (1).

CE caused via the larval stage of the tapeworm *Echinococcus granulosus*. *Echinococcus granulosus* are often identified in the small intestine of the carnivorous, especially the dog and intermediate host including livestock and humans are infected with CE through the fecal-oral route (2-4). Gravid proglottides, or eggs are dispersed along with the dog's stools and then enter the digestive tract of humans or other intermediate hosts (e.g., sheep, goat, cattle, camel, pig, Horses, etc.). The egg hatches in the small bowel in the small intestine and oncosphere is capable of penetrating the intestinal wall, thereafter migration can be occurred via the circulatory system into the liver, lungs

and other organs, leading to creation of a very small cyst (2, 5).

Liver involvement is accounted for 60-70% of organ involvement, followed by lung (25-30%), and other organs, such as brain and spinal cord, spleen, kidneys, heart, muscles, bones, endocrine and exocrine, eyes, genital organs, etc. (6), there is case reports of EC in organs such as breast (7), diaphragm (8), heart (9), ovary and fallopian tube (10) and multi-organ (11).

The clinical symptoms of the disease vary depending on the location and size of the cyst. The incubation period is long and CE may not be seen for many years after human infection. Symptoms of lung hydatid cyst often include coughing, shortness of breath and sometimes chest pain. Cystic fluid leakage and rupture of the cyst due to trauma can lead to symptoms such as increased sensitivity, itching, urticaria, eosinophilia, and even anaphylaxis. Patients with pulmonary CE may have symptoms such as fever, chills, coughing, sputum, chest pain, shortness of breath,

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and hemoptysis. Therefore, timely diagnosis and rapid treatment of the disease is very important in preventing complications from the CE (12).

In areas where the disease is common, there are some cases of atypical manifestations of the disease. Positive atypical manifestations have been described as tumors, extensive pleural effusion, atelectasia, and lung consolidation, which may lead to confusion between the surgeon and the physician (13). The definitive diagnosis of hydatid cyst disease is based on imaging and serological methods. Depending on the location of the cyst, ultrasonography and CT scan can be used. Ultrasonography is one of the most appropriate methods for diagnosis because of the absence of harmful radiation, increased availability, ease of use and low cost. In many parts of the world, including Iran, portable ultrasound apparatuses are used in community-based screening studies (14-16).

A wide range of serologic methods have been used to diagnose the disease, most of which are both ELISA and Western blot methods. However, it should be noted that the sensitivity and specificity of these tests are influenced by several factors, including the purity of the antigen used, the course of the disease and the location of the cyst. Serologic tests in liver cysts show more reliable results than lung and cyst cysts. Diagnosis of chest radiography and CT scan can be used to diagnose the disease. Today, in the treatment of hydatid cyst, drug and surgical treatment, or a combination of both, is mainly used (17,18).

Regarding the importance of CE, the diagnosis and treatment of the patients is of great importance. In this regard, the recognition of paraclinical manifestations and findings, including imaging for each organ, is very important to differentiate from other cosmopolitan disorders with capsule or sac-like structure. Pulmonary cysts are one of the most important types of CE, accounting for 33.3% of human CE in Iran. Therefore, true interpretation of the imaging findings is of great importance for diagnosis, especially as it may be complicated in some cases, when provide a different view of CE compared routine manifestation (19-21).

## 2. AIM

Therefore, the current study was aimed to assess the findings of CT scan imaging of patients with pulmonary CE in Masih Daneshvari Hospital from 2011 to 2017.

## 3. MATERIAL AND METHODS

This descriptive-analytical study was conducted on patients with pulmonary CE referred to Masih Daneshvari Hospital from 2011 to 2017. The aim of this study was to determine the CT scan of patients with pulmonary CE based on age, sex, location, and to provide faster diagnosis of pulmonary CR for its treatment and improvement of prognosis in patients. In this study, eligible patients with pulmonary hydatid cyst confirmed by pathology were included in the study using convenience sampling and census. In this retrospective study, medical records of patients with CE was assessed and demographic characteristics such as age, sex, place of residence, occupa-

tion as well as clinical findings of patients were collected using a researcher-made checklist. In addition, CT scan of patients was re-evaluated. Ethical considerations were regarded in this study and the information of the patients remained confidential.

### Statistical analysis

Data were entered into the statistical software of spss version 20 and analyzed by chi-square and independent t-test.

## 4. RESULTS

In general, 195 patients with mean age of  $35.91 \pm 16.24$  (range 3-77 years) were studied. 91.3% of the patients were over 16 years of age. In terms of sexual distribution, 82 (42.1%) were female and 13 (57.9%) were male. Most of the subjects were housewives (36.9%) (Table 1).

Variables	Frequency	Percent
Sex		
Female	82	42/1
Male	113	57/9
occupation		
Free	64	32/8
Housewife	72	36/9
Farmer	17	8/7
Retired	6	3/1
Students	20	10/3
Employee	16	8/2

Table 1. Demographic characteristics of the participants in the study

Location	Frequency	Percent
Zanjan	7	3/6
Arak	2	1
Ardabil	6	3/1
Urmia	1	0/5
Esfahan	6	3/1
Afghanistan	3	1/5
Ahwaz	1	0/5
Ilam	3	1/5
Mazandaran	3	1/5
Lorestan	16	8/2
Tehran	99	50/8
Khorasan	2	1
Rasht	1	0/5
Semnan	4	2/1
Kordestan	7	3/6
Shahrood	5	2/6
Gazvin	2	1
Qom	1	0/5
Karaj	16	8/2
Kermanshah	5	2/6
Golestan	4	2/1
Hamadan	1	0/5

Table 2. Distribution of participants in the study by location

Variables	Frequency	Percent
Diagnostic method		
Surgical	164	84/1
Sampling involves CT	31	15/9

Table 3. Diagnostic method

Variables	Cyst	Turbidity (Consolidation)
Sex		
Male	102 (%60)	11 (%44)
Female	68 (%40)	14 (%56)
Occupation		
Free	57 (%33/5)	7 (%28)
Housewife	58 (%34/1)	14 (%56)
Farmer	17 (%10)	0
Students	19 (%11/2)	1 (%4)
Employee	16 (%9/4)	0
lung involve site		
RUL	37 (%21)	3 (%12)
RML	14 (%8/2)	5 (%20)
RLL	78 (%45/9)	9 (%36)
LUL	33 (%19/4)	2 (%8)
Lingula	9 (%5/3)	0
LLL	62 (%36/5)	8 (%32)
Clinical symptoms		
Fever	37 (%21/8)	5 (%20)
Cough	115 (%67/6)	17 (%68)
Hemoptysis	57 (%33/5)	10 (%40)
Chest pain	25 (%14/7)	3 (%12)
Asthma	44 (%25/9)	8 (%32)
Detection		
Surgery	158 (%92/9)	6 (%24)
Sampling involves CT	12 (%7/1)	19 (%76)

Table 4. Comparison of demographic variables in patients with lung consolidation

Clinical signs	Cyst rupture	Health	P-value
Fever	13 (11/3)	29 (14/1)	0/291
Cough / phlegm	45 (39/1)	87 (42/2)	0/108
Hemoptysis	26 (22/6)	41 (19/9)	0/858
Chest pain	12 (10/4)	16 (7/8)	0/563
Asthma	19 (16/6)	13 (16)	0/807

Table 5. Comparison of clinical symptoms in patients with healthy cysts and ruptured cysts

In terms of residence location, Tehran province has the highest frequency (50.8%). Furthermore, 1.5% of the people belonged to Afghan refugees (Table 2).

In this study, 84.1% of patients were diagnosed using surgical method and 15.9% of patients were diagnosed with CT scan. It was found that most of the patients had (28.2 %) liver cysts and 3.1 % had spleen cysts (Table 3).

Variables	Mean ±SD
Liver cysts	9/27±9/35
Spleen cysts	14/83±17/88
Total mean	7/57±5/8

Table 6. Average eosinophil score in subjects with liver and spleen cysts

Cyst	Cyst number	Frequency	Percent
1	1	105	61/8
2	2	30	17/7
3	3	10	5/9
4	4	7	4/1
5	5	4	2/3
Multiple	Multiple	14	8/2
Total	Total	170	100
Consolidation	Consolidation	25	12/8

Table 7.

Signs with CT	Cyst		Consolidation	
	Frequency	Percent	Frequency	Percent
Reduce the volume	9	5/3	0	0
Pneumothorax / hydro-pneumothorax	13	7/6	3	12
Pericardial effusion	1	0/6	0	0
involve chest wall	4	2/3	0	0
Pleural effusion/thickening	21	12/3	3	12
pleural effusion	1	0/6	0	0
Infiltration	82	48/6	1	4

Table 8. Distribution of radiological symptoms

Analysis of the variables was also conducted based on the cyst and the lung consolidation. CT scan of pulmonary CE was detected in 170 patients and 25 patients diagnosed as consolidation, which among patients with consolidation, diagnosis was attributed to a frequency 24% for surgical method and 76% of the biopsy. The mean age for patients with CE diagnosis was 37.2 ± 15.27 years and for the group with consolidation, it was 34.11 ± 17.66 years (P = 0.226).

In terms of gender, 60% of the cases had male cysts, followed by 44% of the subjects with a pronounced lung consolidation (P = 0.130). The comparison of the subjects in terms of occupation showed that the difference between the two groups was significant (P = 0.005). There was no significant difference between the place of lung involvement and the clinical symptoms of patients

	Cyst rupture type	Frequency	Percent
Contained Cyst rupture signs	Air crescent or meniscus sign	33	63/1
	Inverse crescent sign	5	9/6
	Air bubble sign (Mass signet a cavity sign)	14	26/9
Total		52	100
Communicating Cyst rupture Signs	Waterlily or Camalote sign	26	45/6
	Cumbo or double arc sign	11	19/3
	Signet ring sign	4	7
	Whirl sign	9	15/8
	Dry cyst sign	7	12/3
Total		57	100
Direct Rupture		26	13/3

Table 9. Distribution of rupture type

Cyst site	Cyst		Consolidation	
	Frequency	Percent	Frequency	Percent
Right Upper Lobe (RUL)	37	21/8	3	12
Right Middle Lobe (RML)	14	8/2	5	20
Right lower Lobe (RLL)	78	45/9	9	36
Left Upper Lobe (LUL)	33	19/4	2	8
Lingula	9	3/5	0	0
(LLL) Left Lower Lobe	62	36/5	8	32

Table 10. Distribution of pulmonary CE location

with cystic presentation and lung consolidation. Analysis of clinical data showed that cough was the most common complaints of patients with frequency of 115 (67.6%) and 17 (68%) in patients with cysts and consolidation, respectively. Other symptoms for cyst and consolidation diagnosis included hemoptysis (33.5% and 40%) dyspnea, (25/9%, 32%), fever (21.8% and 20%), chest pain (14.7% and 12%) respectively. The diagnostic method was more surgery for patients with cysts and CT scan in combination with biopsy for people with consolidation (Table 4).

Clinical symptoms in subjects with cyst and ruptured cysts showed that cough/phlegm was the most common among patients with ruptured cysts and healthy cysts

Variables	Rupture cyst		Health cyst		P-value
	Frequency	Percent	Frequency	Percent	
Sex					0/972
Male	43	58/1	70	57/8	
Female	31	41/9	51	42/2	
Lung involve site					0/830
RUL	17	23	23	19	
RML	7	9/4	12	9/9	
RLL	40	54	47	38/8	
LUL	17	23	18	14/9	
Lingula	6	8/1	3	2/5	
LLL	31	41/9	39	32/2	
Position sub-pleural	61	82/4	62	52/9	0/001
Clinical sings					0/772
Fever	13	17/5	29	24	
Cough	45	60/8	87	71/9	
Hemoptysis	26	35/1	41	33/8	
Chest pain	12	16/2	16	13/2	
Asthma	19	25/7	33	27/3	

Table 11. Comparison of variables in healthy cysts and ruptured cysts

(45 patients [39.1%] (87 patients [42.2%]), where the difference between the two groups was not statistically significant (Table 5). Overall, the mean eosinophilia in hydatid cysts was  $7.58 \pm 5.8$ . In patients with liver and spleen cysts, mean eosinophils were  $9.27 \pm 9.35$  and  $17.88 \pm 14.83$ , respectively (Table 6). The distribution of the main radiological characteristics in patients showed that 170 (87.2%) of the patients had cysts and 25 (12.8%) exhibited atypical appearance. Furthermore, the average size of the cyst was determined as  $6,56 \pm 3.37$  (range 1.5 to 23 cm). Most of the subjects showed one cyst (55.4%), while 4.6% had multiple cysts, 13.8% of them had Janet cyst (> 10 cm), and 64.1% of cysts were placed in the sub-pleural position (Table 7)

Radiological examination showed that volume reduction in cysts and opacities was determined as 5.3% and 0%, respectively, followed by pneumothorax (7.6% and 12%), pericardial effusion (0.6% and 0%), chest wall involvement (2.1 and 0%), Pleural effusion (12.3% and 12%), pleural effusion of locale (0.6% and 0%), infiltration (48.6% and 4%), (Table 8). In the case of rupture, 74 (37.9%) patients had normal cysts, the most frequent contained cyst rupture symptoms were determined to be air crescent or meniscus sign (63.1; 33 cases). In addition, the most frequent communicating cyst rupture sign was associated with Waterlily or camalote sign (45.6%; 26 subjects), Moreover, 26 cases (13.3%) had a direct type of rupture (Table 9). Regarding the location of lung cyst (atypical view), findings revealed, the lower right lobe exhibited the highest frequency in subjects with cyst and consolidation manifestation and also the lowest frequency was associated with Lingula (Table 10).

The mean age of patients with ruptured cysts and healthy cysts was determined as  $37.02 \pm 15.27$  and  $63.60 \pm 33.27$  years, respectively, where the difference between the two groups was not statistically significant ( $p = 0.226$ ). The mean cyst size in those who have ruptured and healthy cyst, were determined to be  $68.31 \pm$

34.31 mm and  $63.60 \pm 33.27$  mm, respectively, where the difference between the two groups was not statistically significant ( $p = 0.364$ ). The abundance of subpleural position in the group of ruptured cysts was higher than that of the healthy cyst group ( $p = 0.001$ ) (Table 11).

## 5. DISCUSSION

In the present study, the diagnostic method was more surgery in patients with CE, but the biopsy method was guided by CT scan for people with apparent consolidation. Diagnosis of patients with hydatid cyst is based on epidemiological findings, patient records, clinical signs, laboratory markers, and immunological tests. None of the imaging methods has the ability to specifically detect all CE cases, and only gives a mass in the examined cases with little data about the physical and chemical properties of the tissue. Although serologic and bronchoscopic techniques are applied to diagnose CE (18), but the main role of diagnosis is on radiology that usually displays typical pulmonary cysts, which is usually based on the visualization of a solid mass with the same density. CT scan and magnetic resonance imaging (MRI) and ultrasonography are capable of showing cysts with a specific thin or thick wall (22-25). The results of this study showed that most of the subjects were male. The disease is seen at any age and sex, but the level of infection has been reported to be higher in the age group of over 20 years (26, 27). The average age was reported to be between 30 and 40 years old (28). Other studies have also emphasized the increased incidence of disease in men (28, 29). Bagheri et al (2011) reported the mean age of patients as 4.30 years and men have been infected more than women (30). On the other hand, housewives, farmers and ranchers have the highest percentage of infection, which show a higher chance of exposure to parasites and a higher risk of infection (31). Another study also highlighted the percentage of more males for CE infection (32). Of course, it should be noted that the type of sampling and population should not be ignored in this regard.

The clinical manifestation of lung hydatid cyst depends on whether the cyst is normal or ruptured cysts. Unruptured cysts have no special signs, and clinical manifestations depend on their location and size. Large cysts may cause compressive symptoms of adjacent organs and even superior vena cava syndrome (SVCS). The most common symptom in symptomatic patients is cough. Mediastin cysts may damage the adjacent structure, leading to bone pain, bleeding, or air flow constraints.

Rupture may be accompanied by sudden coughing and fever. The entry of the contents of the cyst into the airway may be accompanied by expectoration of a clear salty tasting fluid consisting of membrane and scolices (33). Sometimes rupture of the pleural space leads to severe and severe symptoms such as severe dyspnea, anaphylactic shock, cyanosis and coughing, or even the appearance of torn hydatid cysts in pleura may include pneumothorax, hidropneumotoraks or empyema, and a patient with primary diagnosis may be admitted in hospital (34). An unruptured cyst may cause frequent itching, hypersensitivity and bronchospasm (35).

Overall, the clinical symptoms of this disease depend on the size, number and location of cysts in the body. In the early stages of infection, there may not be clinical symptoms for many years, but cyst enlarged, in some cases, and ruptured cysts as a result of trauma or secondary infection can lead to clinical symptoms (36).

Based in the distribution of the main radiological characteristics in our patients, the presence of CE was attributed to a frequency of 87.2%, while 12.8% exhibited atypical appearance. Base on the data presented herein, the average size of the cyst was recorded to be  $6,56 \pm 3.37$  (range 1.5 to 23 cm). Most of the subjects showed one cyst in involved organ (55.4%), while had multiple cysts was attributed to a frequency of 4.6%; moreover, 13.8% of them exhibited Janet cyst ( $> 10$  cm), and 64.1% of cysts were found to be placed in the subpleural position.

Studies have shown that coughing has been the most common symptom in these (37-39), which is consistent with the findings of the present study. It has been reported that adult patients with pulmonary CE have non-specific symptoms including cough, shortness of breath, hemoptysis, pleural effusion, and chest wall involvement (37). From the point of view of the location of lung involvement, the presence of cyst and consolidation was found frequently in the lower right lobe, and Lingula showed the lowest abundance. A study showed that the lower lobe of the right lung is the most common site of lung involvement (37,40). Aforementioned study indicated that the involvement of the right lung was the most common site of lung involvement (30, 37). This can be due to more blood supply in this region (41).

In the present study, the most frequent contained cyst rupture signs were revealed as air crescent or meniscus sign, while the most frequent communicating cyst rupture sign was attributed to Waterlily or camalote sign, additionally, 26 cases (13.3%) showed a direct type of rupture. Rupture of cysts is one of the most common side effects that occur in 49% of patients (42). All CE are at risk of rupture, which is classified as complex CE. This complication depends on factors such as age, chemical reactions and body defense mechanism (43), as well as the size and number of cysts.

## 6. CONCLUSION

Our findings showed that surgery is the most important method for detecting hydatid cysts. From the clinical point of view, the cough is more common than other symptoms. Furthermore, in the area of lung involvement, the lower right lobe has the highest frequency. The limitations should be seen in the light of the retrospective nature of the study and the lack of clarity and incompleteness of the information in some medical records of patients.

- **Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms.
- **Author's contribution:** AA, PM, HS,SHT, and BHGH gave substantial contribution to the conception, design, drafting the work analysis and interpretation of data for the work and had in article preparing

for drafting or revising it critically for important intellectual content. All authors gave final approval of the version to be published.

- **Conflicts of interest:** There are no conflicts of interest.
- **Financial support and sponsorship:** Nil.

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