The Diagnostic Value Of The "Air Bubble Sign" In Complicated Pulmonary Hydatid Cysts
G Yuncu, S Örs Kaya, S Sevinc, N Karabulut, H Alper

Introduction
Hydatid disease is prevalent and widespread in most sheep and cattle raising countries throughout the world. Pulmonary hydatid cyst is one of the most common diseases seen in thoracic surgical centers in Turkey with an incidence of 20 per 1,000,000 [1]. Pulmonary involvement occurs in approximately 15% of cases being the second most frequent site after liver [2]. A variety of signs denoting different appearances of the hydatid cysts have been described on chest radiographs and CT. In uncomplicated hydatid cysts, radiologic diagnosis is relatively easy. CT provides further information in equivocal cases by revealing the fluid density of an intact cyst and the air-fluid density of a ruptured cyst. However, infection of the cyst may increase the attenuation values and a produce a solid appearance, which may hamper the correct diagnosis. Such a complicated cyst, in the absence of positive history, serologic tests and other radiologic signs, may simulate a malignant tumour, tuberculosis, abscess and other infected cystic lesions of the lung. The “air bubble sign” was described in complicated cysts and reported to be an important clue in the differentiation of hydatid cysts from other disease processes [3]. This study aimed to assess the diagnostic value of the air bubble sign in the diagnosis of ruptured pulmonary hydatid disease.

Material and Methods
In the past five years, 35 consecutive patients (17 males, 18 females) who underwent surgical treatment for ruptured and infected hydatid cysts were included in the study. The patients ranged in age from 14-69 years (mean, 36.2 years). All patients had preoperative CT examinations which were reported as solid lesions measuring >20 HU in density. The correct preoperative diagnosis was not established in 13 cases based on radiologic and serologic findings. The control group consisted of 30 cases (16 males, 14 females; mean age 52 years, range 23-69 years) with pathologically proven 20 malignant (13 squamous cell carcinoma, four adenocarcinoma, one large cell carcinoma and two small cell carcinoma) and 10 benign (four tuberculosis, four pneumonia, one pulmonary embolism and one lung abscess) pulmonary diseases which may radiologically simulate complicated hydatid cysts. In all patients in the study and control groups, final histopathological diagnoses were available.

CT examinations of both groups were re-evaluated in retrospect and reported by the two radiologists, first without taking account of, then considering the air bubble sign. The final decision was established by consensus. Data were statistically evaluated with the chi-square test using Statistical Package for the Social Sciences (SPSS, 11.0, Chicago, IL).
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RESULTS

Twenty-one cysts (60%) were located in the right lung (10 in upper lobe; four in middle lobe; seven in lower lobe) and 14 cysts (40%) occurred in the left lung (five in upper lobe; nine in lower lobe). Evaluation of the CT examinations in 35 complicated hydatid cysts according to the classical CT signs, ignoring the air bubble sign, led to the diagnosis of complicated hydatid cyst in 18 (51.1%), malignant lung tumour in nine (25.7%), infectious processes (pneumonia and abscesses) in five (14.2%) and tuberculoma or cavitary tuberculosis in three patients (8.5%). In four of the 17 patients otherwise diagnosed, serologic tests and bronchoscopy led to the correct diagnosis of hydatid disease leading to the total correct diagnosis in 22 patients (62.8%). When the air bubble sign was taken into account, it was positive in 30 of 35 cases, increasing the sensitivity to 85.7% (Figs.1,2). In three of five cases in which the air bubble sign was absent correct clinical diagnosis of ruptured, infected hydatid cysts were already established by clinical and other laboratory evaluation. Therefore complementary use of the air bubble sign, and laboratory tests increased correct diagnosis from 62.8 % to 94.3%.

DISCUSSION

Hydatid disease represents the larval form of the canine intestinal tapeworm Echinococcus granulosis and is encountered in most sheep and cattle-raising countries [2]. The lungs are the second most frequent site in adults and the most common site in children [4]. Structurally, the cysts consist of a tough outer pericyst that protects a delicate inner endocyst from which brood capsules and daughter cysts develop. Most intact cysts are asymptomatic and found incidentally on chest radiographs. Occasionally, rupture of the cyst may be the first sign and it may have important allergic or infective sequels. Simple hydatid cysts have water density on CT and ruptured cysts may present with a wide variety of radiological appearances due to different combinations of collapsed membrane, air and fluid [5,6]. Moreover, attenuation values in infected cysts are considerably higher than in unruptured ones producing solid appearance and causing diagnostic errors [7]. Serological tests are often helpful but measurable immunological response does not develop in some patients.

Solid appearances on CT scan, precluding the correct differentiation between hydatid disease and malignant tumour, lead to further, more invasive and time consuming diagnostic attempts such as bronchoscopy, transthoracic needle aspiration, abdominal and cranial CT and scintigraphic examinations. A number of radiologic signs of
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The ruptured hydatid cysts have been described on chest radiographs and on CT due to separated membranes. These include the “crescent”, “water –lily”, “daughter cysts”, “double arch”, “ring within a ring”, “serpent” or “snake” and “spin or whirl” signs [7, 8]. However, Köktürk et al reported that radiologic diagnosis of ruptured hydatid cysts with classical CT signs was possible in only 38 of 65 (58.5 %) patients [3]. In their series, 27 of 65 (41.5%) patients were misdiagnosed as bronchial carcinoma or lung abscesses. They reported significantly higher accuracy rate with air bubble sign. The air bubble sign has also been described as a specific sign in complicated hydatid cysts by Kervancioğlu et al [9].

The mechanism of air bubble production is the dissection of air between the pericyst and parasitic membrane due to rupture or erosion of a bronchiole [2, 8]. Air bubble sign is best demonstrated in mediastinal window settings as single or multiple small, rounded radiolucent areas with very sharp margins within solid media or pericystic areas. They should not, however, be mistaken as cavitations or pseudocavitations.

In a series of 34 patients with surgically proven hydatid cysts, Tör et al reported the air bubble sign to be present in 56% of 18 patients in whom the initial radiologic impression was hydatid cyst and 44% of 16 patients in whom the initial radiologic impression was not hydatid cyst [10]. Köktürk et al reported 83% sensitivity and 94.5% specificity with air bubble sign in the diagnosis of ruptured cysts [3]. In our series, only 51% of cases was correct diagnosis possible based on classical CT findings ignoring the air bubble sign. When combined with the broncoscopic and serologic findings sensitivity increased to 63%. However, the use of air bubble sign significantly increased the sensitivity to 86% when used alone, and 94% when combined with the serologic and endoscopic findings.

CONCLUSIONS

In conclusion, the air bubble sign is proved to be a reliable and reproducible finding in complicated hydatid cysts. The familiarity of radiologists with this sign is essential in establishing the correct diagnosis in equivocal cases and precluding unnecessary investigations and invasive diagnostic procedures, particularly in those countries where the disease is endemic.

CORRESPONDENCE TO

Dr. Seyda Ors KAYA Address: Pamukkale Üniversitesi Mavi Hastane Göğüs Cerrahisi AD Kinikli Denizli, Turkey
Tel: +902582120718 e-mail: skaya@pamukkale.edu.tr
Fax:+90 258 21320 16

References

Author Information

G. Yuncu, M.D.
M.D., Chest Diseases and Thoracic Surgery Teaching Hospital, Faculty of Medicine, Pamukkale University

S. Örs Kaya, M.D.
Department of Thoracic Surgery, Faculty of Medicine, Pamukkale University

S. Sevinc, M.D.
Chest Diseases and Thoracic Surgery Teaching Hospital, Faculty of Medicine, Pamukkale University

N. Karabulut, M.D.
Department of Radiology, Faculty of Medicine, Pamukkale University

Hudaver Alper
Department of Radiology, Agean University Medical School