HYDATIDOSIS: A REVIEW

Abas Andrab, Hidayatullah Tak and Ajaz Rasool

ABSTRACT: Echinococcus granulosus and its metacestode in herbivores occasionally man has been recognized as the most significant helminth Zoonoses and of great economic and public-health significance in developing countries. This review is based on recent literature reporting the occurrence of hydatid disease throughout the world. In this review we discuss its aspects of the biology, life cycle, distribution, diagnosis, clinical manifestations, control and Management. During the last few decades, considerable progress has been achieved in various fields of Hydatidosis research. Several serological as well as immunological tests have been evolved for the diagnosis of echinococcosis spp. in definitive hosts. These tests appear to be valuable in detecting infection with high specificity and sensitivity. Public health and ways of hydatid disease treatment and various control measures, including the use of vaccines is also discussed.

Key words: Echinococcus granulosus; Hydatidosis; prevalence; Zoonosis; antibodies

1 INTRODUCTION

Hydatid disease is an infection caused by tapeworms of the genus Echinococcus. Six species of Echinococcus have been recognized till date; among them are Echinococcus granulosus (which causes Hydatidosis), Echinococcus vogeli and Echinococcus oligarthrus (causing polycystic echinococcosis) and Echinococcus multilocularis (causing alveolar echinococcosis). In addition, E. felidis and E. shiquicus have been found in African lion and Tibetan fox respectively. However, their zoonotic transmission potential is presently unknown to humans. The Echinococcus granulosus parasitizes Canids which are its definitive hosts inhabiting its small intestines. Domestic ungulates act as the intermediate hosts for the parasitic larval stage (metacestode). The cysts of E. granulosus usually develop in organs such as the liver or lungs of the host [1]. This parasite is known to cause hydatid disease or hydatidosis in ruminant animals in humans and echinococcosis in dogs [2]. Parasite remains dormant and clinical symptoms do not appear until the larva of the parasite reaches a certain size. Nevertheless this parasite is globally distributed but is more prevalent in rural areas where sheep and goats are still slaughtered traditionally and carcass wastes are easily accessible to scavenging dogs and other wild carnivores [3]. During the last 10 years new sensitive and specific diagnostic methods and effective therapeutic approaches against Hydatidosis have been developed. In India, several immunochromatographic tests such as ELISA have been developed for determining anti-echinococcus IgG in blood serum for the diagnosis of hydatidosis. Despite some recent progress in the control of Hydatidosis, it continues to be a major public health concern in several countries, and in several others it constitutes an emerging or re-emerging disease. In this review we discuss aspects of the biology, life cycle, distribution, diagnosis, clinical manifestations, control and management of the Echinococcus granulosus.

2 DESCRIPTION OF THE PATHOGEN

Echinococcus granulosus is a cestode and its life cycle involves two animals. A carnivore (dog) acts as the main host harboring adult worms inside their intestines whereas intermediate host of this parasite is almost any mammal, occasionally human beings. Inside the intermediate host, cysts harbouring fluid filled larvae responsible for disease symptoms may be formed in any organ. The cysts commonly known as Hydatid cysts most often develop slowly inside the liver and lungs of the intermediate host. Cysts disrupt various functions of the organs where they develop. Many effects related to this are poor growth, rejection of organs at meat inspection and reduced production of milk. Hydatid cyst inside humans can be dangerous sometimes proving fatal. Each cyst is surrounded by a germinal layer and asexual division in it is responsible for the production of small vesicles internally called brood capsules and producing multiple protoscolices. A cyst may contain thousands of protoscolices. During the course of time, internal septations and daughter cysts can form, disrupting the unilocular pattern typical of young echinococcal cysts. The life cycle of the parasite in definitive host is complex and involves various stages. The adult worms inhibiting the bowel of the dogs pass out gravid segments which carry eggs in the dog faeces. Ruminant animals while grazing ingest the eggs which hatch in their bowels releasing oncospheres penetrating the intestinal wall and travel through the circulating system to various organs of the host. In the organ, oncospheres develop into hydatid cysts producing protoscolices and daughter cysts which are ingested by dogs from the infected ruminant carcasses ingested. The protoscolices on attachment to intestinal wall of the dogs develop gradually into adults in 32 to 80 days. The life cycle in humans starts by eating food contaminated with the parasite eggs. The ingested eggs hatch to release oncospheres in the small intestine penetrating mucosa and migrate through the circulating system to different organs where they develop and produce hydatid cysts (Figure 1).

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Human act as ‘dead end’ hosts for the parasite, since the life cycle gets completed only when carnivores eat infected herbivores [4, 5]. However, infected dead human bodies sometimes also contribute to complete the life cycle of the disease in some African villages as burial is not properly practiced and dogs can get access to those dead bodies [6].

3 CLINICAL MANIFESTATIONS
Cystic Echinococcosis (CE) or hydatidosis is endemic in many countries of the world. In humans, the CE can cause life-threatening illness associated with pulmonary edema, liver failure [7] and rupture of the cyst which may cause fatal anaphylactic shock [8, 9]. Liver is the most common organ affected by Hydatidosis followed by lungs and other organs [10, 11, 12], and this observation is supported by innumerable reports worldwide [13, 14, 12, 15]. The cyst is less frequently seen in the spleen, kidneys, heart, bone, and central nervous system. The cysts gradually displace or induce fibrosis in normal tissue resulting in disease manifestation. The symptoms in humans varies and depends on where in the body cyst develops, and the size and numbers of cysts or metacestode mass. The pain and lump in abdomen occurs when cyst development takes place in liver [16] and other symptoms include nausea, cirrhosis, and other manifestations of liver disease. If the cyst develops in lung then patients suffer from cough as the main symptom (73.6%) followed by pain in chest (54.7%), pleural involvement, lung abscess, pneumonitis and fibrosis like complications [17]. Curiously, lung hydatid cyst may also be present with massive haemoptysis [18]. There is usually surrounding inflammatory reaction and fibrosis and the cyst may die, shrink and calcify after some years. There is general allergic reaction with eosinophilia, bronchospasm etc. Growth of hydatid cyst creates a sort of pressure responsible for tissue damage and obstruction of natural channels. Occasionally, cyst somehow breaks releasing its fluid causing allergic response. Anaphylactic shock may also occur and secondary infections in the surrounding tissues like the peritoneum. Cysts in the brain are fatal producing problems consistent with a slow-growing space occupying lesion [19]. However, even small sized cysts located in the brain or an eye can cause clinical symptoms. The growth rates of cysts are quite variable, ranging from 1 to 5 cm in diameter per year. In the lungs, ruptured cyst membranes usually serve as a suitable site for bacterial or fungal infection. Dissemination of protoscolices can result in multiple secondary echinococcosis disease. Cyst development in bones is also lethal accounts for 0.5~2% of the total number of cases and is potentially the most devastating form of CE. They invade bone marrows and spongiosa and causes extensive erosion of the bone. The most effective treatment is radical resection of the affected bone [20].

4 DIAGNOSIS
Immunodiagnostic techniques are generally used for the detection of specific antigens present in dog fecal sample. Specific antigens of E. granulosus in dog feces were first time reported by Babos and Nemeth (1962) [21]. During last few decades, significant progress has been achieved in various fields of echinococcus research as several immunological and serological tests have been evolved for the diagnosis of Echinococcus spp. in definitive hosts. Deplazes et al. (1992) [22] developed an ELISA test based on a parasite specific layer of capture IgG antibodies that hold on to antigens from faecal supernatants. They achieved sensitivity up to 93% and specificity up to 99 percent for this assay and reported it as one of the most practical ways for collecting prevalence data in large communities. Copro-antigen detection enzyme linked immunosorbent assay (cop-Ag-ELISA) test has also been developed using polyclonal antibodies to E. granulosus excretory/secretory (ES) antigens. This test has proven to be remarkable for detection of the infection in dogs with high specificity (96.5%) and sensitivity (87.5%) [23]. In addition, Sandwich ELISA was found to be highly specific and useful for detecting different stages of Echinococcus spp. and was found to be correlated to the worm burden and the duration of the infection[24],[25]. More specific techniques needs to be developed in cases where the presence of the parasite in the dog population is relatively low [26].In humans combined use of radiologic imaging and immunodiagnostic techniques have been used for the diagnostic purposes. Radiography is used for the detection of hydatid cysts in the lungs. However, calcification is necessary for detecting cysts in other sites for deep-seated lesions in various organs radiographic visualization. Computed tomography, ultrasonography and magnetic resonance imaging are useful for diagnosis and are also useful for determination of the extent and condition of the avascular fluid-filled cysts. Abdominal ultrasonography as a valuable imaging technique for echinococcosis has emerged recently as a most widely used technique for diagnosis because of its widespread availability and usefulness for defining site, dimensions, number and vitality of cysts.[27] Portable ultrasonography machines have been applied for field surveys with excellent results.[28],[29]. Indirect hemagglutination is also used but has now been replaced by the enzyme immunoassay (ELISA) technique for initial screening of sera. Recent studies have shown that ELISA is more sensitive and specific than the other techniques that are available for diagnosing CE, especially lung infection [30]. Excreted antigens in body fluids are also helpful to diagnose parasitic infections [31]. A study conducted in a hospital in North India revealed recognition of 8 and 116 kDa hydatid antigens in serum as a specific test for CE diagnosis [32].

Figure 1 Life cycle of E.granulosus in both animals and humans. (The image adapted from www.dpd.cdc.gov/dpdx).
5 GLOBAL BURDEN
Echinococcosis or hydatidosis is of significant importance causing economic losses globally. It has been included in the list of neglected tropical diseases and is considered to be one of the six priority neglected zoonotic diseases [13]. This disease is distributed worldwide with an annual occurrence ranging from 1 to 200 per 100,000 individuals [33] (Table 1).

6 MANAGEMENT
Surgery was the only options for treatment of hydatid cysts until 1980. However, after that chemotherapy with benzimidazole compounds was found to be effective for protoscoleces [70, 71]. More recently, treatment includes cyst puncture, injection of chemicals and re-aspiration, aspiration and percutaneous thermal ablation have been introduced for management of CE [33]. Though it is more important form of treatment for lesions of liver, but for cysts in lungs, it is not recommended [14, 72, 73]. Albendazole therapy was found effective in 61.5% of inoperable lung hydatid patients and in surgically treated patients when given concomitantly pre- and post-operatively [17].

7 CONTROL AND PREVENTION
Hydatidosis is a strong cause of mortality in many parts of the world and its complete eradication is a very difficult job. To achieve such a goal by current control techniques will take several years of continuing attempts [74]. Control programmes for hydatidosis have been implemented in many endemic regions of the world to reduce or eliminate it completely. Programmes for hydatidosis implemented in some parts of South America, East Africa and Europe have provided success to some extent but some were proved to be as failures [75]. It is very difficult to completely prevent the exposure to Echinococcus eggs from wild animals. Good hygienic conditions and food safety precautions can be helpful. All eatable items, especially those picked up from the wild and open places, should be cleaned with water thoroughly to ensure the removal of the parasite eggs, if any. People dealing with pets or involved in gardening, farming, or preparing food, should wash their hands properly before eating food items. Dogs play an important and primary role for transmission of hydatid disease in humans and other ruminant animals; however, vaccination of dogs provides productive results for control. Furthermore, new ways should be introduced in order to keep dogs and other canids away.

To reduce the hydatidosis in humans, efforts are made to take care of domestic dogs and improvement in husbandry practices. Treatment of dogs with different drugs especially Praziquantel on a monthly basis has proven to be efficient, implementable and cost-effective controlling step in rural areas. On the basis of this strategy, the Chinese Ministry of Health has started a control program on a wide-range in 117 counties in 7 provinces of western China [76]. Results were effective and it was found that echinococcosis may have become hyperendemic in areas where it was once endemic. For example, in the Peruvian central highlands, the sudden cessation of a control program in 1970s may have led to a marked increase in the prevalence of infection in intermediate and definitive hosts and in human population. [77] Other methods include changing home-slaughter practices, abattoirs, inspection of meat and management of dogs. Health education is a paramount controlling measure.

8 CONCLUSION
Cystic Echinococcosis (CE) or hydatidosis is widespread Zoonoses in the world with significant socio-economic repercussions and ramifications. Hydatidosis is of veterinary and medical importance because infection with metacestode may cause severe illness and high economic losses particularly in poor countries. CE continues to be a significant public health problem in endemic areas, as is evident from the published reports from widely distributed geographical areas. The clinical features are variable and are mainly dependent on the organ involved. The early diagnosis and prompt treatment are few of the challenges faced this time. Control of hydatidosis can properly achieved by the support of dog-owners and this is possible through increasing health education, Improving of sanitation, and raising awareness of community regarding the disease [78].
<table>
<thead>
<tr>
<th>S.no</th>
<th>Country</th>
<th>Area of study</th>
<th>Prevalence and sero-Prevalence (%) reported</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Romania</td>
<td>Northwestern Romania(Bistrita Nasaud,Cluj,Maramures and Satu-Mare)</td>
<td>19.2%</td>
<td>Seres et al. (2010) [34]</td>
</tr>
<tr>
<td>2</td>
<td>Czech Republic</td>
<td>Czech Republic</td>
<td>8.1%</td>
<td>Svobodová, V. And Lenská, B. (2002) [35]</td>
</tr>
<tr>
<td>3</td>
<td>China</td>
<td>Sichuan Province</td>
<td>6.8%</td>
<td>Li Tiaoying et al. (2005) [36]</td>
</tr>
<tr>
<td>4</td>
<td>India</td>
<td>Bangalore urban district</td>
<td>4.35%</td>
<td>Prathiush, P.R. et al (2008) [37]</td>
</tr>
<tr>
<td>5</td>
<td>Republic of Kosovo</td>
<td>Gijilan (137 samples), Gore-Opoje (60), Vashtri (53) and Therande (55),</td>
<td>7.5%</td>
<td>Sherifi,K.et al. (2011) [38]</td>
</tr>
<tr>
<td>6</td>
<td>Nigeria</td>
<td>Sokoto state</td>
<td>0.00%</td>
<td>Saulawa, M.A. et al (2011) [39]</td>
</tr>
<tr>
<td>7</td>
<td>Iran</td>
<td>Shiraz</td>
<td>36.19%</td>
<td>Mehrabani, D.et al (1999) [40]</td>
</tr>
<tr>
<td>8</td>
<td>Turkey</td>
<td>Ankara</td>
<td>14%</td>
<td>Öge, H.et al (2017) [41]</td>
</tr>
<tr>
<td>10</td>
<td>Iran</td>
<td>13 provinces of iran</td>
<td>27.17%</td>
<td>Esiami,A. et al. (1998) [43]</td>
</tr>
<tr>
<td>11</td>
<td>Southern Libya</td>
<td>Murzuk province</td>
<td>2.3%</td>
<td>Abugrara,A.et al (2015) [44]</td>
</tr>
<tr>
<td>13</td>
<td>Turkey</td>
<td>Buldan, Honaz, Civril, and Bozkurt in Denizli</td>
<td>6.9%</td>
<td>Akalin et al. (2014) [46]</td>
</tr>
<tr>
<td>14</td>
<td>Iran</td>
<td>Shiraz</td>
<td>33.3%</td>
<td>Hoghoughi, N. and Jalayer, T. (1967) [47]</td>
</tr>
</tbody>
</table>
| 15   | India         | Kashmir valley                                                                 | 6.67%                                      | Chisti, M. - Z.
et al. (2000) [48] |
| 16   | California    | California’s Central Valley from Sacramento south                             | 33.3%                                      | Araujo, F. P.(1975) [49]           |
| 17   | Iran          | Tehran                                                                        | 26.74%                                     | Zohoor, (1989) [50]                |
| 18   | China         | Shiqu County                                                                  | 8%                                         | Budke, C.M.et al.(2005) [51]       |
| 19   | Uruguay       | Florida                                                                        | 1.6%                                       | Carmona, C. et al. (1998) [52]     |
| 20   | Northern Chile | Liman’s province of the Coquimbo region                                       | 2.6%                                       | Acosta-Jamett,G et al.(2014) [53]  |
| 21   | Yemen         | Dhamar and Taiz governates,                                                    | 2.87%                                      | Shaibani, I.A. et al. (2015) [54]  |
| 22   | Iran          | Khorram Abad                                                                  | 15.4%                                      | Zibaei, M. et al.(2012) [55]       |
| 23   | northern Iran | Mazandaran Province                                                            | 31.6%                                      | Hezarjaribi , H.et al.(2017) [56]   |
| 24   | Kyrgyzstan    | Alay valley                                                                    | 25%                                        | Mastin, A.et al.(2015) [57]        |
| 25   | Tunisia       | Kef (sub-humid), Monastir and Sousse (semiariid), Metlaoui, Kasserine, Zarzis and Djerba (arid), and Tataouine (desert) | 25.3%                                      | Banaoues,R.C.et al.(2015) [58]    |
| 26   | Southern China | Fuzhou, Shenzhen, Chongqing, Kunming, Nanchang, Guangzhou and Nanning          | 2.58%                                      | Liao,S. et al.(2016) [59]         |
| 27   | Iraq          | Saedsadq and Sulaimani                                                        | 3.7%and2.4%                                | Mohammed,M.O,(2013) [60]           |
| 28   | North India   | Kashmir region                                                                | 5.03%                                      | Fomda et al(2015) [61]            |
| 29   | India         | Assam, Meghalaya and Mizoram                                                  | 17.02%,27.77%,and18.18%                    | Deka et al. (2008) [62]            |
| 30   | India         | Punjab                                                                        | 15.43 %                                    | Singh et al. (2013) [63]           |
9 REFERENCES


