Original Article	
	
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Title	The Pediatric Hydatid cyst Puzzle: Unmasking a neglected disease
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Abstract : Pediatric hydatid cyst disease caused by *Echinococcus granulosus* presents significant diagnostic challenges due to atypical, often asymptomatic, presentations that mimic other conditions. A retrospective analysis highlights that while lung and liver involvement is common, high-resolution imaging and serological tests enhance detection, making surgical excision and timely intervention

critical for managing this neglected zoonotic threat. For the full article, visit Pediatric Hydatid Cyst Puzzle: Unmasking a neglected disease.

Introduction

Hydatid cyst (HC) is a zoonotic disease caused by cestode class parasite (1). The most common organism causing this disease is Echinococcus granulosus of the phylum Platyhelminthes. It is found globally and appears in four primary forms: cystic echinococcosis (CE), caused by E. granulosus sensu lato (s.l.); alveolar echinococcosis (AE), caused by E. multilocularis; and two rarer neotropical types — polycystic echinococcosis (PE), resulting from E. vogeli, and unicystic echinococcosis (UE), linked to E. oligarthra. (2)

Echinococcus granulosus is the main culprit behind human cystic echinococcosis (CE). Infection happens when hosts ingest the parasite's eggs, which develop into larvae, known as the metacestode stage. Canids, like dogs and wolves, serve as the parasite's definitive hosts, carrying the adult worms in their intestines. Meanwhile, the larval (hydatid) stage flourishes in domestic animals such as sheep, cattle, and camels — the intermediate hosts. Transmission happens through the fecal-oral route when animals or humans accidentally consume contaminated food or water. Since humans don't naturally support the parasite's life cycle, they act as accidental dead-end hosts, meaning the parasite can't complete its development (3)

It is common in areas where pet animals like dogs and cattle were kept. Dogs were the primary hosts for this tapeworm E. granulosus and human beings are the accidental intermediate hosts (4). Hydatis cysts can occur anywhere in the body but most common site of HC in children is lung whereas liver is the most common site in adults (5). The other organs where Hydatis disease can occur are spleen, musculoskeletal system, kidney and very rarely intracranial location.

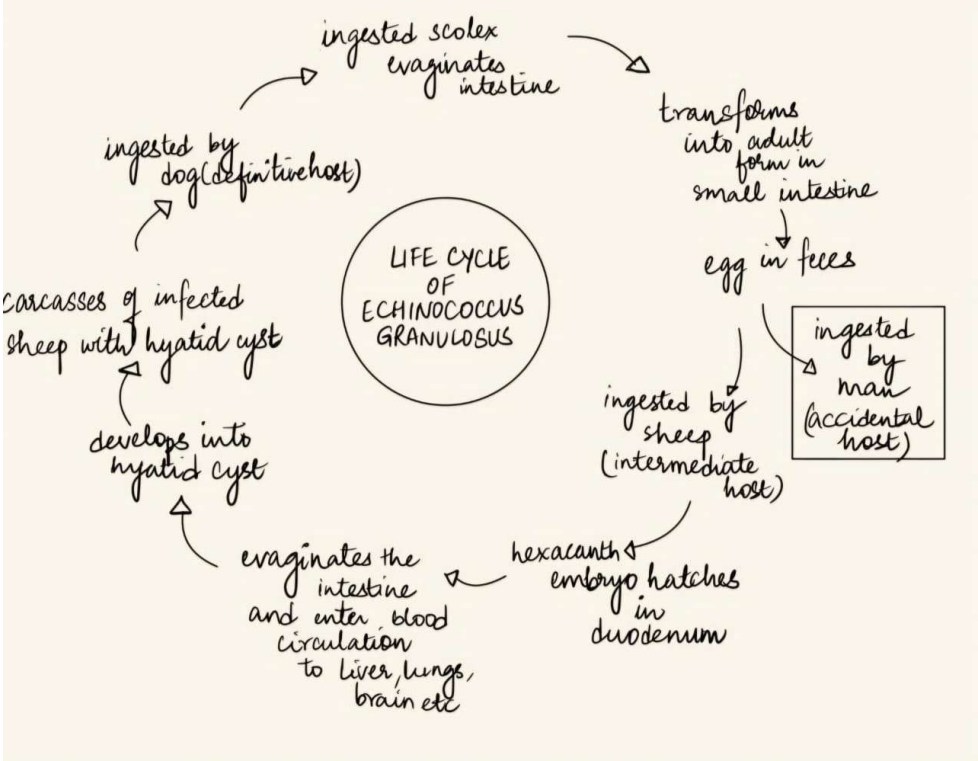
Lifecycle of Hydatid Cyst

Echinococcus granulosus is a parasitic tapeworm that causes cystic echinococcosis (CE) in humans. Infection begins when someone accidentally ingests the parasite's eggs — usually through contaminated food, water, or contact with infected animals. Once inside the body, the eggs develop into larvae, known as the metacestode stage.

Dogs, wolves, and other canids are the primary hosts, carrying the adult form of the parasite in their intestines. Meanwhile, the larval stage grows and forms cysts (hydatids) inside domestic animals like sheep, cattle, and camels. The parasite spreads when eggs are shed in the feces of infected canids and picked up by grazing animals — or occasionally, by humans. Since humans aren't a natural part of the parasite's life cycle, the infection stops with us, making people accidental, dead-end hosts (6-10)

The definitive host of Echinococcus is dog. Adult tape worm generally stays in the small intestine of dogs. This adult worm produces eggs which are then excreted in the stool of the definitive host. These eggs remain alive for a year in humid environment. The intermediate host gets the infection when they ingest these eggs (11,12). These eggs are hatched in the small intestine, penetrates the mucous membrane and enters the blood stream or lymphatic system, from there they can lodge in any organ. After few days fluid filled cyst starts developing and multiple layers will be formed (13,14) (Fig 1).

Fg 1: Life cycle of Echinococcus



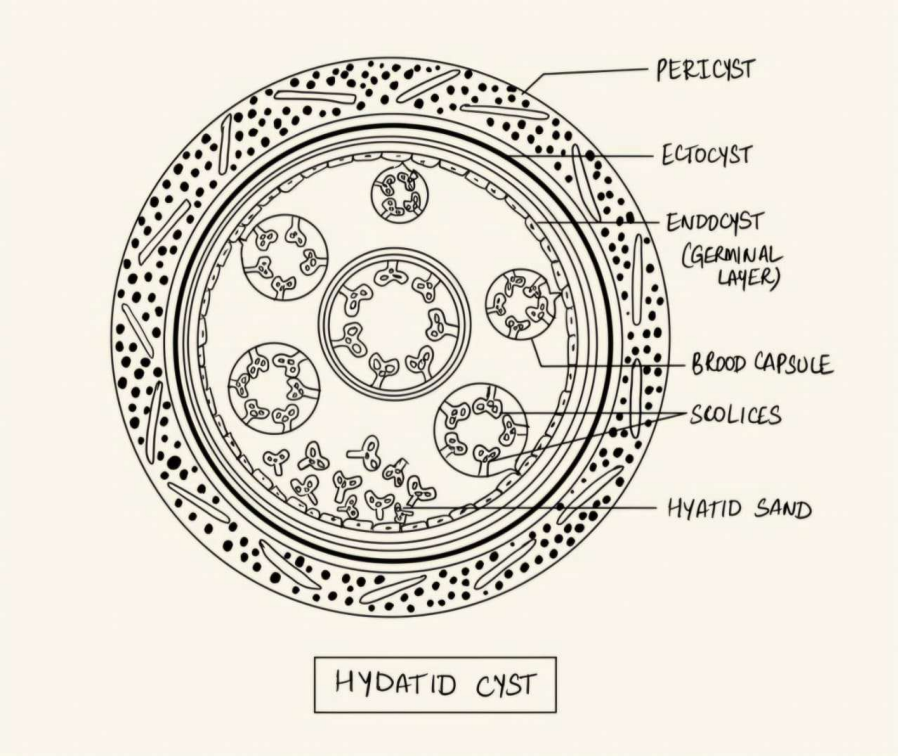
Epidemiology

HC is an endemic disease present worldwide but the highest prevalence of HC is seen in North Africa, Asia, South America and Australia (15). In India it is seen in Madras, Ahmedabad and some parts of Andhra Pradesh and Himachal Pradesh. It is an endemic disease in Rajasthan, Jammu and Kashmir and is more common in the areas where dogs and sheep are raised. The incidence of cystic echinococcosis ranges from 1-220 cases per 100,000 inhabitants and alveolar echinococcosis ranges from 0.03-1.2 cases per 100,000 inhabitants. The prevalence of the disease increases with the age. The primary host being dogs, accidental intermediate hosts are infected by the ingestion of food contaminated with faeces of dog or through direct contact with them (16). Eventhough the incidence is equal in males and females in adults, but in children it is more prevalent in boys because they are more closely associated with animals (17). To prevent the disease there should be brake in the transmission cycle; maintaining hygiene and raising awareness among the general public is also crucial.

Pathophysiology

The cysts can be primary or secondary. Secondary cysts occur after rupture of the primary cyst eg: peritoneal hydatid cyst after rupture of liver or splenic HC. Secondary hydatid cysts occur only in 2% of cases (18). Sometimes the lung involvement can happen by the transdiaphragmatic migration. Hydatid cyst has three layers, innermost layer is the germinal membrane or endocyst which produces hydatid fluid and secondary cysts if ever present, will arise from this layer. The second layer is ectocyst and the outermost layer is the pericyst. The pericyst is a fibrous tissue formed by the host parenchyma (19) (Fig 2). The growth rate of HC is faster in children when compared to adults (20). They enlarge more rapidly in lung when compared to liver because of the elasticity of the compressibility of lung, negative intrathoracic pressure and rich blood supply (21). In 85-90 % of the patients single organ involvement is observed and 60 % of the pulmonary hydatids involves the right lung and among them 50-60 % involves the lower lobes (22). Peripheral calcification and internal hemorrhage are also seen in larger cysts. Intracranial hydatidosis involves the middle cerebral artery territory and multiple intracranial cysts should be investigated for cardiac cysts because myocardial cysts can rupture into left lateral ventricle (23).

Figure 2: Layers of Hydatid cyst



Clinical features

The clinical symptoms and signs of HC depend on the site and size of the cyst. Small cysts are mostly asymptomatic and large cysts produce symptoms related to compression of the surrounding structures or symptoms related to rupture. Non- specific symptoms like low grade fever, myalgia and cough are seen in children with small cysts. Pulmonary HC produces symptoms like cough, dyspnea, chest pain, hemoptysis and expectoration of cyst membranes (24). The lung hydatid can rupture and can present as hydropneumothorax, pneumothorax or empyema. Sometimes they can present with serious complications like severe hypersensitivity reaction, wide spread rash severe bronchospasm and high fever. Sometimes intrabronchial rupture of the cyst can happen sometimes leading to sudden dyspnea and complete bronchial obstruction by hydatid membrane fragments and death (25,26). In cases of liver Hydatid abdominal distention and abdominal mass are the most common complaints. Intraperitoneal rupture is highly fatal with severe anaphylactic reaction. Multiorgan involvement is also reported in children. Liver hydatid causing the pressure effect may lead to obstructive jaundice and biliary rupture may manifest as the classic triad of biliary colic, jaundice and urticaria. Apart from lung and liver, Hydatid disease can affect any organ in the body including spleen, kidney, ureter, heart, brain, pancreas, diaphragm, bone and muscles (27).

Headache, dizziness and reduced level of consciousness are the symptoms in case of cerebral involvement. In case of bony infections they becomes thin and fragile leading to spontaneous fractures. If the child develops anaphylactic reaction, it can manifest with urticaria, rash, bronchospasm, laryngeal edema, wheezing, nausea, vomiting, diarrhea, abdominal cramp, tachycardia, hypotension and cardiovascular collapse.

Diagnosis

History, examination findings, serology and radiological findings together make the diagnosis, as most of them do not have specific symptoms and signs, radiology and serology were the mainstay of investigations to diagnose HC.

Serology

Deranged liver function tests, leukocytosis, eosinophilia, and raised immunoglobulins are seen in some patients. Eosinophilia is seen in 15% of the cases. Serological tests which had a role are complement fixation test, indirect hemagglutination, hydatid antigen dot immunoassay; but enzyme- linked immunosorbent assay (ELISA) is most sensitive and specific (28,29). Antigen 5 and antigen B are the two major antigens used for serological testing of E. granulosus (30,31). Specific Immunoglobulins(Ig) like IgGI or Ig4 increases the specificity rather than choosing total IgG. Negative serology do not rule out HC. Positive serology was observed in 85-95 % of liver hydatid and 65% of lung hydatid (32).

Radiology

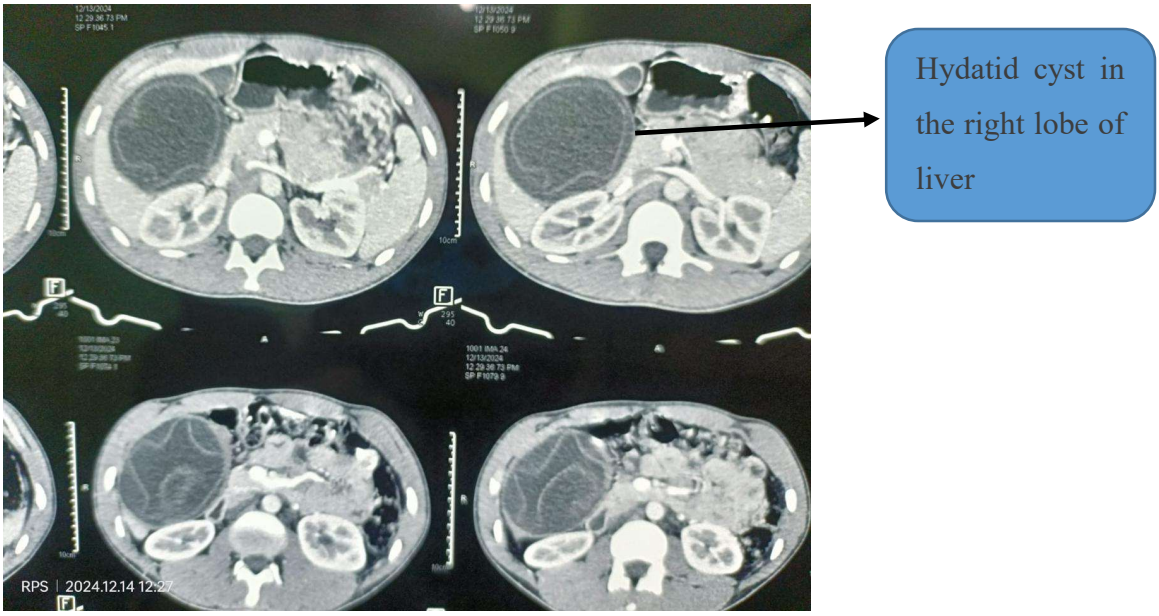
Well circumscribed homogenous lesion is noted on chest radiograph. Egg shell calcification is noted in dead cysts. On sonography HC may appear as simple cyst or simple cyst with haemorrhage due to hydatid sand. ‘Escurado- Nemerow’ sign is, change in the size of the intact cyst during inspiration and expiration (33). When there is rupture of pericyst causing air to enter between the pericsy and the endocyst ‘moon sign’ is observed (34). ‘Water lilly’ sign is observed when the mebrane floats after the rupture of pericyst and endocyst (35). ‘Double domed arch sign’ is seen when both the membranes got ruptured and fluid extravasated in between them (36). Ultrasound (USG), contrast enhanced computed tomography (CECT) and magnetic resonance imaging (MRI) can reveal undulating membranes and daughter cysts. Ultrasound and CECT (Fig 3) are suitable imaging modalities to diagnose HC. Gharbi’s classification is widely used now

which is based on radiological findings. It includes five stages; stage 1: homogeneously hypoechogenic cystic thin-walled lesion, stage 2: septated cystic lesion, stage 3: cystic lesion with daughter lesions, stage 4: pseudo-tumor lesion and stage 5: calcified or partially calcified lesion (inactive cyst) (37).

Table 1: Correlation between the Gharbi and WHO-IWGE Sonographic characteristics (37)

Gharbi	WHO-IWGE	Sonographic Characteristics
-	CL	Unilocular Cyst, anechoic, no wall depicted
Type 1	CE 1	CL characteristics + wall + mobile internal echogenicities
Type 3	CE 2	Multivesicular, multiseptated cyst, daughter cysts, honeycomb pattern
Type 2	CE 3	Detached membrane (water-lily sign)
Type 4	CE 4	Heterogenous, hypo or hyper echoic cyst, no daughter vesicles
Type 5	CE 5	Cyst with a partial or complete wall calcification

Fig 3 – CECT showing Liver



Management

Although medical and surgical treatment play a role, surgical intervention is the mainstay of treatment

Medical Management

Benzimidazole group of drugs like albendazole and mebendazole are most commonly used in the treatment of HC. The role of Praziquantel for primary drug therapy has not yet been demonstrated, but can be used in combination with albendazole (38). These drugs inhibit the polymerization of ß-tubulin into microtubules thereby inhibiting the glucose uptake and transport which leads to energy depletion and death of the organism. Medical management is mainly considered in cases of multiorgan involvement or disseminated disease and multiple peritoneal cysts (39). Before surgery it can be given for 1- 4 weeks and continued after surgery for 1-3 months. The treatment can be given in cycles of 28 days with two weeks treatment free period. Short term medical treatment after surgery decreases the rate of complications and also recurrence (40). The recommended dose of albendazole is 10-15 mg/kg/day in two divided doses. Only medical treatment was offered in patients with small multiple cysts involving both lobes and can be discontinued once the cyst becomes inactive. Medical therapy in HC especially in pulmonary HC weakens the cyst wall making it more prone for rupture, hence care should be taken while handling

the pulmonary HC intraoperatively. The complications with albendazole are headache, anemia, leukopenia, thrombocytopeniaand increased liver enzymes. Different drugs used to treat the anaphylactic reaction in children are pheniramine maleate, antihistamine and corticosteroids and supportive measures.

Percutaneous aspiration – injection and re-aspiration (PAIR) technique (41,42)

It is a minimally invasive technique, and the acronym PAIRD is used when a catheter is left in the cyst cavity temporarily for drainage. Indications for the procedure include type I and II of Gharbi's classification, size of the cyst >5 cm, children more than 3 years or in whom surgery is contraindicated or who refuse surgery and in patients who relapse after surgery. Contraindications of PAIR are cysts in the inaccessible location, cysts in brain and heart, cysts which are communicating with the biliary tree or which are ruptured into abdominal cavity, bronchi. The procedure include puncturing the cyst with cannula under USG guidance, aspiration of the contents of the sac followed by injection of scolicidal agents into the sac for approximately 15 minutes and then reaspiration of the contents until the return is clear. Different scolicidal agents which can be used are hypertonic saline (20%), cetrimide (0.5%) + chlorhexidine (0.05%), absolute alchol, povidine iodine, formalin, hydrogen peroxide, 0.5% silver nitrate. (42) The advantages with this technique are shorter hospital stay, less morbidity and mortality with low recurrence rates.

Surgical management

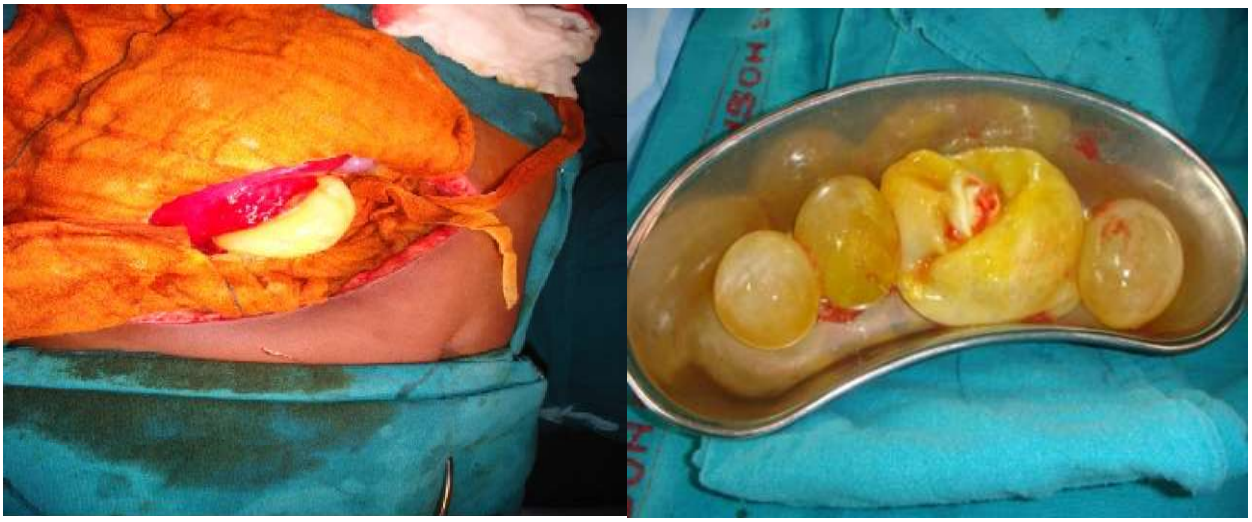
It is the mainstay of treatment. The surgical principles of HC are removal of the cyst, preservation of parenchyma, obliteration of the residual space and prevention of the intraoperative cyst rupture. Various surgical options for lung hydatid are enucleation, removing the intact cyst after aspiration, pericystectomy, wedge resection, segmentectomy and lobectomy. Enucleation is possible in smaller cysts. Enucleation is removing the cyst with germinative membrane. Pericystectomy is removing the HC along with the pericyst which include non-anatomical resection of cyst and the surrounding compressed host tissue. But in lung HC it increases the chance of air leak and pneumothorax. The residual cavity can be managed by marsupialization, capitonnage, partial pericystectomy and omentoplasty. Barrets method is removing the cyst along with the membrane and applying purse string sutures with non-absorbable sutures to bring the walls of the cyst closer (43). If there are multiple cysts in a single lobe, then pulmonary resection or lobectomy can be

considered. In cases of smaller cysts, minimal invasive procedure like video assisted thoracoscopic surgery (VATS) can be attempted. In case of liver HC (Fig-4) cystotomy and pericystectomy were more commonly preferred surgical techniques, but sometimes it may require hepatectomy. Chances of intra- peritoneal rupture of liver HC increases if the size of the cyst is more than 10 centimeters or if it is superficially located. Small hepatic HC can be managed by laparoscopy. A special instrument used in laparoscopy is perforator-grinder-aspirator apparatus, it penetrates the cyst grinds all the particulate matter and sucks out. The advantage with it is, it does not get blocked by daughter cysts or laminated membranes.

Post-operative Complications

In lung HC, especially if pericystectomy increases the chance of air leak, tension pneumothorax, in the early post-operative period and atelectasis, bronchopleural fistula later (44). Bile leak and biliary fistula, cholangitis, sepsis and intraperitoneal abscess can happen after pericystectomy of liver HC. Cavity abscess is also one of the known complication which can be managed conservatively with pig tail drainage and antibiotics (45).

Fig 4 – Intra-operative picture showing (a) Liver hydatid cyst which was packed all around to avoid intraperitoneal spillage (b) daughter cysts in a Hepatic hydatid cyst



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