• Review •

Cysticercosis of the eye

Rebika Dhiman, Saranya Devi, Kavitha Duraipandi, Parijat Chandra, Murugesan Vanathi, Radhika Tandon, Seema Sen

Dr Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi 110029, India
Correspondence to: Murugesan Vanathi. Dr Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi 110029, India. vanathi_g@yahoo.com
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Abstract

• Cysticercosis is a preventable and eradicable cause of blindness endemic in the Indian subcontinent, South-East Asia and other developing countries. Ocular and orbital cysticercosis has varied presentations depending upon the site of involvement, number of lesion and the host immune response. In this article we present a review of the various clinical manifestations, diagnosis and management protocol for orbital and ocular cysticercosis. Owing to its varied presentation, cysticercosis may pose a diagnostic challenge to the health professionals. Early diagnosis and management can prevent the vision loss and optimize visual outcomes.

• **KEYWORDS:** cysticercosis; orbital cysticercosis; ocular cysticercosis; intracameral cysticercosis

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INTRODUCTION

Cysticercosis is a preventable cause of blindness endemic in India[1]. It is a parasitic infestation caused by Cysticercus cellulosae, which is the larval form of Taenia solium. In 1829, Soemmering[2] reported first case of a live anterior chamber cysticercosis. World Health Organization recognized neural cysticercosis as an international public health issue and major cause of epilepsy. Neurocysticercosis was found to be the most common cause of epilepsy in a study from South India[3]. A review of literature on orbital and adnexal cysticercosis shows predilection for children and young adults with no sex predilection[4-5].

PATHOPHYSIOLOGY

Taenia solium belongs to the class of cestodes. Human beings are definitive hosts that harbor the adult parasite in the intestine and pigs are the intermediate hosts harboring the larvae. Human cysticercosis occurs when they act as intermediate host by ingesting the eggs via following modes of infestation: 1) contaminated food and water with the Taenia solium eggs (hetero-infection); 2) reinfection by ingestion ova of the existing parasite (external auto-infection); 3) retrograde peristalsis causing the transport of mature proglottids bearing eggs from bowel to stomach (internal auto-infection).

After ingestion, the eggs of Taenia solium hatch into larvae, which pierce the gut to reach the blood stream and enter various tissues (particularly the central nervous system, eyes and striated muscle)[5] where they develop into cysts producing the clinical syndrome of cysticercosis. Neurocysticercosis can coexist in up to 24% of the cases[6].

Cysticercus celluosae mainly has three stages of evolution. The live or vesicular cyst is the living cyst with a well-defined scolex (Figure 1). It causes minimal or no inflammation in the tissue. As larva begins to die the cyst wall becomes leaky, releasing toxins and causing varying degrees of inflammation. This is the colloidal vesicular stage. Eventually, the larvae die and are either totally resorbed or calcified. This is the calcified nodular stage[7].

Cysticercosis is found in the areas with poor sanitation and is endemic in South East Asia, Indian subcontinent, Mexico, South America and sub-Saharan Africa[5]. Ocular cysticercosis has a varied presentation depending upon the site of involvement, number of lesion and the host immune response. In contrast to Western literature, Indian studies have reported ocular adnexa as the most common site of involvement. While the most common site of localization reported in Western studies is the posterior segment, in the Indian literature the ocular adnexa is the most common site[8-10]. In a study reported by Kruger-Leite *et al*[11], 35% of the cysts were found in the subretinal space, 22% in the vitreous, 22% in the subconjunctival space, 5% in the anterior segment, and only 1% in the orbit. In India, 78% of the cases with ocular cysticercosis have been reported from states of Andhra Pradesh and Pondicherry[10-12].

ORBITAL CYSTICERCOSIS

Orbital and adnexal cysticercosis have varied clinical presentation. The extraocular muscle form is the commonest type of orbital and adnexal cysticercosis. Lodgment of cysts in the subconjunctival space is another common site, followed by the eyelid, optic nerve and retro-orbital space. Lacrimal sac cysticercosis has also been reported[13]. Association between orbital and systemic cysticercosis is uncommon.

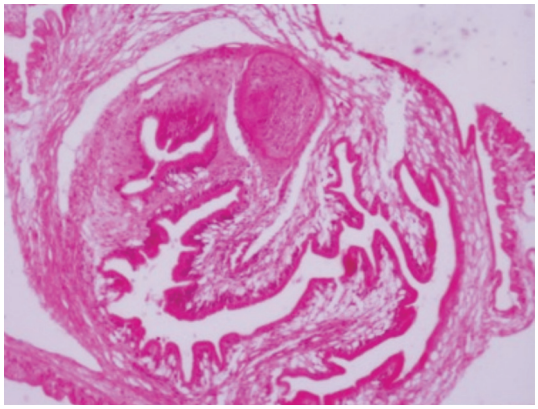

Figure 1 Histopathological appearance of cysticercus showing scolex with sucker and hooklets surrounded by a well-defined cyst wall.

The common clinical complains are periocular swelling, proptosis, ptosis, pain, diplopia, restriction of ocular motility, strabismus, decreased vision, lid edema and orbital cellulitis like clinical picture. In cases of extraocular muscle involvement (Figure 2) superior rectus muscle is the most common site[14]. Subconjunctival presentation could be a secondary stage in those cases in which the cyst may have extruded from the primary extra ocular muscle site[15]. It has to be differentiated from other benign and malignant conditions presenting as ocular mass. One or more extraocular muscles may be simultaneously involved, although a propensity for the involvement of superior rectus muscle complex and lateral rectus muscles has been reported[14-15]. An unusual association of multiple brain neurocysticercosis with ocular cysticercosis involving levator palpebrae superioris and superior rectus muscle has been reported[16]. Another study has reported an unusual case of ocular cysticercosis involving the levator palpebrae superioris and superior rectus muscle[8,17].

Optic nerve involvement is rare. Optic nerve compression by the cyst may be associated with decrease in vision and disc edema[18]. A large cyst may cause axial proptosis and restricted ocular motility. A case of cyst with hooklets on the optic disc has been reported who also had sub-cutaneous and cerebral involvement[19].

The differential diagnosis of orbital cysticercosis includes idiopathic myositis, tumours or metastasis, muscle abscess or haematoma, and other parasitic infections like hydatid cyst.

Diagnosis of Orbital Cysticercosis The diagnosis of orbital and adnexal cysticercosis is based on clinical, serological, and radiological findings. The clinical findings may occasionally be non-specific and hence, non-diagnostic. Serological tests used for the specific diagnosis are indirect hemagglutination, indirect immunofluorescence, and immune electrophoresis such as enzyme-linked immunosorbent assay (ELISA)[20]. The serology may show false positive reports. Thus, imaging studies are the most helpful in establishing the diagnosis. High resolution ultrasonography (USG), computed tomography

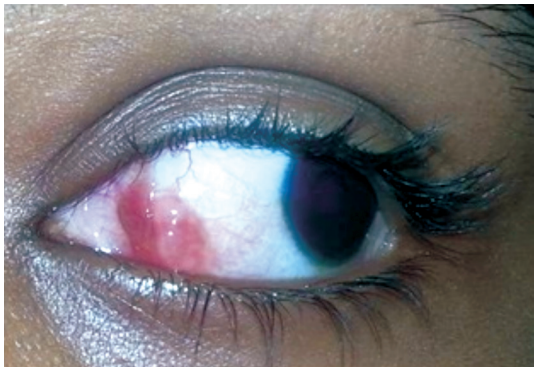

Figure 2 Clinical photograph showing subconjunctival cysticercosis.

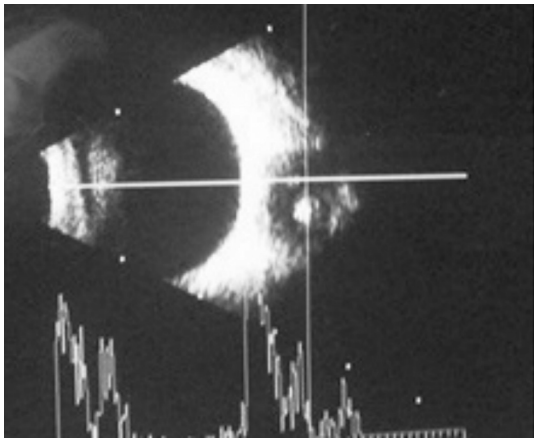

Figure 3 Ultrasonography of orbit showing a well-defined cyst lined by a cyst wall and a hyperreflective scolex.

(CT) and magnetic resonance imaging (MRI) help in detection of the orbital cyst. Stool examination for the adult worm may be performed in cases of suspected cysticercosis.

On B-scan ocular ultrasonography, a well-defined cyst with a hyperechoic scolex is seen[21]. On A-scan, high amplitude spikes corresponding to the cyst wall and scolex is appreciated (Figure 3). The scolex shows a high amplitude spike due to presence of calcareous corpuscles[7]. Ocular ultrasonography is a useful tool for diagnosis and monitoring of the cyst during treatment.

CT scan of the orbits reveal a hypodense mass with a central hyperdensity suggestive of scolex. Adjacent soft-tissue inflammation may be present (Figure 4). The scolex may not be visible if the cyst is dead or ruptured and has surrounding inflammation. Concurrent neurocysticercosis should be excluded[5]. MRI reveals a hypointense cystic lesion and hyperintense scolex within the extraocular muscle. A complete blood count may reveal eosinophilia[22].

ELISA for Follow-up In a recent study[23], ELISA using larval somatic and excretory secretory (ES) antigens was positive in 32.5% and 45% cases respectively. Anti-ES antibodies were detected more frequently in cases having extra ocular cysts compared to intraocular location. These indigenous serum IgG ELISAs might be useful as an adjunct to existing tools for diagnosis and in post treatment follow up of extraocular form of cysticercosis in particular.

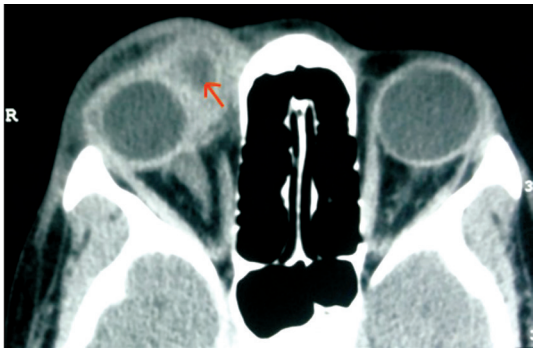

Figure 4 CT scan of the orbit showing well defined cyst involving the right sided medial rectus muscle suggestive of myocysticercosis (arrow).

Management of Orbital Cysticercosis In case of subconjunctival cyst, excision biopsy is done to confirm the diagnosis followed by CT scan imaging to rule out neurocysticercosis. In cases with proptosis, restricted motility, inflammation or ptosis CT imaging must be performed to rule out any cystic intramuscular lesion with scolex. If such a lesion is present or ELISA is positive, oral albendazole[24] (15 mg/kg) and oral steroid (prednisolone 1 mg/kg) are given. In the presence of a cystic lesion without scolex or when ELISA is negative, oral steroids must be prescribed.

In case of recurrence, repeat CT scan is required, and if there is a cystic lesion, a repeat course of albendazole and steroid is to be given. When there is no evidence of a cystic lesion then biopsy is indicated.

Medical therapy is the recommended treatment for the extraocular muscle form and retro-orbital cysticercosis[25]. Surgical removal is advocated for subconjunctival and eyelid cysticercosis. Treatment of optic nerve and lacrimal gland cysticercosis is controversial due to the limited number of cases involving the optic nerve and lacrimal gland.

OCULAR CYSTICERCOSIS

Intraocular cysticercosis can involve either the anterior or the posterior segment. While anterior segment cysticercosis is rarely seen, posterior segment involvement common.

Posterior Segment Cysticercosis In the posterior segment of the eye, vitreous cysts are more common than retinal or subretinal cysts and the inferotemporal subretinal cyst is most frequently encountered[26].

It is hypothesized that the parasite reaches the posterior segment of the eye *via* the high flow choroidal circulation through the short ciliary arteries. The macular region being the thinnest and most vascularized, the larvae lodges itself in the subretinal space from where it perforates and enters into the vitreous cavity. In this process, the parasite can cause a retinal detachment, macular hole or incite an inflammatory response. As the cyst develops, it causes atrophic changes of the overlying retinal pigment epithelium. Sometimes, it may cause exudative retinal detachment and focal chorioretinitis. The central retinal artery is the most likely route for cysticercosis involving the optic nerve head. Very few cases of optic nerve cysticercosis have been reported in literature[27]. In a case report, surgical removal of the cyst was attempted for the optic nerve cyst near the entrance of the optic canal with remarkable visual recovery[28].

A dying cysticercosis cyst can incite a severe inflammatory response, due to the leakage of the toxins from the micro perforations present in the cyst wall[4]. Inflammatory reaction can be present even with living parasite, and more so with vitreous cysts than subretinal cysts. Complications of intraocular cysticercosis include severe inflammation (vitreous exudates, organized membranes in vitreous), severe anterior chamber reaction, retinal haemorrhages, retinal detachment, proliferative vitreoretinopathy, secondary glaucoma, complicated cataract, hypotony and phthisis. Hence, differential diagnosis of posterior segment cysticercosis includes the various causes of leukocoria, choroidal tumours, serous retinal detachment and other parasitic infections like toxoplasmosis and rarely diffuse unilateral subacute neuro-retinitis.

Diagnosis of Posterior Segment Cysticercosis The diagnosis of cysticercosis is made by the clinical findings and supported by other tests like serological tests (ELISA), USG (A and B scan), CT scan and MRI scan.

On indirect ophthalmoscopic examination, a live cyst can be seen as a translucent white cyst with dense white spot formed by the invaginated scolex with typical undulating movements (Figure 5). Serodiagnostic test is helpful but not specific.

A scan ultrasonography shows high amplitude spikes corresponding to the cyst wall and scolex, and B scan ultrasonography shows hanging drop sign *i.e.* echoes corresponding to the cyst with the scolex attached to the inner wall (Figure 6)[29]. CT scan of the orbit is an effective technique to establish a diagnosis of ocular cysticercosis. It is fast and economical when compared to MRI. Cysticercus is seen as a hypodense mass with a central hyperdense scolex[30]. The scolex may not be picked up if the cyst is dead or ruptured and has surrounding inflammation. Neurocysticercosis must be excluded by MRI or CT scan.

Treatment of Posterior Segment Cysticercosis Untreated intraocular cysticercosis incites severe ocular inflammation, more so when the cyst dies. Hence, surgery is the treatment of choice.

Intravitreal cysts Various modalities have been described in the surgical management of intravitreal cysticercosis such as diathermy, photocoagulation and cryotherapy. But these methods have now become obsolete as it results in the release of toxins from the cyst causing severe intraocular inflammation. Surgical removal of the cyst can be through either the transretinal or transscleral route. Earlier, it was

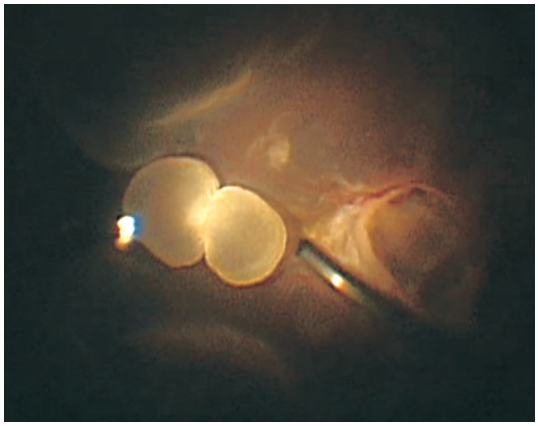

Figure 5 Intraoperative clinical photograph showing a posterior segment cysticercosis in the vitreous.

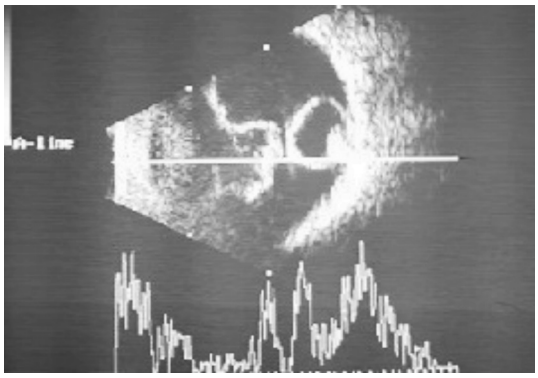

Figure 6 Ultrasonography of the globe revealing a well-defined cystic lesion with a hyper-reflective scolex suggestive of intravitreal cysticercosis. There is associated complete posterior vitreous detachment with attached retina.

recommended that the cyst could be removed *intoto* through one of the ports. The rationale was that the *intoto* removal would help prevent any rupture of the cyst and release of toxic cyst products into the ocular cavity that may induce severe vitritis.

In the era of microincision vitrectomy surgery (MIVS), removal of the cysts using the vitreous cutter is advocated. The high speed cutting rates with the maximum suction ensures that the cyst contents barely come in contact with the ocular structures with minimum release of toxins. Systemic corticosteroids are used before and after surgical removal of the cysticercosis cyst. Medical therapy other than corticosteroids is not advocated.

Subretinal cyst Earlier, small subretinal cysticercus was treated with xenon or argon photocoagulation. Subretinal cysts anterior to the equator may be removed transsclerally, whereas subretinal cysts posterior to the equator are best removed transvitreally[6]. The cyst has to be localized with indirect ophthalmoscopy, the exact site marked with diathermy. A radial sclerotomy of adequate size is made at this site, and preplaced sutures are placed. The choroid is exposed and obvious blood vessels cauterized. Indirect ophthalmoscopy should be repeated to confirm that the parasite had not moved. The cyst can be removed through the choroidal incision with gentle pressure on the globe.

Pars plana vitrectomy is the safest and effective technique to remove the cyst by creating a retinotomy and bringing the cyst into the vitreous cavity. This method ensures complete removal of the toxin and the remnants of the parasite. Also, it avoids extensive periorbital dissection ensuring adequate retinopexy and retinal reattachment with faster recovery.

Communicating cysticercosis Kumar *et al*[31] first described a viable intravitreal cysticercus cellulosae in communication with subretinal space. The cyst was removed *intoto via* the direct scleral approach without incident. Multiple cysts in the same eye at different locations may be present[32]. There may be a rhegmatogenous retinal detachment associated with it. The current modality of treatment is pars plana vitrectomy. Post-surgery, 86% of cases had attached retina after 10mo. The visual acuity correlated with preoperative visual acuity. A vision loss of two lines was noted in 25% patients[6]. With timely pars plana vitrectomy, good visual acuity can be achieved in patients with intravitreal and sub retinal cysticercosis without macular involvement.

Anterior Segment Cysticercosis Anterior chamber cysticercosis is an unusual presentation and the occurrence of a live free floating cyst in the anterior chamber is a rarer occurrence with very few sporadic case reports of intracameral cysticercosis in literature[33].

The route entry of the cyst in the anterior chamber is debatable. It can enter the anterior chamber from posterior segment through the pupil in aphakes, through vessels supplying the ciliary body[34-35] or through the anterior chamber angle[8]. Ocular cysticercosis is commonly seen in the younger age group of first or second decade with no definite gender predilection[36].

The cyst may be adherent to the adjacent structures like the iris, anterior lens capsule or corneal endothelium by a stalk[37], or rarely remains freely floating in the anterior chamber[38]. The patient remains asymptomatic if the cyst is small or may present with complaints of diminution of vision, floater or leukocoria. There may be pain and redness with associated iridocyclitis[39-40] or glaucoma. Glaucoma may be inflammatory in the presence of iridocyclitis[39] or due to pupillary block caused by the cyst[41]. Intracameral cysticercosis has been confused with cataract[41] or anteriorly dislocated lens[42].

The clinical diagnosis of live intraocular cysticercosis is based on the morphology of the parasite as visualized with the ophthalmoscope or slit-lamp biomicroscope. The cyst and the scolex show characteristic undulating movements. When the scolex is invaginated, a dense white spot called the receptaculum capitis[43] indicates its location within the cyst (Figure 7).

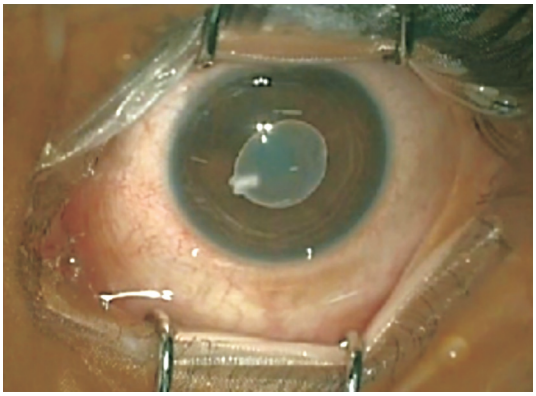

Figure 7 Clinical photograph showing an intracameral cysticercosis with invaginated scolex.

As long as the cyst is live, the anterior chamber reaction is absent or minimal. The degenerative stage of dead scolex results in release of large amount of toxins and heterologous protein causing a significant fibrinous reaction at the site of the cyst[4].

Laboratory studies are of limited value in intraocular cysticercosis. Eosinophilia is usually absent unless there is widespread dissemination of the parasite. Serological tests lack sensitivity[44]. The indirect haemagglutination test shows cross reactivity between cysticercosis and echinococcosis. Evidence of intestinal Taenia solium is seldom found in human cysticercosis. Imaging like ultrasonography of the posterior segment and orbit, CT scan or MRI of the brain helps to rule out other sites of involvement by the cyst- both ocular as well as systemic, especially neurocysticercosis.

As anthelminthic therapy can lead to severe inflammation in the event of a live cyst degenerating, surgical removal of the parasite intoto is the mainstay of treatment. Systemic cysticercosis should be ruled out especially neurocysticercosis with the adequate neurosurgical examination and management of the same, as it would require anthelminthic therapy with steroid cover after intracameral cyst removal. The different surgical modalities of surgical removal of anterior chamber cysticercosis cyst include paracentesis, cryoextraction, erysiphake extraction, extraction with capsule forceps and viscoexpression[33].

Viscoexpression is the treatment of choice as it is a simple and safe technique with minimal surgical manipulation in the anterior chamber, minimal risk of cyst rupture and does not require any sophisticated instrumentation or machinery. Beri *et al*[33] first described this procedure through a single 3 mm supero-temporal incision. Another modification of this technique is a double-incision viscoexpression method described by Kai *et al*[38] for the removal of a large intracameral cyst. Intracameral cysticercosis is a rare occurrence and a timely diagnosis and intervention can optimize the visual outcome.

Cysticercosis is a disease closely related to improper hygiene and sanitary conditions. Therefore prevention by health education of the population is an important aspect of disease control. Prevention is possible by avoiding the consumption of undercooked or raw pork, proper washing of hands after using toilets and before food handling and by washing and peeling of raw vegetables and fruits before eating. Ocular and orbital cysticercosis has varied clinical manifestations depending upon the site of involvement, stage of the cyst and the host-immune responses. With the advent of the new imaging techniques, ocular and orbital cysticercosis is now increasingly diagnosed even in non-endemic zones. A high index of suspicion along with characteristic features on imaging helps us to establish an accurate diagnosis and initiate appropriate treatment depending upon the site of involvement.

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