Echinococcosis, hydatid disease and hydatidosis are terms usually applied interchangeably to the zoonotic infections caused by the adult and larval stage (metacestode) of the cestode genus *Echinococcus*. In the present study the term hydatidosis or hydatid disease is restricted to infection with metacestode, while echinococcosis is applied to adult worm infection.

Hydatid disease is one of the most serious helminthic zoonoses. It is caused in humans and livestock by the post-larval, metacestode stage (hydatid larva) of the tapeworm *Echinococcus* which belongs to family: Taeniidae; order: Cyclophyllidae; class: Cestoda and phylum: Platyhelminthes.

**General description of the parasite**

*Echinococcus* spp. are small tapeworms, rarely more than 7mm in length. The scolex bears four suckers and there are two rows of hooks, one small and one large in size on the rostellum. The number and length of which may vary according to the species. The number of proglottids of the body varies from two to six. The genital pore opens laterally and its position depends on species. The cirrus sac is horizontal or tilted anteriorly and the vitellarium is globular.
The eggs are ovoid (diameter about 30-90\(\mu\)m) consisting of a hexacanth embryo (oncosphere) surrounded by several envelopes, the most noticeable one being the embryophore, which gives the egg a dark striated appearance.

The metacestode (hydatid larvae) basically consists of a bladder with an acellular laminated layer and an inner nucleated germinal layer, which may give rise by asexual budding to brood capsules. Protoscolices arise from the inner wall of the brood capsules or from the germinal layer.

**Life Cycle**

Hydatid disease is a cyclozoonotic infestation i.e., a parasitic disease that humans share with other vertebrates but that requires at least one other vertebrate host to complete its life cycle (Redford, 1984).

*Echinococcus* spp. require two mammalian hosts for completion of their life-cycles. Proglottids containing eggs or free eggs are passed in the faeces of the definite host, a carnivore. The eggs are highly resistant to physical factors and can remain infective for a long period in a suitable environment. The intermediate host, represented by a wide range of mammals acquires infection by the ingestion of eggs. Following the action of enzymes in the stomach and small intestine, the onchosphere is released from the keratinized embryophore. Bile assists in activating the oncosphere, which penetrates the wall of the small intestine. Penetration is then aided by the hook movement and possibly by secretion of the oncosphere. Upon gaining access to a venule or lacteal, the oncosphere is passively transported to the liver, where some are retained others reach the lungs and a few may be transported further to the kidneys, spleen, muscles, brain or other organs.
c) Larval stage (Hydatid cyst) of *Echinococcus granulosus*.

a) Adult *Echinococcus granulosus*.

b) *E. granulosus* egg.

d) Section of hydatid cyst wall with brood capsules.

Photographs showing the various stages in the life cycle of *E. granulosus*. 
Once the oncosphere has reached its final location it develops into the metacestode (hydatid larva) stage. Time of development is variable and it may take several months before protoscolices are produced (fertile metacestode). All metacestodes do not produce protoscolices (sterile metacestode). When protoscolices are ingested by a suitable definitive host, following the action of pepsin in stomach, they envaginate in the upper duodenum in response to a change in pH and exposure to bile. They then develop to the sexually mature tapeworms, approximately four to six weeks after infection, depending on the species and on the susceptibility of the host.

**General Pathology of Hydatid Disease**

No parasite produces lesions in as many anatomical sites as does *E. granulosus*. The adult worms of *E. granulosus* in dogs do not cause much inconvenience. They are found in large numbers (by hundreds or even thousands) in the small intestine of an infested dog where they lie embedded in the mucous membrane and appear on postmortem, as small white specks on the reddish mucous surfaces (owing to the minuteness of size, they are often overlooked).

The larval form (hydatid cyst) of *E. granulosus* causes unilocular hydatid disease in man and livestock. Hydatid cysts have been detected practically in every tissue of the body. Transport of the embryo by means of the circulation appears to explain all the facts concerning distribution.

The great majority of embryos carried by the portal blood stream are arrested in the liver and about 70% of primary cysts are found in that organ. The liver is the first filter or "hepatic filter". Some of the ova pass through the liver capillaries and lodge in the lungs that are affected next
in frequency. This is the second or "pulmonary filter". From lungs via
the pulmonary veins these ova migrate to the left heart, and from there
they are distributed to each and every part of the body "the peripheral
filter". Wherever they lodge they get converted into tiny vesicles-the
hydatids, which slowly grow in size to enormous dimensions.

With the advancement in its development, the cyst enlarge but
its annual increase in diameter becomes less. The structure of the
adventitia becomes more fibrous and degeneration is common.
Judging from the size of the cyst the nature and the thickness of
adventitia, the frequency of daughter cyst formation, the presence of
calcareous deposits and the occurrence of other complications, it is
certain that many of the large hepatic cysts found in adults are of
very long standing. The occurrence, in the presence of some large
hepatic cysts, of complete compensatory hypertrophy of the other
lobe of the liver is also evidence of long age of these cysts. Many of
these cysts are from 30-40 years old, having been acquired in
childhood and giving few, if any, symptoms until they reach
enormous size. Deve, (1916) in one of his monographs, sums up the
situations admirably by stating: "Le kyste hydatique de l'adult est
un kyste deja age". (The cyst is as old as the patient).

The parasite becomes vesicular at the end of two or three weeks
and grows slowly from the accumulation of fluid with in the semi-
permeable laminated membrane into a unilocular cyst. As it grows the
tissue reaction in the host leads to the formation of a fibrous
adventitious capsule. The adventitia thus formed becomes tough and
comparatively avascular, it merges gradually into the fibrous stroma of
the surrounding tissue and exerts a restraining influence on the growth
of the cyst. In some situations it is poorly developed. The adventitia is
well developed in hepatic hydatids, poorly developed in pulmonary hydatids. There is no adventitial reaction in brain and bone hydatids and also in *Taenia multilocularis*. The last mentioned condition causes what is known as "malignant hydatid disease".

As the cyst enlarges it may exert pressure on any structure and since practically any organ may be affected, it can readily be understood that bizarre and protean manifestation may be produced. Owing to the extremely slow growth and the fact that infestation occurs most frequently during the growth period, compensatory changes frequently occur. This is one of the explanations of the latency of even enormous complicated cysts which are sometimes seen. This is particularly well shown in the liver in which a large cyst occupying the greater part of the right lobe may lead to compensatory hypertrophy of left lobe.

The disease is characterized by its latency. The symptoms of the disease are mostly due to the complications which occur in the course of the disease. These complications include:-

1. Suppuration
2. Rupture into:
   (a). Abdominal Cavity
   (b) Biliary Tree.
   (c). Pleural Cavity/ Bronchial Tree.
   (d). Blood Vessels
   (e) Hollow Viscous
3. Anaphylaxis

   It is the onset of complications such as rupture, suppuration, implantation, recurrence or metastases, that makes the disease, not much inferior to malignant disease.
The most important factor in diagnosis of hydatid disease is the awareness of its possibility. The striking clinical resemblance between hydatid disease and malignant disease of some organs makes the correct diagnosis essential. In countries where this disease is endemic, any growing mass or tumour should arouse suspicion of hydatid disease.

A hydatid cyst can be primary or secondary. Primary cysts are those which develop from the hexacanth embryo. The hexacanth embryo is derived from the ova which are passed by the dogs in their faces and taken by the intermediate hosts. The secondary cysts develop from the brood capsules, scolices and daughter cysts. When a primary cyst ruptures, the scolices, daughter cysts and brood capsules are released into the adjacent tissues, and the cyst developing from these are termed secondary hydatid cysts.

**Species of genus Echinococcus**

At present four species of the genus *Echinococcus* are regarded as valid taxonomically. These are *Echinococcus granulosus* Batsch, 1786 causing unilocular or cystic hydatid disease; *Echinococcus multilocularis* Leukart. 1863 responsible for alveolar hydatid disease; *Echinococcus vogeli* Rausch and Bernstein, 1972 causing the less common polycystic form of hydatid disease; and *Echinococcus oligarthrus* Diesing, 1863 for which, to date, there is no confirmed involvement of man in the life-cycle. The four species possess distinct morphological characteristics in the adult and metacestode stage (Thompson and Allsopp, 1988), and are further distinguished by their degree of host-specificity and geographical distribution. These are summarized in Table -1.1.
Table 1.1 Species which have been taxonomically recognized within the genus *Echinococcus*.

<table>
<thead>
<tr>
<th>Species</th>
<th>Geographical distribution</th>
<th>Host range</th>
<th>Location</th>
<th>Proctoscolex hooks</th>
<th>Adults</th>
<th>Metacestode Type</th>
<th>Position of genital pore</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. granulosus</em> (Batsch, 1786)</td>
<td>Cosmopolitan</td>
<td>Primarily dogs and other canids</td>
<td>Visceral, primarily liver and lungs</td>
<td>Mean length (µM) of large hooks (range) 25.9-35.0 (19.4-44.0)</td>
<td>Mean length (µM) of small hooks (range) 22.6-27.8 (17.0-31.0)</td>
<td>Unilocular (cystic)</td>
<td>Mature segment: Near (usually posterior) to middle posterior to middle</td>
</tr>
<tr>
<td><em>E. multilocularis</em> (Leucox, 1863)</td>
<td>Holarctic</td>
<td>Primarily foxes but also other canids and cats</td>
<td>Visceral, primarily liver</td>
<td>Mean length (µM) of large hooks (range) 26.7-28.5 (25.0-29.7)</td>
<td>Mean length (µM) of small hooks (range) 23.1-25.4 (21.8-27.0)</td>
<td>Multivesicular (alveolar)</td>
<td>Gravid segment: Anterior to middle</td>
</tr>
<tr>
<td><em>E. oligarthrus</em> (Dingel, 1863)</td>
<td>Central and South America</td>
<td>Agoutis (<em>Dasyprocta</em> spp.) paca (<em>Cuniculus paca</em>) and spiny rats (<em>Proechimys</em> spp.)</td>
<td>Peripheral, primarily muscles, occasionally visceral</td>
<td>Mean length (µM) of large hooks (range) 30.5-33.4 (29.1-37.9)</td>
<td>Mean length (µM) of small hooks (range) 25.4-27.3 (22.6-29.2)</td>
<td>Polyvesicular</td>
<td>Mature segment: Anterior to middle</td>
</tr>
<tr>
<td><em>E. vogeli</em> (Rausch and Bernstein, 1972)</td>
<td>Central and South America</td>
<td>Bush dog (<em>Speothos venaticus</em>)</td>
<td>Visceral, primarily liver</td>
<td>Mean number of segments (range) 3-6</td>
<td>Total length of strobila (mm) 52.0-42.9 (20.4-31.0)</td>
<td>Polyvesicular</td>
<td>Gravid segment: Anterior to middle</td>
</tr>
</tbody>
</table>

*Source of information: Biology of *Echinococcasis* and *Hydatid disease* (Ed. By Thompson)
Geographical distribution of E. granulosus and E. multilocularis

Of these four species of Echinococcus, only two are of public importance viz., E. granulosus and E. multilocularis. The latter species are distributed in the countries of Northern hemisphere from Canada and Alaska to Japan, Siberia, Northern Europe and U.S.S.R. (Rauseh, 1986). It has restricted range of definitive hosts, all of which are canids, and majority of intermediate hosts are rodents of the family Cricetidae. The life-cycle is perpetuated mainly in sylvatic cycles using foxes and rodents, though domestic dogs and cats may become infected if they ingest infected rodents from the wild or those associated with habitation.

Echinococcus granulosus infects a wide range of definitive hosts and has the lowest intermediate host specificity of the four species. It is these features of the life-cycle that have largely contributed to its world-wide distribution extending from north of the Arctic circle to the southernmost tip of Argentina.

The relationship between the definitive and intermediate host may be ‘domestic’ as when the association is perpetuated by farming practices. The sheep-dog cycle is dominant in Europe, parts of Soviet Union, Western USA, Mexico and the sheep-rearing areas of South America and Australia. The pig-dog cycle is found in Eastern European region, including parts of the Soviet Union, South-eastern USA, Mexico and Central American countries. The house-dog cycle is present in western parts of the Europe, the UK and Ireland, whereas the cattle dog cycle exists in Belgium, Germany, Switzerland, South Africa and Western Australia. Goat-dog, donkey-dog and Camel-dog associations are implicated in the life-cycles in Eastern Mediterranean regions, North Africa and the Middle East, and a buffalo-dog cycle exists in India.
In Arctic and sub-Arctic regions the parasite is maintained within sylvatic cycles involving wolves and foxes as definitive and wild ungulates as intermediate hosts. Cycles involving marsupial hosts have been recorded in Australia. The domestic and sylvatic cycles may interact and man may become involved, as occurs in Northern Canada and Alaska where indigenous Eskimos and Indian feed their hunting dogs on infected offal from mouse and reindeer. Interaction between the two cycles has also been reported in Australia.

Hydatid disease is a public health and economic problem of global proportions. In parts of Latin America and Europe, for example, the prevalence of human cases requiring surgery may be in excess of 10 per 100,000 per year and in some areas 60-70 per cent of the livestock are infected (Schautz and Schwabe, 1969). In parts of Africa and Asia, although not accurately documented, the human prevalence is even greater. In man, the prognosis is often poor, and at the present time, surgery is the only practical treatment.

The public health importance of hydatid disease to any country is reflected not only by deaths among untreated and treated patients, but in diminishing capacity to function optimally during a portion of the often prolonged period, the direct and indirect costs of hospitalization and recovery from surgery, and any residual disability or clinical sequel. A further less tangible factor is anxiety related to knowledge about, and justifiable fear of the disease among certain heavily infected populations.

The economic importance of hydatid disease in livestock is due to the condemnation of livers, lungs, other organs or even whole carcasses. In severe infections the parasite may cause retarded
performance and growth, reduced quality and yield of meat, milk or wool. The importance of these losses will depend to a great extent on the characteristics of the farming or livestock industry. For example, hydatid disease causes a lower loss in Australia, where the sheep are primarily wool producing, than in New-Zealand, India etc. where sheep are primarily for meat production.

Hydatid disease is a public health problem that theoretically is preventable. As with any parasitic disease, successful control requires the breaking of the life-cycle. There are two main control measures available, but several methods of applications (Gemmel, 1979). First, most control authorities regard prevention of dogs gaining access to raw offal at abattoirs, villages, slaughterhouses, and on farms as vital even though it does require great effort in terms of legislation, education and manpower. The second important measure in the reduction of the parasite biomass either by reducing the dog population or by mass dog-treatment programmes. Both measures may be applied. Selection and emphasis on measures and methods depend on socio-economic factors. Such programmes directed against the dog must be combined with education programmes and these require the cooperation of the inhabitants within the endemic areas.

It is impossible to know whether hydatid infection will continue to spread and intensify or whether wide application on well organized and control programmes will reverse this trend. Much will depend upon priorities assigned to this problem by governments, which in turn will depend upon research to disclose the actual hydatid situation.
Although hydatid disease is world-wide in distribution due to adaptability of the parasite to an unusually wide variety of host species, it is most commonly found in those countries where sheep and cattle rearing constitutes an important industry and consequently there is a close association between man, sheep and dog. Sheep is regarded as the best disseminator of hydatid infection. A survey of literature on hydatid infection in different parts of the world was made to obtain a complete picture of the world-wide incidence of the disease, and it was concluded that though India was not principally a sheep rearing country, the incidence of hydatid disease was far higher than it was supposed to be. Even though sheep rearing is not a major occupation in the subcontinent, sheep population is still considerable i.e., 80.331 million in India alone (Anon, 1988).

Hydatid disease has great importance in agricultural based countries with a large rural population. In India, and for this matter, in the entire sun-continent, ideal conditions exist for establishment, propagation and dissemination of hydatid disease both in man and livestock. Yet, some standard textbooks do not mention India as one of the countries where hydatid disease is widely prevalent and is endemic (Parray and Selloss, 1963). It is because, the exact status of hydatid disease is far from clear except for a few periodic surveys on prevalence in animals are reported from some parts of India like Punjab (Gill and Rao, 1967; Deka et al., 1997), Bihar (Pandey, 1971), Bangalore (Hedge et al., 1975), Jaipur (Mathur and Khanna, 1977), Uttar Pradesh (Deka et al., 1983; Singh et al., 1988; Verma and Ahluwalia, 1990; Deka and Gaur, 1998; Varma and Malviya, 1998), Delhi (Rama et al., 1986), North East India (Roy and Tandon, 1989), Himachal Pradesh (Jitheudran, 1996), Calcutta (Das
and Das, 1998), Pondichery (Das and Srikirshna, 1998) and Guwahati city (Sharma et al., 2000). In Kashmir valley no information on the prevalence in animals is reported so far.

"Given a country", says Dr. Davies Thomas, "with many sheep and the organs of which are often eaten raw by the dogs, if the water supply be scanty and procured from bogs, swamps, water holes and dams, on the banks of which dogs may deposit their eggs to be blown in by the winds and washed in by the rains, and there be dogs in abundance, we have all the conditions necessary for the spread of the disease".

The above mentioned factors described by Dr. Davies Thomas, which have a favourable influence on the occurrence and spread of the disease are really abundantly prevalent in Kashmir valley. There is no dearth of stray and ownerless dogs in the valley. These dogs have free and easy access to most unhygienic and unprotected slaughterhouses. The unprotected water from the rivers, streams and ponds where again dogs have an easy access is consumed by the majority of the people in the rural areas. The low economic status of most of the people and overall poor general level of education in hygienic matters further adds to this unfortunate state of affairs. In Kashmir valley 75 per cent of population belongs to rural areas. The majority of people in the rural areas depend partly on sheep and cattle breeding. Besides, the Gujjar and Bakerwal communities whose main occupation is sheep and cattle rearing and farming, their animals are guarded and worked by dogs. Lastly, so far no legislation has been introduced in this state for controlling the dogs. Therefore, it will not be a wrong assumption to state that hydatid disease is not a very uncommon problem in Kashmir valley. Though the infection
in human subjects has been reported from Kashmir valley (Ahanger 1997, Khuroo et al., 1997, Chishti et al., 2001, Ishtiaq et al., 2002, Fomda et al., 2002, Saleem et al., 2002) but these are mainly concerned with case reports and their surgical management except Chishti et al., 2001. In Kashmir valley, there appears to be no documented information concerning the actual situation of hydatid disease.

With this background the present study was undertaken between August 2001 to July 2003 to evaluate the prevalence of hydatid disease (both in man and livestock). The accuracy of various diagnostic procedures, the mode of presentation, clinical course, and the methods of treatment with their success in the hydatid disease is based on the patients admitted to various surgical wards of SMHS & SKIMS, Soura, Srinagar. Besides, the socio-economic conditions of patients suffering from hydatid disease were investigated. Attempts were also made for the study of histopathology of infected tissues especially liver and lungs. Furthermore, the public health and economic importance of hydatid disease was evaluated.

A controlled programme directed against *E. granulosus* was introduced into the Anantnag district and this was restricted to 4 study areas (2 urban and 2 rural). An intensive long-term educational programme was launched combined with legislation designed to prevent the definitive host from gaining access to raw offal. In addition to that, dog population was reduced in most infected areas.