INTRODUCTION
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Hydatidosis is one of the most important zoonotic diseases of global importance, caused by metacestode of *Echinococcus granulosus* which is a cyclophyllidian, hermaphrodite, 3-4 segmented taeniid cestode of 2-6 mm length. On the basis of susceptibility to various intermediate and definitive hosts, different life cycle patterns have been proposed from various geographical regions (Thompson and Lymbary, 1990 a). In India, the life cycle mainly operates between dogs and buffaloes. The adult parasite inhabits the upper part of small intestine of definitive host (dogs and other canines) and after the required prepatent period, the apolysis sets in and the gravid segment containing fully developed hexacanths pass out with faeces. Intermediate hosts (buffaloes, sheep, goat, pigs etc.) acquire the infection during grazing on contaminated pastures, whereas man gets infected accidently due to close contact with dogs/faeces (Fig. 1). Hatching of onchosphere takes place in the small intestine of intermediate host and hexacanths migrate to different organs either through lymphatic or blood circulatory systems. The hexacanths can lodge itself in any organ of the body, however lungs and liver are the most favoured sites. Thereafter asexual phase of reproduction starts, resulting in the formation of fluid filled hydatid cyst.

A hydatid cyst is either fertile or sterile depending upon the presence or absence of protoscoleces respectively. The fertile hydatid cysts having protoscoleces are responsible for the completion of life cycle and perpetuation of infection and therefore assume significant importance. However pathological manifestation is the same, irrespective of the nature of hydatid cysts (Plate 1).

Generally parasitic infections in man and domestic animals, when remain unnoticed, can cause morbidity and severe malnutrition. They are more common in the developing world and the extra burden imposed by them on the community is devastating. The poor health and malnutrition in these countries is not only attributed to scarcity of food but also due to the low quality of food and susceptibility to parasitic infections and their pathological consequences.

The long prepatent period and appearance of clinical symptoms in the advanced stage of the disease leads to significant loss of man power potential. The limitations of conventional
Fig. 1 - Life cycle of *Echinococcus granulosus* in India
Plate 1- Hydatid cysts in various organs of buffalo.

1- Hydatid cyst of liver
2- Hydatid cyst of diaphragm
3- Detached hydatid cyst, showing large number of developing daughter cysts.
4- Recovered adult worm of *E. granulosus* from the experimental infection in puppies.
diagnostic methods further hinder the early diagnosis of the disease. However recent techniques like ultrasonography, radio-isotope scanning, intravenous viscerography and computer-assisted tomography (CAT) etc. can detect hydatidosis in early stage but the cost of these instruments and the running expenses are extremely high which can not be afforded by the tropical rural population. Moreover chemotherapeutic treatment of hydatidosis with some recent anthelmintics has shown to be of limited success due to slow prognosis. Therefore surgery is the only alternate treatment, but in many cases even surgery fails, particularly when multiple cysts are present involving several organs. Hence an early detection and diagnosis is imperative for the application of any effective control programme.

Worldwide prevalence of human hydatidosis has been reviewed by Schwabe, (1986), but no comprehensive study is available from India except few scattered reports. The infection has been reported from different states and pointed out that the prevalence has assumed an increasing trend of incidence (Irshadullah, et al., 1989a, b).

The other important feature of this parasite is the development of different strains, which have been reported from different animals and geographical regions. The problem of strain variation and characterization have been comprehensively reviewed by Thompson et al., (1995). The practical significance of strain variation lies in the fact that each strain showed different host specificity, pathogenesis and other characteristic which profoundly influence the local epidemiology and control measures.

Hydatidosis is an important disease particularly in the Indian perspective because our economy is based on agriculture and agricultural products. The contribution of livestock to gross domestic products (GDP) is highly significant. According to 1987 census India has about 195.87 million cattle, 76.77 million buffaloes, 44.84 million sheep, 99.41 million goats, 10.76 million pigs and 2.9 million pack animals. The gross value of output from livestock sector alone at current prices was about Rs. 588 billion in 1992-93, which is about 26% of the value of total agricultural output. Besides this, cattle are involved in transportation, irrigation, and as draught power as well as provide raw materials like wool, skin, hides, horn etc. for various agrobased industries. Though India has substantial cattle population, but due to the lack of proper care and management, the
livestock fails to contribute to the national economy to their maximum potential as it expected. Among the various factors, poor health caused by parasitic infections is one of the main factor. According to Ramazanov et al. (1978), hydatidosis alone causes high morbidity and 7% loss in milk production was observed in infected animals.

In view of the above facts hydatidosis is a continuing threat to man and domestic animals in our country. The existing conventional control methods which rely on changing the pattern of social behaviour or eradication of definitive host, raise enormous difficulties. Moreover chemotherapeutic control measure in hyper endemic areas may reduce the worm burden, but simultaneously causes suppression of immune system, leading to the development of more susceptible population of the host which is more prone to parasitic infections. Chemotherapy rarely succeeds in elimination of infections, even a single surviving worm will produce large number of eggs, sufficient for infecting thousands of intermediate hosts.

The existing diagnostic technique being used on large scale is purging of dogs with arecoline hydrobromide and examination of purged samples. However it has various disadvantages like poor sensitivity, side effect of arecoline hydrobromide and high risk of infection to persons working on the disease. Therefore it is necessary to explore the possibilities of alternative diagnostic methods. The immunodiagnostic method may prove to be a better alternative for early and accurate diagnosis of infection. Unfortunately very little research has been directed towards the development of immunodiagnostic technique, despite their potential usefulness in control programmes, the accurate serological diagnosis of infection is difficult due to serological cross-reaction with several other parasite species in definitive and intermediate hosts. Analysis of many immunodiagnostic procedures for hydatid infection is difficult to interpret owing to the lack of appropriate age-matched controls. A further problem in immunodiagnosis is apparently poor antibody response to infection in many natural intermediate hosts, however high immune response of specific antibody was seen in human infections. The advances in immunodiagnosis of hydatid disease largely reflects increased characterization of parasite antigens. The source of antigen is important for the evaluation of diagnostic tests. Generally hydatid cysts fluid, protoscoleces and cyst membranes have been used as source of antigen in diagnostic tests. Available informa-
tion on hydatid antigen reveal that different nomenclatures have been used like Ag5/f5/AgA/AgB and their sub classes. Not only this, the selection and reliability of diagnostic techniques applied are also varied with respect to the intermediate host like casoni intradermal test, CF1, indirect fluorescence antibody (IFA), enzyme linked immunosorbent assay (ELISA), immunoelectrophoresis (IEP), precipitation test, generally used in domestic animals. Contrary to this, in the definitive host, a variety of potential sources of antigenic stimulation were noticed. These include E/S molecules, parasite broken down products absorbed by the gut mucosa, scolex secretions at the site of attachment etc.

A number of studies on immunodiagnosis of Echinococcus in dogs have been carried out (reviewed by Lightowler et al., 1993). These studies provide varied degree of specificity and sensitivity for diagnosis of Echinococcosis and seem to be of practical value. However, Gasser et al., (1990) have pointed out and suggested that in order to improve the specificity and sensitivity, further studies should be carried out using antigens from other developmental stages.

Although a lot of work has been carried out on cystic hydatidosis, but intestinal phase of the parasite remains neglected. It is therefore essential to investigate the stage specific antigens and their immune response particularly during the development of the parasite in the definitive host. Such studies would be useful to explain many aspects of immunobiology such as antigenic polymorphism, turnover, antigen sharing and immune evasion. However for the development of a definite diagnostic/protective antigens it is pre requisite to have a complete knowledge of developmental biology, biochemical and genetic changes associated with the development and also the antigen polymorphism along with immune response in the dog.

In the definitive host the intimate contact between the scolex and the gut wall provide an opportunity for direct immunological interaction. In recent years antibodies have been detected against the scolex antigen but their exact characterization is still awaited. In addition to this, antigen from other parts of the worm excreted or secreted by the worm during infection may be absorbed by the host intestine and elicit immune response. Such presentation of antigens via gut have been effectively used for antigen delivery in many bacterial and viral vaccines (Stokes, 1984). In many other helminths the site of synthesis and secretion of antigen have been reported,
but in cestodes no conclusive evidence is available, although the secretory role of the surface tegument in cestodes has already been established particularly in transmembranosis and in antigenicity. The antigenic nature of surface antigens and their polymorphism is an important area of cestode immunity and hence the dynamic nature of these antigens and their immune response with special reference to the developmental biology of the parasite makes an interesting aspect and will provide the results of applied nature. The surface plasma membranes are actively involved in the defence against host immune attack and remain in a dynamic state (Threadgold, 1984). The surface plasma membranes are externally covered with glycocalyx, consisting primarily of polyionic proteins containing both cationic and anionic binding sites. Further various host components including immunoglobulins and other immune components are reported to be absorbed on the glycocalyx (Philipp and Rumjaneck, 1984). Absorption of antibodies to parasite surface may have a protective function whereas other macromolecules may be of metabolic importance.

In most of the cestode infections the host protective immunity can occur against these lumen-dwelling worms, but in *Echinococcus* very little work has been carried out. However studies on host mediated protection like killing of protoscoleces by peritoneal cells and prevention of establishment of parasite by passive transfer of immune serum, and killing of parasite by adaptive transfer of immune spleen cells, have been reported. Moreover, *Echinococcus* specific antibodies have also been detected in dogs, these findings strongly suggest the scope of host mediated protection and immunodiagnostic probe for *Echinococcus*.

In addition to this, immunoprotection has several advantages over other method of parasite control. Thus there is much scope to carry out research on the development of define putative vaccine, which holds great promise for preventing hydatidosis.

Although studies carried out on immunization of dogs against infection with *E. granulosus* often give inconsistent and poor results, however partial protection has been achieved in some studies. In recent years a number of antigens generated by using r-DNA technology have been tested but absolute protection has not been achieved, and the results obtained reveal either cross-reactivity with other helminths or weak immune response was noticed. Hence there is consid-
erable scope for investigation of the host-parasite relationship particularly at gut level. A better understanding of the extent of immune response and immune evasion mechanism utilized by the parasite may provide the pessimistic prospects for effective vaccination.

Keeping these facts in mind, the present work was carried out to investigate the stage specific gene products of different developmental stages isolated from the dog correspondingly showing segmentation, organogenesis and maturation phases and also their antigenic nature. Emphasis has been focused to investigate the surface plasma membrane antigens and their dynamic nature so that a better understanding of immunologic dialogue at the host-parasite interface can be achieved. Further, potential antigenic polypeptides have also been analysed and their localization at sub-cellular level has also been investigated. It is expected that this will provide the basic information for future studies pertaining to immunodiagnostic and immunoprotection.