ECHINOCOCCOSIS (in dogs)
HYDATIDOSIS (in ruminants and humans)
The hydatid cyst (in ruminants and humans)

1-Definition
Larval cysticercosis (metacestodosis), infectious, inoculable, non-contagious, encountered in humans and various animal species. There is development in various tissues and organs, especially the liver and lungs, of a larva called Echinococcus polymorphus.
The adult cestode is located in dogs and is called Echinococcus granulosus, more frequently in rural areas than in urban areas. Indeed, according to KOHIL K *et al*. in 2016, 26.6% (8/30) of dogs were parasitized by *E. granulosus*. Dogs in urban areas also at a rate of: 15.5% (14/90)

Synonymy according to the host Hydatid disease
Hydatid disease
Hydatid cyst disease
Hydatid disease

2-Importance
Major zoonosis
Severe in all hosts including humans, who are an accidental host
2-1-Importance in herbivores
Seizures therefore economic losses
Vital process rarely questioned
2-2-Importance in humans
Important because of surgery for cyst excision
The importance of the disease is related to the large number of canids (definitive hosts), which carry the parasite.
As well as the significant number of ruminants (intermediate hosts), which also contribute to the contamination thru the larvae.
Cosmopolitan disease and the emergence of subspecies with new hosts (case of Australia: wallaby as an intermediate host)
3-Epidemiology
Rural cycle related to the coexistence of the shepherd dog and the sheep (flock)
Urban cycle related to clandestine (family) slaughtering
Wild forest cycle in certain countries
4-Etiology
4-1-Morphological study of the parasite
The larva Echinococcus polymorphus belonging to the cestode Echinococcus granulosus varies in size from that of a walnut to that of a child's head.
Final size in 7 months for pigs
After 16 months in ruminants
After several years in humans
Hydatid cyst of globular shape (size from a walnut to an orange), very tense, opaque; liquid under pressure
The larva is composed of:
Double-textured wall:
The cuticle
The proglottid membrane

A vesicular content: liquid or rock water, germinative elements or proligerous capsules bearing several protoscolices
--Phenomenon of hyperfertility or secondary echinococcosis of the metastatic type (chaotic evolution): this is when an external daughter vesicle forms directly from the wall.
This is due to a rupture of the hydatid following trauma or by poor secretion of the protoscolex.

5-Biology 5-1-The sources of infestation are:
-The herding dog and the butcher dog
-Stray dogs, which in some regions can access slaughterhouses and feed on parasitized organs
-Dogs in rural areas more than in urban areas
-By oral route: ingestion of food, water contaminated by the feces of infested dogs
-The movement of segments, flies, and especially runoff water ensure the dissemination of eggs
-Possibility of transplacental transmission

Definition of sterile capsules: capsules can remain without protoscolex when the hydatid is young or unsuitable for the host; these capsules will be called: sterile capsules or acaecal cysts
5-2-Human Contamination
-Ingestion of raw vegetables or poorly washed raw foods contaminated with E.granulosus eggs
-Petting of pet or stray dogs
6-Parasite resistance
Adult worms have a lifespan of 10 months.
6-1-Resistance of the eggs
On pastures for more than a year between -5 and +30°C and when the humidity is sufficient
They resist chemical agents (15 days in pure formaldehyde).
6-2-sensitivity of the eggs
They are sensitive to cresol,
Low survival in deep water
Desiccation
The scolex in the cyst have: a lifespan of 16 years in horses, 30 years in humans
-Post-mortem: the scolex survive 8 days and 3 weeks at +4°C
Killed by freezing in 70 hours at -15°C. By heat for 1 hour at 50°C, 30 minutes at 60°C
By chemical agents in 5 minutes in 1% formaldehyde, or 0.1% hydrogen peroxide

7-life cycle
Like all taeniids, the biological cycle of Echinococcus granulosus is heteroxenous, occurring in two hosts; a definitive host, mainly the dog and other wild canids (wolf, jackal, coyote...), the cat can harbor the adult worm in its intestines without showing symptoms (asymptomatic carrier). Intermediate hosts are primarily represented by sheep, as well as other herbivores (cattle, goats, camels, horses...), with humans acting as accidental hosts in the cycle (Altintas, 2003). The adult cestode E. granulosus lives in the proximal part of the dog's small intestine. The number of developed echinococcal worms depends on the number of protoscolices ingested. The dog is usually infested by several hundred worms fixed between the intestinal villi of the small intestine. The ovigerous segment, filled with eggs, detaches from the strobila (body of the worm) and is eliminated with the feces into the external environment where it disintegrates and releases the eggs. Each egg or embryophore contains a hexacanth embryo or oncosphere.

After ingestion by an intermediate host, the oncosphere is released from its shell under the action of digestive juices, it crosses the intestinal wall with the help of hooks and its own secretions, it measures 20 to 25µ in diameter but its plasticity allows it to pass thru all capillaries. It reaches the liver thru the portal system, sometimes surpasses the liver via the hepatic veins, and arrives at the lungs. More rarely, the localization can occur at any point in the body thru the general circulation. Once in the organ, the embryo transforms thru a process of "vesiculation" into a hydatid larva. The cycle is closed when the dog (definitive host) ingests the viscera (liver, lungs) carrying fertile cysts from parasitized animals (intermediate hosts) (Tropical Medicine, News, 2004). The ingested protoscolices undergo the action of stomach pepsin and evaginate in the anterior part of the duodenum under the influence of bile and pH modification. They then develop into sexually mature worms (Schantz et al., 1995; Petavy et al., 1990; Bourdeau & Beugnet, 1993). Each ingested protoscolex can give rise to an adult cestode on average six weeks after infestation. However, the duration of the prepatent period varies according to the strains of the species E. granulosus. Humans accidentally enter the parasite's cycle, generally constituting a parasitic dead end. The hydatid, following asexual reproduction in the form of active polyembryony, contains several hundred thousand protoscoleces, which are infective elements for the definitive host. The development of the hydatid is very slow, and fertility (formation of protoscolex) is only achieved after 15 to 18 months in sheep and cattle. Therefore, the contamination of dogs is mainly due to older animals (older ewes and cows).

8-Clinical Study

In ruminants, the symptoms are inconspicuous.

The liver and lungs are the most affected, more rarely the spleen, kidneys, brain, heart, muscles, and bones.

In cattle: it is the lungs that are most often affected due to the size of the lymphatic vessels, which facilitate the migration of embryos thru this route.

In humans, horses, and pigs, it is the liver that is most affected because the blood vessels are more developed.

Description of the parasitized organ

-The organ is deformed, lumpy when the vesicles are numerous, we speak of a "basket of eggs" liver.

-Upon palpation, the element is firm and elastic.

-Upon incision, the liquid spurts out in a jet.

-The cavity is echinulated, containing debris of vesicles that curl into a horn shape.

Secondary echinococcosis lesions are seen on the same organ or in the adjacent serosa (pleura and peritoneum), represented by numerous small and calcified vesicles called: pseudo-tuberculous echinococcosis

When the bones are affected, they become necrotic and take on the appearance of wet sawdust.

Evolution of the hydatid cyst

The hydatid cyst can undergo caseation, calcification that can reach the adventitia, or purulent degeneration.

1: Adventitious
2: Cuticle
3: Proliferative, germinative membrane
4: Hydatid fluid
5: Hydatid sand
6: Exogenous daughter vesicle
7: Proliferative vesicle 8: Protoscolex
9: Endogenous daughter vesicle
10: Small girl vesicle

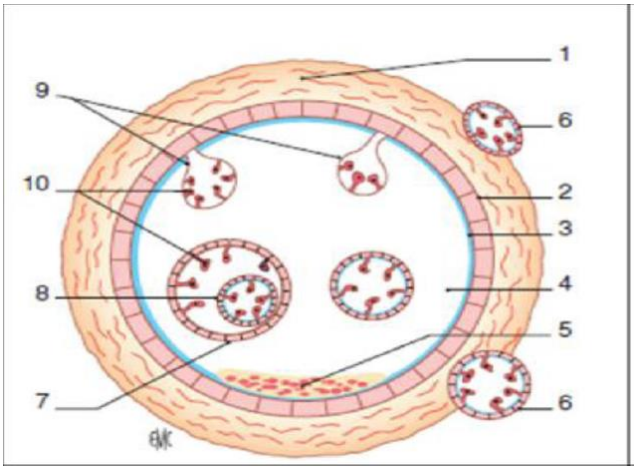

Figure: Structure of the hydatid larva (Lausier, 1987; Koltz *et al*., 2000)

9-Diagnostic

9-1- Ante-mortem Diagnosis

- In ruminants: no diagnosis because the symptoms are not visible ante-mortem
- In humans: tests to obtain immunological reactions such as E.L.I.S.A, immunoelectrophoresis, immunofluorescence.

9-2- Post-mortem Diagnosis

- The autopsy of dogs is the most reliable method for detecting intestinal infestations with *E. granulosus*, although this procedure is subject to the risk of contamination of handlers with the prepared samples.
-in ruminants, it is at the slaughterhouse that hydatid cysts are discovered.

10-Fighting against hydatidosis

10-1-In humans

Only surgical by cyst excision
PAIR method (puncture-aspiration-injection-reaspiration)

10-2-In Dogs

-Use of Arecoline Bromide to rid dogs of parasites, but this technique is dangerous as it can lead to contamination of humans and other dogs.
-Fecal antigen technique
-Finally, treat infested dogs using Praziquantel
-Fight against stray dogs
-Prohibit dogs from accessing slaughterhouses
-Prohibit clandestine slaughtering as it is a source of dog infestation
-Do not give raw offal to dogs but bury it Research for a vaccine