

## Cystic echinococcosis in Sardinia: the current role of sheep

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**Abstract.** Cystic echinococcosis is one of the most widespread parasitosis in the Mediterranean region. Unfortunately this is also true for Sardinia for various reasons, among which is the close relationship between sheep and dogs in the farms. This work first epidemiologically analyses hydatidosis in sheep in Sardinia and then examines the most important causes of the persistence of these metacestodosis in sheep. The work looks at the factors which are responsible for the enormous quantity of illegal slaughtering and the widespread habit of abandoning the sheep carcasses in the grazing areas, as well as possible initiatives which may eliminate these practices. Such initiatives must include reducing the financial costs and bureaucracy involved when sheep are slaughtered in abattoirs, and also increasing the value of sheep meat. In conclusion new checks and controls are hoped for at a political level which will increase the financial support for the farmers and encourage the use of recombinant vaccines which have already been tested in Sardinia. These are extremely useful for effectively curbing cystic echinococcosis.

**Key words:** cystic echinococcosis, sheep, Sardinia.

Cystic echinococcosis (CE) by the metacestode of *Echinococcus granulosus* is an important public health problem in many areas of the world. It is particularly important in the Mediterranean basin where it is one of the main forms of parasitosis in farm animals. It has a marked social impact because it is also frequently found in the human population (Eckert *et al.*, 2001). Sardinia, unfortunately, fits well into this pattern as the parasitosis has always been extremely common in this region, and even today it is still a serious health problem for humans and farm animals. Sardinia is a particular case, firstly because some 2/3 of all Italian sheep (which are the preferred intermediate host for this cestode) are raised here, secondly because there is a high level of epidemiological awareness, and finally because it is also the only Italian region in which there are in operation plans to control this disease. In addition there is also a very particular relationship between dogs, sheep and humans on the island. This relationship has always dominated sheep farming in the island, and it is linked to the slow rate of evolution of social, economic, cultural and biological conditions. These conditions are perfect for allowing *Echinococcus granulosus* to complete its life cycle (Bortoletti *et al.*, 1990). There are more than 3,000,000 Sarda breed sheep in Sardinia; they are also found in almost all the rest of Italy and in other Mediterranean countries, in particular in Tunisia (<http://www.ara.sardegna.it>). This is because the breed can adapt to extensive grazing in hilly and mountainous areas and also to intensive rearing in plains and irrigated areas. The Sarda sheep are good

dairy sheep and supply some 100 or 170-180 litres annually during a 180 day lactation period, depending on whether they are raised extensively or intensively (<http://www.ara.sardegna.it>). The first epidemiological studies for parasitosis were conducted in the island in the 1950s, and these found that the situation was catastrophic. 99.4% of sheep were infected (Tanda, 1960), with 100% of the parasites fertile. The results for dogs infested with the tapeworm were also very high, varying from 8% (Papan-drea, 1951) to 45.2% (Medda and Javedaia, 1960, Deiana and Arru, 1960; Arru *et al.*, 1990).

In a more recent study, Arru *et al.* (1990) confirmed that in 1990 the data for the definitive hosts (dogs), as well as those for the intermediate hosts (sheep), were not significantly different from those they had found ten years earlier (Arru *et al.*, 1980), despite the campaigns to eradicate and/or control the parasitosis in the 1980s. These campaigns had not achieved the results which were hoped for, despite the extensive work carried out by the various professional groups involved.

Hydatidosis is also one of the most serious epidemiological risks for humans in the Mediterranean basin, with an average annual incidence of some 9.8‰. There are marked differences between the various provinces and also clear annual fluctuations (between 1969 and 1990 incidence varied between 15‰ and 8‰ respectively) (Ecca *et al.*, 1998).

In this context a detailed analysis of certain factors related to hydatidosis in sheep would be very valuable, given that they are the intermediate host of choice for this metacestodosis. This research defines the present epidemiological role of the parasitosis in Sardinia more precisely. New data on developments of the parasitosis give the feeling that with time something is changing. Analysing the situation in sheep is probably the most relevant aspect of this in Sardinia, where plans to control the parasite in dogs

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are more problematic, given that, for various reasons, so many of them cannot be systematically checked in any way (many unchecked stray dogs, no efficient statistical data base for dogs, and in particular sheepdogs, etc.).

### Present epidemiological situation

Recent data on sheep in the island shows that the situation is still serious, but that it varies depending on the locality.

In the latest published data for north Sardinia hydatidosis was found in 76% of the sheep checked (Scala *et al.*, 2000). This is not substantially different from the previous survey (Gabriele *et al.*, 1992; Gabriele *et al.*, 1998). However if other epidemiological factors are taken into consideration, such as the percentage of host with fertile hydatids, mixed infestations (liver+lungs), and massive infestation (more than 10 hydatids/sheep examined), then it can be seen that the intensity of the parasitosis is declining in Sardinia (Scala *et al.*, 2000) (Table 1).

The reduction of these parameters does not, however, seem to be connected to a reduction in environmental contamination by the eggs produced by the dogs. The prevalence of infestation in sheep less than two years old (the sentinel animal group) is not significantly different from that of older animals (Scala *et al.*, 2000). Thus it seems that in this case the reduction of fertility may be due to the sheep themselves responding more efficiently to the tapeworm.

In those districts of north Sardinia where sheep rearing has become very efficient in recent years the reduction in parasitic pressure may be due to variety of causes, and in particular to the lower fertility of the hydatids. According to Bortoletti *et al.* (1990): "The epidemiological significance of sterile cysts is, at present, unknown and needs further study but some factors (probably synergistically concurrent) can be considered: a) reduction of transhumance (CENSIS: 1st report on the social situation of Sardinia); b) anthelmintic treatment of dogs; c) unfavourable environmental conditions for the survival and maturation of the eggs; d) genetic selection of animals; e) improvements in animal husbandry standards". However all the above mentioned factors do not take into consideration our information on the routine treatment of animals with benzimidazoles drugs, often more than once a year. It is well known in veterinary and human med-

icine that benzimidazoles devitalises the hydatids. Indeed 47% of Sardinian sheep are treated with these drugs (Scala *et al.*, 1999). This is a significant proportion of the population and it could be responsible for a certain reduction in the fertility of the metacestode. However this reduction of fertility is not evident in all of Sardinia, as has been emphasised by the recent data from the survey by Soro *et al.* (2002) in Goceano (a region of central Sardinia). Here they found an extremely serious situation, with the disease present in 92.8% of sheep and 27.1% of the animals with fertile cysts.

Thus it is clear that in Goceano, a particularly socially and culturally isolated district where public health instruction is more difficult, the parasite continues to spread in an uncontrolled way and that it has serious negative repercussions on the society, human health, and the economy.

There are also epidemiological data available for Sardinia on the percentage of fertile cysts in the lungs. This percentage is significantly higher than that of fertile cysts in the liver (Scala *et al.*, 2000). This means that the lungs are a more dangerous source of infection than the livers in Sardinia, despite usually being underestimated.

A similar situation has been reported in Libya, where the liver was again the organ most commonly infected followed by the lungs and kidneys, although there were more fertile cysts in the lungs than the liver (Gusbi *et al.*, 1987).

### Principal causes of the persistence of CE in sheep

Among the principal causes of the persistence of hydatidosis, and thus more generally echinococcosis, in sheep in Sardinia, is the low commercial value of sheep carcasses. As a result many sheep are slaughtered at home and not in slaughterhouses and the carcasses of sheep which have died in pasture land are left where they have fallen.

There is a series of reasons for the low commercial value of the carcasses. At present the bureaucratic authorities responsible for the logistical and economic aspects of slaughtering, share the outmoded belief that hydatid cysts are a normal part of the anatomy of sheep. This is also widely believed by many Sardinian shepherds, who also believe that the sheep is his own property to do with as he pleases. Consequently illegal slaughtering continues on 93.5% of Sardinian farms (Scala *et al.*, 1996). This

Table 1. Prevalence of sheep with fertile hydatids, mixed infestations (liver + lungs), and massive infestation (more than 10 hydatids/sheep examined) in the province of Sassari.

District	Total prevalence of CE	Mixed infestation (lungs+liver)	% sheep with fertile hydatids	% sheep with massive infestation	Authors
Sassari (1988)	85.1%	62.4%	36.8%	26.6%	Gabriele <i>et al.</i> (1992)
Sassari (1996-97)	76.7%	62.6%	16.9%	30.1%	Gabriele <i>et al.</i> (1998)
Sassari (1999)	75.6%	52.2%	6.9%	14.7%	Scala <i>et al.</i> (2000)

phenomenon is increasing due to the continually higher cost of slaughtering in abattoirs. Today slaughtering is so highly regulated and involves such difficult obligations, responsibilities and taxes that only the most profitable types of farm can afford them to comply with them. It is increasingly clear that the EU regulations have resulted in a drastic reduction in the number of small slaughterhouses which were previously found in the island, and the concentration of slaughtering in a few large, more modern and efficient structures. This is causing an aberrant evolution of our national slaughtering system in favour of industrial intensive farming and the abandonment of the previously widespread small unit productive system. Today the abattoir is a defective health institute whose role is solely to safeguard the quality of the meat which leaves it and its own environmental friendliness, while the remains of animals of low commercial value are either eaten without any health checks or are abandoned in the countryside (Cosseddu, 1998).

This situation is causing both a worsening of the health situation and also economic underdevelopment, and feeding the vicious circle of disease-poverty-disease which is so much feared by the WHO. The EU must bear this in mind and attempt to find a solution (Palmas and Ecça, 1995).

Thus, despite the fact that CE is still widespread in Sardinia, the shepherds and politicians do not attach particular importance to it and instead concentrate on other diseases which are of greater interest to the media (e.g. African Swine Fever, Scrapie and, recently, Blue Tongue in sheep). While these are indubitably serious, they are not more important than CE, especially when one bears in mind that it has, without question, important repercussions on animal health. This lack of interest is also linked to the fact that a control program for CE would certainly have to last more than five years, or, in other words, for longer than the life of a Sardinian regional legislature. As a result it is difficult to interest politicians in a program which would take so long to bear fruit, and which would not have an immediate impact on their public image.

### Useful initiatives to control illegal slaughtering

In the areas where extensive methods of sheep farming are practiced, financial support should be given to encouraging the following indispensable initiatives: a) encouraging the slaughtering in slaughterhouses of animals of low commercial value such as sheep; b) developing the organisations involved in collecting the animals and taking them to the slaughterhouses; c) supporting organisations involved in finding ways of increasing the commercial value of the meat; d) establishing the norms used for slaughtering of local production (Cosseddu, 1998); e) providing adequate systems for disposing of the carcasses of animals which have died in the fields. This

last point in particular could be solved by giving each farm a suitable container with the correct dimensions and structural characteristics. This would certainly reduce the number of carcasses abandoned in the fields, which then become a source of food for sheepdogs and/or the stray dogs that infest the island. In this respect, in the 90's, the previous Public Health authorities of Ales (Oristano) in took a useful initiative by inviting the shepherds to take the liver and lungs of dead sheep to the veterinary authorities. These were then kept in freezers and later incinerated. In this way the dead animals were removed from the stock list without any other bureaucratic formalities. This initiative was extremely successful but for various reasons, mainly bureaucratic, it was abandoned.

Certainly heightened awareness of the problem would be a positive step, as would be setting up a series of voluntary certification policies designed to give maximum value to animals raised extensively in "natural" environments. Certain commercial companies which already prepare sheep meat sausages and ham should also be encouraged. These are not adequately supported by the local authorities, unlike initiatives in other sectors. The local authorities are encouraging initiatives which follow the misguided approach used for wild ruminants in Valtellina (Lombardy), whose so-called "hams", and are being marketed, principally to elite and foreign tourists from North-East Europe, at high prices (some € 40/kg). The demand from the market is so great that at present the suppliers cannot satisfy it. The situation for sheep sausage is different. This is not always to the taste of the local Sardinian population, but is greatly appreciated by and in demand from the growing Muslim immigrant population. It is clear that if this activity was adequately financed it would provide a useful source of income for shepherds and this would reduce illegal slaughtering. Another possibility is exporting sheep at the end of their productive life to the Arab world, as Australia already does on a large scale (cf. Australia and Arabia, The incredible sheep war, "Il Venerdì di Repubblica" 24/10/2003). The sheep are then slaughtered and the meat prepared in a way which conforms with the rules of their religion. At a local level the consumption of mutton from adult sheep should be encouraged. At present only lambs are eaten, and these are usually only one month old. The sale of mutton could be encouraged by selling the types of cuts that the consumers value (e.g. cutlets and steaks ready for cooking) and above all by making the public aware of the positive virtues of sheep meat for human health, such as the quantity of unsaturated fatty acids it contains. This is widely appreciated by consumers as being of importance in the struggle against cholesterol (Santercole *et al.*, 2003).

Another action could also be taken to reduce the parasitic pressure on sheep. Restrictions could be placed on the transportation and sale of sheep from

farms where the sheep were found on slaughtering to have a level of infestation which is higher than the average for the area. A program of this type to check the spread of CE was used successfully in Tasmania in the 1970s (Thompsons and Lymbery, 1995). Obviously such a program would have to be supported by financial assistance to the farmers to avoid a boomerang effect and an increase in home slaughter.

## Conclusions

From what is written above it is clear that the situation in Sardinia is, unfortunately, still very serious and integrated control measures on various fronts are necessary. At the same time one must remember that all the previous attempts to eradicate or control this important zoonosis in Sardinia ran into various obstructions and obstacles. Most of these were, however, financial and political, as Eckert *et al.* (2000) reported was also the case in other geographical areas where CE was fought with programmed plans. They state: "... furthermore, financial restrictions and political instability are major obstacles in control and prevention of echinococcosis ....."

However not all is lost! While it is clear that routine or classical control measures will only be partially successful, if these are combined with a series of important innovations in the field of animal husbandry, and also a new sense of social solidarity, then important results can be achieved. The recent establishment of The National Reference Centre for Echinococcosis-Hydatidosis at the Experimental Institute for Zooprophyllaxis of Sardinia could certainly encourage these new initiatives. Electronic tagging of sheep, which should come into force from 2006, should be particularly encouraged. So should research into a vaccine which impedes the development of metacestode in sheep. These are the most important intermediary hosts for the parasite in the island, and preventing its development in sheep is the most important aspect of the battle against CE. The results on the development of such a vaccine are encouraging (Lightowlers and Gauci, 2001; Tola *et al.*, 2002) and should be studied with great attention, because if the vaccine, which has already been developed and is presently being tested, passes the field tests then it will be without any question the real weapon to defeat this parasitosis.

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