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TRICHINELLOSIS OUTBREAKS IN ARAGON (1998-2017)

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ABSTRACT

Background: In Aragon, official veterinary controls to detect the presence of Trichinella in meat products have allowed trichinosis to be a low-incidence disease in the form of outbreaks associated with family consumption of meat products that are not sanitarily controlled. The aim of the work was to describe the epidemiological characteristics of the trichinosis outbreaks that occurred in Aragon during the study period and the action measures carried out, which served as a basis for redesigning and strengthening prevention and control measures

Methods: Descriptive study of the characteristics of time, place, person, food implicated, etiological agent and control measures implemented in the outbreaks identified by the Epidemiological Surveillance Network of Aragón from 01/01/1998 to 31/12/2017. For the descriptive analysis, the mean with its standard deviation and proportions were calculated.

Results: During the study period (from 01/01/1998 until 31/12/2017) there were 7 family outbreaks with 294 exposed, 103 cases (Attack Rate 35%), of which 29 were hospitalized (28.1%). The case fatality rate was 1%. The average age of the cases was 43.3 years (standard deviation 15.9). 70.8% of the cases were male. Outbreaks were concentrated between December and May. Five outbreaks originated after consumption of wild boar. The etiological agent identified in meat and/or biological samples from the cases was Trichinella spiralis in four outbreaks and Trichinella britovi in two other outbreaks, while the agent could not be identified in one outbreak. In all outbreaks, actions were carried out in accordance with the recommendations established by the National Epidemiological Surveillance Network (RENAVE).

Conclusions: Trichinosis in Aragon takes the form of sporadic family outbreaks coinciding with the time of wild boar hunting and home slaughtering of pigs and is associated with the consumption of meat products not controlled sanitarily, so it is necessary to strengthen health education and intersectoral collaboration in the development and implementation of prevention and control strategies.

Key words: Trichinosis, Outbreaks, Zoonoses, Aragón, Spain.

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RESUMEN

Brotes epidémicos de triquinosis ocurridos en Aragón durante el periodo 1998-2017

Fundamentos: En Aragón, los controles oficiales veterinarios para detectar la presencia de triquina en productos cárnicos, han permitido que la triquinosis sea una enfermedad de baja incidencia, que se presenta en forma de brotes, asociados al consumo familiar de productos cárnicos no controlados sanitariamente. El objetivo del trabajo fue describir las características epidemiológicas de los brotes de triquinosis ocurridos en Aragón durante el periodo de estudio y las medidas de actuación llevadas a cabo, lo que sirvió de base para rediseñar y fortalecer las medidas de prevención y control.

Métodos: Estudio descriptivo de las características tiempo, lugar, persona, alimentos implicados, agente etiológico y medidas de control implementadas en los brotes identificados por la Red de Vigilancia Epidemiológica de Aragón desde el 01/01/1998 al 31/12/2017. Para el análisis descriptivo se calcularon la media con su desviación estándar y las proporciones.

Resultados: Durante el periodo de estudio (desde el 01/01/1998 hasta el 31/12/2017) se declararon 7 brotes familiares con 294 expuestos, 103 casos (Tasa de Ataque 35%), de los que 29 fueron hospitalizados (28,1%). La tasa de letalidad fue del 1%. La media de edad de los casos fue de 43,3 años (desviación típica 15,9). El 70,8% de los casos fueron varones. Los brotes se concentraron entre diciembre y mayo. Cinco brotes se originaron tras el consumo de jabalí. El agente etiológico aislado en muestras cárnicas y/o muestras biológicas procedentes de los casos, fue Trichinella spiralis en cuatro brotes y Trichinella britovi en otros dos brotes. En todos los brotes las actuaciones se realizaron conforme a las recomendaciones establecidas por la Red Nacional de Vigilancia Epidemiológica (RENAVE).

Conclusiones: La triquinosis en Aragón se presenta en forma de brotes familiares esporádicos coincidentes con la época de caza de jabalí y matanza domiciliaria del cerdo y se asocia al consumo de productos cárnicos no controlados sanitariamente, por lo que es necesario reforzar la educación para la salud y la colaboración intersectorial en la elaboración e implantación de estrategias de prevención y control.

Palabras clave: Triquinosis, Brotes epidémicos, Zoonosis, Aragón, España.

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INTRODUCTION

Trichinosis is a globally distributed zoonosis produced by an intestinal nematode of the genus *Trichinella*. Although 9 species and 12 genotypes[1,2] have been identified so far, the species capable of producing the disease in humans are only *T. spiralis*, *T. native*, *T. britovi*, *T. pseudospiralis*, *T. murrelli*, *T. nelson* and *T. papuae*. In Spain, the species usually identified are *T. spiralis* and *T. britovi*[3,4]. It is important to highlight the relative resistance to freezing of *T. britovi*[5,6]. In 2014, *T. pseudoespiralis* was detected for the first time in our country.

In our environment, the main source of infection for people is the consumption of raw or undercooked meat and/or meat products from infected wild boar or pigs. There is no direct person-to-person transmission.

The incubation period ranges from 8 to 15 days (range 5-45 days), depending on the number of larvae ingested, the immune status of the host and the species involved[7,8].

Clinically it can manifest as an asymptomatic infestation or as a severe condition, with neurological and cardiological complications that can put in serious risk the life of the person. Diagnosis is based on the identification of the history of potentially infected meat consumption, the patient's clinical presentation and laboratory tests (identification of nematode larvae in muscle tissue or determination of antibodies in blood). In the context of an outbreak, diagnosis can be made in asymptomatic persons with a history of infested meat consumption by positive laboratory tests. Postexposure prophylaxis may be effective within 6 days of eating the contaminated meat[9]. Albendazole or mebendazole are the most commonly used drugs as a treatment[10].

In Aragón, the law 222/1996,[11] which regulates epidemiological surveillance, establishes the obligation to report trichinosis cases numerically (number of suspected cases of trichinosis per week), individually (by means of a specific epidemiological survey) and urgently (by telephone). In Aragón, we have reliable data since 1996. Surveillance of the disease makes it possible to know and describe the pattern of presentation of trichinosis in the population, as well as to detect cases early in order to control the spread of the disease, establish prevention measures and avoid outbreaks. Preventive and control measures in the event of a trichinosis case and/or outbreak are included in the RENAVE[12] protocol.

Trichinosis is considered a re-emerging disease worldwide. The Centers for Disease Control and Prevention[10] (CDC) estimates that approximately 10,000 cases occur worldwide annually. According to the latest 2016 report on trichinosis[13] from the European Centre for Disease Prevention and Control (ECDC), 320 confirmed cases of trichinosis were reported in 28 countries of the European Union/European Economic Area (EU/EEA) in 2014. The reporting rate in 2014 was around 0.07 cases per 105 inhabitants. Bulgaria and Romania reported 88% of confirmed cases. According to the report, the consumption of undercooked meat from domestic slaughtering of pigs or wild boar hunting is the most important risk factor for acquiring trichinosis today in the EU/EEA.

In Spain, official controls to detect the presence of *Trichinella* in meat products, largely regulated by European[14] and national[15] regulations, have allowed it to be a rare zoonosis[16]. In addition, Community legislation in force in the European Union obliges the competent authorities of the Member States to draw up contingency

plans that include measures in the event of suspicion or detection of *Trichinella* in animals or meat. Since 1996, the date from which we have data reliable, trichinosis in Aragón is, similar to what occurs in Spain, a low incidence disease, which occurs in the form of outbreaks[17].

The aim of this work was to describe the epidemiological characteristics of the trichinosis outbreaks that occurred in Aragón in the period 1998-2017 and the action measures carried out.

MATERIAL AND METHODS

Descriptive study in which the epidemiological characteristics of reported trichinosis outbreaks were analysed according to the description time, place, person, food involved, the etiological agent and the control measures implemented. The time period studied was from January 1, 1998 to December 31, 2017. The information comes from the database of the Epidemiological Surveillance Network of Aragon. In order to calculate the incidence, the populations of the National Statistics Institute were used (population resident in Spain on 1 July of each year of the study period).

The trichinosis surveillance and control strategy is included in the trichinosis protocol of National Epidemiological Surveillance Network. It includes the mode and circuit of notification, the epidemiological survey, which collects clinical, epidemiological and laboratory data, preventive and control measures and the classification of the case according to the degree of diagnostic certainty. People who met the criteria for probable or confirmed cases were included as cases. A probable case is any person who meets the clinical and epidemiological criteria and a confirmed case is any person who meets the clinical and laboratory criteria.

– Clinical criteria: Person presenting at least three of the following six manifestations: fever, myalgia, diarrhoea, facial edema, eosinophilia, subconjunctival, subungual and/or retinal haemorrhages.

– Laboratory criteria (at least one of the following two): (1) confirmation of larvae of *Trichinella* in muscle tissue obtained by biopsy 2) specific *Trichinella* antibody response (IFA, ELISA or immunoelectrotransference).

– Epidemiological criteria: (at least one of the following two epidemiological relationships): (1) a person who has consumed contaminated laboratory-confirmed food, or possibly contaminated products from an infested/colonised animal confirmed by the laboratory. 2) a person exposed to the same common source or vehicle of infestation as a confirmed human case (contamination of the food is not confirmed).

Any person who ingested contaminated food was therefore considered an exposed individual.

An outbreak was defined as the occurrence of two or more cases of trichinosis with a history of eating a common food (meat or meat products). Based on the scope of exposure, an outbreak was classified as familial when the food involved had been processed and consumed in a private home.

For the descriptive analysis, the mean with its standard deviation and proportions were calculated. The Statistical Package for the Social Sciences (SPSS) version 23 (licence from the Government of Aragón) was used for the analysis of the data.

RESULTS

Incidence rates in Aragón during the study period were low, except in 1998, when there

was an annual incidence rate (per 100,000 inhabitants) of 5.1 (table 1).

During the study period 109 cases of trichinosis were reported. Of these, 103 cases were associated with an outbreak. A total of 7 outbreaks were identified (table 2). Of these, 5 were reported from the preventive medicine services and another two from the health centres. No outbreak affected another autonomous community.

Geographically, four outbreaks (57%) were detected in Huesca and three in Zaragoza.

A total of 7 outbreaks identified 294 exposed and 103 cases (Attack Rate 35%). Attack rates ranged from 9.1% in the 2009 outbreak to 66.6% in the 2017 outbreak. The average age of cases was 43.3 years (standard deviation 15.9). Seventy-eight per cent of the cases were male. Of the 103 cases, 29 of them were hospitalized (28.1%). The case fatality rate was 1%.

Outbreaks were concentrated between December and May and all took place in the family setting.

In 54% of cases the diagnosis was clinical and in 46% serological.

Five outbreaks (71%) originated after consumption of wild boar and two after consumption of pork.

The etiological agent identified in meat and/or biological samples from the cases was *Trichinella spiralis* in four outbreaks and *Trichinella britovi* in two other outbreaks, while the agent could not be identified in one of the outbreaks.

In all outbreaks, the Epidemiological Surveillance Section of the relevant province conducted the appropriate epidemiological investigation and issued recommendations for prevention and control of the disease (health education). Within the Aragón´s Health Service, all outbreaks involved the analysis of clinical samples and the treatment of cases.

In five outbreaks, the Veterinary Public Health Service immobilised, analysed and destroyed suspicious foods. In the 1999 outbreak, they were not able to carry out the prospecting of food samples since the patients had ingested all the contaminated food. The detection of the etiological agent was carried out by identifying *Trichinella* larvae in the patient's muscle tissue obtained by biopsy. The last outbreak, reported in 2017, with two confirmed cases, was related to the ingestion of pork from home slaughter in Romania and sent to Aragón at Christmas by the family of origin. Likewise, in this outbreak it was not possible to carry out the prospection of the sample since the patients had ingested all the contaminated food. In two outbreaks chemoprophylaxis was recommended to asymptomatic exposed persons, as they were identified within the post-exposure period in which administration of chemoprophylaxis could be effective. We do not know the number of people who received post-exposure prophylaxis in each outbreak.

DISCUSSION

According to the results obtained in our study and in a similar way to what happens in our country[17,18], the incidence of trichinosis in Aragón is low and the disease is presented in the form of sporadic outbreaks coinciding with the time of wild boar hunting and home slaughtering of pigs (between the months of December and May). The annual range of outbreaks is between 0 and 1, with the exception of 2011 when 2 outbreaks were identified. There were no significant variations in the trend over the years studied. These results, similar to those of the rest of Spain[19], support the effectiveness of the current controls[20].

Table 1
Summary of the number of cases and incidence of trichinosis in Aragón and Spain. Years 1998-2017.

Year	Number of cases Huesca	Number of cases Teruel	Number of cases Zaragoza	Number of cases Aragón	Annual incidence rate (per 100,000 inhab.) Huesca	Annual incidence rate (per 100,000 inhab.) Teruel	Annual incidence rate (per 100,000 inhab.) Zaragoza	Annual incidence rate (per 100,000 inhab.) Aragón	Annual incidence rate (per 100,000 inhab.) Spain
1998	0	0	61	61	0.0	0.0	7.1	5.1	0.15
1999	5	0	0	5	2.5	0.0	0.0	0.4	0.04
2000	0	0	0	0	0.0	0.0	0.0	0.0	0.11
2001	0	0	0	0	0.0	0.0	0.0	0.0	0.11
2002	0	0	0	0	0.0	0.0	0.0	0.0	0.06
2003	0	0	0	0	0.0	0.0	0.0	0.0	0.12
2004	0	0	0	0	0.0	0.0	0.0	0.0	0.08
2005	0	0	2	2	0.0	0.0	0.2	0.2	0.03
2006	0	0	2	2	0.0	0.0	0.2	0.2	0.09
2007	0	0	13	13	0.0	0.0	1.4	1.0	0.26
2008	1	0	0	1	0.5	0.0	0.0	0.1	0.11
2009	7	0	0	7	3.2	0.0	0.0	0.7	0.05
2010	0	0	0	0	0.0	0.0	0.0	0.0	0.05
2011	16	0	0	16	7.4	0.0	0.0	1.2	0.07
2012	0	0	0	0	0.0	0.0	0.0	0.0	0.05
2013	0	0	0	0	0.0	0.0	0.0	0.0	0.07
2014	0	0	0	0	0.0	0.0	0.0	0.0	0.01
2015	0	0	0	0	0.0	0.0	0.0	0.0	0.01
2016	0	0	0	0	0.0	0.0	0.0	0.0	0.03
2017	0	0	2	2	0.0	0.0	0.2	0.2	sin datos

Source: National Centre of Epidemiology. Available in: http://www.isciii.es/ISCIII/es/contenidos/fd-servicios-cientifico-tecnicos/fd-vigilancias-alertas/fd-enfermedades/enfermedades-declaracion-obligatoria-series-temporales.shtml

Table 2
Summary of trichinosis outbreaks. Aragón. Years 1998-2017.

Epidemiological characteristics		Year of outbreak						
		1998	1999	2007	2009	2011	2011	2017
Notifying source		Hospital	PCC	Hospital	Hospital	Hospital	Hospital	PCC
Scope		Family setting	Family setting	Family setting	Family setting	Family setting	Family setting	Family setting
Place		Zaragoza	Huesca	Zaragoza	Huesca	Huesca	Huesca	Zaragoza
Time		Dec-Jan	Apr-May	Jan	Apr-May	Feb-Mar	Feb-Mar	Jan-Feb
Person	People exposed (number)	143	5	29	77	10	27	3
	Cases (number)	61	4	13	7	6	10	2
	Attack Rate (%)	42.66	80	44.83	9.09	60	37.04	66.67
	Age of cases (mean and standard deviation)	42 (15.8)	25 (17.9)	40 (10.4)	63.14 (11.1)	56.3 (14.7)	43.9 (5.1)	31.5
	Age of cases (median and range)	41 [4 – 75]	25.5 [8 - 41]	36 [29 - 60]	65 [45 - 78]	55 [52 - 65]	45 [24 - 68]	31.5 [30 - 33]
	Percentage of men among cases (%)	74%	25%	69.70%	71.40%	83.30%	70%	50%
	Hospitalized people (number)	20	0	1	2	6	0	0
	Hospitalization rate	32.7%	0%	7.6%	28.5%	100%	0%	0%
	Deceased (number)	0	0	0	0	1	0	0
Diagnostic method(**)	Clinical diagnosis (number)	54	0	0	0	1	0	0
	Serological diagnosis (number)	7	4	13	7	5	10	2
Animal involved		Wild boar	Wild boar	Wild boar	Wild boar	Wild boar	Pig	Pig
Food involved		Sausage and cooked meat	Sausage and cooked meat	Sausage	Sausage and cooked meat	Sausage and cooked meat	Sausage and cooked meat	Sausage
Aetiological agent		*T. britovi*	*T. spiralis*	*T. britovi*	*T. spiralis*	*T. spiralis*	*T. spiralis*	Unknown
Control measures	Epidemiological research	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	IAD suspicious food(*)	Yes	No	Yes	Yes	Yes	Yes	No
	Analysis of clinical samples of cases	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Treatment of cases	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Health education	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Administration of chemoprophylaxis	No	No	Yes	Yes	No	No	No

(*) Immobilization, analysis and destruction of suspect food; PCC: Primary Care Center; (**) Patients diagnosed by clinical data are considered probable cases and those diagnosed by laboratory tests are considered confirmed cases.

Regarding the number of affected people, as stated in the epidemiological bulletin of the National Center of Epidemiology[17], the outbreak in Zaragoza in 1998, Jaén in 1996 and Burgos in 2003 stand out due to the high number of affected people.

With regard to the seasonal distribution, the outbreaks appeared as expected and in a similar way to what happens in Spain, only between November and May of the following year, coinciding fundamentally with the wild boar hunting period[17].

191 exposed persons did not present clinical, analytical and/or serological alterations. Due to the poor quality of the records, the number of exposed persons treated preventively in each outbreak is not available. For this reason we do not know which exposed persons did not get sick due to the effectiveness of the preventive treatment and which did not get sick because they probably ate a minimal amount of infected meat.

As published in other studies[16], the mortality rate was low (1%), a single death, secondary to renal failure. Although the most frequent causes of mortality associated with trichinosis are myocarditis, encephalitis or pneumonia, deaths associated with renal failure have also been documented[21].

Most of the outbreaks identified in Aragón (five) originated from the consumption of wild boar. This observation is congruent with that published in other articles[18,22] and represents an important change in the source of trichinosis, given that years ago it was associated with the intake of intensively raised pork. This finding may be at least partly explained by the fact that the prevalence of Trichinella in wild boar is 4,100 times higher than in pigs raised in homes without veterinary control[23].

T. spiralis was isolated in four outbreaks and *T. britovi* in two other outbreaks. The identification of these two species was expected, given that they are the two predominant circulating species in our country[3,4].

All the outbreaks took place in the family setting, without the opportune veterinary controls, which shows the effectiveness of the controls in force[13,14,15].

The last outbreak, reported in 2017, was related to the consumption of pork from a domestic slaughter in Romania. This finding is consistent with the findings published by Dubrescu[24] in Romania, where most trichinosis outbreaks are reported in January and February reflecting the high prevalence of the consumption of meat at Christmas from home slaughters of pigs.

In all outbreaks the prevention and control measures adopted were in accordance with the national protocol of National Epidemiological Surveillance Network. In two outbreaks, the early detection of cases made it possible to recommend chemoprophylaxis to asymptomatic exposed persons, since it is documented[9] that prophylaxis administered in the first six days after exposure may be effective as a preventive measure.

The indication for chemoprophylaxis may be questioned as there may be asymptomatic cases that have received deworming unnecessarily, however, taking into account that trichinosis can be a serious or even fatal disease, and that according to the Spanish Medicines and Health Products Agency (AEMPS) serious adverse reactions such as anaphylactic reactions or neutropenia are very rare (less than 1/10,000), the recommendation for chemoprophylaxis is justified. Delay in the administration of chemoprophylaxis, if one waits until characteristic symptoms of the disease appear, such as myalgia or

periorbital edema, puts at risk the effectiveness of the drug, since they appear beyond six days after exposure.

All the outbreaks studied were related to the consumption of meat products derived from wild boar or pork not controlled sanitarily. Therefore, the recommendations of the Codex Alimentarius International Food Standards[25] should be disseminated and health education should continue for hunters on the risk of consuming meat from wild animals, and the importance of analysing it, even if only for personal consumption, as established in the existing regulations[13] relating to the control of both pig meat from home slaughters and wild boar killed in hunts. In addition, it is necessary to insist on the need to adequately cook meat from wild animals with an internal temperature of at least 71° C. It should also hunters are informed of the risk of disseminating and maintaining the forest life cycle by abandoning the guts or heads of animals, thereby increasing the likelihood of transmission to new hosts. It is also necessary to inform consumers, including people visiting regions or countries where *Trichinella* is endemic, about the temperature at which meat should be cooked, to avoid becoming ill due to contaminated meat consumption, and about the ineffectiveness of freezing meat as a control measure in endemic regions where known cold resistant *Trichinella* species and genotypes such as *Trichinella T6*, *T. britovi* and *T. native* are present.

Climate change is expected to have effects on zoonotic infectious diseases, such as trichinellosis, by changing their temporal or spatial (annual/seasonal) distribution and increasing their incidence and severity. Rising temperatures are expected to increase the survival of vectors during winter, thus increasing the transmission of diseases such as brucellosis, toxoplasmosis, trichinosis, Q fever and Puumala hantavirus[26,27].

As zoonotic pathogens are particularly sensitive to climate change, their surveillance[28] needs to be prioritised and the Epidemiological Surveillance Services and Veterinary Public Health Services need to work in coordination.

As recommended by the ECDC, alignment with existing EU surveillance practices will improve preparedness and facilitate public health response to emerging infectious diseases associated with climate change[29].

"One Health"[30] is an approach introduced in the early 2000s and led in a coordinated way by the World Health Organisation, the World Organisation for Animal Health, and the World Health Organisation.

Food and Agriculture Organization of the United Nations. Human and animal health are interdependent and linked to the ecosystems in which they coexist. This global collaborative approach is therefore needed to prevent, detect, control and eliminate risks to human health, environmental health (domestic or wild animals) and ecosystems. The tripartite alliance's priority fields of action are food security, zoonosis control and antibiotic resistance.

In order to achieve the objectives set, it is necessary to develop global strategies for the prevention and control of pathogens and to implement them at the global, regional and national levels through the implementation of appropriate policies.

In conclusion, in Aragon, the Epidemiological Surveillance Network has allowed the collection and analysis of epidemiological information on trichinosis, the assessment of its temporal-spatial evolution and has contributed to the implementation of control measures. Trichinosis in Aragón is a low-incidence disease that occurs in the form of sporadic outbreaks coinciding with the time of wild boar hunting

and home slaughtering of pigs. Eating undercooked pork or wild boar meat not subject to veterinary controls is the main risk factor for trichinosis in Aragon, therefore it is necessary to educate the population on the need to consume only meat certified as free of trichinosis. In addition, it is essential to continue monitoring the incidence, identify changes in the epidemiological characteristics of the disease and establish the differential diagnosis of *Trichinella* species detected in outbreaks, all with the aim of providing information that allows the planning and evaluation of policies and preventive programs, as the fight against zoonoses begins with the elimination of the pathogen in its animal source of infection. It is also necessary to strengthen the intersectoral collaboration in the development and implementation of prevention and control strategies.

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