Chronic wasting disease as a part of animal spongiform encephalopathies

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Abstract

Chronic wasting disease belongs to a group of infectious diseases known as transmissible spongiform encephalopathies. The disease has been found in the *Cervidae* family, specifically mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), red deer (*Cervus elaphus*), elk (*Cervus canadensis*), moose (*Alces alces*), and reindeer (*Rangifer tarandus*). Unlike bovine spongiform encephalopathy and other animal transmissible encephalopathies, except scrapie, chronic wasting disease is a contagious prion disease that to our present knowledge affects only members of the *Cervidae* family. The causative agent of transmissible spongiform encephalopathies originates from the host-encoded cellular prion protein (PrP^C), which is misfolded into a pathogenic conformer and was referred to as the abnormal prion of scrapie (PrP^{Sc}). Chronic wasting disease is the only prion disease to affect wild animals. The disease was first detected in Colorado (USA) in the late 1960s. Since 2024, chronic wasting disease has been diagnosed in at least 32 states in the United States and four provinces in Canada. In addition to North America, chronic wasting disease-infected elk have also been confirmed on ranches in South Korea. In terms of zoonotic potential, bovine spongiform encephalopathy is only prion disease in animals confirmed to be zoonotic, and numerous studies have yielded no conclusive evidence of the zoonotic potential of chronic wasting disease. However, to protect public health, further research on aspects of the disease is necessary. Chronic wasting disease first appeared in Europe in 2016, and the first case was in a reindeer in southern Norway. This was also the first evidence of natural infection with chronic wasting disease in reindeer. Very soon after, the second case was described in moose. It was confirmed that the European strain differed from the US strain, and that the strains of the two cases in Europe also differed. The European Union has since implemented Decision (EU) 2016/1918 on certain protection measures for chronic wasting disease. In addition, the European Food Safety Agency issued an opinion proposing a three-year surveillance system in eight countries to determine possible presence of the disease (EU Member States: Estonia, Finland, Latvia, Lithuania, Poland, Sweden, and non-EU Member States, Norway and Iceland), and these countries implemented a monitoring programme for chronic wasting disease from 1 January 2018 to 31 December

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2020 (EU 2017/1972). By the end of 2022, 42 positive cases of chronic wasting disease were confirmed in moose, red deer, and reindeer in Norway, Sweden, and Finland.

Background

Prion diseases or transmissible spongiform encephalopathies are fatal neurodegenerative diseases that include Creutzfeldt-Jakob disease (CJD) in humans, scrapie in sheep and goats, bovine spongiform encephalopathy (BSE) in cattle, exotic ungulate spongiform encephalopathy (EUE) of exotic zoo-ruminants, camel spongiform encephalopathy (CSE) in camels, and chronic wasting disease (CWD) in cervids (Prusiner, 1982, 1998; Smith and Bradly, 2003; Takada and Geschwind, 2013; Liberski et al., 2019; Table 1). They are characterised by vacuoles seen histologically in the brain that were described as spongy (Belay, 1999). One of the main characteristics of prion diseases is a long incubation period and a neuropathological disorder (Kimberlin, 1992; Belay, 1999).

The causative agent for TSE is a transmissible agent called a prion which is an abnormal form of normal protein (Prusiner, 2004). The normal prion protein, PrP^C, ("C" from cell), is a highly conserved glycoprotein ubiquitous on the cell surface in mammals (Bendheim et al., 1992; Morales, 2017; Manni et al., 2020; Henzi and Aguzzi, 2021). It is found in various organs and tissues, with the highest level of expression in the nervous and immune systems (Linden, 2017; Wulf et al., 2017). The function of the prion protein is still not clear. However, some studies have linked PrP^C to myelin homeostasis, neuroprotection, cell signalling, cell adhesion, as a copper-binding protein, and with a protective function against stress (Zeng et al., 2015).

TSEs are referred to as prion disease because normal prion proteins misfolded during synthesis and aggregated into infectious prion particles (PrP^{Sc}, or "Sc" from scrapie), which inevitably leads to fatal neurodegenerative diseases (Prusiner, 1982, Aguzzi and Callela, 2009, Cobb and Surewitz, 2009). More specifically, PrP^{Sc}, a misfolded isoform of PrP^C, promotes the conversion of the cellular prion protein PrP^C into the nascent PrP^{Sc}, the pathogen responsible for the disease. The accumulation of PrP^{Sc} in the brain causes neurodegeneration (Colby and Prusiner, 2011). Prion diseases are inherited or sporadic diseases caused by misfolding of PrP^C, which can occur spontaneously or be triggered by somatic or germ-related mutations in the gene encoding PrP^C (Prusiner and Hsiao, 1994; Uchiyama and Sakaguchi, 2018).

The cellular prion protein, PrP^C undergoes constitutive proteolytic cleavage, whereas the abnormally folded version of the prion protein (PrP^{Sc}) is resistant to Proteinase K cleavage and yields fragments of about 30 kD in size (Cobb and Surewitz, 2009). The proteinase K-resistant fragments of PrP^{Sc} can be analysed by western blot (WB), and immunohistochemistry (IHC), and are referred to as PrP^{res} (resistant). The terms PrP^{Sc}, PrP^{res}, and PrP^{CWD} all refer to the same aberrant prion protein.

Compared to conventional infective agents, prions have unusual properties. They consist of misfolded protein aggregates that are remarkably stable and can

remain infectious in the environment for years. Prions are notorious as resistant pathogens because they are difficult to inactivate using conventional sterilisation methods. For example, alcohol or formalin, or even cooking in high concentrations of formalin, autoclave (121°C, 20 min), and γ-ray irradiation used for disinfection, antisepsis or sterilisation of viruses and bacteria, are ineffective against prions (Sakudo, 2020).

The pathogen has the following characteristics: (1) the pathogen is much smaller than any virus particle and is highly resistant to heat, ultraviolet light, ionising radiation, and common disinfectants that normally inactivate viruses or bacteria; (2) the TSE agent does not cause a detectable immune or inflammatory response in the host; and (3) the pathogen cannot be observed even by electron microscopy.

The term "prion" was introduced by Stanly Prusiner in 1982 to describe "proteinaceous infectious particles". Initially, researchers thought that the TSE pathogen was a "slow-acting" virus (Sigurdsson, 1954). As scrapie has been known as a disease of domestic sheep and goats for more than two hundred years (Brown and Bradly, 1998), most research has been conducted on this disease (Alper et al., 1967; Brown and Bradly, 1998). However, no viruses or viroids have been isolated as scrapie causative agents (Alper et. al., 1966; Pattison and Jones, 1967; Prusiner, 1996). Prusiner persistently put forward the idea that infectious proteins can cause brain diseases (Prusiner and Hsiao, 1994) with a hypothesis called "the protein-only hypothesis" (Ma and Wang, 2014), though the idea that a protein alone, without DNA and RNA, could transmit disease was inconceivable to the academic community (Zabel and Raid, 2015). Therefore, many studies were conducted to identify the causative agent of TSEs.

After only a decade of research, many discoveries have provided decisive evidence in favour of the prion hypothesis (Soto, 2011).

Stanly Prusiner was not the first researcher to propose the idea of a proteinaceous pathogen (Prusiner, 1982). Tikvah Alper was a researcher who suggested that a protein particle could be the cause of the scrapie (Alper, 1967). She found that high doses of ionising radiation and UV radiation which normally wipe out all nucleic acids did not destroy scrapie infectivity (Alper et al., 1967). From this, she concluded that the infectious agents of scrapie did not contain nucleic acid. Griffith was the first scientist to make the bold assumption that the causative agent of scrapie was proteinaceous (Griffith, 1967).

History of animal TSEs

Scrapie is the oldest known transmissible spongiform encephalopathy disease of sheep and goats. It was first described in sheep in the United Kingdom in 1732 and in Germany in 1750 (Brown and Bradly, 1998; Williams, 2003). In the 1960s, scrapie-like disease was observed in captive wild ruminants of the *Cervidae* family in North America (Williams and Young, 1992; Chesebro, 2003; Rivera et al., 2019). The disease, later identified as CWD, was first observed clinically in 1967 in Colorado (Fort Collins), where captive mule deer (*Odocoileus hemionus hemionus)* developed symptoms resembling body wasting syndrome (Williams, 2005). The cases occurred mainly in captive animals, spreading over time to nearby free-ranging animals (Williams and Young, 1992). The aetiology of CWD was unclear until Elizabeth Williams and Stuart Young recognised a resemblance between brain lesions in mule deer with

Table 1. Human and animal TSEs and their epidemiological profile (from Tranulis and Tryland, 2023)

	Disease	Mode of Occurrence	Host
	Kuru	Acquired, cannibalism	Fore people
HUMANS	Iatrogenic Creutzfeldt Jakob disease (iCJD)	Acquired, medical or surgical treatment	Humans
	Variant Creutzfeldt Jakob disease (vCJD)	Acquired, foodborne zoonosis	Humans
	Gerstmann-Sträussler-Scheinker disease (GSS)	Familial, PRNP mutations	Humans
	Fatal familia insomnia (FFI)	Familial, PRNP mutations	Humans
	Sporadic Creutzfeldt Jakob disease (sCJD)	Sporadic	Humans
	Genetic Creutzfeldt Jakob disease (gCJD)	Familial, PRNP mutations	Humans
	Sporadic fatal insomnia (FSI)	Sporadic	Humans
ANIMAL	Scrapie: Classical Atypical /Nor98	Contagious Sporadic	Sheep, goat, moufflon
	Bovine spongiform encephalopathies (BSE): Classical C-BSE Atypical L-BSE Atypical H-BSE	Foodborne Sporadic Sporadic	Cattle
	Transmissible mink encephalopathies (TME)	Foodborne (BSE Atypical L-BSE)	Farmed mink
	Chronic wasting diseases (CWD): Classical C-CWD Moose sporadic CWD Red deer sporadic CWD	Contagious Sporadic Sporadic	Deer species
	Feline spongiform encephalopathies (FSE)	Foodborne (BSE Atypical L-BSE)	Domestic cats and captive exotic felines
	Exotic Ungulate Spongiform Encephalopathy (EUE)	Acquired, foodborne zoonosis	Exotic zoo ruminants of the family *Bovidae*
	Camelid prion disease	Contagious	Camel

those in transmissible spongiform encephalopathies (Williams and Young, 1980). They noticed similarities in the clinical course, neuropathology, and the presence of scrapie-associated fibrils in the spleen and/or brain of both species of affected deer and elk (Williams, 2003). Additionally, they observed the presence of plaques in the brain that reacted with anti-protease resistant protein serum, in-

dicating similarities to scrapie (Williams, 2003). In addition to classic neuronal perikaryonic vacuoles, the aggregates of the prion protein were confirmed by IHC (Williams and Young, 1980; Spraker et al., 2002). Soon after, prion disease was identified in elk (*Cervus elaphus nelsoni*) in Wyoming (Williams and Young, 1982). CWD was also detected in free-ranging elk in Colorado. The origin of CWD is unknown and could be a spontaneous TSE that occurred in deer (DEFRA, 2018).

BSE was first detected in cattle in the UK in 1986 (Kimberlin, 1992). Research suggests that the first probable BSE infections in cows occurred in the 1970s, with two cases of BSE detected in 1986 (Cohen and Valleron, 1999). BSE may have originated from the feeding of meat and bone meal to cattle containing BSE-infected products from a spontaneous BSE case or sheep products infected with scrapie.

The last known case of transmissible mink encephalopathy (TME) occurred in the United States in 1985. Before this outbreak, there were several cases before 1964 (Liberski et al., 2009).

Exotic ungulate spongiform encephalopathy (EUE) is a TSE of exotic zoo-ruminants of the family *Bovidae*. During a period that overlapped with the BSE epidemic, six greater kudus, six elands, two Arabian oryx and ankole cattle, and one gemsbok, nyala, scimitar-horned oryx, and bison were diagnosed with EUE in the UK. The affected animals had been fed meat and bone meal (MBM) derived from ruminants (Imran and Mahmood, 2011).

The first case of prion disease in dromedary camels (*Camelus dromedarius*) was confirmed in 2015 in the Saharan population in Ouargla in south-eastern Algeria, where the disease was observed in animals brought to slaughter (Babelhadj et al., 2018).

Chronic wasting disease (CWD)

CWD is a prion disease that belongs to transmissible spongiform encephalopathy (TSE) (Williams 2005; Sigurdson and Aguzzi, 2007; Sigurdson, 2008). CWD and EUE are the only prion diseases that affect wildlife and they are of unknown origin (Williams and Miller, 2002; Chesebro, 2003). CWD is certainly the most contagious prion disease with the significant horizontal transmission of infectious prions through urine, faeces, and saliva (WOAH, 2003; Hannaoui et al., 2022). Although the origin of the prion causing CWD is unknown, various hypotheses have been proposed, including transmission from a scrapie-infected sheep, a mutation in the Prnp gene, and a spontaneous misfolding of PrP^C into PrP^{Sc} (Saunders et al., 2012; Greenlee et al., 2023).
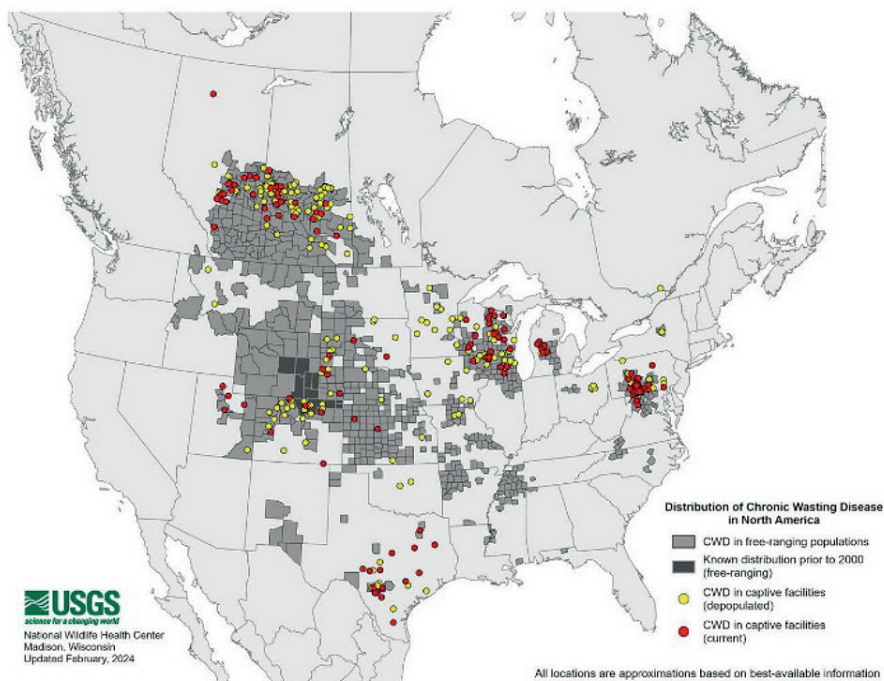
Distribution of CWD

According to the United States Geological Survey, National Wildlife Health Center (official website of the US government), CWD has been detected in free-ranging cervids in 32 US states and five provinces in Canada. CWD has also been confirmed in captive cervid facilities in 18 US states and three Canadian provinces (as of 3 February 2024). This map is based on the best available information from various sources, including state wildlife agencies and the USGS (Figure 1).

The first diagnosis of CWD in Canada was in 1981 in mule deer at the Toronto Zoo (Kim et al., 2002; Kahn et al., 2004; Dube et al., 2006), introduced with imported animals from the USA. Furthermore, in 1996, CWD was diagnosed in farmed elk in Saskatchewan, Canada.

In addition to North America, CWD has also spread to Korea (Sohn et al., 2002; Kim et al., 2005; Watts et al., 2006).

Figure 1. Distribution of CWD in North America (February, 2024) https://www.usgs.gov/media/images/distribution-chronic-wasting-disease-north-america-0

The elk in which CWD was confirmed was imported into Korea from Canada in 1997. This was the first case of CWD occurring outside of the USA and Canada.

The occurrence of CWD in Europe

Norway has conducted a national health surveillance programme for CWD since 2002 (annual report for 2016, Viljugrein et al., 2021). Samples from free-ranging cervids older than 18 months were routinely collected for CWD testing and until 2016, 2159 cervids were tested with no evidence of disease detected (Tranulis et al., 2021).

However, in March 2016, CWD was diagnosed in reindeer for the first time in Europe (Figure 2, Benestad et al., 2016; Tranulis et al., 2021). The diseased female reindeer (*Rangifer tarandus*) was detected in the population of free-ranging reindeer in the Nordfjella population, in southern Norway (Figure 2). The animal

Table 2. Distribution of positive CWD samples in Europe

Period	Norway			Sweden	Finland
	Reindeer	Moose	Red Deer	Moose	Moose
2016 – 2022	21	11	3	4	3
Total	42				

Figure 2. The first case of CWD in Norway (female reindeer, March 2016, from Tranulis et al., 2021)

died spontaneously and the carcass was handed over to the Norwegian Veterinary Institute in Oslo where CWD was confirmed by routine test (enzyme-linked immunosorbent assay, ELISA), and confirmed by WB and IHC (Benestad et al., 2016; EFSA 2017; Tranulis et al., 2021). This was not only the first case of CWD in Europe but also the first time the disease was confirmed in wild reindeer anywhere in the world. Previously, US reports stated that CWD was found only in mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), elk (*Cervus elaphus nelsoni*), and moose (*Alces alces shirashi*). It is not yet known how the disease has emerged in Europe. Shortly after the reindeer report, an infection in moose (*Alces alces*) was diagnosed in May 2016 about 300 km north of the first case, in the Selbu area (Surveillance programmes in Norway for CWD, Norwegian Veterinary Institute 2017). Two weeks later, a second positive free-ranging moose was found in the same area, giving three positive CWD animals in just two months in Norway.

When CWD emerged in Norway, the Norwegian Ministry of Agriculture and Food planned to cull the wild reindeer population remaining in the Nordfjella administrative area after the hunt, due to the risk of spreading the disease and with the aim of eradicating CWD. Among the reasons supporting such a decision is the fact that Nordfjella area is actively used as summer sheep pastures (Tranulis et al., 2021). The eradication plan for Nordfjela zone 1 included the culling of all wild reindeer (about 2000 animals) by regular hunting in the season from 10 August – 31 October 2017 by official hunting teams (starting around 1 November), and by driving them into the fenced area and killing them. The deadline for this eradication plan was 1 May 2018. During eradication, 2424 animals were killed. The samples were included in the CWD surveillance, and 18 new cases were

identified (Tranulis et al., 2021). However, CWD was not eliminated in wild Norwegian with the first cull (Tranulis et al., 2021). The problem is that the prions causing the disease remain infectious in the environment for many years, makes eradication extremely difficult (Report from the Norwegian Scientific Committee for Food Safety, VKM, 2017).

Following increased surveillance of cervid populations in Norway, three cases of red deer (*Cervus elaphus*) were confirmed in Norway in November 2022. So far, the positive cases in Norway have been confirmed in 11 moose, 21 reindeer and three red deer (Table 2).

In 2018, the first case of CWD in the European Union was detected in Finland, with new cases also in 2020 and 2022, totalling three positive cases (Tranulis et al., 2021; Sola et al. 2023) (Table 2).

In Sweden, three cases of CWD were detected in 2019 and an additional case in September 2020, totalling four positive cases (Agren et al., 2021; Tranulis et al., 2021; Sola et al., 2023) (Table 2).

CWD strains

In general, the first reports based on molecular and IHC characterisation of European CWD isolates from wild reindeer and moose showed that they are distinct both from each other and from North American strains (Benestad et al., 2016; Pirisinu et al., 2018; Nono et al., 2020; Pritzkow et al., 2021; Wagner et al., 2022; Otero et al., 2023; Sola et al., 2023). Prion strains can be distinguished based on biochemical differences, the length of the incubation period, and clinical symptoms, as well as the distribution and extent of spongiform changes in the brains of infected animals (Haley and Hoover, 2015; Kovač and Čurin Šerbec, 2022; Otero et al., 2023). Strain differences may influence important disease characteristics

including interspecies transmission, the ability to recognise prion infections, and the potential of the pathogen to survive inactivation and/or persist in the environment. (Wagner et al., 2022). Pritzkow et al. (2021) analysed prion strains derived from three different species of North American cervids and three Norwegian deer species, and confirmed the difference in the molecular structure of those different prions, as the migration profile on the WB was different depending on the strain.

Another fact is that there are two different phenotypes of CWD in Europe. The data show two main phenotypes of the disease, which differ in the presence (Ly+) or absence (Ly-) of detectable, disease-associated PrP in the lymphoreticular tissues and in the central nervous system (Sigurdson et al., 2002). To date, the Ly+ phenotype has only been observed in wild reindeer, and the Ly- phenotype only in moose and red deer (EFSA, 2023). Initial published data showed genetic variation in Norwegian reindeer, with some PRNP-alleles being more common in CWD Ly+ cases (EFSA, 2023).

EU Programmes related to CWD

EU Programmes to control CWD were implemented twice in Europe: between 2007 and 2010 and between 2018 and 2020. After implementation of the first programme, the European Food Safety Authority (EFSA) evaluated the results and concluded that the occurrence of CWD in Europe cannot be ruled out (EFSA, 2010). When the outbreaks of positive CWD cases in Norway were confirmed, for the first time a three-year surveillance programme was initiated by the European Commission Regulation (EU) of 20 October 2017 (EU 2017/1972). This programme covers all EU Member States with moose and/or reindeer pop-

ulations (Estonia, Finland, Latvia, Lithuania, Poland, and Sweden). The sampling target was set at 3000 captive and 3000 wild or semi-domesticated cervids. Sampling should focus on fallen stock, culled, sick, and road-killed animals as well as hunted or slaughtered cervids. Brainstem and lymph nodes should be analysed with a rapid test approved in Regulation 2017/1972, and any suspicious results should be confirmed by WB or IHC.

Most positive cases of CWD detected in Finland and Sweden were confirmed as part of the three-year monitoring programme for CWD in cervids and were found in wild moose (EFSA 2023: Monitoring of CWD).

Diagnostic of CWD

According to the TSE EU Reference Laboratory, several commercial rapid tests are used for routine monitoring of BSE and scrapie in EU Member States and are authorised for use by the EU (Regulation (EC) No 1148/2014 - amending Regulation (EC) No 999/2001) (TSE EU Reference Laboratory Guidelines, 2017). In the absence of a full EFSA assessment of CWD in Europe, several peer-reviewed publications have demonstrated the potential of TSE rapid tests for the detection of CWD from North America and Canada.

In addition, two rapid test manufacturers have undertaken validation attempts to obtain approval from the United States Department of Agriculture and the Canadian Food Inspection Agency for the use of their rapid tests for the detection of CWD in North America and Canada. The TSE EURL currently recommends testing both the obex and retropharyngeal lymph nodes to maximise the sensitivity of surveillance using two rapid tests. To date, two commercial rapid tests for CWD testing are authorised in the EU.

The TSE laboratory of the Croatian Veterinary Institute is the National Reference Laboratory for TSEs and the official and reference Laboratory for Food and Feed. Since 2001, the laboratory has been testing samples for BSE and scrapie, with nearly half a million samples tested to date (Branović et al., 2022). The laboratory is accredited according to HRN EN ISO/IEC 17025:2017 and is trained and fully capable of analysing CWD samples. The method used for CWD diagnostics in the laboratory is approved by TSE EURL. Since there is no mandatory programme for CWD testing in Croatia, only sporadic *ad hoc* sample testing of deer deaths due mostly to traffic accidents was performed with negative results. However, due to the importance of deer game and deer meat consumption, the implementation of a national monitoring programme is strongly advocated.

Transmission of TSEs and the zoonotic potential

In general, TSEs are rare diseases and although transmissible, are not usually contagious (Gajdusek et al., 1966; Ironside et al., 2017). The exceptions are classical scrapie in sheep, CWD in deer, and camelid prion disease in dromedary camels (Belay et al., 2004; Babelhadj et al., 2018). As the infectious prions are present in high titres in body excretions, they allow horizontal or indirect transmission via contaminated environments which is an important mechanism of natural transmission (Gough and Maddison, 2010; Saunders et al., 2012). Vertical transmission from infected mothers to newborns has been found in deer (CWD), as well as other TSEs in animals, including prion diseases in cattle and sheep (Foster et al., 2013). In addition, natural transmission of CWD occurs more frequently between genetically susceptible individuals of the

same or very closely related species (Kurt and Sigurdson, 2016). Another typical characteristic of prions that they share with conventional microorganisms is their ability to infect only certain animal species, a phenomenon commonly referred to as the "species barrier" (Moore et al., 2005). The ability of prions of one species to infect animals of another species depends on the sequence homology between the donor and acceptor prion proteins and the specific properties of the prion strain of the infectious material (Moore et al., 2005; Moazami-Goudarzi et al., 2021). The most important species barrier is the barrier between deer and humans, namely the zoonotic potential of CWD prions (Moore et al., 2005). The current evidence for the transmission of CWD to humans is controversial. Although transgenic mice expressing human PrP did not develop disease when exposed to CWD prions in various laboratories (Kong et al., 2005; Walker et al., 2006), experimental inoculation of CWD into squirrel monkeys resulted in disease (Spraker et al., 1997; Race et al., 2009). Studies on macaques, which are phylogenetically closer to humans than squirrel monkeys, have shown mixed results (Race et al., 2018; Pritzkow et al., 2022). Species barrier analysis between cervids and humans by *in vitro* prion replication showed that PrP^{Sc} from CWD-infected cervids can convert the human PrP^{C} to the pathogenic form under certain conditions (Barria et al., 2011; Pritzkow et al., 2021).

In general, Norwegian CWD appeared to be more capable of overcoming species barriers than North American isolates, except for white-tailed deer which also appeared to be highly transmissible (Pritzkow et al., 2022; Tranulis and Tryland, 2023).

Conclusions

CWD is currently a prion disease of major concern. The reasons for this are that affects different free-living animal species, spreads efficiently, and has a high rate of spreading of infectious agents and a long incubation period. Although the exact processes underlying the easy spread of CWD remain unknown, significant environmental contamination is most certainly one of them.

The number and characteristics of prion strains linked to spontaneous CWD and their specific role in the disease's transmission are also unknown. Although, so far, the only animal TSE disease that has been transmitted to humans is BSE in cattle, the zoonotic potential of CWD is still a perilous mystery. Therefore, much more research at every level is required to effectively combat this cryptic illness and prevent the introduction of new diseases.

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Chronic wasting disease, spongiformna encefalopatija jelena kao dio animalnih spongiformnih encefalopatija

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Spongiformna encefalopatija jelena (*Chronic wasting disease*) je bolest koja spada u skupinu transmisivnih spongiformnih encefalopatija. Bolest se javlja u porodici *Cervidae*, a do sada je opisana u sljedećim vrstama: crnorepom jelenu (*Odocoileus hemionus*), bjelorepom jelenu (*Odocoileus virginianus*), jelenu običnom (*Cervus elaphus*), kanadskom jelenu (elk, wapiti) (*Cervus canadensis*), losu (*Alces alces*) i sobu (*Rangifer tarandus*). Za razliku od goveđe spongiformne encefalopatije, spongiformna encefalopatija jelena spada u najinfektivnije prionske bolesti. Uzorčnici transmisivnih spongiformnih encefalopatija su proteinske stanične molekule nazvane prion (PrP^{C}), koje se prilikom sinteze pogrešno preslože pa nastane patogena forma priona nazvana (PrP^{Sc}). Spongiformna encefalopatija jelena je jedina prionska bolest koja pogađa divlje životinje. Bolest je prvi put opisana u državi Kolorado u Sjevernoj Americi šezdesetih godina prošlog stoljeća. Do 2024. godine proširila se na 32 države Sjedinjenih Američkih Država i 4 kanadske pokrajine. S obzirom na zoonotski potencijal bolesti, jedino je u goveđoj spongiformnoj encefalopatiji potvrđen prijenos na čovjeka. Zoonotski potencijal spongiformne encefalopatije jele-na još je nepoznat i predmet je višebrojnih istraživanja. Bolest se prvi put pojavila u Europi 2016. godine. Prvi slučaj spongiformne encefalopatije jelena potvrđen je u južnoj Norveškoj na sobu. Bio je to ujedno i prvi slučaj te bolesti na sobu uopće do tada opisan. Vrlo brzo potvrđen je i drugi slučaj u Norveškoj, ali na losu. Analiza uzročnika bolesti u Europi potvrđuje da je taj soj priona različit od onog iz Sjeverne Amerike, a i međusobno različit u ta dva slučaja u Norveškoj. Europska unija je reagirala na pojavu spongiformne encefalopatije jelena na način da su propisane privremene zaštitne mjere povezane s tom bolesti (EU 2016/1918), a uveden je i trogodišnji program nadzora spongiformne encefalopatije jelena u Estoniji, Finskoj, Latviji, Litvi, Poljskoj i Švedskoj (članice EU) te Norveškoj i Islandu, i to u razdoblju od 1. siječnja 2018. do 31. prosinca 2020. (EU 2017/1972). Ukupno su do kraja 2022. godine potvrđena 42 pozitivna slučajeva spongiformne encefalopatije jelena u Norveškoj, Švedskoj i Finskoj na sobovima, losevima i jelenima običnim.

Ključne riječi: *Prion, Transmisivne spongiformne encefalopatije (TSE), Spongiformna encefalopatija jelena (SEJ), Chronic wasting disease (CWD)*