Bovine Spongiform Encephalopathy (BSE)

Overview

Bovine spongiform encephalopathy (BSE), widely known as "mad cow disease," is a chronic, degenerative disease affecting the central nervous system of cattle. Worldwide there have been more than 180,000 cases since the disease was first diagnosed in 1986 in Great Britain. BSE has had a substantial impact on the livestock industry in the United Kingdom. The disease has also been confirmed in native-born cattle in Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Luxembourg, Liechtenstein, the Netherlands, Northern Ireland, Poland, Portugal, Slovakia, Slovenia, Spain and Switzerland. However, over 95% of all BSE cases have occurred in the United Kingdom. BSE is not known to exist in the United States.

BSE belongs to the family of diseases known as the transmissible spongiform encephalopathies (TSE’s). These diseases are caused by a transmissible agent which is yet to be fully characterized. They share the following common characteristics:

a. a prolonged incubation period of months or years;
b. a progressive debilitating neurological illness which is always fatal;
c. when examined by electron microscopy, detergent treated extracts of brain tissue from animals or humans affected by these diseases reveal the presence of scrapie associated fibrils (SAF);
d. pathological changes appear to be confined to the CNS and include vacuolation, and astrocytosis;
e. the transmissible agent elicits no detectable specific immune response in the host which has inhibited the development of a preclinical live animal diagnostic test to date.

Similar Diseases of Humans and Other Animals

TSE's are caused by similar uncharacterized agents which usually produce spongiform changes in the brain. TSE's include scrapie (which affects sheep and goats), transmissible mink encephalopathy, feline spongiform encephalopathy, chronic wasting disease of deer and elk, and in humans, kuru, Classical Creutzfeld-Jakob Disease (CJD), Gerstmann- Straussler syndrome, fatal familial insomnia, and vCJD.

Clinical Signs of BSE in Cattle

Affected animals may display changes in temperament, such as nervousness or aggression; abnormal posture; incoordination and difficulty in rising; decreased milk production; or loss of body condition despite continued appetite. There is no treatment, and affected cattle die.

The incubation period ranges from 2 to 8 years. Following the onset of clinical signs, the animal's condition deteriorates until it dies or is destroyed. This usually takes from 2 weeks to 6 months. Most cases in Great Britain have occurred in dairy cows between 3 and 6 years of age.

The Causative Agent of BSE

The causative agent of BSE as well as other TSE's is yet to be fully characterized. Three main theories on the nature of the agent have been proposed:

- An unconventional virus.
- A prion or abnormal partially-proteinase K-resistant protein, devoid of nucleic acid, capable of causing normal prion protein in the host to change and form more abnormal protein.
- A virino or "incomplete" virus composed of naked nucleic acid protected by a host protein.

The BSE agent (1) is smaller than most viral particles and is highly resistant to heat, ultraviolet light, ionizing radiation, and common disinfectants that normally inactivate viruses or bacteria; (2) causes no detectable immune or inflammatory response in the host; and (3) has not been observed microscopically.
How BSE Is Currently Diagnosed

There is no test to detect the disease in a live animal. Currently there are two laboratory methods to confirm a diagnosis of BSE: 1. microscopic examination of the brain tissue to identify characteristic changes; 2. techniques to detect the partially-proteinase resistant form of the prion (PrPres) protein. These techniques are immunohistochemistry, immunoblotting and ELISA.

Can the USDA guarantee that BSE will never occur in the United States?

There are still a number of unknowns regarding the origin and transmission of BSE. Given these scientific uncertainties, we cannot assure zero risk from BSE. However, we can and will continue to monitor new scientific findings and world events and adjust our regulations and policies to keep the risk of BSE infecting the national herd as low as possible.

BSE Has NOT Been Found in the United States

No cases of BSE have been confirmed in the U.S.A. with 12 years of active surveillance.

What About Other Animal TSE's in the US?

These TSE's HAVE been found in the United States: Scrapie in sheep and goats, transmissible mink encephalopathy, and chronic wasting disease of deer and elk.

The Cause of BSE in Great Britain

Epidemiological data suggest that BSE in Great Britain is a common-source epidemic involving animal feed containing contaminated meat and bone meal as a protein source. The causative agent is suspected to be from either scrapie-affected sheep or cattle with a previously unidentified TSE. Changes in rendering practices in the late 70's—early 1980's may have potentiated the agent's survival in meat and bone meal.

For more information about BSE in the United Kingdom, please visit the Department for Environment, Food and Rural Affairs (formerly the Ministry of Agriculture, Fisheries and Food, UK) web site.

Countries Other Than the United Kingdom With Confirmed Cases of BSE

In native cattle: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Luxembourg, Liechtenstein, the Netherlands, Northern Ireland, Poland, Portugal, Slovakia, Slovenia, Spain and Switzerland. While there is a decline in the number of cases of BSE in the United Kingdom, confirmed cases of BSE have risen in other European countries. Oman, the Falkland Islands, Canada, and the Azores have detected BSE in cattle imports from other countries known to have BSE.

For more information, please see Office International des Epizooties.

Outcome of the One Imported Case in Canada

There have been NO cases of BSE in native cattle in North America. The one case of BSE in a single cow in Canada in 1993 imported from Great Britain has been dealt with by destroying the affected cow and all its herdmates, as well as other cattle determined to be a risk by animal health officials in Canada.

Transmission of BSE

There is no evidence that BSE spreads horizontally, i.e., by contact between unrelated adult cattle or from cattle to other species. Some evidence suggests that maternal transmission may occur at an extremely low level. Results of British research show that there is approximately a 9-percent increase in the occurrence of BSE in offspring of BSE-affected dams as compared to calves born to dams where BSE was not detected. The study did not ascertain if this was the result of genetic factors or true transmission. The research did however point out that at this level if maternal transmission does occur it alone will not sustain the epidemic (Wilesmith et al. 1997).
A recently published study found no evidence of disease transmission via embryos collected from cows with BSE. The embryos were collected and handled in accordance with international health standards (Wrethall et al., 2001).

**About Classical Creutzfeldt-Jakob Disease (CJD)**

CJD is a slow degenerative disease which affects the central nervous system of humans. CJD occurs sporadically worldwide at a rate of approximately 1 case per 1 million people per year. More rare are the other TSE conditions affecting humans: Gerstmann- Straussler syndrome, kuru, vCJD, and fatal familial insomnia.

**Classical CJD in the USA and in Britain**

The incidence of classical CJD in the United States (about 1 case per 1 million population per year) is similar to the incidence found in the rest of the world, which includes Australia and New Zealand—countries that have NOT reported either scrapie or BSE. CJD, which was first diagnosed in the 1920's, occurs with roughly the same frequency in Britain as in other countries at the present time.

For more information on CJD in the United States, please visit the Centers for Disease Control and Prevention’s National Center for Infectious Diseases website.

**BSE and vCJD—Human Health Concerns**

On March 20, 1996, the UK's Spongiform Encephalopathy Advisory Committee (SEAC) announced the identification of 10 cases of a new variant form of CJD (vCJD). All of the patients developed onset of illness in 1994 or 1995. The following features describe how these 10 cases differed from the sporadic form of CJD:

• The affected individuals were much younger than the classical CJD patient. Typically, CJD patients are over 63 years old. The average patient age for the onset of variant CJD was 28 (range of 12 to 74) years.
• The course of the disease in the vCJD averaged 14 months. Classical CJD cases average a 4–6 month duration.
• In the variant cases, electroencephalographic (EEG) electrical activity in the brain was not typical of classical CJD.
• Although brain pathology was recognizable as CJD, the pattern was different from sporadic CJD, with large aggregates of prion protein plaques.

Epidemiological and case studies have not revealed a common risk factor among the cases of vCJD. According to the SEAC, all victims were reported to have eaten beef or beef products in the last 10 years, but none had knowingly eaten brain material. One of the affected individuals had been a vegetarian since 1991.

The SEAC concluded that although there was no direct scientific evidence of a link between BSE and vCJD, based on current data and in the absence of any credible alternative, the most likely explanation at that time was that the cases were linked to exposure to BSE before the introduction of control measures, in particular, the specified bovine offal (SBO) ban in 1989.

Research reported in later 1996 and 1997 has found evidence to further support a causal association between vCJD and BSE. Two significant studies published in the October 2, 1997 edition of Nature lead the SEAC to conclude that BSE agent is highly likely to be the cause of vCJD. Dr. Moira Bruce and colleagues at the Institute for Animal Health in Edinburgh, Scotland inoculated 3 panels of inbred mice and one panel of crossbred mice with BSE, vCJD and sporadic CJD. Results indicate that mice inoculated with BSE showed the same pattern of incubation time, clinical signs and brain lesions as mice inoculated with tissues from patients with vCJD. This provides evidence that BSE and vCJD have the same signature or are the same "strain". In addition, sporadic CJD and known scrapie strains were not similar to vCJD or BSE.
Results from a study published by Dr. John Collinge and colleagues of Imperial College School of Medicine, London, UK strongly support Bruce's results. Collinge's paper reports findings of BSE transmission to transgenic mice expressing only human PrP.

Another paper by Collinge et. al. in the October 24, 1996 edition of Nature also provides data to support the association between vCJD and BSE.

More recently, studies using transgenic animals expressing the bovine PrP have supported the view that BSE infected cattle are responsible for vCJD. These mice not only propagated the BSE infectious agent in the absence of a species barrier, but also were highly susceptible to vCJD. Furthermore, the transgenic mice inoculated with either vCJD or BSE had indistinguishable disease characteristics.

**Where has vCJD been detected?**

vCJD has been detected in the United Kingdom. The UK CJD Surveillance Unit provides a monthly update. There have also been 6 cases of vCJD in France, 1 in Ireland, and 1 probable case in the United States and Italy.

On April 18th, 2002, the Florida Department of Health and the CDC reported a likely case of new variant Creutzfeldt Jakob disease (vCJD) in a 22-year-old citizen of the United Kingdom living in Florida. The clinical diagnosis was recently made at a hospital in the U.K. and she has since returned to the U.S. Information provided by the U.K. indicates that the patient's clinical condition and history are consistent with vCJD acquired in the U.K. However, the only way to confirm a diagnosis of vCJD is through study of brain tissue obtained by a brain biopsy or at autopsy.

New variant CJD is a rare, degenerative, fatal brain disorder that emerged in the U.K. in the mid-1990's. Although experience with this new disease is limited, evidence to date indicates that there has never been a case transmitted from person to person. Rather, the disease is thought to result from consumption of cattle products contaminated with an agent that causes a disease called bovine spongiform encephalopathy (BSE, commonly known as mad cow disease). To date, no case of this cattle disease has been identified in the United States by the USDA.

If confirmed, this would be the first case of vCJD reported in a U.S. resident. However, because the disease is thought to have a long incubation period, CDC believes the patient acquired the disease while living in the U.K.

For more information, please visit the CDC web site or the Florida Department of Health web site.

**BSE, vCJD and the International Traveler**

The Centers for Disease Control have published an advisory for international travelers.

**British vCJD Cases and the Scrapie Agent**

The reason it is thought that the vCJD cases in Britain were NOT caused by scrapie is because scrapie has existed in the sheep population in the United Kingdom for over 300 years and has never been shown to be a human health risk.

For more information, please visit the United Kingdom's Department of Health website.

**USDA Actions**

**What is the USDA policy in regard to BSE, and what actions has USDA taken?**

The USDA policy has been to be proactive and preventative. APHIS has taken measures in surveillance, prevention, education, and response. Import restrictions have been in place since 1989, and active surveillance efforts began in 1990. The USDA continually monitors and assesses all ongoing events and research findings regarding spongiform encephalopathies, as new information and knowledge may lead to revised conclusions and prevention measures. APHIS has also created a Transmissible Spongiform Encephalopathy (TSE) Working Group to analyze risks of BSE to the United States, disseminate accurate information about the TSE’s, and act as a reference source for responding to questions about TSE’s.
Is APHIS working with other agencies and groups to coordinate efforts?
Yes. APHIS has actively shared information and met with State and Federal agencies, including the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), the Food Safety and Inspection Service (FSIS), the National Institutes of Health (NIH), and stakeholders to assure we are taking the proper actions in response to changing knowledge and information concerning BSE.

Is BSE a notifiable disease in the United States?
Yes. Under Title 9 Code of Federal Regulations, Parts 71 and 161, BSE is a reportable disease by accredited veterinarians.

What types of BSE surveillance are we doing?
USDA-APHIS, in cooperation with USDA-FSIS and State diagnostic laboratories, has a surveillance program which targets the segment of the cattle population where the disease would most likely be found if it were to occur.

- APHIS educates veterinary practitioners, veterinary laboratory diagnosticians, industry and producers on the clinical signs and pathology of BSE.
- APHIS monitors the remaining cattle imported from countries known to have BSE or have high risk factors for BSE.
- Since 1990, more than 60 veterinary diagnostic laboratories across the United States and USDA's National Veterinary Services Laboratories continue to examine hundreds of cattle brains each year submitted from adult cattle displaying neurologic signs either at slaughter or on the farm. FSIS performs antemortem slaughter inspection at all federally-inspected slaughter establishments, and inspectors are alert for central nervous system (CNS) disorders. Any CNS suspect animals are condemned and tested. Public health laboratories also submit to APHIS any samples that have tested negative for rabies.
- The network of private veterinary practitioners that refers unusual cases to veterinary schools or State diagnostic laboratories around the United States provides an extensive informal but important surveillance system.
- USDA has trained more than 250 State and Federal field veterinarians located throughout the United States in the recognition and diagnosis of foreign animal diseases, including BSE.
- Veterinary pathologists at zoos in the United States routinely conduct postmortem examinations on the brains of zoo animals exhibiting neurologic signs since BSE-like encephalopathies have been diagnosed in seven species of exotic Bovidae at zoos in England.

What type of adult cattle do we test?
1. Neurologically ill cattle found on farm
2. Neurologically ill cattle presented at veterinary diagnostic labs or hospitals
3. Rabies-negative cattle
4. Cattle condemned at slaughter for neurologic disease
5. Non-ambulatory (down/fallen stock)
6. Adult cattle dying on farms from an unknown cause

Has the United States imported cattle from the United Kingdom?
Yes. Between 1981 and 1989, 334 cattle were imported from the United Kingdom and 162 from the Republic of Ireland. These imports have been traced, and there are only 3 cattle still alive in the United States (as of November 2001). These animals have been under quarantine since April 1996. APHIS is currently attempting to purchase these cattle for diagnostic purposes. In July 1989, the importation of live ruminants from the United Kingdom was banned.

In addition, 5 head of cattle imported from other countries in Europe in 1996 remain under quarantine. APHIS, in cooperation with the States and industry, continues to purchase these animals for diagnostic purposes. No evidence of BSE has been found in any of these imported animals.

Does the United States still permit the feeding of ruminant protein to ruminants?
On August 4, 1997, the Food and Drug Administration (FDA) established regulations that prohibit the feeding of most mammalian proteins to ruminants.
What proactive initiatives are underway to educate farmers, veterinarians, extension agents, etc.?
An important part of the USDA's active surveillance program is the training of veterinary practitioners in the clinical signs, diagnosis and sample submission for BSE. Videotapes of cattle showing clinical signs of BSE have been distributed to veterinarians in Federal and State governments, veterinary diagnostic laboratories, and pathology departments of veterinary colleges. Microscope slides showing typical BSE lesions have been distributed to the above diagnostic laboratories, and Federal Foreign Animal Disease (FAD) diagnosticians have trained in Great Britain in BSE recognition. BSE factsheets, risk assessments, and reviews have also been sent to State and Federal veterinarians, private practitioners, other industries, and to producers. In addition, APHIS personnel have given numerous presentations to various animal health groups. Finally, over 250 Federal and State veterinarians throughout the US have been trained in the recognition of FAD's including BSE.

What measures has USDA-APHIS taken to prevent the introduction of BSE?
To prevent BSE from entering the United States, APHIS has restricted the importation of live ruminants and certain ruminant products from countries where BSE is known to exist.

In 1989, APHIS banned the importation of all ruminants and restricted the importation of certain cattle products from the United Kingdom and other countries where BSE was diagnosed.

On December 6, 1991, APHIS restricted the importation of ruminant meat and edible products and banned most byproducts of ruminant origin from countries known to have BSE (56 Federal Register [FR] 63868 and 63869). Prior to this, the products were prohibited by not issuing permits.

Certain products cannot be imported into the United States, except under special permit for scientific, educational or research purposes, or under special conditions to be used in cosmetics. These products include serum, glands, collagen, etc.

As of December 12, 1997, APHIS has prohibited the importation of live ruminants and most ruminant products from all of Europe. The restrictions applied to Albania, Austria, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Federal Republic of Yugoslavia, Finland, Germany, Greece, Hungary, Italy, the former Yugoslavian republic of Macedonia, Norway, Poland, Romania, Slovak Republic, Slovenia, Spain, and Sweden. These actions were in addition to those already in place regarding countries that had reported BSE in native cattle.

This action was taken in 1997 because the Netherlands, Belgium, and Luxembourg have reported their first cases of BSE in native-born cattle. There is evidence that European countries may have had high BSE risk factors for several years and less-than-adequate surveillance.

An interim rule was published and the comment period closed on March 9, 1998. Criteria to assess the risk factors were developed in accordance with the standards adopted by the Office of International Epizootics (OIE).

Have we allowed the importation of cattle semen and embryos from BSE-affected countries?
Yes.

No BSE infectivity has been detected in embryos, semen, or reproductive tissues of BSE-affected cows and bulls. Embryo transfer experiments have been completed in cattle. This recently published study found no evidence of disease transmission via embryos collected from cows with BSE. The embryos were collected and handled in accordance with international health standards.

Importation protocols exceed the recommendation of the Office of International Epizootics (OIE). All bulls producing semen for export to the United States are required to meet all 5 of the following conditions:

1. The semen donor has not been on premises where BSE has occurred within 5 years of the date of embryo or semen collection;
2. The semen donor is not affected with BSE;
3. No progeny of the semen donor is affected with BSE;
4. The parents of the semen donor are not affected with BSE; and
5. The semen donor has not been fed ruminant-derived protein.
These importations were suspended during the first week of April 1996, in response to the reported possible association of vCJD cases in the United Kingdom and exposure to the BSE agent. We have since resumed the importation of bovine semen as there is no scientific evidence to support that semen harbors the BSE agent.

What actions are taken at USDA-inspected slaughter establishments to ensure that cattle with neurological disease would not enter the human food supply?
All cattle presented for slaughter in the United States are inspected before slaughter by FSIS for signs of CNS impairment. Any animals exhibiting neurologic signs during this inspection are condemned, and the meat is not permitted for use as human food. The brains from these animals are submitted to USDA's National Veterinary Services Laboratories for analysis.

Does USDA have a response plan in the event a case of BSE or TSE is diagnosed in US cattle? In 1990, APHIS developed a plan to respond to a confirmation of BSE in the US. In August 1996, a joint APHIS-FSIS working group updated this BSE response plan. The purpose of the plan is to provide a step-by-step plan of action in the event that a case of BSE is detected in the United States. The plan outlines those events that should take place, including identification of a suspect animal, confirmation, the epidemiologic investigation, animal and herd disposition activities, and communication of information. The plan has been shared with other government agencies that have developed their own plans to coordinate with those of USDA.

**BSE Response Plan Summary**

**Contacts for More Information About BSE**

For animal health issues, contact APHIS' Lisa Ferguson at (301) 734-8073.

All general inquiries about APHIS’ role regarding BSE or animal health should be referred to Legislative and Public Affairs at (301) 734-7799.

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<td>food safety, meat and meat products, or meat inspection</td>
<td>Food Safety and Inspection Service</td>
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<tr>
<td>human health, Creutzfeldt-Jakob disease, overseas travel and BSE risk</td>
<td>Centers for Disease Control and Prevention</td>
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<td>National Institutes of Health</td>
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<td>food, feed, drugs, cosmetics, or biological products</td>
<td>Food and Drug Administration</td>
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