Mad Cow Disease
To Beef or Not to Beef?

REPRINTED FROM *THE NEW CHILDREN'S HOSPITAL MONTHLY INFECTIONS DISEASE REPORT.*

In March 1996, British beef and beef products were banned throughout the world as a result of a possible link between bovine spongiform encephalopathy (BSE), a degenerative brain disorder of cattle, and Creutzfeldt-Jakob disease (CJD), a rare degenerative brain disorder of man. For seven years the British government and farming industry had been steadfastly reassuring the public that there was no possible risk to man from the sharp rise in BSE[1] to over 30,000 cases per year in 1992 and 1993, which followed the use of contaminated sheep offal in cattle-feed from 1982 onwards (and was stopped in 1989).

In a three-year period from 1992-1995, four British dairy farm workers known to have been exposed to cattle with BSE, died from Creutzfeldt-Jakob disease. In addition, two British teenagers developed CJD in the same period, which is unusually young for the age of onset of CJD. A number of experts were asked by the British Medical Journal to comment[2]. Their opinions on the likelihood of any connection between BSE and CJD, and any risk from the consumption of beef, varied, but the resulting furore saw the demise of the British hamburger at least temporarily.

What is bovine spongiform encephalopathy?

Bovine spongiform encephalopathy (BSE), dubbed "mad cow disease" by the lay press although the affected cows stagger from ataxia, is one of the so-called prion diseases. Other examples of prion diseases, once called slow virus diseases, are scrapie, and Creutzfeldt-Jakob disease. Kuru, described in the Fore tribe in New Guinea, is a degenerative spongiform encephalopathy thought to be transmitted by eating the infected brains. Since it is mainly relatives' brains which are eaten, it was long thought to be a genetic disorder. Scrapie is a spongiform encephalopathy of sheep.

What are prions?

Prions are proteins rather than complete virions. It is not known how they reproduce, since no nucleic acid has ever been demonstrated in the transmission of prion diseases. However, it is extremely difficult to decontaminate instruments which have been contaminated with prions. Susceptibility to prion diseases is thought to depend on the following:

Species

Many of the diseases are relatively species-specific, eg scrapie may affect sheep, but is not thought to affect man. However, the agents of Creutzfeld-Jakob disease, kuru and scrapie have all been transmitted orally to non-human primates[8].

Inoculum size

Most infectivity in human prion diseases is in neural tissue (brain, spinal cord, eyes) and lympho-reticular tissues (liver, spleen, lymph nodes). In both human prion diseases and bovine spongiform encephalopathy, infectivity is not found in skeletal muscle, fat or body fluids, eg milk.

Route of inoculation

The most efficient route of inoculation is intracerebral, followed in descending order by intravenous, intraperitoneal, subcutaneous and oral[7]. This would be more reassuring if it were not known that oral transmission of kuru certainly occurs.

Genetic

There is a human prion gene, *PrP*, which appears to determine susceptibility to prion diseases. In experimental animal models, the *PrP* gene has been shown to be the main determinant of species specificity.

What is Creutzfeldt-Jakob disease?

Creutzfeldt-Jakob disease (CJD) is a human spongiform encephalopathy, caused by a prion or prions.The incidence generally increases with age, and most cases occur in middle age. Affected subjects develop dementia, myoclonus, hyper-reflexia and/or cerebellar signs with truncal ataxia and slurred speech.

About 15% of cases are genetic in origin, with susceptibility thought to be determined by the prion (*PrP*) gene. Most of the remaining cases are idiopathic with no family history and no apparent source[6]. A small number of cases are known to have been acquired iatrogenically: the main source is pituitary extracts used for growth hormone, but infected corneal transplants, intracerebral EEG electrodes and liver transplants have also been described as modes of transmission from person to person[9].

Clinical

Sporadic CJD is generally characterised by dementia and multifocal neurological deficits, whereas when CJD occurs as a result of accidental transmission cerebellar manifestations usually predominate. The clinical presentation of the farmers and the teenagers in Britain was more typical of the sporadic form[3].

Molecular biology

The CJD agent is not particularly close genetically to the BSE agent. Indeed the bovine agent (BS) is scarcely any closer than scrapie to the human agent (CJD)[2], and scrapie is not thought to be transmissible to man.

Epidemiological considerations

At first glance the finding of four British dairy workers dying from CJD over a 3-year period, and previously exposed to BSE, appears extremely suspicious. Of course, the main suspicion then is of occupational exposure to the agent, perhaps through aspiration or inoculation, rather than of ingestion.

However, the incidence of CJD has been found to be higher than the rest of the population in farmers from Europe and the United States, where cattle are apparently unaffected by BSE. Either farming is an unexplained risk factor for developing Creutzfeldt-Jakob disease independent of BSE, or else BSE is more widespread than is admitted.

There have only been six cases of CJD described in teenagers in the world, of whom two are from Britain.

However, British surveillance for CJD has been formally reactivated since 1990[4]. This has presumably increased awareness: CJD can only be diagnosed by immunohistochemistry for the prion protein.

Overall, the incidence of CJD in Britain in 1993 and 1994 was no higher than in other European countries without BSE[5]. This does not exclude a link, since if most cases were idiopathic, a large rise in BSE-linked cases might still be swamped by the overall numbers. The Dutch epidemiologists conclude with a firm piece of fence-sitting: ***"Taken together, the epidemiological evidence of date does not point to a causal link between BSE and CJD but, unfortunately, does not strongly reject that possibility either".***

Conclusions

There is no evidence to suggest that beef or milk from cattle infected with bovine spongiform encephalopathy agent are infectious to man, and reasonable evidence that they are not[7, 10-13]. The decision that MacDonalds UK switch from beefburgers to vegeburgers was one based more on hysteria than on science, and has been described already as ***Beefgate.*** As a long-term consumer of British beef, I am not losing any sleep over this storm in a tea-cup (of beef broth)

References

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