ANTHROPOLOGICAL IMPLICATIONS OF KURU

by

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ABSTRACT

This paper examines the etiology and epidemiology of the micro-organism 'slow' or 'unconventional' virus. The hypothesis outlined suggests that four previously unrelated disease processes (Kuru-New Guinea; Creutzfeld-Jacob Disease-Europe; Alzheimer's-North America and a 'New Entity'-Japan) may be manifestations of the same organism spreading globally, or, that the virus involved in each case is of the same familial group. It is further hypothesized that the primary differences between these diseases are dose/inoculation related. The consequences of this incurable virus infection are discussed, and suggestions are made with respect to prevention of the infection.

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RESUME

Cet article examine l'étiologie et l'épidémiologie du micro-organisme le virus 'lent' ou 'non-conventionnel'. L'hypothèse dont nous avons exposé les grandes lignes suggère que quatre processus morbides qui n'étaient au préalable pas liés l'un à l'autre (Kuru -Nouvelle Guinée; syndrome de Creutzfeld-Jacob -Europe; maladie d'Alzheimer ou démence présénile -Amérique du Nord et une 'Nouvelle Entité -Japon) pourraient être des manifestations du même organisme se propageant globalement, ou, que le virus impliqué dans chaque cas appartient au même groupe familial. Par ailleurs, il est suggéré que les différences primaires entre ces maladies sont liées au rapport dose/ inoculation. Nous avons discuté les conséquences de cette infection virale incurable et fait des suggestions en ce qui concerne la prévention de l'infection.

INTRODUCTION

The fatal affliction of the Central Nervous System previously described as affecting only the Fore people of Papua, New Guinea (Glasse 1970:210) may, in fact, be more widely spread than was previously suspected. This paper presents a preliminary overview of the slow virus and the various manifestations exhibited by this disease process are described. Specific reference is made to Kuru, Creutzfeld-Jacob Disease, Alzheimer's Syndrome and an unidentified entity from Japan.

The causative organism for a slow viral infection is a viroid (that is, a microorganism which has a nucleus containing a single strand RNA that normally affects plants). It is expected that the viruses affecting humans (for example, Rubella) are inactivated by ultraviolet radiation (sunlight) or gamma radiation, among other things. However, viroids infecting plants have evolved an inherent predisposition to resist ultraviolet or gamma radiation (Diener 1974:23). It has been suggested that the slow or unconventional virus which infects humans is akin to the plant viroids because it is impervious to conventional viral inactivation methods such as boiling temperatures (80 C), ultrasonics, proteases, nucleases, formaldehyde, freeze-drying, and freezing up to -70 C. On the other hand, a slow virus can be destroyed by autoclaving at 121 C at 20 lbs/in.^{2} for thirty minutes (this is a higher setting than is commonly used to sterilise surgical instruments), 0.5-5.0% hypochlorite (bleach), 90% phenol, iodine disinfectants, ether, acetone and strong detergents.

This organism, for classificatory purposes, is called an unconventional or slow virus because it is different from other human infective virii but, when examined under the electron microscope, the micro-organism exhibits definite virus like particles (Mandell 1979: 1442-6). The transmission of the virus from one individual to another is by direct inoculation of infected body fluids (for example, blood, nasal/oral vaginal/seminal secretions) into an open cut or wound of the recipient (Gajdusek 1977:943). The infection produces no inflammatory response in the recipient (that is, no pain, swelling or fever) and will incubate for a very long time (up to 20 years or more) before any symptoms appear. By this time, the slow or unconventional virus has multiplied sufficiently to cause irreversible, untreatable biological damage which is fatal (Mandell 1979:1442-6).

The symptoms of slow virus infections follow a progressively worsening pattern, these symptoms include:

-disorientation leading to sensory hallucinations, forgetfulness and finally a complete state of dementia,

-shivering tremors of the head, trunk and legs which are more obvious than the arm tremors,

-dysarthria, or the inability to form normal speech patterns due to decreased motor control which is caused by the viral damage of the central nervous system. This includes myoclonic (seizure-like) contractions of the facial muscles during which the afflicted person appears to be grinning or grimacing (hence the term 'laughing to death'),

-dysphagia (difficulty in swallowing) develops as well as ulcerated sores from lack of movement. The inability to control the bladder or bowel makes this condition worse.

-a progressively developing inability to move, eat, control the bladder or bowels and muscle contractions. Dementia or complete separation from the real world takes place probably as a result of sensory nerve damage. The person usually dies of pneumonia, starvation, dehydration, burns (rolling into a fire), or infection from open sores (for instance, pressure ulcers or yaws), and not from the disease organism itself.

-pathological damage to the central nervous system is manifested by a spongiform degeneration of the grey matter, a decrease in the normal number of neuron cells and vacuolisation of the neural cytoplasm with a marked proliferation of astrocytes, accompanied by little, if any, inflammatory response (Mandell 1979:1442-6).

A virus normally attaches itself to a body cell and, during replication, the virus will substitute its own RNA for the cells' genetic material. Therefore, the virus is reproduced rather than the normal body cell. The cell is now programmed as a virus and will continue to replicate as such. In the case of a foetus to which the virus can be passed via the placental barrier in the first trimester, the cells being re-programmed are made useless and prevent development in key areas (Hoeprich 1972:859). The latter process has not been proven for the slow virus, but it appears probable that the viroid could pass across the placental barrier within the first trimester.

KURU OF THE FORE PEOPLE OF PAPUA, NEW GUINEA

Kuru, in 1956, was thought to be a genetically inherited problem, but actual inheritance has been disproved and this theory has been replaced with an infectious disease etiology (Sorenson 1976:36). In 1959, Hadlow showed that there are strong similarities between scrapie (a transmissable viral infection of sheep) and Kuru (Mandell 1979:1442-6). The discovery of the similarities between the two micro-organisms led to attempts to transmit Kuru from infected human hosts to animals. In 1965, chimpanzees which had been inoculated with Kuru infected material exhibited pre-mortum Kuru symptoms, expired 20 months later and had the same post-mortum pathological changes as the Kuru victims (Mandel 1979:1442-6).

Kuru nearly decimated the Fore people at a rate of 1% per year from 1950 until 1965. During that time, all ages and both sexes were equally affected (Sorenson 1976:36). By 1965, contact with Europeans had been felt by the Fore. The Australian Government legally enforced the prevention of cannibalism and with little or no exposure to the virus infecting the dead, direct introduction of viral material into open cuts or sores also decreased. The death rate due to Kuru dropped dramatically at which time the females appeared to suffer more from Kuru than did any other age or sex (Mandell 1979:1442-6).

Many social practices of the Fore people encouraged the rampant survival and transmission of Kuru prior to Australian intervention. These practices included the following:

-women, apparently, practised the ritual cannibalism of dead relatives, encouraging their children (both sexes) to assist in the preparation and eating of the deceased's brain (Sorensen:1976:32). Adult males never helped in the preparation and rarely indulged in cannibalism, and if they did, they never ritualistically partook of a female relative (Sorensen 1976:43).

-women were responsible for caring for semi-domesticated pigs which roamed nearby thickets as mature animals, but were fed and handled from birth in the women's huts (Sorensen 1976:54). Any abrasion or cut on the hand would introduce infective viral material from the pigs into the Fore women's and children's systems. It will be remembered that Kuru was successfully passaged to chimpanzees in 1965. It may be possible for other mammals (such as pigs) to act as hosts for this disease as well,

-women and children lived together separately from the men, except, of course, during coitus. Once a woman conceived, and while the woman bore the child and continued nursing, there was no intimate, physical contact between the man and woman (Sorensen 1976:72),

-yaws is prevalent in the Fore people as are other diseases which cause open sores (Rowley 1966:12,13) and these would be an adequate path for Kuru inoculation by contact with viroid infected material.

To reiterate regarding epidemiology, the women and children in Fore Society were exposed to the Kuru virus in larger doses and more frequently than the men because the females and children prepared (handled) possibly infected corpses (both human and animal) and the adult males were relatively segregated from body fluids of possibly infected females due to custom.

This trend appears to suggest an accumulation hypothesis. That is, the larger the initial dose of infected material plus the repeated auto/external inoculation in high doses through time could equal a high volume of slowly multiplying organisms. This could account for a more

rapid demise (for instance, children dying at 18-24 months.) Since the Australian Government forced the Fore people to change their social habits, only a very few old men and fewer old women are dying of Kuru (Mandell 1979:1442-6). In other words, with a very low initial dose and little or no subsequent exposure, then one would expect to observe no symptoms for 20 years or more. Unfortunately, studies to determine the actual amount of a slow virus over time have not been done, and therefore a dose-response gradient has not been determined.

CREUTZFELD-JACOB DISEASE (C.J.D.) - NORTH AMERICA AND EUROPE

Creutzfeld-Jacob Disease (C.J.D.) has recently been classified as a slow virus akin to Kuru displaying the same symptoms and causing the same anatomical damage as Kuru (Mandell 1979:1442-6). However, further research must be done to ultimately prove that the identical micro-organism causes both C.J.D. and Kuru. The two disease processes were thought to be different because C.J.D. affects both males and females equally in their fifth to sixth decade. On the other hand, both C.J.D. and Kuru have been labelled as slow virii and do belong to the same family; therefore, it is possible that the differences between C.J.D. and Kuru could be the result of low initial exposure and minimal (if any) further exposure vs. large initial inoculations, respectively.

The frightening and insidious aspect of C.J.D. is that it doesn't appear, as far as symptoms are concerned, until middle-age or later. Unfortunately, there are many other causes of pre-senile or senile dementia. These disoriented or emotionally distressed symptoms are the first sign -- and these have many varied causes. It would be very easy to overlook C.J.D. as a normal aspect of aging -- that everyone "gets a little senile". However, this disease follows a very definite pattern and it is only truly confirmed at autopsy where the significant changes in the brain anatomy are apparent. In the United States, 200-500 new cases are diagnosed every year (Mandell 1979:1442). Oddly enough, the highest incidence of C.J.D. has been observed among Libyans (30 times higher than the average occurence). A possible correlational factor could be that the Libyans have the dietary habit of consuming sheep's eyeballs (Mandell 1979:1442). It will be remembered that sheep carry scrapie which Hadlow proved to be highly similar to Kuru. If Kuru and C.J.D. can be passed to other animals, it is possible that animals could pass it to humans by inoculation. If this is possible, then, hypothetically, the handling and preparation of infected sheep's eyeballs could pass the micro-organism on to humans by direct inoculation rather than by ingestion. However, as yet, there is no scientific proof of a causative relationship between handling sheep's eyeballs and the higher incidence of C.J.D. in Libyans.

ALZHEIMER'S SYNDROME - EUROPE AND NORTH AMERICA

Alzheimer's syndrome occurs with much more frequency in North America than C.J.D., to the extent that 90,000 to 100,000 deaths per year are attributed to this disease. This would make it the fourth to fifth most common cause of death in the United States and, as Karasu and Katzman (1976) emphasize, "one is dealing with a disease that is responsible for a significant portion of the morbidity and early mortality of the aged." (Birren and Sloane 1980:564). The symptoms for Alzheimer's are the same

as given for Kuru and C.J.D. -- that is, a decrease in neurons, neurofibrillary tangles, progressive dementia with visual, verbal and hearing disorientation, but occurring in those over the age of 60 to 65 (Birren and Sloane 1980:565-566). Dr. Clarence J. Gibbs, director of the National Institute of Neurological and Communicative Disorders and Strokes has stated that, speaking conservatively, a virus is a possible hypothesis as the cause of Alzheimer's. He also stated that the findings so far certainly justify further virological research to study Alzheimer's (Trubo 1981:124-125). It is also noteworthy that Alzheimer's could be linked to genetic disorders. For example, the incidence of trisomy 21 (Down's syndrome) is much higher among the kindred of probands diagnosed as having Alzheimer's syndrome. Those individuals with the $HP1^1$ genotype (greater incidence of leukaemia and low immune response to disease) have been shown to have a higher incidence of senile dementia and Alzheimer's than normal individuals or those with an HP2 genotype. It has been suggested that $HP1^1$ genotypes facilitate the disease process more than other genotypes do. Furthermore, persons with Down's syndrome, if they survive past the age of 40, have an increased incidence of Alzheimer's (Birren and Sloane 1980:566-567). Is the genetic disorder of trisomy 21 caused by the infection of the mother-to-be by a slow virus (which Alzheimer's may be) much the same way that a normal virus can affect the foetus or is there a facilitative genotype ($HC1^1$) which is common to both Down's syndrome and Alzheimer's (and quite possibly Kuru and C.J.D. as well)? Only more research will answer these questions. It would be interesting to study the typical Immunological genotypes of those suffering from Kuru, Creutzfeld-Jacob and Alzheimer's to observe any correlation.

A "NEW ENTITY" - JAPAN

As these are infectious processes, it is interesting to note that the Japanese have recently (1979) found what they consider to be a "new entity" in disease. So far, only eleven cases of pre-senile dementia with motor neuron disease have been described in Japan, and they are similar to the C.J.D. pathogenesis except that the reporters state that extra-pyrimidal disturbancs (a functional unit responsible for motor activities), myoclonus (regular muscular contractions and relaxations not under voluntary control), cerebellar abnormalities are apparently not present, the severe destruction of the central nervous system is absent, and Alzheimer's neurofibrillary tangles are absent (Mitsuyama and Takamiya 1979:592-593). And yet, the process is very much like that of the slow virus infections previously described:

"1. All patients have progressive dementia with insidious onset in the pre-senile period.

2. Muscular wasting...appears in the course of the illness.

3. The prognosis is poor and the duration of illness from illness to death is 15 to 40 months.

4. Extra-pyrimidal symptoms and definite sensory deficits are not present.

5. No characteristic changes in the cerebral spinal fluid or EEG are found.

6. There is no known parental consanguinity or familial occurrence (yet no figures are presented to show that the families' kinship had been studied!).

7. Pathologic findings in common are nonspecific mild degenerative changes throughout the central nervous system."

(Mitsuyama and Takamiya 1979:592-593)

As a result, I question the classification of this as a disease different from C.J.D. or Alzheimer's because the patient mentioned earlier in this same article was described as having a borderline normal EEG showing some abnormal changes with a normal cerebral spinal fluid. This is similar to both C.J.D. and Alzheimer's, but the slightly abnormal EEG was not included as a criteria for the "new entity". The authors also state that there are no symptoms of motor imbalance, yet the description of the female patient in the article indicated symptoms such as muscle weakness, dysarthria (imperfect articulation of speech due to disturbances of muscular control due to central or peripheral nervous system damage) and difficulty in swallowing (Mitsuyama and Takamiya 1979:595-593). These symptoms are also found in Kuru, C.J.D. and Alzheimer's. These authors appear to contradict themselves, and I therefore find emphasis on a "new disease" questionable. With attention focused on this condition in Japan, however, perhaps more information will come to light. If this is, indeed, a slow virus, then certain questions arise -- is the virus universal to all humans, has it evolved differently in different areas of the world, or is it the same disease being spread from one area to another?

PREVENTION/CONTROL OF SLOW VIRUS

There is no known cure for any slow virus, and, further more, there is no immunisation for this disease. Therefore, the only way of controlling this infection is to prevent inoculation in the first place. Vigorous washing of wounds with hypochlorite (bleach) could inactivate at least some of the virus, but this is not a complete prevention. Care not to allow any infective material near an open wound, avoiding the handling or consumption of any animal that could be infected with scrapies or possibly Kuru, and scrupulous detergent scrubbing of any utensils used in the preparation or serving of food, would prevent the transmission of a slow virus. It will be remembered the temperatures high enough to cook meat will not destroy a slow virus. The virus is not dangerous when ingested (the hydrochloric acid of the stomach would inactivate the micro-organism) but even a small gum cut or ulceration will allow viral entry. The Fore normally bury body wastes (placentas, faecal matter, hair clippings) so that others can't use them for sorcery (Sorenson 1976:39) and these could easily be a source of reinfection. The bleach could be poured over wastes at the time of burial as a preventative measure.

Any anthropologist working in Papua New Guinea should keep these simple precautions in mind, particularly if any blood samples for genotyping are to be examined. Slow virii have been fully documented as

being passaged from one infected individual to another through a corneal transplant and also through the re-use of stereotactic brain electrodes (which had been cleaned with alcohol but not bleach) (Duffy 1974:692). Therefore, any accidental stab with a used needle is a guaranteed inoculation. The used needles would have to be soaked in bleach before ultimate disposal. In the field, if any researcher accidentally cuts themself, the wound must be immediately flushed with 0.5% bleach (hypochlorite), iodine or phenol (90% strength) (Duffy 1974:692).

SUMMARY

In North America, the social ramifications can be tremendous. "By the year 2000, there will be 30 million people beyond age 65..." and that "...these two dementias (C.J.D. and Alzheimer's) could impinge on every family group in the United States." (Trubo 1981:124-125). North American society is having problems facilitating healthy older people now. If the incidence of slow viral infection remains the same or increases, then our over-extended health care system for the elderly will be sorely insufficient by the year 2000. Because there are no immune responses to these infections, there is no hope of any form of immunisation as it now exists. Dr. Kingsbury states that they hope to prolong the incubation period of the disease itself in the hope that the symptoms of the disease don't appear. That is, the incubation time would exceed the human life span. The key to this is that some people are affected at age 20 or 55 and others not until 70 or 80 (Trubo 1981:124-125). But what if these slow virus infections are accumulative in nature -- that is, higher initial doses and frequent re-exposures in large doses, cause earlier symptoms and death to occur? So far, only Kuru has been seen to affect young children, and yet, in this case with enforced lower exposure, only adult females and a few old men are now showing symptoms. If this is the case, then those showing symptoms of C.J.D. at age 40 are actually exhibiting an earlier, larger initial dose of infective material and a more frequent exposure than the individual who exhibits symptoms of Alzheimer's at age 80.

Since this slow virus is masked and not diagnosable until symptoms appear, it is truly frightening that one might have it and face a future of dementia and slow death. It is even more frightening that, as yet, the condition is not treatable and that social institutions would be hard-pressed to care effectively for a large number of demented and physically handicapped aged people. Hopefully, with further research, either a cure or control can be found for this disease because of the potential strain it may place on North American Health Care systems. It is suggested that both cultural and physical anthropologists exercise caution in areas known to harbour slow virii, and to remember that, without preventative measures, Kuru decimated the Fore of Papua, New Guinea to the point of near extinction.

REFERENCES

Birren, J.E. and R.B. Sloane, ed.
1980 Handbook of Mental Health and Aging. New Jersey: Prentice-Hall.

Diener, T.O.
1974 Viroids. Annual Review of Microbiology, 28:23.

Duffy, P., Wolfe, J. and G. Collins
1974 Possible Person to Person Transmission of Creutzfeld-Jacob Disease. New England Journal of Medicine, 290:692.

Gajdusek, D.
1977 Origin and Disappearance of Kuru. Science, 197:943.

Glasse, R.M.
1970 Some Recent Observations on Kuru. Oceania, 40:210-211.

Henschke, G.
1978 Alzheimer's Disease and HLA. Tissue Antigens, 12(2):132-135.

Lewis, T.
1981 On the Problem of Dementia. Discoverer, August:34-36.

Mandell, D., ed.
1979 Principles and Practices of Infectious Disease, Vol. 2; pp. 1442-1446. New York: I. Wiley and Sons.

Mitsuyama, Y. and S. Takamiya
1979 Pre-Senile Dementia with Motor Neuron Disease in Japan - a New Entity? Archeological Neurology, 36:529-593.

Rowley, C.D.
1966 The New Guinea Villager. New York: Frederick A. Praeger Inc.

Sorenson, E.R.
1976 The Edge of the Forest. Washington, D.C.: Smithsonian Institution Press.

Trubo, R.
1981 The Senility Virus. Science Digest, August:124-125.