



Aluminium and Alzheimer's disease

Introduction

Alzheimer's disease is the commonest form of dementia. It causes progressive loss of all mental powers - the powers to think, to remember and to reason. Alzheimer's disease affects about 35,000 people in Scotland. The disease kills brain cells and leaves behind a tell-tale scattering of dead cells with tangled fibres (neurofibrillary tangles) and the accumulation of clumps of a protein called 'A beta'. These clumps are known as plaques. Its not yet clear if the plaques cause the cells to die, if they are part of a defence mechanism or possibly both at different times.

Causes

No-one really understands the cause (or causes) of Alzheimer's disease. Genetic inheritance may play a part and it does seem that a rare early onset form of the disease is inherited in a few families.

Scientists have also suggested that environmental factors such as virus infections, toxins, head injuries and metabolic disorders may be involved. No-one really knows for sure.

Some people think that one of the clues to the mystery may lie in aluminium. There is circumstantial evidence linking aluminium with Alzheimer's disease. But it is impossible to say so far whether aluminium may be a cause of Alzheimer's disease, although it is looking less and less likely.

Scientific evidence

The evidence has accumulated over a period of decades and comes from several sources:

1. Aluminium is one of the few substances known to cause tangles when injected into animals. Although these tangles are not identical to those which occur in man, they appear to contain some similarities. These experiments also cause a loss of memory in the animals.
2. It has been claimed that, in Alzheimer's disease, the aluminium content in the nerve cells with tangles is higher than in adjacent, undamaged nerve-cells. Similar findings have been claimed for tangle-bearing cells present in a rare disease similar to Alzheimer's disease

Introduction	1
Causes	1
Scientific evidence	1
Sources of aluminium	2
Controlling intake	2
1. Food	3
2. Packaging	3
3. Pots and pans	3
4. Medicines	4
5. Water	4
6. Air	4
Summary	4

(the so-called 'Guam' disease). However, recent studies using a new and very powerful kind of analytical microscope (nuclear microscopy) have shown that the high levels of aluminium in tangles are actually caused by the way the cells were prepared when they were being examined.

3. Studies in Newcastle appeared to show that there is a deposit of aluminium combined with silicon at the centre of the senile plaque. However, other research has suggested that this is not the case.

4. Aluminium was identified as the cause of 'dialysis dementia'. Patients undergoing dialysis for kidney disease developed severe memory loss and other symptoms including convulsions. By removing aluminium from the dialysis fluid this condition was prevented. Patients with 'dialysis dementia' do not, however, seem to develop the plaques and tangles seen in Alzheimer's disease.

5. Studies on the uptake of aluminium have indicated that it enters the brain bound to a protein called transferrin. Transferrin is a protein that binds and transports iron around the body. The greatest uptake of aluminium in the brain occurs in areas rich in transferrin receptors and these coincide with the regions which are vulnerable in Alzheimer's disease.

Iron, together with copper, binds to proteins such as A beta. Iron and copper are highly reactive 'transition metals' which are involved in 'oxidation-reduction reactions'. These reactions lead to the production of highly toxic chemicals called 'free radicals', which are probably responsible for cell death in all degenerative diseases. There is some evidence that aluminium, which is not a highly reactive metal like iron or copper, may interfere with this process, possibly allowing more free iron to circulate and so generate more free radicals which in turn generate yet more free radicals in a chain reaction.

6. A recent survey suggests that rates of Alzheimer's disease are higher in areas with

the highest level of aluminium in the water supply. The disease was approximately one and a half times more frequent in districts with higher levels of aluminium in the water, compared with those in which it was low or absent. This is a relatively small increased risk and the researchers agree that this research is inconclusive, raising more questions than answers.

Taking all the research findings together, the Scots law verdict of 'not proven' seems like the best verdict, although 'not guilty' is beginning to look more likely. However there is little doubt that aluminium is neurotoxic (poisonous to brain cells) and excessive intake should be avoided.

Sources of aluminium

Aluminium is all around you - visible in pots and pans, invisible in food, water and air. It is the most abundant metal in the earth's crust.

An average person has a daily intake of 7mg of aluminium. By far the greatest intake comes from food. But most is not retained and passes straight through the gut and is excreted.

At Camelford in Cornwall, 20 tons of aluminium sulphate was accidentally discharged into the water supply in 1988. Some people were exposed to very high concentrations of aluminium in the water. There were short-term toxic effects including diarrhoea, vomiting, headaches and fatigue. There have been reports of persistent illness since the incident including instances of memory loss. Reports have failed to agree on whether these health complaints could have been caused by the water contamination.

Controlling intake

Is it possible to control aluminium intake from the six main sources - food, packaging, medicines, pots and pans, water and air?

1. Food

Most foods contain some aluminium. Tea and some herbs and spices contain particularly high levels. Scientists think you probably absorb very little of the aluminium you take in from food. Aluminium often binds strongly with other substances in food such as fluoride and phosphate, which may make it less absorbable. Tannin in tea combines with aluminium so that little is absorbed.

Studies have found that beverages (tea, coffee and soft drinks) and cereals (cakes, puddings, biscuits, breakfast cereals, bread, flour, oatmeal and rice) are our main sources of aluminium from food.

Some aluminium is naturally present in food but some, in the form of aluminium salts, is added for various purposes. Aluminium-based additives are widely used in bleaching, in preserving and pickling processes, and in powdered foods such as instant coffee, dried milk, artificial 'creamers' and table salt. Bread, cake, biscuits and baking powders may be high in aluminium if they contain aluminium food additives.

Four aluminium additives have E-numbers: E173, E541, E554 and E556. Others are shown by name in additive listings on foods. Additive E173 is powdered aluminium. Its only permitted use is for coating a range of sweets from small cake decorations to sugared almonds. Eating just a handful of the bigger 'silvered' sweets could double your daily aluminium intake from food. There are plans to tighten the regulations to allow additive E173 to be used only on the small silvered cake decorations.

Aluminium concentrations are 10 to 20 times greater in most cow's milk formulas (and 100 times greater in soya-based formulas) than in breast milk. But this is generally not thought to pose a risk, except in premature babies or infants with kidney disease, who may absorb and retain more aluminium.

2. Packaging

Your food may come into contact with aluminium from packaging, foil trays, foil lined cartons and aluminium cans. Or you may cook or store food in foil.

The amount of aluminium added to most foods by freezing, storing and cooking it in foil or disposable aluminium trays is negligible.

Most foil-lined cartons or aluminium cans have a layer of lacquer, plastic or cardboard covering the metal and the food or drink picks up very little aluminium.

3. Pots and pans

The aluminium added to most foods by cooking in uncoated aluminium pans is less than 0.1mg per 100 gram serving. But the acid in some foods can increase the amount of aluminium in food picks up from uncoated aluminium pans.

Rhubarb cooked in an uncoated aluminium pan or pressure cooker can, for example, pick up 4mg of aluminium per 100g serving. Adding sugar can halve the amount of aluminium dissolved. If you want to reduce your aluminium intake from cookware, you could avoid cooking acidic foods (most fruits, including tomatoes) in uncoated aluminium pans.

Cooking food in coated/non-stick or hard-anodised aluminium pans adds virtually no aluminium. Coated or non-stick pans are easy to distinguish from uncoated pans. Hard-anodised aluminium pans are steely grey or black.

It is best not to clean uncoated aluminium pans with cleaning soda or bleach. These strip away the surface of pans, leaving newly exposed metal, which is more likely to dissolve into food. Acidic food stored in uncoated aluminium cookware can also accumulate aluminium.

Recent reports suggesting that fluoride in water increases the aluminium dissolved from cooking utensils have been disproved.

4. Medicines

Many antacids used for treating indigestion and ulcers contain large amounts of aluminium compounds. But little of the aluminium is normally absorbed.

The recommended daily dose of some antacids may contain 1,000mg to 2,000mg of aluminium. Studies of people using antacids have shown however that those exposed to high levels of aluminium over long periods are no more prone to Alzheimer's disease than other people. Antacids make the stomach more alkaline, and this prevents the absorption of most of the aluminium. Aluminium absorption is higher if antacids are taken with orange juice instead of water.

Some deodorants also contain aluminium but there is no evidence that aluminium salts in deodorants pass through skin.

5. Water

Your intake of aluminium from water is very small. But some scientists think the aluminium in water is in a form that's easier for your body to absorb.

Even if your water was at the maximum recommended European standard for aluminium content (0.2mg in a litre), your intake from two litres a day would be only 0.4mg - less than one-tenth of the average daily aluminium intake from food.

Aluminium is naturally present in some water. In addition, aluminium sulphate is widely used in the filtering of public water supplies. The European standard is not based on any estimate of possible health risk, but on aesthetic considerations of water colour. Most people's water in the UK has less aluminium than 0.2mg in a litre.

Aluminium salts are added to water supplies in virtually all areas of Scotland. There are alternative ways of treating the water but they are more expensive and less effective. You have the right, as a consumer, to be provided with an analysis of your supply. We believe that no water authority should exceed the European limits.

Some water filters will remove aluminium from the water though not all are effective.

6. Air

There isn't much you can do about aluminium in the air. Your intake from the air is in any case negligible. Some inhaled aluminium enters your lungs, but hardly any enters the rest of your body.

All in all, there isn't a very great deal that you can do to reduce your aluminium intake. And until we know more about how aluminium might affect the brain we can't even be sure about any risks or benefits.

Summary

None of the evidence so far has proved that aluminium contributes the degenerative changes which cause Alzheimer's disease. However, there is more evidence linking aluminium with this disorder than there is for any other environmental factor. The disease may involve an interaction between genetic and environmental factors.

The majority of older people do not get Alzheimer's disease despite the widespread presence of aluminium in the environment. The risk from increased exposure to aluminium must be small in general terms. At the moment there is no known test which will identify those at risk from Alzheimer's disease and it is not known whether limited aluminium would prevent the disorder or slow down its progression.

It is extremely difficult to control exposure to bioavailable forms of aluminium. The evidence

linking aluminium in water supplies with Alzheimer's disease is inconclusive.

Although foods and medicines rich in aluminium additives can be avoided, it must be emphasised that we do not know if they constitute a risk.

Any precise link between Alzheimer's disease and aluminium will remain a mystery for the meantime.

This information sheet was revised in 2003 with the kind assistance of Dr Nikki MacLeod, University of Edinburgh. It was first written in 1991, based on material prepared by Professor J. A. Edwardson for the Alzheimer's Disease Society and in the consumer magazine Which?, June 1990.

This publication was produced with the support of the Community Fund.

**COMMUNITY
FUND**
Lottery money making a difference



Alzheimer Scotland

22 Drumsheugh Gardens, Edinburgh EH3 7RN

Telephone: 0131 243 1453

Fax: 0131 243 1450

Email: alzheimer@alzscot.org

Alzheimer Scotland - Action on Dementia is a company limited by guarantee and is recognised as a charity by the Inland Revenue. Registered in Scotland No. 149069. Scottish Charity No. SC022315.

Find us on the internet at
www.alzscot.org