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Aerotoxic Syndrome – The Poisoning of Airline Pilots, Cabin Crew and Passengers that is possible in any air flight.

Over the past few decades there has been a fundamental design fault in the majority of aeroplanes used to move people around the world. Cabin air is taken from air that is used to cool the engine. This is cheap because this air has already been warmed and compressed by the jet engines. However it is subject to contamination from the engines particularly if engine design is faulty or if engine seals become worn. Indeed all jet engines leak oils and fumes to a certain extent and these chemicals get in to cabin air. Because jet engines run at such high temperatures, additives are put into oil so they can work better. Therefore depending on the design, the age and the recent service history of the engine, occupants of any aircraft will be more or less poisoned by these fumes. It's not the job of this letter to detail the extent of the poisoning – you can see that from the following website: www.aerotoxic.org

What is the poison?

One of the additives to oil is a chemical called tri-cresol phosphate. This is an organophosphate. However it is not just one organophosphate, it is a series of them from mono-cresol phosphate, di-cresol phosphate, tri-cresol phosphate, ortho-cresol phosphate and others. These isomers are very much more toxic than the named parent compound tri-cresol phosphate, furthermore we know that chemicals are much more toxic when given in combination rather than isolation.

In addition to these organophosphates there will be range of volatile organic compounds that arise as the result of burning petrochemicals which are likely to be benzene compounds, phenolics, possibly fire retardants or whatever.

Again because engines wear there are likely to be heavy metals present from the engine itself.

It is also possible that there are noxious gases such as carbon monoxide, ozone, sulphur and nitrogen compounds.

How do I know if I'm being poisoned?

The smell of these chemicals is alikened to that of sweaty feet or old trainers. Indeed some of the cabin crew have commented that when they notice this smell they would walk up and down the aircraft trying to see if one of the passengers had their shoes off and was emanating this smell.

During the flight one may get direct reactions to these chemicals. Obviously people with multiple chemical sensitivity will react much sooner than people who have not been sensitised to chemicals. The symptoms will be very similar to the mild acute poisoning that farmers suffer from with sheep-dip 'flu i.e. a flu-like illness with a bit of a headache, nausea, muscle aches, maybe irritation of the airways such as conjunctivitis, rhinitis, sinusitis, pharyngitis and bronchitis, difficulty thinking clearly, possibly low grade fever and just generally feeling ill. All too often these symptoms are ascribed to an infectious cause and people accept this readily since there are many different people in a tiny space for some length of time where a virus could be easily picked up.

As you will see from the aerotoxic website there have been thousands of "incidents" described by airline pilots and cabin crew where they have felt acutely ill and not in control of their senses. This is an extremely worrying situation – it is tantamount to the airline staff being under the influence of alcohol! On some occasions the pilots have actually lost consciousness.

Following the flight

The severity of the symptoms will depend not only on the dose of chemical that has been received, but also the individual susceptibility of the traveller. We know from work done with the sheep dip 'flu and the Gulf

war veterans that roughly a third of the population are poor detoxifiers of organophosphate. These people will be more severely afflicted. The above symptoms may persist for some days, for a few susceptible individuals a long term illness may be triggered.

The dose of organophosphate received is unlikely to cause the acute enzyme abnormalities so beloved of the Poisons Units who use this as a marker for organophosphate poisoning. The poisoning has to be extremely severe for this to occur. Therefore this test (to measure cholinesterase levels) is sometimes used as proof of the fact that travellers have not been exposed!

Long term chronic effects

These symptoms develop in some susceptible individuals. They can either occur following a single massive exposure, or after several years of regular sub-lethal exposure to OPs. These symptoms are:

1. Symptoms of chronic fatigue syndrome:

Severe, debilitating fatigue which is physical and mental.

- physical – no stamina, loss of muscular strength (episodic blurred vision), sudden "hitting a wall", has to rest regularly and pace all activity
- mental – poor short term memory, unable to learn new things, poor concentration, speech difficulty with poor word finding. Long term memory usually fine.

Malaise – sufferers feel ill, "hung over", "poisoned".
Muscle aching – often widespread, flitting from one group of muscles or joints to another, often requiring painkillers; degeneration of handwriting.
Drug intolerance (such as alcohol, antidepressants)
Sleep disturbance

2. Multiple chemical sensitivity. Sufferers
   a) become more sensitive to OPs, which means that they get bigger reactions with smaller doses.
   b) become sensitive to other chemicals. This is called a "spreading phenomenon" and classically these people start to react to many other chemicals such as diesel fumes, perfumes, cigarette smoke, alcohol and so on.
   c) Develop an exquisite sense of smell – they can smell chemicals long before anybody else – they are true "canaries"

3. Personality change
   - destabilisation of mood (mood swings)
   - increased tearfulness, irritability and aggression
   - impulsive suicidal thoughts
   - rage

An extreme version of these symptoms results in psychiatric disorders including depression and psychosis.

Symptoms which may arise as a combined effect of the above problems include:
Chest pain,
Shortness of breath
Muscle twitching or cramp
Irritable bowel syndrome (abdominal pain, bloating, diarrhoea/constipation etc)
Sweating
Poor balance and dizzy spells
Numb patches, clumsiness
Tendency to pick up infections
Many other symptoms

Toxic chemicals also accelerate the normal ageing process so that diseases which one might expect in patients in their eighties one sees in patients in their fifties and sixties. These diseases include:

- Degenerative conditions such as Parkinson's disease, osteoporosis, heart disease and dementia.
- Genetic and DNA damage causing cancer (and of course birth defects).
- Immune disruption - this can cause allergies (to foods, inhalants and chemicals), tendency to acquire infections and difficulty getting rid of infections, autoimmunity.

Making a diagnosis of chemical poisoning (which includes organophosphates, volatile organic compounds and heavy metals).
At the moment there is no single test which will diagnose acute chemical poisoning. This is because the chemicals get into the body, do damage, and are then distributed throughout the body into fatty departments. The problem here is that many tests are done on blood levels. This does not reflect the total toxicity outside the blood. This means that by the time a sufferer gets to see a doctor the chemicals are in such low levels in the blood they are not detectable by conventional tests and only the damage remains.

These chemicals are extremely toxic chemicals even in sub-lethal doses. Every bodily system can be adversely affected by toxic chemicals, therefore sufferers present with a multiplicity of symptoms. Any one of these symptoms can be ignored or coped with. It is when they come together and are so persistent, that sufferers present to their GPs.

When patients come, they will not arrive with a list of all their symptoms. Sufferers will only tell me about the symptoms which they believe might be serious. Many sufferers present with chest pain or headaches suspecting heart problems or a brain tumour. They have to be asked specifically for details of other symptoms, or the diagnosis will be missed. Toxic chemical poisoning is a clinical diagnosis made on the basis of past medical history, symptoms, signs and investigations.

Past Medical History
Often there is no serious illness in the past. However when asked, many sufferers will give a history of reactions to other chemicals such as air fresheners, cigarette smoke, perfumes or whatever. Some people may give a similar history of symptoms following previous flights such as headaches, muscle aches, chest pains and nausea.

These symptoms of acute chemical poisoning also occur in sick building syndrome, sheep dip 'flu, 9/11 syndrome (firemen being poisoned by toxic fumes), Gulf War syndrome, fumes from toxic waste sites and industrial pollution, photographic and printing industry, painting and carpet industry as well as mercury from dental amalgam and so on.

Clinical signs
Standard medical examinations often reveal no clinical signs of disease and the sufferer looks well. Indeed his looks belie his feelings. These patients feel terrible but look well. One has to rely on tests to support the diagnosis. It is a combination of the clinical history plus positive tests which make the diagnosis.

Laboratory Investigations
Chemicals get into the body, cause damage and are then excreted. Conventional medical tests are not sufficiently sensitive to identify these chemicals and pick up the widespread and subtle damage which results from them. Sensitive tests have to be done most of which are not routinely available and certainly not on the NHS. So many sufferers get the standard "work up" of medical tests which are either inappropriate, or overlook minor abnormalities. For example:
Full blood count – usually normal – (there may be a low white cell count)
Urea and electrolytes – usually normal
Liver function tests – usually normal. There may be slightly raised liver enzymes (often ignored) or a slightly raised bilirubin, suggesting Gilbert's syndrome.
Muscle enzymes – sometimes these are slightly raised

Hormone tests – usually interpreted as normal, but actually often show low normal levels
X-rays – all normal
ECGs – usually normal
Nerve conduction studies of the motor and sensory nerves – usually normal. Abnormalities may be found if tests are done within 2 years of the most recent exposure to OPs.
MRI scan of the brain - normal

Most chemical sufferers get this standard battery of tests and are told there is nothing wrong with them. However, there are abnormalities which would be picked up by the following tests:

- Finding the toxic chemical - this can be done with fat biopsies to identify pesticides and volatile organic substances.
- Heavy metals can be detected by measuring blood toxic metals or analysing the metal content of sweat
- More sensitive tests of mitochondrial function or antioxidant status often pick up these toxins which get stuck onto membranes and proteins.
- Immune function tests – most of these are research only tests, but, if available, look for low levels of natural killer cells, low levels of B cells, abnormal T suppressor/helper lymphocyte ratios, raised C reactive protein and hypogammaglobulinaemia. ANCA, TNF and interleukin 6 may also be abnormal.
- Sensitive tests of liver function (including glutathione S transferase, 5 nucleotidase, RBC glutathione, urinary D glucaric acid), and tests of the liver's ability to detoxify (caffeine, paracetamol loading) – often abnormal Standard Detoxification Profile and Toxic effects screen.
- Hormonal studies suggest a suppression of the pituitary gland with borderline underactivity of the thyroid (hypothyroidism), mild Addison's disease (tested for by doing adrenocortex stress profile – salivary cortisol and DHEA levels over 24 hours), inappropriate ADH secretion, poor melatonin levels resulting in sleep problems, low levels of sex hormones etc. The thyroid abnormality is interesting classically with low TSH and low T4 (in the lowest 20% of the "normal" range). Thyroxine can be very helpful.
- Osteoporosis – bone density scan at the wrist, hip and spine is mandatory. All people with significant exposure to chemicals should have this investigations. Urine tests may show abnormal levels of metabolites of bone namely deoxypyridinoline (Dpd) and N-telopeptides (NTx) indicating faulty bone metabolism.
- Psychometric testing – this often shows severe impairment of memory, information processing, learning, concentration etc. This is not easy to get on the NHS but should be demanded – available via consultant neurologists. It should be possible for your GP to refer you to a neurologist because you are suspected to be suffering from a "sub-cortical dementia". The neurologist has to be asked to refer you on for psychometric testing. This may take several hours to do (if it doesn't you are not getting the right test!). These tests are an objective assessment of brain function and can be very helpful for getting street credibility (with your GP – there is often a dramatic change of attitude when it is discovered there is something really the matter!) and for getting benefits (as you are suffering from a pre-senile dementia). Indeed Doctor Sarah McKenzie Ross is the most experienced neuro-psychologist in this field and she has identified a pattern of brain damage that is particular to chemical poisoning and different from say dementures or depressions.

- Nerve conduction studies of the autonomic nervous system – presently only done by Drs Jamal and Julu. The autonomic nervous system controls automatic functions such as temperature, sweating, blood pressure, heart and respiratory rate, gut function etc. Abnormalities are commonly found in OP poisoned sufferers and are persistent.

- Brain scans to demonstrate function (such as SPECT scanning) may show poor perfusion of particular areas of the brain. Most of this work has been done on Gulf War veterans who were similarly poisoned.

- Trace elements levels – often deficiencies of magnesium and selenium found.
- Vitamin deficiencies – particularly of the B vitamins – in fact, this is so common that I do not bother to do tests, but use multivitamins routinely.
- Antibodies to brain proteins (cytoskeletal antibodies) sometimes raised (test not available in UK).
- Conduction abnormalities in the heart – arrange 24 hour ECG monitoring for symptoms such as chest pain or palpitations (needs referral to cardiologist).
- Allergy testing – Thanks to the brilliant biochemist Dr John McLaren Howard with whom I work very closely we now have a whole new range of specialist nutritional tests which look at the functional problems caused by chemical poisoning. We can look at how these chemicals actually interfere with the workings of cells in particular mitochondria (which are the power houses of cells supplying energy to cells and therefore centrally important in chronic fatigue syndromes, the DNA (which contains the genetic blueprint for life), the antioxidant systems and cell membranes. Not only can we see what chemicals have been stuck onto these structures but John can tell the precise biochemical lesion that is causing the clinical problem. This of course is extremely helpful in the management of patients with chemical poisoning and an essential part of their work-up.

Treatment – the environmental approach
The priority is to recognise the illness and stop further exposure to toxic chemicals. Not all people are equally susceptible to the toxic effects of chemicals – those that get symptoms are more susceptible and need to be doubly careful to avoid further exposure.

Fatigue – mental and physical. This has the most severe effects on lifestyle. Most sufferers are unable to work full-time. I estimate many sufferers are reduced to 25% or less of their pre-morbid potential. All activities have to be carefully paced as over-doing things one day will cause a relapse lasting several days.

Pain – the pain and muscle symptoms are often diagnosed as fibromyalgia. I see fibromyalgia as mitochondrial failure in the muscles. See my fibromyalgia h/o.

Acceleration of the normal aging process
The mechanism by which chemicals cause damage is to interfere at a fundamental level with biochemical processes and in effect accelerate the normal ageing process. This is what makes these victims of chemical poisoning difficult to detect by a discrete syndrome – sufferers get normal diseases suffered by normal people but before their time. So for example the Gulf War veterans have a greatly increased risk of cancer heart disease and degenerative conditions like osteoporosis, arthritis, prion disorders such as Alzheimer's disease, Parkinson's disease and motor neurone disease and so on, none of which constitutes a recognisable and different syndrome but is all symptomatic of an accelerated ageing process.

Treatment – the environmental approach
In the short, medium and sometimes long term the commonest problem is a chronic fatigue syndrome. This is just a symptom and the name of the game is to identify and treat the underlying causes. This is given in detail in my book which can be downloaded free of charge from my website www.drmyhill.co.uk . It is vital to go through this step by step and address all the issues. Do not be tempted to cherry pick the easy things or you will slow your recovery. In particular the diet – dietary changes are the most difficult to make and people often leave these till last whereas actually they should be done first.

To prevent ongoing damage from chemicals already lodged in the body it is essential to get these out with Far Infrared saunaing.

The details of treatment are in the book but the priorities are as followsl:

- Avoid further chemical exposures and make your house a chemically safe environment
- Eat a stoneage diet (diet for CFS which is of low glycaemic index and avoids the common allergens)
- Get a good night's sleep on a regular basis
- Take my basic package of nutritional supplements
- Do a good detox regime such as far infrared saunaing

If this doesn't bring about improvements go on to the next stage:

- Either do tests of mitochondrial function or take the package of supplements to support mitochondria
- Test thyroid function
- Test adrenal function
- Address any gut problems which have not been tackled by the stoneage diet such as hypochlorhydria, pancreatic enzyme deficiency, gut dysbiosis.

What can you expect from your GP?

The problem with GPs is that they are not trained to look for toxicological (poisoning) as a cause of illness. You may be referred to the Poison's Units (now called Medical Toxicology Units). The Poison's units have not made a single diagnosis of chronic organophosphate poisoning in the last ten years, I suspect because funding for the Poison's Units comes from the chemical companies. This is an issue I have written about in the Journal of Nutritional and Environmental Medicine which the Poison's Units have failed to refute.

You can expect your GP to do a series of blood tests and tell you there is nothing abnormal and therefore nothing wrong. The next step might be referral to a neurologist who again will trot out the party line – chronic chemical poisoning does not exist. The next port of call is usually the psychiatrists who do not have a "toxicological" diagnostic pigeon hole and will squeeze you into the next nearest fit, ie chronic depression. The treatment of this, namely anti-depressants, will make the poor sufferer worse, he will refuse to take them and be discharged as an unco-operative patient. The chemically poisoned person is left to sort out his life as best as he can and usually ends up with declining health.

Fortunately most chemically poisoned people are intelligent and realise the above state of affairs. But the lack of street credibility and help from Government Agencies make this illness a social and financial disaster area.