Public Health Guidance Note

Organophosphate and Carbamate Insecticides

Introduction
Medical practitioners often are requested to undertake tests of pesticide absorption in patients who have had significant exposure to pesticides, usually in their work. Among the commonest pesticides for which testing is required are the organo-phosphate and carbamate insecticides. This Environmental Health Guidance Note is intended to aid medical practitioners in assessing exposure to such insecticides.

Organophosphate Insecticides
There are many organo-phosphate insecticides in common use in agricultural and domestic pest control. They vary considerably in their toxicity. Examples of organophosphate insecticides (with some of their common trade names) are:
- Parathion (Folidol)
- Fenamiphos (Nemacur)
- Methidathion (Supracide)
- Monocrotophos (Azodrin, Nuvacron)
- Chlorpyrifos (Dursban, Lorsban)
- Demeton-S-Methyl (Metasystox)
- Diazinon (Basudin, Gesapon)
- Dimethoate (Rogor)
- Fenthion (Lebaycid, Baytex)
- Maldison (Malathion)
- Trichlorphon (Dipterex)
- Temephos (Abate)

Carbamate Insecticides
Carbamate insecticides also are used commonly in agricultural and domestic pest control. Members of the carbamate insecticide group include:
- Carbaryl (Sevin)
- Methiocarb (Mesurol, Baysol)
- Methomyl (Lannate)
- Propoxur (Baygon)

Symptoms and Signs of Poisoning
Organophosphate and carbamate insecticides are cholinesterase inhibitors. Thus, they cause classical cholinergic symptoms and signs following excessive absorption. Depending on the particular insecticide involved, symptoms may develop during the time of exposure or up to 12 hours (though nearly always within 4 hours) later.

Typical early symptoms are headache, nausea and dizziness. In more severe poisoning, symptoms and signs include salivation, sweating, blurred vision, pinpoint pupils, chest tightness, bronchospasm, abdominal cramps and diarrhoea. In severe poisoning, muscle fasciculation, weakness and paralysis occur.

Blood Cholinesterase Levels
As red cell acetyl-cholinesterase activity and/or plasma pseudocholinesterase activity are depressed by organophosphates and carbamates, the measurement of cholinesterase levels in blood is the standard test for evaluating exposure.
Plasma pseudocholinesterase is relatively non-specific and deviations in this enzyme can have other explanations eg. advanced liver disease, malnutrition and chronic alcoholism. Also, a small percentage of the population has a genetically determined low level of plasma pseudocholinesterase. On the other hand, red cell acetyl-cholinesterase is less affected by factors other than exposure to cholinesterase inhibitors. Red cell membrane disorders, such as haemolytic anaemias, can affect red cell acetyl-cholinesterase levels.

Following absorption of carbamate insecticides, reactivation of the enzymes is rapid. Thus, testing on the same day as the exposure is usually necessary to explain transient symptoms during use. As this reactivation occurs in vitro as well as in vivo, a rapid same day test is needed. Conversely, following absorption of organophosphate insecticides, red cell acetyl-cholinesterase regenerates as new red cells are produced, which is about 1% per day. Plasma pseudocholinesterase regenerates more rapidly as it is reproduced within the liver.

Chemical analyses for organophosphate or carbamate insecticides in blood or urine are not indicated for routine monitoring due to the usual rapid metabolism of these insecticides. However, such tests can have a role in special circumstances such as forensic cases.

Interpretation of cholinesterase results
Symptoms due to organo-phosphate or carbamate insecticides are likely once the cholinesterase level is less than about 30% of the person's usual or baseline level. As it is a change from the person's usual level which is the critical factor, it is ideal if a baseline test is done when the person has not been exposed to any organophosphate or carbamate insecticides for at least some weeks. In the case of people who work with organophosphates or carbamates, the baseline level can be measured at times of the year when the person has not had any exposure to any organophosphate or carbamate insecticide for a few weeks or more, such as immediately after holidays or between spraying seasons. Where a baseline level is not available, interpretation can be based only on the reference levels quoted by the laboratory which conducted the tests in the context of any other clinical information.

A depression in cholinesterase levels of more than 25% from the person's baseline level is regarded generally as evidence of excessive exposure and the need to improve exposure control practices when handling pesticides. Results less than 50% of the person's usual level warrant immediate intervention in the form of avoidance of further exposure to any organophosphate or carbamate insecticides until the cholinesterase levels have returned to their baseline level for that person.