MANAGEMENT OF INSECTICIDE RESISTANCE IN HEAD LICE *PEDICULUS CAPITIS* (ANOPLURA: PEDICULICIDAE)

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Abstract - In 1994 evidence was obtained that insecticide resistance in head lice was spreading in the United Kingdom and other countries. The situation was not being managed correctly by the health authorities in UK for two reasons: primary health care workers adhered to rigid procedures regardless of the changing clinical situation; infection control procedures were not applied to pediculicides as they would have been to microbial antibiotics. Many family physicians, unsure about accurate diagnosis of lice, and other practical aspects, stopped prescribing pediculicides because some products showed poor efficacy. Patients resorted to using unregulated products and home remedies. The approach now being adopted in UK incorporates aspects of integrated pest management employed against other public health pests. Using this methodology, any health care worker can assess the reasons for treatment failure, whether due to inappropriate application, resistance or failure to kill louse eggs; decide the appropriate treatment approach and provide support for families, without becoming intensely involved themselves.
Key words - Pediculosis, pediculicides, integrated pest management

INTRODUCTION

A variety of insecticides have been introduced for use against head lice (*Pediculus capitis* DeGeer) since the late 1940s. Some of them for commercial reasons and some in relation to the appearance of insecticide resistance. To date all the major groups of insecticide have been investigated for this application. In this context the use of insecticides for the treatment of human lice and other ectoparasites can be considered an unique form of antibiotic therapy. As with bactericidal antibiotics the target organisms can and do develop a physiological tolerance to the treatment, but history shows that the resistance to each of these classes of biocides is not considered in the same way by health personnel.

Although the management of head louse infestation in any community is a pest control procedure, it cannot be approached in quite the same way as control of other pest species because it falls within the clinical field. Furthermore, because treating head louse infections involves application of pesticides to people, it is viewed quite differently by health care workers, educationalists and the public, who each contribute an emotional element to the process.

At the beginning of the 1990s it became evident that resistance to some of the insecticides available had developed in head lice. This appeared to be spreading in the UK and other geographical regions where pediculicide use is intensive. At the International Conference on Insect Pests in the Urban Environment in 1996 a workshop on resistance management showed that the strategies used in conventional public health pest control were inadequate for application to this problem, because in other spheres eradication is not only impossible but may actually be undesirable. For head louse management only complete elimination of the infection from each individual is acceptable.

This paper sets out a rational approach to dealing with head lice and demonstrates the ability to provide treatment success in the presence of advanced resistance.

IDENTIFYING THE PROBLEM

The possibility that head lice might have become resistant to modern insecticide products was anticipated in the late 1970s and it was with this in mind that carbaryl was introduced into the UK in addition to malathion (Maunder, 1981). The widespread use of shampoos in the past was also seen as a risk factor

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(Maunder, 1991), as was the variability of ovicidal activity of different formulations of the same insecticide (Burgess, 1990, 1991, 1996; Burgess *et al.*, 1992). Similarly, the residual bonding to hair of some insecticides e.g. permethrin had been recognised as a risk factor because as the material wears off sublethal levels are reached and lice can thus live in the presence of the insecticide (Maunder, 1991). Physiological resistance in head lice to permethrin was reported from the Czech Republic (Rupes *et al.*, 1995) and Israel (Mumcuoglu *et al.*, 1995).

Resistance

The first real evidence of head lice resistance to permethrin in the UK came in late 1994, when head lice taken from a patient who had had a number of consecutive unsuccessful treatments with permethrin were found to survive exposure to around 20 times the normal lethal dose. It was anticipated that this was not an isolated occurrence and within three months we had been contacted by health workers from several localities in the UK who shared our convictions. In each case lice were sent from patients who had received several applications of pyrethroids. All showed signs of resistance (Burgess *et al.*, 1995). In the Spring of 1995 we were contacted by a school nurse concerned that the change from pyrethroids to malathion in her district, for management of a perceived resistance problem, had apparently failed. The samples of head lice from the area around Brighton, on the SE coast of England, showed a resistance to malathion in excess of 400 times. The insects were also resistant to pyrethroids at a lower level, but susceptible to carbaryl (Figure 1). A similar pattern began to emerge in other parts of the UK, and continues today.

At this time most health authorities were operating a policy whereby insecticides were used on a rotational basis, usually three years, in the belief that this would avoid the problems of resistance. Once resistance had been confirmed in an area there was no mechanism to change to another insecticide outside the three year period. The policy had become so entrenched that many practitioners ignored new guidelines issued to deal with the problems, and the public insisted on purchasing products used previously, or that they deemed more acceptable. In parallel with this health authorities lost Crown Immunity, under which school health service personnel and health visitors distributed free head louse treatments irrespective of the requirements of the Medicines Act 1968. This led to patients and their families approaching family doctors more frequently than previously for prescriptions for head lice treatment, these being free of charge to children under the age of 18 in the UK.

Despite the growing concern that pyrethroid treatment was failing, after the publication of a systematic review of head louse treatment (Vander Stichele *et al.*, 1995), whose findings were largely misinterpreted as claiming that permethrin was the only insecticide for which evidence of activity existed, the use of this chemicals persisted and possibly increased. At the same time carbaryl was rescheduled as a "prescription only" medicine based on, as yet, unpublished evidence which was somewhat controversial (Boulton, 1995). Over the next 12 months there were several press and other media publications claiming to link malathion with the same polyneuropathy that has been associated with diazinon sheep dips used by farmers, and also with Gulf War Syndrome. All of this seemed only to confuse the public and professionals alike and create an atmosphere of concern lest treatment with insecticides would induce similar adverse reactions in children.

The outcome

Up until 1996 family doctors had been on the periphery of head louse management and their grasp of the problem was and is often sketchy and inaccurate (Dawes *et al.*, 1999). The result in many cases was patients demanding and being given prescriptions without any confirmation of diagnosis. The consequence of which was multiple applications of seemingly ineffectual products. Once doctors began to appreciate the extent of the problem and the drain it made on their time and prescribing budgets, reaction began. Some would only issue a limited amount per patient per year whilst others refused to prescribe treatment at all. Patients were sent home with advice to purchase "over the counter" products or find alternative treatment methods. At this time the UK Department of Health issued a leaflet promoting a combing method of treatment for which there has been no published evidence.

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Once families found they had to deal with the problem on their own, and unsure about practical aspects of head louse control, they began to turn to alternative unregulated products. Meanwhile family doctors perceived the level of infection as diminishing and patients as cured because they were no longer attending surgery.

We then began, and continue, to receive samples, recipes and enquires about unregulated formulations, and other products from aromatherapists, homeopaths and members of the public, all convinced that their inventions cure people of head lice. When tested under laboratory conditions most have turned out to be ineffectual. Unfortunately there seems to be great difficulty in stopping the promotion and sale of these products. Recent contact with members of the public has revealed an alarming lack of knowledge compounded by modern day myths, and the perception that nothing can be done to effect a cure. There has also been an increase in the number of children with long term and heavy infections.

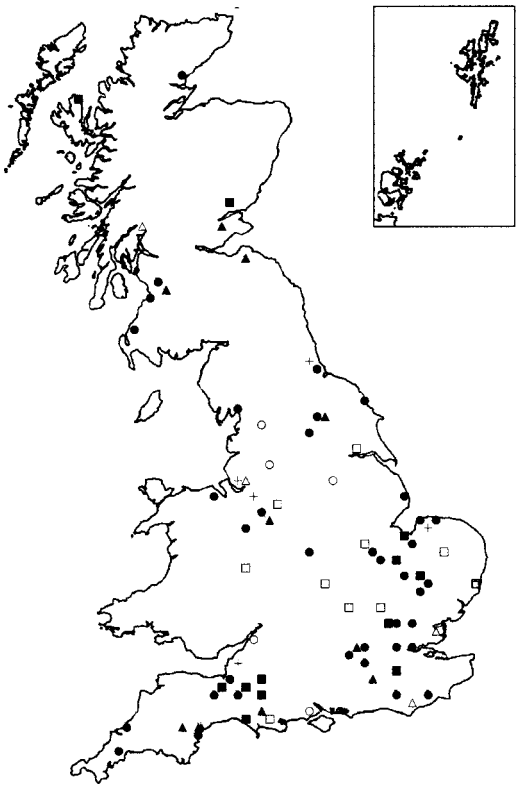

Figure 1: Log-probit plot to show the comparative susceptibility of head lice from two localities to insecticides. Lice were exposed continuously to treated filter papers and fed at eight hour intervals where appropriate. Papers were treated with either 5% malathion or 1% carbaryl. ■ Cambridge lice on malathion; □ Brighton lice on malathion; ● Cambridge lice on carbaryl; ○ Brighton lice on carbaryl.

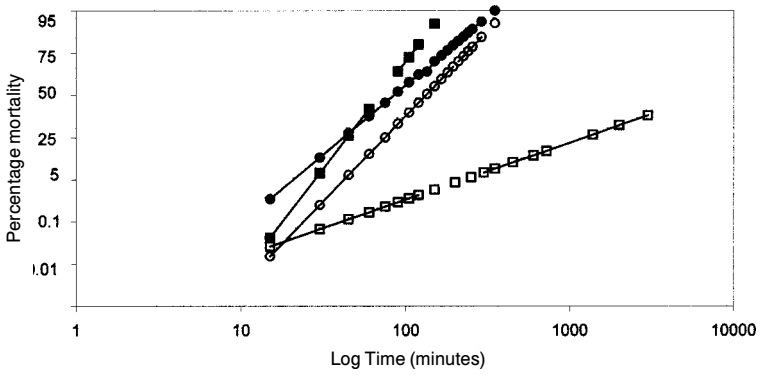

Figure 2: Distribution of localities from which lice have been tested for pediculicide resistance in the UK. □ Pyrethroid resistance identified by other workers; ■ Pyrethroid resistance confirmed by MEC; Malathion resistance identified by other workers; ▲ Malathion resistance confirmed by MEC; Malathion and pyrethroid resistance identified by other workers; ● Malathion and pyrethroid resistance confirmed by MEC; + Malathion and carbaryl resistance confirmed by MEC.

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DEVELOPING A MANAGEMENT POLICY

By late 1997 conversations with general practitioners revealed that for a majority head lice remained a problem for several reasons: they were unfamiliar with the biology and epidemiology of lice; they were not cognisant with effective methods of diagnosis; and they were unaware of the range and relative effectiveness of insecticidal products.

Several practitioners had, however, begun to affect a more rational approach with moderate success. Meanwhile we had begun to develop a procedure document (GP Good Practice Protocol), incorporating elements of best practice, for dealing with individuals perceived to have an ongoing head louse infection (Burgess, 1998).

The aim of the protocol is to enable members of the Primary Health Care team to effect: a proper diagnosis, prescribing only on evidence of live lice; a structured follow up; an accurate interpretation of the results of the follow up; and an appropriate course of treatment and to give good simple advice on routine checks to guard against re-infection. It became apparent that we needed to have more information from the field if we were to expand our own knowledge on the spread of resistance in head lice. Having developed a routine test procedure that has been proven by use in our own field experiments, we then devised a series of workshops for public health personnel to enable them to understand resistance and perform field tests in their own areas. We continue to carry out resistance testing on head lice sent to us from various locations and, augmented by information sent to us by workshop delegates, are able to map areas showing resistance to the different insecticides (Figure 2). This information is now used when providing advice on treatment options following enquiries by health care professionals.

During 1997 a working party was set up by the Public Health Medicine Environmental Group (PHMEG), an association of communicable disease and public health physicians, to develop a strategy document for managing head lice in a climate of resistance, in lieu of further research and treatment development. Most aspects of the GP Protocol have been incorporated into a statement of best practice procedure and this has now been adopted as PHMEG policy (Aston *et al.*, 1998).

For the first time ever, there is now a countrywide standard approach for head louse control which can be used to manage the practical issues, including resistance, in the short term. Provided the methodology is adopted comprehensively health workers can assess the reason for treatment failure, whether due to inappropriate application, resistance or merely failure to kill louse eggs, and then decide the most effective treatment approach. In practice, health workers have been able to advise appropriate treatment and provide the support for families in dealing with a highly emotive problem, without becoming intensely involved themselves.

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