LESSONS FROM THIRTY YEARS OF MAREK’S DISEASE CONTROL IN AUSTRALIA FOR 2000 AND BEYOND

C.A.W. JACKSON

Summary

An analysis of the history of Marek's disease control in Australia over the past 30 years revealed some differences from that experienced by overseas countries. However, the outcomes from short-term approaches to control are likely to lead to similar consequences through the evolution of more virulent strains of Marek's disease virus. Further data required to make sound judgements on the control of the disease in Australia are listed. However, the level of control that can be maintained beyond 2000 is largely in the hands of the poultry industry.

I. INTRODUCTION

Some 30 years of Marek's disease (MD) control in Australia has provided significant economic benefits for the poultry industry and to a lesser extent to the vaccine manufacturers. This period has been marked by two major successes, the initial control of classical and acute strains of Marek's disease virus (MDV) in 1971 and the more recent control from 1998 of very virulent strains in imported genotypes by Rispens and high titred herpesvirus of turkey (HVT) vaccines. However, there have been long periods of only moderate control and some significant vaccine failures. It is the intention of this paper to analyse the history of MD control in Australia and recommend steps to ensure that control beyond 2000 is maintained at a high level.

II. MAREK’S DISEASE IN AUSTRALIA

The incidence and economic impact of MD in Australia has followed what could be described as "a roller-coaster ride" affected by government policy on importation, emergence of more virulent strains of MD virus and the introduction from overseas of strains of chickens that are more susceptible to MD. A chronological history of MD control over the past 30 years in Australia can be summarised as follows:

- 1960 - Widespread and heavy losses from MD in the poultry industry
- 1971 - HVT vaccine introduced resulting in rapid improvements in MD control
- 1973 - Maternal antibody interference problems with cell-free HVT vaccines
- 1974 - Contamination of HVT with reticuloendotheliosis virus (REV)
- 1975 - Improved vaccine manufacturing standards
- 1978 - Introduction of a serotype 2 MD vaccine (Maravac)
- 1983 - Low potency vaccine batches
- 1985 - Recognition of very virulent strains of MDV
- 1986 - Wider adoption of bivalent vaccine and improved hygiene
- 1992 - Importation of poultry genetic material
- 1993 - Increasing incidence of MD problems in layers and broiler breeders
- 1995 - Introduction and failure of a serotype 1 MDV vaccine (CR/6)
- 1996 - MD problems in broiler chickens increasing
- 1997 - Importation of Rispens and HVT vaccine masterseeds from France
- 1998 - Dramatic improvement in MD control using the above vaccines
- 1999 - Adoption of in ovo vaccination of broiler chickens

Biological Technology Transfer Pty Ltd, 2 Victory Avenue, Camden NSW 2570.

186
III. AN ANALYSIS OF THE HISTORY

The pattern of MD history overseas has some similarities to that observed in Australia. However, Witter (1997) makes frequent reference to a step-wise increase in virulence often related to the introduction of new strains of MD vaccines. He has suggested that the use of new vaccines can be expected to generate environmental pressure that will most likely result in the appearance of yet newer and more virulent strains of MD virus. In Australia, it would appear as though this step-wise increase in virulence has been blurred by the existence of more resistant strains of chickens and a greater reliance on hygiene and biosecurity than undertaken overseas. Whereas very virulent strains of MD virus appeared both overseas and in Australia in the mid 1980s, Australia experienced only sporadic outbreaks of disease associated with these more virulent strains (McKimm-Breschkin, et al 1990) compared to the heavy losses described overseas. Concurrent problems in the 1980s associated with other infectious agents resulted in the adoption of higher standards of biosecurity and hygiene. Hygiene programs often included the use of high levels of formalin followed by terminal fumigation with formaldehyde gas. These measures are thought to have reduced the challenge from MD on many farms.

The importation of more MD susceptible strains of both layer and meat genotypes and their commercial supply throughout Australia from 1993 saw increasingly more serious outbreaks of MD. Producers adopted increasingly more complex and expensive vaccination programs. The locally manufactured vaccines were inappropriate both in potency and cost to curb the heavy losses. Finally, intense industry lobbying resulted in the importation of masterseeds of MD vaccine strains (Rispens CVI988 and HVT FC 126) that were able to be manufactured with a higher potency and to a quality standard that allowed safe and efficacious vaccination of the imported genotypes (Jackson, 1998).

(a) Recommendations from the analysis

(i) Vaccine Standards. To avoid a reoccurrence of the problems associated with maternal antibody interference, contamination with extraneous microorganisms and low potency, it is essential that vaccine manufacturers adhere to standards that are contemporary with current research and the programs adopted by the poultry industry. Standards for MD vaccines in Australia were written in the 1970s and do not meet current usage of those vaccines by the poultry industry. The NRA has promised to develop monographs for each of the poultry vaccines. It should be noted, however, that in the USA where standards are constantly under review, the existing standard on potency for MD vaccine is considerably below industry practice. One area where the US has made significant progress is in the area of standardisation of a challenge model to determine virulence of field isolates (Witter, 1999). Access to this model would be of value to Australian vaccine manufacturers. Despite standards, the poultry industry will often use a product contrary to the label.

(ii) Vaccine Usage. Rudd (1996) has warned about the misuse of MD vaccines in the USA. He stated that the history of vaccination in the USA has been one of increasing virus virulence counted by additional vaccine antigens. The new vaccines are often required to be used in the first instance in areas where there is a high intensification of production. The short-term cost benefit approach by the US poultry industry has seen excessive dilution of vaccines and a switch to new vaccine strains where older strains were still highly effective. Companies may choose to vaccinate broiler chickens because they are not prepared to leave them unvaccinated lest managers be considered at fault if a MD problem does arise. The switch to Rispens vaccine in the USA prompted warnings against dispensing with bivalent vaccines (Witter, 1997). Concern was raised that Rispens may be the last effective antigen and that it should be held in reserve and only used where essential (Shane, 1999a). In
Australia it is apparent that Rispens is a very effective vaccine and certain strains are more responsive to it than to the bivalent vaccines. However, we do not know if Rispens is essential in all situations.

(iii) **Vaccine Administration.** Jackson (1999) identified a number of deficiencies in the methods of handling and administration of MD vaccines by Australian hatcheries. He outlined an audit system used by The Marek's Company (TMC) to support the correct administration of that company's vaccines. It is essential that Australian hatcheries maintain high levels of vaccine administration and not resort to cost cutting measures as described in the USA such as excessive chick handling speeds, excessive tubing for vaccine distribution, inclusion of incompatible antibiotics and high vaccine dilution rates (Rudd, 1996). The introduction of *in ovo* vaccination has provided many benefits in terms of reduced labour costs and lowering of stress levels on chickens. However, hatcheries must remain conscious of the need to avoid excessive vaccination speed and to ensure that an early vaccine viraemia is induced in every chicken.

(iv) **Vaccine Evaluation.** The response to vaccination can easily be measured where there is a dramatic reduction in mortality. In the broiler industry the benefits may be more difficult to measure. It is essential for the industry to continue to measure the benefits from MD vaccination. Whilst most failures may be the result of errors in administration, there are recent reports from overseas of biological changes in the virus showing up as variations in the clinical syndrome observed in the field. Witter (1997) has described the appearance of a paralysis syndrome in young chickens aged 1-2 weeks of age associated with more virulent strains of MDV. The appearance of MD in turkeys in France (Witter, 1997) is further evidence of a change in the biology of the virus. MD vaccination failures should be reported and investigated. The causative virus should be isolated and protection tests undertaken with existing vaccines.

(v) **Industry Factors.** In addition to the correct use of vaccines, the future outlook for MD control can be significantly influenced by the approach that the industry takes to the choice of genetic stock, biosecurity and hygiene, and husbandry factors that could act as stressors. The serious outbreaks of MD in Australia that followed the importation of layer and meat strains in 1993 have been attributed to poor responsiveness to the locally manufactured MD vaccines (Jackson, 1996) and to differences in immune competence (Walkden-Brown, *et al.*, 1999). There is also evidence that some strains of chickens respond better to different serotypes of MD vaccine (Bacon and Witter, 1993). Hence the industry can have a significant impact on the future of MD vaccines depending upon the choice of genotypes that it imports into Australia. The level of biosecurity and hygiene in Australia is considered to be significantly higher than in some areas of the US. However, there is an obvious trade-off in the cost of shed clean-out with the cost of MD vaccination. Cost/benefit analysis of MD broiler vaccination should take into account the risk of creating resistant strains of MDV. Shane (1999a) has reported an association of outbreaks in mature birds with poor biosecurity on multi-aged sites. There is also evidence that mature birds may become infected with MDV possibly related to the presence of immuno-depressive factors associated with some form of environmental stress (Witter, 1999). Taylor *et al.* (1999) described an experiment in which birds fed a lower calcium ration had a significantly higher level of MD. Witter (1999) has recommended that the industry needs to adopt a truly integrated approach involving vaccines, biosecurity, genetics and management. He considers that these multiple barriers are needed to reduce the likelihood of evolution of new virus strains. He warns against assuming that new vaccines will always be discovered.
III. CONCLUSIONS

Australia has obtained good control of MD from 1998 following the importation of masterseeds and local manufacture of vaccines from those masterseeds. However, the vaccination programs adopted by the industry, whilst apparently cost effective in the short term, could lead to vaccine failures in the longer term. This opinion is consistent with that of a number of overseas authorities following reviews of the current USA vaccination practices (Shane, 1999a,b; Witter, 1999). The practices of concern are (1) the dependence on Rispens vaccine in layers and breeding flocks, and (2) the dilution of HVT vaccine in broilers to a point where escape mutants of more virulent viruses could be generated.

If the industry adopts a short-term approach to MD control, the evolution of more virulent strains of MDV is a problem that the industry will have to face. The following information should be made available to allow industry to make correct judgements on effective MD control in the future:

1. The range of pathogenicity of isolates of MDV present, particularly those that have resulted in vaccination failures.
2. The clinical and pathological features of the syndromes that those isolates can produce in the field. Tests to differentiate MD from other diseases causing tumours should be available.
3. The level of protection that can be expected from the existing range of MD vaccines in Australia against those isolates. This knowledge could extend to the sending of Australian MDV isolates overseas to determine if more effective vaccine seeds exist.
4. Factors that can contribute to vaccination failures or failure to optimise response to MD vaccination (e.g., defective administration of vaccine, environmental stress, immunosuppressive agents, husbandry factors, interfering maternal antibody, etc.).
5. Development of alternate types of vaccines or vaccination programs that may replace or augment the existing vaccines. This could include the importation of masterseeds of vaccines that have been demonstrated to be effective in overseas challenge trials.
6. The response of different genotypes of poultry to different serotypes of MD vaccines.

REFERENCES