PROGRESS IN CONTROL OF BOVINE TUBERCULOSIS

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Bovine tuberculosis

Major economic problem in many countries (50 million cattle infected)

Significant public health risk in others
- unpasteurised milk, shared dwellings

Traditional control - “test and slaughter”
- less effective - wildlife reservoirs of infection
  - Possums (New Zealand)
  - Badgers (UK, Ireland)
  - White-tailed deer (USA)

- developing countries - unacceptable

Need for improved diagnostic tests and vaccines
Transmission of bovine TB from possums to cattle

Culling of possum to control wildlife reservoir of bovine TB
Number of infected cattle and deer herds and expenditure on vector control 1977 - 2007

TB control in New Zealand

TB status - June 2011
79 cattle and deer herds infected

Location of TB wild animals

39% of NZ has TB in wildlife
Period prevalence of bovine TB in cattle and deer herds

New Pest Management Strategy for bovine TB

2025 - Reduce the area endemic for TB in wildlife by 25%
**Need for improved tests for the diagnosis TB in cattle**

Caudal fold skin test – primary screening

Proportion of false positives rising with the decrease in the incidence of TB in cattle

Farmers are demanding

- improvements in specificity
- faster removal of confirmed infected cattle
- use of alternative tests to clear infected herds and to allow movement of stock

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**Introduced two new blood tests: BOVIGAM**

**Standard BOVIGAM test**

- Confirmation of TB, retest skin test reactors
- Reduce false positives & faster removal of infected animals
- Use for pre-movement testing

**Special antigen BOVIGAM test (2 proteins from M. bovis)**

- Use for re-testing skin test reactors from TB-free areas
- Markedly reduce the number of false positives
Current research

1) Pooled milk ELISA test
   Less frequent skin testing, need for ancillary tests
   Collect milk samples in association with herd testing
   Test pooled milk samples, if positive re-test individual
   milk samples and possibly skin test herd

Current research (continued)

2) Differential skin test using selected mycobacterial proteins

   Use *M. bovis*-specific proteins (collaboration DEFRA, UK)
   Proteins not present in BCG and other mycobacteria
Specific tuberculin skin test

Skin test responses

- **TB-infected**
  - Avian PPD
  - Bovine PPD
  - Protein cocktail

- **Non-infected**
  - Avian PPD
  - Bovine PPD
  - Protein cocktail

- **JD-infected**
  - Avian PPD
  - Bovine PPD
  - Protein cocktail
Example of future use of a TB vaccine in New Zealand

Location of TB wild animals

West Coast of South Island
27% of infected herds
2% of total cattle

TB vaccine for cattle

- Questions
  - Can BCG be used and still retain the use of the existing or modified skin test
  - How long does BCG vaccine protection last and can immunity be boosted by revaccination
  - Can we develop an effective protein vaccine which does not induce a skin test response
Long term effects of BCG vaccination and can immunity be boosted

Vaccine groups (total 82 calves)
1. Non-vaccinated
2. Subcut BCG
3. Subcut BCG, revaccinate subcut BCG
4. Subcut BCG, revaccinate oral BCG
5. Subcut BCG, revaccinate with TB protein vaccine

Vaccinate calves at 2-5 weeks of age
Revaccinate some groups at 2 years of age
Challenged with TB at 2 ½ years of age and slaughter 4 months later

Experimental TB challenge of calves

- Challenged with *M. bovis*
- Necropsy at 16 weeks after challenge
  - TB lesions

TB containment facility at Kaitoke
Develop a novel TB protein vaccine

TB protein vaccines do not induce a skin test response

Produce a novel vaccine with TB proteins displayed on nanoparticles produced in bacteria (bionanoparticles, BNPs)

BNPs produced in E. coli host

Functionalised BNP

- PHA synthase
- Vaccine antigen e.g. Ag85A-ESAT6
- Alternative functional protein e.g. IgG binding site or cytokine
- Granule associated protein
- Polyester chain core
Oral BCG vaccine for possums

- Encapsulation of BCG vaccine in a lipid matrix
- Protect against experimental aerosol challenge with *M. bovis*  
  - Decrease severity of disease
- Stable for 3-5 wks field conditions
- 85 and 100% of field possums accessed baits at bait densities 40-80 sachets/ha

Protection against natural exposure to *M. bovis* in possums (Tompkins et al., 2009)

- Approx. 50% of possums orally vaccinated with BCG
- Non-vaccinated matched controls (age, sex, body condition and location)
- Trap every 2 mths and check for TB lesions
- After 2 years, kill all possums in the grid and surrounding area and detailed necropsy undertaken
Protection against natural exposure to *M. bovis* in possums (Tompkins et al., 2009)

Proportion with TB lesions of infected
12/71 control v. 1/51 vaccinated
(P<0.05)

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