Investigate Babesia bovis vaccine breakthroughs

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Research Institute: ARC-Onderstepoort Veterinary Institute

Research focus area: Animal Health and Welfare

Aims of the project

- To determine if the B. bovis vaccine protects against virulent field isolates.
- To determine the impact and possible consequences that field isolate variants of B. bovis from different areas may have on the movement of vaccinated and unvaccinated cattle and disseminate this information to the industry.

Executive summary

Immune-competence of Babesia bovis (Asiatic redwater) vaccinated cattle to heterologous challenge

Babesia bovis is an intra-erythtrocytic protozoon found in cattle and is only transmitted in South Africa by the one-host tick vector Rhipicephalus (Boophilus) microplus, which is also commonly known as the blue tick. Distribution of disease is determined by the prevalence of this vector, which is normally restricted by humidity and temperature to areas in the eastern parts of the subcontinent.

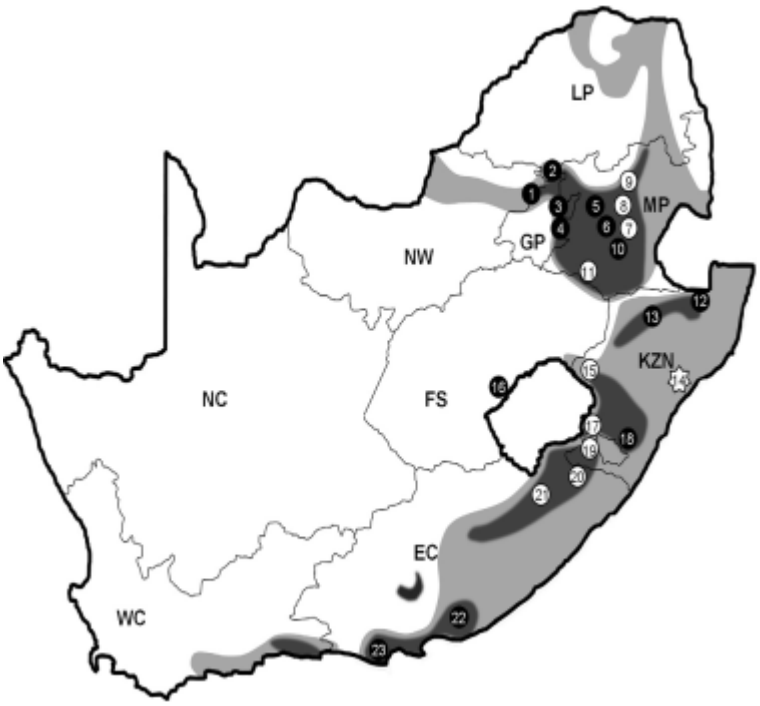

Fig. 1 A map of South Africa indicating the geographic distribution of 44 genotyped B. bovis (Asiatic redwater) field isolates collected in this study. The distribution of Rhipicephalus (B.) microplus is indicated in light gray. Areas of dark gray indicate historical reported incidents of redwater outbreaks from 2002 to 2013. Black dots with white numbering indicate sites where clinical isolates were sampled. White dots with black numbering indicate sites where field isolates were obtained during visits to farms. The star indicates where the isolate was from a tick. Numbers indicate regions sampled: 1 – Pretoria, 2 – Bela-Bela (Warmbaths), 3 – Bronkhorstspruit, 4 – Delmas, 5 – Middelburg, 6 – Hendrina, 7 – Carolina, 8 – eMakhazeni (Belfast), 9 – Dullstroom, 10 – Ermelo, 11 – Standerton, 12 – Pongola, 13 – Vryheid, 14 – Eshowe, 15 – Bergville, 16 – Ladybrand, 17 – Underberg, 18 – Ixopo, 19 – Swartberg (Kokstad), 20 – Kokstad, 21 – Maclear, 22 – Grahamanstown, 23 – Humansdorp. Provinces are indicated by WC (Western Cape), EC (Eastern Cape), NC (Northern Cape), FS (Free State), NW (North West), GP (Gauteng), MPL (Mpumalanga), LP (Limpopo) and KZN (KwaZulu-Natal).

Disease control by total eradication of the tick vector or allowing natural infection by limiting the degree of tick control may not prove sustainable solutions in those areas where the vector is already well established. Therefore, integration of the strategic use of acaracides and application of the vaccine should prove the most cost efficient method of control.

Applying B. bovis infected blood as a live vaccine, requires a parasite genotype characterized by low pathogenicity and the ability of developing lasting protective immunity against heterogeneous challenge. It is known that B. bovis vaccine strains with little genotypic diversity are not as immunogenic as those with more diverse populations. Considering the rumour that the vaccine was inadequate (although the contrary was proven at the time), that the South African B. bovis vaccine consists of only 1 genotype parasite population and have since use as a commercial vaccine only been evaluated successfully against challenge from 2 field isolates collected from cattle during vaccine failure claims, obviously required re-assessment of it's immune-competence to heterogeneous challenge from more isolates.

During 2011 to 2012, with the collaboration of farmers and veterinarians, visits were made to 46 farms in 20 districts across the country where blood samples were collected from 1,947 cattle. Rural veterinarians also contributed by sending in blood samples collected from clinical cases (Fig. 1). In this way 44 genotypic diverse field isolates of Asiatic redwater were collected from which the vaccine strain could be clearly distinguished from the field isolates with the polymerase chain reaction (PCR). The vaccine strain was found on 1 farm only, approximately 3 weeks after vaccine application, during the expected vaccine reaction period. This unique differentiation of the vaccine parasite can be utilized in the South African setting to determine if the vaccine plays a role in Asiatic redwater disease outbreaks. To date, none of the clinical cases indicated the presence of the vaccine during disease outbreaks.

Seventeen of the 44 field isolates collected were selected on the basis of their unique distinguishable genetic differences and their presence in areas prone to problems experienced with B. bovis. These isolates were tested individually in vaccinated and non-vaccinated animals, where after the individual reactions obtained in the cattle were evaluated against each other to determine vaccine efficacy. Results indicated that the vaccine showed adequate protective response against all 17 genotype different field isolates. Serving as proof that although the current Asiatic redwater vaccine consists of only 1 B. bovis genotype population, it is suitable for continued use as a live vaccine.

This study clearly illustrated how underestimated the effect is that stress related factors such as age, feeding, climate, disease status, internal parasites etc. have on the inherent ability of an animal to immunologically resist and cope with disease during primary or re-infection reactions. It can be accepted that the degree of vaccination and challenge reactions obtained for this study, will in all probability be more pronounced under field

conditions. It is therefore good practice to vaccinate only healthy animals in good condition.

The study also showed a high level of genotypic diversity for the B. bovis field isolates, found not only across South Africa, but in herds on the same and adjacent farms. Continued movement of parasite infected cattle and ticks in the country will effectively contribute to the diversity of the existing gene pool. Consequently it is impossible to predict the outcome that movement of cattle may have and vaccination of cattle before moving is advised.

List of outputs

SCIENTIFIC ARTICLES

- M.P. Combrink, P. C. Troskie, A.A. Latifa,B.J. Mansa. () Immune-competence of Babesia bovis vaccinated cattle to heterologous challenge in South Africa.
- M.P. Combrinka, P.C. Troskie, R. Pienaar, A.A. Latif, B.J. Mans. (2014) Genotypic diversity in Babesia bovis field isolates and vaccinestrains from South Africa. Veterinary Parasitology 199, pp144– 152.

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