MUCOSAL DISEASE: Fighting back

by John Leitch

It can cause so much damage in a herd. I went to one farm in Berkshire where 46 out of 60 replacement cattle died. I've also visited herds in Herefordshire and Buckinghamshire where 50 out of a total of 100 animals died."

The disease has been known for the past 40 years, but it was only 18 months ago when it was first induced experimentally. That was at Compton.

Dr Brownlie reports: "Animals are usually 6-24 months old when they get Mucosal Disease. The virus destroys their lymphoid tissue, the very tissue that should attack it. Normally when a virus invades an animal you would expect lymphocytes to come pouring out from lymph nodes, spleen, thymus, and (most important) from raised areas of the gut called Peyer's patches."

"But with Mucosal Disease there is no lymphocyte attack. Instead there is deformation of the gut, abscesses, and a collapse of the Peyer's patches."

The four-man team working on Mucosal Disease at Compton comprises of Joe Brownlie, Michael Clarke, Chris Howard and Dave Pooceck.

They have found that there are two forms of BVD virus (Fig 1) responsible for causing Mucosal Disease. The aggressive one is non-cytopathic (ie, it doesn't damage or kill the host animal's body cells), while the other is cytopathic. Close examination of the two reveals that a certain viral protein (VP2) is absent in the non-cytopathic form.

Both forms of the virus infect cattle.

This discovery led Joe Brownlie and his colleagues to put forward a hypothesis which accounts for the pattern of Mucosal Disease outbreaks on farms.

They looked at all the 60 animals on the Berkshire farm mentioned earlier. The cattle fell into four groups (Fig 2).

Group 1: Healthy. Neither antibody nor virus.

Group 2: Healthy. Antibodies, but no virus.

Group 3: Viral. Had the non-cytopathic form of the virus (VI) but no antibodies.

Group 4: Mucosal Disease. Had both non-cytopathic (VI) and cytopathic (V2) forms of BVD. No antibodies.

"The Group 3 animals are like the cow Theresa who featured in the Dairy Farmer story on Mucosal Disease in May 1985 (p22). "Every animal we have examined so far that has had Mucosal Disease has had both VI and V2 forms of the BVDV," reports Dr Brownlie.

He admits: "Our theory about there being two forms of BVDV - a non-cytopathic VI and a cytopathic V2 causing Mucosal Disease - were contentious for a while. However, it has now been accepted, as other research teams in America, New Zealand, and Scotland have confirmed our original findings."

"As a young calf develops in the cow's womb, if there are 110-120 days before its immune system is fully functional. Only then does it have the ability to make antibodies to defend it against viruses. After this time it recognises the difference between its own tissues (heart, lungs, etc) - which it doesn't reject - and potentially-dangerous invading organisms. But if the virus is already there before the calf is 110-120 days old, then the developing immune system is tricked into saying: 'This is my own; this is not foreign; this is me!'"

\[\text{Fig. 2. In outbreaks of mucosal disease, four combinations of virus and antibody were found.}\]

\[\text{Table:} \begin{array}{|c|c|c|c|}
\hline
\text{Anti-1} & \text{Body} & \text{2} & \text{3} & \text{4} \\
\hline
\text{Virus} & \text{non-cytopathic} & \text{cytopathic} & \text{non-cytopathic} & \text{cytopathic} \\
\hline
\text{Healthy} & \text{No antibodies} & \text{No antibodies} & \text{No antibodies} \\
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\end{array}\]

Which leads to the question why do we get so many outbreaks of Mucosal Disease? Why is it that so many cows come into contact with BVDV when they are in early pregnancy; when they are at greater risk?

In order to provide the answers, Dr Brownlie and his team did a survey of commercial herds. They fell into two groups:

- Herds. Cattle bought in.
- Closed herds. Only used AI. No females ever brought in.

"We consistently found that cows and youngstock in closed herds had no antibodies," discloses Joe. "There was no evidence of BVDV. In other words, these were highly-susceptible groups of cattle with no immunity.

"The open herds, on the other hand contained animals with antibodies, so they were protected. The virus was there on the farm, spreading from animal to animal. Youngstock were being exposed to infection long before they reached breeding age, so antibodies developed. The consequence was that any further virus attack during the first..."
They now suggest that the virus V2 arises from the population of V1 virus, most probably by mutation.

“You get one mutation at every 100 multiplications of the V1 virus,” reveals Joe. “Just remember that there are a staggering number of viruses present — every 1 ml of blood contains 10 billion virus, and a bulling heifer has about 100 million of blood. So there are obviously a lot of mutations occurring.

So many mutations, in fact, that you would think it would only be a matter of hours before a freshly-calved animal progressed from V1 to the deadly cytopathic V2 form. But animals can be anything up to two years old before Mucosal Disease develops.

“The explanation for this is that most mutations don’t survive. Those that are significantly different from the V1 are immediately gobbled up by the calf’s immune system. So it takes 6-24 months before a V2 emerges that is sufficiently close to the original V1 that the immune system is fooled."

Dr Brownlie’s team are now linking with New Zealand researchers in an attempt to produce a vaccine.

Fig 3 shows Dr Brownlie’s current interpretation of the Mucosal Disease pattern. A susceptible cow has no antibodies to VBDV. She is in early pregnancy when the virus comes along. This is the non-cytopathic form (V1), and both cow and foetus are uninfected.

The cow develops immune tolerance and protects itself, but the foetus is unable to make antibody because it is too young. It becomes tolerant.

Eventually at nine months the cow produces a live calf. It might look normal, but it is persistently viraemic. It carries the disease for life. It sheds virus every day.

Many months later there is a mutation of the virus. The cytopathic V2 form is produced, and this spreads to all viraemic animals on the farm. The cytopathic virus causes Mucosal Disease and this is fatal.

The theory is that whenever you have viraemic calves there is a chance that a mutation in any one of them will produce V2 at any time and Mucosal Disease will then occur a couple of weeks later.

“So if you are fattening animals and you know they have VBDV, it is better to get them slaughtered as soon as you know they are infected, because once V2 arrives it will go through the herd very quickly indeed,” suggests Joe. “It would be immoral to sell the animals to another farmer.”

If a closed herd is only buying in semen then it is safe. “You are unlikely to get VBDV from semen because AI centres do check for this,” replies the Compton researcher.

It is best to mix stock as much as possible in open herds, to ensure that infection spreads to all youngstock before they are old enough to start breeding.

“No, this is too unreliable,” warns Dr Brownlie. “The best thing is to get all newly-purchased animals checked.”

“Any animal that has no virus can be safely mixed. Others that show the presence of non-cytopathic form of VBDV, but no antibodies, should be isolated two weeks later. If the result is still the same, you should get rid of them. Don’t bring them onto the farm.”