How to Get the Most out of Your Vaccination Program

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On The Road to Control Disease

- Multi-factorial Diseases
- Management
- Vaccination

Credits

- Immunobiology, 6th edition
- David Topham, University of Rochester
- Dr. Chris Schneider, University of Idaho
- Dr. Nichols, Australia

Bovine Respiratory Disease Complex (BRDC)

- Single most significant infectious disease in cattle
- Multifactoral: Stress, Viruses, Bacteria
- All of these pathogens are in the normal bovine population
- Incidence in the first 40 days on feed
  - 10 – 30 days peak challenge
- Up to 90% of morbidity
- Up to 70% of mortality

BRDC

- Major challenge to cattle industry
- 31% of cattle/calf death in US
- $625 M impact/year
- Feedlot Industry:  - 65-79% of sickness  - 44-72% of death

Bovine Respiratory Disease Complex

- Cost of BRD:  - Mortality  - Morbidity: Hospitalization, Medication costs, Increasing feeding time, Labor costs  - Subclinical: Reduction of ADG and FCR
Stress

- Stress is anything that reduces immune response capability
- Adaptation to intensive production is stressful
  - Anything that improves adaptation will reduce costs and improve production
- The reason that this condition is seen more in intensive operation rather than extensive

Stress – Prior to Entry

- Weaning
- Saleyards
- Co-mingling or mixing
- Transport
- Dehydration
- Time off feed
- Injury

Stressors at the Feedlot or in the Cow Herd

- Co-mingling
- Injury
- Water - palatability and supply
- Feed - time to first
- Pen density
- Pen total number
- Handling and movements
- Pen “add-ons”
- Weather extremes
- Dust
- COMPETITION

Pathogens

- Viruses
- Mycoplasma
- Bacteria

Stressors

- Physical
- Environmental
- Psychological

Uncomplicated respiratory disease

Damage

Bacterial pneumonia

Stress Hormones And Adaptive Response

Comparison of Changes in Cell-mediated Immunity

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<th>Treatment</th>
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Direction of arrows indicate increase, decrease or no change compared to corresponding control levels.
Stress will decrease chemotaxis

Inflammatory Response
What Does Stress Do to Neutrophil Motility and Phagocytosis?

Neutrophil Chemotaxis and Phagocytosis
What Does MLV BVDV Do to Neutrophil Motility and Phagocytosis?

Immune Response–Animal
Doesn’t Lie

• Immune response
  – Proinflammatory response necessary
  • Expect Some Side effects
  • No side effects- no response
  – Higher disease
  • Poorer immunity (passive and/or active response)

Prevention of BRDC

• Management
  – Eliminate stress factors where possible
  – Recognize the “Critical Period” for disease detection (3 weeks that follow weaning: placing on feed; shipping of cattle)

Prevention of BRDC

• Management
  – Avoid co-mingling cattle from different sources during critical 3-week period
  – Keep new cattle close to feed and water
  – Don’t over crowd (especially early in feeding period)
  – Control dust and mud

Summary

• Environmental factors
• Reducing group size is desirable
• Ventilation and dust control are important
• Transport time, rest, food water
• Commingling should be avoided
• Weaning before shipping decreases stress
• Gradual feed changes with proper supplements are beneficial
Diet and Immunity

• Immune system doesn’t get a free ride- energy consumer- calves on poor nutrition- poor response to vaccines
• Multiple demands on energy for the calf- overvaccination can effect growth and development
• Calves- Vaccinating prior to acclimation to feed (weaning; feedyard) Acidosis, poor vaccine response

Breeding Heifer

Energy Available

- Maintenance
- Reproduction
- Growth & Lean Deposition

Prepartum Animal + Immunization

Energy Available

- Maintenance
- Fetal Development
- Immunity
- Growth & Body Condition

Postpartum Beef Animal + Immunization

Energy Available

- Maintenance
- Reproduction
- Immunity
- Lactation

Nutrition & Immunology

Order of importance of nutrients to immune system

• Energy
• Protein
• vitamin A
• vitamin E
• Copper, Zinc, Selenium
• IRON
Summary

- Energy is important for immune response
- Vitamin A deficiency can decrease mucosal homing
- Zinc is very important at times of stress
- Vitamin E/Selenium important for many immune responses

Prevention of BRDC

- Management
- Vaccines

Intranasal Vaccines

- Nasalgen
  - Day old calves
- Onset
  - Conducted in young calves (2-8 days of age)
  - Challenged with virulent strains of IBRV, BVD 1, BVD 2, BRSV, Pm, Pasteurella multocida – 21 to 28 days post-vaccination
- Enforce -3 BRSV Nasal studies 14 day old calves

Respiratory Immunology

- Mucosal Immune Response is the most important defense system
- Almost all bovine pathogens enter via the airways and the mucosa surface
- Viruses- BHV-1, BVDV, PI3, BRSV, BRCV
- Bacteria- M. haemolytica, P. multicida, H. somnus, M. bovis
Mucosal Immunity - Local response

When Do We Begin Vaccinating Calves?
- At a week of age
- At a month of age
- At 2-3 months of age
- Before they are born by vaccinating the cow-High quality colostrum

Maximizing Colostrum Production
- Cow management
  - Nutrition
    - Good balanced diet
    - BCS 6.0-7.0 (on a 9)
    - BCS 3.25-3.75 (on a 5)
  - Cu, Se, Zn- Immune Minerals

What Respiratory Infectious Agents are Important
- Calves
  - 3 weeks- 3-4 months
    - Pasteurella multocida
    - Mannheimia (Pasteurella) hemolyticae- herd history
    - Clostridial diseases
    - BRSV- herd history, summer pneumonia
    - Leptosporosis
    - Mycoplasma bovis (pneumonia, inner ear)??
    - BVDV???

What Respiratory Infectious Agents are Important
- Calves
  - 3-4 months- 12 months
    - Brucella abortus
    - Pasteurella multocida
    - Mannheimia (Pasteurella) hemolyticae
    - Leptosporosis
    - Clostridial diseases
    - Mycoplasma bovis-arthritis
    - BVDV
    - BRSV
    - PI3
    - IBR
**Beef Vaccination Schedules**

- **Calves (<4 months)**
  - **Respiratory Diseases**
  - MLV
    - Calves on Vaccinated Cows-MLV Intranasal vaccines
    - Depends on Maternal Antibody levels-MANY MLV IM or IC NOT EFFECTIVE, ONLY adjuvanted MLV IM or IC
    - Not vaccinated, not affected by Maternal Antibody
  - NOT Vaccinate with MLV BVDV before 1 month
  - Better after 2-3 months of age

- **Calves (>4 months)**
  - **Respiratory Diseases**
    - 2-3 weeks prior weaning
      - MLV-1 dose
    - Inactivated-2 doses
    - At weaning:
      - MLV-Immunosuppressive
      - Inactivated-2 doses
  - 2-3 weeks post weaning
    - MLV-1 dose
    - Inactivated-2 doses

**Stress + Immunosuppressive Viruses= Super Immunosuppression**

IBR and BVDV MLV are immunosuppressive

**Pregnant Cows and MLV Vaccination**

- Safe in pregnant animals vaccinated with the same product prior to breeding (within 12 months)
- NOT without recent vaccination

**What was the origin of safe in Pregnant Cows Claim?**

- Companies requested safe for use in calves nursing pregnant cows (Beef Claim)
- USDA decided that it would extend the claim to safe in pregnant cows
  - Animals vaccinated with the same product prior to breeding (within 12 months)
- Pregnant cow claim is only a safety claim. There is no efficacy data indicating that vaccination during pregnancy had any effect on reproductive health in subsequent pregnancy
- Twelve month duration of safety
Beef Cow Vaccination Program

- Cows-Precalving
  - Inactivated-1 doses Viral-Lepto
    - 4-6 weeks before calving optimal but often given earlier
  - Enteric Disease Vaccines
    - 4-6 weeks before calving

Beef Cow Vaccination Program

- Cows-post calving
  - MLV or Inactivated-Viral (IBR, BVDV)-Lepto-Vibro?
    - 2-4 weeks prior to breeding

Beef Cow Vaccination Program

- Pregnant Cows
  - Vaccinating after the first 40 days of pregnancy will not prevent BVDV PI

Precautions

- MLV-IBR-Corpus Luteum-Necrosis- not in naïve animals
- Synchronization protocols- break up and give it at least a month before breeding

What about the Effect in Previously Vaccinated Animals?

- Literature- single paper- MLV no effect on conception
- Active Interference? Why vaccinate?
- What about susceptible animals?

Summary

- Pregnant cows have two targets-
- Pregnant cow claim-Safety- not efficacy
- Pregnant cow is immunosuppressed
- MLV vaccines can be abortifacient and immunosuppressive

Laws of Immunological “Common Sense”

- Vaccination of dams 4-6 weeks prior to calving improves colostral antibodies
- Passive antibodies (colostrum) are protective
- Vaccinate before shipping
- Vaccinate at least a few days after shipping- a week or two later is best
- Interval for boosting needs to be more 21 days- length depends on vaccine
- Too short a vaccination interval can cause problems
Timing of Boosters

Timing and the Adaptive Immune Response - Anamnestic Response

Lymphocyte apoptosis
Lymphocyte proliferation
1° response to antigen A

Magnitude of specific response

Days

What is the Best Time Interval for Boostering?

Timing and Immune Response - Young Animals

Primary vs Booster Response

Percent Susceptible

Days Post Vaccination

0 7 14 21 28 35

70%

21%

Days Post Rechallenge

Passive Immunity
Active Immunity

Booster Time Interval and Response

451 Calves
Branding time 67 days
3 weeks prior to weaning 167 days
Weaning 190 days

Group 1 vacc 67d and 190d ~120d interval
Group 2 187d and 190d ~25d interval
0 % seroconverted to each virus was same
No difference in morbidity and mortality, feedlot performance or carcass quality
Kirkpatrick et al. 2008 JAVMA 233:136-142

Timing of Boosters

- MLV 2-3 doses by time 8-10 months
- Inactivated 2-3 doses by time 8-10 months
- Combination of MLV and inactivated vaccines

Boostering MLV vs Inactivated -
Use them in combination - Better adjuvants

- Evidence in either sequence MLV/Inactivated or Inactivated/MLV results in similar responses

Grooms et al 2002, Royan 2009
Summary

• Vaccination of dams 4-6 weeks prior to calving improves colostral antibodies
• Passive antibodies (colostrum) are protective
• Vaccinate before shipping
• Vaccinate at least a few days after shipping- a week or two later is best

Summary

• In general we vaccinate calves too much and too soon
• No need to vaccinate for BVD before 2-3 months of age (don’t do it before 1 month)
• Better colostrum management, less need to vaccinate
• Intranasal vaccines in young calf especially for BRSV important- if BRSV is a problem

Summary

• Interval for boosting needs to be more 21 days- length depends on vaccine
• Too short a vaccination interval can cause problems