ADVERSE VACCINATION REACTIONS IN ANIMALS AND POULTRY

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Vaccines are devices that help save animals from many diseases. They are generally composed of live or killed microorganisms or immunogenic fragments of microorganisms. Killed vaccines are produced by chemically inactivating the infectivity of virulent microbes, while permitting retention of immunogenicity. Most live vaccines are attenuated microbes that are relatively avirulent. The live microbes multiply in the recipient and stimulate the immune system without causing any disease except mild febrile reaction. To get the optimum immunity, it is necessary that vaccines must stimulate the host immune system. The absence of vaccine reaction indicate that the immune system has not been stimulated. Due to the biological variability in both vaccine and host, sometimes there may be excessive stimulation of immune system, which results into adverse reactions. These vaccine reactions adversely affect the livability and productivity of animals which is costly to the owner and painful to the animal. These reactions may arise from defective vaccines, inappropriate use of vaccines, dose variability, dilution of the vaccine and suppressed immune system in the vaccinated animals.

Clinically important vaccination reactions may be local or systemic. Local reactions are due to inflammation provoked by some non-antigenic components of vaccines like the adjuvant. Systemic reactions occur in almost every immunization procedure, characterized by mild fever and myalgia but it is rarely life threatening. Poultry farmers are more concerned with preventing vaccine reactions as it can have a negative economic impact. Excessive vaccine reaction can result in decreased body weight, increased mortality, increased veterinary cost etc.

Vaccination reactions due to adjuvants

Adjuvants are the "compounds that are added to vaccines for potentiating the immune responses with low antigen quantity". Some adjuvants cause considerable tissue injury e.g. adjuvants of Clostridium perfringens are highly irritating and frequently produce abscess. It is observed that adverse reactions produced by the aluminium hydroxide gel vaccine are milder to those produced by the alum-precipitated vaccine. Oil adjuvant (Freund's type) cause sever granulomatous reactions. Oil adjuvant of E. coli / Campylobacter bacterin (vaccine) may cause unilateral to bilateral lameness in bovines. An inflammatory mass was
observed at the site of vaccination on post-mortem examination and pyrogranulomatous inflammation and myostitis on histopathological examination. Oil-based FMD vaccine when given to the pre-sensitized animals may cause regional gross oedema along with leucocytosis and neutrophilia histologically. There may be reduction in milk production also.

**Vaccination reaction due to tissue components**

As the antibody titres to microbial antigens rise in an animal after vaccination, there may be production of antibodies against the tissue components in which the vaccine is prepared. These antibodies can lead to serious hypersensitivity, either anaphylaxis or delayed type.

The vaccines of nervous tissue origin have been known to produce a variety of local and systemic reactions. Severe local coetaneous reactions and systemic anaphylaxis are major problems like post-vaccinal encephalomyelitis due to rabies vaccine in canines. The animal may die because of immune-mediated reactions against their own nervous tissue. Rabies vaccines produced from sheep brain may cause spongiform encephalopathy due to the transmission of the scrapie agent. It has also been observed that use of these types of vaccines may cause Creutzfeldt Jacob Disease (CJD) in humans.

Repeated use of live FMD vaccine grown in baby hamster kidney (BHK) cell culture may cause eczema, nodular dermal lesions with ulceration on the udder, peritoneal skin and coronary bands. There may be abortions in pregnant animals. These reactions are due to the antibodies produced against the BHK cells. Similar lesions may also be seen in the Bluetongue vaccination in sheep.

**Vaccination reactions due to preservatives**

Formaldehyde (formalin) is used as an inactivating agent in many veterinary vaccines, particularly Clostridial vaccines. Clinical signs of focal burning is seen when formaldehyde is used more than 1800 pg/ml in vaccine. These type of vaccines may cause severe pain and discomfort to the animals.

Antibiotics are used as preservative in vaccines, which may cause various types of hypersensitivity reactions like allergic reactions, serum sickness or arthus reactions. These reactions are particularly associated with streptomycin and neomycin.

**Vaccination reactions due to antigens**

**Bacterial vaccines**

Use of killed bacterins in cattle against the *Pasteurella multocida* and *P. haemorrhagica* may cause severe respiratory reactions. When exposed to field pathogens
vaccinated animals often show more serious respiratory reactions than those unvaccinated animals. This may be due to the "cytotoxic factor" produced by *P. multocida* which replicate in the presence of specific IgG and ultimately produce serious lung lesions may produce in vaccinated animals. There is loss of appetite and reduction in milk yield due to febrile reactions of this vaccine.

Progressive diarrhoea is often seen shortly after paratuberculosis vaccination in cattle and goats. This is due to the hyper-sensitization of gut against the newly administered bacterial antigens. *Brucella abortus* strain 19 vaccinations in cattle may produce lameness and chronic granulomatous arthropathy in various joints. These reactions are due to the deposition of immune complexes in joints. Similarly renal lesions are seen in calves after immunization with *Salmonella typhimurium* vaccine.

**Viral vaccines**

Severe pneumonitis has been reported in animals vaccinated against respiratory virus when they get natural exposure to the same respiratory virus. NCD vaccine may cause flaccid paralysis and lameness in birds. Cattle vaccinated with FMD vaccine show post-vaccinal reactions in the form of significant increase in rectal temperature, plasma progesterone and corticosteroid level. There may be premature birth or abortion or the cow may come in oestrus within 5-6 days of vaccination. There may be decline in motility and viability of sperms and increase in abnormal count in bulls vaccinated with polyvalent FMD vaccines. Similar effect may occur when black quarter (*Clostridium chauvoei*) and FMD vaccines are used simultaneously. If combined FMD-rabies vaccine is used more frequently, there may be loss of hairs and scrotal oedema after 8-20 days of vaccination in bulls.

**Protozoal vaccines**

High mortality has been reported in calves after two weeks of immunization with live attenuated schizont *Theileria annulata* vaccine. The adverse reactions may be due to a high dose of immunogen in immunologically or MHC-mismatched recipients. Immunized animal may show long inter-oestrus interval characterized by high progesterone level and persistent corpus luteum (PCL).

**Vaccination reactions due to contaminated vaccines**

Abortion and chronic wasting are not in consistent signs in cattle vaccinated with rota-corona vaccine contaminated with bovine viral diarrhoea (BVD) virus. In calves severe body weight loss, mild enteritis, thymic atrophy and weakness is seen. MD vaccine contaminated with reticulo-endotheliosis virus is used in birds, which may cause stunted syndrome, anaemia, abnormal feathers and leg paralysis during post-vaccinated period.
Viral vaccine, if contaminated with bacteria may cause local reaction or abscess at the site of administration. Sometimes there is contamination of vaccine with bacteriophages leading to vaccination failure.

**Vaccination reactions due to virulent vaccines**

One of the most common problems in vaccine production is failure of attenuation of the microbial agents. This is especially true with viral vaccines (modified live vaccines) containing viruses that replicate in the host to produce immunity. In certain cases, viruses of low virulence may produce disease in immunosuppressive animals. Infectious canine hepatitis (ICH) vaccines contain live canine adenovirus-1 strain, which may cause corneal oedema and opacity called “blue eye” condition. There may be hypersensitivity reaction in Iris and limbus. Two strains of Newcastle disease virus are used for vaccination against Newcastle disease. The first one is a relatively avirulent (mesogenic) strain followed by a strain of low virulence (lentogenic strain). The mesogenic strain replicates throughout the upper respiratory tract and destroys epithelium, which may predispose the birds to bacterial infections. Bovine viral diarrhoea (BVD) vaccine may cause diarrhoea, lameness and seromucous oronasal discharges after 10-20 days of vaccination. Current evidence indicates that BVD vaccine strain viruses may be dangerous when given to calves persistently infected with non-cytopathic strain of BVD virus. Equine herpesvirus-1 (EHV-1) vaccine is used to control equine rhinopneumonitis. If this vaccine is given in a pregnant mare, it may cause abortion.

**The wrong vaccine**

Disaster can result from the administration of a vaccine to an animal species for which it is not designed. These accidents, for instance, administering a good vaccine to the wrong species of animal, usually occur due to human error.

Most vaccine strains of rabies virus can produce rabies in small rodents such as hamsters and hence should not be used in these species as vaccines. Lethal pseudorabies has occurred when lambs have been given vaccines designed for pigs. In some cases, the vaccine was administered by error, but in most cases pseudorabies occurred in lambs vaccinated for some sheep disease using unwashed syringes that had previously been used to vaccinate pigs with an attenuated pseudorabies vaccine.

Vaccine induced canine distemper (CD) commonly occurs when wild zoo animals are given CD vaccine designed for dogs. Ferrets and foxes are highly susceptible to this disease.
The wrong route

Inadvertent injection into an artery or vein during subcutaneous (SIC) or intramuscular (I/M) injection allows rapid dissemination of antigen, leading to anaphylaxis. Marek’s disease vaccine is placed s/c in the neck region of day old chicks. Wrong placement of this vaccine can cause central nervous system problems, twisted neck or even death.

The wrong time

Death of newborn animals may occur, if vaccination is done immediately after birth. It is very necessary to vaccinate the animal at the right time.

Vaccination reaction in pregnant animal

Some vaccines that are safe in young animals can cause abortion when given to pregnant animals. This is the danger with modified live viral vaccines, particularly with Herpesvirus vaccines. Losses can be disastrous when large breeding herds are vaccinated during gestation. Infectious bovine rhinotracheitis (IBR) vaccine may cause abortion “without warning” especially in cows with 5-6 months of pregnancy. Congenital abnormality of the brain in lambs appeared after vaccination of pregnant ewes with Bluetongue virus vaccine.

The ideal vaccine should:

- Be capable of mass application,
- Be cost effective,
- Be safe to use,
- Be capable of inducing a strong immunity, but not vaccination reaction,
- Be capable of inducing both local and general immunity,
- Induce an immune response that can be distinguished from that induced by infection or maternal derived antibody,
- Require only one dose to give life long immunity,
- Be packaged in different sizes and easily available,
- Be capable of producing immunity even in the presence of maternal antibodies.

Such a vaccine does not exist at present.

However, to enhance the success of the vaccination programme, the following points should always be kept in mind:

- The general health of the flock and the local pattern of disease should be known before vaccination.
• Vaccination should not be done in the animals affected with other diseases or are in poor condition/ weak animals.

• Keep stress factors at minimum and give a balanced diet and optimum management.

• The genetic type, function, sex and age of the animals to be vaccinated.

• The short or long-term protection required and cost benefit ration of vaccination.

• Monitor the maternal antibody level of the young animals.

• Use proper methods of transportation, storage and vaccination.

• All the animals of a herd should be vaccinated on the same day.

• Vaccine should be purchased from suitable sources only.

• Never keep the vaccine at farm more than a week in the refrigerator. At the time of vaccination the reconstituted vaccine, particularly live viral vaccines should be kept in ice and used as soon as possible.

• Follow the manufacturer's instructions strictly.

• Give immunostimulant and antistress formula at least for two weeks before and after vaccination.

• As far as possible do not use strong antibiotics or any other immunosuppressant during and after (at least for two weeks) vaccination.

• Vaccination should be preferably done at early hours or in the late evening to minimise the heat stress.

• Clean and disinfect all the equipment after vaccination and destroy the empty vials.

• Vaccination should be performed by trained personnel, under the guidance of a qualified veterinarian.

• Keep a record of the brand, kind, batch number, manufacturing date, source, date of vaccination etc.

**CONCLUSION**

Excessive vaccine reactions are not desirable but can be prevented through good management, vaccine handling, selection and administration. Finally, adverse reactions do not serve a useful purpose and so attempts should be made to prevent them.