Introduction

- Lumpy skin disease virus (LSDV) belongs to the genus *Capripoxvirus* within the family *Poxviridae*
- Categorised as a notifiable disease by the OIE
- Serious economic burden for all cattle producers, particularly small-scale farmers in affected countries
- Direct production losses are estimated be 40-60%
- Indirect losses caused by control and eradication measures and restrictions/total ban of international trade of live cattle and their products
Direct and indirect losses due to LSD

- Sharp drop in milk field and mastitis
- Loss of body weight
- Damaged skins and hides
- Abortions
- Infertility problems in cows
- Temporary or permanent sterility in bulls
- Losses due to animal movement restrictions
- Expensive vaccination campaigns
- Limited or banned exportation of live animals and their products
Geographic distribution of LSDV
Characteristic clinical signs of LSD

- High fever
- Enlarged lymph nodes (particularly prescapular and precrural)
- Circular skin lesions of 1 to 5 cm in diameter
- Within 1 to 2 weeks the top of the lesion forms a scab which then sloughs off, leaving a raw ulcer (sitfasts)
- Eye and nasal discharge
- Lesions in the oral, nasal and ocular mucous membranes
- Swellings in the leg and lameness
- Oedema in the dewlap
Fever, viraemia and skin lesions
Deep skin lesions and scar formation
Older skin lesions, in non-viraemic animal scabs are good sample material.
Lesions in the mouth, tongue and oral mucous membranes
Lesions in the cornea and the mucous membranes of the eye
Differential diagnosis

- Pseudo lumpy skin disease; BHV-2 (Bovine herpes virus); more superficial lesions and shorter course of the disease
- Insect bites and allergic reactions (urticaria)
- Besnoitiosis (widely distributed in Africa, recently also in central and western Europe)
- Demodicosis
- Onchocerciosis
Transmission of LSDV

- Mechanical transmission by a wide variety of blood-feeding vectors (insects and ticks)
- Iatrogenic transmission: by contaminated needles during veterinary treatments or vaccination campaigns
- By contaminated feed or water (common drinking troughs)
- Seminal transmission via mating or artificial insemination
- Transplacental transmission
- Direct contact ineffective?? Requires further investigations
Transmission by blood-feeding insects

- Mechanical mode of transmission Aedes aegypti mosquito (Chihota et al., 2001)
- Stable fly (Stomoxys calcitrans) transmission of SPPV (Kitching et al., 1986)
- What other species involved?
- Horn flies, horse flies, midges?
- Does the virus multiply in insect cells?
Transmission of LSDV by ixodid ticks

- Transmission has been demonstrated in common sub-Saharan ticks: *Rhipicephalus* (Boophilus) *decoloratus* (transovarial), *Rhipicephalus appendiculatus* and *Amblyomma hebraeum* (mechanical/intrastadial).
- Some evidence on biological transmission have been obtained but further studies on actual replication of the virus in ticks are needed.
- Surveillance of the virus in ticks contaminates the environment.
- Closely related species in the Middle East region: *R. (Boophilus) annulatus*, *R. sanguineus*, *A. variegatum* and *Hyalomma extravatum*.
Epidemiology

- Morbidity 5-45%, mortality usually <10%
- LSDV infects domestic cattle and water buffaloes but the disease has been confirmed in some wild ruminants such as springbok, impala and giraffe
- Outbreaks may occur anytime but are more common during warm and wet season, with high levels of insect activity
- Any situation when high densities of cattle come to close contact (communal grazing and watering points, cattle markets, quarantine stations)
- No known carrier stage
- Wildlife or insect/tick reservoir?
Epidemiological observations

- In experimentally infected cattle only 50% are likely to show clinical disease although all animals become viraemic.

- Viraemic cattle without skin lesions have been shown to mechanically transmit the disease via tick vectors.

- In infected herds the number of animals capable for transmitting the disease via arthropod vectors is likely to be much more than those animals showing skin lesions.

- Culling of only those animals showing clinical signs of LSD is not likely to control the spread of LSDV effectively.
Immunity against LSDV

- Poxviruses have a large genome and they stimulate host immune system effectively
- Lifelong immunity follows a natural infection
- Immunity is predominantly cell-mediated but also humoral response
- Antibodies can be detected approximately 3 months after infection
- Neutralization tests are not sensitive enough to detect low antibody levels in vaccinated animals or in those showing mild or silent disease
- LSDV has been used as vaccine vector for Rift Valley fever, PPR, rabies - however, none of these vaccines are commercially available
- No ELISAs are commercially available
Sample collection

- Specimens should be collected in early acute phase of infection from febrile animals
- Length of viraemic stage varies but approximately 1 to 2 weeks
- Tissue samples for the isolation of a live virus should be collected before the appearance of neutralizing antibodies
- Live LSDV in skin lesions live virus up to 39 days post infection
- Dried scabs: live virus is well protected inside the scabs and viral DNA can be detected for several months
- Antibodies against CaPV start to rise about 2 weeks post detection of the first clinical signs
Samples

- Skin lesions
- Scabs can be transported in a container without any medium
- Lung or other tissue with pox lesions (10% glycerole in PBS*)
- EDTA blood for PCR and heparin blood for virus isolation
- Blood in FTA paper suitable for PCR analysis
- Nasal, saliva and ocular swabs (transport medium such as DMEM**+ antibiotics***)
- Whole blood for serology

*Phosphate buffered saline
** Dulbecco’s Modified Eagles Medium
***Ampicillin 0.05mg/ml, Gentamycin 0.1mg/ml and AmphotericinB 5µg/ml
Control and eradication (1/2)

- Vaccination with homologous vaccine
- Total stamping-out of all infected and in-contact animals (if feasible)
- Culling only those animals, showing clinical disease is not effective as a sole control measure
- Quarantine
- Strict animal movement restrictions and border control
- Awareness campaigns for farmers, animal carers and veterinarians
- Early detection/reporting - Enforcement of local diagnostic capacity
- Strict bio security measures on farm level on entry and exit (people, animals and vehicles)
Control and eradication (2/2)

- Active surveillance (clinical signs and sample collection from infected and suspected animals)
- Farmers practising nomadic pastoralism – vaccination of the cattle should be a priority
- Vector control in animals and facilities – may decrease the infection rate but no studies available
- Zoning (at the radius of 25-50 km)
- When restocking an affected farm - Sentinel animals first
- Major problem - political unrest, armed conflicts and movement of refugees in the region
Previous CaPV research indicates

- All strains of capripoxvirus of ovine, caprine or bovine origin examined so far share a major neutralising site, so that animals recovered from infection with one strain are resistant to infection with any other strain (Capstick, 1961)

- Life-long immunity after natural infection but not likely after vaccination

- No recent long term studies have been carried out on the duration of the protection after vaccination
Currently available vaccines against LSDV

- Lumpy Skin Disease Vaccine for Cattle by Onderstepoort Biological Products, SA (Neethling strain)
- Lumpyvax – Merck, Intervet, SA (attenuated field strain)
- Herbivac LS – Deltamune, SA (Neethling strain)
- SPPV RM-65 (JOVAC) (10 x sheep dose)
- KSGP O-240 and O-180 strains (LSDV) by many producers
Successful LSD vaccination campaign

- Large scale annual vaccinations, using homologous vaccine
- Sufficient herd immunity (80% coverage) needs to be created and maintained in large areas around infected zone
- Affordable/subsidized particularly for small-scale farmers and cattle owners, practising transhumance farming
- Vaccinate also pregnant animals
- Calves from vaccinated cows at the age of 4 to 6 months and from non-vaccinated cows as soon as possible
- Imported animals: Vaccination of naïve European breeds before entering farms located within affected regions
Efficacy of the currently available live vaccines

- In general, good protection in case a homologous vaccine and sufficient vaccination coverage (80-90%) is used.
- Total protection is not provided for each individual.
- Quality of different vaccines varies a lot and the vaccine is not stable in direct sunlight.
- The efficacy of SPPV (RM65) vaccine against LSDV has never been evaluated by challenge experiments in controlled environment.
- Recent studies by Gari et. al. (Vaccine, in print) indicate that Gorgan goatpox vaccine protects cattle against LSDV.
- The number of experimental animals in challenge experiments needs to be a minimum of 6 plus controls.
- Many vaccine producers rely on field experiments, measuring antibody response of vaccinated animals and skin reaction at the vaccination site.
Safety of the live vaccines

- Adverse reactions caused by the live vaccines, particularly LSDV
- Fever and temporary drop in milk yield
- Local reaction at the vaccination site (should be accepted)
- Some animals (<10%) show mild generalized disease
- KSGP O-240 and 180 strains (LSDV) are not recommended for European high-producing dairy breeds
- Other SPPV vaccines rarely cause adverse reaction in cattle but the protection is not that good as homologous vaccines
- Cattle vaccinated with SPPV and then booster with LSDV vaccine show less severe reaction against the LSDV vaccine
Correct handling of the vaccine

- Maintain cold-chain
- Keep the vaccine out of sun
- Opened bottles must be used within 6 hours and then discarded (without exception)
- Proper needle hygiene must be practised (change of the needle between animals)
- Farmers should be informed about adverse reactions and warned that black market vaccines may not be safe nor provide sufficient protection
Thank you for your attention!

Any questions?

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