Brucellosis in Cattle, Sheep & Goats: Diagnosis, Surveillance and Eradication programs

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Epidemiology & diagnosis of Brucellosis…

Key elements for a sound strategy…
Epidemiology of Brucellosis….

Brucellosis is a "multi-species" infectious disease…

- different animal species
- different Brucella species

…..to be considered
Wild Ruminants, Rodents, Carnivores, Swine

B. abortus

B. melitensis

B. suis

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Cattle, sheep, goats or pigs, ... and wildlife

frequently in contact... in many areas
Abortion is the main sign of brucellosis...

But, most infected females give birth normally...

In both cases, huge and durable excretion of Brucella
Survival of *Brucella* out of their host is long (compared with most other non-sporing pathogenic bacteria, under suitable conditions)

Brucella survive on/in many materials
Brucella are excreted primarily in:

- Abortion & normal birth materials
- Vaginal secretions
- semen
- Milk and colostrum
Epidemiology of Brucellosis

Transmission (in animals)

Entry point Mucous membranes & skin
Conjunctivae, nasopharynx & respiratory tract, oral route, genitalia

Vertical transmission (in utero): congenital infection

Horizontal transmission

- Direct
  Infected aerosols
  Consumption (or licking) of infected materials and milk
  Contact
  Sexual transmission

- Indirect (water, manure, materials, shoes,...)
Neighbouring /transhumance

Resurgence (partial depopulation)

Purchase

Transmission away (Water, manure, materials, shoes, vehicles)
Epidemiology of Brucellosis is complex...

Lots of transmission routes, most of them being almost impossible to control...
Diagnosis of Brucellosis...

- No single test able to...
  - identify all infected animals, or
  - certify all free animals

- Tests repetitions needed

- Tests associations (parallel/series), modify considerably the results predictive values (-ve/+ve)
Diagnosis of Brucellosis

Serological tests
- Early, sensitive but low specificity (RBT/FPA)
- Sensitive but low specificity (iELISA)
- Late, more specific but less sensitive (CFT)
- Highly specific but lower sensitivity (cELISA)
- Highly sensitive/specific (iELISA on milk, but..)
≠ tests: ≠ antibodies detected

Cell tests: BST (highly specific, but..)
- Frequent discrepancies between tests
- Associations usually needed
- Predictive values (-ve/+ve) linked to prevalence.

Choice of tests and interpretation should always be based on epidemiological reality.
Immune response of the infected host - Antibodies

- **Foetus**
  - abortion
  - congenital infection – no Ab before 1st gestation

- **Young**
  - low and transitory response

- **Adults**
  - response in 1-2 months, sometimes no or low
  - persistence 6 months or more
  - fluctuant (delivery/abortion) - milk

- Latent infection frequent
- Great individual variations
- Tests results discrepancies (e.g. milk/serum)
INFECTED UNIT
(herd / flock / area)

Infected/ Not infected   I /NI
Shedding / Not shedding  S/NS
Test Positive / Negative P/N

Relative rates of each category depends on:
- Outbreak history
- Control measures

Control means:
☞ To protect naïve animals (vaccination)
☞ To identify and eradicate infection more rapidly than it spreads
Epidemiology & diagnosis of Brucellosis….

Brucellosis is a herd/flock disease…

- the epidemiological unit is the herd, the flock or the group including all epidemiologically-related sensitive animals
- the individual prevalence has no significance for control monitoring
Brucellosis Control / eradication strategies ....

Tools & strategies...
Control / elimination of animal brucellosis: The tools

- Test and isolation/slaughter
  - Partial or full depopulation

- Control of animal movements

- Vaccination

  ...and adequate

  - Political will
  - Budget
  - Vet. Services / Lab. infrastructure
  - Animal/herd identification
  - Good quality vaccines
Vaccination (Rev.1 & S19)

- Vaccination increases resistance to infection and decreases abortion risk
  - Thus, decreases the spread of infection
  - Thus, decreases individual and herd/flock prevalence
  - Thus, decreases incidence in human populations
  - But,
    - insufficient on its own to eradicate
    - vaccine-induced serological/cell-immune reactions

- Sub-cutaneous or conjunctival route at standard dose
  - Cattle (females): S19
    - 3-6 months: SC 5-10x10^{10} CFU/dose
    - Adults: SC 0.3-3x10^{9} CFU/dose (non pregnant, lactating or late pregnancy)
    - Both: CR 5-10x10^{9} CFU/dose
  - Sheep & Goats: Rev.1
    - 3-6 months: SC 0.5-2x10^{9} CFU/dose
    - Both: CR 0.5-2x10^{9} CFU/dose (non pregnant, lactating or late pregnancy)
Brucellosis Control
/eradication strategies ....

Which tools...
Which strategy...

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Preliminary considerations

The epidemiological situation is almost never homogeneous in a given country/region. Different epidemiological / livestock contexts within a country/region lead to different & adapted control / eradication strategies to be implemented. Primary goals of a control programme: Knowledge of situation & definition of Epidemiological units of intervention.
First objective in endemic areas
⇒ Control of the infection

Final objective ⇒ Eradication

Mid / short-term objective ⇒ Regularly decrease the prevalence

Progressive strategy
Decision tree for brucellosis control in animals

Is brucellosis present in a certain area/country?

Yes

Are there adequate means / expertise / vet. services?

No

Surveillance/test-and-slaughter/movement control

Yes

(survey/prevalence/epidemiological units)

Mass vaccination

Combined young animal vaccination and test/slaughter

No

No

Intermediate prevalence

Low prevalence

Test/slaughter

high prevalence
The basic control programme: vaccination

Main objective:
- Reduction of the prevalence to an acceptable level (i.e. minimising disease impact)
- The highest level of immunity in the highest possible number of animals in the shortest possible time interval

Tools required:
- Minimal infrastructure and budget
- Good vaccines (quality control / cold chain)

Possible strategies
- « Conservatory »: Vaccination of young replacements only
- « Expeditious »: Vaccination of the whole population
Control strategy based on mass vaccination (S19/Rev.1)

- Immunisation of the whole population in only one intervention
- Reinforcement of immunity in previously vaccinated animals

- If repeated at regular intervals
  ⇒ *the most economic and effective way to control the disease in endemic areas*

Also applicable to control outbreaks in eradication programmes (emergency vaccination) if depopulation unfeasible
Mass vaccination – conditions of success / drawbacks

- Good quality vaccines (and cold chain)
  - S19
  - ☺ replacement cows & non pregnant adults
  - ☺☻ lactating adults → 0.1-2% udder infection
  - ☺☻ pregnant → 0.1-2% abortions
  - ☹ bulls → fertility?
  - Rev.1
  - ☺☻ all animals but pregnant → abortions
    - Problems minimised by the use of conjunctival route and seasonal breeding → late pregnancy/calving/lambing/lactation/pre-breeding season

- To be applied to the whole population
- To be maintained (10-12 years) and repeated every 2 years (FAO in Tunisia & Morocco – WHO in Mongolia)
Eradication Programmes

- Combined strategy (vaccination / T & S)
- Exclusive T & S (no vaccine)

"Iceberg" Conditions: tests and vaccines are the emerged part!!
- Adequate design and organisation
- Available means / expressed needs / Political long-term will
- Effective involvement of professionals (breeders)
- Control of animal movements / permanent individual identification
- Continuity – Repetition – Long term

Moreover, the better the results are, the more severe the control policy should be… Otherwise…no or little progress…
Combined program: Young replacement vaccination - T. & S. adults

- **When?**
  - Low to moderate herd/flock prevalence < 5-10%
  - Important risk factors (movements, outbreaks)
  - If ICEBERG conditions fulfilled

- Allows eradication & protection of herds/flocks

- **Requirements for success**
  - Regular (at least annual) sero-testing of all adult animals
  - Rapid culling of positive animals (depopulation if needed)
  - Retest positive herds at short intervals (every 2 months)
  - Sufficient means for:
    - the surveillance of the whole population – herd certification
    - adequate rapid culling / slaughter compensation
Eradication by exclusive Test & Slaughter

When?

- Very low herd/flock prevalence < 5%
- Very low risk factors (movements, outbreaks)
- If ICEBERG conditions fulfilled (excellent Vet. Serv. organisation)

- Allows eradication but not the protection of herds/flocks

Requirements for success

- Vaccines prohibited
- Regular (at least annual) sero-testing of all adult animals in all herds
- Qualification of herds/flocks (OIE)
- Partial depopulation of positive herds/flocks is risky
- Depopulation of positive herds/flocks when possible
- Sufficient means for:
  - Surveillance of the whole population – herd certification
  - Adequate rapid culling / slaughter compensation
  - Movement control / Epidemiological investigations
When? Eradication achieved / no permanent risk factors left

Regular surveillance
- Of the whole population
- Of a representative sample
  - To detect new outbreaks as soon as possible
  - To prevent reintroduction of infection from foreign sources

Avoid commercial movements from herds re-qualified after partial depopulation

Animal introduction only from truly free herds of free regions
Don’t forget the iceberg!

Diagnostic tests
Vaccines

Political long-term will
Strategy adapted to real situation
Adequate means
Individual identification
& movement control
Control pressure – Periodic test repetition
Commitment of professionals
Thanks for your attention...

Hvala ..Хвала..