

Bayesian latent class analysis of the characteristics of three diagnostic tests to assess the passive immunity transfer status in neonatal dairy calves.

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INTRODUCTION

The assessment of diagnostic tests for the evaluation of failure of passive transfer (FPT) in calves is usually performed applying the radial immunodiffusion (RID) test as the gold standard.

The value of the RID test as gold standard is, however, debatable.

OBJECTIVE

The main objective of the study was to determine the diagnostic test parameters of three different tests for the evaluation of FPT in the absence of a gold standard, applying a Bayesian latent class model.

A second objective was to obtain prevalence data on FPT in dairy calves in Belgium.

MATERIALS AND METHODS

Neonatal dairy calves (n = 95) from 6 commercial farms in Belgium were randomly selected for the study. Only calves aging between 2 and 7 days were eligible to be included in the trial. All enrolled calves had received at least 2L of colostrum in the first 24 h of life.

IgG measurement in serum samples:

- ▶ Lateral flow sandwich immuno-chromatography: FPT cut-off value: IgG < 10g/L (manufacturer's recommendations)
- ▶ Digital brix refractometry - FPT cut-off value: <8.3%⁽¹⁾
- ▶ Serum electrophoresis (independent, accredited lab, Zoolyx, Aalst, Belgium); FPT cut-off values: < 10g/L⁽²⁾, <12g/L (new cut-off evaluated in the study)

FPT was considered as the positive outcome in all interpretations of the test results.

Posterior distributions of the prevalence and sensitivity and specificity of each diagnostic test were determined⁽³⁾.

The brix refractometry method (applying a cut-off value of 8.3% brix) provided the best characteristics for the evaluation of Failure of Passive Transfer in neonatal calves. The highest Negative Predictive Value was recorded for the serum electrophoresis using a cut-off value of 12g/L of gamma-globulins.



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RESULTS

The mean age of the calves at sampling was 3.5 days (SD ± 1.6).

The median and 95% credibility interval (CI) for the prevalence of FPT was 48.2 (95% CI: 27.4-67.4%).

The Bayesian multivariable latent class analysis indicated that the best combination of sensitivity and specificity was obtained with the digital brix refractometry method (Table 1).

For the practitioner, the negative predictive value (NPV) of a FPT test is the most important. Both the commercial lateral flow immuno-chromatography and serum electrophoresis NPV scores were low (Table 1). Change of cut-off improved NPV of electrophoresis (Table 2).

TABLE 1. Bayesian latent class analysis of the test characteristics of three conditionally independent diagnostic tests for the evaluation of failure of passive transfer of immunity in neonatal dairy calves. Serum electrophoresis: **cut-off value 10g/L gamma-globulins.**

	Se Median (95%CI) ¹	Sp Median (95%CI)	PPV Median (95%CI)	NPV Median (95%CI)
Bovine IgG Test ²	0.34 (0.21-0.54)	0.95 (0.21-0.54)	0.86 (0.62-0.98)	0.61 (0.39-0.82)
Serum Electrophoresis	0.58 (0.38-0.88)	0.97 (0.85-0.99)	0.95 (0.74-0.99)	0.71 (0.46-0.95)
Brix Refractometry ³	0.91 (0.81-0.97)	0.75 (0.60-0.88)	0.77 (0.49-0.93)	0.90 (0.74-0.97)

Se: sensitivity; Sp: specificity; PPV: positive predictive value; NPV: negative predictive value;
¹CI: Credibility interval ²Commercial lateral flow sandwich immuno-chromatography method: cut-off value 10g/L serum immunoglobulins ³Brix refractometry: cut-off value used 8.3%.

TABLE 2. Bayesian latent class analysis of the test characteristics of three conditionally independent diagnostic tests for the evaluation of failure of passive transfer of immunity in neonatal dairy calves. Serum electrophoresis: **cut-off value 12g/L gamma-globulins.**

	Se Median (95%CI) ¹	Sp Median (95%CI)	PPV Median (95%CI)	NPV Median (95%CI)
Bovine IgG Test ²	0.34 (0.20-0.53)	0.94 (0.84-0.99)	0.82 (0.55-0.96)	0.61 (0.41-0.81)
Serum Electrophoresis	0.97 (0.85-0.99)	0.68 (0.46-0.92)	0.73 (0.44-0.95)	0.96 (0.81-0.99)
Brix Refractometry ³	0.83 (0.69-0.93)	0.85 (0.73-0.92)	0.83 (0.60-0.93)	0.85 (0.64-0.96)

Se: sensitivity; Sp: specificity; PPV: positive predictive value; NPV: negative predictive value;
¹CI: Credibility interval ²Commercial lateral flow sandwich immuno-chromatography method: cut-off value 10g/L serum immunoglobulins ³Brix refractometry: cut-off value used 8.3%.

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