

PAPER

Relationships between metabolite and IGF-1 concentrations and fertility and production outcomes following left abomasal displacement in dairy cows

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Context

Left displacement of the abomasum (LDA) is an important periparturient disorder in dairy cows. It is associated with reduced milk yield, fertility, weight gain and increased risk of culling. The aetiology is multifactorial, with reduced dry matter intake (DMI) in the early postpartum period likely to be an important factor. The condition has been associated with high serum non-esterified fatty acids (NEFA) during the prepartum period and high beta hydroxybutyrate (BHB) and aspartate aminotransferase (AST) levels early postpartum.

Insulin-like growth factor-1 (IGF-1) is part of the somatotrophic axis and is thought to be one of the links between nutrition and fertility in cattle. Previous work has shown that the circulating IGF-1 concentration measured in the first week postpartum correlates positively to DMI, body condition score (BCS), and circulating insulin concentrations and negatively with NEFA and BHB. Cows with low IGF-1 levels postpartum are likely to take longer to resume oestrous cycles and are less likely to conceive again. The hypothesis tested in this study was that low IGF-1 levels in the periparturient period may contribute to the subsequent poor performance seen in cows affected with LDA.

Main conclusion

Cows affected with LDA had lower levels of IGF-1 compared to those without LDA, although affected cows were not at increased risk of culling. Irrespective of LDA status, low IGF-1 levels at the time of sampling were associated with increased risk of culling. This suggests that metabolic status during the early postpartum period, and thus transition cow management, is ultimately a more important determinant of culling than whether an animal develops LDA.

Approach

A matched case-control study of Holstein-Friesian cows was conducted between April and November 2008 in Somerset, UK. Eligible farms were those that allowed access to routine milk recordings. Practitioners recruited cases and decided on clinical management, completing questionnaires on cow details, LDA management and concurrent disease.

Controls were healthy cows from the same farm matched for number of days since calving and parity. Blood samples were taken from cases and controls and tested for BHB, NEFA, glucose, urea, insulin and IGF-1. Samples were taken from cases before any treatment was given. Controls were sampled as soon as possible after case recruitment.

Follow-up data were collected for all cows on subsequent milk yield, days from calving to first service, days from calving to conception, number of services per conception, being alive at 60 days after enrolment and whether the animal was culled in the subsequent lactation. Culling was defined as the animal exiting the herd without having another calf. Paired data were analysed using McNemar's tests, paired t-tests and conditional logistic regression. For

analysing data from LDA cases alone, chi-squared, unpaired t-tests and logistic regression were used.

Results

A total of 67 case-control pairs were recruited from 24 farms. Compared to matched controls, LDA cases tended to have longer dry periods; greater odds of an assisted delivery; lower BCS; higher circulating levels of BHB, NEFA and glucose; and lower IGF-1 levels. There was a trend towards higher urea levels among cases but no difference in insulin levels between the cases and controls.

Ninety per cent of LDAs were treated by the roll and toggle technique. There was no statistical evidence that cows with LDA were at increased odds of being culled in the subsequent lactation compared to controls (odds ratio [OR] 1.4, 95 per cent confidence interval [CI] 0.62-3.2, $P=0.42$). This was also the case for being alive at 60 days after enrolment (OR 2.5, 95 per cent CI 0.49-12.9, $P=0.27$). Similarly, there was no difference in the number of days to first service or the number of services required per conception. However, cases tended to have longer calving to conception intervals and produced on average 2272 litres less milk in that lactation.

Considering all enrolled cows irrespective of LDA status, the mean IGF-1 level at the time of sampling was associated with subsequent risk of culling (culled cows 11.7 ng/ml versus not culled cows 23.5 ng/ml, $P=0.005$). No other parameters measured were found to be similarly associated.

Interpretation

These results support those of previous studies in finding higher BHB and NEFA concentrations in LDA cases and subsequent reduced milk yield and fertility. The reduced milk production could be related to the method of correction used, with evidence from other studies suggesting that laparoscopic approaches may lessen this impact.

The tendency of LDA cases to have longer dry periods and the association of LDA with assisted delivery at calving also provides evidence for the significance of the dry period in its aetiology. Longer dry periods are more likely to result in overweight cows with subsequent reduced DMI in the postpartum period.

Although cases were sampled at clinical diagnosis, the fact that IGF-1 concentrations in postpartum cows change gradually rather than abruptly supports the idea that lower IGF-1 concentrations are likely to precede the development of LDA.

Significance of findings

Levels of IGF-1 appear to have more of an impact on subsequent herd longevity than whether an animal develops LDA. The significance of the dry period in the aetiology of the condition emphasises the importance of correct transition cow management in preventing it. Directing future research efforts toward optimal transition cow management to minimise the postpartum nadir in IGF-1 levels is therefore recommended.